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Nils Martin Stølen

Wage Formation and the Macroeconomic Function of the Norwegian Labour Market

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Preface

This study renders the dissertation which is part of my Dr. polit exam at the University of Oslo, Department of Economics, from 25th October 1993. The work is based on analyses done in the Research Department in Statistics Norway to enhance the understanding of wage formation in Norway and the implications for the macroeconomic functioning of the labour market. During the work I have benefitted from an inspiring atmosphere in Statistics Norway, and especially I am grateful to Ådne Cappelen for his comments and helpful advice. I also owe a lot of thanks to my supervisor Steinar Strøm for stimulating advice.

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Nils Martin Stølen

Abstract

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The growing rate of unemployment in Norway since the end of the 1980s has increased the demand for knowledge about wage formation and the macroeconomic functioning of the Norwegian labour market. To analyze these questions the most relevant theoretical aspects for labour market and wage formation are discussed, and the understanding of wage formation is enhanced through a comprehensive empirical analysis. The importance of wage formation for the macroeconomic functioning of the labour market and for policy analyses is further evaluated by analyzing the properties of the macroeconometric model MODAG developed in Statistics Norway. A main conclusion is that wages are only weakly influenced by high unemployment, and in the best case the labour market may need several years to restore equilibrium after a negative shock.

Keywords: Econometrics, labour market, macroeconomic model, time series analyses, unemployment, wage formation

JEL Classification: C1, E1, J2, J3, J5, J6

Sammendrag

Nils Martin Stølen

Lønnsdannelse og den makroøkonomiske funksjonsmåten til det norske arbeidsmarkedet

Doktoravhandling fra Universitetet i Oslo, Sosialøkonomisk institutt– forsvart 25. oktober 1993

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Den voksende arbeidsledigheten i Norge siden slutten av 1980-tallet har skapt et økende behov for kunnskap om lønnsdannelsen og funksjonsmåten til det norske arbeidsmarkedet. De viktigste teoriene for arbeidsmarkedet er vurdert for å belyse disse problemstillingene, og lønnsdannnelsen er drøftet gjennom en omfattende empirisk analyse. Betydningen av lønnsdannelsen for funksjonsmåten til det norske arbeidsmarkedet og for effektene av ulike tiltak med sikte på å redusere ledigheten, er videre analysert ved å drøfte egenskapene til Statistisk sentralbyrås makroøkonometriske modell MODAG.

Analysen gir ingen entydig konklusjon på om arbeidsmarkedet er i stand til å vende tilbake til den opprinnelige likevekten eller ikke. Lønnsutviklingen reagerer uansett såpass svakt på en situasjon med høy ledighet at det i beste fall kan ta lang tid før den blir betydelig redusert av seg selv. Det kan heller ikke ses bort fra at de strukturelle problemene på det norske arbeidsmarkedet har tiltatt i løpet av 1980-tallet.

For industrien indikerer resultatene at utviklingen i produktpriser og produktivitet er de viktigste forklaringsfaktorer bak lønnsveksten. En god del av tapet i industriens konkurranseevne fra 1970 og fram til slutten av 1980-tallet kan forklares med et stramt arbeidsmarked forårsaket av innfasingen av oljeinntektene i norsk økonomi, men skatteøkninger og arbeidstidsforkortelser har også vært av betydning. Lønnsutviklingen i industrien er av stor betydning for lønnsutviklingen i mer skjermete sektorer. Vekt på hensynet til utviklingen i disponibel realinntekt kan imidlertid være en medvirkende årsak til den relativt svake lønnsutviklingen i offentlig sektor i løpet av de siste 20 årene.

Analysene ved hjelp av MODAG indikerer at lavere lønnsvekst i seg selv ikke har noen stor effekt på ledigheten. Selv om en dempet lønnsvekst har en positiv betydning for industriens konkurranseevne, og også leder til mindre rasjonalisering av arbeidskraft, vil lavere inntekter for lønnsmottakerne ha en negativ effekt på produksjon og sysselsetting i mer skjermete sektorer. Lavere lønnsvekst har imidlertid positive effekter på offentlig budsjettbalanse og utenriksøkonomien. Dersom en gjennom et inntektspolitisk samarbeid lykkes i å få redusert lønnsveksten, vil det skape økt finanspolitisk handlefrihet for myndighetene.

Økte offentlige utgifter, redusert arbeidstid og tiltak som reduserer tilbudet av arbeidskraft er effektive virkemidler når det gjelder å redusere arbeidsledigheten på kort og mellomlang sikt. Negative konsekvenser som høyere kostnadsvekst, tap av konkurranseevne, svekket offentlig budsjettbalanse og svekket utenriksøkonomi setter imidlertid grenser for hvor langt en kan gå. Reduserte skatter og avgifter innebærer mindre av disse negative effektene, men er heller ikke fullt så effektive virkemidler for å redusere ledigheten raskt.

Emneord: Arbeidsledighet, arbeidsmarked, lønnsdannelse, makroøkonomi, tidsserieanalyse, økonometri.

Contents

1. Introduction and summary

1.1. Introduction

The growing rate of unemployment in Norway since the end of the 1980s has increased the demand for knowledge about wage formation and the macroeconomic functioning of the Norwegian labour market. Important questions in this situation are whether wages react to move unemployment back to the initial equilibrium or not after a shock, how fast the economy moves towards equilibrium and how economic policy may influence the development.

To analyze these questions the most relevant theoretical aspects for labour market and wage formation are discussed, and the understanding of wage formation is enhanced through a comprehensive empirical analysis. The importance of wage formation for the macroeconomic functioning of the labour market and for policy analyses is further evaluated by analyzing the properties of the macroeconometric model MODAG, developed in Statistics Norway.

When evaluating the functioning of the labour market in a macroeconomic context theoretical consistency is important. A large part of the work is therefore devoted to a discussion of relevant theoretical aspects. The emphasis is put on theories which seem to be of importance when explaining the main features of the labour market and wage formation in a country like Norway. However, the macroeconomic focus does not mean that microeconomic theories are left out. On the contrary, to understand the macroeconomic development a microeconomic foundation is needed.

As the labour market is composed of different segments, one theory may be significant for one segment, while a different theory may be of importance for another. To explain the macroeconomic development one single theory may only be of limited relevance, but it may constitute a necessary part in a total understanding of the functioning of the labour market. The aim of the work is therefore to extract the most important aspects from the different theories and evaluate their relevance.

It is convenient to distinguish between two main classes of theories regarding labour market and wage formation: i) Theories based on the assumtions of perfect competition, and ii) theories based on assumptions of coordinated behaviour among employees and some formal organization. A question of particular interest is whether wages react to move the rate of unemployment back to the initial equilibrium after a shock, or if a new equilibrium is established with higher unemployment as a result of a negative shift in demand or a positive shift in supply of labour. The implications of the different theories for this question will be discussed, and it is also of interest to deduce the most important factors behind wage formation and to be aware of possible restrictions on the parameters imposed from economic theory.

The main emphasis in the empirical part is given to wage formation. A lot of work in this field based on Norwegian data has been done in the last decades, but due to different data and different methods of estimation the results differ quite a lot. It is thus necessary to discuss the new empirical findings against the earlier results and try to explain the differences. Because of the availability of data most of the earlier works have concentrated on explaining wage formation in manufacturing industries. A large weight is given to this sector also in this work. According to the Scandinavian theory of inflation wage formation in manufacturing industries, which are highly exposed to foreign competition, is of great importance for wage formation in the more sheltered industries. However, wage growth in the different sectors has not been quite parallel. To get an understanding of wage formation in the whole economy, it is of interest to analyze wage formation in sheltered industries and test to what extent they act as wage followers relative to manufacturing or if they influence manufacturing wages.

By estimating wage equations for different industries it is possible to get an overview of the relative importance of different explanatory factors. Both consumer, product and competitive prices, alternative incomes, productivity, income and payroll taxes and the rate of unemployment are from economic theory held to be possible explanatory factors. Institutional factors behind wage formation such as wage and price freeze, catch-up effects and shortening of the normal working hours are also relevant in this respect.

Total wage growth in manufacturing industries may be divided into two components, central negotiated wage growth and wage drift. As the different factors may influence the components in a different way, they have been analyzed separately in many of the earlier works. The relative importance of these two components will be discussed, but because it is reasonable to assume that central negotiated wage growth and wage drift depend on each other in the long run, the main emphasis will be put on explaining total wage growth.

The question whether wages react to move the rate of unemployment back to the initial equilibrium after a shock, is tested in the empirical analysis. A Phillips curve approach may be in accordance with a fixed equilibrium rate of unemployment, while a specification implying a connection between the wage level and the level of unemployment may indicate that the rate of unemployment returns to a new equilibrium. Irrespective of this question it is of interest to analyze how fast the economy moves towards equilibrium. The real wage flexibility is of great importance in this respect.

The high and lasting rate of unemployment in other Western countries has raised the question if there has been an increase in mismatch and structural problems. The growing rate of unemployment in Norway has actualized the question if the equilibrium rate of unemployment has moved outwards also in this country. In addition to the implications for wage formation the question will be analyzed by looking at the composition of the rate of unemployment and by comparing the series for unemployment with series for vacant jobs.

Unfortunately, lack of data of high quality for different kinds of labour has prevented a thorough analysis of the stuctural problems in the empirical part of the work. An assumption of labour beeing homogenous when analyzing wage formation obviously represents a simplification. Shocks in the economy may affect different kinds of labour differently. There may be excess supply in some submarkets simultaneously with excess demand in others, and it is too simple to represent disequilibrium by the aggregate rate of unemployment. This is a topic for further research when data is made available.

As Norwegian manufacturing industries to a large extent have lost competitiveness from 1966 to 1990 it is of interest to decompose in factors behind this loss. The choice of wage equation is probably of great importance for this decomposition, and it is especially of interest to find out if the loss is caused by a tight labour marked or other factors influencing price and wage formation.

Because of the close connection between the labour market and the general economic performance, the functioning of wage formation is of great importance for the macroeconomic development and how economic policy may be used to reduce unemployment after a negative shock. To analyze these questions different wage equations will be implemented in the macroeconometric model MODAG. By analyzing wage formation together with supply and demand for labour in a macroeconomic model, this may give a good insight in the macroeconomic functioning of the labour market. This analysis may show whether the labour market returns to the original equilibrium or not, and how fast an equilibrium is achieved.

If a specification of wage formation seems to cause large and lasting imbalances in the economy, this may indicate that the specification is misspecified, but it may also indicate severe weaknesses in other parts of the model or actual structural weaknesses in the system of wage formation which have to be changed to improve the macroeconomic performance. In the analyses of policy experiments the effects may depend on how wage formation is influenced. As the calculated effects may be of importance for choice of economic policy to influence the development in the labour market, it is of particular interest to reveal in which experiments the results are almost independent of choice of wage specification and in which experiments uncertainty about wage formation creates uncertainty about the effects.

1.2. The main features of the development in the Norwegian labour market 1970-1991

Chapter 2 gives an overview of the most important characteristics of the development in the Norwegian labour market in the period 1970 to 1991. The total development and changes in the composition of employment, labour supply and unemployment are presented. To discuss the degree of structural problems the employment series are confronted with the series for vacant jobs.

A main feature of the development in the Norwegian labour market in the last two decades is that the number of man-hours was about the same in 1991 as in 1970 while the number of persons employed has grown by almost 400 000 persons, or 24 per cent. The disparity may be explained by shortenings of the normal weekly working hours and an increase in the extent of part-time employment. The growth in employment is accompanied by growth in the labour force which is due to an increase in the population in the group 16-74 years as well as increasing participation rates, especially among married women.

The rather stable growth in the number of employed during the seventies is an important reason why the number of unemployed stayed at a rather low and stable level in those years. Lower growth in employment in the beginning of the 1980s contributed to an increase in unemployment which reached a temporary peak at 3.4 per cent in 1983. The strong growth in employment in the period 1985 to 1987 caused the rate of unemployment to fall again, but after the fall in employment in the period 1988 to 1991, the rate of unemployment reached 5.5 per cent in 1991.

From the analysis in section 2.2 there was no sign of an increase in the structural problems in the Norwegian labour market up to 1983, while mismatch problems have worsened in the period 1984-1991. The main reason behind the worsening from 1984 seems to be the large fluctuations in the Norwegian economy indicating dramatic shifts in the composistion of demand for labour by industry. A higher number of long term unemployed may also reflect an increase in the structural problems. The structural problems seem to have stabilized since 1989, as the change in employment by industry has smoothed out.

Section 2.3 presents a summary of the institutional background for the wage settlements during the period 1970 to 1991 including an overview of the income policy by the central government. Except from two shortening of the normal working hours in 1976 and 1987 and the wage and price regulations in 1978/79 and 1988/89 it is hard to find institutional factors which may have had a large effect on wage formation during this period.

Sections 2.4 and 2.5 present the development in real disposable wages, wages in other industries relative to manufacturing, competitiveness for manufacturing industries and possible relevant factors behind wage formation. A strong growth in wages caused a substantial increase in the real disposable wages in the period 1974 to 1977 while competitivenss for manufacturing industries deteriorated. The price and income regulations in 1978 and 1979 and the succeding growth in prices caused real disposable wages to decline in the period 1978 to 1980 while competitiveness improved. Real disposable wages show a slow growth during the 1980s, but has strenghtened in 1990 and 1991 as a result of reductions in income taxes. Competitiveness worsened in the period 1980 to 1987 as a result of a relatively larger growth in wage costs and a slower growth in productivity than abroad. The income regulations in 1988/89 and stronger growth in productivity has caused competitiveness to improve again from 1988 to 1991. Wage differentials between different industries have smoothed out in the period 1970 to 1990, and compared to wage earners in manufacturing industries wage growth has been weaker in most of the other industries.

1.3. A survey of economic theories for labour market and wage formation

Chapter 3 gives a review of different theories of possible relevance for the Norwegian labour market and wage formation. Theories for the labour market under assumptions of perfect competition and efficiency wages are presented in section 3.2, while theories for wage formation in the cases of trade unions and bargaining are presented in section 3.3. From the characteristics of the development in the Norwegian labour market presented in chapter 2 it is evident that there exist both organized and unorganized employees, and the aspects discussed both in section 3.2 and section 3.3 may contribute to explain the overall development of the Norwegian labour market. Because of this it may seem rather difficult to test the two approaches against each other in an empirical analysis. The explanatory variables turn out to be the same under perfect competition as well as with efficiency wages or trade unions and bargaining.

A main difference between the theoretical approaches seems to be the specification of how unemployment affects wage rates. Under perfect competition and classical price dynamics it seems reasonable to argue that a Phillips curve approach with a negative relation between the *growth* in wage rates and the *level* of unemployment, as outlined in section 3.5, is the most relevant. But it is not in contradiction with this theory that a *change* in unemployment may cause a *change* in wages. According to the discussion in section 3.5 this is called *temporary hysteresis.*

In theories of efficiency wages and trade unions and bargaining, it is usually assumed that it is the *level* of unemployment which affects the *level* of wages. In this approach the equilibrium rate of unemployment does not only depend on structural characteristics. When there is an exogenous shock causing an increase in the rate of unemployment, the equilibrium rate also increases. This is called *permanent hysteresis*. In the literature hysteresis is considered to be associated with lack of physical capital, loss of qualifications among the long term unemployed and/or trade unions which leave little concern for the unemployed in the wage negotiations. In spite of these arguments there is not necessarily a contradiction between the existence of trade unions on one hand and wage formation moving the economy back to the initial equilibrium on the other. Even with trade unions a high rate of unemployment may dampen the wage increases until equilibrium is restored.

From the discussion of classical price dynamics and the Phillips curve in section 3.5 it seems reasonable that a macro Phillips curve has a convex shape due to aggregation over different submarkets with both excess demand and excess supply for labour. The implication of this is that a reduction in unemployment will cause a large increase in wage inflation when the labour market is tight, and only a small increase in wage inflation when there is large unemployment. This may also hold in a situation with trade unions. Trade unions may be reluctant to accept large reductions in real wages when unemployment is high, but may be able to get high wage increases when unemployment is low. A low effect from unemployment to real wages is denoted *low real wage flexibility*, and hysteresis may be regarded as a case with only temporary flexibility in correcting the level of real wages.

In the theories of perfect competition as well as trade unions it is evident that prices and alternative wages are important factors in determining nominal wages. In both approaches it is also held that there must be homogeneity in the nominal development in the long run. This means that a large weight on alternative wages means a low weight on prices and vice versa.

From the Scandinavian theory of inflation presented in section 3.6 it is clear that prices on foreign competing products have to be of great importance for wage formation in the exposed industries, especially in the long run. This is also in accordance with the theory for trade unions since effects on demand for labour are taken into account in the wage negotiations. As no industry is perfectly exposed and the degree of exposedness may differ, it is possible that consumer prices and alternative wages are of importance, even in these industries. In the more sheltered industries alternative wages and consumer prices are assumed to be of great importance.

From the theory of perfect competition it does not matter whether it is the employers or the employees who pay the tax. In a world with perfect competition income taxes and pay-roll taxes ought to be included in a relation for wage formation in a symmetrical way. How much of an increase in taxes which is paid by the employers and employees respectively is dependent on the steepness of the demand and supply curves.

In the case of a trade union and bargaining the effects of an increase in pay-roll tax rates and income tax rates may no longer be symmetrical. While an increase in pay-roll tax rates shifts the demand curve in the same way as in perfect competition, normally implying lower nominal wages, an increase in income taxes has an uncertain effect. On the one hand lower disposable incomes should induce higher wages, but on the other hand a higher marginal tax rate means that the gain in marginal disposable income as a result of higher nominal wages declines relatively to the marginal costs of lower employment.

In most theories income taxes are treated symmetrically with consumer prices while pay-roll taxes are treated symmetrically with product prices. If a trade union care about the level of public consumption and transfers it is possible that tax increases have a smaller effect on wage growth than increases in consumer prices not caused by tax increases.

When firms operate under perfect competition or monopolistic competition a neutral technical progress shifts the demand for labour outwards resulting in higher wages both under assumptions of perfect competition in the labour market or a trade union and bargaining. In the Scandinavian theory of inflation the exposed sectors are assumed to act as price takers, and an increase in productivity is to the full degree assumed to be reflected by an increase in wages in the long run. In the sheltered industries, which have the possibility to shift higher costs to higher prices, the effect of an increase in productivity on wages is more unclear.

In section 3.4 aspects with macroeconomic policy and wage formation in economies with central trade unions are discussed. In this case it may be in the interest of the trade union to take the macroeconomic consequences regarding unemployment, price inflation and the balance of payments into account when bargaining about wages, while a local trade union is concerned about the local effects on employment. The greater concern for the negative macroeconomic consequences may moderate the wage claims from central unions.

When the behaviour of trade unions have macroeconomic effects they also consider the government's reactions when setting wages. The problem for the central government is then to decide on an optimal macroeconomic policy. One aim may be to counteract variations of employment around a chosen target through changes in public sector employment or other forms of macroeconomic stabilization policy. If an accommodating policy is perceived, the trade unions is induced to raise the real wage with negative consequences for employment. The lower employment then has to be balanced against higher stability.

An agreement between the trade union and the central government may give a better solution than a non-cooperative equilibrium. However, both actors have the temptation to cheat, and a cooperative agreement is not stable. To achieve a better solution for the central government rules rather than discretion may improve the situation.

The degree of accommodation may influence the weight the trade unions put on unemployment and may thus have consequences for wage formation. A change in accommodation policy may alter the impacts of some of the explanatory variables, and especially this may influence expectations and thereby the short run dynamics.

1.4. Wage formation in Norway, some empirical evidence

Chapter 4 presents some new empirical evidence regarding wage formation in Norway. The new empirical findings are discussed against earlier results, and the main reason why the results differ are given. A rather large weight is given to an analysis of wage formation in manufacturing industries, but a rather detailed analysis of wage formation in the sheltered sectors is also performed.

Wage formation in the total manufacturing sector is discussed in section 4.3. Because of a rather parallel development in the possible explanatory variables such as foreign prices, output prices, consumer prices and alternative wages, the empirical conclusions are not evident as discussed according to the overview in table 4.3.6. As in the earlier analysis minor differences in data and methods are found to give quite different results.

According to the discussion of economic theories in chapter 3 a main issue in the work has been to analyze the question of hysteresis or an equilibrium rate of unemployment dependent on structural characteristics only. An error correction model, giving a long term connection between the level of unemployment and the level of wages, corresponds to the hysteresis case. A Phillips curve specification with a connection between the level of unemployment and the change in wages, gives a fixed equilibrium rate.

Econometrically the Phillips curve may be seen as a special case when the error correction terms do not have any significant effects in an estimation where the change in wage rates is the left hand side variable, and the rate of unemployment is significant. As manufacturing industries to a large degree have lost competitiveness the last two decades, a single error correction term for the Scandinavian theory of inflation is not significant. When a wedge term representing the effects of tax increases and the effects of growth in Norwegian consumer prices relative to competitive foreign prices is included, the coefficients for the error correction terms get significant. The estimations also give a significant error correction term for alternative wages when they are ended in 1987. When foreign prices are replaced by product prices, mainly dependent on domestic costs, an error correction term for the share of wage costs also is significant.

Significant coefficients for the error correction terms favour these specifications against the Phillips curve. Because the wedge term somewhat seems to balance the other error correction terms in a specification with foreign prices, the Phillips curve specification is econometrically not much weaker giving a more parsimonious specification which passes all the misspecification tests. Tests of the Phillips curve specification against the more general error correction models are somewhat arbitrary depending on the number of apriori restrictions imposed.

As further discussed in section 4.7 the inclusion of the wedge term and alternative wages in the wage equation for average manufacturing gives as result that increases in taxes and price wedges are the main explanatory factors why Norwegian manufacturing industries have lost competitiveness the last two decades. As further discussed in the impact analyses presented in section 4.6 this is quite in contradiction with the Scandinavian theory of inflation.

The Phillips curve specification on the other hand opens for the possibility that much of the loss in competitiveness may be explained by a tight labour market during the 1960s, 1970s and parts of the 1980s. This specification gives an elasticity of foreign prices of 0.8 which is much more in accordance with the Scandinavian theory of inflation. But also in the Phillips curve specification tax and price wedges are found to have an elasticity of 0.2.

By extending the period of estimation to 1990 the error correction term for alternative wages is not significant in a specification where import prices are included, although dummies are used for 1988 and 1989 to catch up the income regulations. These error correction models also seem to have greater problems in explaining the wage growth in post-sample 1991 (based on preliminary data) than the Phillips curve.

The error correction specification where the gross factor income deflator is used instead of import prices and where the wedge variable is excluded, seems to perform rather well also in 1991. This specification has partial effects of the explanatory variables very close to the Phillips curve specification and is thus very close to the Scandinavian theory of inflation. An objection against this specification is that the factor income deflator is not a quite relevant variable for competing prices as wage costs to a large degree is passed over to product prices even in the exposed industries. Because of the great simultaneity between wages and product prices in this specification, the nominal development is quite sensitive for wedges. As discussed in section 4.7 lower sector taxes and higher subsidies, causing higher factor income, are the main reasons why Norwegian manufacturing industries have lost competitiveness according to this specification. This means that competitiveness and production in manufacturing industries could be improved by harder taxation of these industries. This is a very unlikely effect.

In free estimations the effects from income taxes and pay-roll taxes are very uncertain. Symmetry restrictions both between taxes and the corresponding prices could not be rejected neither in most of the error correction specifications, nor the Phillips curve specification. As discussed in section 4.3 and the impact analysis in section 4.6 changes in income taxes thus have a large effect on the nominal wage rates in the error correction models based on import prices. In the Phillips curve model and the error correction model based on the factor income deflator the effects are rather small. On the contrary a change in pay-roll taxes has a large effect on the wage rates in the factor income deflator specification and the Phillips curve specification and no effect at all in the other error correction specifications.

The partial long run elasticity of a change in productivity is estimated to be close to 1 in the Phillips curve specification, restricted to 1 in the error correction specifications without alternative wages and estimated to only 0.35 in a specification based on import prices and with alternative wages. When the indirect effects through price and wage formation are taken into account the total effect gets larger indicating that productivity growth is overcompensated in the error correction model without alternative wages. On the other hand productivity is still undercompensated in the specification where alternative wages are included, giving a positive contribution to competitiveness as long as productivity grows. These error correction specifications thus seem to be erroneous.

The estimations confirm that real wage flexibility is lower when unemployment is high compared with when it is low. In the Phillips curve case recursive estimations indicate that the equilibrium rate of unemployment has increased from about 2 - 2½ per cent ending the estimations in the early eighties to about 3 per cent ending at estimations in 1987. This is quite in accordance with the discussion of the structural problems in chapter 2, but of course there is a lot of uncertainty connected with this estimate. By ending the period of estimation in 1990 the equilibrium rate seem to be somewhat lower than 3 per cent confirming the results found in the structural analysis of a probable stabilisation in the structural problems over the last years, as the shifts in demand for labour between industries has declined.

All specifications indicate that the reductions in normal working hours have had an immediate positive effect on hourly wage rates. The results seem somewhat arbitrary regarding the long terms effect of this variable. It may be discussed if normal working hours should be included in the error correction term for real wages, and econometrics are quite inconclusive. In the Phillips curve specification no catching up effect of the reduction in normal working hours were found to be significant, but it is important to note that the price and income regulations in 1978/79 and 1988/89 followed rather close after the reductions in normal working hours in 1976 and 1987.

The conclusion about the price and income regulations corresponds very much to the conclusion about the effects from the reduction in normal working hours. The immediate effect was quite significant in both periods, almost independent of the chosen specification. There is however some uncertainty if these regulations have had a lasting effect on the wage level or not, but it is difficult to find any significant catch-up effects in the Phillips curve specification based on yearly averages. Based on quarterly data other analyses indicate that there may be some catch-up effects in the short run.

Estimation results for wage equations for the most important sectors regarding employment according to the aggregation level of the macroeconomic model MODAG are discussed in section 4.4, and updated estimations of the preferred specifications up to 1990 are presented in section 4.5. Because of the coordination of the central settlements for total manufaturing the wage structure seems to be quite stable, even in the short run. Wages for total manufacturing (or factors determining wages for total manufacturing) thus seem to be of great importance for most of the manufacturing sectors. Some weight is however put on prices on their own competing products in the main exposed sectors. In some sectors concern is given to the real disposable income in addition to what follows by wages for average manufacturing.

Wages for total manufacturing also seem to have a large impact on wages in the sheltered industries, but in these sectors concern for real disposable incomes is of some importance except for Wholesale and retail trade. The concern for real disposable income especially seems to be large in Central administration, Public education, Building and construction and Financial services, reflecting that these sectors have experienced the greatest loss in relative wage position compared to Manufacturing.

Smaller reductions in normal working hours, smaller growth in productivity and an increasing share of women with lower pay than men, are held to be possible factors when explaining the loss in relative wage position for private and public services. Little support for this view is found in this study. It is however striking that wage growth seems to be underestimated in 1991 for the sectors which have lost most of their relative wage position during the period of estimation. This may indicate a structural change. In the sheltered industries where consumer prices are found to be of importance in the long run, personal income taxes and reductions of normal working hours are assumed to be of importance due to the chosen error correction specification.

1.5. The labour market in the macroeconomic model MODAG

In chapter 5 the functioning of the labour market in Norway is discussed with basis in the macroeconomic model MODAG. Section 5.2 contains a short description of the main features of the model, while the structure in the equations and the main explanatory factors for demand and supply of labour are presented in section 5.3. In this section the impacts of wages on demand and supply of labour are also discussed, based on an impact analysis of a version where wages are assumed to be exogenous.

Reduction in wage rates has three main impacts on demand for labour in MODAG:

- an income effect because of a redistribution from wages to operating surplus, reducing private consumption and employment in private services,

- a market share effect because of gain in market shares both in the export market and the domestic market, increasing production and employment in the exposed industries,
- a substitution effect as labour becomes relatively cheaper compared to other inputs.

In the short run the positive and negative effects almost seem to balance while the positive effect of a reduction in wages dominates in the long run. The long run elasticity with respect to real wages in private industries is however numerically as low as -0.4, indicating that a reduction in wages only has a small effect on demand for labour.

In MODAG there is only a weak direct effect of changes in real wages to supply of labour, indicating that the supply curve for labour is rather steep. However, since supply of labour is found to be dependent on growth in service industries and unemployment, a shift in demand will move the supply curve about half the way of the shift in the demand curve. A negative direct effect of lower wages on the labour force is then more than balanced in the long run by a positive shift in demand for labour and a reduction in unemployment. According to the model a reduction of wages by 2 per cent may in the long run reduce unemployment only by about 2 500 persons.

Both the balance of payments and the government budget surplus improve as a consequence of a reduction in wage rates. The balance of payments improves because of a reduction in domestic demand and gain in market shares, while the government budget surplus improves because public sectors expenditures are more sensitive to growth in domestic nominal variables than is the case for incomes. An improvement in the balance of payments and the government budget surplus make room for a reduction in taxes and/or an increase in public services. This may increase employment by more than the direct effect of a reduction in wages.

Some macroeconomic implications of choice of wage equations are analyzed in section 5.4. A main point is the discussion of hysteresis versus a fixed equilibrium rate of unemployment which is only dependent on structural characteristics. From the theoretical discussion in chapter 3 the arguments that the equilibrium rate of unemployment may change somewhat as a consequence of the situation in the labour market are relevant. On the other hand it may cause troubles to assume that this process lasts for ever as a consequence of a sequence of shocks moving the rate of unemployment in the same direction. Arguments for stationarity regarding the rate of unemployment in the long run support the Phillips curve specification.

The different arguments are further evaluated by constructing reference scenarios for MODAG based on four alternative wage equations for manufacturing industries; a Phillips curve, an error correction model with a wedge variable without alternative wages, an error correction model where alternative wages also are included, and an error correction model based on the factor income deflator. The main differences between the four model versions show up in the development in wages for average manufacturing. Due to large simultaneity between wages and product prices an unfortunate development in price-wedges cause the factor income deflator model to show the greatest growth in wage rates. Because productivity growth is overcompensated in the error correction model with a wedge variable this version also gives a high growth in wages. The error correction model with alternative wages gives the lowest growth in wages because productivity growth is undercompensated. The Phillips curve specification gives a wage growth somewhere in between.

Because of the impact from wages on unemployment, unemployment is lowest with the alternative wage specification and highest with the factor income deflator specification. As the growth in wages also is of great importance for the balance of payments and government budget surplus these balances are highest with the alternative wage specification and lowest with the wedge variable and the factor income deflator specification.

The divergence between the four specifications gets larger and larger as time elapses. There is a tendency for the alternative wage specification to end up in a situation with low unemployment and a large positive balance of payments and government budget surplus. On the other hand, the wedge model and the factor income deflator model end up in high rates of unemployment and large deficits regarding government budget surplus. With higher elasticities of real wages in demand and supply for labour, which was the case in an earlier version of the model, these problems would have been even more severe than in this study. The main reason for the problems is that the the wedge model and the alternative wage model do not behave according to the Scandinavian theory of inflation. When assuming no changes in tax- and price-wedges manufacturing industries may gain competitiveness for ever according to the alternative wage specification and loose competitiveness for ever according to the specification without alternative wages. The factor income deflator model may also deviate from the Scandinavian theory if price-wedges arise.

The close correspondence with the Scandinavian theory favours the Phillips curve specification. It is hard to defend that large and lasting imbalances in both the labour market, the balance of payments and the government budget surplus represent equilibrium in the Norwegian economy. One equilibrating force may work through wage formation, but is also possible with equilibrium forces working through exchange rates and other financial variables not sufficiently modelled in MODAG.

In section 5.5 the macroeconomic properties of MODAG regarding the labour market is further discussed. Although choice of wage equation for average manufacturing is of some importance for the macroeconomic properties of MODAG, the low real wage flexibility at high rates of unemployment and low wage elasticities in demand and supply of labour, cause the economy to need several years to restore equilibrium in the labour market. This holds even if the Phillips curve is the most relevant description of wage formation. As supply of labour also is very sensitive for shifts in demand and unemployment, this lowers the reduction in unemployment of a growth in the economy.

To shed further light on the functioning of the Norwegian labour market and evaluate the properties of the different wage equations the effects of an increase in government consumption, a reduction of pay-roll-, personal income- and value added taxes, a reduction of the normal working hours, a negative shift in supply of labour (caused by lower growth in population) and a devaluation are discussed.

With exception from the uncertainty about the long run effects on wages of a reduction of normal working hours, the choice of wage equation is only of minor importance regarding the effects from an increase in government consumption, a reduction in normal working hours and a negative shift in supply of labour at the present high rates of unemployment. All these policies are rather effective in reducing the rate of unemployment in the short run. Higher inflation, loss of competitiveness and crowding out of production and employment in the exposed industries follow as negative consequences of these policies, which also have negative impacts on the balance of payments and government budget surplus. In a situation with a low rate of unemployment, the non-linear effect from the rate of unemployment to wages would make the negative effects of these policies more evident with all specifications, and especially with the Phillips curve specifiation.

Because the wedge model and the alternative wage model do not behave according to the Scandinavian theory of inflation, the effects on wages and other macroeconomic variables of a reduction in pay-roll taxes, income taxes and value added taxes deviate quite a lot in these models compared to the Phillips curve model and the error correction model based on the factor income deflator. Regarding total employment and unemployment the effects are more modest in all cases compared to an increase in government consumption, although the wedge model and the alternative wage model give the most positive effects. The positive effects on exports, domestic market shares and thereby production and employment in manufacturing industries are also largest with these models while the effects on private consumption and thereby production and employment in service industries are largest with the Phillips curve model and the factor income deflator model. The largest differences occur for the balance of payments and government budget surplus. In the long run these balances are only to a small degree weakened as a result of the tax cuts according to the wedge model and the alternative wage model while the effects are quite negative according to the Phillips curve specification and the factor income deflator model. Irrespective of the chosen specification the effects on domestic prices, production in exposed industries and the balance of payments are more favourable with a cut in taxes compared with a corresponding growth in government consumption.

A devaluation leads to an improvement in competitiveness for manufacturing industries in the short and medium term irrespective of the chosen specification. Manufacturing industries therefore improve their market shares both on the export market and the domestic market, and this leads to higher production and employment, which also have positive indirect effects on other sectors. The positive effects on total employment are however rather small. Because of the homogeneity properties in the wage equations, wages are fully compensated in the long run irrespective of the chosen specification. After 8 years a devaluation has no effects on real variables at all, but only leads to higher nominal wages and prices.

2. The main features of the development in the Norwegian labour market 1970-1991

This chapter gives an overview of the most important characteristics of the development in the Norwegian labour market in the period 1970 to 1991. The total development and changes in the composition of employment, labour supply and unemployment are presented, and the unemployment series are compared with the series for vacant jobs to discuss the degree of mismatch and structural problems.

The chapter also contains a summary of the institutional background for the wage settlements during the period, including an overview of the income policy by the central government. Nominal wage increases in manufacturing industries, wages in other industries relative to manufacturing and expected relevant factors behind wage formation are also presented.

2.1. Employment, labour supply and unemployment

The main features of the development in the Norwegian labour market in the period 1970-1991 are presented in figure 2.1.1 and table 2.1.1. The series regarding the number of persons employed and man-hours are derived from the employment calcula-

Table 2.1.1. Population aged 16-74 years in the labour force. Labour force, unemployment and employed in 1000 persons, man-hours calculated as 1000 man-years à 1725 hours per year

	1970	1975	1980	1983	1987	1991
Total 16-74 years[1]	2 692	2 793	2 885	2 952	3 043	3 100
In the labour force	1 666	1 772	1 980	2 032	2 179	2 149
Unemployment	26*	33*	32	69	45	116
Employed	1 640	1 739	1 948	1 963	2 133	2 033
- Man-hours	1 679	1 666	1 693	1 675	1 761	1 659

[1] Calculated at the end of the year.
* Calculated/corrected on the basis of registered unemployment.

Figure 2.1.1. Total number of persons employed and total man-hours. Indices,1970=100

tions in the National accounts (see Harildstad (1989)) while the number of persons unemployed is given from the Labour Force Sample Survey (LFSS). The derived figures for the labour force are calculated as the sum of employment and unemployment.

Figure 2.1.1 and table 2.1.1 show that the number of man-hours worked was about the same in 1991 as in 1970. Growth in labour productivity has caused the number of man-hours to stay constant in spite of a clear growth in production. During the period man-hours fluctuated according to the business cycles. Growth in 1980 was followed by a reduction in 1982 and 1983. From 1984 to 1986 the number of man-hours increased by 5.0 per cent caused by the strong growth in production and domestic demand. A weak development in production caused a decline in the number of man-hours of 5.4 per cent from 1988 to 1991.

Although the number of man-hours was about the same in 1991 as in 1970, the number of persons employed has grown by almost 400 000 persons, or 24 per cent. The deviation may be explained by the shortening of the normal weekly working hours (from 42.5 to 40 hours a week in 1976, and a further reduction to 37.5 hours a week in 1987) and an increase in the extent of part-time employment. The reduction in the average number of hours worked per employee is also due to an increase in paid abscense.

The growth in employment parallels the growth in the labour force which is due to an increase in the population in the group 16-74 years and increasing participation rates. From figure 2.1.1 it can be seen that the growth in the number of employed persons was especially strong in the two periods 1974 to 1980 and 1985 to 1987. The number of employed persons was almost constant from 1980 to 1984 and declined by 100 000 persons from 1987 to 1991.

The rather stable growth in the number of employed persons during the seventies is an important reason why the number of unemployed stayed at a rather low and stable level in those years. Although the stabilization in the number of employees during the first eighties caused a similar stabilization in the participation rates, growth in the population in the group 16-74 years contributed to an increase in unemployment which according to LFSS reached a temporary peak at 3.4 per cent of the labour force in 1983. The strong growth in employment in the period 1985 to 1987 caused the unemployment to fall again in spite of a rather strong growth in the labour force. The fall in employment in the period 1988 to 1991, however, caused the rate of unemployment to increase to 5.5 per cent in 1991.

2.1.1. Employment

Figure 2.1.2 and table 2.1.2 show the development in man-hours and the number of employed persons in different industries. The main trend in the period 1970 to 1991 consists of a considerable reduction in the number of employed persons, both in primary industries and manufacturing. On the other hand there has been a strong growth in employment both in private and public services. While the strong decrease in the number of persons employed in the primary industries during the seventies seems to have been somewhat reduced during the eighties, the opposite seems to be the case for manufacturing industries. The growth in public services seems to have been stronger in the seventies than the eighties. The growth in private services was stronger in the seventies than in the eighties as a whole.

While employment in the seventies was characterized by a rather stable development in the different industries, the fluctuations in the eighties were far more pronounced as shown in table 2.1.3. Especially fluctuations were large in the private sectors, while the growth in employment in the public services was more stable.

From 1980 to 1983 the number of employees in the manufacturing industries declined with 40 000 persons. An international slowdown and problems with declining market shares as a result of high costs in Norwegian firms compared to abroad may be the main reason for this. The international recovery contributed to stabilize the employment in manufacturing industries from 1983 to 1987. Due to stronger growth in productivity and a slowdown in domestic demand, employment in manufacturing industries decreased by 59 000 persons from 1987 to 1991. The upswing in the domestic economy caused a strong increase in employment in building and construction and private services during the period 1983 to 1987. Total employment increased by 170 000 persons in that period. When the economy slowed down again employment declined by 100 000 persons in the period 1987 to 1991.

Figure 2.1.2. Man-hours by sector1). Calculated as 1000 man-years à 1725 hours per year

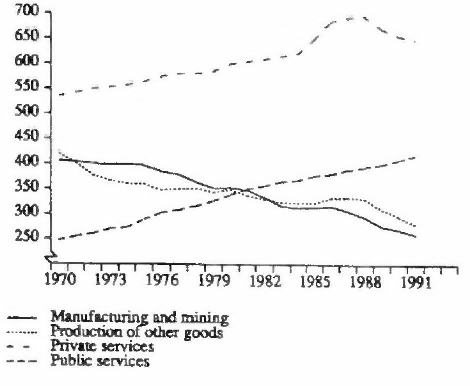


Table 2.1.4 presents the number of employed in different sociodemographic groups. The total figures for men and women are taken from the National Accounts while the distribution by age, and for women by marital status, is based on the Labour Force Sample Surveys.[1]

The table shows that there was a strong increase in the number of employed married women from 1970 to 1987, and there has also been a considerable increase in employment of unmarried women. Regarding men aged 25 to 59 years there has been a smooth and modest growth in the period up to 1987.

1 The construction of these data series is documented by Lindquist and Sannes (1989).

Table 2.1.2. Employment by industry. 1000 persons[1)]

	1970	1975	1980	1983	1987	1991
Total employment	1 640	1 739	1 948	1 963	2 133	2 033
Oil and ocean transport	56	46	47	50	37	52
Mainland Norway	1 584	1 693	1 901	1 913	2 096	1 980
Manufacturing, incl. mining	399	409	394	354	355	296
Primary industries	211	168	163	149	140	125
Building and construction, Electricity	149	151	167	163	192	156
Wholesale and retail trade	220	240	283	282	309	281
Domestic transport and communication	112	122	140	142	156	146
Other private services	221	257	302	330	408	395
Public services	272	346	452	492	536	583

[1)] According to the National Accounts.

Table 2.1.3. Change in employment in different industries. 1000 persons[1)]

Industry	1980-1983	1983-1987	1987-1991
Oil and ocean transport	3	-13	15
Manufacturing and mining	-40	1	-59
Primary industries	-14	-9	-15
Building and construction, Electricity	-4	29	-36
Wholesale and retail trade	-1	27	-28
Domestic transport and communication	2	14	-10
Other private services	28	78	-13
Public services	40	44	47
Total employment	15	170	-100

1) According to the National Accounts.

Table 2.1.4. Employment by sociodemographic groups. 1000 persons*

	1970	1975	1980	1983	1987	1991
Youths, 16-19 years	109	100	116	114	131	81
Youths, 20-24 years	191	192	221	215	245	213
Married women, 25-66 years	295	358	459	475	532	521
Unmarried women, 25-66 years	119	136	166	188	223	248
Men, 25-59 years	765	800	832	823	865	863
Men, 60-66 years	100	107	110	105	93	77
Pensioners, 67-74 years	62	46	44	43	43	29
Total employment	1640	1739	1948	1963	2133	2033

* Based on the National Accounts in combination with the Labour Force Sample Survey.

After a modest growth from 1970 to 1980 the number of employed men between 60 to 66 years has fallen considerably during the eighties.

Employment among youths grew strongly in the period 1975 to 1980 and especially from 1985 to 1987. From 1987 to 1991 there has been a considerably fall in employment for youths, especially for those between 16-19 years.

2.1.2. The labour force

Data for the population by gender, age and marital status at the end of the year are presented in table 2.1.5. From the table it is evident that some part of the growth in employment shown in table 2.1.4 may be explained by growth in population for the different groups. This is especially the case for men aged 25-59 years, and to some degree also youths 16-19 years and unmarried women. A considerable divergence between the growth in employment and the growth in population for the other groups may be explained by changes in participation rates as shown by table 2.1.6.

The average participation rate in the group 16-74 years increased from 62 per cent in 1970 to almost 72 per cent in 1987 and fell again to just above 69 per cent in 1991. A large part of the growth from 1970 to 1987 is due to a considerable increase in labour force participation among married women. In an analysis by Lindquist, Sannes and Stølen (1990), the main factor behind this development is to be found in the large growth in public and private services shown in table 2.1.2, which has made it both warranted and possible for the married women to join the labour force. The increase in the participation rate for this group also has to be seen in connection with the reduction in the number of pre-school children.

The participation rates for unmarried women and youths aged 20-24 years increased up to 1987. For youths this also seems to be due to the expansion in the service sectors, while the level of education and real wages seem to have been of importance for unmarried women. From 1987 to 1991 the decrease in demand for labour and a greater number of students at the universities have caused a fall in participation rates for these groups. The participation rate for the youngest group (age 16-19 years) seems to be very elastic with regard to the employment situation in the service sectors, and this is the main reason for the great fluctuations in the eighties. An increase in the capacity of the school system has also prevented a growth in the participation rate for this group when the period is taken as a whole. Together with the decrease in demand for labour this is the main reason behind the fall in the participation rate from 1987 to 1991.

Men in the group 25-59 years have shown a rather stable participation rate of about 94 per cent up to the beginning of the 1980s, while the participation rate has fallen somewhat from 1987 to 1991. The participation rate for men aged 60-66 years has fallen considerably during the eighties. This seems to be due to a higher rate of unemployment and more liberal practice regarding disability pensions. A shortening of the pension age from 70 to 67 years in 1973 is an important reason behind the drop in the participation rate for the oldest group, but the increase in unemployment during the eighties may also be of importance through a discouraged worker effect.

Table 2.1.5. The population in different sociodemographic groups by the end of the year. 1000 persons

	1970	1975	1980	1983	1987	1991
Youths, 16-19 years	241	247	251	264	268	246
Youths, 20-24 years	314	303	309	310	332	337
Married women, 25-66 years	751	781	783	778	756	727
Unmarried women, 25-66 years	197	206	232	258	301	360
Men, 25-59 years	812	851	879	898	938	988
Men, 60-66 years	132	143	148	152	144	130
Pensioners, 67-74 years	246	261	282	291	303	311
Total, 16-74 years	2692	2793	2885	2952	3043	3100

Table 2.1.6. Labour force in per cent of population in sociodemographic groups.[1]

	1970	1975	1980	1983	1987	1991
Youths, 16-19 years	49.0	46.1	50.8	49.0	53.1	40.2
Youths, 20-24 years	63.0	66.2	73.5	74.3	76.8	71.0
Married women, 25-66 years	40.0	46.8	59.8	62.6	71.5	73.9
Unmarried women, 25-66 years	61.5	67.5	71.6	75.1	75.6	72.0
Men, 25-59 years	94.7	94.7	95.3	93.4	93.3	91.6
Men, 60-66 years	76.2	75.7	74.7	70.1	64.9	60.8
Pensioners, 67-74 years	25.1	17.5	15.7	14.6	14.3	9.4
Total, 16-74 years	61.9	63.4	68.6	68.8	71.6	69.3

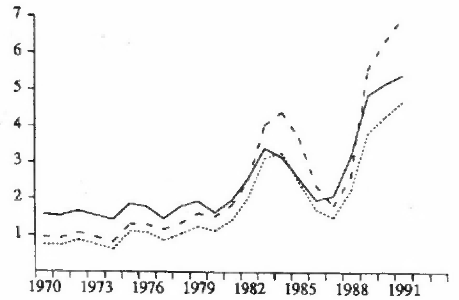
1) Based on the National Accounts in combination with the Labour Force Sample Survey and population statistics.

2.1.3. Unemployment

Figure 2.1.3 shows the rate of unemployment both according to the Labour Force Sample Survey and the registrations at the employment offices. The rates of unemployment are calculated as per cent of the labour force equal to the sum of employment from the National Accounts and the number of unemployed according to the Labour Force Sample Survey.

Up to 1980 the two curves are rather parallel with unemployment at a low level. The employment according to the Labour Force Sample Survey was somewhat higher than the registered unemployment in those years because some of the non-employed persons seeking work did not register at the employment offices. Due to the weak development in demand for labour, the rate of unemployment rose considerably from 1981 to 1983, and at its peak in 1983 the number of unemployed reached 3.4 per cent of the labour force. Registered unemployment in- creased more than the LFSS-unemploy- ment, probably as a result of a larger propensity to register in order to join the government's labour market programmes.

Figure 2.1.3. The rate of unemployment. Per cent of the labour force



—— The Labour Force Sample Surveys
.... Registered at the employment offices
- - Registered unemployment and at ordinary programmes

Source: The Directorate of Labour and Statististics Norway

When the strong demand for labour in the period 1985 to 1987 caused the rate of unemployment to decrease again, the registered unemployment decreased more than the LFSS-unemployment. But in 1986 and 1987 the distance between the two curves was smaller than in the seventies indicating a lasting shift in the propensity to register. The registered rate of unemployment also seems to lag somewhat behind the rate of LFSS-unemployment.

A 2.0 per cent level of the rate of LFSS-unemployment in 1986 compared to 1.4 per cent in 1974 indicates a less perfect functioning of the labour market in the eighties than in the seventies.

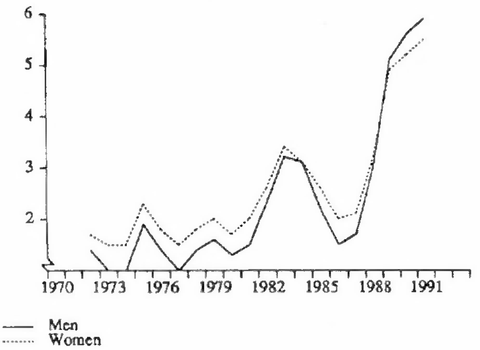
Due to the slack in demand for labour the rate of unemployment grew considerably in the period 1988 to 1991. The number of unemployed according to LFSS increased faster than the number of persons registeres unemployed and reached 5.5 per cent in 1991. Although the propensity to register may have increased also in these last years, the difference between the number of registered unemployed and the number of unemployed according to LFSS has increased again probably because some of the participants at the labour market programmes in the last years are calculated as non employed persons seeking jobs in the LFSS. A larger part of the labour market programmes in the years from 1988 has been directed towards education, while direct government employment was more common in 1983 and 1984. When the ordinary labour market programmes (excluding retraining of disabled persons) are added to the registered unemployed as shown in figure 2.1.3 this number constituted about 7 per cent of the labour force in 1991.

During the seventies the share of persons unemployed more than 26 weeks, and hence the absolute number of long term unemployed, were at a low level. When unemployment increased during the eighties the share of long term unemployed also increased. While the first period of an increase in unemployment often is dominated by an increase in inflow, the share of long term unemployed naturally lags behind the actual unemployment. The share of persons unemployed more than 26 weeks according to the Labour Force Sample Survey calculated as yearly average and according to the registered unemployment calculated in January next year are shown in figure 2.1.4. A weakness with these series as pointed out by Aaberge (1987) is that they only give the number of persons with uncompleted unemployment spells and do not tell anything about total duration. This is especially a weakness in an analysis of inflow and duration, but not as severe when the main concern is about the share of long term unemployed. An increase in the lenght of the period where the unemployed can achieve unemployment insurance

Figure 2.1.4. The share of unemployment more than 26 weeks. Per cent

Source: The Direcorate of Labour and Statistics Norway.

Figure 2.1.5. The rate of unemployment by gender according to the Labour Force Sample Survey



from 40 to 80 weeks in July 1984 may have influenced the series from the employment offices somewhat.

From figure 2.1.4 it is evident that the share of long term unemployed increased substantially in 1983 and 1984 in accordance with the increase in unemployment. When unemployment fell again from 1985 to 1987 the share of long term unemployed also fell, but it did not reach the level from the early eighties indicating a growth in the structural problems on the labour market. Part of the increase in the share of registered long term unemployed may however be due to the lengthening of the maximal period where unemployed are allowed to achieve unemployment insurance. After the increase in unemployment from 1988, the number of long term unemployed according to LFSS reached 40 000 persons, or about 35 per cent of total unemployment, in 1990 and 1991.

Figure 2.1.5 shows the rates of unemployment by gender according to LFSS. The rate of unemployment has traditionally been lower for men than for women. In years with high unemployment however the difference is smaller than in years with lower unemployment. Since 1989 the rate of unemployment among men has in fact been higher than the rate of unemployment among women. The reason for this is that men to a larger degree than women work in industries, especially Manufacturing and Building and construction, which have been exposed to large decreases in employment.

2.2. Mismatch and structural problems in the Norwegian labour market

The labour market may be divided into submarkets according to job-characteristics, such as industry, kind of work, demand for qualifications and the firms' localisation, or characteristics of the workers, as place of living, age, gender, education and qualifications. If there is excess supply in some submarkets at the same time as there is excess demand in others, this is denoted structural problems or mismatch in the labour market. A change in the composition of demand and supply for labour may cause an increase in the structural problems. The structural problems may also increase as a result of increasing frictions in the labour market caused by a greater diversification in submarkets, greater barriers between these submarkets and lower mobility. More rigid wages also explain an increase in the structural problems.

A common way to illustrate mismatch in the labour market is to analyze the connection between the rate of unemployment (U) and the rate of vacant jobs (V). On Norwegian data such studies have earlier been carried out by Cappelen (1983), Falk (1988 and 1989) and in NOU 1988:24. Most of the data used in these analyses are based on the registrations of persons employed and vacant jobs at the labour market offices. A problem with these data is that the propensity to register may change over time and may violate the data if no correction is possible.

By comparing the registered unemployment with the figures from the LFSS Falk (1988 and 1989) concludes that the propensity to register increased from 1982 to 1984. This is also in accordance with the discussion in connection with figure 2.1.3. Although the propensity to register may have declined again when unemployment fell in the period 1985 to 1987, the propensity to register was probably higher than in the seventies.

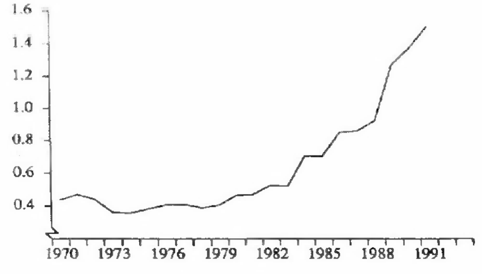
By comparing the supply of vacant jobs at the employment offices by the number of advertisements in the newspapers Falk also concludes that the propensity to register vacant jobs may have increased from 1985 to 1986. Better routines in registration of vacant jobs at the employment offices including registration of advertised jobs in the newspapers have probably led to a more complete register.

In an analysis of mismatch and structural problems based on the registrations at the employment offices one has to keep in mind the probably higher propensity to register with regard to unemployment and vacant jobs. Figure 2.2.1 shows the product of the rate of unemployment and the rate of vacancies registered at the employment offices. An increase in this product is an indication of more structural problems and mismatch.

From the figure it seems evident that the product of the unemployment rate and the vacancy rate was rather constant in the period 1970 to 1983 with only a weak increase at the end of the period. This fact is in accordance with the conclusion in Cappelen (1983) that there was no sign of an increase in the structural mismatch in the Norwegian labour market before 1983. From 1984 to 1991 the curve shows a marked upward slope indicating increasing structural problems. Although the increase in mismatch indicated by this figure is somewhat exaggregated as a consequence of the higher propensity to register, the increasing structural problems are confirmed by a higher rate of unemployment measured by the Labour Force Sample Survey in 1986/87 than in 1973/74. The growth in employment and probably the pressure on the labour market was well as high in the latter period as in the former. A higher share of long term unemployed in 1986/87 than in the seventies as shown by figure 2.1.4 is also an indication of larger structural problems.

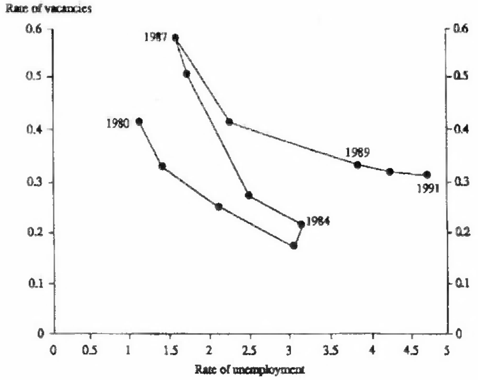
The increase in the structural problems in the eighties also shows up in the socalled Beveridge curve between the rate of unemployment and the rate of vacancies drawn in figure 2.2.2.

Figure 2.2.1. The product of the rate of unemployment and the rate of vacancies regitsered at the employment offices



Source: The Directorate of Labour

Figure 2.2.2. The relation between the rate of unemployment and the rate of vacancies registered at the employment offices



Source: The Directorate of Labour

The figure shows a nice falling curve between the rate of unemployment and the rate of vacancies from 1980 to 1983. But an increase in structural problems in the years 1984 to 1986 shifts the curve, and a new shift occurs in 1988. It may seem like a paradox that the structural problems do not seem to have risen during the period 1981 to 1983 where the rate of unemployment grew considerably, but increased in the period 1984 to 1986 with strong growth in employment and a fall in unemployment. However, because the strong growth in employment in that period as shown by table 2.1.3 was concentrated to private services while the strong decline in the earlier period, and also from 1987 to 1989, was concentrated to manufacturing industries, this may be the main reason behind the growth in the structural problems during the eighties.

To analyze the reasons behind the structural problems further it has been common to look at the composition of unemployment by gender, age, education, region and occupation, and correspondingly for vacant jobs regarding region and occupation. As demonstrated by Falk (1988 and 1989) the dispersion of unemployment by different characteristics may be analyzed by calculating coefficients of variations. The development in such coefficients from 1972 to 1991, calculated as the unweighted standard deviation for the rate of unemployment among the different groups relative to the unweighted mean, is shown in table 2.2.1. The coefficients by gender and age are based on the Labour Force Sample Surveys while the coefficients by county and occupation are based on the registrations at the employment offices. While the coefficients by county, gender and age are based on relative numbers, the coefficients by occupation are based on absolute numbers because of no clear correspondance between the occupation classification for the unemployment figures and the industry classification for the employment series in the National Accounts.

Compared with figure 2.1.3 the table indicates a negative correlation between the coefficients of variation and the rate of unemployment for both gender and county. The coefficients of variations by these characteristics were relatively high during the seventies when unemployment was low, declined substantially in 1982 to 1984 when the rate of unemployment was relatively high, increased again in 1985 to 1987 when the labour market was tight, and finally decreased to a low level in the period 1989 to 1991.

The negative correlation between the coefficient of variation and the rate of unemployment by gender is caused by the fact that men to a larger degree than women work in sectors which are influenced by business cycles, i.e. manufacturing and building and construction. In economic slowdowns with large reductions in employment in these sectors men are more severely affected than women. In economic upswings the growth in employment particularly seems to have been strong in private and public services where a large share of the employees are women. The service sectors are also to a large degree concentrated in central areas with traditionally low unemployment. In a tight labour market the demand pressure in the central areas seems to have been very high. A greater dispersion of unemployment by county in a situation with a tight labour market is characterized by high coefficients of variation in those periods. The slowdowns reducing employment in manufacturing industries seem to have affected both central and rural areas. Norway thus seem to have experienced the rather paradoxal situation that mismatch problems by gender and region seem to have decreased when unemployment increased.

Table 2.2.1. Coefficients of variation[1] for unemployment by county, gender, age and occupation[4]

Year	County[2]	Gender[3]	Age[3]	Occupation[2]
1972	0.50	0.20	0.92	0.69
1973	0.57	0.41	0.98	0.61
1974	0.67	0.39	1.08	0.55
1975	0.52	0.21	0.96	0.81
1976	0.51	0.22	0.89	0.63
1977	0.49	0.38	0.96	0.62
1978	0.49	0.26	0.89	0.65
1979	0.44	0.20	0.89	0.57
1980	0.52	0.28	1.01	0.55
1981	0.42	0.29	0.82	0.60
1982	0.35	0.13	0.86	0.70
1983	0.28	0.09	0.72	0.76
1984	0.29	0.02	0.74	0.66
1985	0.33	0.17	0.71	0.59
1986	0.39	0.25	0.82	0.56
1987	0.42	0.19	0.75	0.57
1988	0.39	0.06	0.81	0.64
1989	0.23	0.04	0.68	0.62
1990	0.18	0.08	0.64	0.59
1991	0.15	0.08	0.65	0.55

1) Defined as the unweighted standard deviation for the rate of unemployment among the different groups relative to the unweighted mean.
2) Unemployed persons registered at the employment offices.
3) Non-employed persons seeking work according to the Labour Force Sample Survey.
4) The coefficients of variation are based on relative figures of unemployment for county, sex and absolute figures for occupation.

The coefficients of variation by age are calculated based on the rates of unemployment for the groups, 16-19, 20-24, 25-49 and 50-74 years from the Labour Force Sample Surveys. Sample uncertainty as a result of a rather small number of people in the different groups of unemployed may cause rather large fluctuations in the series. A special problem occurs for the youngest group, 16-19 years, where most of the population is full time at school and therefore outside the labour force leaving the rate of unemployment very high and to a large degree dependent on the share at full-time education. Although the coefficients of variation by age also seem to move counter-cyclically, this movement is not as clear as by gender and region. Fluctuations in the rate of unemployment then seem to hit all age groups.

The coefficients of variation by occupation are calculated based on the number of unemployed registered at the employment offices by seven groups of occupation, work in Primary sectors, Mining and manufacturing, Building and construction, Transport and communication, Administration, offices and sale, Services and Technical, physical and humanistic work. An objection to this division is that it is arbitrary and the coefficient of variation may depend on the composition of the different groups.

Contrary to region, gender and age the coefficient of variation by occupation shows a procyclical pattern. According to the classification the number of unemployed has been highest in the group Mining and manufacturing and it is also this group which has showed the greatest increase in unemployment during slowdowns. However, the coefficients of variation were not higher at the beginning of the 1990s when unemployment was high than in the seventies when unemployment was low, indicating that the occupational mismatch may have declined in the last years.

To conclude this section it seems that mismatch problems in the Norwegian labour market has worsened in the period 1984-1991 while there seems to be no significant signs of change from 1970 to 1983. The main reason behind the worsening from 1984 seems to be the large fluctuations in the Norwegian economy indicating dramatic shifts in the composition of demand for employment by industry. It looks like the structural problems has stabilized in the last years as the change in employment by industry has smoothed out. This has happened in spite of a large number of long term unemployed which could have caused a permanent shift outwards in the Beveridge curve.

2.3. Institutional background for the Norwegian wage settlements

About 58 per cent of the wage earners, or more than 1 million persons were organized in a countrywide trade union in 1990. The Norwegian Federation of Trade Unions (LO) has been the dominating organization, but as seen from table 2.3.1 the share of wage earners organized in The Confederation of Vocational Unions and The Federation of Norwegian Professional Associations has shown a marked increase during the last twenty years. The main reason for this is that organizations outside LO have joined the two other confederations.

The employers' organizations embrace about 50 per cent of the wage earners with The Confederation of Norwegian Business and Industry (NHO) and The Association of Local Authorities as the two most important. Even though there exists no formal employers' organization in the central government, the Ministry of Labour possesses the employer's responsibility.

As presented in "An analysis of income formation in Norway" (NOU 1988:24) the share of wage earners which are organized differs across industries. Members of different unions are often employed in the same industry. The degree of organization and the relative strength between the different organizations may influence both the bargaining process and the outcome. The ability and willingness to strike or carry out other sanctions may also be of importance.

The bargaining process in the LO-NHO area has been a mixture of central and local negotiations where the relative importance of the central negotiations has diminished in the eighties compared to the seventies. Both in the central and the local government the average increase in wages has been fixed in the central negotiations, while the distribution of a minor part of this has been the object for local negotiations. The wage earners who are not organized often get the same increase in wage rates as the members of the trade union. In industries where the degree of organization is low, wage formation may be looked at as the result of perfect competition where alternative wage and the profitability of the firms may be of importance.

Because the degree of central versus local bargaining differs across industries the timing of the negotiations in the different industries may influence the outcome. Most of the local negotiations are carried out after the central ones are finished and the average outcome and the distribution in the central negotiations may influence the outcome of the local.

In addition to direct control over wage formation in the central government and indirectly over the negotiations for the local governments, the central government may also influence wage formation in the private sector by different forms of income policy. As pointed out in NOU 1988:24 tax policy and subsidies were used during the seventies to influence the outcome of the wage negotiations. Guaranties about the development in prices were quite common, and to limit the growth in prices, freeze in prices were used several times. Especially the price and income freeze from September 1978 to the end of 1979 and the income regulation from March 1988 to April 1990 have limited the growth in wages and prices in those years.

2.3.1. The degree of organization

The shares of organized wage earners in the different trade unions are presented in table 2.3.1. The table shows that about 58 per cent of the wage earners or more than one million persons were organized in a countrywide trade union in 1990. The degree of organization was somewhat larger in the eighties compared to the seventies, but has been remarkably stable during the last decade.

The Norwegian Federation of Trade Unions (LO) has been the dominating organization, but its relative importance has diminished due to a decreasing share of employment in those sectors (especially manufacturing) where LO has a high degree of organization. The Confederation of Vocational Unions (YS) and The Federation of Norwegian

Table 2.3.1. Organized wage earners in different trade unions[1]

Year	Employed wage earners[3] 1000 persons	Organized in per cent[2]				
		Total	LO	YS	AF	Others
1970	1 322	54.0	39.6	-	-	14.5
1975	1 452	54.3	38.4	-	3.9	12.0
1980	1 665	57.4	37.9	5.5	5.2	8.8
1985	1 758	58.4	35.3	6.9	6.5	9.7
1990	1 785	58.3	33.5	9.1	9.4	6.3

1) LO - The Norwegian Federation of Trade Unions
YS - Confederation of Vocational Unions
AF - Federation of Norwegian Professional Associations
2) The per cents organized are calculated at the end of the year. For LO pensioners are excluded. For YS both pensioners and students are excluded. For AF both pensioners, self employed, students and members temporary out of work are excluded. From the available data it has not been possible to exclude the pensioners for the other trade unions.
3) The number of employed is calculated exclusive conscripts and distributors of newspapers.

Professional Associations (AF) have grown in relative importance the last twenty years due to growth in both private and public services and fusions of the organizations outside LO.

In NOU 1988:24 the degree of organization in the different industries is calculated by combining information about the different occupational groups in the different unions with the number of employed wage earners. Because of no clear correspondence between the occupational groups and employment in different industries the calculations are limited to 1980 and 1985 making some simplifying assumptions. However, the main differences between the different sectors may be valid.

The degree of organization differs between industries. Especially in the public sectors (education and central and local administration) the degree of organization is high, but this is also the case for blue collar workers in manufacturing industries, oil extraction, transports and bank and insurance. In wholesale trade and other private services the degree of organization is quite low.

LO is the dominating trade union among workers in manufacturing, construction and transports. A large share of the employees in the governmental sectors are also members of this union, but both AF and YS have a large part of their members in those sectors. Except from the Norwegian Union of Teachers most of the wage earners in the educational sector are organized in AF. In the health sector The Norwegian Nurses Association and The Norwegian Association of Auxiliary Nurses have joined AF and YS respectively in the last years. AF also has a lot of members among white collar workers in the manufacturing sectors while YS is a dominating organization in bank and insurance.

2.3.2. An overview of the Norwegian income settlements 1970-1991
A rather detailed overview of the Norwegian income settlements for the period 1961-1986 is given in an appendix to NOU 1988:24, and only a brief summary will be given here. The overview is limited to the most important sectors with a wage agreement, i.e. the LO/NHO (earlier NAF) area and the public sector.

During the 1960s wage settlements in the different sectors were concentrated in time to spring in the same year. By 1970 only a few agreements were not coordinated in time. In the whole period 1970-1991 agreements lasted for two years with *main negotiations* in 1970 and every second year thereafter.

In the *intermediate negotiations* up to 1975 it was quite common that wage increases were linked to the consumer price index, either with automatic regulations or right to negotiate if the index passed a negotiated limit ("the red line"). After 1976 most of the agreements both in public and private sector have included a clause that negotiation about possible wage regulations in the second year of the agreement should be carried out before the end of the first year.

In the LO-NHO area the wage negoatiations in all the intermediate settlements have been *coordinated* between the different sectors. The form of the main settlements has however differed. The main settlements in 1970, 1976, 1978, 1980, 1988 and 1990 were coordinated. In 1972 some general questions were negotiated through central bargaining while more special questions were settled in the different sectors. The negotiations in 1974, 1982, 1984 and 1986 were wholly settled by sectoral negotiations.

In the 1970s the central government participated in the income settlements by offering tax cuts, increasing transfers, increasing subsidies and omitting planned increases in tax duties. The settlements where the central government participated in that way were called *combined coordinated settlements*. In 1976 the coordination also included the wage settlements outside the LO-NHO area.

The income settlement in 1978 was planned to be combined and coordinated. Because no agreement was reached, and mediation not successful, the wage increases were fixed by The Central Wage Commission. The 12th of September 1978 the central government introduced a wage and price freeze that lasted to the end of 1979. Some dispensions were however given.

According to the traditional pattern there was planned to be a main settlement for most groups of wage earners in the spring of 1988. At the end of February the central government introduced a law which implied a freeze in wage rates at the existing level. This law was succeded by a new law the 22nd of April which limited the growth in incomes to the result agreed upon in the LO/NHO area. This agreement prohibited local bargaining in the first year of the settlement and allowed only modest increase in wage rates and incomes for most groups. The income regulations was prolonged by a new law in the spring of 1989 and lasted to the 1st of April 1990. The growth in wages and incomes was however larger than given by the first act, but local bargainings were still prohibited.

In years with coordinated settlements, i.e. all the intermediate settlements and in some of the main settlements, the agreements between LO and NHO (NAF) were of importance also for other areas. One exception is 1981 where mediation in the LO/NHO area was delayed until the results from the settlements in the public sector were known. The wage increases in the LO/NHO area were then fixed by The Central Wage Commission.

1978 and 1981 are the only years during the seventies and eighties where the settlements between LO and NHO (NAF) were decided by The Central Wage Commission. In several years there has been a Wage Commission deciding the wage increases for one or a few minor groups. After 1980 this has been the case in some of the settlements in the public sectors and the oil sector.

Under the settlements with wage agreements in different sectors, Production of fabricated metals has often been the first sector reaching an agreement which has influenced the results in other sectors. This was the case both in 1972, 1974, 1982, 1984 and 1986, but in the last two of these years some of the other areas got an agreement at the same time as Production of fabricated metals. As negotiations in the public sector often are lagging behind the central LO/NHO settlement these settlements have influenced the wage increases in the public sector and probably also settlements in the private sector not included in the LO/NHO area.

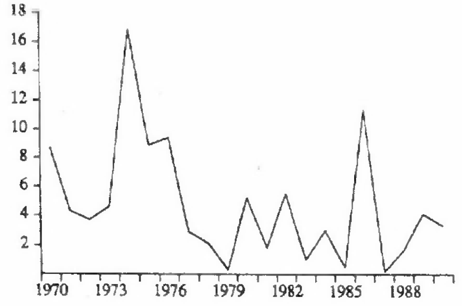
2.3.3. Central wage increases and wage drift

In the LO/NHO area wage settlements for most groups are characterized by both central and local bargaining. The central negotiations are either coordinated or carried out in the different sectors. The central wage increases may depend on both the general economic situation regarding prices, taxes and unemployment and estimates of wage increases agreed upon in the local negotiations. The central wage increases include both general increases, low wage increases, and guaranties. It is also often usual to include compensation for shortening of the weekly working time as a part of the central increases.

The local negotiations are carried out at a firm level and depend mainly on the economic situation in the firms. 1978, 1979, 1981 and 1988-89 are exceptions from this while local negotiations were limited or prohibited. *Wage drift* is defined as the residual between the total wage growth and central agreed increases. In addition to local increases the wage drift may depend on the degree of contract work and changes in the composition of the workers. An increase in the share of employment in firms with a relatively high wage level inside the area will be registered as wage drift in this sector.

The figures 2.3.1 and 2.3.2 show the central, local and total wage increases for blue collar workers according to NHO's (NAF's) wage statistics from the period 1970 to 1990. The series show the development in average hourly earnings exclusive of compensation for overtime, moving holidays, vacations etc. The compensation in hourly earnings for shortening of the working time is included in the central increases. Most of the central increases are given in the second quarter. To eliminate seasonal variations, the figures show the increase in the series from the first quarter in the depicted year to the first

Figure 2.3.1. Central negotiated wage increases for blue collar workers in the NHO area from 1. quarter in the depicted year to 1. quarter in the next. Per cent



Source: NHO quarterly wage statistics

Figure 2.3.2. Wage drift and total wage growth for blue collar workers in the NHO area from 1. quarter in the depicted year to 1. quarter in the next. Per cent

Source: NHO quarterly wage statistics

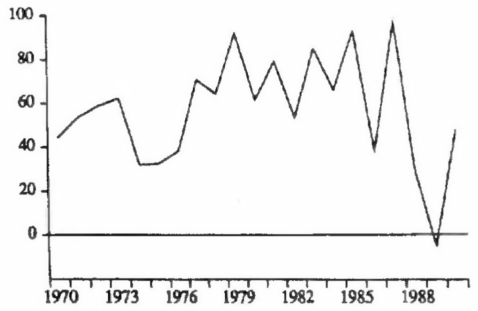
quarter in the next. Figure 2.3.3 shows the share of wage drift out of total wage growth for blue collar workers in the NHO area.

The oscilliations in the figures are mainly caused by the shift between main and intermediate negotiations. This is especially the case for the central negotiated wage increases, but the situation is also reflected in the graph for total wage increases calculated from the first quarter one year to first quarter in the next.

In addition to the oscilliations between main and intermediate negotiations there is also a great difference between the size of the central negotiated increases in the different main negotiations and the different intermediate negotiations. In 1974 the central negotiated growth in wage rates for workers in the NHO (NAF) area was as high as about 17 per cent. Even the intermediate negotiations in 1975 resulted in an increase in the central negotiated wage rates of about 9 per cent. As a result of the shortening of the normal working hours from 42.5 to 40 hours a week, there was also a large increase in 1976. The shortening of the normal working time from 40 to 37.5 hours a week from 1st of January 1987 also explains the large increase in the central negotiated wage rates from the first quarter of 1986 to the first quarter of 1987. Compensation for the introduction of the value added tax may explain the increase in 1970.

On the other hand there was only a modest increase in the central negotiated wage rates during the price and income freeze in 1979, and in the intermediate negotiations in 1983, 1985 and 1987. The income regulation during 1988 and 1989 may also have contributed to rather low increases in the central negotiated wage rates in these years. Except for the shortening of the working time in 1987 agreed upon in the main negotiations in 1986, the central negotiated wage increases during the eighties have been significant lower than in the seventies.

Figure 2.3.3. Wage drift out of total wage growth for blue collar workers in the NHO area from 1. quarter in the depicted year to 1. quarter in the next. Per cent



Source: NHO quarterly wage statistics

As seen from figure 2.3.2 the wage drift shows a smoother path, and it is difficult to point at systematic fluctuations between main and intermediate negotiations. Because of the reduced importance of central negotiated wage increases during the eighties, the share of wage drift out of the total wage growth depicted in figure 2.3.3 has increased. As a result of the price and income regulation in 1988 and 1989 the wage drift was rather low in these years, and even in 1990 and 1991 wage drift was lower than in the 1970s and the 1980s. After the wage and price freeze in 1978/79 some of the lost wage increases may have been compensated by high wage drift during 1980.

As pointed out in NOU 1988:24 the composition of central negotiated wage increases and wage drift differs from industry to industry. In the public sector almost all of the increase in wage rates has been decided in the central negotiations, while local nego- tiations has only dealt with the distribution of a minor part of it. Some wage drift may, however, occur in the public sector as a result of a shift in the composition of employ- ment towards a greater share of higher paid. In industries where a large part of the workers are not organized (mainly private services) a large part of the wage increases are determined by local negotiations.

NOU 1988:24 also shows great differences between the different industries in the LO/NHO area regarding the composition of central negotiated wage increases and wage drift. In the period 1970-77 the central negotiated wage increases constituted some less than a half of the total wage increases in Production of fabricated metals and Building and construction. In Land transport, Manufacturing of textiles and Wood products the main part of the growth in this period was due to central negotiated wage increases.

Compared to in the seventies the importance of the central negotiated wage increases decreased during the first of the eighties in every industry and constituted only a minor part of the total wage growth both in the production of Fabricated metals and Paper products, and Building and construction.

The difference in the importance of the central negotiated wage increases between the different industries in the LO/NHO area may be explained by the relative wage differ- ences shown in table 2.53 in NOU 1988:24. In most of the central negotiations an intention from LO has been to smooth out differences by claiming extra wage increases for the lowest paid. However, these centrally decided low wage increases have been counteracted by wage drift in industries with the highest wage level keeping up wage differences. The increases for workers with low wages may however have prevented larger differences. It also looks like the succeding wage drift has been underestimated during the central negotiations.

2.3.4. Conflicts

Under central negotiations the trade unions may threathen with a strike, while the employers' organizations may threaten with lock-out. The survey given in NOU 1988:24 shows that in most years only a few working days have got lost as a consequence of conflicts during wage negotiations. One exception was 1986 when 166 000 or more than 9 per cent of the wage earners were embraced. More than 1 million working days got lost corresponding to 0.3 per cent of the total number of man years worked by wage earners during a year. About 60 per cent of the days lost in 1986 was due to NAF's lock-out which embraced 100 000 workers and lasted more than a week. The strike in the local governments constituted a large part of the rest.

In 1974 318 000 working days got lost, and most of it was due to the strike in the LO/NHO (NAF) area in connection with the bargaining in the different industries. The banks and manufacturing of metals and chemicals were affected by a strike in 1976 while strikes in building and construction and the oil sector contributed to a large part of the working days lost in 1980. There were strikes in some parts of the oil sector every year from 1980 to 1986, and especially the strike in 1986 led to loss in working days. In 1982 there were strikes in several of the sectors in the LO/NHO (NAF) area and especially in land transport a significant number of working days got lost. In 1984 and 1990 strikes in the central and local governments gave the largest contribution.

2.4. Wage growth in different sectors

2.4.1. Comparable wage statistics

As pointed out in section 2.2 the labour market may be divided into submarkets according to characteristics of jobs and workers. A change in demand and supply of labour in different submarkets may then cause the growth in wage rates to differ. However, as pointed out in section 2.3 solidaristic wage policy in the income settlements may have contributed to maintain wage differentials or at least prevented a further dispersion. It is also conceivable that some of the wage differentials existing in Norway are caused by more or less discrimination and professional monopolies.

Although it would have been of interest to illuminate wage differentials by characteristica such as education, gender and region this chapter is limited to show the wage differentials by sector. The reason for this is that wage statistics is mainly prepared by sector even though other characteristics are included. To present comparable wage statistics by education additional work had to be done. An attempt at this is carried out in NOU 1988:24, and the conclusions from this work are taken into consideration in the presentation below.

Even by sector there are problems by using the wage statistics to compare wage level and wage growth. The main reason for this is that hourly earnings are registered for workers in manufacturing, building and construction and some other minor groups, while monthly earnings are registered for wage earners elsewhere. Hourly earnings does not include wage components as paid vacation, pay under illness and other absences. Although some work is carried out in the wage statistics to calculate yearly wages for full time workers in the different sectors it has shown difficult to calculate time series back to the seventies, especially because of the problem with pay under illness.

In the National Accounts information from the wage statistics is compared with wage sums and employment from other statistics to get a consistent view of the development (see Harildstad (1989)). The National Accounts also aim at giving consistent series for both hourly and yearly wages in the different sectors. Because the National Accounts in principle cover all the firms in the different industries as well as all the wage components, the hourly wage growth will deviate somewhat from the wage growth given by the wage statistics. A main reason for deviation regarding the manufacturing industries is that only blue collar workers are included in the hourly wage statistics while also white collar workers are included in the National Accounts.

The change in the average hourly earnings for wage earners in the manufacturing industry according to the National Accounts is in figure 2.4.1 compared with the change in hourly earnings for blue collar workers in the same industries according to the wage statistics. Because both series are calculated as a yearly average the fluctuations between wage increases in main and intermediate settlements calculated from first quarter in the depecited year to first quarter in the next as shown by figure 2.3.2, are smoothed out.

As shown by figure 2.4.1, the growth in the two series have been rather parallel the last two decades, but the growth in the data from the National Accounts has been somewhat larger since the second part of the seventies. The main reasons for this are an increasing share of white collar workers with a higher wage level than the blue collar and an increase in pay under illness.

Figure 2.4.1. Percentage growth in hourly wage rates for employees in manufacturing industries

The figure shows that there was a strong growth in the hourly wage rates in manufacturing industries in the years 1974 to 1976. Strong growth in world market prices may be an important reason for this, and the shortening of the normal weekly working hours in 1976 also has to be taken into account. The further shortening in 1987 contributed to a relatively high hourly wage growth in that year. The relatively low growth in 1978/79 and 1988/89 is influenced by the direct regulation of wages in those years. The low growth in 1990 and 1991 is probably caused by a high rate of unemployment and low growth in prices.

2.4.2. Growth in relative wages between different industries

Table 2.4.1 and figures 2.4.2 to 2.4.5 show the wage levels in different industries relative to the average wage level for wage earners in manufacturing. The series are based on calculations from the National Accounts, but are somewhat preliminary. In several sectors in the National Accounts, especially private services, wage sums are calculated indirectly on basis of the employment figures. However, after the revision of the employment figures (see Harildstad (1989)), no revision of the wage sums has taken place implying some degree of inconsistency between wage sums and employment. As a result of this both the level and the growth in wage rates based directly on the National Accounts are not satisfactory. The presented series for Building and construction and sectors in private services are thus based on unofficial calculations of the wage sums and wage rates in conformity with the new employment series in the National Accounts. Both the table and the figures show that wage differentials between different industries have smoothed out when the period 1970 to 1991 is taken as a whole. However, most of the industries/groups which had a higher wage level than average in 1970, still have a higher wage level in 1991. This may be explained by differences in education and qualifications across sectors. A great share of employees with higher education is probably the main reason why the average wage level in Public education and reasearch has been higher than for wage earners in Manufacturing. This may also be the case among white collar workers in Manufacturing, Financial services, Business and rental services and the Central administration.

Compared to wage earners in manufacturing industries, the growth in yearly wages has been weaker in most of the other industries during the period 1970 to 1991. Particularly employees in Building and construction, the Central government, Education and research and Other private services have experienced a weaker growth in wages. The difference in wage growth was especially large in 1974 and 1975 where wages in Manufacturing industries grew strongly. After a stronger growth than for Manufacturing industries in 1981 and 1982 employees in Public sectors have experienced a continuing fall in relative wages, and employees in Education and research experienced the lowest growth in wages in the period 1970 to 1987.

Wholesale and retail trade and Business and rental services are the two sectors with a higher growth in yearly wages than for wage earners in Manufacturing. Regarding Wholesale and retail trade this was especially the case in the beginning of the seventies, while there was a rather strong growth in wages in Business and rental services in 1982 and 1983. This was probably caused by a large growth in this sector, which also helps to explain the strong increase in wage rates in Financial services in the beginning of the eighties.

As the shortening of the normal weekly working hours especially have benefited blue collar workers in Manufacturing industries, which in 1970 had a lower hourly wage than most of the other groups, wage differentials have smoothed more for hourly wages than for the yearly wages. Measured in hourly wages the loss in relative wage position for Central government and Education and reasearch has been even more pronounced than for yearly wages.

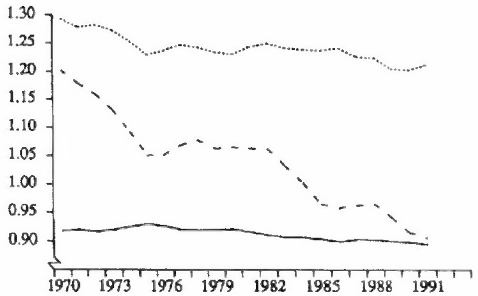
Table 2.4.1. Hourly and yearly wages in different industries relative to the average wage level for all wage earners in manufacturing industries*

Industry	1970	1975	1980	1985	1988	1991
Manufacturing, blue collar workers						
Yearly wages	0.92	0.93	0.92	0.90	0.90	0.90
Manufacturing, white collar workers						
Yearly wages	1.29	1.23	1.23	1.24	1.22	1.21
Building and construction						
Hourly wages	1.14	1.02	1.03	0.94	0.94	0.90
Yearly wages	1.20	1.05	1.07	0.97	0.97	0.91
Domestic transport						
Hourly wages	1.13	1.09	1.09	1.07	1.03	1.04
Yearly wages	1.10	1.08	1.08	1.05	1.02	1.01
Wholesale and retail trade						
Hourly wages	0.87	0.90	0.95	0.93	0.96	0.99
Yearly wages	0.85	0.89	0.94	0.92	0.94	0.94
Financial services						
Hourly wages	1.29	1.19	1.17	1.19	1.13	1.15
Yearly wages	1.14	1.08	1.10	1.11	1.10	1.08
Business and rental services						
Hourly wages	1.30	1.24	1.13	1.30	1.26	1.27
Yearly wages	1.15	1.13	1.07	1.22	1.25	1.22
Other private services						
Hourly wages	1.08	1.01	0.96	0.91	0.87	0.87
Yearly wages	1.09	1.02	1.00	0.96	0.93	0.91
Central administration						
Hourly wages	1.46	1.28	1.17	1.15	1.09	1.06
Yearly wages	1.25	1.15	1.10	1.06	1.02	0.98
Public education and research						
Yearly wages	1.32	1.20	1.14	1.09	1.04	1.04
Local administration						
Hourly wages	1.23	1.12	1.09	1.03	1.01	0.99
Yearly wages	1.07	1.00	0.98	0.98	0.94	0.93
Public health and welfare						
Hourly wages	1.02	1.00	1.00	0.98	0.97	0.96
Yearly wages	0.98	0.95	0.93	0.93	0.89	0.88

* Based on preliminary calculations from the National Accounts.

The shortening of the normal working hours in 1987 contributed particularly to reduce differences in hourly wages between blue collar workers in Manufacturing industries and other groups. The Local administration and Public health and welfare are the two sectors (exclusive Education and research) with the lowest average weekly normal working hours explaining why the yearly wage level in those sectors are lower relative to wage earners in Manufacturing industries than the hourly wage rate.

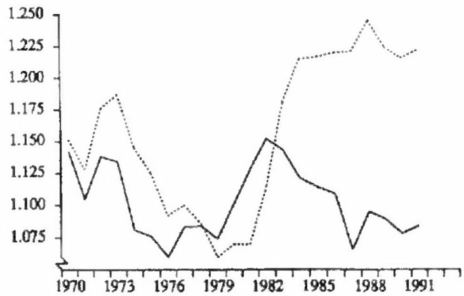
Figure 2.4.2. Yearly wages relative to the average wage level for wage earners in manufacturing industries



— Manufacturing, blue collar workers
······ Manufacturing, white collar workers
- - Building and construction

Based on preliminary calculations from the National Accounts

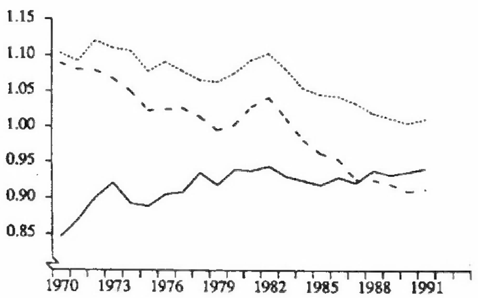
Figure 2.4.3. Yearly wages relative to the average wage level for wage earners in manufacturing industries



— Financial services
······ Business and rental services

Based on preliminary calculations from the National Accounts

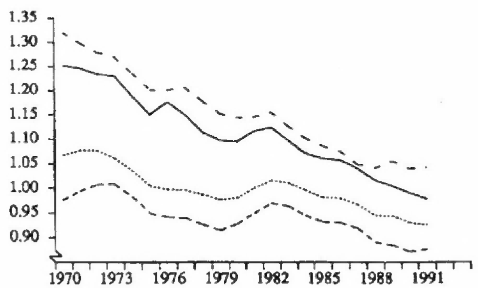
Figure 2.4.4. Yearly wages relative to the average level for wage earners in manufacturing industries



— Wholesale and retail trade
······ Domestic transport
- - Other private services

Based on preliminary calculations from the National Accounts

Figure 2.4.5. Yearly wages relative to the average wage level for wage earners inmanufacturing industries



— Central administration
······ Local administration
- - Public education and research
--- Public health and welfare

Based on preliminary calculations from the National Accounts

2.5. Possible factors behind wage growth in manufacturing industries and consequences for growth in real disposable incomes and competitiveness

Although the presentation of the theories for wage formation is left to chapter 3, this section gives an overview over some important variables that may affect wage formation in manufacturing industries in addition to the labour market variables presented earlier in this section. The main such variables are consumer prices, output prices, prices on competing foreigh products, productivity and taxes. By combining the growth in wage rates with these variables it is possible to derive the consequences for the development in the wage earners' real disposable incomes, the functional distribution of income and the manufacturing industries' competitveness.

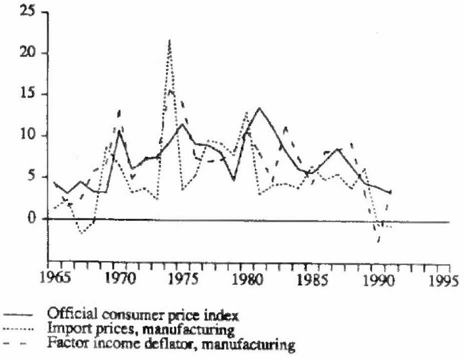
2.5.1. Consumer prices, output prices and prices on competing foreign products

Figure 2.5.1 shows the growth in the official consumer price index, the growth in output prices calculated by gross factor income relative to gross product and the growth in the price index for imported manufactured goods according to the National Accounts. This import price index may be considered as a relevant measure of prices on competing foreign products although there may be a deviation between these prices and world market prices faced by Norwegian exporting industries. The sector for Refined petroleum products are excluded in the calculations of output prices and import prices as only few persons are employed in this sector while production is rather large.

From the figure it is evident that the import prices show stronger oscilliations than the consumer prices and the factor income deflator. The growth in import prices was especially strong in 1974 with more than 20 per cent. The preceeding shock in oil prices is probably an important reason behind the strong international inflation that year. The second shock in oil prices also caused the international inflation to get as high as 11 per cent in 1980 while lower pressure in the international labour markets may have contributed to lower inflation in the eighties.

The growth in the factor income deflator for manufacturing industries follows the growth in import prices during the 1970s, but with a smoother movement. In the 1980s the growth in the factor income deflator has deviated somewhat from the growth in import prices, but both prices declined in 1990.

Figure 2.5.1. Growth in the official consumer price index, the factor income deflator for manufacturing and priceson imported manufactured goods. Per cent



The growth in consumer prices also seems to be smoother than the growth in import prices and lags somewhat behind. Consumer prices grew relative strongly from 1973 to 1978 and from 1980 to 1983. The low growth in consumer prices in 1979 is due to the price and income regulation in 1978/79, and a possible compensation for this wage and price freeze may also partly explain the strong growth in 1980. The peak in 1970 is caused by the introduction of the value added tax.

In general the growth in consumer prices and the factor income deflator have been stronger than for the competing import prices. This may partly be caused by a stronger growth in prices on other imported products than competing manufactured (e.g. petroleum products), but a tighter Norwegian labour market may also have caused a higher rate of inflation.

2.5.2. Productivity

Labour productivity may affect wage formation because higher productivity leaves room for higher wages without reducing the firms' competitiveness. The growth in value added per hours worked in manufacturing industries, excluding petroleum refining, which is shown in figure 2.5.2, may be a relevant measure for the possibilities of growth in real incomes. (The choice of variable is further discussed in section 4.2.)

As shown by the figure the growth in productivity shows large fluctuations with a somewhat procyclical pattern. At the beginning of an economic slowdown as from 1976 to 1978 and 1980 to 1981 the growth in productivity is rather low. However, if the slowdown lasts for some time, as was the case from 1980 to 1983 and from 1988 to 1991 the last period of the slowdown is characterized by a rather large growth in productivity, most likely because of firing of workers and the closure of firms. The growth in productivity also seems to be rather large at the beginning of a growth period as in the beginning of the seventies, 1979 and 1983 to 1984 probably as a result of more effective use of hoarded labour.

2.5.3. Taxes

In addition to value added taxes and other indirect taxes, which influence the growth in wage rates via consumer prices, personal income taxes and pay-roll taxes may have a direct effect on wage formation. (The impact of taxes is further discussed in chapter 3.) While personal income taxes may influence wage formation because they are of importance for the wage earners' disposable incomes, pay-roll taxes influence the firms' wage-bill and thereby their competitiveness.

Figure 2.5.2. Growth in value added per man hour in manufacturing industries excluding petroleum refining. Per cent

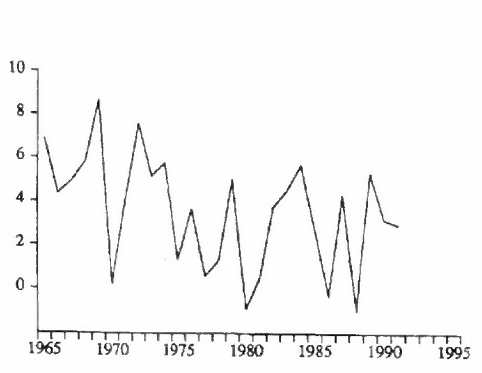


Figure 2.5.3. Average pay-roll tax rate for manufacturing industries and average income tax rate for an average wage earner in manufacturing in tax category 1 with standard deductions. Per cent

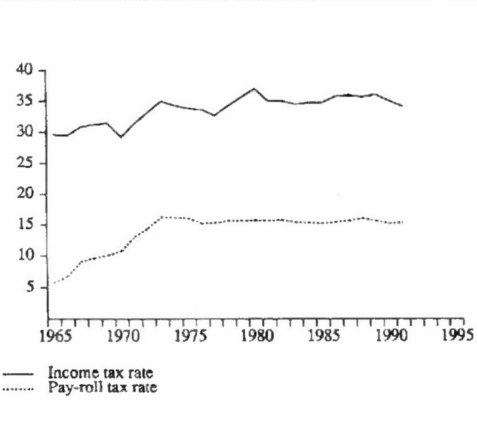


Figure 2.5.3 shows the average pay-roll tax rate in manufacturing industries and the average income tax rate for an average wage earner in manufacturing industries in tax category 1 and no other deductions than standard.

The pay-roll tax rate increased up to 1973. Thereafter it has been almost constant. The personal income taxes was reduced in 1970 as a consequence of the introduction of the value added tax. However, in the first years afterwards income brackets in the tax system were not regulated according to inflation, inducing a growth in the average tax rate from 1970 to 1973. The tax rate was somewhat reduced from 1974 to 1977, while a tightening of the economic policy caused an increase again in 1979 and 1980. There was a rather large decline in personal income taxes in 1981 while the tax level was almost constant during the rest of the eighties with a weak increase especially in 1986. In 1990 and 1991 income taxes have been reduced.

Due to a large extent of deductions from interest payments the actual average income tax has been lower than the one depicted in figure 2.5.3, and according to the National Accounts the average level has fluctuated around 25 per cent of the gross income. Although the level has been lower, the fluctuations have been about the same as for the standard tax rate.

2.5.4. Real disposable income

By combining information about wages, prices and taxes, it is possible to derive the consequences for the development in the wage earners' real disposable incomes. Figure 2.5.4 shows both the real yearly income and the real disposable yearly income for an average wage earner in manufacturing industries. While the expenditure deductions in reality are of great importance for the personal tax level, only standard deductions are assumed in this case and the wage earner is considered as a single person regarding tax rules. The incomes are deflated by the National Accounts' deflator for private consumption with 1990 = 1.

In spite of growing real wages, a higher tax level prevented any significant growth in real disposable wages for wage earners in manufacturing industries from 1970 to 1973. A strong growth in wages however caused a substantial increase in the purchasing power in the period 1974 to 1977.

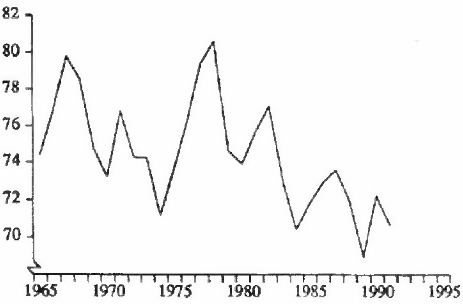
The price and income regulations in 1978 and 1979, the succeding growth in prices and tax increases caused the real disposable income for a single wage earner to decline in the period 1978 to 1980. As a result of higher growth in wages than in prices real disposable incomes have shown a slow growth during the 1980s. As a result of the tax cuts in 1990 and 1991, the growth in real disposable incomes strenghtened in these years.

2.5.5. The functional distribution of income

Figure 2.5.5 shows the share of wage costs out of gross factor income (inclusive consumption of fixed capital) for Manufacturing and mining excluding oil refining. The share of wage costs has been fairly constant between 70 and 80 per cent the period 1965 to 1991 taken as a whole, but with a weak negative trend during the 1980s. The fluctuations reflect the international business cycles mainly influencing the wage share

Figure 2.5.4. Real yearly income and real disposable yearly income for an average wage earner in manufacturing industries with standard expenditure deductions. 1000 N.kr, fixed 1990 prices.

Figure 2.5.5. Share of wage costs out of gross factor income for Manufacturing and mining excluding oil refining. Per cent



in the export oriented industries. A low share of wage costs in 1970, 1974, 1980, 1984 and 1989 reflect economic upswings abroad, while the peaks in 1967, 1971, 1977-78, 1982 and 1990 represent international slowdowns.

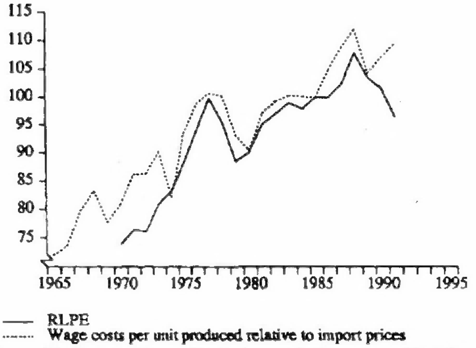
2.5.6. International competitiveness for Norwegian manufacturing industries

It is difficult to define a country's competitiveness. A possible definition may be ability to maintain the balance of payments. However, the balance of payments is only one among several of the targets held by the central government. It is conceivable that the central government also is concerned about the level of employment, allocation of resources, income distribution, and an optimal development in consumption and savings. A country's ability to compete is then a question of how to fulfill a total of all these targets.

In spite of this an often used indicator for the development in a country's competitiveness is the relation between wage costs per unit produced in manufacturing industries and the corresponding foreign wage costs corrected for changes in the exchange rates (RLPE). Another indicator which seems convenient regarding analysis of wage formation is to look at the relation between wage costs per unit produced and the prices on competing foreign products corrected for changes in exchange rates. The two indicators coincide if the increase in the international competing prices follows the increase in the international wage costs per unit produced.

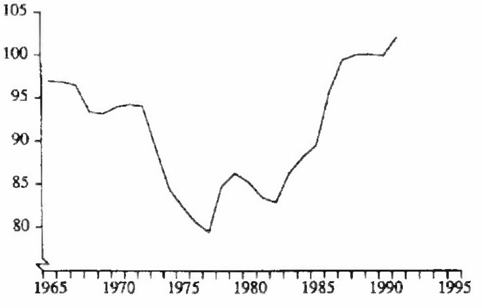
Figure 2.5.6 shows the RLPE for Norwegian manufacturing industries and wage costs per unit produced relative to prices on competing imported goods. The figure shows that although the series differs somewhat, Norwegian manufacturing industries have lost competitiveness the last two decades. The loss was especially visible in the seventies up to 1977 because of the strong growth in domestic costs relative to prices and costs

Figure 2.5.6. Relative wage costs per unit produced, and wage costs per unit produced relative to import prices for Nor-wegian manufacturing industries. 1985 = 100



Source: The Technical Committee for Income Settlements and Statistiscs Norway

Figre 2.5.7. Effective exchange rate for manufacturing industries. Yearly average. October 1990 = 100



Source: Bank of Norway

abroad. An appreciation of the Norwegian currency in the period 1973 to 1976 as shown by figure 2.5.7 and a relatively slow growth in productivity also contributed to the loss in competitiveness. The improvements from 1979 to 1980 and in 1988/89 is mainly due to the income regulations in these periods.

The worsening from 1980 to 1987 is also a result of a relatively larger growth in Norwegian wage costs and a slower growth in productivity than abroad, although a rather large depreciation of the exchange rate in the period 1978 to 1987 should have contributed to improve the competitiveness. The organisations in the labour market might have expected the devaluations, showing smaller responsibility for wage growth than otherwise. From 1988 to 1991 weaker wage growth as a result of the income regulations and a stronger growth in productivity caused a clear gain in competitiveness measured by relative wage costs per unit produced. Measured by wage costs relative to the price index for competing import products the improvement has not been very evident. The divergence the last years stresses the uncertainty in such measures, especially as a result of preliminary figures for the growth in productivity, both in Norway and abroad.

3. A Survey of economic theories for labour market and wage formation

3.1. Introduction

In recent research much attention has been devoted to analyses of labour market, and it is therefore impossible to give a survey of the results from all this research. The emphasis in this chapter will be on theories which seem to be of importance in explaining the main features of the macro-economic functioning of the labour market and wage formation in a country like Norway. However, the macroeconomic focus does not mean that microeconomic theories are left out. On the contrary, to understand the macroeconomic development a microeconomic foundation is needed.

The labour market is composed of different segments where one theory may be significant for one segment, while a different theory may be of importance for another. To explain the macroeconomic development one single theory may only be of limited relevance, but it may constitute a necessary part in the construction of a total understanding of the functioning of the labour market. The aim of this chapter is therefore to extract the most important aspects from the different theories and evaluate their relevance.

A review of different theories of possible relevance for the Norwegian labour market and wage formation has been presented in The analysis of income formation in Norway (NOU 1988:24) and further elaborated in Torp (1988). The presentation in this chapter mainly follows the disposition in these surveys, but the presentation is more formalized, and to a larger degree the relevance of the different theories for the understanding of the Norwegian labour market is discussed. In a recent work Layard, Nickell and Jackman (1991) give a good survey of theoretical and empirical aspects regarding the labour market, and this is embedded in a macroeconomic framework. Some aspects regarding labour market and macroeconomics are also discussed by Blanchard and Fischer (1989). In several works by Lindbeck and Snower (c.f. Lindbeck and Snower (1989)) important aspects regarding the inflation-unemployment trade off are analyzed, and a classical work regarding this question was presented in Santomero and Seater (1978). A survey of economic theories for trade unions is presented by Oswald (1985).

There is no unique measure of employment or wage rates, and as pointed out by Torp (1988) the most relevant measure differs with respect to the problems discussed. In analysing labour as a factor of input in production, man hours in efficiency units may be the most relevant measure, while the number of persons is more relevant in measuring unemployment. In this theoretical survey the question of the unit of measurement is left out where not strictly needed for the discussion.

Services from labour are rather heterogenous, and while it is common both in national accounts and macroeconomic models to deal with several commodities, labour is treated as one factor of input. To shed light over some important aspects of the functioning of the labour market, it may be sufficient to deal with homogenous labour. Considerations of heterogeneity is, however, needed when explaining the functioning of the labour market.

It is convenient to distinguish between two main theories regarding labour market and wage formation: i) Theories built on the assumptions of perfect competition and no unions (c.f. section 3.2). ii) Theories built on assumptions of coordinated behavior among employees and some formal organization (c.f. section 3.3). In actuality there are organized as well as unorganized employees present in the labour market. The degree of organization may differ across segments of the labour market, and in some markets there may be more than one union. From this it is clear that one single theory is only able to explain parts of the development in the labour market, while a bundle of theories is required to get an overall understanding.

In the macroeconomic literature much concern in recent years has been focused on the game between trade unions and the central government regarding the possibilities of achieving full employment (c.f. section 3.4). A heavy debate has also focused on the question of the existence of a natural rate of unemployment (c.f. section 3.5). Based on theories for efficiency wages and trade unions with insiders/ outsiders it has been claimed that the natural rate of unemployment tends to follow the actual rate. In this situation, which is named hysteresis, there exists no Phillips curve relation between the growth in wage rates and the level of unemployment. Section 3.6 contains a discussion of the Scandinavian theory of inflation which may be of relevance in explaining wage formation in a small open economy like the Norwegian. A summation and evaluation of the empirical consequences of the different theories for labour market and wage formation outlined in sections 3.2 to 3.6 is given in section 3.7.

3.2. Theories for labour market and wage formation under assumption of no organization among employees

As pointed out in chapter 2, there is a strong degree of organization in the Norwegian labour market. At first glance it may therefore seem to be of minor relevance to present a theory for the labour market and wage formation under assumptions of no organization among employees and perfect competition. This theory may nevertheless be useful in understanding important aspects of the functioning of the Norwegian labour market.

In spite of a high degree of organization in parts of the labour market, many employees are not organized, and descriptions based on perfect competition may be quite relevant for this group. Even in markets with a rather strong trade union, the scope for the union may be influenced by changes in market conditions. In some respects trade unions and employers' organizations may be considered as "visible hands" making the economy function efficiently.

The employees always have the opportunity to leave the trade union and work as unorganized if the trade union acts in a way which make the employees worse off than in a situation with perfect competition. It is therefore of interest to compare the situation under perfect competition with situations where one or several of the assumptions for perfect competition are not satisfied.

3.2.1. Perfect competition

To proceed with the analysis we consider a homogenous labour market with many small agents on the supply and demand side of the labour market equipped with perfect information. Furthermore, there is no uncertainty, free entry prevails, and sellers as well as buyers regard prices and wages as given. In this classical approach employees are assumed to adjust consumption and leisure in such a way that utility is maximized under a budget constraint and a constraint on time disposable for work and leisure.

Formally the situation for each individual may be written as:

(3.2.1) $Max\ U(C,L,Z)$ with regard to C and L given

(3.2.2) $PC = W(1-t)H + Y_0$

and

(3.2.3) $\bar{L} = H + L$

where

C	=	Consumption of commodities and services
L	=	Leisure
H	=	Hours of work
$\bar{L}$	=	Time constraint
Z	=	Socioeconomic variables
P	=	Price level
W	=	Wage level
t	=	Average income tax (For simplicity, a proportional tax system is assumed)
Y_0	=	Non-labour incomes

The first order condition may be written as

(3.2.4) $$\frac{W(1-t)}{P} \overset{<}{=} \frac{U'_L}{U'_C},$$

where U_L' is the marginal utility of leisure and U_C' is the marginal utility of consumption.

If (3.2.4) is fulfilled with equality this means that the gain in utility of one krone used on leisure is equal to the gain in utility of one krone used on consumption. If the inequality sign holds for $L = \bar{L}$, this means that $H = 0$ is an optimal solution. The individual then choose not to work as the marginal gain in utility of more leisure is greater than the marginal gain of more consumption.

Given $H > 0$, the supply of labour from each individual may be written as:

$$(3.2.5) \qquad H = h\left(\frac{W(h-1)}{P}, \frac{Y_0}{P}, Z, \bar{L}\right).$$

An increase in W has two effects on supply of labour: (i) If there is an increase in the real wage after taxes, leisure will be more expensive compared to consumption. This causes a substitution away from leisure towards consumption which means an increase in supply of labour. (ii) On the other hand an increase in wages implies an increase in income. This income effect tends to increase demand for all normal goods inclusive leisure, and this effect works to reduce the supply of labour. The sum of the two effects gives an increase in demand for consumption goods, but the effect on supply of labour is uncertain. If the substitution effect is stronger than the income effect, an increase in wages will have a positive effect on supply of labour.

The right hand side of (3.2.4) expresses the individual's shadow price on leisure. By substitution for C and L the shadow price may be written as

$$(3.2.6) \qquad r = r\left[\frac{W(1-t)H + Y_0}{P}, \bar{L} - H, Z\right].$$

When $H = 0$, $r_0 = r(Y_0/P, \bar{L}, Z) > W(1-t)/P$ and the shadow price is denoted the reservation wage. This is the lowest real wage after taxes where the individual is willing to supply labour. An increase in the real wage after taxes relative to the reservation wage thus has a positive effect on participation rates.

Although the model presented over is quite simple, it gives the most fundamental elements in understanding the supply of labour. Killingsworth (1983) shows how this model may be refined in different ways. Especially a lot of research has been carried out regarding the treatment of the tax system, rationing on jobs and hours and more dynamic models. The Norwegian system of income taxes are rather complicated, and in Dagsvik and Strøm (1992) these complicated budget sets are accounted for in the estimation of supply of labour for married couples.

The aggregation from micro to macro regarding supply of labour is not trivial, and the distribution of the explanatory factors across different individuals has to be taken into account. In a simplified form the macro supply of labour N^S in man hours may be written:

(3.2.7) $$N^S = S\left(\frac{W(1-t)}{P}, \frac{Y_0}{P}, Z\right),$$

where both endogenous participation rates and working hours is accounted for.

Under perfect competition employers are assumed to choose the input of labour and other factors in such a way that profit is maximized under assumptions of fixed output and input prices and a given production technology. The firm's profit may be written as:

(3.2.8) $$\Pi = P_x f(N,K,z) - W(1+s)N - qK,$$

where

N	=	Input of labour
K	=	Input of capital (and other factors)
z	=	Parameter indicating technical progress
q	=	User cost of capital
s	=	Pay-roll tax rate
P_x	=	Product price index

From the first order conditions and after aggregation over firms the macro demand function for labour may be written

(3.2.9) $$N^D = D\left(\frac{W(1+s)}{P_x}, \frac{q}{P_x}, z\right).$$

Under normal assumptions with regard to functional forms an increase in the wage rate or the pay-roll tax rate lowers demand for labour, both because of a substitution away from labour towards other inputs and because of an increase in costs. An increase in the product price index has a positive effect on production and the input of all normal factors. A neutral technical progress is equivalent with a reduction in the cost per unit produced, and has a positive effect on production and normal inputs under assumptions of perfect competition. It is not so clear what will happen with the demand for one factor as a result of a factor specific technical progress for another factor. If for example there is an increase in the marginal productivity of capital, the demand for labour may decrease if labour and capital are technical alternatives in production. It is also not clear what will happen to the demand for one factor of an increase in the price of another factor. An increase in the price of capital may only have a positive effect on demand for labour if the two factors are technical alternatives in production.

By combining the supply and the demand for labour we get a solution which gives equilibrium in the labour market. As pointed out in section 3.1 the labour market may be considered as composed of different segments. It is then problematic to talk of a perfect equilibrium in the total labour market, and the term is more relevant when considering a homogenous segment.

Equilibrium is characterized by

$$(3.2.10) \qquad S\left(\frac{W(1-t)}{P}, \frac{Y_0}{P}, Z\right) = N = D\left(\frac{W(1+s)}{P_x}, \frac{q}{P_x}, z\right).$$

The equilibrium value of the nominal wage rate is such that (3.2.10) is fulfilled. If an marginal input of labour has the same real value both for employers and employees the solution under perfect competition is known to be efficient. This may not be the case here because taxes induce a wedge between wage costs for producers and wage incomes for consumers. There may also exist a difference between consumer prices and the product prices. If we denote real wages after tax for consumers by W_c, and real wage costs for producers by W_p, the wedge may be written as:

$$(3.2.11) \qquad \theta = W_p/W_c = \frac{1+s}{1-t} \cdot \frac{P}{P_x}.$$

The demand and supply of labour under perfect competition may be illustrated as in figure 3.2.1. In addition to wages demand for labour depends on product prices, prices on other inputs, pay-roll tax rates and technical progess. Supply of labour also depend on consumer prices, income tax rates, non-labour income and socioeconomic variables. A change in some of the factors other than wages will induce a shift in the supply or the demand curve and imply new values both for the level of employment and the equilibrium wage rate.

A shift outwards in the demand curve means both higher employment and higher wage rates. This may be the result of a growth in demand and product prices, neutral technical progress or a reduction in pay-roll taxes. A shift upwards in the supply curve also means higher wage rates, but lower employment. Such a shift may be caused by an increase in consumer prices, higher income tax rates, an increase in non-labour income, a decrease in the number of people in the working age, or other factors which have a negative influence on participation rates or normal working hours.

If all product, input and consumer prices shift by the same amount this causes a corresponding shift in nominal wage rates, while employment is unchanged. As pointed out by Bruno and Sachs (1985), Layard and Nickell (1986) and Calmfors and Forslund (1989) when there is not a parallel increase in product and consumer prices this means an increase in the wedge, which causes an increase in wages relative to product prices.

Figure 3.2.1. Demand and supply of labour under perfect competition

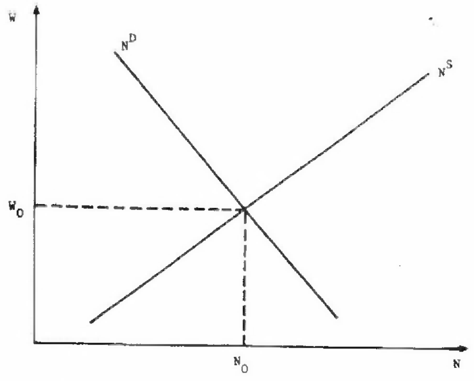
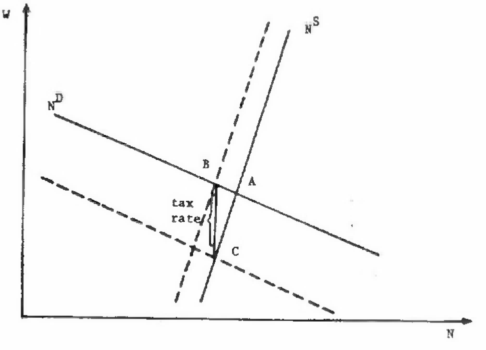


Figure 3.2.2. The effects from an increase in income tax rates and pay-roll tax rates in the case of a steep supply curve



The impacts on wages and employment of shifts in the demand or the supply curve will depend on the steepness of the curves, i.e. how elastic demand and supply are with respect to a change in wage rates. With an elastic demand (flat curve) a shift in supply will cause a larger change in employment and a smaller change in wage rates than if the demand is unelastic. A shift in demand will also cause a larger change in employment and a smaller change in wage rates the more elastic the supply of labour is (flatter curve).

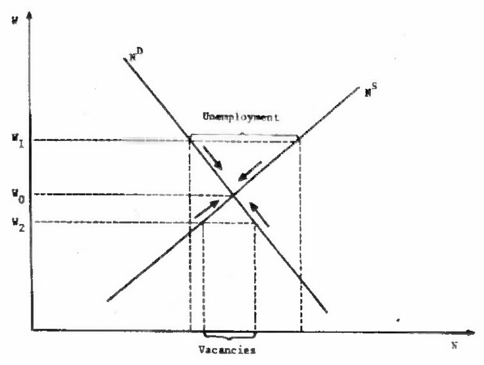
The steepness of the curves is of great importance in analysing the effects of an increase in the tax-wedge on wage formation. A steep demand curve relative to the supply curve means that an increase in income taxes, which shift the supply curve upwards results in a corresponding increase in nominal wages and the burden is shifted over to the employers. An increase in payroll tax rates which shifts the demand curve inwards only implies a small reduction in nominal wages in this case. On the contrary if the supply curve is much steeper than the demand curve the burden of an increase in tax rates is shifted backwards to employees. This case is illustrated in figure 3.2.2. An increase in income tax rates is here only weakly compensated by an increase in nominal wage rates from A to B, while an increase in pay-roll tax rates results in a rather large reduction in nominal wage rates (from A to C).

3.2.2. Disequilibrium in the labour market

Under perfect competition it is assumed that all markets clear. In reality this is often not the case, and observations of unemployment indicate that the labour market is not in perfect equilibrium. Different segments, structural changes and frictions, when people move between the segments, may be one reason for this, and this is further discussed in section 3.4. But even in a rather homogenous market disequilibrium may be observed.

Lindbeck and Snower (1985) give a survey over theories of unemployment. The discussion is influenced by the traditional debate between Keynesian and Classical views.

Figure 3.2.3. Disequilibrium in the labour market



While Keynesians have emphasized the lack of demand for goods, those holding the classical view have seen unemployment as the outcome of either misguided government regulations or errors in peoples price and wage expectations. Throughout the seventies the Keynesian view was reappraised by reference to rationing as a result of a sluggish adjustment in prices and wages while the Classicals refined their analysis of how expectational errors caused fluctuation in the rate of unemployment.

A known weakness with the theory of perfect competition is that none has the power to set prices and wages. The theory only predicts market clearing prices and wages which secure equilibrium, but very little is said about how equilibrium is restored after a shift in demand or supply. A criticism that is raised against both the Keynesian and Classical direction is therefore the assumption that agents act as pricetakers both regarding wages and prices. But when markets do not clear and there is no perfect information, the conditions for perfect competition is not satisfied. Lindbeck and Snower then argue that several of the economic theories for the labour market developed in more recent years may be useful in explaining unemployment. Theories of implicit contracts, imperfect competition, increasing returns to scale, efficiency wages and trade unions with insiders/outsiders may be of relevance. The most important aspects from these theories are discussed in the following sections.

In the theory of classical price dynamics it is assumed that "market forces" tend to move prices and wages towards equilibrium. The situation can be illustrated as in figure 3.2.3.

The labour market is in equilibrium at wage rate W_0. With a wage rate higher than W_0 there will be an excess supply of labour and unemployment will occur. The "market forces" are then assumed to move the wage rate down to W_0 and restore equilibrium as indicated by the arrows in the figure. In the opposite case where the wage rate is lower than W_0, demand exceeds supply and vacancies may be observed. In this situation "market forces" tend to increase the wage rate.

One standard assumption in the theory of classical price dynamics referred to among others by Lipsey (1960), Santomero and Seater (1978) and Sumner and Ward (1983) is that the change in prices or wages to restore equilibrium is approximately proportional to the level of excess demand. Formally this may be written as:

$$(3.2.12) \qquad \frac{\Delta W_t}{W_{t-1}} = \alpha \frac{N^D_{t-1} - N^S_{t-1}}{N^S_{t-1}}, \text{ where } \alpha > 0 .$$

The larger the excess demand for labour is, the stronger is the growth in wage rates. Excess demand in the labour market is, however, not observable, and the problem of choosing the most relevant measure is further discussed in section 4.3.

3.2.3. Implicit contracts

The theory of implicit contracts is presented in Azariadis (1975), Hall (1980) and Hart (1983). In most of these studies the theory is based on individual welfare maximization and profit maximization. The theory differs from perfect competition as there are no perfect markets for risk distribution at the same time as workers are immobile among firms. The main idea in the theory is that long term contracts exist because this involves important risk-sharing and intertemporal utility smooting aspects.

The theory is further formalized by Horn and Svensson (1986). They show that if workers are more risk averse than firms it may be optimal for both workers and firms to establish long term contracts where wages vary less and profit more over the business cycle than in a situation with a spot market for labour. In the situation with uncertainty the firms will work as insurance companies, and risk is shifted from workers to firms. The workers will gain from this because of a diminishing marginal utility of income. The firms may gain from a better reputation, and because of an increase in supply of labour to such firms, the general wage level will be lower than in firms with greater variability in wage rates. The lower wage may be looked at as an insurance premium paid by workers.

The theory of implicit contracts may contribute to explain wage rigidities over the business cycle. It is known that both product prices and labour productivity vary over the cycle. Smoothed changes in these variables are then more relevant in explaining changes in wage rates than the change in the current period. A dynamic specification with lags seems to be necessary.

As pointed out by Torp (1988) implicit contracts may also be of relevance when explaining temporary layoffs which is partly compensated by firms, on the job training and efficiency wages. Temporary layoffs and on the job training may be beneficial for employers because this may establish an internal market which prevents skilled workers from seeking work elsewhere.

3.2.4. Efficiency wages

A premise in the efficiency wage theory is that labour is not homogenous, and the productivity of given worker can vary considerably depending on the amount of effort he devotes to his work. Employers do not have perfect information on the productivity of the individual workers, and in the efficiency wage theories productivity are assumed to be affected by the wage the firm pays. Wages may be sticky as a result of this because it may be costly for firms to cut it when the productivity effects are taken into account.

Different explanations are offered for the efficiency wage mechanism. The gift exchange explanation of efficiency wages assumes that workers have an assumption of a "fair" wage relative to other firms, increasing their effort and attracking workers with high productivity in firms where they are treated well; see Malcomsen (1981), Akerlof (1984) and Akerlof and Yellen (1987). The higher the wage is, the more workers can be induced to stay with the firm giving positive effects as a result of learning by doing, and the lower is the firm's costs associated with workers quitting (Stiglitz (1974)).

The moral hazard explanation of efficiency wages assumes that workers productivity depend on their effort on the job, which the firm cannot observe directly. High wage rates compared to the income under suspension increases the magnitude of the punishment and thereby induces more work effort, see Shapiro and Stiglitz (1984).

The theory of efficiency wages therefore implies that higher wage rates will induce higher productivity. In the theory of perfect competition in section 3.2.1 causality worked the opposite way as an increase in real wage rates could be explained by an increase in labour productivity. In reality the causality may work in both directions, and the two theories are not necessarily in conflict with each other.

The theory of efficiency wages may also explain involuntary unemployment. In the theory of classical price dynamics in section 3.2.2 it was assumed that "market forces" tended to move wages towards equilibrium if there was unemployment as the unemployed may be willing to work for less pay than those already employed. In a situation where productivity depends positively on wages this is not necessarily the case as the decrease in productivity as a result of lower wage rates also means a decrease in the firms' marginal revenues. A simplified discussion is given below. For a more general discussion, see Blanchard and Fischer (1989, pp. 455-463), Layard, Nickell and Jackman (1981, pp. 150-171) and Strøm (1992).

By assuming a given amount of capital in the short run, the profit function in a firm (3.2.8) may be written as:

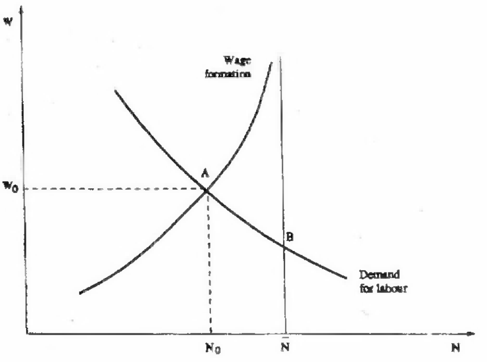
$$(3.2.13) \qquad \Pi = P_x f\,(e(W/\overline{W},U)\,N,Z) - W \cdot N,$$

where N is the number of workers and e is effort which is assumed to depend on the wage paid by the firm relative to wages paid in alternative employment ($\partial e/\partial W > 0$) and the rate of unemployment ($\partial e/\partial U > 0$). In the gift exchange explanation the "fair" wage is assumed to depend on expected wages in other firms, but is lower if unemployment is higher as workers then are more afraid to loose their jobs. Almost the same argument may be given in the moral-hazard explanation where a high rate of unemployment increases the probability of lower income if caught in shirking reducing the alternative income.

The firms are assumed to maximize (3.2.13) with respect to N and W. The first order conditions are:

$$(3.2.14) \qquad P_x \cdot f' \cdot e'/\overline{W} = 1$$

Figure 3.2.4. Equilibrium unemployment under efficiency wages



and

$$P_x \cdot f' \cdot e = W. \tag{3.2.15}$$

(3.2.14) and (3.2.15) gives the "Solow condition"

$$\check{e}\,(W/\bar{W},U) = 1\,. \tag{3.2.16}$$

The model gives as a result that the wage rate is given by (3.2.16) and independent on, among other things, the technical progress parameter Z. As a result of this, wage setting represents a negative relation between wages and the rate of unemployment, and may according to Strøm (1992), also depend on the probability for becoming included in the labour market measures, the replacement ratio, the income when attending labour market programmes and normal working hours.

Each firm's demand for labour is given by (3.2.15). By aggregating we get the macro demand curve for labour sloping downwards in figure 3.2.4. Relation (3.2.16) gives a negative connection between wages and unemployment in each firm, and this will also be the case in macro. Because $U = 1 - N/\bar{N}$ where $\bar{N}$ is the supply of labour, which for simplicity is assumed to be exogenous in this model, we have an increasing relation between wages and employment representing wage formation as shown in figure 3.2.4. The equilibrium is given by A and is associated with unemployment and a higher wage than in the competitive equilibrium B. It is advantageous for the firms to pay higher wages than in the competitive market because lower productivity may be costly. Unemployment is involuntary in this model.

3.3. Trade unions and wage formation

In the last two decades a lot of research has been devoted to theories for wage formation in a situation with trade unions. Surveys over this research has been given by Oswald (1982) and (1985), Calmfors (1985), and an overview is also given by Torp (1988). The theories of trade unions are especially relevant for Scandinavia and some other European countries where a large part of the labor force is organized in trade unions. Neglect of this aspect may be fatal for the understanding of wage formation and macroeconomic problems in these countries.

Compared to atomistic behaviour, coordinated behaviour through trade unions implies two important aspects. The first is that the trade unions have the power to influence wage rates. By using this power the trade unions may be able to influence wages to be higher than under perfect competition. The literature distinguish between two directions regarding theories for trade unions, one where a union act as a monopolist in the labour market and has the power to fix wage rates (cf. section 3.3.2), and second where a trade union uses its power to negotiate with the employer (cf. sections 3.3.3-3.3.5).

In the case of a monopolistic trade union it is often assumed that the employer fixes the level of employment after wages are set. In the case of negotiations several possibilities are treated in the litterature. Negotiations may concern both the wage level and employment (efficient bargaining), negotiations about the wage level while employers fix employment afterwards (right to manage) and negotiations about the wage level where employment are fixed by the firms in advance (implicit profit-sharing). The wage bargaining in the public sector in Norway has characteristics which are very close to the situation with implicit profit-sharing.

In the eighties theories for profit-sharing has been further elaborated (cf. section 3.3.6). Compared to a fixed wage system profit-sharing may have favourable macroeconomic consequences, see e.g. Weitzman (1985).

In the theories for negotiations it is also distinguished between central and local bargaining. A central trade union has to take the macroeconomic consequences regarding unemployment, price inflation and the balance of payments into account when negotiating about wages, while a local trade union only is concerned about the local effects on employment. When the behaviour of a trade union has macroeconomic consequences the relation between the union and the central government is more important than the negotiation between the union and the employers' organisation. The situation may then be characterized as a game between the union and the central government, and a lot of concern in the economic litterature has been devoted to the question of how to decide on an optimal macro-economic policy in the case of a central trade union. These problems will be further discussed in section 3.4.

The second important aspect with trade unions compared to atomistic behaviour is that trade unions have the possibility both to collect and distribute information. A weakness in the theory of perfect competition is that nothing is said about how the different agents achieve the relevant information. The trade unions may therefore be looked at as "visible hands" which also have the possibility to influence the economic development. Compared to atomistic behaviour trade unions represent an average worker, not a marginal. Trade unions may also explain the existence of implicit contracts as pointed out by Horn and Svensson (1986). Such contracts which may be fixed for two or three years may cause real wage rigidities and contribute to a higher level of unemployment as pointed out by Taylor (1980).

3.3.1. The preferences of a trade union

In the theory of trade unions it is common to assume that a trade union has stable and consistent preferences represented by a welfare function. This function is assumed to reflect the interest of a representative member in the union.

As pointed out by Torp (1988) a trade union may be concerned about many aspects. The members' level of income, level of employment, normal working hours, job security and the working environment may be of importance, and in addition to the development in real disposable income, a trade union may also be concerned about the members' relative wage position. A central trade union may also take macroeconomic aspects as total employment, inflation, economic growth, income distribution and the balance of payments into account. In central negotiations the unions will also consider the effects of the settlement on the general economic policy.

A local union is not concerned about this macroeconomic aspects, and as pointed out by Oswald (1985) the arguments in the preference function is usually limited to the members' level of income and employment. A quite common approach has been to specify a quasi-concave union utility function $U(w,N)$ where $w = W(1-t)/P$ denotes the real disposable income for an average member (proportional taxes are assumed for simplicity) and N the level (or share) of employment among the members of the trade union. This approach can be found in the works of among others Calmfors (1982), Hersoug (1983) and Pencavel (1984). The level of unemployment enters the preference function of the trade union mainly because the trade union is concerned about the loss in income for members loosing their job. This is further discussed below.

Usually a specific functional form has been chosen, and a Stone-Geary-function as in 3.3.1 has been quite common.

$$(3.3.1) \qquad U = (w-\gamma)^{\theta} (N-\delta)^{1-\theta}, \quad 0 \leq \theta \leq 1 .$$

γ and δ may be thought of as minimum or reference levels of wages and employment. The parameter θ captures the relative importance of wages and employment for the trade union. The advantages with this function is that it is simple and nests as special cases some other assumptions about union preferences (i.e. wage bill representation when $\theta = \frac{1}{2}$ and $\gamma = \delta = 0$). Dertouzoz and Pencavel (1981) also argue that because of the interpretation of γ and δ, the specification captures the notion of a comparable wage rate if the union is concerned about relative wages.

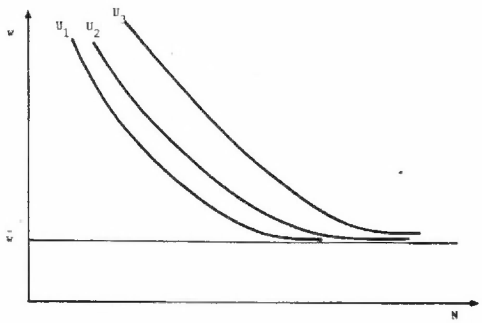
A difficulty with the Stone-Geary union utility function is that it is not derived explicitly from conventional axioms about workers' preferences. It is not obvious why risk-averse workers would, as a group, behave as if maximizing a Stone-Geary function. The utility for risk-averse workers will not only depend on the difference $w - \gamma$, but the wage level will also be of importance.

As an alternative to (3.3.1) an expected utility or utilitarian function as presented in (3.3.2) and (3.3.3) are suggested. This approach may be found in the works by Dreze and Modigliani (1981) and McDonald and Solow (1981).

Expected utility:

$$(3.3.2) \qquad U = \frac{N}{M} u(w) + \frac{M-N}{M} u(\overline{w})$$

Figure 3.3.1. The preference structure of the trade union



or

Utilitarian:

$$(3.3.3) \qquad U = Nu(w) + (M - N)\, u\,(\overline{w})\,.$$

$u(\cdot)$ is the concave utility function of an individual worker, where each worker for simplicity only is assumed to be concerned about their real disposable income. M is the number of members in the trade union, N the number of members employed and $\overline{w}$ is the real value of the unemployment benefit (or an alternative wage).

If M is fixed these two alternatives have the same properties, but if membership is variable and influenced by the union, the two forms will not be equivalent as the number of members also is of importance in the utilitarian case. In the utilitarian form the union is assumed to treat people identically and to care about the sum of their utilities. In the expected utility form the unions welfare is assumed to be dependent on the expected utility of an average member, where some members are employed at a wage w and other members are unemployed or employed elsewhere at income $\overline{w}$. Each union member is assumed to face a random draw and the utility of getting a job is N/M. The advantage of this approach is that individuals' preferences and the size of employment relative to the membership appear explicitly.

The preference structure for the trade union with an expected utility or an utilitarian preference function can be illustrated as in figure 3.3.1. The indifference curves have the usual downward-sloping convex shape in the (N,w) plane. They have the special property that they are all asymptotic to the horizontal at $w = \overline{w}$.

A more general form of expected utility for the trade union than (3.3.2) when differenting between unemployment and alternative employment may be written as:

$$(3.3.4) \qquad EU = p \cdot u(w,h) + q \cdot u(b,0) + (1 - p - q)\, u\,(\overline{w},\overline{h}),$$

where

p = the probability of employment in the same firm
q = the probability of getting unemployed
$1 - p - q$ = the probability of alternative employment
b = the unemployment benefit

$\overline{w}$ = wages in alternative employment
h = normal working hours, $u_h' < 0$
$\overline{h}$ = normal working hours in alternative employment.

Expected utility is thus a weighted average over the possible outcomes for the members of the trade union. In a situation with unemployment, the individual is not assumed to work.

An increase in the unemployment benefit, alternative wages or a reduction in the probability of getting unemployed will move the indifference curves upward and make them flatter at every point. This may be seen from deriving the slope of the indifference curves in the expected utility or the utilitarian case:

$$\frac{dw}{dN} = -\frac{U_N'}{U_w'} = \frac{-(u(w) - u(\overline{w}))}{Nu'(w)} . \tag{3.3.5}$$

An increase in $\overline{w}$ will decrease the numerical value of the numerator and the cost of loosing employment decreases. Higher wages become more important.

Remembering that $w = W(1-t)/P$ we can derive the effect on the slope of the indifference curves in the (N,W) plane of an increase in the proportional income tax:

$$\frac{dW}{dN} = \frac{-U_N'}{U_w'} = \frac{-(u(w) - u(\overline{w}))}{Nu'(w) \cdot (1-t)/P} . \tag{3.3.6}$$

As an increase in t both increases the marginal and average tax rate in a situation with proportional taxes, the effect on the indifference curves is not unique. There is also a complicating element: $\overline{w} = \overline{W}(1-t)/P$. To get a clear view of the importance of the different effects in this case I define

$$f(W,\overline{W},t) = -\frac{dW}{dN} N,$$

set P equal to 1 for simplicity and differentiate $f(\cdot)$ with respect to t.

$$\frac{\partial f}{\partial t} = \frac{1}{(1-t)^2 u'(w)} [-u'(w)w + (1 + r(w))(u(w) - u(\overline{w})) + u'(\overline{w})\overline{w}], \tag{3.3.7}$$

where

$$r(w) = \frac{u''(w)w}{u'(w)} < 0.$$

The first term in the parenthesis is negative contributing to make the indifference curve flatter as a result of tax increases. More weight is thus put on wages in order to prevent a large decrease in disposable income. If $r(w) < -1$ and the last (positive) term is neglected, this is also the total effect. Most probably $r(w) < -1$ and the total effect is uncertain. This is caused by a higher marginal tax rate indicating that the gain in marginal disposable income as a result of higher nominal wages declines relatively to a loss in employment. From (3.3.6) it can be seen that an increase in the consumer prices works in the same way, and the total effect of this increase is also uncertain. However, an increase in product prices and consumer prices will often be rather parallel and this may make the result more clear as analyzed in section 3.3.2.

3.3.2. Monopolistic trade union

Theories for a monopolistic trade union may be relevant when analysing wage formation in a segment of the labour market dominated by a strong local union or for the total economy in the case of a countrywide and strong central union. In this section we look at the situation where a local trade union organizes the supply of labour to a single firm or a limited segment of the labour market as presented among others by McDonald and Solow (1981) and Oswald (1985). In the short run firms are not able to buy labour from other workers than the members of the trade union, and the trade union is assumed to know the demand for labour. In the case of perfect competition in the product market demand for labour may be denoted as in (3.2.9) and will be negatively correlated with the wage level and positively correlated with product prices.

The trade union's preferences may be represented by a preference function as in section 3.3.1. In the monopolistic case the union fixes the nominal wage W which the firms take as given in their decision about the level of employment. The trade union takes this effect on employment into account when fixing a wage rate in order to maximize the welfare for the members.

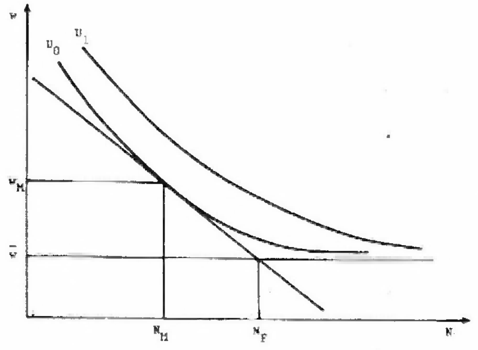
In the case of an utilitarian preference function and proportional taxes the first order condition may be written:

$$(3.3.8) \qquad Nu'(w)\,\frac{1-t}{P} = -\,(u(w) - u(\overline{w}))\,D_W{}'\,\frac{1+s}{P_x},$$

where $w = W(1-t)/P$.

The first order condition states that at the optimum the union's marginal benefit from raising the wage must equal its marginal cost by doing so. The marginal benefit is the increase in utility gained by each worker multiplied by the total number of employed members. The marginal cost is the number of members who lose their jobs multiplied by the utility a member loses when he is transferred from the pool of employed to the pool of unemployed.

Figure 3.3.2. Wage and employment in the monopoly union model



Graphically the situation may be illu0strated as in figure 3.3.2. The optimal wage is given by the point of tangency between the labour demand curve and an indifference curve for the trade union. From the figure it can be seen that the monopoly union model implies a higher wage rate and lower employment than in a situation with perfect competition where the wage rate equals the alternative wage $\overline{W}$.

From (3.3.8) it is clear that an increase in the unemployment benefit (or the alternative wage) will increase the nominal wage. The cost of loosing employment decreases and the trade union is more concerned about higher wages.

A lower probability of getting unemploy- ed works in the same direction. As there may be a positive correlation between the average level of unemployment and the probability of getting unemployed in a macroeconomic context, this gives a negative connection between the wage level and the level of unemployment. For a given supply of labour this gives a positive sloped curve between the wage level and employment level in macro, and the situation is very much the same as in the case of efficiency wages shown in figure 3.2.4. Wage formation in a situation with trade unions may thus explain unemployment.

As can be seen from the discussion in section 3.3.1 it is not clear how an increase in consumer prices will pivot the indifference curves, and as a result of this the effect on the wage rate is uncertain. (3.3.8) may be written as:

$$\frac{u'(w)w}{u(w) - u(\overline{w})} = -\frac{wD_w'}{N}\frac{(1+s)\cdot P}{(1-t)P_x} = -\frac{wD_w'}{N}\theta \qquad (3.3.9)$$

where the wedge θ is defined in (3.2.11).

From (3.3.9) it can be seen as pointed out by Oswald (1985) that as long as there is proportionality between consumer prices and product prices a rise in the price level has no effect on the union's desired real wage rate when the elasticity of demand for labour is constant and the real value of the unemployment benefit is constant. This is in accordance with the traditional neoclassical assumptions about homogeneity; a parallel increase in the nominal unemployment benefit, consumer prices and product prices will always cause an increase in nominal wage rates by the same amount. The unit of account is unimportant within this neoclassical framework.

An isolated increase in the price of the product (with the consumer prices unchanged) will shift the demand curve outwards and result in higher nominal wages. An increase in the payroll tax rate shifts by the same reasons the demand curve inwards and results in lower nominal wages. As analyzed in section 3.3.1 it is not clear how an increase in the income tax rate pivot the indifference curves, and the effect on wages is uncertain. This is evident when differentiating (3.3.8) with respect to t under the simplifying assumption that

$$A = \frac{-D'w}{N} \frac{1+s}{P_x} P > 0$$

is idenpendent on t (which may be unrealistic as N is endogenous) and P is set equal to 1. When A is set equal to 1 (3.3.8) may be written

$$\text{(3.3.10)} \quad u'\,(W(1-t))(1-t) = u\,(W(1-t)) - (\overline{W}(1-t)),$$

where alternative incomes also are assumed to be taxed. Differentiating (3.3.10) with respect to t and solving for dW/dt gives

$$\text{(3.3.11)} \quad \frac{dW}{dt} = \frac{1}{n}\,[u'(w) + u'(w)(r(w) - W) + u'(\overline{w})\overline{W}],$$

where $n = u''(w)(1-t)^2 - u'(w)(1-t) < 0$ and

$$r(w) = \frac{u''(w)w}{u'(w)} < 0.$$

The term $\frac{u'(w)}{n}(r(w) - W) > 0$ contributes to higher wages as the trade unions need higher wages to maintain their members'disposable incomes. On the other hand the term $u'(w)/n < 0$ contributes to lower wages because the gain in marginal disposable income of higher nominal wages declines relative to the marginal costs of lower employment when the marginal tax rate is increased. If alternative incomes also are taxed the term $u'(\overline{w})\overline{W}/n < 0$ contribute to limit the growth in wage rates as an increase in taxes also decreases the value of alternative incomes.

If $r(w) = -1$ this means that $U = \log(wN)$ and $dW/dt = 0$ from (3.3.11). With this preference structure (which may be quite relevant) an increase in tax rates has no effect at all on wages when alternative incomes also are taxed. While an increase in the income tax rate and the payroll tax rate had symmetrical effects on wages in the case of perfect competition analyzed in section 3.2.1, this is not the case with a monopolistic trade union because a trade union balance the effect of higher wages on real disposable income against the loss in employment. In addition a change in income tax rates also may have an effect on the income distribution. If a trade union cares about this, this may be another reason for asymmetry.

3.3.3. Efficient bargaining

A well known criticism against the monopoly model as pointed out among others by McDonald and Solow (1981) is that the wage-employment solution is not efficient. From figure 3.3.3 it can be seen that compared to the monopoly solution M there will be wage-employment combinations where both employers and the trade union will be better off. The constant profit curve Π_1 passing through M is by construction horizontal at M and cuts the downward-sloping indifference curve U_1. The shaded area south-east of M, between the isoprofit curve and the indifference curve, is the set of outcomes which is Pareto preferred to M. Compared with an efficient solution employment is too low and wages too high at M since the employers' marginal willingness to pay for one more unit of labour is larger than the trade union's marginal claim.

Bargaining between the employers and the trade union may result in an efficient solution if the bargaining is about wage and employment simultaneously, socalled "efficient bargaining". The outcomes of this bargaining are obviously the points of tangency between the isoprofit curves and the indifference curves, and these points are denoted the contract curve (C in figure 3.3.3).

If we for simplicity ignore taxes and assume proportionality between consumer and product prices, the contract curve is given by

$$(3.3.12) \qquad w - f'(N) = \frac{u(w) - u(\bar{w})}{u'(w)},$$

where $w = W/P$ denotes the real wage and $f'(N)$ the marginal product of employment.

This solution represents the points where the marginal balance between wage and employment is the same for employers and the trade union. The contract curve intersects the labour demand curve at $w = \bar{w}$ because $f'(N) = w$ along the demand curve and the right hand side of (3.3.12) is zero only at $\bar{w}$. The point $(\bar{w},\bar{N})$ represents the equilibrium under perfect competition. This solution is not attainable by negotiations. Only the part of the curve in the shaded area gives the possible outcomes of the bargaining between the employers and the trade union.

The slope of the contract curve is given by

$$(3.3.13) \qquad \frac{dw}{dN} = \frac{f''(N) \cdot u'(w)}{(w - f'(N))\, u''(w)}.$$

Figure 3.3.3. Wage and employment under efficient bargaining

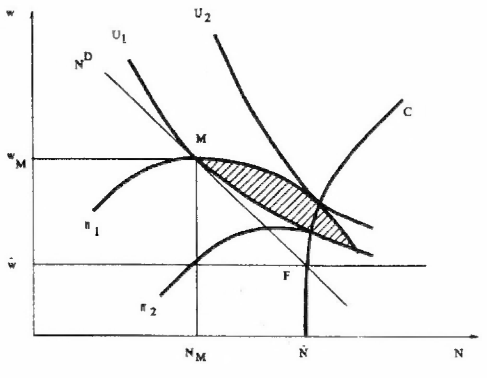
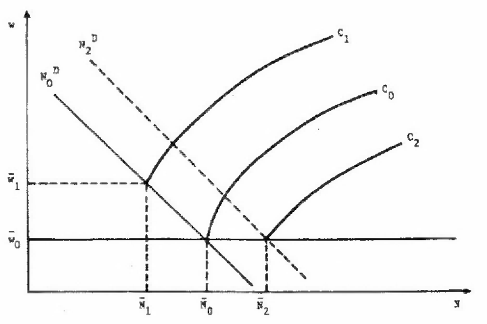


Figure 3.3.4. Shift in alternative wages and demand for labour under efficient bargaining



When the trade union is risk averse, i.e. $u''(w) < 0$, the contract curve will be upward sloping, but vertical at $(\overline{w},\overline{N})$. If the trade union is risk neutral, the whole curve is vertical at $\overline{N}$.

Everywhere along the contract curve, except at $(\overline{w},\overline{N})$, the real wage exceeds the marginal product of employment. When the trade union is risk averse, efficient bargaining gives higher employment than the situation with perfect competition where $w = \overline{w}$. The employment has been pushed beyond the level which would be generated without a trade union in the labour market.

An increase in $\overline{w}$ (alternative wage for the workers or the unemployment benefit) results in an upward shift in the contract curve to C_1 as illustrated in figure 3.3.4. The contract curve then intersects the labour demand curve at a lower employment $\overline{N}_1$. This means both a higher real and nominal wage at any level of employment.

An outward shift in demand for labour shifts the contract curve in the same direction, and the contract curve intersects the labour demand curve at a higher employment $\overline{N}_2$. This shift results in a higher level of employment, at any real wage. Nominal wages will however also in this case increase at any level of employment. By assuming non-proportionality between product and consumer prices and including taxes, the contract curve may be written as

$$(3.3.14) \qquad W - \frac{P_x}{1+s} f'(N) = \frac{P}{1-t} \frac{u(w) - u(\overline{w})}{u'(w)},$$

where $w = W(1{-}t)/P$.

From (3.3.14) it is clear that a positive shift in demand for labour caused by an increase in the product price P_x, a reduction in pay-roll taxes s, or a positive shift in the marginal productivity for labour results in a higher nominal wage W at any level of employment. As discussed in section 3.3.1 it is however not clear how an isolated change in the consumer price P or the income tax rate t will pivot the indifference curves for the trade union in a (W,N)-diagram. The effect on nominal wages is then also uncertain in the case of efficient bargaining.
A general upswing in the economy will often result in a positive shift both in demand for labour and the alternative wage. These two effects work in the opposite direction with regard to the contract curve, and the net effect on real wages is uncertain. Nominal wages will however increase.

The contract curve gives the locus of all Pareto-optimal points in a bargaining, but the location on the curve may be considered as a game between the employers and the trade union dependent on the dynamics of the game, institutional set up, alternative income, possibilities for sanctions and bargaining strength. Points to the northeast along the contract curve are successively less profitable for the employers and more favourable to the workers. A powerful union might be able to force the firm to accept zero profits where $P_x f(N) = W(1+s)\,N$.

Another alternative pointed out by McDonald and Solow (1981) is a "fair" division of net revenue between the workers and the employers according to

$$(3.3.15) \qquad WN = k\frac{P_x}{1-s}f(N), \quad \text{where } 0 \leq k \leq 1$$

Now (3.3.14) and (3.3.15) are the two equations defining the negotiated wage and employment. A positive shift in demand for labour (i.e. an increase in P_x shifts both the contract curve and the distribution locus outwards in a (W,N)-diagram resulting in higher employment and higher nominal wages, but the effect on real wages is uncertain. McDonald and Solow shows that under these conditions real wages may be sticky if the elasticity of demand for labour is fairly constant at the going wage when there is a shift in demand for labour.

The best-known formal solution to the bargaining problem is the Nash solution, and the most important aspects of this solution is discussed by Binmore (1987). The solution is built on a set of axioms such as individual rationality and independence of irrelevant alternatives, but does not say much about the bargaining process. The Nash solution selects the efficient point that maximizes a weighted geometrical average of the union members' utility and the firms' profit above the minimum acceptable. The weights connected to the goals of the different agents express the agents' relative strength in the bargaining. In a Rubinstein bargaining model, the most impatient agent has the smallest bargaining power. The bargaining power may also depend on the costs imputed to the different agents in the case of a breakdown in the bargaining.

Formally the Nash bargaining solution may be written as

$$(3.3.16) \qquad \underset{w,N}{Max}\ (Nu(w) + (M - N)\, u\, (\overline{w}))^{\beta}\ (f(N) - w - \Pi_0)^{1-\beta},$$

where β expresses the relative bargaining power of the trade union and Π_0 the minimum acceptable profit. $\beta = 1$ represents the situation where employers have no power, and the trade union will force them to accept zero profit. If the union is only able to fix wages we are back to the monopoly model which gives a lower level of employment than along the contract curve.

The solution to (3.3.16) gives two equations in W and N which define the solution on the contract curve. Because this curve has a positive slope as in figure 3.3.3, the employment in the model of efficient bargaining gets higher the higher the relative power of the trade union is. Nickell and Andrews (1983) find this contraintuitive and claim that a bargaining only about wages with employers fixing employment is more relevant. This case will be further discussed in section 3.3.4.

3.3.4. Bargaining with right to manage

A problem with the theory of efficient bargaining is that there are incentives to break the deal. When wages are agreed upon the firms are interested to move employment down to the demand curve for labour as this curve represents the points giving maximal profit. Bargaining both about wages and employment is not usual in Norway and is therefore of minor practical relevance.

A common apporach in empirical analyses of wage formation based on bargaining theories as done by Nickell and Andrews (1983) and Hoel and Nymoen (1988) is therefore to assume that only wages are determined in an asymmetric Nash bargaining solution, while the firms are assumed to choose employment so that profit is maximized given the wage rate. This approach is often denoted bargaining with right to manage, and the monopolistic union case where the union is assumed to have all power when fixing wages is a special case of this.

The trade union is assumed to know the firms' strategy in fixing the employment and take these aspects into concern when negotiating with the firms about the wage rate. As in the case of efficient bargaining the outcome will depend on the dynamics of the game and the institutional set up. Moene (1986) discusses how different rules of the game affect employment incentives and equilibrium payments. The outcome may depend on the alternatives for the different agents if negotiations break down and of the possibilities to accomplish different sanctions. In Norway it is not legal to carry out strikes or lock-outs under local negotiations, but the trade union may be able to impose extra costs to the firms by reducing effort, working to rule and refusing overtime.

To illustrate the solution under right to manage, we denote the preference function for the trade union by $U(w,\overline{w},N)$ where w is the real wage and $\overline{w}$ the real alternative income. The firms are assumed to maximize real profit denoted by $\Pi(w,N) = f(N) - wN$ where proportionality between product prices and consumer prices is assumed for simplicity and taxes are ignored. The outcome of the bargaining process is assumed to be given by an asymmetric Nash bargaining solution where the trade union takes the effect from wages on employment into account in the negotiations. The Nash solution is given by the wage rate which maximizes

$$(3.3.17) \quad U(w,\bar{w},N)^{\beta}\,\Pi(w,N)^{1-\beta},$$

where $0 < \beta < 1$ represents the relative bargaining power of the trade union.

The first order condition to this problem satisfies:

$$(3.3.18) \quad \beta\,\frac{U_w' + U_N'\,\dfrac{dN}{dw}}{U} - (1-\beta)\,\frac{N}{\Pi} = 0.$$

Because firms are fixing employment to give maximal profit at the negotiated wage rate we are always at the demand curve given by:

$$(3.3.19) \quad f'(N) = w.$$

From (3.3.18) and (3.3.19) it is possible to derive the solution for N and w in this model. The demand curve for labour has a negative slope as illustrated in figure 3.2.1, but the slope of the connection between N and w derived from (3.3.18), $w(N)$, is not obvious. However, in the case where the trade union is not concerned about employment, i.e. $U_N' = 0$, it follows that $w^*(N)$ has a negative slope, but not as steep as the demand curve as illustrated in figure 3.3.5.

When analysing the effect on nominal wages of a change in alternative incomes, product prices, consumer prices, income taxes, pay-roll taxes or productivity, Hoel and Nymoen (1988) find that the effects have the same signs as pointed out in the cases of a monopoly trade union and efficient bargaining. While an increase in alternative incomes, product prices, productivity and a fall in pay-roll taxes have a positive effect on nominal wages, the effects from an increase in consumer prices or an increase in income taxes are not obvious. If, however, the trade union is only concerned about disposable real wage, and not employment, the effect is positive. In this case there is only an income effect compared to the analysis in section 3.3.2 when assuming that alternative incomes are not taxed. The marginal substitution effect between disposable real income and employment is then of no importance. This case may be as illustrated by the point R in figure 3.3.5.

When the trade union is only concerned about disposable real wages the preference function may be simplified to

$$(3.3.20) \qquad U = w(1-t) - \overline{w}(1-t) = (1-t)(w-\overline{w})$$

when alternative incomes are taxed, and $w = W/P$ denotes the real wage. From the asymmetric bargaining solution the real wage is given by

$$(3.3.21) \qquad w = \beta\frac{f(N)}{N} + \overline{w}(1-\beta) = w^*(N),$$

which is a downward sloping curve in the (w,N)-diagram not as steep as the demand curve (when the demand curve is assumed to be linear). An increase in t will in this case have no effects on wages. If alternative incomes are not taxed an increase in t will shift the $w^*(N)$-curve upwards increasing the wage to w_R' and decreasing employment to N_R'.

From (3.3.21) it can be seen that a positive shift in $\overline{w}$ will shift the $w^*(N)$-curve upwards having a positive effect on wages. A positive shift in consumer prices will also have a positive effect on nominal wages and a negative effect on employment if product prices are unchanged. A positive shift in the demand for labour caused by higher product prices, lower pay-roll taxes or a growth in productivity will cause both higher wages and higher employment. These last results are of course in accordance with the results from shifts in demand from labour in the more general case when the trade union also is concerned about employment. As pointed out by Nickell and Andrews (1983), Hoel and Nymoen (1988) and Calmfors (1989) higher employment and thereby lower unemployment may strengthen the bargaining power of the trade union. increases when the rate of unemployment decreases because the opportunities of getting other jobs improve. Differentiating (3.3.21) with respect to β gives

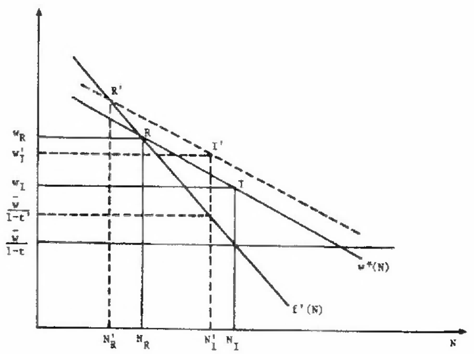
$$(3.3.22) \qquad \frac{\partial w}{\partial \beta} = \frac{f(N)}{N} - \overline{w} > f'(N) - w = 0$$

when $\overline{w} < w$. Higher bargaining strength may thus also contribute to explain why a lower rate of unemployment has a positive effect on wages in addition to the effect through higher expected alternative incomes.

3.3.5. Bargaining with implicit profit sharing

Another approach, which is probably less relevant than the right to manage model, is bargaining about wages when employment is fixed in advance. This approach is called bargaining with implicit profit sharing. With N fixed, the trade union may only be concerned about the level of disposable real wages. Under the simplifications in (3.3.20) the asymmetric Nash bargaining solution is given by (3.3.21), which is a downward sloping

Figure 3.3.5. Wage and employment with right to manage or implicit profit sharing. Effects of higher taxes when alternative incomes are not taxed



curve in the (w,N)-diagram. For a given level of employment the solution for the wage rate is then given by the $w^*(N)$-curve in figure 3.3.5.

The firms are assumed to know that the negotiations result in a point on the $w^*(N)$-curve given by (3.3.21) and take this into consideration when fixing the level of employment which maximizes the profit. Maximum profit is then given by the level of employment which satisfies

$$(3.3.23) \qquad f'(N) = \bar{w}.$$

Together with (3.3.22) this gives a solution at I in figure 3.3.5, while the right to manage solution is given by R.

When the trade union is not concerned about employment and $\bar{w} < w$, R must lie to the northwest of I as the opposite case would imply that the wage paid at R was lower than the alternative income. The right to manage approach will in this case give higher wages, lower employment and lower profit for the firms than the implicit profit sharing approach. How- ever, if the trade union is concerned about employment this is not necessarily the case as the right to manage solution then lies more to the southeast in the figure along the $f'(N)$-curve. This means higher profits to the firms, and if R then is southeast of I this may be one explana- tion why firms prefer the right to manage approach. Fixed wages in the period between two negotiations, while employ- ment is more flexible may be another reason which makes it profitable for the firms to adjust to the curve where $f'(N) = w$.

When alternative incomes are taxed, a change in taxes will have no effect on wages in this model. If alternative incomes are not taxed it can be seen from figure 3.3.5 that an increase in the tax rate will shift both the real value of the alternative wage and the $w^*(N)$-curve upwards. As in the right to manage model, this has a positive effect on wages and a negative effect on employment illustrated by the shift from I to I' in the diagram.

3.3.6. Profit-sharing

A more genuine theory for profit sharing is developed by Weitzman (1985). In this theory the wage rate (or some part of it) depends on the firms' profit. In the most common presentation of this theory the wage system is assumed to consist of a fixed base wage, W_b and a share λ of the firms' gross profit $pf(N) - WN$ per worker. The average wage is then given by

$$(3.3.24) \qquad W(N) = W_b + \lambda \frac{Pf(N) - W_b N}{N}.$$

The firms are assumed to fix employment to maximize profits given the price of the product and the labour payment formula (3.3.24). The first order condition to this maximization problem is given by:

$$(3.3.25) \qquad Pf'(N) = W_b.$$

In optimum the value of the firms' marginal productivity of labour is equal to the base wage.

Compared to a fixed wage system a convertion to profit-sharing where the employed workers are paid the same amount will cause higher employment if there is excess supply of labour at this wage. This follows directly from (3.3.24) and (3.3.25) with $W > W_b$ and diminishing marginal product of labour.

In the long run wages are endogeneously determined through competition in the labour market and Weitzman argue that the pay under profit sharing must in fact be equal to the pay in a fixed wage system because workers are assumed to be able to move without costs between firms. There is thus an inverse relationship between the long-run equilibrium values of λ and W_b. Weitzman (1983) then shows that when there is equilibrium in the labour market under a fixed wage system a shift to a profit sharing system cause excess demand for labour because $W_b < W$. The marginal costs for firms by adding an extra worker will in this situation be smaller than the value of the marginal product. In spite of a small negative shift affecting the firms' demand for products it may be possible to maintain full employment while unemployment is created in the short run in the case of a fixed wage system.

3.4. Macroeconomic policy and wage formation in economies with a central trade union

In the Scandinavian countries, Austria, Germany and the Netherlands there are economy-wide employer and labour organizations that bargain over wages. Under such conditions it may be in the interest of the organizations to take the macroeconomic consequences regarding unemployment, price inflation and the balance of payments into account when bargaining about wages, while a local trade union only is concerned about the local effects on employment. A central trade union may also have greater knowlegde about the possibilities for negative macroeconomic consequences in the long run compared to a local trade union. Concerns about these negative effects may then moderate the claims.

When the behaviour of the labour market organizations have macroeconomic effects they also have to consider governmental reactions when setting wages. Economic policy and wage formation thus have the characteristic of a game between the government and the labour market organizations. The relation between the union and the government may in this case be more important than the bargaining between the union and the employers' organization, and most of the literature dealing with these subjects assumes that the whole labour force is organized in one encompassing union with monopolistic power to fix wages. The problem for the central government is then to decide on an optimal macroeconomic policy.

One aim may be to counteract variations of employment around a chosen target through changes in public-sector employment or other forms of macroeconomic stabilization policy. A discussion of choosing an optimal public employment and the impacts on wage formation is carried out by Sampson (1983), Driffil (1985), Calmfors and Horn (1985 and 1986) and Gylfason and Lindbeck (1986), while Horn and Persson (1986) discuss the same problems by use of an optimal exchange rate policy. The literature stresses the importance of trade union perceptions. If an accommodating policy is perceived, the trade union is induced to raise the real wage with negative consequences for employment. One question may then be as analyzed by Calmfors and Horn (1985) how to restore equilibrium if the economy has ended up in a situation with unemployment because of government accommodation. In this aspect it is important to discuss the problem of credibility.

The degree of accommodation may influence the weight the trade union puts on unemployment and may thus have consequences for wage formation. A change in accommodation policy may alter the impacts of some of the explanatory variables, and especially this may influence expectations and thereby the short run dynamics.

3.4.1. Wage formation under a central trade union compared with several local unions

As pointed out in section 3.3.1 the preferences of a local trade union is often limited to the members' level of income and the local employment. In addition to wages a central union on the other hand may be concerned about macroeconomic aspects such as total unemployment, inflation, economic growth, income distribution and the balance of payments. A central union is also to a larger degree capable of gathering information about the macroeconomic functioning of the economy. Such a union may then know that higher wages cause higher prices, reduce economic growth, increase unemployment and detoriate the balance of payments which may result in a further tightening of the economic policy.

A central trade union may thus attach lower weight than a local union to an increase in nominal wages because it knows that the wage increase partly is outweighted by higher prices, and maybe higher taxes and higher rates of interest. It may also attach higher weight to employment than a local union because it knows both the direct effects on employment and the indirect ones through an possibly tighter economic policy. The demand curve for labour faced by a central union may then be more elastic (less steep) than the average demand curve faced by the local unions.

It may be reasonable to assume that at some real wage $\widetilde{w}$ the central government chooses its own employment at $\widetilde{G}$ to achieve a target of full employment. At a higher wage rate, which may have detoriated the balance of payments and/or the government budget surplus, the central government may choose a lower employment according to the following reaction function:

(3.4.1) $G = \bar{G} + h(w - \tilde{w})$, where $h' < 0$.

Total demand for labour, E, is equal to the sum of private and government demand.

(3.4.2) $E = N(w) + G = N(w) + \bar{G}\, h(w - \tilde{w})$.

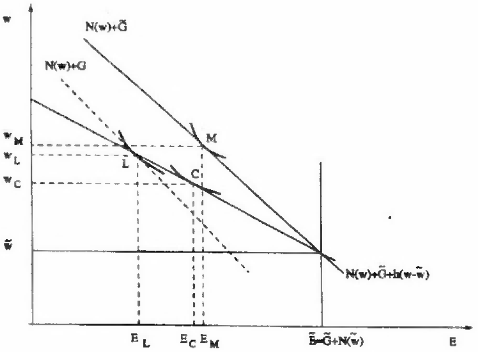
As $h' < 0$ the total demand curve in an (E,w) diagram is less steep than the private demand curve. A central trade union may understand this situation while local unions, each organizing only a minor part of the workers, will not recognize the effect of higher wages on the balance of payments and then indirectly on economic policy. On average they will face a demand curve for labour with slope equal to the private demand curve.

The situation may be as illustrated in figure 3.4.1 where the preference structures for the central union and the local unions at average are assumed to be the same. If the central government had not been concerned about the balance of payments and/or the government budget surplus it may have chosen the desired policy $\bar{G}$. Under assumption of monopolistic trade union(s) this would have led to the traditional monopoly solution M, if the policy $\bar{G}$ was perceived.

In a situation where the central government also is concerned about the balance of payments and/or the government budget surplus it may choose a lower level of public employment when wages are higher then $\tilde{w}$ as is the case in figure 3.4.1. A central union which knows the government reaction function (3.4.1) may then fix the wage rate at w_C. While $w_C < w_M$, the employment E_C may be either larger or smaller than E_M due to a substitution and income effect which work in opposite directions.

The local trade unions do not know or care about, the government reaction function. They may, however, be able to know the aggregate level of employment (or unemployment) thus taking the level of the public activity into account. An equilibrium may then occur at L. When the local unions expect an economic policy giving a labour demand curve through L, they will choose the wage rate equal to w_L. At w_L the central government will choose the level of activity along the time reaction function giving total employment equal to E_L. At L both the wage rate and employment is lower than at M due to an income effect. Compared to C the employment at L is lower both due to a substitution effect and an income effect, while the two effects work in the opposite direction regarding the wage rate. In the case where the central government is concerned about the balance of payments local bargaining may lead to lower employment than central bargaining while the effect on the wage rate is uncertain.

Figure 3.4.1. Wage and employmentwith a central (C) and local (L) trade unions



The effect on employment is strengthened by the fact that a central union to a larger degree than a local knows the effect from wages on prices and maybe also on tax rates and rates of interest. When the trade unions are concerned about real disposable wages and employment, knowledge of this type may influence the preference curves in a diagram with nominal wages and employment along the axes. A central trade union may attach lower weight than local unions to an increase in nominal rates.

There is an argument which works in the opposite direction. As shown in the next section an accommodating economic policy by the central government to prevent high unemployment may contribute to higher wage rates under a central union compared to local unions if the central union perceives this policy. The situation is then the opposite of the one pictured in figure 3.4.1 as the demand curve for labour under an accommo- dating policy is steeper than the private demand curve.

3.4.2. Centralized wage setting with accommodating policy

As pointed out by Calmfors (1985) it may be beneficial to a central trade union to consider government reactions when setting wages. Economic policy and wage formation thus have the characteristic of a game between the government and the trade union, and the question for the central government is then to decide on an optimal macroeconomic policy.

Following Sampson (1983) and Calmfors and Horn (1985 and 1986) it is assumed that the trade union organizes all workers, acts as a monopolist in the labour market and maximizes the expec- ted utility of a representative worker as discussed in section 3.3.2. The firms are assumed to act as price takers in the product market and maximize their profit given the price of the product and the wage rate. The private demand for labour may be denoted as in (3.2.9) and will depend negatively on the real wage. The total demand for labour, *E*, is equal to the sum of private and govern- ment demand, *G*, as shown by the first part of equation (3.4.2).

If the trade union takes the economic policy as exogenous at $\bar{G}$, and thus independent of its own actions, it solves its maximization problem by equating the marginal rate of substitution between wage and employment with the slope of the labour demand curve illustrated by *M* in figure 3.4.1.

As discussed by Hersoug (1985) and Driffil (1985) the game between the union and the central government may take many forms. Hersoug argues that a Stackelberg solution with the trade union as leader may be the most likely outcome. The trade union is then assumed to fix wages in advance based on expectations of government policy parameters. The government is however free to act whenever it likes on the basis of perfect information about the wage rate. In Driffil (1985), however, the government is supposed to make the first move by choosing the form of its stabilization policy, and this is further discussed in section 3.4.5.

The central government is assumed to have preferences about the size of the public sector, $\bar{G}$, and total employment, $\bar{E}$. Instead of postulating an explicit preference function for the central government, Calmfors and Horn (1985) state a reaction function. If total employment deviates from $\bar{E}$, employment in the public sector is expanded above or reduced below $\bar{G}$ according to the response function (3.4.3).

(3.4.3) $G = \bar{G} + \gamma\,(\bar{E} - E)$,

where the parameter $0 \leq \gamma \leq 1$

From $E = N(w) + G$ and (3.4.3) we get

(3.4.4) $E = \gamma \bar{E} + (1-\gamma)[N(w) + \bar{G}]$.

Actual employment E thus becomes a weighted average of the government goal and the employment that would arise without government intervention.

In figure 3.4.2 three different cases are illustrated when E < E . The situation is the opposite of the one shown in figure 3.4.1.

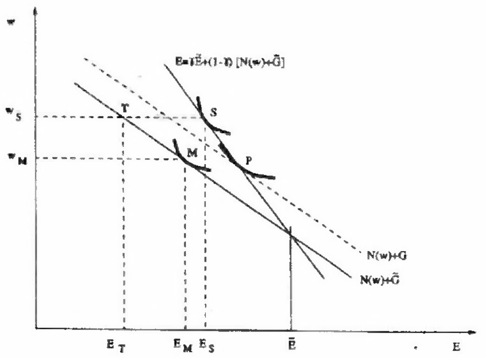
M: Not an accommodating economic policy.

P: An accommodating policy which is not perceived by the trade union corresponding to L in figure 3.4.1.

S: An accommodating policy which is perceived by the trade union corresponding to C in figure 3.4.1.

In the case of a non-accommodating economic policy the central government is not concerned about the level of employment. The optimal policy is then to choose $G = \bar{G}$, and if this is perceived by the trade union this leads to the traditional monopoly solution denoted by *M*. If the central government has a target regarding employment which is higher than the monopoly solution it may want to expand the government sector. This will cause the trade union to choose a higher wage which in turn will induce new policy reactions. An equilibrium is obtained at *P* where both the wage and total employment are higher than without the employment stabilization. The effect of the stabilization in this case is analogous to an increase in income in the theory of consumer demand and corresponds to the situation *L* with local trade unions in section 3.4.1 which only consider the level of government employment and not the reaction function.

Figure 3.4.2. Wage and employment in the case of an accommodating central government



When the trade union is aware of the employment policy rule it optimizes against the steeper curve following from the government reaction function. This results in a new equilibrium at *S* which is a Stackelberg solution with the trade union as the leader and the government as the follower. This corresponds to the situation *C* in figure 3.4.1. While the wage rate is higher than at *P*, employment is lower. When the union understands the policy rule, its perceived "price" of wage increases in terms of lost employment is reduced. This creates an incentive to rise the wage.

The effect on employment compared to the non-accommodating case at *M* is however uncertain. This is due to the income effect and the substitution effect which work in opposite direction regarding employment. Employment declines as a result of the accommodation if the substitution effect dominates.

3.4.3. Methods of restoring equilibrium

If the employment stabilization rule has caused the Stackelberg solution *S* in figure 3.4.2, Calmfors and Horn (1985) discuss four different policies to restore equilibrium at *M*:

(i) Nonaccommodation without any attempts at stabilization.
(ii) Continued accommodation policies but with a lower employment target.
(iii) A social contract.
(iv) A tax-based income policy.

The first option analyzed is when the government stop accommodation at *S*, setting $G = \bar{G}$. One problem with this policy is that an announcement of nonaccommodation may not be credible. The trade union may not believe that an announced shift to a nonaccommodation policy will take place and continue to set the wage rate at w_S. If the government then follows its intentions the economy will end up at *T* with employment falling from E_S to E_T. But it is conceivable that the government still prefers *S* to *T* when *M* cannot be reached. Then the government feels compelled to continue its earlier policy and this undermines the credibility of future policy declarations and tends to lock the economy at the Stackelberg solution *S*. In order for the government to convince the union, there seems to be no other possibility than to accept a period of temporary unemployment if the nonaccommodation policy is to succeed. Aspects about optimal policy in an intertemporal game are further discussed in the next section.

The second possibility pointed out by Calmfors and Horn is to lower the employment target around which employment stabilization takes place. This means that $\bar{E}$ and the government reaction curve is shifted to the left. This will reduce the real wage, but employment will also tend to fall. This policy meets in principle the same credibility problem as the nonaccommodation policy, and the trade union may continue to set the wage at w_S if it does not believe in the policy announcement that the employment target has been lowered. This may cause an equilibrium which is inferior both for the government and the trade union compared to the accommodation equilibrium *S*.

An alternative to a nonaccommodation policy is some kind of incomes policy which means a mutual agreement between the trade union and the government about the wage rate and the size of the government sector. The trade union will prefer any other point to *S* that lies above the indifference curve passing through this point. If the government is only concerned about the total level of employment it will also prefer points to the east of S. As pointed out by Calmfors and Horn a budget constraint may set limitations to superior points for the government, but usually there exist agreements with higher employment which both the union and the government prefer compared to *S*.

Another type of income policy is a tax on wages if they increase above a certain norm. This may pivot the indifference curves for the trade union putting more weight on employment and less on wages. But also in this case there exists a credibility problem.

3.4.4. Wage setting and macroeconomic policy in an intertemporal game

Even though both Sampson (1983) and Calmfors and Horn (1985) mention that the government's budget may set constraints for economic policy, their analyses are mainly discretionary. In the long run the budget constraint, concern about the balance of payments and inflation may be as important for the central government as achieving full employment in each period. This does not mean that the government does not care about employment. The above mentioned goals may be important for achieving full employment in the long run, and as analyzed in section 3.4.1 concern about these goals may give other conclusions than in the analysis in section 3.4.2. Concern about future periods also opens for an intertemporal game between the trade union and the central government, and this may also lead to conclusions other than in a static analysis.

Intertemporal aspects are discussed by Horn and Persson (1986). The structural features are about the same as in the set up by Calmfors and Horn presented in section 3.4.2. Horn and Persson assume a monopolistic trade union which for simplicity is concerned about the real wage bill choosing the wage rate to maximize this bill under assumptions about prices and consequences for employment. The preference structure for the trade union may be written as:

$$(3.4.5) \qquad U_t = \frac{W_t N_t}{P_t},$$

where *t* denotes time.

The firms are assumed to maximize profits given prices and wages, and this leads to a traditional downward sloping demand curve for labour $N(W_t/P_t)$ where $N' < 0$.

The central government is assumed to be concerned about the deviation from full employment $\bar{N}$, and the rate of inflation Π_t. For simplicity the government's preference function is assumed to be of the form

$$(3.4.6) \qquad \Phi_t = \alpha(N_t - \bar{N}) - \beta(\Pi_t)^2/2,$$

where $N_t \leq \bar{N}$ and $\Pi_t \geq 0$, $\alpha > 0$ and $\beta > 0$.

Maximum utility for the government in this model is achieved when $N_t = \bar{N}$ and $\Pi_t = 0$.

The exchange rate is assumed to be the policy instrument for the central government. The connection between domestic prices, the exchange rate and foreign prices is given by

$$(3.4.7) \qquad P_t = V_t P_t^I$$

where V_t is the exchange rate, and P_t^I is the price on foreign product which is assumed to be fixed during the analysis.

A devaluation increases the level of employment, given wages, but also results in higher inflation. A devaluation may also cause claims for higher wages from the trade union. As shown by Horn and Persson the outcome of this game in a discrete situation may be a devaluation-wage spiral with small gains in employment, but with substantial losses in terms of higher inflation.

By recognizing that $\Pi_t = ln(P_t/P_{t-1})$, normalizing $\ln P_t^I = 1$ and assuming that $N(W_t/P_t) = zln(P_t/W_t)$ where $z > 0$, the optimal exchange rate is given by

$$(3.4.8) \qquad \ln V_t = \frac{\alpha z}{\beta} + \ln V_{t-1}$$

which means a devaluation in every period.

The optimal wage for the trade union is given by

$$(3.4.9) \qquad W_t = V_t$$

which means that the nominal wage rate is proportional to the exchange rate when we disregard the factor of normalization. The situation may be as illustrated in figure 3.4.3.

For a given V_t the level of the government's welfare is higher the lower W_t is. For a given W_t welfare declines on both sides of $\hat{V}_t$ which is the response curve for the central government. The optimal exchange rate is independent of the wage rate in this model because of the simplifying assumption that employment counts linearly in the government's preference function.

In a discrete game where the trade union acts as a Stackelberg leader fixing wages given the optimal government reaction, the solution is given by *A* where $W_t = \hat{V}_t > V_{t-1}$ which means a devaluation-wage spiral. *A* is a non-cooperative quilibrium corresponding to *S* (or rather *P*) in figure 3.4.2, and it is well-known that such an equilibrium is Pareto inefficient. When the trade union in this model is indifferent as long as W_t is proportional to V_t a lower nominal wage and a lower exchange that would reduce inflation would make the central government better off. As in section 3.4.2 there is a problem about credibility in such a game where there are no future consequences of discretionary behaviour. Once the union has set the lower nominal wage, the government faces a temptation to set a higher exchange rate than agreed upon.

Horn and Persson show that the non-cooperative equilibrium also will be the solution to a finite game repeated over *T* periods. In the last period the government has an irresistable temptation to choose the discretionary exchange rate since it will not result in any future repercussions. The outcome in the last period will hence be independent of previous outcomes. In the second to last period the parties neither have to worry about how their actions will affect the outcome, and by backward induction this is the situation for all periods back to t. As a result of this wage-devaluation cycle, there is a constant level of employment $N_t = z$ and a constant rate of inflation $\Pi_t = \alpha z/\beta$.

To achieve a better solution for the central government it is wellknown since the work by Kydland and Prescott (1977) that rules rather than discretion may improve the situation. In the model presented in this section a rule like prescribing a fixed exchange rate yielding zero inflation would be an obvious candidate. This would give a solution at *B* in figure 3.4.3 where the central government will be better off than in *A*. However, there is also a question about credibility in this case. The trade union would rationally be aware of that nothing prevents the Government from devaluating once the wage is set. The economy may then end up in a noncooperative equilibrium.

To get out of the credibility problem the government has to make a binding commiment to a predetermined rule. Due to the sequentiality of the wage and exchange rate setting the government could do even better than a binding commitment about a fixed exchange rate. Since the exchange rate is set after the wage, the government could achieve its targets by making a rule for the exchange rate contingent on the wage.

The optimal wage giving full employment $\bar{N}$ in the case of a fixed exchange rate is given by

$$\text{(3.4.9)} \qquad \ln \hat{W}_t = \ln (V_{t-1}\, p^I) - \bar{N}/z.$$

Figure 3.4.3. Wage and exchange rate in different games between the trade union and the central government

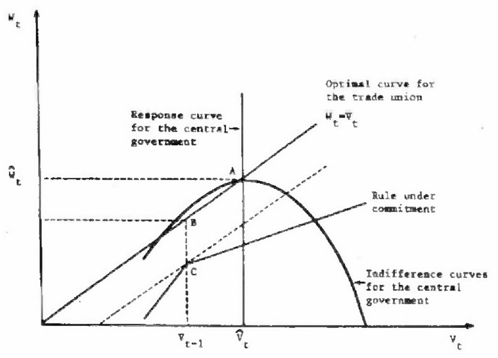
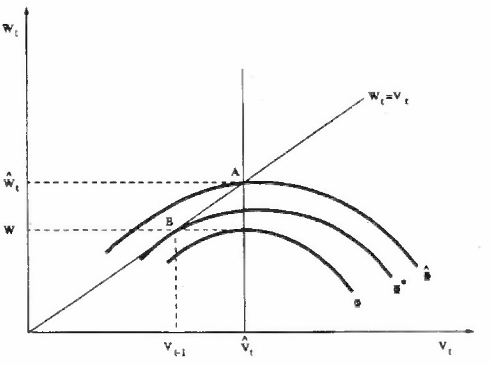


Figure 3.4.4. Government utility in an infinite game



The rule

$$(3.4.10) \qquad \ln V_t = \begin{cases} (1-\sigma)\ln W_t & \\ \ln V_{t-1} & \text{if} \quad W_t \;\substack{<\\=\\>}\; \hat{W}_t \\ (1+\sigma)\ln W_t & \end{cases}$$

where $0 < \sigma < 1$, punishes wage deviations from the level that gives full employment. In figure 3.4.3 the optimal solution is then given by C where full employment and zero inflation exist simultaneously.

In a small open economy like Norway a situation with a punishment rule in the case of too high wage increases may be quite as relevant as an accommodating reaction as in figure 3.4.2. This is caused by the concern about inflation and the constraint set by the balance of payments. Higher inflation than abroad, which means loss of competitiveness, may make it difficult to keep up full employment in the long run if there occurs a large deficit in the balance of payments. A central union which has the interest and ability to get information about the macroeconomic functioning of the economy may understand this aspect.

Horn and Persson (1986) also show that an equilibrium with a low rate of inflation may be possible in an infinite game if there are future costs for the government, such as higher inflation or lower employment, when breaking a commitment about a fixed exchange rate. The situation may be as illustrated in figure 3.4.4.

Under a commitment of a fixed exchange rate the utility for the government is given by Φ^*. The total payoff from following the rule is

$$(3.4.11) \qquad S^* = \sum_{\tau=t}^{\infty} \Phi_\tau^* \, \delta^{t-1} = \frac{1}{1-\delta} \Phi^*,$$

where δ is the rate of discount.

If the government breaks the commitment by devaluating, the utility will increase to $\tilde{\Phi}$ in the instant period. When the union experiences this it will increase wages and the solution will end up in the non-cooperative equilibrium A in the succeeding periods. The payoff under a conflict for the central government is given by

$$(3.4.12) \qquad K^* = \tilde{\Phi} + \sum_{\tau=t+1}^{\infty} \tilde{\Phi}_t \, \delta^{\tau-t} = \tilde{\Phi} + \frac{\delta}{1-\delta} \tilde{\Phi}.$$

A sufficient condition for the rule to be time-consistent is that

$$(3.4.13) \qquad \tilde{\Phi} - \Phi^* \frac{a}{1-\delta} \left(\Phi^* - \tilde{\Phi}\right)$$

(3.4.13) says that the rule is time-consistent if the immediate gain from cheating is smaller than the future costs of cheating.

3.4.5. The accommodation dilemma in the case of external shocks

A disadvantage with a fixed rule about economic policy is that this may cause large fluctuations in the economy as a result of external shocks. If stability of employment round a given target also counts in the preferences of the central government, Rogoff (1985) points out that it is optimal with some flexibility in the economic policy in the short run, at the same time as credibility is kept up in the long run.

These aspects are also discussed by Driffil (1985) and Søderstrøm (1985). Following the work by Driffil he assumes that there is only one encompassing union which is concerned about real wages (w) and employment (N) in the following form:

$$(3.4.14) \qquad u = w - \beta \, (N - \bar{N}), \quad \beta > 0$$

where $\bar{N}$ is the socially optimal employment level in the economy.
The union is assumed to face a downward sloping aggregate curve for labour. Demand for labour is also assumed to depend on a random factor (θ) and the extent of government intervention (G) in the labour market, for simplicity in a linear form:

(3.4.15) $N = \alpha_0 - \alpha_1 w + G + \theta, \quad \alpha_0, \alpha_1 > 0.$

The government is assumed to stabilize employment around a target level N^* by offsetting any deviations from it to a degree indicated by γ:

(3.4.16) $G = \gamma(N^* - N), \quad 1 + \gamma > 0.$

To ensure that G is pure stabilization policy and that the government budget is in balance on average, it is assumed that G has no effect on average employment.

(3.4.17) $E(G(N)) = 0.$

The social welfare function is assumed to be quadratic in deviations of actual employment from the social optimum and allows for an effect of a cost ϕG^2 associated with deviations from a zero deficit:

(3.4.18) $v = -(N - \overline{N})^2 - \phi G^2.$

The government is supposed to make the first move of the game by choosing the form of its stabilization policy. Given (N^*, γ) the union faces a demand curve for labour by inserting from (3.4.16) in (3.4.15):

(3.4.19) $$N = \frac{\alpha_0}{1+\gamma} - \frac{\alpha_1}{1+\gamma} w + \frac{\gamma}{1+\gamma} N^* + \frac{1}{1+\gamma} \theta.$$

By maximizing (3.4.14) with respect to w, given (3.4.19) the response function for the union is:

(3.4.20) $$w = \frac{\alpha_0 + \gamma N^* - (1+\gamma)\overline{N}}{\alpha_1} + \frac{(1+\gamma)^2}{2\beta\alpha_1^2}.$$

In a Nash equilibrium the government maximizes expected utility over (γ, N^*) given w and (3.4.17). From (3.4.17) and (3.4.15) this gives

(3.4.21) $N^* = \alpha_0 - \alpha_1 w,$

which says that employment target depends on the real wage chosen by the union. Maximization of expected social welfare with respect to γ gives

(3.4.22) $\gamma = 1/\phi$

which says that in the Nash equilibrium the amount of stabilization depends on the aversion against budgetary imbalances.

From (3.4.20) and (3.4.21) the real wage is

$$(3.4.23) \quad w = \frac{\alpha_0 - \overline{N}}{\alpha_1} + \frac{1+\gamma}{2/\beta\, \alpha_1^2}.$$

The real wage is thus higher with stabilization policy than without it, and this corresponds to the result from section 3.4.2. From (3.4.19) and (3.4.23), given γ

$$(3.4.24) \quad E(N) = \overline{N} - \frac{1+\gamma}{2/\beta\, \alpha_1}$$

and

$$(3.4.25) \quad var(N) = \frac{var\ \theta}{(1+\gamma)^2}.$$

In this model higher degree of stabilization reduces the expected level of employment as a consequence of higher wages, but the variance is reduced. Higher stability then has to be balanced against lower employment.

As in the previous sections Driffil points out that a non-cooperative solution is not efficient and that a cooperative agreement would be beneficial for both parties. However, there is a strong temptation to cheat, and in the absence of being able to make a binding commitment a non-cooperative equilibrium will be a probably outcome. If the process is modelled as a repeated game, threats of punishments may induce the actors to follow the commitment. Because a punishment policy which imposes low welfare on both the unions and the government probably not is a credible thereat, Driffil concludes that governments have a limited ability to achieve such a result, except from in special cases.

3.5. The Phillips curve, natural rate of unemployment and hysteresis

The theories outlined in sections 3.2 and 3.3 are static and deal with equilibrium solutions. Almost nothing is said in these theories about disequilibrium and how fast equilibrium is restored after a shock in the economy. As unemployment has stayed at a high level for more than 10 years in many western countries, it is relevant to discuss why disequilibrium in the labour market has existed for such a long period of time. It is also relevant to discuss how fast the economies work to eliminate unemployment left alone without any intervention from the central government.

The Phillips curve approach is the traditional one saying that the level of unemployment may have a negative impact on wage growth until unemployment is reduced to its natural rate. The concept of hysteresis is an alternative approach which has become quite popular in the last decade. This approach says that the equilibrium in the labour market may be influenced by the development in the actual rate of unemployment.

3.5.1. The Phillips curve

The origin of the Phillips curve descends from the empirical study by Phillips (1958) on observations of growth in wage rates and the level of unemployment in the United Kingdom in the period 1861-1957. In this study Phillips finds a negative correlation between the two variables which he explains with the theory of classical price dynamics.

It also appears that wages are bid up quite rapidly when unemployment is low, while workers seem reluctant to cut wages when unemployment is high so that wage rates fall only very slowly. The Phillips curve then seems to be convex and become rather flat at high levels of unemployment as illustrated in figure 3.5.1 where $\Delta W/W$ denotes the change in wage rates and U the rate of unemployment.

Phillips also argued that there was a positive correlation between a change in demand for labour, and thereby unemployment, and the change in wage rates because employers would bid more vigorously in a year of rising business activity compared to a year of falling activity. He also pointed out that changes in retail prices might be of importance. But as the level of inflation at average was very low in the period included in his study, he argued that this factor had little or no effect on the rate of change of money wage rates except at times when retail prices were forced up by a very rapid rise in import prices.

Phillips (1958) presented only a few remarks on the theoretical foundation for the Phillips curve. A more formalized theory explaining the observed connections between growth in wage rates and the level of unemployment is given among others by Lipsey (1960) and Hansen (1970). Santomero and Seater (1978) present an survey over both theoretical and empirical works regarding the inflation-unemployment trade-off.

Both Lipsey and Hansen point out that the labour market consists of different sub-markets where labour may be considered as rather homogenous. In such a market wage formation may be explained with the theory for classical price dynamics as discussed in section 3.2. When there is excess demand for labour, wage rates will rise, and when there is excess supply wage rates will fall. In this theory it is also assumed that wages will change more rapidly the greater is the distance from equilibrium, and the situation may be as characterized by (3.2.12):

(3.5.1) $$\frac{\Delta W}{W} = k\,\frac{N^D - N^S}{N^S}, \quad \text{where } k \geq 0.$$

Figure 3.5.1. The Phillips curve

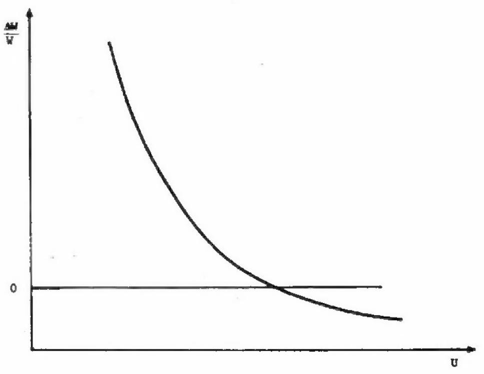
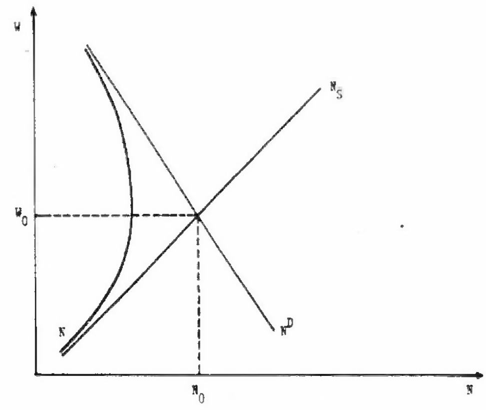


Figure 3.5.2. Demand and supply of labour and total employment in a situation with submarkets



Lipsey also argues that this relation may be in accordance with the behaviour of a trade union causing an increase in wages when there is excess demand. The convex shape of the Phillips curve may also be explained by trade unions being reluctant to accept a large cut in wages if there is excess supply.

However, there are some problems with the specification in (3.5.1). Shifts in both supply and demand for labour may make it difficult to separate wage changes caused by shifts in the curves from changes tending to restore equilibrium. It may also be difficult to explain why a disequilibrium has occurred. A special problem is caused by the fact that excess demand for labour is not directly observable. Aggregation from a single submarket to demand or supply for the whole economy is neither trivial.

The problem of aggregation is discussed by Hansen (1970) and further elaborated by Brunstad (1980). As a consequence of the different submarkets, structural changes and frictions in moving labour from one submarket to another, there will always exist unemployment and vacancies at the same moment of time. The situation may be as illustrated in figure 3.5.2.

In a situation with submarkets and frictions total employment N may never be as large as total demand or supply of labour. When wages are high and there is excess supply of labour total employment is close to demand. Because the difference between supply of labour and actual employment at a given wage rate is equal to the number of unemployed, unemployment is high when wages are high. At high unemployment employers will only have small problems to get workers to vacant jobs, and the number of vacancies equal to the distance between the demand curve and actual employment, is small. In the opposite cases where wages are low, there is excess demand, low unemployment and a large number of vacancies.

Because the number of vacancies $N^V = N^D - N$ and the number of unemployed $N^U = N^S - N$, we have

$$(3.5.2) \qquad N^D - N^S = N^V - N^U.$$

Equation (3.5.1) may be expressed as

$$(3.5.3) \qquad \frac{\Delta W}{W} = k \frac{N^V - N^U}{N^S}.$$

From figure 3.5.2 it is also evident that there is an inverse connection between N^U and N^V which may be expressed as

$$(3.5.4) \qquad N^V = h \frac{1}{N^U}, \text{ where } h > 0.$$

Inserting in (3.5.3) and denoting the rate of unemployment by $U = N^U/N^S$ the relation may be written as

$$(3.5.5) \qquad \frac{\Delta W}{W} = kh \frac{1}{UN_S^2} - kU,$$

and this gives a negative convex relation between the growth in wage rates and unemployment as drawn in figure 3.5.1.

As pointed out by Lipsey (1960), Archibald (1971) and further elaborated by Brunstad (1980) the distribution of excess demand across the different submarkets is essential for the rate of wage inflation. Archibald demonstrates that a historically stable Phillips curve estimated from time series data will not be observed unless the distribution of excess demand displays some constant features. Brunstad points out that the more uneven the distribution of excess demand and supply is, the further from the origin lies the Phillips curve. Higher mobility between the submarkets will however move the Phillips curve inwards.

Brunstad also discusses the effects of trade unions and solidary wage policy in the central wage settlements. The outcome of a central settlement is often a so-called low-wage profile which means that the groups with the lowest wage level working in markets with excess supply get the highest percentage increases. On the other hand the groups with the highest wage level working in markets with excess demand often have the possibility to obtain the highest wage drift. A central settlement will then work to conserve the relative wages, reducing mobility and moving the Phillips curve outwards.

However, in the long run this may have consequences for the employment for the groups with excess supply.

Because Phillips was not quite clear if prices should be included in explaining wage inflation or not, there was a debate on this subject in the years afterwards. Lipsey argued that prices ought to be included, and Phelps (1967) and Friedman (1968) pointed out the wellknown result that the Walrasian system of general equilibrium equations determines relative and not absolute prices. Santomero and Seater (1978) also claimed that the Phillips curve was misspecified if it was written in terms of nominal wages because employers and employees bargain over real wages. Excluding prices might then disturb the effect from unemployment on wage growth. Santomero and Seater also pointed out that it is the expected rate of price change $\Delta p^e/p$ that should appear in an equation explaining nominal wage rates. When the effect from changes in expected inflation on wage growth is included, the Phillips curve may be written as

$$(3.5.6) \qquad \frac{\Delta W}{W} = g(U) + \gamma \frac{\Delta P^e}{P}, \quad \text{where} \quad 0 < \gamma \leq 1.$$

3.5.2. The natural rate of unemployment

The excistence of submarkets with different excess demand as a result of structural changes and not perfect mobility of labour between markets means that unemployment and vacancies exist at the same moment of time. At some level of unemployment there is then an equilibrium where wages tend to rise at a normal rate according to price expectations and is defined as $g(U) = 0$ from (3.5.6). A lower level of unemployment is an indication of excess demand for labour which will cause an upward pressure on the real wage. Friedman (1968) denotes this equilibrium rate of unemployment as the "natural" rate depending on the structural characteristics of both the labour and the commodity markets. A change in these characteristics may change the natural rate.

With a Phillips curve like (3.5.6) Phelps (1967) and Friedman (1968) argue that people learn from their experiences and that any rate of inflation which is held constant for some length of time will finally be anticipated by the participants in the labour market. When people learn from their experiences, expectations are *adaptive,* and if we denote inflation $\Delta P/p$ with Π the inflation expectations may be written as

$$(3.5.7) \qquad \Pi_t^e = \lambda \Pi_{t-1} + (1-\lambda)\, \Pi_{t-1}^e = \Pi_{t-1}^e + \lambda\, (\Pi_{t-1} - \Pi_{t-1}^e), \quad \text{where } 0 \leq \lambda \leq 1.$$

Equation (3.5.7) says that expected inflation is a weighted average of actual inflation last period and expected inflation last period. The greater is λ, the more weight is put on actual inflation in the formations of expectations. Expected inflation in the present period may also, according to (3.5.7), be seen as expected inflation in the past period partly corrected for the divergence between actual and expected inflation.

An alternative view regarding expectations is that they are *rational*. This means that people know the functioning of the economy and are able to predict inflation and other economic variables except from a stochastic error term. With an error term of inflation rational expectations may be written as

(3.5.8) $\Pi_t^e = \Pi_t + \varepsilon_t$.

The possibilities of performing an economic policy under different assumptions of price expectations and the importance from price expectations on wage formation are discussed below. Especially the case where $\gamma = 1$, i.e. wages grow proportional to expected changes in prices, is of great interest. The discussion may be performed with a simple macroeconomic model where in addition to (3.5.6) and alternatively (3.5.7)/(3.5.8) we have the following equations:

(3.5.9) $X = h(G,T)M/P$, where $h'_G > 0$ and $h'_T < 0$,

(3.5.10) $N = F^{-1}(X)$,

(3.5.11) $U = 1 - N/\bar{N}$,

(3.5.12) $P = aW$,

where X - aggregate production

G - the level of government consumption
T - the level of taxes
M - supply of money
N - employment
$\bar{N}$ - supply of labour, assumed exogenously given

Equation (3.5.9) gives demand for commodities on a reduced form dependent on fiscal policies G and T and money policy M. (3.5.10) is an inverted macro production function, (3.5.11) defines the rate of unemployment, and (3.5.12) is a simple mark-up equation for prices.

When assuming *adaptive* expectations and that wages are not fully compensated as a result of changes in expected inflation, $\gamma < 1$, the *short term* Phillips curve follows from (3.5.12) and (3.5.6):

(3.5.13) $\Pi = g(U) + \gamma\Pi^e$.

In the long run expected inflation equals actual inflation irrespective of how price expectations are formed. Inserting in (3.5.13) and solving for Π gives the *long run* Phillips curve

$$(3.5.14) \qquad \Pi = \frac{1}{1-\gamma} g(U).$$

As $0 < \gamma < 1$ the long run Phillips curve is steeper than the short run curve as illustrated in figure 3.5.3.

Assume that the economy is at the equilibrium rate of unemployment U^* giving zero inflation and that the Central government wants to reduce unemployment to U_1 through an expansionary fiscal policy. This expansion causes an almost immediate increase in production and employment which lead to a reduction in unemployment. Inflation increases to Π_1 as a result of this according to the short run Phillips curve. In the next period price expectations are adjusted shifting the short term Phillips curve upwards increasing inflation even more.

The increase in the price level causes, according to (3.5.9), a reduction in real money balances which has a negative effect on production. (Implicitly lower money balances are assumed to increase the rate of interest having a negative effect on private demand.) The process continues (probably with damped cycles) until the rate of unemployment stabilize at its equilibrium level U^* and actual and expected inflation return to 0 as pointed out by Friedman (1968). The expansionary fiscal policy is crowded out.

The central government may try to avoid this crowding out effect by counteracting the fall in real money balances by a continuous increase in supply of money. From the situation (U_1, Π_1), adjustments in price expectations shift the short term Phillips curve upwards. When the supply of money is increased proportionally a new equilibrium will occur where $\Pi = \Pi^e = \Pi_2$ at the long term Phillips curve. To maintain this equilibrium the growth in supply of money has to be $m_2 = \Pi_2$ every period. In this model unemployment may be kept below the equilibrium rate even in the long run by inflation and a continuous printing of money.

If prices are fully compensated in wage formation, $\gamma = 1$. The long run Phillips curve is vertical from (3.5.14). When there is only an expansionary shift in economic policy without any concern for real balances the economy will return to its equilibrium rate as in the case when $\gamma < 1$. When the long run Phillips curve is vertical no equilibrium is reached in the long run by keeping up the real balances as illustrated in figure 3.5.4. We are in a situation where unemployment may be kept below its equilibrium value only with increasing inflation and increasing growth in money supply. (Friedman denoted this "accelerating" inflation.)

If expectations are *rational*, $\Pi = \Pi^e$ in every period, apart from the error term. Furthermore, the short and long term Phillips curve coincide. If $\gamma < 1$, the long term Phillips curve is falling as illustrated in figure 3.5.3. By increasing the supply of money to keep

Figure 3.5.3. The Phillips curve in the case of adaptive expectations and prices not fully compensated

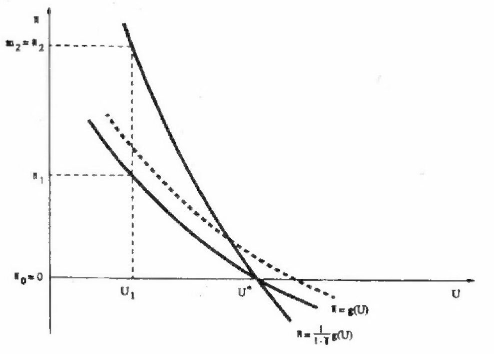
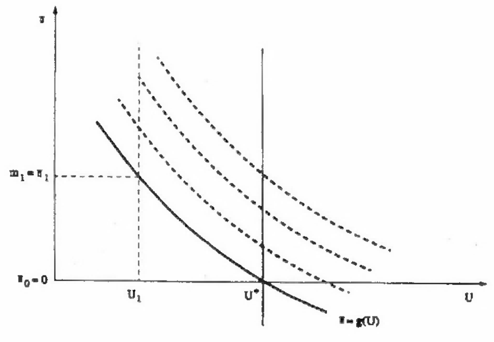


Figure 3.5.4. The Phillips curve in the case of adaptive expectations and prices fully compensated



up real money balances the central government may choose whatever combination of unemployment and inflation they want on the long run Phillips curve as discussed in the case of adaptive expectations. A shift in fiscal policy without keeping up the real money balances will in this case also lead to crowding out. Unemployment will return to its equilibrium rate.

When $\gamma = 1$, the Phillips curve is vertical both in the short run and long run with rational expectations. The rate of unemployment may then never deviate from U^* except when there is an unexpected shock in the economy. This is also the conclusion in Lucas (1973) which shows that only unanticipated changes in nominal money affect output.

As pointed out by both Friedman (1968) and Santomero and Seater (1978) the natural rate is determined by real factors like the degree of mobility in the labour market, structural changes, speed of information, institutional arrangements affecting wage bargaining and the power of the trade unions. As some of these factors change, the natural rate of unemployment is affected, and it may change over time.

In his Nobel lecture Friedman (1977) further discusses the conditions for a vertical long-run Phillips curve. Especially he is concerned about the impact of a change in inflation on the natural rate of unemployment. Friedman argues that a vertical Phillips curve depends on constant inflation or that relative price adjustments are the same at both high and low rates of inflation. In a transitional period this may not be the case, and Friedman puts forward a theory of a long-run positively sloped Phillips curve. This is caused by higher variability in inflation on different commodities in a high inflation period producing wrong relative prices combined with a greater government interference in the price mechanism. This may then create higher unemployment and the long run Phillips curve may be positively sloped.

The arguments of Friedman are further formalized and discussed by Cross (1987). The natural rate of unemployment is assumed to be expressed as

(3.5.15) $U^* = U_R + \beta_1 \dot{P},$

where U^* is the natural rate, U_R represents the component of the natural rate determined by real factors and β_1 reflects the effects of the *level* of the rate of inflation $\dot{P}$ on the natural rate. Friedman argues, however, as if it is the *increasing* volatility and *increasing* government intervention which rise unemployment, not a *high* volatility or a *high* level of intervention. This suggests an alternative formulation such as

(3.5.16) $U^* = U_R + \beta_2 \ddot{P},$

where β_2 reflects the effects of the *rate of change* in inflation on the natural rate. An implication of this form is that the long-run Phillips curve is not necessarily positively sloped with respect to the rate of inflation.

Cross (1987) analyses a combination of (3.5.15) and (3.5.16) in a simple macroeconomic model. An expansionary shock decreasing unemployment, raises the actual rate of inflation above the expected rate in his model. This may give an explosive movement upwards both in price level and unemployment. The possibility of a vertical Phillips curve in the long run is then a knife-edge problem, and Cross argues that there are strong reasons for rejecting the positive sloped Phillips curve in (3.5.15). The underlying assumptions made by Friedman about the variability in relative prices and the consequences of government intervention are also discussed, and Cross points out that doubts can be raised against these assumptions. A major difficulty with a positive-sloped long-run Phillips curve is that it fails to account for the prolonged higher unemployment which has been associated with measures to reduce the anticipated rate of inflation.

In recent studies concern has been given to the structural factors influencing the natural rate of unemployment. In the studies by Adams and Coe (1990) and Coe (1990) they try to separate between the cyclical and structural components determining the actual rate of unemployment. The natural rate are assumed to depend on these structural components and the actual rate may deviate around this as production deviates from trend output according to (3.5.17).

(3.5.17) $U = \alpha_0 + \alpha_1 (X - X^{tr}) + h(Z),$

where X is actual production
X^{tr} is trend production
Z represents structural variables influencing the rate of unemployment.

The natural rate is given by

$$(3.5.18) \qquad U^* = \alpha_0 + h(Z).$$

Among the structural variables Adams and Coe (1990) include a correction factor for changes in the composition of unemployment by age and gender, union members as per cent of total private sector unemployment, relative minimum wages, the average weekly unemployment insurance replacement ratio adjusted for the proportion of employees covered by the unemployment insurance system, and non-wage labour costs as a per cent of total wages and salaries. The strength with the studies made by Coe and Coe and Adams is that they try to identify the factors influencing the natural rate in a system where actual unemployment, wages, prices and production are determined simultaneously. A weakness with the approach is that the choice of structural variables, although relevant, may be somewhat arbitrary, and it is strange that the non-wage labour costs as a per cent of total wages and salaries turns out to be the most important explanatory factor for the development in the natural rate in the empirical analysis. Another weakness is the assumption of a close correspondance between the deviation between the actual and natural rate and the deviation between actual and trend (or potential) output. At first there is a problem of defining potential output. Second there is a aggregation problem, as the connection between production and employment differs between sectors. Third the approach neglects the changes in supply of labour.

In their cross country study of factors influencing the rate of unemployment Layard, Nickell and Jackman (1991) look at the importance of several structural factors, which also may influence the natural rate of unemployment in the different countries. In their empirical analysis based on observations from 20 OECD countries for the period 1983-88 the following structural variables are found to have a positive (+) or a negative (-) effect on the natural rate of unemployment

Duration of unemployment benefits	+
Replacement ratio	+
Expenditure on national manpower policies	-
Union coverage	+
Co-ordinated bargaining by unions	-
Co-ordinated bargaining by employers	-

3.5.3. Hysteresis in the natural rate

An alternative approach in the discussion on the variability in the natural rate of unemployment which has become popular in the last decade, is the concept of *hysteresis*. The term hysteresis means what comes after, or behind, and in a historical overview Cross and Allan (1988) point out that the term was coined for application to phenomena in the science of physics. A characterizing feature of a system with hysteresis is that the behaviour of the system cannot be explained by reference to current state variables alone. The past history of the system also has to be invoked.

Phelps (1972) was the first to suggest that the natural rate of unemployment could well be haunted by hysteresis because it partly could be determined by the actual unemployment experienced during the movement from one steady state of inflation to another. In the recent years aspects of hysteresis in the labour market are further discussed among others by Hargreaves Heap (1980), Coe (1985 and 1988), Blanchard and Summers (1987 and 1988), Cross (1987) and Juhn, Murphy and Topel (1991). Three types of explanations which loosely speaking might be referred to as the physical capital, human capital and insider-outsider stories can be adduced to explain why shocks which cause unemployment in a single period may have long term effects on the natural rate of unemployment.

The physical capital argument is based on the works by Sneessens (1983) and Drèze and Sneessens (1986). In their works they present a macroeconomic disequilibrium model where price and wage adjustments are not sufficient to clear the goods and the labour markets at each moment of time. Actual employment may be determined either by a sales constraint (Keynesian unemployment), by a capacity constraint (classical unemployment) or by a labour supply constraint (repressed inflation).

Drèze and Sneessens assume a long run capacity production function in labour and capital under the prevailing production technology. Optimal factor proportions are chosen so as to minimize production costs. It is assumed to be costly to change technology, and labour and capital appear as complementary inputs in the short run although they are substitutes in the longer run. By assuming constant returns to scale the classical demand for labour may be written as

$$(3.5.19) \qquad N^{CD} = \bar{X}\alpha\left(\frac{W}{q}, z\right),$$

where
- N^{CD} is classical demand for labour
- $\bar{X}$ is production capacity
- W is the nominal wage rate
- q is the user cost of capital, and
- z reflects technical progress.

In the short run, the technical coefficient α is fairly rigid. Actual production have to be less or equal to production capacity. In the Keynesian case characterized by excess supply, production X is determined by demand for products. The Keynesian demand for employment N^{KD} may then be written as

$$(3.5.20) \qquad N^{KD} = \alpha X.$$

In the whole economy there exist markets with classical unemployment, Keynesian unemployment and repressed inflation at the same time. Simple assumptions about the frequency distribution of the different situations (see Lambert (1988)) lead to an employment equation where the aggregate employment level is a CES-aggregate of the different concepts, N^{CD}, N^{KD} and supply of labour N^S:

(3.5.21) $$N = \left\{ (N^{CD})^{-\rho} + (N^{KD})^{-\rho} + (N^S)^{-\rho} \right\}^{-1/\rho}.$$

The parameter ρ expresses the structural mismatch in the economy. The lower ρ is, the larger is the mismatch. It is a close correspondence between ρ and the structural component of the natural rate of unemployment, U_R. In a macroeconomic equilibrium where $N^{CD} = N^{KD} = N^S$ the structural rate of unemployment is given by

(3.5.22) $$U_R = 1 - 3^{-1/\rho}$$

and is a negative function of ρ.

An immediate implication of (3.5.21) is that the elasticities of employment with respect to N^{CD}, N^{KD} and N^S are all less than unity corresponding to the proportions of firms or markets in each regime. The elasticities of aggregate employment with respect to the wage rate is a weighed average of the elasticities in each regime, with the different proportions as weights.

(3.5.23) $$\varepsilon_w = \Pi_{CD}\, \varepsilon_w^{CD} + \Pi_{KD}\, \varepsilon_w^{KD} + \Pi_S\, \varepsilon_w^S,$$

where ε_w^i denote the wage elasticity in regime i and Π_i the corresponding weight. As both ε_w^{KD} and ε_w^S are positive while ε_w^{CD} is negative the sign of ε_w is indeterminate in a situation with firms in all three regimes. A parallel to this may be found in the macroeconomic model MODAG discussed in section 5.3 where a change in wages affects both profitability and demand, and the total effect on aggregate employment is thus not quite certain.

Based on empirical estimates of their disequilibrium model for Belgium, Drèze and Sneessens find that total unemployment may be decomposed in factors according to structural mismatch, insufficient demand and capital gap. An increase in demand would then not be sufficient to eliminate unemployment without creating inflationary pressure. Creation of additional capacity and better adjustment of supply to demand would also be necessary to eliminate unemployment. Because it takes some period of time to build up new capacity, it may be difficult to get a substantial decrease in unemployment by increasing demand without creating inflation, and the equilibrium rate of unemployment where wages tend to increase at a normal rate according to prices and productivity may have increased because of reduced production capacity during a recession.

Blanchard and Summers (1988) seem to be somewhat sceptical of this argument that some part of unemployment may be explained by lack of capacity. They point out that substantial reduction of capacity during the 1930s did not preclude the rapid recovery of employment associated with rearmament in a number of countries. Neither did the substantial reduction in the size of the civilian capital stock that occurred during the war prevent the attainment of full employment after the war.

The second mechanism which may explain hysteresis is loss of human capital among the long-term unemployed. This argument can be found in Phelps (1972) and Hargreaves Heap (1980), and it is tested empirically in later works referred to in section 4.3. Juhn, Murphy and Topel (1991) argue that a negative shift in demand for the less skilled workers are the main reason why the increase in unemployment especially has hurt these groups in the US. The human capital argument states that workers who get unemployed, loose the opportunity to maintain and update their skills by working. In fact, lack of skill and further loss of skill when unemployed for a long time may make it difficult to get a new job because the employers may regard them as unsuitable for employment. An increasing number of long-term unemployed may then increase the wage pressure for a given total number of unemployed. As the number of long-term unemployed normally is positively correlated with the level of unemployment the natural rate of unemployment may grow if there is a growth in the actual rate. Hargreaves Heap (1980) suggest the following relationship

$$(3.5.24) \quad U_t^* - U_{t-1}^* = c\,(U_{t-1} - U_{t-1}^*), \text{ where } c > 0,$$

which means that $U_t^* > U_{t-1}^*$ if $U_{t-1} > U_{t-1}^*$. The natural rate of unemployment increases if the actual rate is greater than the natural rate.

If the real wage Phillips curve from (3.5.6) is of the form

$$(3.5.25) \quad \Delta w_t/w_{t-1} = -b(U_{t-1} - U_{t-1}^*), \text{ where } b > 0,$$

assumption (3.5.24) means that

$$(3.5.26) \quad \Delta w_t/w_{t-1} = -b/c(U_t^* - U_{t-1}^*).$$

(3.5.26) says that real wages declines according to growth in the natural rate of unemployment. If there is hysteresis and the natural rate grows according to the actual rate this means that the *change* in unemployment is a better explanatory factor for the development of real wages than the *level* of unemployment as suggested by the traditional Phillips curve.

Because there may be some lags from the change in the actual rate of unemployment to the natural, Coe (1985 and 1988) suggests a specification of the form

$$(3.5.27) \quad \Delta w_t/w_{t-1} = \beta_0 - \beta_1 U_t + \beta_2 U_t^*,$$

where U_t^* is defined as a weighted average of past values of U_t. A significant positive estimated coefficient on U_t^* of roughly the same size as β_1 would then be an indication of hysteresis in the natural rate. According to the argument about loss of human capital among the long-term unemployed, Coe (1988) also suggests that the development in U^* in (3.5.27) could be approximated by the rate of long-term unemployment. Letting U^L and U^S be the longand short-term rates of unemployment and approximating U^* by U^L, (3.5.27) may be written as

$$(3.5.28) \qquad \Delta w_t/w_{t-1} = \beta_0 - \beta_1 U^S + (\beta_2 - \beta_1)\, U^L.$$

If the long-term unemployed have no impact on wage growth the coefficient attached to U^L in (3.5.28) would be zero, i.e. β_2 would be equal to β_1.

The third mechanism which is put forward to explain hysteresis and the percistence of high unemployment is the distinction between insider and outsider workers developed in a series of contributions by Lindbeck (see e.g. Lindbeck and Snower 1985, 1988 and 1989). In the extreme case wages are assumed to be fixed by bargaining between employed workers, the insiders, and firms, with outsiders playing no role in the bargaining process. Insiders are concerned with maintaining their jobs and do not care about the unemployed.

In a simplified model all firms and groups of workers are assumed to be homogeneous and the group of insiders is sufficiently strong to set the wage to make expected employment equal to the size of membership. Blanchard and Summers (1987 and 1988) argue that the wage rate is the same in all firms and that employment is equal to membership plus a disturbance equal to the effect of an unanticipated shock in the economy:

$$(3.5.29) \qquad N = M + (G - EG),$$

where M denotes membership and $(G - EG)$ is additional employment caused by the unanticipated shock, e.g. in the public sector.

The crucial issue in this model is how membership is determined. If the union only cares about the currently employed from the past period; $M = N_{t-1}$, (3.5.29) may be written as

$$(3.5.30) \qquad N_t = N_{t-1} + (G_t - EG_t).$$

The implication of this assumption is that employment follows a random walk and is only influenced by unexpected movements in aggregate employment. For a given labour force equilibrium unemployment is equal to last period's value of actual unemployment.

In the case of an adverse shock which reduces employment, some workers lose their insider status and the new smaller group of insiders sets the wage rate so as to maintain this new lower level of employment. There is then no connection between the *level* of unemployment and the change in wage rates in this approach, and the natural rate of unemployment moves according to the actual rate.

Although Blanchard and Summers regard the insider-outsider approach as the most promising to explain hysteresis and the high and persisting unemployment, some critical remarks have to be made. First it may be doubtful if the trade union has the power to fix wages to make expected employment equal to the size of membership. For instance in Norway less than 60 per cent of the wage earners are organized. Even more critical is the assumption that the trade union only cares about the currently employed while there obviously are members which are unemployed. As also pointed out by Blanchard and Summers (1987) higher unemployment means worse reemployment prospects if laid off, and thus should lead the insiders to accept a lower wage if unemployment gets larger. This may not only influence the level of wages but also the change in wage rates as a result of higher unemployment. Real wage rigidity as implied by the convex Phillips curve may however limit the downwards wage adjustments.

When unemployment increases, the possibility for the firms to hire workers among the outsiders also increases. This strengthens the bargaining position of the firms and weakens the bargaining position for the trade union. Although hiring costs may prevent the firms from replacing a large part of the labour force because of the presence of specific human capital, a large wage differential between the employed and the unemployed may induce hiring of unemployed.

3.5.4. A macroeconomic framework for wages and prices

In order to analyze the connection between unemployment and wage inflation in Britain, Layard and Nickell (1986), Nickell (1987) and Layard, Nickell and Jackman (1991) present a macroeconomic model for wage and price formation. The main aspect of the model is that unemployment in the long run brings into equality (i) the "feasible" real wage implied by the pricing behaviour of firms and (ii) the "target" real wage implied by the wage setting behaviour of wage bargainers.

In the price setting behaviour firms may be thought of as setting value-added prices as a mark-up on wages, where the mark-up is modified in the short run by the level of activity in the product market and by price surprises. An increase in economic activity may tend to rise the mark-up whereas a positive price surprise will be associated with a fall in mark up. In the longer run productivity improvements also will lead firms to reduce their mark-up of prices on wages. Based on this description the price equation when the variables are in logarithms may be written as:

$$(3.5.31) \qquad P - W = \beta_0 - g(U) - \beta_2 (P - P^E) - \beta_3 Z,$$

where
P = is the price level
P^E = the expected price level
W = the wage level
U = the rate of unemployment denotes the level of activity
$g()$ = is a functional form between unemployment and price setting
Z = productivity.

In the wage setting firms and workers bargain about nominal wages as a mark-up on expected value-added prices, where this mark up in the short run depends on the level of activity in the labour market, on real wages previously attained and on a series of structural characteristica of the labour market. In the longer run growth in productivity may lead workers to bargain for a higher mark-up of wages on prices. Under some simplifying assumptions about the dynamics the wage equation may be written as

$$(3.5.32) \qquad W - P = \gamma_0 - f(U) - \gamma_2(P - P^E) + \gamma_3 Z + W_S,$$

where W_S denotes the wage pressure stemming from the structural characteristica of the labour market and $f()$ is a functional form between unemployment and wage setting.

From this simple model it is possible to determine the no-surprise $(P - P^E = 0)$ equilibrium values of unemployment and the real wage without knowledge to any other parts of the macro-model. Nickell (1987) admits that this may be too simple disregarding factors influencing W_S, e.g. import prices in an open economy. Although there is a close correspondence between the price equation (3.5.31) and demand for labour in a limited homogeneous market, this connection is not as evident in a macroeconomic context with several markets and other factors influencing the level of employment than real wages. The connection between the wage equation (3.5.32) and supply of labour in a macroeconomic context is also far from evident.

By eliminating the real wage from (3.5.31) and (3.5.32) we obtain

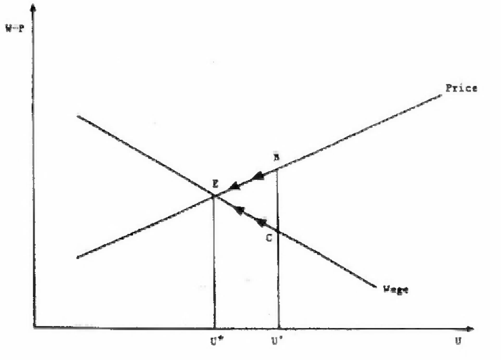
$$(3.5.33) \qquad g(U) + f(U) = (\beta_0 + \gamma_0) - (\beta_2 + \gamma_2)(P - P^E) + (\gamma_3 - \beta_3)Z + W_S.$$

Equation (3.5.33) reveals how unemployment is determined in the long run when price expectations are fulfilled and in the short run how price surprises are associated with deviations from this long run level.

By assuming $g(U) = \beta_1 U, f(U) = \gamma_1 U$ and $\gamma_3 - \beta_3 = 0$ the long run equilibrium defining the natural rate of unemployment is given by

$$(3.5.34) \qquad U^* = \frac{\beta_0 + \gamma_0 + W_S}{\beta_1 + \gamma_1}.$$

Figure 3.5.5 Equilibrium in price and wage formation



The situation may be as illustrated in figure 3.5.5. Equilibrium between the real wage supplied and the real wage demanded is given by *E*. If aggregate demand is reduced below the level to sustain U^*, the real wage supplied is larger than the real wage demanded. Market forces are then assumed to reduce inflation moving the economy back to equilibrium.

Nickell (1987) and Layard, Nickell and Jackman (1991) assume that when inflation is rising, prices turn out to be higher than expected and vice versa. When inflation is completely stable, $P = P^E$. They therefore suppose that

$$(3.5.35) \qquad P - P^E = \lambda\, \Delta^2 P, \quad \text{where} \quad \lambda > 0.$$

Under the linear assumption about $g(U)$ and $f(U)$ made above and inserting from (3.5.32), (3.5.33), (3.5.34) and (3.5.35) in (3.5.31) we get

$$(3.5.36) \qquad \Delta^2 P = -\frac{(\beta_1 + \gamma_1)(U - U^*)}{\lambda\,(\beta_2 + \gamma_2)}.$$

In this model the change in the rate of inflation depends on the deviation between the actual and the natural rate of unemployment. By comparing with equation (3.5.13) this is quite similar to an ordinary Phillips curve model where expected inflation is adaptive of the kind $\Pi_t^E = \Pi_{t-1}$ and wages are fully compensated for changes in prices.

3.5.5. Hysteresis in a macroeconomic context

One important point made by Nickell (1987) and Layard, Nickell and Jackman (1991) is that the change in the rate of unemployment may have an independent effect on inflation irrespective of the level. This is often attributed to hysteresis according to the comments made to (3.5.26), but if there also exists a level effect it is only *temporary hysteresis* since the long term natural rate of unemployment is constant independent of the actual rate. By assuming

$$(3.5.37) \qquad g(U) = \beta_1 U + \beta_{11}\Delta U, \quad \text{where} \quad \beta_1, \beta_{11} > 0,$$

$$(3.5.38) \qquad f(U) = \gamma_1 U + \gamma_{11}\Delta U, \quad \text{where} \quad \gamma_1, \gamma_{11} > 0$$

the change in the rate of inflation is

(3.5.39) $$\Delta^2 P = -\frac{(\beta_1 + \gamma_1)(U - U^*) - (\beta_{11} + \gamma_{11})\Delta U}{\lambda(\beta_2 + \gamma_2)}.$$

Compared with (3.5.36) the additional term $(\beta_{11} + \gamma_{11})\Delta U$ implies that an attempt to bring down unemployment also increases inflation even if $U > U^*$. This may make a reduction of unemployment more difficult even when starting from a position well above the natural rate. Layard, Nickell and Jackman argue that this may be one reason why both unemployment and inflation have stayed at a high level for many years in Britain.

In order to emphasize this LNJ define the short term NAIRU U_s^* as the level of unemployment which is consistent with stable inflation during the current period. By inserting for $\Delta SUP2P = 0$ in (3.5.39) we get

(3.5.40) $$U_s^* = \frac{(\beta_1 + \gamma_1)U^* + (\beta_{11} + \gamma_{11})U_{-1}}{\beta_1 + \gamma_1 + \beta_{11} + \gamma_{11}}.$$

The short run NAIRU is a weighted average of the equilibrium rate of unemployment and the rate of unemployment from the last period.

The situation with temporary hysteresis may be as illustrated in figure 3.5.6 where U^* denotes the equilibrium rate which only is assumed to depend on structural characteristics in the long run. The rising unemployment curve reflects a negative connection between real wages w and demand for labour as well as a positive connection between real wages and supply of labour.
A weakness in the approach made by Layard, Nickell and Jackman is that aspects from the traditional IS-LM model, as presented by e.g. Dombush and Fischer (1987), vanish. In a macroeconomic context there is not a simple connection between price formation and demand for labour, as is the case in the LNJ-model.

From the discussion in Dreze and Sneessens (1986) (cf. section 3.5.3) demand for labour may be affected by Keynesian factors as well as classical. When aspects from the IS-LM model as (3.5.9) are included in addition to real wages, and we assume an open economy, demand for labour may be expressed as:

(3.5.41) $$N^D = D(W/P, G, T, M/P, MAR, P/P^*)$$

where W/P = real wages,
G = the level of government consumption,
T = the level of taxes,
M/P = real supply of money,
MAR = demand from the world market,
P/P^* = domestic prices relative to foreign prices.

Figure 3.5.6. Temporary hysteresis

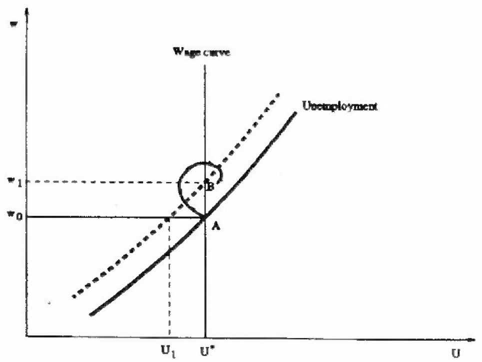
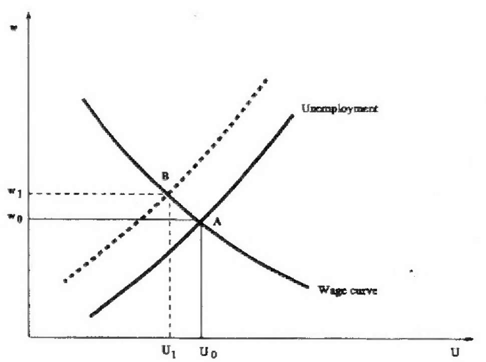


Figure 3.5.7. Partial hysteresis



In a simplified form the macro supply of labour may be written as:

(3.5.42) $N^S = S(W/P, Z, NB)$

where Z = exogenous factors influencing the participation rates,
NB = population in working age.

If N^D and N^S represent demand and supply of labour measured in number of persons and we for simplicity neglect vacancies, the rate of unemployment is given by

(3.5.43) $$U = \frac{N^S - N^D}{N^S} = h(W/P, G, T, M/P, MAR, P/P^*, Z, NB)$$

A permanent positive shift in demand or a negative shift in supply of labour may cause a temporary fall in unemployment according to figure 3.5.6. If wages are not influenced at all instantaneously unemployment falls to U_1. In the long run the new equilibrium is given by B where unemployment has returned to its equilibrium rate according to the discussion in section 3.5.2. The new equilibrium level for real wages is w_1. If the change in unemployment has an independent effect on the change in wages in addition to the level effect, as illustrated by (3.5.38), it is possible that we get some overshooting in the medium term as illustrated in the figure.

In models with efficiency wages and trade unions and bargaining it may be argued that wage formation implies a connection between the *level* of unemployment and the *level* of wages as presented in figure 3.2.4. This is due to a larger expected loss in welfare by getting unemployed when unemployment is high since this reduces the chance of finding alternative employment elsewhere. From the right to manage model in section 3.3.4 it seems relevant to assume a positive connection between the wage level and the bargaining power for the trade union. This also makes it relevant to adopt a negative relation between the *level* of wage rates and the *level* of unemployment.

When such a wage equation as presented by (3.5.32) is combined with an unemployment equation like (3.5.43) there is no natural rate of unemployment given by structural characteristics only. When there is a permanent exogenous shock causing a decrease in the rate of unemployment it does not return to its original level, but stabilizes at a lower level according to the discussion in connection with figure 3.2.4. This works in the same way as if there is hysteresis in the natural rate of unemployment and is also pointed out in a criticism to the LNJ-model by Phelps (1992).

Also Layard, Nickell and Jackman recognize that when there are no level effects ($\beta_1 = \gamma_1 = 0$) there is no fixed equilibrium rate of unemployment, and denote this "pure hysteresis". In their context there is then a connection between the *change* in unemployment and *inflation* which is equivalent with a connection between the *level* of unemployment and the *level* of wages/prices. According to the discussion by Blanchard and Summers (1987 and 1988) presented in section 3.5.3 unemployment may then follow a random walk depending on the shocks in the exogenous variables.

The situation is illustrated in figure 3.5.7 and may be denoted *partial* hysteresis because the effects through higher wages may dampen the effects from a positive shock. A new equilibrium is obtained at B where wages are higher and unemployment lower than the original equilibrium A. This situation corresponds to what Nymoen and Kolsrud (1992) have called "The general case". The situation with a fixed equilibrium rate, corresponding to the Phillips curve, is a special case where the wage curve is vertical.

Figure 3.5.8. Pure hysteresis

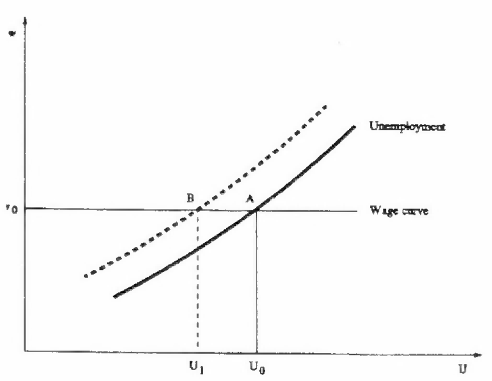
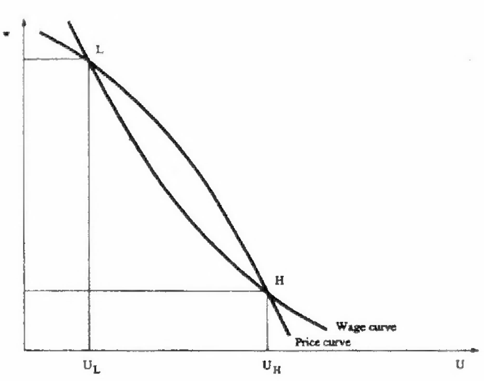


Figure 3.5.9. Multiple equilibria in price and wage formation



Another special case occurs if wages are not dependent on unemployment at all, and the wage curve is horizontal as illustrated in figure 3.5.8. A shift affecting the rate of unemployment may then shift the equilibrium with the same magnitude having no effect on wages at all in the long run. This situation may be called *pure* hysteresis.

3.5.6. Multiple equilibria

From the framework presented by Layard, Nickell and Jackman (1991) multiple equilibria may occur if the connection between the rate of unemployment and the wage or price markup is non-linear (cf. that the $g(U)$ and $f(U)$ functions are assumed to be linear in (3.5.37) and (3.5.38)). This is further discussed in Manning (1990 and 1992) in a situation where there is increasing returns to scale in production. Because there is a close correspondence between the returns to scale and the impact of unemployment on the price-mark-up, the parameter β_1 in (3.5.37) is negative in this case giving a positive connection between the rate of unemployment and the price mark-up.

In the normal case with decreasing returns presented in figure 3.5.5 a unique equilibrium always exists. When there is increasing returns, and the effects from unemployment on wages and prices are non-linear, the situation is more complicated as shown in figure 3.5.9. If the price equation is sufficiently far to the left there may be no equilibrium at all, and when the price and wage curve intersect they always intersect twice. One of the equilibria has low unemployment and high real wages, the other has high unemployment and low real wages.

Manning (1990) argues that there is no reason to believe that one equilibrium is more stable than the other. If the only rigidities are in wage-setting so that the economy is always on the price curve, the wage from price-setting is above the wage from wage-setting at any rate of unemployment between the two equilibrium rates. Real wages will fall in this situation moving the economy towards the high equilibrium unemployment rate. On the other hand if all the rigidities were in price-setting, the low unemployment equilibrium would be the only locally stable one. Manning (1990) argues further that if we have both sorts of rigidity, either or both of the two equilibria may be locally stable. A shift in the price curve or the wage curve can shift the economy from one equilibrium to the other.

Based on estimations of a price equation, a wage equation and a capital stock equation Manning (1992) finds evidence of increasing returns to scale, and hence multiple equilibria in the long run when capital is variable. In the short run, when capital is fixed, the estimations indicate decreasing returns to labour and a unique equilibrium rate. Manning also finds that a model based on two equilibria does at least as well in explaining the behaviour of unemployment as a model with a single equilibrium, and there are indications that the British economy has shifted from a situation with a low equilibrium rate of unemployment to a situation with a high equilibrium rate in the early 1980s.

Also Manning points out that the single equilibrium model cannot decisively be rejected, and Layard, Nickell and Jackman (1991, p. 370) and Blanchard and Fischer (1989, p. 261) are quite sceptical and claim that "conditions needed to generate stable multiplicities of equilibria are not met in practice". Non-linearities in the economy may of course exist, and the crucial point regarding the Manning study is if there are increasing returns to scale or not. These aspects regarding the functioning of the labour market in Norway are further discussed in chapter 5.

3.6. Inflation in a small open economy

3.6.1. The Scandinavian theory of inflation

To analyze wage and price formation in a small, open economy, Odd Aukrust developed a model which later has been named "The Scandinavian theory of inflation" (see Aukrust (1977)). A short term version of the model PRIM (see Aukrust (1970)) analysing price and income formation taking wage rates as given, was developed in 1966 to provide background material for that year's round of income settlements. In a long term version developed later that year wages were also endogenous. In Sweden the EFO-model, see Faxén, Odhner and Spånt (1989) was developed along the same main lines as the Aukrust wage and price model.

A central element in the Scandinavian theory of inflation is the distinction between sheltered and exposed industries which seems to be fundamental in a small, open economy as the Norwegian. The distinction is very close to the division between tradables and non-tradables in Salter (1959). The exposed industries (E industries) are those exposed to strong competition from abroad, either because they export most of their products or because they sell their products on the domestic market under strong foreign competition. The output prices of these industries will be largely determined in the world market. They therefore cannot compensate for a cost increase through an upward adjustment of prices. If their costs increase they must absorb the whole effect in the form of reduced profits and perhaps reduced production.

The sheltered industries (S industries), on the other hand, are those whose products are marketed at home under conditions that leave them relatively free of foreign competition. Because they do not risk loosing their market to foreign competitors they tend to compensate for cost increases by raising output prices.

The main aspects of the Scandinavian theory of inflation may be formalized in the following model where lower case letters means percentage growth in one variable from the previous period:

$$p_E = p_I + v, \tag{3.6.1}$$

$$w_E = p_E + z_E, \tag{3.6.2}$$

$$w_S = w_E, \tag{3.6.3}$$

(3.6.4) $p_S = w_S - z_S,$

(3.6.5) $p = \alpha\, p_E + (1 - \alpha)\, p_S,$

where p_I denotes world market prices
v the exchange rate
p_E output prices on exposed products
w_E wage level in exposed industries
z_E productivity in exposed industries
w_S wage level in sheltered industries
p_S price level on sheltered products
p aggregate price level.

Equation (3.6.1) says that output prices measured in national currency on products from exposed industries are determined by world market prices and the exchange rate.

Equation (3.6.2) says that the wage level in exposed industries is determined by output prices and productivity. Together output prices and productivity determine the total surplus available for distribution as wages or profits. The relation indicates that the share of profit in these industries are constant, and Aukrust argues that this may be regarded as a reasonable and empirical acceptable long term approximation. The Scandinavian theory of inflation then build on an assumption of "profit-sharing" in the long run. However, in the short run the share of profit may show large fluctuations in these industries.

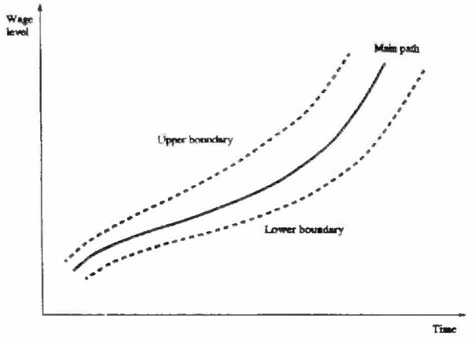
Equation (3.6.3) says that the wage level that is established in the exposed industries determines the wage level in the sheltered industries. Aukrust (1977) argues that both market forces and solidaristic trade union policy tend to keep wages in the two industry groups in a normal relation to each other.

Equation (3.6.4) says that the prices on products from the sheltered industries are determined by the wage level and productivity. This means that there is assumed to exist a constant profit share in the long run also in these industries. Prices are dependent on labour costs per unit produced, and growth in productivity in the sheltered sector will dampen the effect on prices from growing wage rates.

Equation (3.6.5) says that the national price level is a weighted average of prices on exposed products and sheltered products. Taken as a whole the model explains trends in the national wage and price level in terms of price trends in the world market, changes in exchange rates and productivity trends in the sheltered and exposed industries respectively.

Aukrust (1977) points out that doubt may be raised against the assumption implied by (3.6.2) about a constant rate of profit in the exposed industries. It is certainly not a relation that holds on a year-to-year basis, and even in the long run it may be valid only

Figure 3.6.1. The Wage Corridor



with a considerable slack. On the other hand, the wage level in the exposed industries may hardly change independently of what happens to prices and productivity in these industries. Aukrust argues that if actual profits in the E industries deviate much from normal profits, it must be expected that sooner or later forces will be set in motion that will tend to close the gap. Both the system of wage negotiations, market forces and economic policy may tend to correct the deviations.

Abnormally high (low) profits will be taken as a sign by the trade union to ask for larger (smaller) wage increases than usual, and at the same time weaken (strengthen) the tendency of entrepreneurs to resist the claims. If the wage level gets low (high) com- pared to prices and productivity, profits get high (low). High (low) profits may through effects on the production level tend to a tighter (less tight) labour market, and this may influence the wage drift or negotiated wage increases in future periods until a normal level of profits is restored.

A high wage level in the exposed industries compared to prices and productivity may weaken the balance of payments and make it difficult to maintain full employment in the long run. In such a situation deflationary measures also may be carried out in order to slow down wage increases to restore profits to normal levels.

For these reasons Aukrust postulates that the national wage level follows a path through time given by the changes in prices of exposed products and productivity in these indu- stries. Aukrust refers to this as the main path of wages. Because of slack in the system, wages may diverge, within bounds, from either side of the main path, but the further they diverge, the stronger will be the forces pulling them back. This is illustra- ted by figure 3.6.1. If wages are near the upper border of the corridor, the level of profits for the exposed industries will be low, and the wages will be pulled back against the main path.

A devaluation will shift the wage corridor upwards leading to a steeper rise of actual wages and thereby prices in the years following the devaluation. Other things being equal countries that have devaluated their currencies would be expected to witness higher price increases than others. As pointed out in section 3.4 the direction of causation may be dis- cussed as the central government may devaluate the currency in order to improve competitiveness for the exposed industries if the wage level gets too high. If a central trade union expects the central government to behave in this way, there may exist a game between the trade union and the government in fixing wages and exchange rates.

In the Scandinavian model of inflation the effects from changes in supply or demand for labour work through the balance in the labour market. According to the model this balance is the key element in the correction mechanisms that are supposed to guarantee that actual wages will not deviate too far from the main path of wages. If there is excess demand in the labour market wages will increase also exerting a cost push on prices on sheltered products. Since excess demand for labour often exists together with excess demand for commodities, excess demand in the product market may also cause growth in prices and wages. Although the formalized part of the model in equations (3.6.1) to (3.6.5) may look like a costpush model, such a description is inadequate to the Scandinavian theory of inflation as a whole since excess demand also is assumed to increase wages and prices.

Aukrust (1977) points at two particular weaknesses of the model. The presented relations are static and therefore ignore the time dimensions of the inflationary process. Some assumptions about dynamics are necessary to make the model operational. Second, it is necessary to give an operational definition of normal profit to tell whether actual wages are high or low in the wage corridor at any particular point of time. This is necessary when analysing the short term movements in wages, but is not necessary to analyze the trends in the long run.

3.6.2. The natural rate of unemployment and NAIRU in a small open economy

In the literature the term natural rate of unemployment is often used synonymously with the term NAIRU (Non Accelerating Inflation Rate of Unemployment), which is the rate of unemployment which is consistent with stable inflation and inflation expectations. In a closed economy with no change in tax wedges or other shocks affecting inflation it may be relevant to use the two terms synonymously. However, as pointed out by Coe (1985) this may not be the case in a small open economy where wage and price inflation to a large degree may be affected by imported inflation.

The approach usually adopted for computing the NAIRU is based on the augmented Phillips curve, a mark-up price equation and adaptive expectations. The Phillips curve may be of the form

$$w = a_0 + a_1 p^* + a_2 p_I - a_3 U + a_4(z - s) + a_5 t, \tag{3.6.6}$$

and the price equation may look like

$$p = b_1(w + s + z) + b_2 p_I, \tag{3.6.7}$$

where
w = the relative growth in the wage rate from previous period,
p^* = expected growth in consumer prices,
p = actual growth in consumer prices,
p_I = change in international prices,

U = the rate of unemployment,
z = change in productivity,
s = change in 1 + the pay-roll tax rate,
t = change in 1 - the income tax rate.

NAIRU is defined as the rate of unemployment which gives $p^* = p = p_{t-1}$. Inserting for $p^* = p$ and (3.6.7) in (3.6.6) gives

$$(3.6.8) \qquad \bar{U} = \frac{1}{a_3}[a_0 + (a_1b_1 - 1)w + (a_1b_2 + a_2)p_I + (a_1b_1 - a_4)(s - z) + a_5t].$$

In a closed economy $a_1 = b_1 = 1$ and $a_2 = b_2 = 0$. If $a_4 = 1$ and $a_5 = 0$ or there is no change in productivity or taxes the NAIRU may be written as

$$(3.6.9) \qquad \bar{U} = a_0/a_3,$$

which is equal to the natural rate of unemployment when $g(U)$ in (3.5.6) is assumed to be linear. However, a change in income taxes may affect the NAIRU in a closed economy if $a_5 > 0$. (A change in pay-roll taxes may also change the NAIRU in a more general model where pay-roll taxes are not included in the same way as productivity.)

In an open economy it is reasonable to assume that $0 < a_1, b_1 < 1$ and $0 < a_2, b_2 < 1$. This means that the NAIRU depends on the change in international inflation and the change in productivity. A NAIRU calculated in this way, as is rather common in the literature (see e.g. Coe (1985)), seems to be of minor relevance. The question then boils down to what the level of unemployment should be to secure stable inflation. Stable inflation then becomes the main target while the rate of unemployment becomes an instrument.

Based on estimates for the coefficients in the wage and price equation NAIRU calculated by (3.6.8) naturally moves according to the actual rate of unemployment. This has then wrongly been taken as an indication of hysteresis. Within the period of estimation this follows by assumptions, and this may also be the case "out of sample" because of the correlation between the variables.

In an open economy where wages move in the wage corridor (either as a result of the negotiations or by exchange rate policy) $w = p_I + z - s$. If there is homogeneity in the price and wage equations ($a_1 + a_2 = 1, b_1 + b_2 = 1$), $a_4 = 1$ and $a_5 = 0$ (or there is no change in productivity or taxes), NAIRU may be calculated by (3.6.9) even in an open economy. In empirical works (see e.g. Coe (1985)) all the assumptions referred to above are not satisfied giving a NAIRU dependent on growth in international prices and productivity.

3.7. An evaluation of the different theories and their relevance for the Norwegian labour market

The aim of this section is to summarize and evaluate the empirical consequences of the different theories for labour market and wage formation outlined in the sections 3.2 to 3.6. Especially their relevance for the Norwegian labour market will be discussed based on the characteristics given in chapter 2.

In the preceeding sections both theories built on perfect competition and organization among the employees are presented. It will be of particular importance to discuss the differences between these two approaches and to illuminate equalities and differences regarding the impacts from the different factors affecting wage formation in Norway. It may be relevant to pose the question if the two approaches are fundamentally different or if they contain common features.

3.7.1. Theories for perfect competition versus organizations

From the characteristics of the development in the Norwegian labour market presented in chapter 2 it is evident that there exist both organized and unorganized employees. The degree of organization differs between the different parts of the labour market, and in some markets there are more than one union. Both theories for perfect competition and theories for organizations may then contribute to explain the overall development of the Norwegian labour market.

Calmfors and Forslund (1989) point out that the high degree of organization offers great possibilities for testing the models of trade unions and bargaining in the Nordic countries (e.g. Sweden). "If the models do not work with the high degree of unionization in Sweden, they are not likely to explain aggregate wage setting anywhere." This is of course true, but it may seem rather ambigious to test the two approaches against each other in a market with both organized and unorganized employees. A necessary condition for the test to be relevant is that wages for the unorganized move "pari passu" with the wage level for organized. As good data regarding wages for organized versus unorganized employees in the different sectors are not available, it is difficult to test this separate question.

In the literature union and bargaining models are used as a basis for empirical estimations in two ways. The first approach is to work with specific functional forms for union welfare, labour demand etc. and estimate various structural parameters. This method is used among others by Hersoug, Kjær and Rødseth (1986), Pencavel (1986) and Alogoskoufis and Manning (1988). The problems with these studies are that a large number of restrictive assumptions are imposed and that elaborate estimation techniques are often required. The choice of functional form may even have been too restrictive and may have contributed to very imprecise estimates for the structural parameters or to rejection of the model. Pencavel (1986) also points at the problems of aggregation over different submarkets where there may be both organized and unorganized workers. His conclusion is then that it seems ill-advised to place much reliance on these models for the purpose of macroeconomic policy evaluation and prescription.

The other approach, used among others by Nickell and Andrews (1983), Hoel and Nymoen (1988), Nymoen (1989) and Calmfors (1989), is to identify relevant variables and then to try out functional forms on a more ad-hoc basis. The explanatory variables turn out to be about the same both when the points of departure are perfect competition, efficiency wages or a model based on trade unions and bargaining.

A fundamental problem with this approach, which is not often discussed, is the fact that the variables are included in the estimations without any discussion of whether they are due to the wage equation or to shifts in the demand or supply equation. The problem is most obvious in the case of perfect competition where a well defined demand and supply function together with the equilibrium condition (3.2.10) makes it irrelevant to speak of a specific wage equation except from the problem of estimating the speed of adjustment when the labour market is not in equilibrium. In the efficiency wage theory there is a wage curve (3.2.16) depending on alternative wages, the rate of unemployment and some structural parameters in the labour market, but variables like product prices, technical progress and pay-roll taxes affect wages through shifts in demand for labour. This is also the case in models with trade unions, e.g. the wage curve (3.3.21) in the right to manage model. In efficient bargaining, however, wages along the contract curve (3.3.14) depend on most of the relevant variables, and parameters from the production function and the trade union's preference function are of importance.

As further discussed in chapter 5, supply and demand for labour may depend on many factors in a macroeconomic context, and it may not be easy to identify these functions by single equations. The best practical solution to the problem then seems to be to try to estimate the effect of the relevant variables. As theory sets some restrictions, as discussed below, this estimation is not completely ad-hoc.

3.7.2. Phillips curve versus hysteresis

A main difference between the theoretical approaches seems to be the specification of how the rate of unemployment affects the wage rates. Given perfect competition and classical price dynamics it seems reasonable to argue that the Phillips curve approach with a negative relation between the *growth* in wage rates and the *level* of unemployment, as outlined in section 3.5, is the most relevant. But it is not in contradiction with this theory that a *change* in unemployment may cause a *change* in wages indicating *temporary* hysteresis effects as also pointed out by Nickell (1987) and Layard, Nickell and Jackman (1991).

From theories of efficiency wages and trade unions and bargaining it may be argued that wage formation implies a connection between the *level* of unemployment and the *level* of wages, and according to the discussion in section 3.5.5 this is equivalent with hysteresis. A problem with this relation in a model with trade unions is that the number of employed is an endogenous variable, and the union takes the effect on employment into account when fixing wages. This is, however, not a severe objection as the theory is not sufficiently specified regarding dynamics. Also with this theory it may be relevant to include the effect from unemployment from the past year or in other markets (general unemployment) to argue as if some part of it is caused by other reasons than the trade union's wage fixing in the instant period.

It seems reasonable that high unemployment from past periods may weaken the bargaining power of a trade union. But it is not necessarily a contradiction between the existence of trade unions and wage formation moving the economy back to a fixed equilibrium again. Cahuc and Laurent (1987) present a rather similar bargaining model as Hoel and Nymoen (1988) and argue that a high rate of unemployment may dampen the wage increases until equilibrium is restored. The same kind of reasoning may be found in Aukrust (1977) where he argues that a tight labour market as a result of low level of wages compared to the main path will induce "wage explosion" until a normal level of profits is restored.

Trade unions and employers organisations may be considered as "visible hands" collecting information and moving the economy, and there does not seem to be a large controversy between theories of perfect competition and trade unions regarding how the different factors affect wage formation. However there may be differences in the suggested size of parameters, and as analyzed in section 3.3.2, a monopolistic trade union may fix a higher wage rate than in perfect competition.

If the trade union cares only about the insiders, an adverse shock which reduces employment may cause the equilibrium rate of unemployment to move according to the actual. As pointed out in section 3.5.3 some critical comments may be given also against this approach. It seems strange that the trade union does not care about the members getting unemployed, and the firms may have the possibilities of hiring outsiders if the wage differentials between insiders and outsiders get too large.

However, hysteresis may also come up as a result of loss of human capital, and this may happen regardless if there is a trade union or not. Even in the abscence of the aggregation problem it may then sound to ambigious to test whether wage formation is best explained from theories for perfect competition or theories for trade unions. Hysteresis may appear in both cases, although the insider/outsider approach indicates that hysteresis is more likely in a situation with trade unions. A test of hysteresis seems to be relevant, but as analyzed in the next section it may be difficult to separate between hysteresis and a Phillips curve specification in an empirical analysis because slow adjustments of wages in a Phillips curve may look like hysteresis.

3.7.3. The functional form of unemployment in the wage equation

From the theory of classical price dynamics it is evident that is is unemployment from the previous period(s) which affect wage growth in the present period. This is the case both with prefect competition or a trade union aiming at restoring equilibrium. Even with the theories of trade unions and insiders/outsiders it seems most relevant to include the rate of unemployment from previous time periods, eventually affecting the bargaining power, while the trade union has in power to influence the rate of unemployment in the instant and future periods by fixing wages. In the case with loss of human capital it also seems most relevant to include the rate of unemployment from previous periods. A distinction between the short term and long term unemployed as done by Coe (1988) may be relevant in this case. In the specification (3.5.26) past values of both US and UL should therefore be recommended.

From the analysis of classical price dynamics and the Phillips curve in section 3.5.1, it seems reasonable that a macro Phillips curve has a convex shape as indicated by (3.5.5) due to aggregation over different submarkets with both excess demand and excess supply for labour. The implication of this is that a reduction in unemployment will cause a large increase in wage inflation when the labour market is tight, but only a small increase in wage inflation when there is large unemployment. This may also hold in a situation with a trade union. A fall in unemployment may in this case strengthen the bargaining power relatively more if the unemployment is low compared to when it is high. This may also hold if there is hysteresis.

Reluctance by the trade union to accept large reductions in real wages may be another reason why the Phillips curve gets rather flat at high rates of unemployment. If in addition the distance between the Phillips curve and the line for no real wage growth is rather small at high rates of unemployment, this may be an important reason why it may take a long period of time before equilibrium is restored. In the literature this is denoted low real wage flexibility, and hysteresis may be regarded as a case with only temporary correcting of the real wage level. With low real wage flexibility it may be difficult in an empirical test to distinguish this from hysteresis, and the practical difference between the Phillips curve approach and hysteresis is only of minor importance.

3.7.4. The impacts from prices and alternative wages

Both from the theories of perfect competition and trade unions it is evident that prices and alternative wages are important factors in determining nominal wages. In both approaches it is also held that there must be some form of homogeneity in the nominal development in the long run. This means that a large weight on alternative wages in one industry means a low weight on prices and vice versa. From the Scandinavian theory of inflation it is clear that prices on foreign competing products have to be of great importance for wage formation in the exposed industries, especially in the long run. As no industry is perfectly exposed and the degree of exposedness may differ, it is possible that consumer prices and alternative wages may be of some importance, even in these industries, especially in the short run. In the more sheltered industries alternative wages and consumer prices may be of greater importance even in the long run. Because of a rather parallel development in the different nominal variables in the long run it may be difficult to distinguish between them in an empirical test and it may be necessary to impose some theoretical restrictions in advance.

One theoretical assumption which may sound reasonable, is to assume wage cost per unit produced in the manufacturing sector to move in accordance with the price of competing products in the long run according to the Scandinavian theory of inflation. However, as shown in chapter 2, the manufacturing sector has lost competitiveness successively the last two decades. It does therefore not seem relevant to impose the main path restriction for only a part of the exposed sector, and this is quite obvious when a single industry, e.g. production of clothes and footwear, is considered.
An accommodating policy may to some degree change the parameters in the wage equation, and this may especially regard the dynamics. The problem was stressed by Lucas (1976) which in a critique of macroeconometric models argued that a change in

economic policy also would influence the parameters in the models implying that econometric models were more or less useless for policy simulations.

The problem with changes in parameters in a wage equation as a result of a change in economic policy may be of especially importance for the dynamics of prices if the policy is changed towards devaluation to maintain the competitiveness, but the degree of accommodation carried out regarding e.g. labour market measures may also affect the impact of unemployment. To some degree the problems may be reduced by choosing proper data, and this is further discussed in section 4 regarding how to measure the pressure on the labour market. Regarding the effect from competitive prices measured in national currency, some caution may be necessary regarding the dynamics as a consequence of the devaluations during the period 1982-1986. Such a change in exchange rate expectations may have changed the impacts from foreign prices in the short term, but it seems reasonable to assume that the long term relationships may still hold as they are more structural relations.

3.7.5. The impacts from income taxes and pay-roll taxes

From the theory of perfect competition it is evident that it does not matter whether it is the employers or the employees who pay the tax. In a world with perfect competition the two types of taxes therefore ought to be included in a relation for wage formation in a symmetrical way. How much of an increase in taxes which is paid by the employers and employees respectively is dependent on the steepness of the demand and supply curves.

A steep demand curve relative to the supply curve means that an increase in income taxes which shift the supply curve upwards for a given wage rate results in a rather corresponding increase in nominal wages and the burden is carried over to the employers. An increase in pay-roll tax rates which shifts the demand curve inwards only means a small reduction in nominal wages in this case. On the contrary if the supply curve is much steeper than the demand curve the burden of an increase in tax rates is carried by employees having only a small effect on nominal wage rates.

In the case of a trade union and bargaining the effects of an increase in pay-roll tax rates and income tax rates may no longer be symmetrical. While an increase in pay-roll tax rates shifts the demand curve in the same way as in perfect competition normally implying lower nominal wages, an increase in income taxes has an uncertain effect. On the one hand lower disposable income should induce higher wages, but on the other hand a higher marginal tax rate means that the gain in marginal disposable income as a result of higher nominal wages declines relatively to the marginal costs of lower employment.

An additional argument is that a trade union may care about the income distribution among the employees. If the union prefer a more even distribution of income and if an increase in income taxes hurts those with the highest incomes most, the trade union may only demand a small compensation for the tax increase.

From the theory of perfect competition and the trade union consumer prices and income taxes were assumed to affect wages symmetrically. Concern about the income distribution in the way outlined above may imply smaller compensation from an increase in income taxes than in consumer prices. As income taxes and indirect taxes contribute to finance public consumption and transfers it is also possible that tax increases have a smaller effect on wage growth than increases in consumer prices by other reasons.

3.7.6. The impact from productivity

Most of the theories presented in the preceeding sections are built on the assumptions that the firms act as price takers or are faced with monopolistic competition on the product market. Under these assumptions a neutral technical progress shifts the demand for labour outwards resulting in higher wages both under assumptions of perfect competition in the labour market or a trade union and bargaining.

In the Scandinavian theory of inflation the exposed sectors are assumed to act as price takers and an increase in productivity is to the full degree assumed to be reflected by increase in wages in the long run. From section 2 it can be seen that the growth in productivity shows great fluctuations over time. Some smoothed series or long lags therefore seems to be necessary in an econometric specification. This is also in accordance with the theory for implicit contracts.

In the sheltered industries which have the possibility to pass on higher costs to higher prices the effect of an increase in productivity on wages is more unclear. The Scandinavian theory of inflation says that wages are determined by wages from exposed industries implying that an increase in productivity results in lower prices. If the sheltered industries produce at a given demand, an increase productivity shifts the demand for labour inwards, producing and downward pressure on wage rates. However, if some of the growth in productivity results in lower prices the demand for the product may increase, leaving the effect on demand for labour more uncertain.

4. Wage formation in Norway, way,some empirical evidence

4.1. Introduction

The aim of this chapter is to present some new empirical evidence regarding wage formation in Norway based on the theories outlined in chapter 3 and the data presented in chapter 2. A lot of work has been done in this field the last decades, but due to different data and different methods the results show a rather great variability. It is therefore necessary to discuss the new empirical findings against the earlier results and try to point at the main reasons why the results differ. Based on the different theoretical approaches in chapter 3, there has also been a rather large debate about the Phillips curve versus hysteresis, and one important aim of this chapter is to review this discussion. It has therefore been important to analyse if there is an equilibrium rate of unemployment, and eventually how this rate may change.

Because of the availability of data most of the earlier works have concentrated on explaining wage formation in manufacturing industries. A rather large weight will be put on this sector also in this work. According to the Scandinavian theory of inflation wage formation in manufacturing industries, which are highly exposed to foreign competition, may be of great importance for wage formation in the more sheltered industries. From the development in relative wages shown in section 2.4 it is clear that wage growth has not been quite parallel. To get an understanding of wage formation in the whole economy it is therefore important to analyse wage formation in sheltered industries and to test to what extent they act as wage followers relative to manufacturing.

By estimating wage equations for different industries it is possible to get an overview of the relative importance of different explanatory factors. The discussion in chapter 3 suggests that consumer and competitive prices, alternative incomes, productivity, income and payroll taxes and the rate of unemployment are possible explanatory variables. Institutional factors behind wage formation as wage and price freeze, catchup effects and shortening of the normal working hours may also be relevant.

Total wage growth in manufacturing industries may be divided into two components, central negotiated wage growth and wage drift. As the different factors may influence the two components in a different way, they are analysed separately in many of the earlier works. Because it is reasonable to assume that central negoatiated wage growth and wage drift are dependent on each other in the long run, the main emphasis in this chapter will be put on explaining total wage growth, but the importance of central agreements and wage drift will be discussed.

When looking for the most relevant explanatory factors for a time series variable, it is important to pay attention to time series properties of these variables. By testing for stationarity of the different variables and cointegrating properties between them, it is possible to get an idea of long term restrictions and what variables that only have short term effects. Tests for misspecification are also important in finding an appropriate relation. When choosing among different specifications it is important to evaluate the impact of different explanatory variables against economic theory.

4.2. Explanatory factors and the most relevant data

4.2.1. Explanatory factors

From theories of perfect competition, efficiency wages and trade unions it is evident that prices and alternative wages are important factors in determining nominal wages. The theory of trade unions also suggests that there may be a trade-off between wage rates necessary to maintain the wage earners' real disposable income and wage rates necessary to maintain the firms' competitiveness and employment. As shown by Hersoug, Kjær and Rødseth (1986) the weights put on the different components depend on the structural parameters in the trade union's preference function. Common in wage formation theories is to impose some form of homogeneity in the nominal development in the long run. This means that if a large weight is put on alternative wages, smaller weights are put on both real disposable income and competitiveness. On the contrary, if a large weight is put on competitiveness, smaller weights are put on the other components.

Based on the trade-off, more or less implied by all theories mentioned above, a long term specification for the nominal wage level in a specific industry may be written as:

(4.2.1) $$w = \alpha_1 \overline{w} + \alpha_2(p-h-t) + \alpha_3(p_I+z-s)$$

where lower case letters means that the variables are in natural logaritms

w	-	denotes the nominal wage level
$\overline{w}$	-	alternative wage level
h	-	normal annual working hours
p	-	consumer prices
t	-	logaritm of 1 the average personal income tax rate
p_I	-	price index on competing products
z	-	index for the level of productivity
s	-	logaritm of 1 + the pay roll tax rate.

α_k ($k = 1,2,3$) represent the weights for the different components, and the homogeneity restriction means that $\alpha_1 + \alpha_2 + \alpha_3 = 1$. Because of a rather parallel development in the different nominal variables in the long run it may be difficult to distinguish between them in an empirical test, and it may be necessary to impose some a priori theoretical restrictions.

From the Scandinavian theory of inflation it is clear that prices on foreign competing products and productivity are of great importance for wage formation in the exposed industries in the long run. In these industries the negative effects on employment of too high wages may be quite severe. As no industry is perfectly exposed, it is possible that consumer prices and alternative wages are of some importance, even in these industries, and this is also suggested by Nymoen (1989 and 1990) and Rødseth and Holden (1990).

In the sheltered sectors firms can shift higher wages into higher prices without severe consequences for production and employment. As relative wages are relevant when choosing a job, the sheltered industries can be forced to offer a parallel development of wages as in the exposed industries. In addition to preserve the members' relative wage position, the trade unions in the sheltered sectors may also be concerned about the members' real disposable income. The wage rates in the sheltered sectors may thus be the result of a balance between wage rates necessary to keep up relative wage positions and real disposable income.

The degree of disequilibrium in the labour market may influence wage formation both in the exposed and the sheltered sectors. The overall rate of unemployment may be a relevant variable in this respect, but other variables may also reflect important aspects. An evaluation of the functional form of how unemployment affects wage formation seems to be important in the empirical analysis, and based on the different theoretical approaches in chapter 3 some concern should be devoted to the question about a Phillips curve specification versus hysteresis.

Changes in the composition of demand and different changes in technology cause the changes in employment to differ by industry. Together with different growth in productivity and prices on goods exposed to foreign competition these aspects may cause the changes in wage rates to differ. Wishes to smooth out existing wage differentials may also be of some importance.

Institutional factors such as changes in the normal working hours, wage and price freeze and catchup effects may also be of great importance for wage formation, especially in the short run. As pointed out in section 2.3 there have been three large reductions in the normal working hours since 1965, in 1968, 1976 and 1987. The price and income freeze in 1978 and 1979 and the income regulations in 1988 and 1989 have clearly contributed to reduce wage growth in these years. Duration of unemployment benefits, the replacement ratio, the amount of active labour market spending and the degree of unionisation, centralisation and coordination in the wage settlements are also often used as factors explaining wage formation. Unfortunately it has been difficult to collect good time series data for these variables, and only a minor concern is given to them in the empirical work. The replacement ratio has been almost constant during the period of estimation, and the duration of unemployment benefits was also constant until it was increased from 40 to 80 weeks in 1984 after the increase in unemployment prior to 1984. Although these variables may influence wage formation in Norway it is unlikely that they should have been of great importance during the period of estimation. The importance of labour market measures and institutional aspects regarding wage formation are however discussed.

Regarding taxes the theories presented in chapter 3 indicate that pay-roll taxes are to be included in about the same way as productivity and prices of competing products. The theory gives no unambiguous indication of the effects of income taxes on wages, and thus it is not obvious how this factor should be modelled in a wage equation. From section 2.5 it is evident that the changes in the average income tax rate have been rather small during the seventies and the eighties, and there does not seem to be room for an advanced treatment of this factor based on aggregate time series. One simple way of departure is to analyse the effect of changes in the average tax level.

Based on the discussion above a rather general wage equation is presented in (4.2.2) including most of the relevant variables. The equation contains both error correction terms and lag polynomals in the coefficients denoted by $c_k(L)$ to open for the possibility of a sluggish response from a change in the different explanatory factors to the change in wage rates as a result of eventually adaptive expectations

$$
\begin{aligned}
\Delta w_t = {} & c_0 + c_1(L)\, g(U_t) + c_2(L)\Delta p_t + c_3(L)\Delta p_{It} + c_4(L)\Delta z_t \\
& + c_5(L)\Delta h_t + c_6\Delta s_t + c_7\Delta t + c_8 D79 \\
& + c_9\Delta n_t + c_{10}\Delta \overline{w}_t \\
& + c_{11}\,(w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}) \\
& + c_{12}\,(w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}) + c_{13}\,(w_{t-1} - \overline{w}_{t-1})
\end{aligned}
\tag{4.2.2}
$$

In addition to the variables explained in connection with (4.2.1) we have

U	-	the rate of unemployment
$D79$	-	dummy-variable for the wage and income freeze in 1978 and 1979
n	-	the number of wage earners employed

The last three terms in (4.2.2) are error correction terms indicating that wage rates in the long run may move according to a weighted average of wage rates necessary to keep up competitiveness, yearly real disposable incomes and relative wage position. These terms correspond to (4.2.1) and the weights may differ between industries. If (4.2.1) holds in the long run wage rates are said to be cointegrated with the variables on the right hand side in that equation. One very important result by Engle and Granger (1987) is that a dynamic system with non-stationary but cointegrated variables may be presented as an error-correction model like (4.2.2). The terms given by differences of the first order in a relation where at least one of the error-correction terms are present may only catch up the short run dynamics. Inclusion of U_t in levels in addition to the explanatory variables introduced in (4.2.1) means that the rate of unemployment will also have a long term effect on wages irrespective of significant error-correction terms or not.

An obvious problem in estimating the coefficients in (4.2.2) is lack of degrees of freedom. Most of the time series available start in 1962, and because of the income regulations in 1988 and 1989 and weaker quality in the preliminary national accounts for 1990 it has been necessary to end the estimations in 1987 in the main estimations. In section 4.5 the preferred equations for the different sectors are later on reestimated up to 1990. With some lags on the explanatory variables it is clear that few degrees of freedom are left and a simultaneous estimation of all the coefficients in (4.2.2) is impossible.

A natural way to proceed is to impose restrictions on some of the coefficients and test the others. When this is done in an iterative way, it has been possible to test all coefficients. A well known weakness with such a procedure is that the results may not be quite independent of the succession of the tests.

As aggregate manufacturing in many respects is viewed as a wage leader the different tests for this sector have been carried out in more detail than for the others. It is important to test the significance of the error-correction terms. This is done by putting restrictions both on values and dynamics for the coefficients for some of the terms given by first differences. These restrictions are based on some tentitative estimations of general character and earlier experiences.

If none of the error-correction terms turn out to be significant, (4.2.2) might be interpreted as an augmented Phillips curve with a fixed long term equilibrium rate of unemployment. This corresponds with the Nickell model presented in section 3.5.4.

If at least one of the error-correction terms and the rate of unemployment in (4.2.2) are significant there is a long term connection between the wage *level* and the *level* of unemployment. This is equivalent with hysteresis according to the discussion in section 3.5.3 and 3.7. However, as pointed out by Nickell (1987) and Layard, Nickell and Jackman (1991), hysteresis effects may also be present in a specification with no error- correction terms if there is a significant effect from *changes* in unemployment on *changes* in wages (inflation) as indicated by relation (3.5.26). If in addition the *level* of unemployment has a significant effect on *changes* in wage rates the situation is characterized with what Lipsey (1960) called "loops" around the Phillips curve. In the long run there is in this case also a fixed equilibrium rate, while there may be what Layard, Nickell and Jackman call a "short term NAIRU" deviating from this long term rate.

When at least one of the error-correction terms is significant the variables included as changes only have short-term effects on wage formation, while they also have long term effects in a Phillips curve specification. After excluding the insignificant error correction terms the significance and restrictions on some of the other coefficients are tested, but still with restrictions on some of them. Examples of such test are tests of homogeneity restrictions of prices and productivity in the Phillips curve specification, and the significance and possible restrictions on the coefficients for pay-roll and personal income taxes. Different functional forms and different variables regarding the impact from the labour market and the impact of the wage and price freeze in 1978/79 and possible catch up effects are also tested.

To obtain dynamic stability in the wage equation the sign of the coefficients for the error correction terms as presented in (4.2.2) has to be negative. If the degree of competitiveness is of importance for wage formation and wage rates are too high, this will have a negative impact on wage growth in the next period.

The expected signs of the coefficients for both prices and productivity are positive, while increases in pay-roll taxes are expected to have a non-positive effect on hourly wage rates. When there has been a reduction in normal working hours the trade unions in Norway have aimed at maintaining the yearly wages. This means an increase in hourly wage rates and the expected sign of the coefficient for normal working hours is thus negative. Although the effect from income taxes is quite uncertain according to the theory, one should expect tax increases to have a positive effect on wages if the concern for real disposable income dominates. A higher rate of unemployment is expected to have a negative effect while the effect of growth in employment is uncertain. The wage and price freeze in 1978 and 1979 are assumed to have a negative effect on wage growth in 1978 and 1979, but the possibilities for a catch up effect in 1980 and perhaps 1981 will be tested.

4.2.2. Choosing the most relevant data

An important aim of this project is to improve the wage equations in the macroeconomic model MODAG. As the national accounting system forms both the conceptual framework and the empirical basis for the model, it seems natural to build the analysis on these data. A main principle in the National Accounts is to collect information from different sources to give a consistent picture of the economic development. The quality of the economic time series from the National Account should therefore be at least as high as the quality of the time series from primary statistics.

As a consequence of this almost all data for the variables outlined in (4.2.2) are collected from the National Accounts. This is the case for hourly wage rates, product prices, productivity, normal annual working hours, the number of persons employed and the average pay-roll tax rate. Although the National Accounts also contains a deflator for private consumption, the official consumer price index is chosen as the price index as much of the considerations during the income settlements are attached to this variable.

The series for the average tax rate based on the income part of the National Accounts starts in 1975 which gives a too short time series for the analysis. It may also be a problem with this variable that the average actual level of income taxes has been influenced by changes in interest deductions. This has probably been of minor relevance for the income settlements which have been more concerned about changes in rules and formal tax rates. The average income tax rate for a single average wage earner in manufacturing industries with only standard deductions is therefore chosen as an explanatory factor. A weakness with this tax rate is that it does not take care of changes in child allowances which was used as a policy instrument in some of the combined coordinated settlements during the seventies.

The rate of unemployment is taken from the Labour Force Sample Surveys. As discussed in section 2.1 this variable seems to be more relevant than the registered rate of unemployment because of changes in the propensity to register. Unfortunately this also seems to be the case for the rate of vacant jobs, indicating that the changes in this variable have to be interpreted with care. In spite of these problems both the rate of registered unemployment, a division into short and long-term unemployment and the rate of vacant jobs are tried out as explanatory factors in the estimations.

Although most of the data are taken from the National Accounts they are not without measurement errors, and there is a question of relevance when choosing among different series. In the analysis of wage formation for the aggregate manufacturing sector Petroleum refining is excluded as there are only few employees in this industry. The three main petroleum refining plants in Norway were established during the period of estimation, and production in these plants is large enough to disturb both prices and productivity for the manufacturing sector as a whole.

Average labour productivity is calculated as value added per man-hour. A measure of gross production per man-hour would be quite irrelevant as employees hardly would get compensated for higher production per man-hour caused by an increase in intermediate inputs per unit produced. Some measure of total factor productivity would probably be more relevant attached to gross production.

By concentrating on the functional income distribution a value-added price deflator would seem appropriate, and is chosen by among others Coe (1990), Rødseth and Holden (1990, ch. 4) and Johansen (1991). There is a problem with this variable since production costs, according to Cappelen and Longva (1987), to a large degree are shifted to higher prices, even for products exposed from foreign competition. As a result of wage rates growing faster in Norway than abroad this also explains why the product price deflator has grown faster than prices on competing products (cf. section 2.5). Although the simultaneity problem may be avoided when using an error correction representation in the estimation, to include this variable means that the concern for competitiveness is almost excluded a priori. Demand for labour in an exposed industry is mainly dependent on wage costs per unit produced relative to prices on competing products. When value added prices mainly are dependent on domestic costs, choice of this variable is not quite in accordance with the theories for trade unions where concern is offered to the demand for labour in the wage negotiations.

To represent the frame for wage increases given by the prices on competing products an import price indicator thus seems to be a more relevant variable, and from figure 2.5.5 it is evident that this variable to a large degree catches up for the development in wage costs per unit produced among Norway's trading partners. However as pointed out by Fehr (1987) domestic costs may also be of importance for the prices foreign producers set on goods delivered to Norway, and this indicate that even the import prices are not completely independent of domestic costs. But even if this is the case, they are relevant as an explanatory factor since demand for labour in the exposed industries is dependent on wage costs per unit produced relative to competing prices irrespective of competing prices are dependent on domestic costs or not. Also Hoel and Nymoen (1988) recommend that prices fixed by foreign firms should be included as explanatory variables.

A possible weakness in using import prices is that these prices correspond to the price deflator for gross production rather than value added. The link to the functional income distribution is therefore not so clear, and changes in prices on intermediate inputs may induce a wedge between the two product price deflators. It is however likely that prices on intermediate inputs depend both on import prices and domestic costs. Because of this possible weakness an alternative set of estimations for the manufacturing industries using the factor income deflator (factor incomes divided by value added) is performed.

4.3. Wage formation in the aggregate manufacturing sector

According to the Scandinavian theory of inflation wage formation in manufacturing industries, which are highly exposed to foreign competition, may be of great importance for wage formation in the sheltered sectors. The discussion for manufacturing therefore will be carried out in more detail than for the other sectors. Because of the availability of data most of the earlier works have also concentrated on explaining wage formation in this sector (see e.g. Nymoen (1989 and 1991) and Rødseth and Holden (1990)).

We start with discussing the general wage equation (4.2.2). One important issue is to test the significance of the error-correction terms as these terms, together with the rate of unemployment, are of importance for the long term implications of the relation. If none of the error-correction terms turn out to be significant while the rate of unemployment is, the relation may be interpreted as an augmented Phillips curve.

When looking for the most relevant long run explanatory factors for a time series variable, it is crucial to pay attention to time series properties of the variables. This gives a good indication of what error-correction terms we should be looking for. Before estimating a wage equation for average manufacturing stationarity and cointegrating properties for the most important variables as the wage rate, the rate of unemployment, the competitiveness, the real disposable income the wage share and relative wages are tested in section 4.3.1.

4.3.1. Analysing time series properties

An important argument regarding time series regressions as pointed out by Granger and Newbold (1974) is that the conventional use of R-squared and t-values may be misleading if the variables are non-stationary time series. This argument has, together with the practical success of the Box-Jenkins methology and a growing awareness of the need for a proper dynamic econometric modelling, materialized into a huge literature originating from the socalled LSE econometricians (see e.g. Davidson et al (1978), Harvey (1981), Hendry and Richard (1983) and Spanos (1986)). The main idea advocated by the LSE econometricians is to combine differences and levels in the same model. This means that short run dynamics and long run fluctuations are modelled simultaneously. The error-correction model is the most widely used dynamic specification emerging from this programme. In this model the change in the dependent variable is explained by the lagged deviations from an equilibrium path.

The concept of co-integration has advanced the literature of dynamic econometric modelling further the recent years (see Granger (1986), Engle and Granger (1987) and Engle and Yoo (1987)). Variables are said to be co-integrated if each of them is non-stationary (integrated of degree 1, I(1) or higher), but there exists a linear combination of them which is stationary, I(0). One very important result by Engle and Granger (1987) is that a system with non-stationary but co-integrated variables may be represented as an error-correction model.

In his works Nymoen (1989 and 1990) uses the LSE methology in analysing wage formation in Norway. In the wage equation (4.2.2) the error-correction term $(w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1})$ implies an assumption of wage rates developing according to the Scandinavian theory of inflation in the long run. In this theory wage rates have to grow according to prices of competing foreign products, productivity and pay-roll taxes to maintain competitiveness. If this long term connection holds, wages, foreign prices, productivity and pay-roll taxes are cointegrated variables. As no industry is perfectly exposed, it may however be the case, as suggested by both Nymoen (1989 and 1991) and Rødseth and Holden (1990), that some weight is put on real disposable incomes indicated by the term $(w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1})$ and concern for relative wages denoted by $(w_{t-1} - \bar{w}_{t-1})$. c_{11}, c_{12} and c_{13} represent the weights of these three factors, and if all these coefficients are significantly negative, wages are cointegrated with the other six variables.

The rate of unemployment is included on the level form in (4.2.2), and if c_{11}, c_{12} and $c_{13} < 0$ the static long run solution is given by

$$
\begin{aligned}
& w = c_{11}/(c_{11}+c_{12}+c_{13}) \cdot (p_I + z - s) + c_{12}/(c_{11}+c_{12}+c_{13}) \cdot (p - h - t) \\
(4.3.1) \quad & + c_{13}/(c_{11}+c_{12}+c_{13}) \cdot \bar{w} - c_0/(c_{11}+c_{12}+c_{13}) \\
& - c_1/(c_{11}+c_{12}+c_{13}) \cdot g(U)
\end{aligned}
$$

This gives a long run relationship between the level of unemployment and the level of wage rates. A change in unemployment to a new level will in this model only have a short run effect on wage inflation, but a lasting effect on the wage level. If, however, $c_{11} = c_{12} = c_{13} = 0$ (4.2.2) is a traditional Phillips curve. In this case a change in the rate of unemployment to a new level will have a lasting effect on wage inflation in this single wage equation. If the rate of unemployment drops below an equilibrium rate this may mean a lasting loss in competitiveness, even if $c_3(1)$ and $c_4(1)$ equal to one (and the other coefficients equal to 0). As pointed out by Nymoen (1990), the conditional variance of the competitiveness indicator is unbounded in this case while it is bounded in the error-correction model.

It is important to note that this argument about unboundedness does not hold in a model where a Phillips curve is combined with a downward sloping demand curve for labour and/or an upward sloping supply curve. In such a model wage growth deviating from the Scandinavian theory of inflation as a result of the rate of unemployment differing from the equilibrium rate, will - as a result of increased supply or reduced demand of labour - move the rate of unemployment back to the equilibrium rate again in the long run, also giving an equilibrium level of wage rates as shown in figure 3.5.6.

The time series properties of the rate of unemployment and the degree of competitiveness may indicate which theory is the most relevant in explaining wage formation. Nymoen (1990) discusses this in four windows according to the stationary properties (stationarity, I(0), or integrated of degree 1, I(I)) for the index of competitiveness and the rate of unemployment, under the assumption that both the growth in wage rates and the other growth variables in (4.2.2) are I(0):

i) In the case where all the indices for competitiveness, real disposable income, relative wages and the rate of unemployment are I(0), there are no I(1) terms in (4.2.2). Both c_1, c_{11}, c_{12} and $c_{13} < 0$ may be possible in this model giving an error-correction model where wages in the long run depend on both competitiveness, real disposable income, relative wages and unemployment. If the real disposable income and relative wages are I(1), this means that $c_{12} = c_{13} = 0$, giving the Scandinavian model of inflation, eventually corrected for the level of unemployment if $c_1 < 0$.

ii) In the case where the rate of unemployment is I(0) while the indices of competitiveness, real disposable income and relative wages are I(1) the rate of unemployment matches the I(0) property of wage inflation. If the indices of competitiveness, real disposable income and relative wages are not cointegrated, there is a Phillips curve, indicating that deviations in the rate of unemployment from its equilibrium rate may cause changes in competitiveness.

iii) In the case where the rate of unemployment is I(1) while the indices of competitiveness, real disposable income and relative wages are I(0) it seems reasonable that unemployment is not a relevant variable explaining wage growth, and $c_1 = 0$. This gives an error-correction model with no unemployment effect, where wages in the long run depend on the other variables. If the real disposable income and relative wages are I(1) and are neither internally cointegrated nor with unemployment, we have the Scandinavian model of inflation with short term fluctuations within the wage corridor.

iv) In the case where both the rate of unemployment, the indices of real disposable income, competitiveness and relative wages are I(1), neither of these factors may explain wage growth unless some of them are cointegrated. If this is the case, there is a long term relationship between the levels of the four variables as indicated by (4.3.1).

Dickey and Fuller (see Fuller (1976) and Dickey and Fuller (1979 and 1981)) have developed rather simple tests based on ordinary "t"- and "F"-statistics to analyse the time series properties of a variable. As pointed out by Haldrup and Hylleberg (1991) among others, these tests may be somewhat arbitrary in deciding if there are a deterministic trend and/or a constant term and how many lags in the change of the actual variable which ought to be included. Seasonally versus yearly data and the period of analysis may also be of importance. In principle it seems reasonable to start with a general specification as possible. A natural point of departure could be a relation of the form:

$$(4.3.2) \qquad Y_t - Y_{t-1} = \alpha + \beta t + (\rho-1)Y_{t-1} + \sum_{j=1}^{n} \rho_j (Y_{t-j} - Y_{t-j-1}) + \varepsilon_t$$

Under the assumption H_0: non-stationarity, $\rho = 1$, which means that the variable Y_t is integrated of order 1.

In testing $\rho = 1$ it is important to note that the coefficient for Y_{t-1} and its standard deviation may depend on the constant term and the trend. As pointed out by Dickey (1984) a test for $\rho = 1$ when $\alpha = \beta = 0$ may be weaker in a specification where α and β are included than in a specification where they are excluded. On the other hand when $\alpha \neq 0$, $\beta \neq 0$ a test for $\rho = 1$ will have more strength when α and β are included rather than excluded. It therefore seems reasonable to have a test strategy where also $\alpha = 0$ and $\beta = 0$ are checked. One possible strategy may be to check first if $\alpha = 0$ and $\beta = 0$, both separately and simultaneously, in a specification where no restrictions are imposed on ρ. Depending on rejection or not of these hypothesises, $\rho = 1$ may be tested in the chosen

Table 4.3.1. Dicky-Fuller tests for stationarity of variables[1] regarding wage formation

Variable	t-statistics	α	β	Period
Δw	-2.22	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-2.94	0	0	1967-1987
U	-1.27	+	0	1965-1987
$1/U^2$	-0.73	+	0	1965-1987
	-1.99	+	-	
$U_t - U_{t-1}$	-3.23	0	0	1966-1987
COMP	-0.92	+	0	1965-1987
	-2.81	+	+	
$\Delta COMP_t/COMP_{t-1}$	-4.35	+	0	1966-1987
WCSH	-2.11	+	0	1965-1987
$\Delta WCHS_t/WCHS_{t-1}$	-5.31	0	0	1966-1987
DISP	-1.83	+	0	1965-1987
$\Delta DISP_t/DISP_{t-1}$	-1.96	0	0	1966-1987
WWR	-2.77	+	+	1965-1987
	-0.32	+	0	
$\Delta WWR_t/WWR_{t-1}$	-3.14	0	0	1966-1987
WEDGE	-2.21	+	+	1965-1987
	-0.27	+	0	
$\Delta WEDGE_t/WEDGE_{t-1}$	-3.50	+	0	1966-1987

1) For some variables the table contains two figures because there may be some doubt if a deterministic trend should be included or not.

Lower case letters means that the variables are in natural logarithms.	
w	-nominal hourly wage rate for employees in mining and manufacturing according to the National Accounts
U	-the rate of unemployment in the whole economy according to the Labour Force Sample Survey
COMP	-indicator for competitiveness for mining and manufacturing exclusive petroleum refining
log (*COMP*)	$= w + s - p_I - z$ where
	s -logarithm of 1 + the average pay-roll tax rate for mining and manufacturing
	p_I -price index on competing imported manufactured products (excl. refined petroleum products) according to the National Acconts
	z -value added per man hour in mining and manufacturing excluding petroleum refining according to the National Accounts
WCSH	-share of wage costs of gross factor income for mining and manufacturing excluding petroleum refining
log (*WCSH*)	$= w + s - q - z$ where
	q -factor income deflator defined as gross factor income relative to gross product
log (*DISP*)	$= w + h + t - p$ where
	t - logaritm of (1 - the average income tax rate)
	p - the official consumer price index
	h - normal annual working hours for employees in manufacturing industries
WWR	-hourly wage-level in manufacturing relative to average hourly wage level for the other industries
log (*WEDGE*)	$= s - t + p - p_I$

specification. This procedure seems to give the strongest test for non-stationary when also α and β are taken into account. When testing the stationarity properties for a variable with expected mean different from zero, a constant term ought to be included if there is no unit root. If the constant term is excluded for such a variable ρ is biased towards 1.

Table 4.3.1 shows the results of stationarity tests for the most important variables regarding wage formation for manufacturing industries giving the t-statistics. The results of the tests for α and β are also presented indicating if these coefficients are equal to 0 or not. In all the tests the number of lags on $Y_{t-1} - Y_{t-j-1}$ are fixed to 2 and are not tested.

In accordance with the assumptions made by Nymoen (1990) in his discussion of the four windows presented above, the relative change in wage rates seems to be stationary. On the other hand it is not possible to reject that the rate of unemployment has been non-stationary in the period of analysis reflecting a substantially larger rate of unemployment in the eighties compared to the sixties and the seventies, although unemployment was relatively low in 1986 and 1987. Based on quarterly data, Nymoen (1990) finds that the rate of unemployment is stationary over roughly the same period. One reason for this may be that quarterly data allows for a greater number of observations, and the tests may have more power than based on yearly data. By extending the period to 1991 the non-stationarity would probably have been more evident. As the rate of unemployment is a measure of imbalances in the labour market principal arguments favour that this variable is stationary in the long run.

Some of the arbitrariness in the tests of stationarity shows up in the analysis of the time series properties of competitiveness giving no clear conclusion about this variable being non-stationary or stationary with a deterministic trend. Both these results, reflecting the loss in competitiveness according to figure 2.5.6, is in contradiction with the Scandinavian theory of inflation suggesting that competitiveness is I(0) without a trend. But as oil extraction has become an important exposed sector in Norway during the seventies and the eighties there may be a misinterpretation of the Scandinavian theory to suggest that the traditional exposed sectors like mining and manufacturing should keep up competitiveness during this period. The spending of oil revenues in a situation with almost no unemployment may have caused wages to increase to crowd out employment in the traditional exposed sectors.

As competitiveness and the rate of unemployment seem to be I(I) over the period of analysis, we may be in window iv) outlined by Nymoen (1990). The two variables are, however, not cointegrated because in this case the increase in unemployment should have lead to an improvement in competitiveness according to the theory of trade unions and not a detoriation.

As shown in chapter 2 there has been a growth in real disposable yearly wages for wage earners in manufacturing industries, and the wage growth has even been stronger than in most other industries. According to the Dickey-Fuller test a non-stationarity assumption for real disposable yearly wages may not be rejected and the test does not give a clear conclusion about relative wages being non-stationary or stationary with a deterministic trend reflecting that hourly wages in manufacturing have increased more than hourly wages in most other sectors (cf. section 2.4). Although the growth in alternative wages, taxes and prices may explain some of the loss in competitiveness, it seems difficult to find a cointegrating combination between competitiveness, relative wages and real disposable wages. As there is a positive trend in all three variables, cointegration is possible only if one of the weights for the three factors discussed in connection with (4.2.1) has a negative sign, but this clearly contradicts the theory of trade unions.

To include a variable which may cointegrate with the loss in competitiveness and which also is in accordance with economic theory Nymoen (1989 and 1990) suggests the wedge term $(s_{t-1} - t_{t-1} + p_{t-1} - p_{It-1})$ to represent the effects of tax increases and the effects of Norwegian prices increasing more than competitive foreign prices instead of the term for real disposable income in 4.2.2. From table 4.3.1 it may be doubted if this variable is non-stationary or stationary with a deterministic trend. But because of the growth in the variable it may be a relevant factor explaining the loss in competitiveness. An increase in the rate of unemployment may have contributed to limit this loss during the eighties.

According to the presentation in section 2.5, the share of wage costs out of gross factor income has also been almost constant during the period of estimation. From table 4.3.1 the share of wage costs thus seems to be a stationary variable.

Although the stationarity tests may give some indications when searching for the most relevant explanatory factors, the power of these tests may be too weak to draw a definitive conclusion. An important limitation in the time series analysis which has shown up in this section is that theoretically long term properties of some variables may not show up even over a period of 25 years. While one should expect the rate of unemployment and the degree of competitiveness to be I(0) variables, both seem to be I(1). This may be due to some kind of arbitrariness in the choice of period of analysis, as a I(0) variable may show a substantial increase over some periods outweighed by a fall in other periods. More important are structural changes in the economy which may lead to a lasting shift in the level of a I(0) variable showing up as temporary non-stationarity. Structural problems in the labour market in this period as discussed in chapter 2 can explain some part of the growth in unemployment. The use of incomes from oil extraction causing growth in the service sector, implicating pressure on the labour market, may be an important factor explaining the loss in competitiveness for traditional manufacturing industries in addition to taxes and domestic prices.

Changes in some of the other variables may also have lasting effects on the wage level. The rather large and instant shortenings of the normal working hours in 1968, 1976 and 1987 and the income regulations in 1978/79 and 1988/89 may have been of significant importance.

4.3.2. Overview of the most relevant specifications

To review the long term characteristics of wage formation in manufacturing industries it is important to estimate and test the significance of the error correction terms in (4.2.2). Because of lack of degrees of freedom and problems with multicolinearity, restrictions are imposed on some of the short run dynamics. These restrictions are based on tentitative estimations and earlier experiences. Several of the restrictions are discussed in more detail later on, and some of these results are only referred to here as the estimations and testing are done in an iterative way.

The specification of the rate of unemployment in the wage equation is an important point which is further discussed in section 4.3.7. A very tight labour market in the sixties and the seventies seems to cause a rather large coefficient for the unemployment term in a linear specification ending the period of estimation in the beginning of the eighties. When extending the period to years with higher unemployment, the coefficient becomes significantly lower indicating problems with parameter stability in the chosen specification. A non-linear specification therefore seems to be more appropriate, and $1/U^2$ is chosen. The choice of functional form for the rate of unemployment term only seems to be of minor importance both for the tracking performance and the error-correction coefficients. The empirical analysis also indicate that the lagged rate of unemployment ought to be included as an explanatory factor in favour of the present. This seems to be in accordance both with the theory for classical price dynamics and the theory of the behaviour of a central trade union.

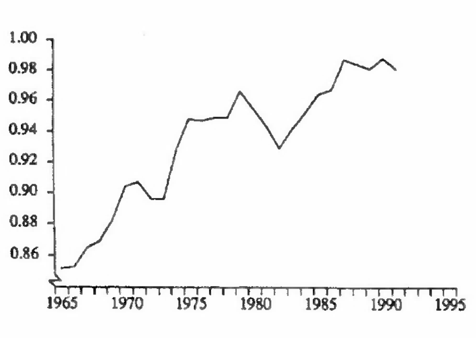
Tentitative estimations indicate that two lags seem to be relevant for both prices on competing products and productivity, and in the presented relations weights of 0.2, 0.5, 0.3 on the short run dynamics for competing prices and 1/3 in each of the three periods for productivity are imposed. Test not reported indicate that these restrictions are not rejected.

Changes in consumer prices seemed to have no instantaneous effect, and only changes in the previous period is included. From the discussion in section 4.3.9 it was also difficult to find a significant short term effect of both personal income taxes and pay-roll taxes, and these variables are omitted in most of the estimations in this section.

In a wage equation for average manufacturing it may be important to discuss the effects from alternative wages both in the short run and the long run. Although there may be large deviations in wage development in the different sectors as presented in chapter 2, these differences are quite smaller when wages in other sectors are weighted together. In figure 4.3.1 the average hourly wage rates in aggregate manufacturing is modelled against the wage rate in other sectors. While the average hourly wage level in aggregate manufacturing was about 10 per cent below wages in the other sectors in 1970, the difference was only 2 per cent in 1991.

When wage rates move in a parallel way, it may be difficult to say which sector is the wage leader and which is the follower. One way to proceed to get an indicator of the direction of causation is by applying Granger's (1969) causality tests. When two time series x and y are the result of a joint autoregressive process, x is said to "Granger-cause" y if past values of x help in predicting y. This is tested by running a regression of y on lagged values of both variables. x is said to cause y if at least one of the coefficient for x is significant. The Granger causilaty concept is built on the principle that cause must precede effect. In observations of a given length, especially as long as yearly averages, one has to include for simultaneity because of aggregation over time.

Figure 4.3.1. Average hourly wage rate in aggregate manufacturing relative to wages in other sectors



The Granger-causality test of wage leaders is shown in table 4.3.2. If simultaneity is allowed the tests give no clear conclusion, in accordance with the result found by Rødseth and Holden (1990). Wages in the two sectors mutually seem to cause each other. But the test statistics for manufacturing wages to cause other wages are clearly larger than for causation the other way, giving an indication of the direction. When simultaneity is dropped only the hypothesis that manufacturing wages cause other wages is significant. The institutional background for the Norwegian wage settlements

Table 4.3.2. Granger causality tests for wage growth in average manufacturing and average wage growth for other sectors*)

	Simultaneity	Non-simultaneity
Manufacturing wages cause other wages	$F(4,15) = 16.94$	$F(3,16) = 3.27$
Other wages cause manufacturing wage	$F(4,15) = 10.68$	$F(3,16) = 0.66$

*) F(i,j) is the F-statistics where i,j represent the degrees of freedom.

reported in section 2.3 also favour the view that manufacturing act as a wage leader as wages in this sector normally are settled first.

As a result of the discussion above it is possible that wages in the other sectors may have some effect on wages in average manufacturing. Because of the simultaneity involved, ordinary OLS is not an appropriate method of estimation when contemporaneous values of alternative wages are included. As it has proved difficult to find instruments giving a good tracking performance, as most of the other short term variables have to be excluded because of high multicolinearity, contemporaneous values of alternative wages are not included in the results presented in table 4.3.3.

The wage equation for average manufacturing industries may thus be presented as

$$\begin{aligned} \Delta w_t = {} & c_0 + c_1/U_{t-1}^2 + c_2\Delta p_{t-1} + \sum_{i=0}^{2} c_{3i}\Delta p_{It-i} \\ & + \sum_{i=0}^{2} c_{4i}\Delta z_{t-i} + c_5\Delta h_t + c_8 D79 + c_9\Delta n_t \\ & + c_{11}(w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}) \\ & + c_{12}\, l(s_{t-1} - t_{t-1} + p_{t-1} - p_{It-1}) \\ & + c_{13}\, (w_{t-1} - \overline{w}_{t-1}) \end{aligned} \tag{4.3.3}$$

where $c_{31} = 0.2$, $c_{32} = 0.5$, $c_{33} = 0.3$ and $c_{41} = c_{42} = c_{43} = 1/3$

Instead of the error-correction term for real disposable income the wedge term $(s_{t-1} - t_{t-1} + p_{t-1} - p_{It-1})$ suggested by Nymoen (1989 and 1990) is included as a variable which may cointegrate with the loss in competitiveness.

According to the discussion in section 4.2.1, a Phillips curve model is implied if none of the error-correction terms are significant ($c_{11} = c_{12} = c_{13} = 0$) and the level of unemployment has a significant negative effect on wage growth ($c_1 > 0$). The equilibrium rate of unemployment is in this case given by $U^* = \sqrt{-c_1/c_0}$. A hysteresis model is implied if some of the error-correction terms are significant. Hysteresis may be present in a specification with no error-correction terms, if the level of unemployment has no significant effect on wage growth ($c_1 = 0$) while there is a significant effect from changes in employment (or unemployment) on wage growth ($c_9 > 0$).

The results from the estimation of the most general specification according to (4.3.3), are presented in table 4.3.3, column (1). According to this specification all the error-correction terms have the expected sign, but the error-correction term for competitiveness is not significant. The level of unemployment has a significant effect, and this is also the case for changes in import prices, the shortening of normal working hours and the price and wage regulations in 1978 and 1979. More doubt may be raised regarding the effect from changes in employment, productivity and consumer prices. The results regarding the error-correction terms and unemployment in this specification are rather close to the results reported by Nymoen (1991). A major problem with specification (1) is that the coefficient for competitiveness (c_{11} in 4.3.3) is smaller in absolute value than the coefficient for the wedge term (c_{12}) indicating that the partial effect of import prices on wage growth is negative in the long run. As this is in contradiction with economy theory the restriction $c_{11} = -c_{12}$ is imposed in column (2) saying that import prices and pay-roll taxes have no effect in the long run.

The long term coefficient for alternative wages in specification (2) ($c_{13} / (c_{11} + c_{13})$) is as high as 0.65. This is in contradiction with the Scandinavian theory of inflation which says that the concern for competitiveness is of decisive importance for wage growth in manufacturing industries in the long run. By also excluding that alternative wages have a long run effect in specification (3) and relaxing the restriction $c_{11} = -c_{12}$, which is not necessary in this case, the tracking performance is not much weakened and the Durbin Watson statistics is even improved.

However, when the wedge term is excluded in specification (4), the tracking performance gets weaker and the error-correction term for competitiveness gets a small coefficient of the wrong sign. This seems to contradict the results found by Coe (1990), Rødseth and Holden (1990, ch. 4) and Johansen (1991) who report a significant error correction term in wage formation of the Norwegian manufacturing industries. The main reasons behind this discrepancy is use of different explanatory factors and fewer lags on prices and productivity in these studies.

Instead of prices on competing foreign products an implicit output deflator are used in the studies referred above. As the Norwegian manufacturing industries to a large degree seem to have shifted increased costs to higher prices, the output price deflator has increased more than the deflator for competing products. Thus what is really estimated in those studies are the short and long term factors behind the development in the wage share. As a result of the price formation, a weakness with those studies is that no direct concern is offered to competitiveness. The implicit output deflator may, however, be a relevant variable when the concern is about the functional income distribution. Estimations where import prices are replaced with the factor income deflator are presented in section 4.3.3.

Table 4.3.3. Wage equations for manufacturing industries[1]

	Estimated coefficients[2]						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-1.20	-1.40	-1.24	0.062	-0.010	-0.007	-0.008
	(2.50)	(3.58)	(2.39)	(0.56)	(0.71)	(0.93)	(0.91)
$1/U^2_{t-1}$	0.063	0.069	0.091	0.064	0.050	0.049	0.070
	(2.30)	(2.67)	(3.45)	(2.21)	(2.44)	(2.40)	(3.46)
Δp_{t-1}	0.13	0.14	0.21	0.16	0.20	0.15	0.18
	(1.11)	(1.47)	(2.08)	(1.07)	(1.70)	(1.49)	(2.57)
Δp_{It}	0.20*)	0.17*)	0.15*)	0.18*)	0.18*)	0.17*)	0.16*)
Δp_{It-1}	0.51*)	0.47*)	0.37*)	0.45*)	0.45*)	0.43*)	0.41*)
Δp_{It-2}	0.30*)	0.28*)	0.22*)	0.27*)	0.27*)	0.26*)	0.25*)
$\Sigma\Delta p_I$	1.01	0.93	0.74	0.89	0.90	0.85*)	0.82*)
	(5.74)	(6.45)	(6.01)	(5.93)	(7.46)		
Δz_t	0.08*)	0.12*)	0.24*)	0.34*)	0.30*)	0.33*)	0.31*)
Δz_{t-1}	0.08*)	0.12*)	0.24*)	0.34*)	0.30*)	0.33*)	0.31*)
Δz_{t-2}	0.08*)	0.12*)	0.24*)	0.34*)	0.30*)	0.33*)	0.31*)
$\Sigma\Delta z_t$	0.23	0.37	0.72	1.02	0.91	1*)	0.93
	(0.72)	(1.37)	(3.23)	(4.22)	(4.79)	(6.32)	
Δs_t	-	-	-	-	-	-	-0.82*)
Δt_t	-	-	-	-	-	-	-0.18*)
Δh_t	-0.90	-0.92	-0.85	-0.77	-0.81	-0.76	-0.70
	(5.70)	(6.12)	(5.05)	(3.83)	(4.48)	(4.27)	(3.95)
D79	-0.059	-0.054	-0.054	-0.074	-0.071	-0.067	-0.076
	(4.88)	(5.47)	(4.21)	(6.10)	(6.40)	(6.16)	(6.81)
Δn_t	0.109	-	-	-0.063	-	-	-
	(0.68)			(0.33)			
$w_{t-1}+s_{t-1}-p_{It-1}-z_{t-1}$	-0.099	-0.164	-0.167	0.028	-	-	-
	(1.19)	(3.56)	(1.98)	(0.67)			
$s_{t-1}-t_{t-1}+p_{t-1}-p_{It-1}$	0.158	0.164*)	0.136	-	-	-	-
	(3.14)	(3.56)	(2.55)				
$w_{t-1}-\overline{w}_{t-1}$	-0.509	-0.311	-	-	-	-	-
	(2.12)	(2.06)					
<u>Statistics</u>							
DW	1.77	1.80	1.97	1.93	1.75	1.49	2.06
SER × 100	0.83	0.81	0.90	1.09	1.04	1.05	1.07
SSR × 1000	0.83	0.91	1.14	1.65	1.73	2.00	1.95
<u>Equilibrium rate</u>							
U*	-	-	-	-	2.2	1.6	3.0

1) Left hand side variable: Δw_t.

2) T-statistics in brackets.

*) Apriori restrictions imposed.

Estimation method: OLS. Estimation period: 1965-1987.

Significant coefficients for the error-correction terms are strong arguments for these models, but the significance seem to be based on the wedge term rejecting the Scandinavian theory of inflation. Inclusion of the wedge term implies an apriori assumption that increases in taxes and consumer prices increasing more than prices on competing products are the main explanatory factors behind the loss in competitiveness for manufacturing industries during the 1970s and the 1980s. A further evaluation of these aspects with a Phillips curve specification may still be of interest.

The idea behind the error-correction term for competitiveness in (4.3.3) was to let wage rates grow according to foreign prices, productivity and pay-roll taxes. Even in the Phillips-curve specification this seems to be a reasonable theoretical restriction when the actual rate of unemployment is equal to the equilibrium rate. In relation (5) the sum of coefficients in front of prices (consumer prices and import prices together) and productivity do not deviate much from 1, and these homogeneity restrictions are imposed in relation (6) without significantly weakening the tracking performance. When testing the more parsimonious specification (6) against (3), an F-statistics, $F(4,14) = 2.64$, indicates that a relevant Phillips curve may not be rejected against this specification. When testing (6) against (2), $F(4,14) = 4.19$ indicates rejection of the Phillips curve. It may be a objection against these tests that they are dependent on the number of restrictions imposed in the specifications. To evaluate the different specifications further a set of misspecifcation tests and recursive estimations are presented in section 4.3.4. The properties of the different models are also discussed in view of economic theory.

As further discussed in section 4.3.4 it may be doubtful to impose homogeneity restrictions on productivity in a specification where consumer prices have long term effects, and this restriction is therefore removed in specification (7). In addition pay-roll taxes and income taxes are included as a symmetric treatment of taxes and prices may be appropriate from economic theory (cf. section 3.7). It is therefore convenient to restrict the effect from pay-roll taxes to be equal to the effect from competitive prices, and the effect from personal income taxes to be equal to the effect from consumer prices. Inclusion of taxes in that way also seems to improve the Durbin-Watson statistics. (7) is therefore the preferred Phillips curve which is further evaluated against the error-correction models in section 4.3.4. The effects of pay-roll taxes and personal income taxes are further discussed in section 4.3.9.

4.3.3. Estimations based on the factor income deflator

To concentrate on the concern for the functional income distribution it may be relevant to use an implicit output deflator instead of prices on import competing manufactured goods. This has also been common in recent studies, cf. Coe (1990), Rødseth and Holden (1990, ch. 4) and Johansen (1991). Like in the study made by Langørgen (1993) this is somewhat modified in this analysis as a factor income deflator, calculated by dividing the gross factor income for mining and manufacturing excluding oil refineries with gross product in fixed prices for the same sector, is used in the estimations.

The estimation results with this explanatory factor, denoted q, are presented in table 4.3.4. Compared to the results in table 4.3.3, the short term effects from changes in consumer prices and productivity were far from significant when the wedge term is inclu-

Table 4.3.4. Wage equations for manufacturing industries based on the factor income deflator[1)]

Variable	Estimated coefficients[2)] (8)	(9)	(10)	(11)
Constant	-1.95 (4.51)	-1.95 (4.66)	-1.01 (4.96)	-0.87 (4.18
$1/U_{t-1}^2$	0.125 (4.52)	0.125 (4.69)	0.118 (4.64)	0.132 (4.91)
Δp_{t-1}	-	-	0.39 (3.86)	0.30 (3.05)
Δq_t	0.16*)	0.16*)	0.35 (3.97)	0.33 (3.40)
Δq_{t-1}	0.40*)	0.40*)	-	-
Δq_{t-2}	0.24*)	0.24*)	-	-
$\Sigma\Delta q$	0.80 (5.52)	0.80 (6.24)	0.35 (3.97)	0.33 (3.40)
Δs	-	-	-0.64 (1.35)	-0.44 (0.86)
Δh_t	-0.67 (3.70)	-0.67 (3.88)	-0.73 (4.13)	0.71 (3.50)
D79	-0.024 (1.70)	-0.024 (1.93)	-0.022 (1.66)	-0.032 (2.34)
$w_{t-1} + s_{t-1} - q_{t-1} - z_{t-1}$	-0.230 (2.57)	-0.228 (4.68)	0.398 (5.06)	-0.349 (4.29)
$s_{t-1} - t_{t-1} + p_{t-1} - q_{t-1}$	0.228 (3.86)	0.228*) (4.68)	-	-
$w_{t-1} - \overline{w}_{t-1}$	-0.279 (2.91)	-0.279 (3.09)	-0.160 (1.96)	-
Statistics				
DW	1.56	1.55	1.70	1.50
SER × 100	1.07	1.04	1.02	1.11
SSR × 1000	1.71	1.72	1.46	1.86

1) Left hand side variable: Δw_t.
2) T-statistics in brackets.
*) Apriori restrictions imposed.
Estimation method: OLS. Estimation period: 1965-1987.

ded, and these variables are excluded in specifications (8) and (9). The short term effects from changes in the factor income deflator are, however, clearly significant. Regarding the long term properties derived from the error correction coefficients, the results in (8) and (9) are in some respect independent of the choice between import prices and the factor income deflator. From specification (8) where alternative wages are included the coefficient for the functional income distribution is in absolute value very close to the coefficient for the wedge term. This is imposed as a restriction in specification (9), indicating that no concern is offered to the functional income distribution in the long run. While the long term weight for alternative wages is 0.65 in specification (2) the effect is 0.55 in specification (9).

The results reported in (8) and (9) are somewhat in contradiction with the studies mentioned above. The main reason for this is probably that a wedge term is not included in these studies, but Johansen (1991) reports that such a wedge term is not significant. Also Langørgen (1993) finds that consumer prices ought not to be included among the error correction terms.

Further analysis of this subject indicates that the significance of the wedge term is quite dependent on the specification of the short run dynamics. By including the change in consumer prices from the past period and the change in the factor income deflator and pay-roll taxes only from the instant period, the wedge term drops out, and specification (10) is somewhat better than specification (9). The change in pay-roll taxes is not quite significant in (10), but when this variable is excluded, the Durbin Watson statistics is clearly weaker.

When the term for alternative wages also is excluded in specification (11), we end up with a specification which is in accordance with the results reported by Coe (1990), Rødseth and Holden (1990, ch. 4) and Johansen (1991). This specification is somewhat weaker both regarding autocorrelation and tracking performance than the other actual specifications reported in table 4.3.4.

A difference compared to the results in table 4.3.3 is that the coefficient for the rate of unemployment is larger when the factor income deflator is used in the estimation. As import prices seem to be more relevant from economic theory, specifications with a factor income deflator are not further discussed in this section, but an updated specification is presented in section 4.5.

4.3.4. Further evaluation of error-correction models versus Phillips curves

To evaluate the error-correction models and the Phillips curve some misspecification tests of the specifications (2), (3), (7) and (10) in table 4.3.3 and 4.3.4 are reported in table 4.3.5.

From the table it is evident that all the four specifications pass tests for heteroscedasticity (ARCH), autocorrelation (AUTO), misspecification (GOFF), normality in the residuals (NORMBJ) and parameter stability between 1985 and 1987 (CHOW). The error correction models are somewhat better than the Phillips curve specification, especially regarding parameter stability, heteroscedasticity and normality in the residuals.

Table 4.3.5. Misspecification test for different wage equations*)

Test	References	Test statistics			
		Alt. wage (2)	Wedge (3)	Phillips curve (7)	Factor income deflator (10)
ARCH	Engle (1982)	F(1,11) = 0.49	F(1,12) = 0.46	F(1,15) = 1.14	F(1,10) = 0.46
AUTO	Kiviet (1986)	F(1,12) = 0.09	F(1,13) = 0.00	F(1,16) = 0.21	F(1,11) = 0.10
GOFF	Harvey (1981)	F(1,11) = 0,05	F(1,12) = 0.03	F(1,15) = 0.38	F(1,10) = 0.04
NORMBJ	Spanos (1986)	$\chi^2(2) = 0.01$	$\chi^2(2) = 0.03$	$\chi^2(2) = 0.81$	$\chi^2(2) = 0.23$
CHOW	Chow (1960)	F(2,11) = 0.74	F(2,12) = 0.38	F(2,15) = 2.23	F(2,10) = 0.13

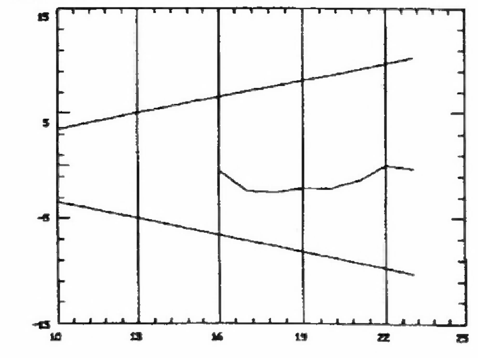
*) $\chi^2(i)$ is the Kji-squared statistics and F(i,j) the F-statistics, where i and j represent the degrees of freedom.

To check the qualities of parameter stability further Cusum tests and recursive estimations of all the coefficients in the alternative wage model, the wedge model and the Phillips curve are presented in figures 4.3.2 to 4.3.7.

All specifications seem to perform quite well, but the Cusumsq-observator indicates weaker parameter stability in the Phillips-curve specification, especially in the beginning of the period. From the recursive estimations presented in figure 4.3.5-4.3.7 it is evident that the coefficients in the alternative wage model and the wedge model show great parameter stability from 1983 to 1987. The coefficients in the Phillips-curve are also quite stable from 1983 to 1986, but some of them change in 1987.

Figure 4.3.2. CUSUM- and CUSUMSQ-statistics for recursive estimations of the alternative wage model at 5 per cent significance level

CUSUM-observator



CUSUMSQ-observator

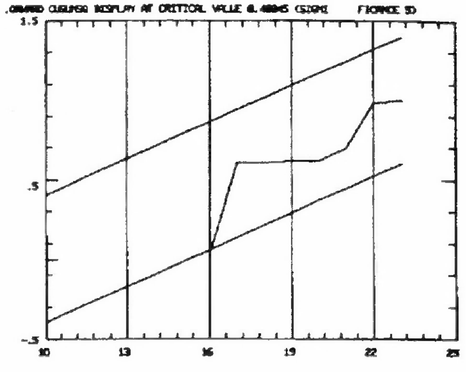


Figure 4.3.3. CUSUM- and CUSUMSQ-statistics for recursive estimations of the wedge model at 5 per cent significance level

CUSUM-observator CUSUMSQ-observator

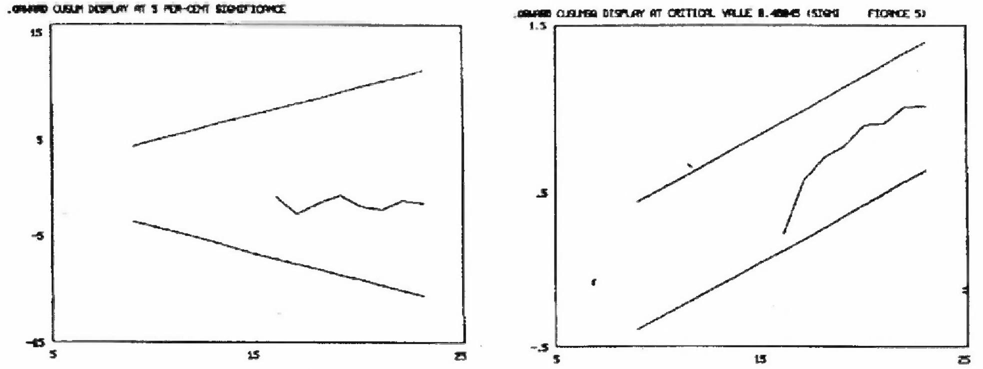


Figure 4.3.4. CUSUM- and CUSUMSQ-statistics for recursive estimations of the Phillips curve at 5 per cent significance level

CUSUM-observator CUSUMSQ-observator

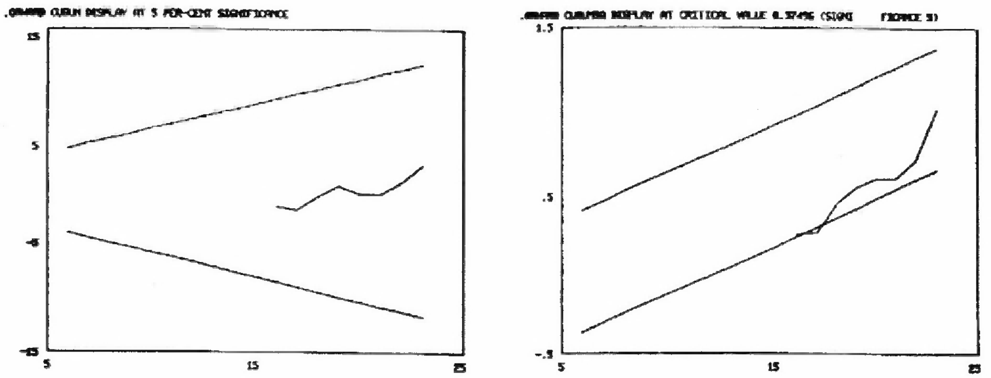


Figure 4.3.5. Recursive estimations of the coefficients in the alternative wage model

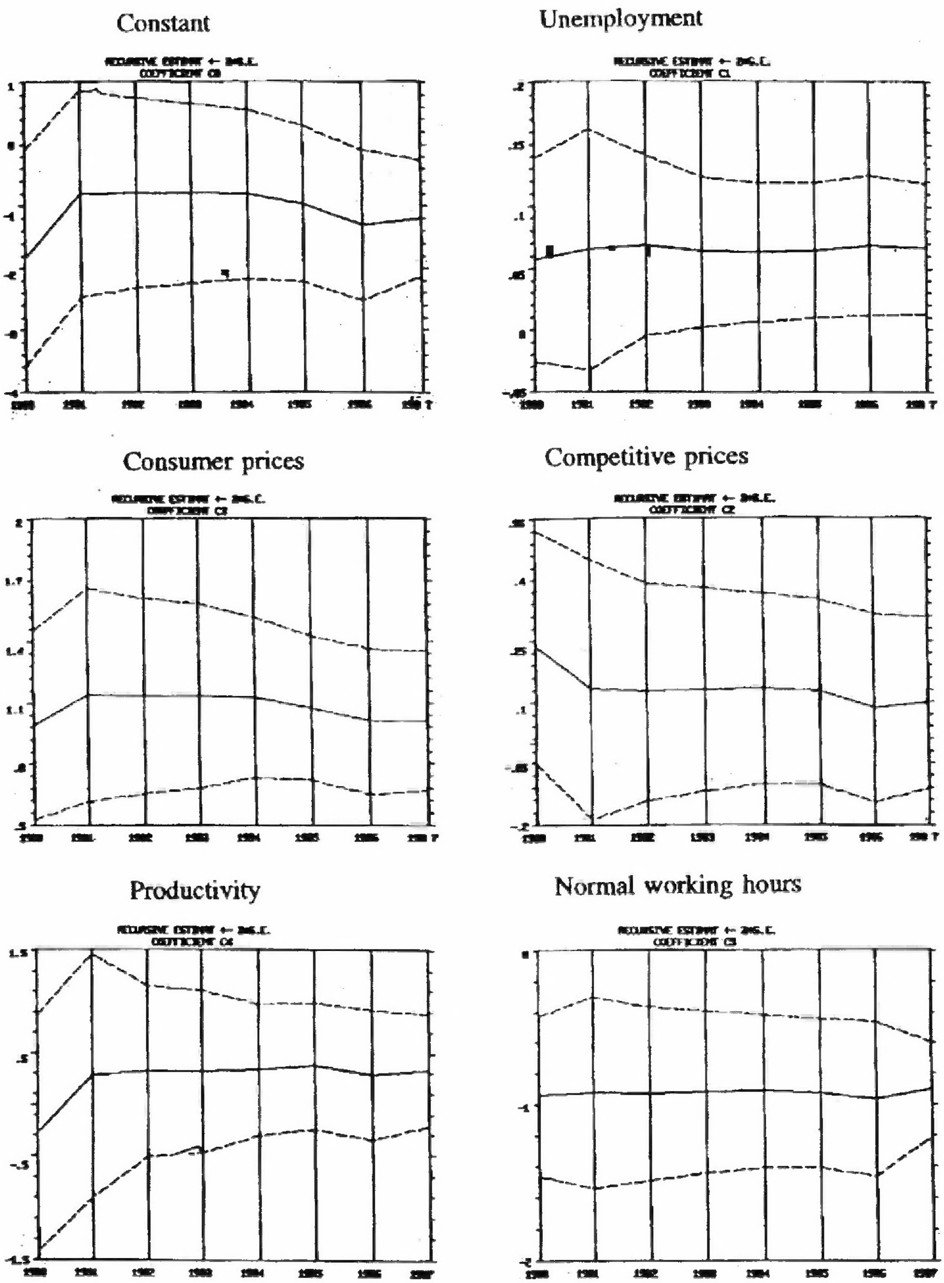
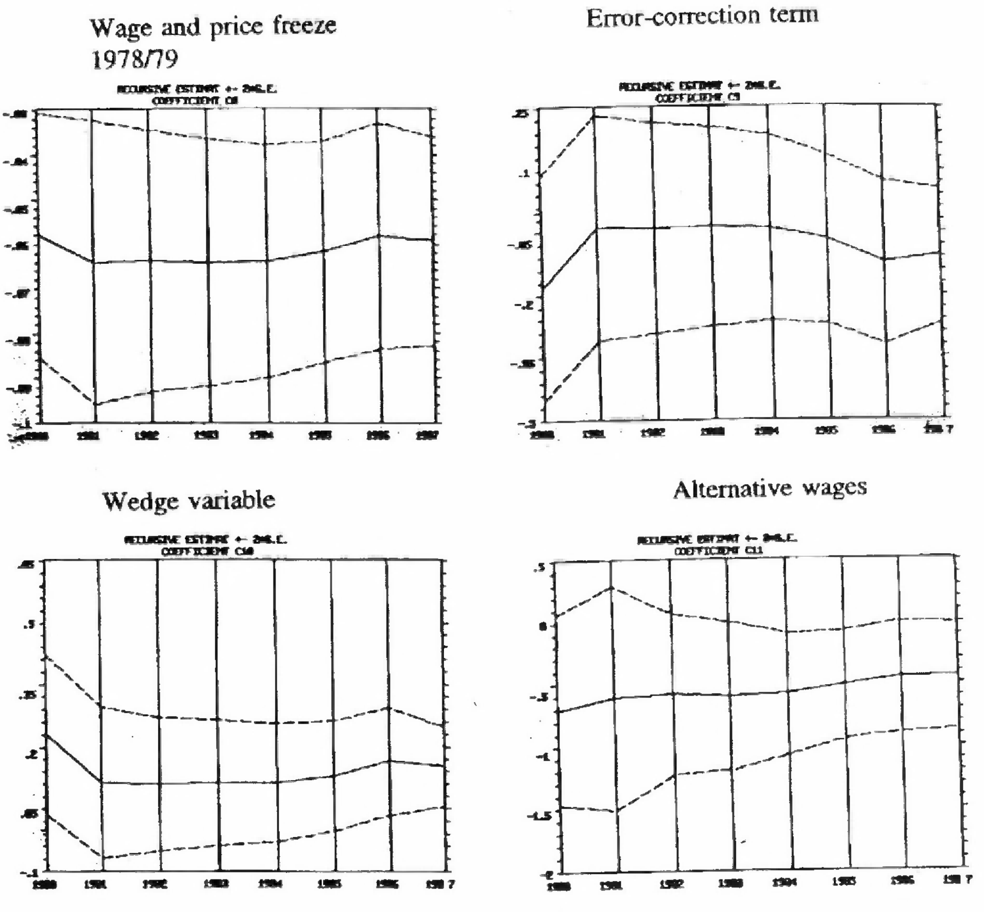


Figure 4.3.5. (cont.)



The shortening of the normal working hours seems to be the main reason behind this, having a larger impact on wages in 1987 than was the result of the other main shortenings in 1968 and 1976. It may be a problem with the shortenings of normal working hours that they occur at discreet jumps, and the long run effect may be smaller than the short run effect. As a result of the income regulation in 1988 and 1989 the period of estimation is not extended beyond 1987. This regulation may have been initiated by the large wage increases as a result of the shortening of normal working hours. A nice property of the error-correction models is that shortenings of the normal working hours only have short term effects, and this is probably the reason why the coefficient for this variable is quite stable in the error-correction models, also in 1987.

Figure 4.3.6. Recursive estimations of the coefficients in the wedge model

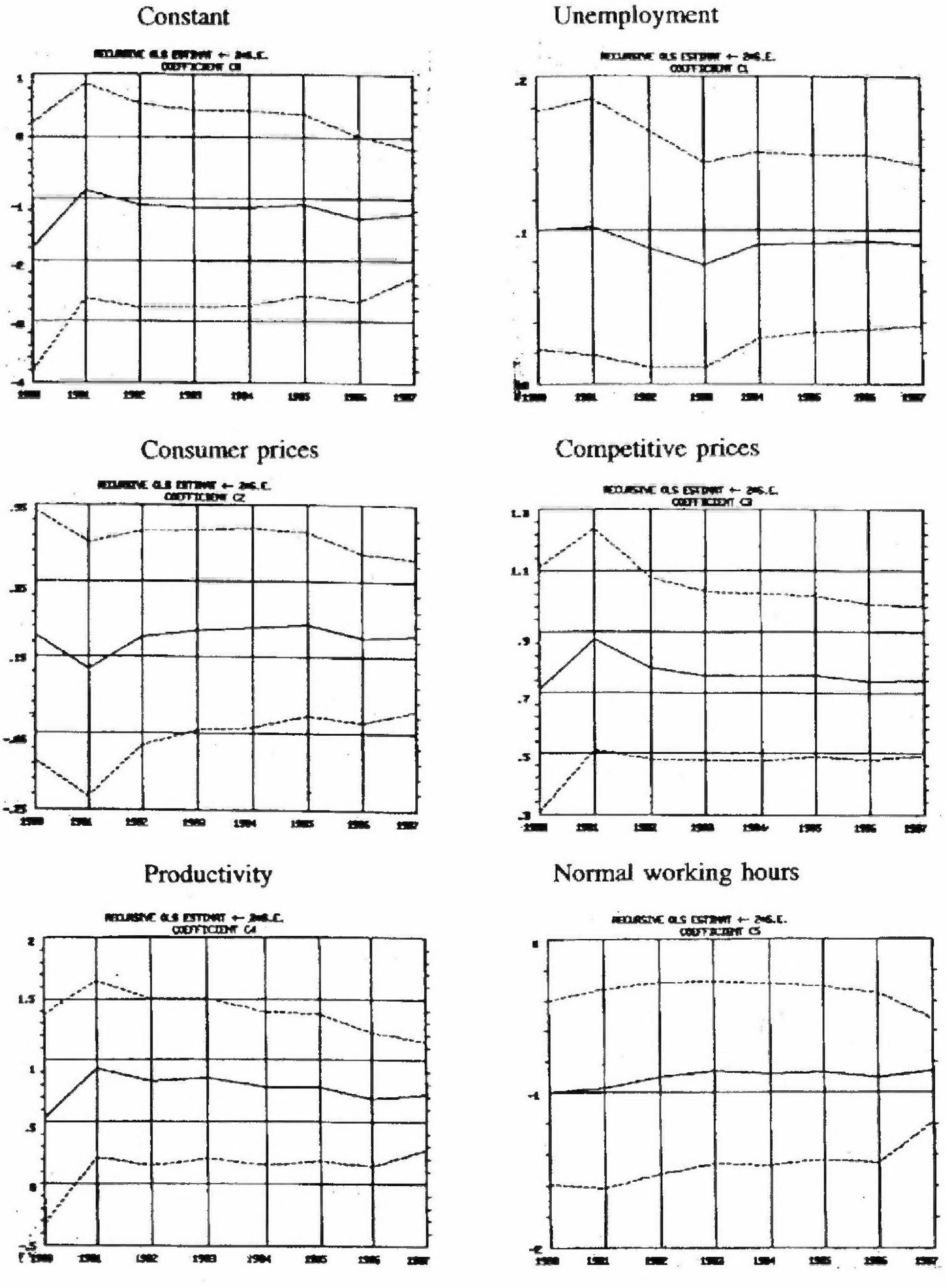
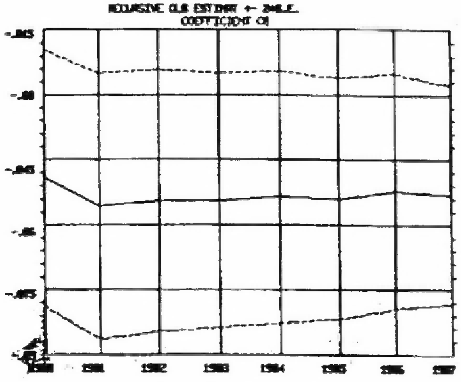
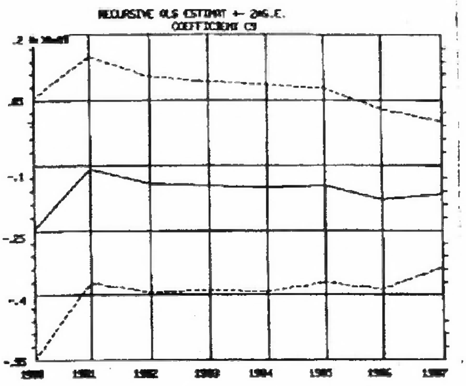


Figure 4.3.6. (cont.).

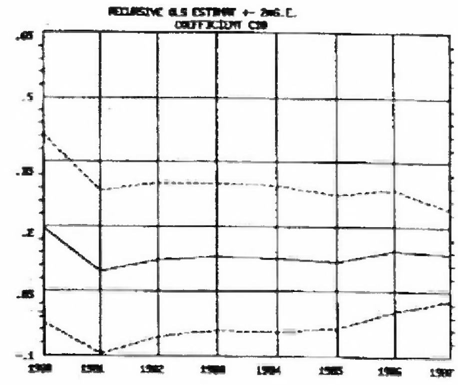
Wage and price freeze 1978/79



Error-correction term



Wedge variable

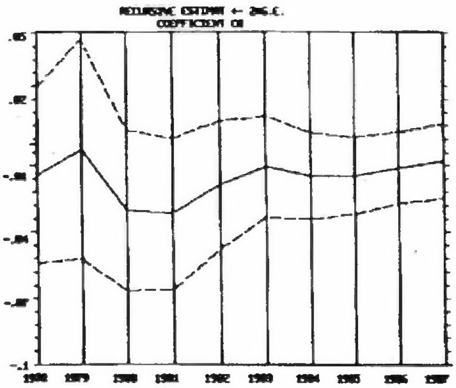


The change in the impact from normal working hours also seems to have affected the coefficients for productivity and consumer prices in the Phillips curve specification. It is also an important result that the higher propensity to devaluate during the first part of the eighties does not seem to have had any effect on the changes from prices.

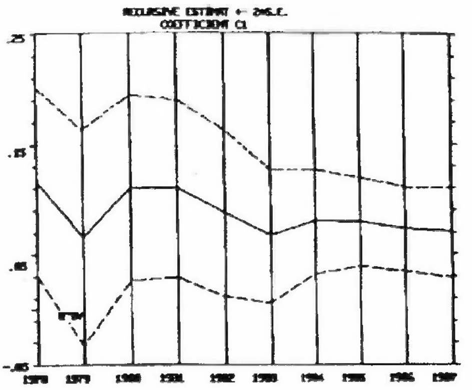
Neither the constant term nor the coefficient for unemployment seem to be much affected by the shortening of the normal working hours in the Phillips curve specification. Both these variables were rather imprecise before the increase in unemployment in 1983/84, but afterwards the standard deviations have declined substantially. The absolute value of both coefficients have declined during the eighties, but the constant

Figure 4.3.7. Recursive estimations of the coefficients in the Phillips curve

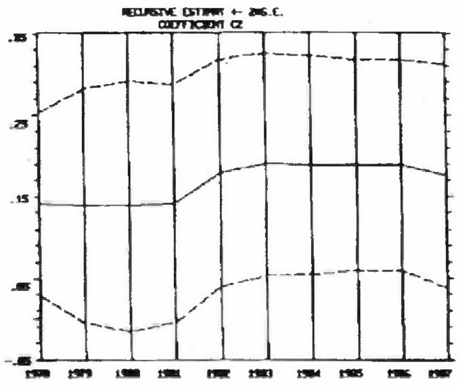
Constant



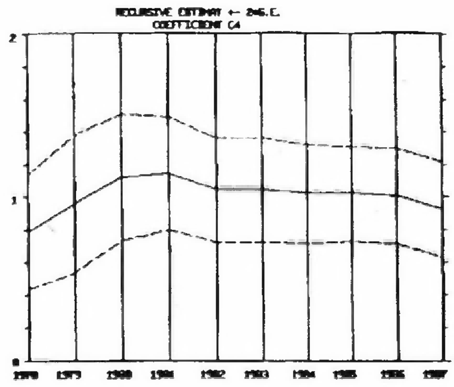
Unemployment



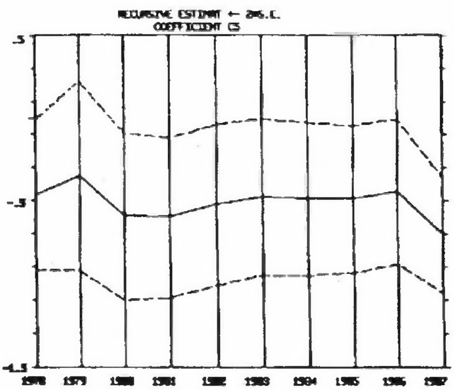
Consumer prices



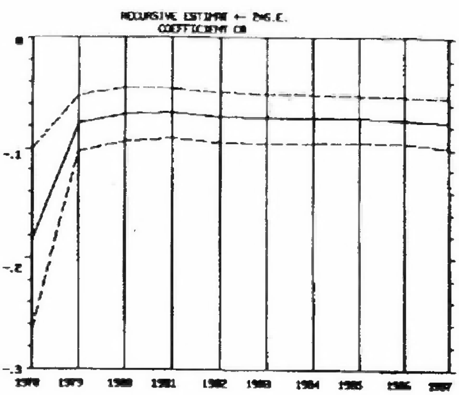
Productivity



Normal working hours



Wage and price freeze 1978/79



term relatively more than the coefficient attached to unemployment, indicating an increasing equilibrium rate of unemployment from about 2 per cent in 1980 to about 3 per cent in 1987, which is in accordance with the discussion in section 2.3. This may be an indication of hysteresis effects, but as discussed in chapter 2 the large shifts in unemployment by sector in the eighties and higher long term unemployment may be important factors behind the larger mismatch problems and the increase in the equilibrium rate in that decade.

The different statistics discussed above are in the favour of the error-correction models. In choosing between different specifications which do not differ very much empirically it is however necessary to evaluate the qualities against economic theory. One way to look at the qualities of the different specifications is to look at the impact on nominal hourly wage rates of shifts in the explanatory variables. The long term weights of different nominal variables for wage formation in average manufacturing based on different studies are presented in table 4.3.6.

One striking result is that the different specifications differ very much regarding the long run effects from consumer prices, alternative wages, output prices and import prices. Because of a symmetry restriction between consumer prices and income taxes on the one hand and output/import prices and pay-roll taxes on the other in most of the studies, these differences also show up in the corresponding effects from income taxes and payroll taxes. The problem with uncertainty about the weights put on different prices is also well known from earlier empirical analysis, and it looks as these weights are rather sensible both regarding the choice of explanatory factors, level of aggregation and dynamic structure. Most of the works from the seventies and the early eighties (e.g. Brunstad and Aarrestad (1972), OECD (1975), OECD (1978), Tveitereid (1979), Isachsen and Raaum (1983), Isachsen (1983) and Hersoug (1983)) even found that the sum of the weights were less than one, indicating no price homogeneity. The main reason for these results seems to be that neither alternative wages, output prices nor import prices were included in a proper way and the effects of these variables were caught up in the constant.

Due to the presentation in table 4.3.6 a restriction of price homogeneity is imposed in all studies. This restriction is normally not rejected as shown in the Phillips curve case by testing (6) against (5) in table 4.3.3. As may be seen from table 4.3.6 there is a close correspondance between the results from the traditional error correction model with a wedge variable in this study and the results reported by Nymoen (1989), where the weight on consumer prices is about 0.80. There is also a close correspondance between the alternative wage specification and the results reported by Nymoen (1991), except from the fact that Nymoen has not restricted the partial negative impact from import prices to 0.

The Phillips curve version gives a far higher weight on import prices than the other specifications, which are based on error correction models. This result is due to the fact that a large part of the loss in competitiveness is explained by a lower rate of unemployment than the equilibrium rate in the Phillips curve specification, while the loss is explained by alternative wages and the wedge variable in the error correction models with import prices.

Table 4.3.6. Long term weights of different nominal variables for wage formation in average manufacturing based on different studies

Study	Alternative wages	Consumer prices	Import prices	Output prices
Coe (1990)	-	-	-	1
Rødseth and Holden (1990, ch. 4)	-	-	-	1
Rødseth and Holden (1990, ch. 6)	-	1	-	-
Johansen (1991)	-	0	-	1
Nymoen (1989)	-	0.79	0.21	-
Eitrheim and Nymoen (1991)	-	0.59	0.41	-
Nymoen (1991)	0.75	0.33	-0.08	-
Stølen (1985)	-	0	1	-
Langørgen (1993)	0.33	-	-	0.67
This study				
Alternative wage (2)	0.65	0.35	0	-
Error correction (3)	-	0.81	0.19	-
Phillips curve (7)	-	0.18	0.82	-
Factor inc. def. (9)	0.55	0.45	-	0
Factor inc. def. (10)	0.29	-	-	0.71
Factor inc. def. (11)	-	-	-	1

In the case of error correction models with output prices the problem with loss in competitiveness "vanishes" because wage costs per unit produced to a large degree is shifted over to output prices. This is probably the main reason why a coefficient for output prices equal to 1 is quite common in studies where this variable is used as an explanatory factor. But as shown from the estimations in table 4.3.4, this result is not obvious when alternative wages and consumer prices also are included. Specification (10), however, gives results very close to the ones reported by Langørgen (1993).

Because changes in wage costs are an important explanatory factor for changes in consumer prices (an effect of about 0.5 is reported in Stølen (1987)), alternative wages and the factor income deflator, specifications including effects from these variables may not be interpreted as "reduced form" specifications for wages in the long run where the feedback effects also have to be taken into account. This is analysed in a tentative way in table 4.3.7 where the long run solutions for the Phillips curve specification and the error-correction specifications with wedge variable, alternative wages and the factor income deflator are combined with equations where the feed-back effects are modelled.

The long term solution for the different wage equations may be written (when lower case letters means that the variables are in natural logaritms):

Alternative wage specification (2):

$$(4.3.4) \qquad w = 0.65\overline{w} + 0.35p - 0.35t + 0.35z + \ldots$$

Error correction based on import prices and wedge variable (3):

(4.3.5) $w = 0.81p - 0.81t + 0.19\, p_I - 0.19s + z + \ldots$

Phillips curve (7):

(4.3.6) $w = 0.18p - 0.18t + 0.82\, p_I - 0.82s + 0.93\, z + \ldots$

Error correction based on the factor income deflator (10):

(4.3.7) $w = 0.29\overline{w} + 0.71\, q - 0.71\, s + 0.71\, z + \ldots$

Based on the results from the estimations in section 4.4 a representative long term equation for alternative wages may be written as:

(4.3.8) $\overline{w} = 0.7\, w + 0.3\, p - 0.3\, t + \ldots$

From the presentation of the macroeconomic model MODAG in Cappelen (1992) and also the calculations presented in Stølen (1987) a simplified specification for consumer prices may be given by:

(4.3.9) $p = 0.5\, p_I + 0.5\, \overline{w} + 0.5\, s - 0.5\, \overline{z} + t_M + \ldots$

where $\overline{z}$ - productivity in sheltered industries
t_M - logarithm of 1 + the rate of value added taxes

A long term specification for the factor income deflator may be given by:

(4.3.10) $q = 0.5 p_I + 0.5\, w + 0.5\, s - 0.5\, z$

A more thorough analysis when the different wage specifications are included in the macroeconomic model MODAG are discussed in chapter 5.

Because of the homogeneity assumption imposed both in the wage and price equations, the long term coefficient of foreign prices equals one in all specifications, indicating that foreign prices are decisive for wage and price growth in a small open economy. One

Table 4.3.7. Long term elasticities for manufacturing wages on "reduced form" wrt. explanatory variables

Model	Explanatory variables					
	p_I	z	$\bar{z}$	s	$-t$	t_M
Error correction, alt. wages	1	1.06	-0.98	0.98	1.98	1.98
Error-correction, wedge variable	1	1.49	-0.72	0.43	1.43	1.43
Error-correction, factor income deflator	1	0.87	-0.13	-0.74	0.25	0.25
Phillips curve	1	1.00	-0.12	-0.77	0.23	0.23
Scandinavian theory	1	1	0	-1	0	0

main difference between the models shows up in a long term coefficient greater than 1 for productivity in the error-correction model with a wedge variable. This is caused by an effect of one directly imposed in the wage equation and an indirect effect working through consumer and product prices. A long term effect from productivity greater than one in the exposed sectors means that productivity growth according to the specification may explain some of the loss in competitiveness and that a decline in productivity may improve competitiveness. As this seems to be a very unlikely effect, this error-correction model with a wedge variable is not a sound specification of wage formation for Norwegian manufacturing industries.

In the error-correction models with alternative wages and the factor income deflator the long-term effect of changes in productivity is about 1, and these specifications may thus be relevant. However, a large negative coefficient for productivity in the sheltered sector in the alternative wage specification may lead to a lasting gain in competitiveness. This is further discussed in chapter 5.

Except from productivity, the effect from taxes is the main difference between the Phillips curve and the error correction model based on the factor income deflator on the one hand and the other error correction models on the other. Tax increases are important variables when explaining the loss in competitiveness in the error-correction models based on import prices. From the table it is evident that increases in taxes are highly overcompensated in these models in the long run because of the effects through the wage/price and wage/wage spirals. Although such effects also are present in the Phillips curve specification, the effects are much weaker. It is noteworthy that the long run marginal properties of the explanatory variables in the error correction model based on the factor income deflator are about the same as with the Phillips curve, although the Phillips curve specification is based on import prices. This similarity may be somewhat arbitrary depending on the weights both in the wage equation and the equation for the factor income deflator.

To conclude this section: Significant coefficients for the error correction terms favour these specifications against the Phillips curve. Because the wedge term somewhat seems to balance the other error correction terms in a specification with foreign prices, the Phillips curve is econometrically not much weaker giving a more parsimonious specification which passes the misspecification tests. An error correction model where import prices are replaced by the factor income deflator and where the wedge variable is excluded is also a very relevant specification. A close correspondence to the Scandinavian theory of inflation favours this specification and the Phillips curve. A long term total elasticity for productivity greater than 1 in the error-correction model with a wedge variable may lead to a lasting loss in competitiveness according to this specification. A total effect from productivity in the exposed sector close to 1 in the alternative wage model combined a large negative effect from productivity in sheltered sector may lead to a lasting gain in competitiveness according to this specifications. These results seem rather unlikely, and changes in taxes and other price wedges may have large effects on competitiveness in these models.

4.3.5. Further tests of hysteresis

To discuss the question of hysteresis further, alternative ways of including the rate of unemployment in a Phillips-curve specification is analysed. All the results presented in table 4.3.8 are based on modifications of the preferred Phillips curve shown in specification (7) in table 4.3.3. In this relation the effects from consumer prices and income taxes on the one hand and competitive prices and pay-roll taxes on the other are assumed to have equal effects, and homogeneity in consumer prices and competitive prices are also imposed. It is noteworthy that none of the other estimated parameters are much influenced by the modification of the unemployment term, and neither is the tracking performance.

Based on the argument of loss of human capital among the long-term unemployed discussed in chapter 3, it has been suggested that the change in unemployment may be a better explanatory factor for the development of real wages rather than the level of unemployment. Changes in unemployment in the past periods are included in specification (12) and seem to be of some relevance, while the change in the present period was of the wrong sign and is excluded from the presented specification. By including the change in unemployment from the previous period only, the coefficient was far from significant, and this specification is not reported in the table.

The coefficient for the level of unemployment is somewhat reduced in specification (12) compared to specification (7), in table 4.3.3, but an apriori restriction on the equilibrium rate is imposed to get a negative constant term. A positive constant would mean that the economy was unstable which is not likely. According to the discussion regarding the error-correction specifications, it is a problem that productivity is overcompensated also in this specification. Some effects from changes in the rate of unemployment, although not significant, may be an indication of hysteresis effects, but as the level term also is of importance this specification means loops around the Phillips curve as suggested by Lipsey (1960).

Table 4.3.8 Wage equatins for manufacturing industries[1]

Variables	Estimated coefficients[2]					
	(12)	(13)	(14)	(15)	(16)	(17)
Constant	-0.005	0.008 *)	-0.011	0.015	0.020	0.013
	(2.31)	(0.63)	(-0.77)	(2.35)	(1.97)	
$1/U^2_{t-1}$	0.045 *)	0.111	-	0.082	-	-
		(3.80)		(2.33)		
$1/U^2_{t-2}$	-	-0.029	-	-	-	-
		(0.73)				
$1/U^2_{t-3}$	-	0.026		-	-	-
		(0.74)				
$1/U^2_{t-4}$	-	-0.051	-	-	-	-
		(1.72)				
$(U^*_{t-1}/U_{t-1})^2$	-	-	-	-	0.023	0.022
					(4.91)	(4.73)
$1/US^2_{t-1}$	-		0.064	-	-	-
			(2.03)			
UL_{t-1}	-	-	-0.004	-	-	-
			(0.27)			
LUR_{t-1}	-	-	-	0.026	-	-
				(0.45)		
Δu_{t-1}	-0.029	-	-	-	-	-
	(1.57)					
Δu_{t-2}	-0.014	-	-	-	-	-
	(0.81)					
Δu_{t-3}	-0.025	-	-	-	-	-
	(1.40)					
Δp_{t-1}	0.19	0.19	0.17	0.18	0.18	0.18
	(2.75)	(2.69)	(2.48)	(2.51)	(3.08)	(3.17)
$\Sigma\Delta p_i$	0.81 *)	0.81 *)	0.83 *)	0.82 *)	0.82 *)	0.82 *)
$\Sigma\Delta z$	1.08	1.04	0.97	0.94	1.05	0.9 *)
	(8.54)	(7.72)	(6.54)	(6.11)	(8.62)	
Δs_t	-0.81 *)	-0.81 *)	-0.83 *)	-0.82 *)	-0.82 *)	-0.82 *)
Δt_t	-0.19 *)	-0.19 *)	-0.17 *)	-0.18 *)	-0.18 *)	-0.18 *)
Δh_t	-0.64	-0.71	-0.66	-0.69	-0.47	-0.48
	(3.58)	(4.04)	(3.67)	(3.82)	(3.04)	(3.09)
DUM79	-0.072	-0.070	-0.075	-0.075	-0.072	-0.075
	(6.17)	(5.70)	(6.55)	(6.44)	(7.74)	(8.16)
Period of estimation	1966-1987	1966-1987	1965-1987	1965-1987	1965-1987	1965-1987
Statistics						
DW	2.16	2.12	2.10	2.14	2.46	2.27
SER x 100	1.01	1.02	1.09	1.10	0.90	0.91
SSR x 1000	1.43	1.46	1.91	1.93	1.37	1.50
Equilibrium rate						
U^*	3.0	2.7	2.4[3]	2.3[3]	[4]	[4]

1) Left hand side variable: Δw_t. 2) T-statistics in brackets. 3) When there are no long term unemployed. 4) Variable equilibrium rate.

*) Apriori restrictions imposed. Estimation method: OLS.

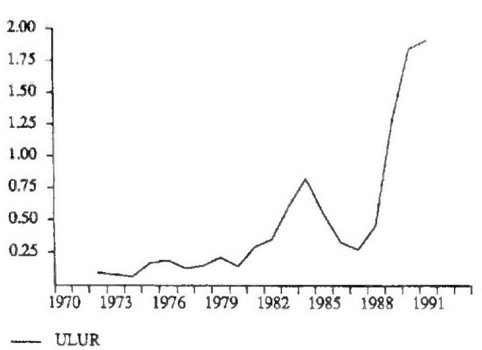
Another way of testing the hysteresis effects as suggested by Coe (1988) is to include a distributed lag on past values of U_t. If the equilibrium rate moves in line with the actual rate with some lags, this means that the effect from the level of unemployment on wage growth is only temporary, and lagged levels of unemployment may tend to cancel out the effects from (more) present unemployment. The wage level may however have increased during the intermediate period, and this specification should thus give roughly the same impact on wages of a change in unemployment as the error-correction specifications discussed in section 4.3.3.

The results from this estimation is shown in relation (13) in table 4.3.8. However, the coefficients for U_{t-2} to U_{t-4} are not significant, and for U_{t-3} also of the wrong sign. The coefficient for U_{t-1} is larger than for the simple Phillips curve in relation (7) in table 4.3.3, and the sum over all periods is about the same. Thus no clear sign of hysteresis follow from this estimation.

Coe (1988) also suggests that the change in the equilibrium rate of unemployment may be approximated by the rate of long-term unemployment as the long term unemployed may loose qualifications and do not have a lowering effect on wage increases. Because of a rather low unemployment in Norway during the sixties and the seventies it has proved difficult to establish satisfactory time series for this variable. The variable used for estimation showed in figure 4.3.8 is based on the number of unemployed more than 26 weeks according to the Labour Force Sample Surveys after 1980 and is up to then calculated on the basis of the total LFSS unemployment rate combined with the share of registered unemployed more than 26 weeks.

In relation (14) in table 4.3.8 the rate of unemployment is divided into short term unemployment US and long term unemployment UL. Short term unemployment is included in a non-linear way to catch up the effects from a tight labour market in the sixties and the seventies. More doubt may be raised regarding the functional form for the long term unemployment which is included in a linear way for simplicity. The estimation shows that the rate of long-term unemployed has no significant effect on wage formation indicating that some hysteresis effects may be present. However, as may be seen from the figure, except from the years 1983 to 1985, the rate of long-term unemployed was quite low during the whole period of estimation while wage growth fluctuated a lot. It is therefore not surprising that there is only a weak correlation between long term unemployment and wage growth.

Figure 4.3.8. The rate of long term unemployed. Per cent of the labour force



When the share of long term unemployed, LUR, is included in addition to total unemployment in column (15), the coefficient for the share becomes rather small and insignificant giving no support to the hysteresis hypothesis although the coefficient is of the correct sign. Ending the estimations in 1987 therefore seems to be too early to tell if the growth in the long term unemployment during the eighties has increased the structural problems in the Norwegian labour market. Specification (15) indicates an equilibrium rate of 2.3 per cent when there is no long term unemployment and a rate of 3.3 per cent when the share of long term unemployed out of total unemployment is about 30 per cent as in 1989.

4.3.6. Changes in the equilibrium rate of unemployment

As concluded in chapter 2 the structural problems in the Norwegian labour market seem to have increased since 1983. It is therefore of interest to investigate if the equilibrium rate of unemployment implied by the wage equations also have increased during the eighties. This may be done by recursive estimation of the Phillips curve specification by comparing the computed equilibrium rates in each period. With the chosen specification for the unemployment term in (4.3.3) the equilibrium rate of unemployment may be calculated by $U^* = \sqrt{c_1/-c_0}$.

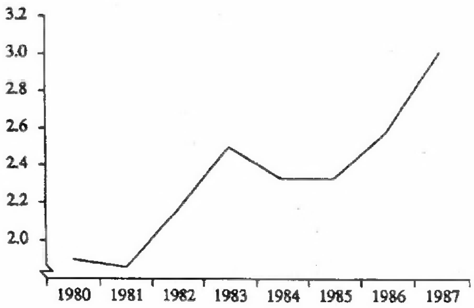
Figure 4.3.9 shows the average equilibrium rate of unemployment based on recursive estimations of the Phillips curve specification (7) in table 4.3.3 from 1965 and up to the end year depicted in the figure. These estimations gave an average equilibrium rate about 2.0 per cent ending the period of estimation in 1980 while it seems to increase during the eighties. The increase was most evident from 1981 to 1983 and from 1985 to 1987, and in the last year the average equilibrium rate reached 3.0 per cent.

As discussed in section 4.3.3 the constant term and the coefficient for unemployment were imprecisely estimated before the increase in unemployment in 1983/84, also giving a rather imprecise result for the derived average equilibrium rate. Thus, there is a lot of uncertainty about the size of the increase. In a period of an increasing equilibrium rate the marginal rate in the last year of estimation is greater than the average rate estimated in that year. It may therefore be argued that an estimated increase in the average equilibrium rate may underestimate the increase in the marginal equilibrium rate.

As discussed in section 2.2, the large fluc- tuations in the composition of unemployment by industries may have contributed to the outward shift in the equilibrium rate during the eighties. A large rate of long term unemployment has probably also been of importance. The increase in the equilibrium rate may thus have been caused by both structural phenomena and hysteresis effects, although the division between these two effects is not quite clear. As it is not obvious what is the main factor behind the growth in the equilibrium rate, and as a result of the great uncertainty in the estimations up to the beginning of the eighties it is also difficult to get a good estimate for the increase.

A bottom level of the actual rate of 2.0 per cent in 1987 against 1.5 per cent in 1974 indicates an increase of only 0.5 per cent which is less than indicated by the recursive Phillips curve estimations. Although the marginal rate should be larger than the actual rate in this situation, the estimated average growth in the equilibrium rate presented in figure 4.3.9, may be a possible approximation to the growth in the actual equilibrium

Figure 4.3.9. The average equilibrium rate of unemployment based on recursive estimations of the Phillips curve. Per cent of the labour force



rate. The rate of unemployment relative to this equilibrium is therefore used as an indi- cator for the tightness in the labour market in specification (16) in table 4.3.8. The tracking performance is somewhat improved in this specification, but not significant, and the Durbin-Watson statistics is weaker.

Because of the stipulated growth in the equilibrium rate in 1987, the coefficient for the shortenings of normal working hours is reduced. The coefficient for productivity gets larger than 1 indicating overcompensation which seems unlikely according to the dis- cussion in section 4.3.4. A restriction on this coefficient set equal to 0.9 is therefore imposed in specification (17), but still the tracking performance is somewhat better than in specification (7) in table 4.3.3, also indicating that it may be too restrictive to impose a fixed equilibrium rate during the period of estimation. Based on (17) an actual equili- brium rate of 2.6 per cent may be calculated for the years up to 1981, while it may have increased to 3.5 - 4.0 per cent by the end of the eighties. This is larger than the esti- mated equilibrium rate based on the share of long term unemployment above according to specification (15), and these calculations are of course very tentative and uncertain. The increase in the equilibrium rate reflects some of the structural problems caused by large shifts in employment between the different industries. If these changes smooth out in the nineties, this may work to reduce the equilibrium rate. A lasting high number of long term unemployed may, on the other hand, cause the equilibrium rate to grow further. Because unemployed start their spells at 0 after having joined a labour market programme, these programmes may "violate" the series for the long term unemployed. If the equilibrium rate has increased as a result of hysteresis, a careful economic policy stimulating demand, may bring both the actual and the equilibrium rate down again, without increasing inflation.

4.3.7. Evaluation of different functional forms for the rate of unemployment

From the economic theory outlined in chapter 3 it seems reasonable to assume that the Phillips curve has a convex shape as shown in figure 3.5.1. This shape may be explained by aggregation over submarkets with different excess demand or supply as pointed out by Santomero and Seater (1978) and Brunstad (1980). In this theory wage growth may depend on the aggregate excess demand in the labour market. Because of an inverse connection between the rate of vacancies and the rate of unemployment, this means that the disequilibrium term influencing wage growth should include both the level and the inverse of the rate of unemployment. The convex relationship between the growth in wage rates and unemployment may however also be explained by trade unions being reluctant to accept a large cut in wages if there is high unemployment.

Most empirical estimates of the Phillips curve prior to 1980 specified only the inverse of the unemployment rate, and Santomero and Seater (1978) report that the weight of the evidence lies with a significant non-linear relation. In the eighties with higher rates of unemployment more doubt has been raised against this specification although wage inflation has fallen sharply. In an OECD study by Coe (1985) the linear specification dominates since 1980 when judged by the standard criteria and equation preformance for the United States, France, Canada and especially the United Kingdom. There do seem to be a problem with the OECD studies that the coefficients for the rate of unemployment in the linear specification decline when unemployment increases both over time and between countries. This may indicate hysteresis effects and/or a non-linear Phillips curve. The difference between hysteresis and a non-linear Phillips curve may not be so great, as both phenomena have something to do with real wages being rigid

Table 4.3.9. Evaluating different functional forms for unemployment

Functional form	Estimated coefficients[1]: Unemployment term 1965-1982	Unemployment term 1965-1987	Constant 1965-1987	SSR × 1000	DW	CHOW F(5,12)	GOFF F(5,15)	U^*	Impact on Δw of U from 3 to 5
U	-0.039 (2.36)	-0.015 (3.37)	0.042 (3.84)	1.99	1.89	1.18	0.07	2.8	-3.0
logU	-0.065 (2.35)	-0.034 (3.43)	0.035 (3.80)	1.96	1.93	1.12	0.12	2.8	-1.7
$U^{-0.5}$	0.167 (2.35)	0.098 (3.46)	-0.058 (2.74)	1.95	1.95	1.09	0.16	2.8	-1.3
U^{-1}	0.107 (2.34)	0.071 (3.46)	-0.024 (2.01)	1.95	1.98	1.08	0.21	2.9	-0.9
U^{-2}	0.088 (2.32)	0.070 (3.46)	-0.008 (0.91)	1.95	2.06	1.06	0.38	3.0	-0.5
U^{-3}	0.094 (2.29)	0.087 (3.40)	-0.002 (0.24)	1.98	2.12	1.08	0.58	3.6	-0.3
$c_1/U^2 + c_2U$	-0.030 (0.09) -0.052 (0.36)	0.044 (0.72) -0.006 (0.43)	0.011 (0.25)	1.93	1.99	0.98[2]	0.20[3]	2.8	-1.4

[1] Absolute t-values in parenthesis.
[2] F(5,11)
[3] F(1,14)
U^* expresses the equilibrium rate of unemployment.

downwards. The difference between hysteresis and a linear Phillips curve is more fundamental.

From table 4.3.9 problems with parameter stability also seem to be the case for Norway, especially when comparing estimates in a linear specification for the period 1965-1982 with the period 1965-1987. Because of the rather low unemployment up to 1982 the standard deviations of the estimates from the first period are rather large, and as a result of this Chow-tests do not indicate any structural break.

Compared with earlier estimations documented in NOU 1988:24 it is not quite evident which is the best functional form. All the forms give about the same tracking performance, Durbin-Watson statistics, Chow statistics and goodness of fit statistics (GOFF). The level of the average quilibrium rate of unemployment also seem to be about 2.8 per cent irrespective of the chosen functional form except from $1/U^{-3}$ as a result of a low and unstable constant term. The GOFF statistics favour the linear specification while the SSR and DW statistics favour the non-linear specifications from $1/U^{-0.5}$ to $1/U^{-2}$. The numerical value of the estimated coefficients for the unemployment term decline relatively less with the non-linear specifications by extending the period of estimation to 1987. Large standard deviations on the estimated coefficients, especially when ending the period of estimation in 1982, may make it difficult to reject that the coefficient for unemployment based on estimations up to 1987 is significantly smaller than in the estimations up to 1982, even in the linear case.

The low parameter-stability for the linear specification is caused by the increase in the rate of unemployment in the eighties. For example the linear specification estimated up to 1982 would predict a rather low growth in nominal wages in 1990 when unemployment has reached about 5 per cent. Even the linear specification estimated up to 1987 would probably predict a too low wage increases at this level of unemployment. A more general specification for the rate of unemployment including a linear term and a quadratic inverse is also estimated. Although this specification estimated up to 1987 favours the non-linear specification the standard deviations for the estimated coefficients get rather large without improving the tracking performance, indicating that this specification is overparametrized.

An evaluation of the constant term may also be of help in choosing between the different specifications. When the rate of unemployment is included as a reciprocal term the constant term may be interpreted as the lower border for growth in real wages in a situation with no growth in productivity and no effect from other relevant factors. This may also be interpreted as a lower bound for the gain in competitiveness when unemployment gets high.

With a linear term there is no lower bound which seems unrealistic. With the term $U^{-0.5}$ the constant term is estimated to -0.058 which means that it is possible to gain 5.9 per cent in competitiveness each year when unemployment gets high (above 5 per cent). This is probably too optimistic while the gain of 0.2 per cent a year with the specification U^{-3} is probably too pessimistic. The specifications U^{-1} or U^{-2} give a possible gain of about 1 to 2 per cent a year when unemployment gets high.

However, as the peak of unemployment in the period of estimation reached 3.4 per cent in 1983 there may still be some uncertainty about what is the effect on wage growth when unemployment reaches 5 per cent. A further evaluation of the functional form therefore seems to be necessary based on years with high rates of unemployment. Unfortunetely wages was regulated in 1988 and 1989, but revised estimations on data up to 1990 presented in section 4.5, indicate that the constant term is about -0.01 favouring the $1/U^2$ specification.

The question may be raised if choice of functional form for the rate of unemployment is of importance for the discussion about a Phillips curve versus an error-correction model. As presented in table 4.3.9 the functional form is of no importance for the tracking performance in the Phillips curve model. When checked as in the works by Johansen (1991), the $1/U^2$-specification is even more clearly preferred in the error-correction models.

Earlier estimates reported in NOU 1988:24 indicated that the level of unemployment lagged one year was a more relevant explanatory factor for wage formation than the current level. From the results presented in table 4.3.10 this is still the case and this is in conformity with the view that disequilibrium in a market in one period affects the change in prices in the following period.

Although the coefficient for current unemployment alone is not much different from the lagged unemployment both the SSR- and DW-statistics are weaker. Because of a very small constant term the equilibrium rate of unemployment is also meaningless in this case. When both present and lagged unemployment are included, the lagged unemployment gets the larger coefficient, and the coefficient for the present rate is far from significant. Inclusion of the present rate also increases the simultaneity in a macroeconomic model as there is a link from the wage level on demand for labour and thereby unemployment.

Table 4.3.10. Current or lagged rate of unemployment

Rate of unemployment	Estimated coefficients[1)]			SSR × 1000	DW	CHOW F(5,12)	GOFF F(5,15)	U^*
	Constant	$U^{-2}(-1)$	U^{-2}					
Lagged	-0.008 (0.91)	0.071 (2.46)	-	1.95	2.06	1.06	0.38	3.0
Current	-0.001 (0.11)	-	0.055 (2.25)	2.56	1.83	0.82	0.00	7.5
Both	-0.017 (0.94)	0.063 (2.27)	0.04 (0.38)	1.93	1.99	1.06	0.20	3.0

[1)] Absolute t-values in parenthesis.
U^* expresses the equilibrium rate of unemployment.

4.3.8. Evaluation of different measures for the pressure in the labour market

As discussed in chapter 2 there are two main statistical sources for the measure of disequilibrium in the labour market; the registrations at the labour offices and the figures from the Labour Force Sample Surveys (LFSS). Because the propensity to register seems to change procyclically with the rate of unemployment, the registered rate of unemployment fluctuates more than the rate of workseekers from the LFSS.

In the eighties the two unemployment measures and the distance between them may have been influenced by the labour market programmes. During 1983 and 1984 direct government employment constituted a great part of the labour market programmes. Obviously, this contributed to lower the level of registered unemployment, but the LFSS rate was probably also influenced as many of these persons were counted as employed. From 1988 to 1991 a greater part of the labour market programmes was directed

Table 4.3.11. Different measures for the pressure on the labour market

Measures	Estimated coefficients 1965-1987[1)]						SSR × 1000	DW	CHOW F(5,11 /12)	GOFF F(1,14 /15)
	Const.	U^{-2} (-1)	UR^{-2} (-1)	URT^{-2} (-1)	RT (-1)	RTURT (-1)				
Registered rate of unemployment	0.005 (0.90)	-	0.014 (4.10)	-	-	-	1.67	2.05	1.43	0.31
Registered unemployment + ordinary programmes	0.009 (1.48)	-	-	0.022 (4.08)	-	-	1.68	1.92	1.74	0.10
Registered unemployment and and ordinary progr.	-0.001 (0.12)	-	0.017 (3.19)	-	0.005 (0.76)	-	1.61	2.22	1.23	0.67
LFSS unemployment and ordinary progr.	-0.202 (1.04)	0.092 (2.51)	-	-	0.006 (0.72)	-	1.89	2.24	1.01	0.75
Registered unemployment + ordinary progr. and share of ordinary progr.	-0.013 (0.79)	-	-	0.028 (4.22)	-	0.001 (1.42)	1.49	2.27	1.17	0.76

1) T-values in parenthesis.

UR -Registered unemployment at the labour offices in per cent of the labour force
URT -Registered unemployment at the labour offices + participants on ordinary labour market programmes (exclusive retraining of disabled persons) in per cent of the labour force
RT -Participants on ordinary labour market programmes in per cent of the labour force
RTURT -Participants on ordinary labour market programmes in per cent of registered unemployed + ordinary labour market programmes

towards education. This also influenced the rate of registered unemployment, but had probably a smaller effect on the LFSS figures. As some of the programmes also were directed towards education in 1983 and 1984, the registered rate was more influenced than the LFSS rate even in those years.

Based on the Phillips curve specification (7) in table 4.3.3 different measures for the disequilibrium in the labour market have been tried out, and the results are reported in table 4.3.11.

When the LFSS rate is replaced by the registered rate of unemployment the results from the first line in the table indicate a somewhat better tracking performance than for specification (7) in table 4.3.3. Compared to the specification $1/U^2$ in table 4.3.10 the Chow-statistics is much higher and clearly indicates more problems with parameter stability when the registered rate of unemployment is used as an explanatory factor. Changes in the propensity to register may be one important reason for this. A positive constant term is also troublesome as this indicates no equilibrium rate of unemployment. This problem could have been avoided by choosing a linear specification, but this contradicts the conclusion from section 4.3.6.

According to the theories for efficiency wages and trade unions, an increase in the extent of labour market programmes may increase wages if workers are better off in such programmes than unemployed. The expected loss of loosing the job may in such a situation decrease. Against this stands the view by Layard, Nickell and Jackman (1991) which argue that an increase in the extent of labour market programmes may reduce the mismatch problems in the economy and thereby the wage pressure.

Inclusion of ordinary labour market programmes (excluding retraining of disabled persons) in addition to the registered unemployed in the second line does not alter the results very much, but the constant term is still of the wrong sign. The results are also only weakly affected of separate treatment of the registered unemployment and the participants in the ordinary labour market programmes in line three. The Chow statistics is improved while the Durbin-Watson statistics and GOFF-statistics get worse. No significant effect of labour market programmes is thus found in this analyses. Based on Swedish data Calmfors and Forslund (1990 and 1991) find that labour market programmes have a significant positive effect on wages. The results in table 4.3.11 are not much altered by using the LFFS-rate instead of the registered rate of unemployment.

Introducing the ratio of participants in labour market measures relative to total unemployment inclusive of those attending the measures in addition to total unemployment in line five, improves the tracking performance somewhat, but the coefficient for the share of measures is neither significant. Also this result differes from the ones reported by Calmfors and Forslund (1990 and 1991) for Sweden.

As some of the participants at the labour market measures are employed in the public sector and thereby counted as employed in the LFSS, the rate of unemployment according to this survey is also reduced as a result of an partial increase in these measures. From table 4.3.3 a reduction in unemployment has a significant positive effect on wages.

An increase in the labour market programmes may thus have contributed to higher wages in 1983 and 1984 where government employment constituted a large part of the programmes.

As discussed in chapters 2 and 3 unemployment and vacancies may coexist as a result of different submarkets and frictions in moving labour from one submarket to another. From (3.5.2) excess demand is equal to the difference between the number of vacancies and the number of unemployed and this is the relevant explanatory factor for wage formation according to the theory of classical price dynamics. Because of the inverse connection between the total number of unemployed and the total number of vacancies, the vacancies are often eliminated giving an explanation for an inverse relationship between the wage growth and the rate of unemployment.

However, the connection between vacancies and unemployment is not quite clear, and some information may get lost by eliminating the vacancies. Therefore it seems reasonable to try to include the vacancies among the explanatory factors. According to the estimations and discussion regarding the rate of unemployment in section 4.3.7, the vacancies are lagged one period. As pointed out in section 2.2 there is a problem with the series for vacancies from the employment offices since new routines have caused an increase in the propensity to register.

Because of lack of good data for vacancies before 1971 the estimations, which otherwise are based on the Phillips curve specification (7) in table 4.3.3, are limited to the period 1971 to 1987.

Table 4.3.12. Different measures for the pressure on the labour market

Measures	Estimated coefficients 1971-1987[1]			SSR × 1000	DW
	$U^{-2}(-1)$	VR(-1)	URVR(-1)		
Rate of unemployment	0.064 (2.90)	-	-	1.40	2.40
Rate of vacancies	-	0.068 (3.48)	-	1.17	2.29
Rate of unemployment and rate of vacancies	-0.013 (0.22)	0.079 (1.41)	-	1.16	2.24
Rate of unemployment and mismatch indicator	0.081 (2.86)	-	0.028 (0.96)	1.28	2.49

[1] T-values in parenthesis.

U -The rate of unemployment according to the Labour Force Sample Survey.
VR -The rate of vacancies registered at the labour offices.
URVR -Indicator of mismatch equal to the product of the rate of unemployment and the rate of vacancies both registered at the labour offices.

Table 4.3.12 indicates that the rate of vacancies when included separately catches up much of the same effects as the rate of unemployment, and the tracking performance is even better than when only unemployment is included. This confirms with the results reported by Holden (1989). When both variables are included, the rate of vacancies is able to explain the whole effect from the disequilibrium in the labour market while the coefficient for the rate of unemployment is of the wrong sign. However, when a mismatch indicator (the product of the rate of unemployment and the rate of vacancies both registered at the labour offices) is used as an explanatory variable in addition to the rate of unemployment, unemployment is able to explain much of the effect on wages. But also the coefficient for the mismatch indicator is rather small and far from significant. The results from this section seem to favour the rate of vacancies for the rate of unemployment, but the problems with the change in quality in the registrations of vacancies makes use of this variable troublesome. But as discussed in chapter 2, the increase in the rate of vacancies relative to the rate of unemployment during the eighties shifting the UV-curve outwards is an indication of larger mismatch and larger structural problems on the Norwegian labour market.

4.3.9. Evaluation of the effects from personal income taxes and pay-roll taxes

The theories presented in chapter 3 indicate that pay-roll taxes are to be included in about the same way as productivity and prices on competing products, while the effects from personal income taxes are quite more unclear. As shown by Eriksen, Qvigstad and Rødseth (1981) and Offerdal and Strøm (1983) it is especially the progressivity in the tax system which makes it difficult to model the effect on wage formation in a simple way. Because of rather small changes in the average income tax rate in most of the years since 1970, there seems to be no room for an advanced treatment of this factor based on aggregate time series. Most of the earlier works also have problems in finding a significant effect of this variable. This is also the case for pay-roll taxes which increased substiantially from 1966 to 1973, but have been almost constant since then.

The effects from pay-roll and income taxes are estimated in both the error-correction specification and the Phillips-curve specification. A significant error-correction term for taxes would indicate that these variables had long term effects on wage formation. From specification (1) in table 4.3.13 this is not the case. When the traditional wedge term is split up into a tax wedge and a price wedge, only the price wedge gets significant, and taxes may be excluded without loss of tracking performance as shown by specification (2). However, this means that pay-roll taxes have a large effect on nominal wages even in an error correction model, somewhat contradicting the effects discussed in section 4.3.4.

In specification (3) (which is the same as specification (3) in table 4.3.3) an equal effect from the tax wedge and the price wedge may not be rejected. As discussed in section 4.3.3, this induces very large effects from income taxes on wages in the long run, especially when wage formation in other sectors and price formation are taken into account. Thus data is not able to give a clear conclusion about the effects from taxes, and apriori restrictions have to be imposed.

Table 4.3.13. Evaluation of the effects form average personal income taxes and pay-roll taxes[1]

	Estimated coefficients[2]					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-1.456 (2.43)	-1.50 (2.66)	-1.24 (2.38)	-0.004 (0.36)	-0.009 (1.00)	-0.008 (0.91)
$1/U_{t-1}^2$	0.109 (3.16)	0.102 (3.60)	0.091 (3.45)	0.059 (2.45)	0.073 (3.36)	0.070 (3.45)
Δp_{t-1}	0.21 (1.99)	0.21 (2.12)	0.21 (2.08)	0.18 (1.59)	0.22 (1.98)	0.18 (2.56)
$\Sigma\Delta p_I$	0.75 (4.69)	0.82 (6.24)	0.73 (6.01)	0.82 *)	0.78 *)	0.82*)
$\Sigma\Delta z$	0.68 (2.90)	0.62 (3.09)	0.72 (3.22)	0.85 (5.15)	0.94 (6.18)	0.93 (6.32)
Δs_t	-0.38 (0.50)	-	-	-0.24 (0.46)	-0.87 (7.55)	0.82 *)
Δt_t	-	-	-	0.03 (0.20)	-0.13 *)	0.18 *)
Δh_t	-0.77 (3.83)	-0.77 (4.43)	-0.85 (5.05)	-0.74 (3.83)	-0.67 (3.56)	-0.70 (3.95)
D79	-0.053 (4.02)	-0.053 (4.54)	-0.053 (4.21)	-0.070 (5.66)	-0.074 (6.17)	-0.076 (6.81)
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	-0.178 (2.09)	-0.188 (2.64)	-0.167 (1.98)	-	-	-
$s_{t-1} - t_{t-1} + p_{t-1} - p_{It-1}$	-	-	0.136 (2.55)	-	-	-
$s_{t-1} - t_{t-1}$	0.060 (0.56)	-	-	-	-	-
$p_{t-1} - p_{It-1}$	0.179 (2.37)	0.188 *)	-	-	-	-
Statistics						
DW	2.16	2.07	1.97	1.60	1.95	2.06
SER × 100	0.94	0.90	0.90	1.07	1.10	1.07
SSR × 1000	1.06	1.15	1.14	1.73	1.92	1.95

[1] Left hand side variable: Δw_t
[2] T-statistics in parenthesis.
*) Apriori restrictions imposed.
Estimation method: OLS. Estimation period: 1965-1987

In column (4) where the effects from pay-roll and income taxes are freely estimated in a Phillips curve specification, income taxes seem to have no effect at all, while only a part of pay-roll taxes is shifted backwards somewhat contradicting the results above. However, in specification (5), a restriction is imposed that the coefficient for taxes sum up to -1. This restriction is in accordance with economic theory which says that it ought not to matter much in the long run for wage costs paid by firms or disposable wages for workers which of the firms or the workers which actually pay the tax. When this restriction is imposed the result becomes very close to the error-correction specification (1). The restriction does not worsen the tracking performance very much compared to (4) and the Durbin-Watson statistics is even improved.

The results from both the error correction specification and the Phillips curve specification indicate that employees in manufacturing industries bear most of the taxes. This means that an increase in income taxes only has a modest effect on nominal wages, while an increase in pay-roll taxes to a large degree is shifted backwards. This is in accordance with both the Scandinavian theory of inflation and the theory of perfect competition when assuming a steep supply curve for labour towards manufacturing where a large part of the employees consist of men.

According to the theories for trade unions discussed in chapter 3, the small effects from a change in income taxes may also be due to the fact that both average and marginal tax rates are changed simultaneously. While a cut in the average tax rate should make it possible to maintain real disposable incomes with lower wage increases, a cut in marginal tax rates favour higher wage increases as the relative marginal gain of higher wages relative to the costs of lost employment is improved.

A problem with the error correction specification (1) (in addition to overcompensation of productivity when the effect through consumer prices is taken into account) is an assymmetry between income taxes and consumer prices. According to the theories for perfect competition and trade unions consumer prices and income taxes are included symmetrically when the concern is about real disposable income. As income taxes are balanced by government consumption and transfers this symmetry is not obvious. A progressive income tax system and concern among the trade unions about the distribution of income may also violate the symmetry. A more severe problem is that pay-roll taxes are not included symmetrically with prices of competing products, although the effect on competitiveness is the same. But from (3.2.9) a change in pay-roll taxes and prices on competing products do not have an equal effect on demand for labour when other inputs are taken into account in the firms' optimizing behaviour.

Although there are arguments against a symmetrical treatment of respectively consumer prices and income taxes and competing prices and pay-roll taxes, it is not likely that the assymmetry is very large. When symmetry restrictions are not rejected by data it is also most in accordance with the Scandinavian theory of inflation to have these restrictions imposed.

In specification (6) which is a special case of (5) these restrictions are also imposed without changing the results. Specification (6) is equal to the preferred Phillips curve (7) in table
4.3.3.

4.3.10. Evaluation of separate effects from productivity

From the discussion in section 4.3.4 it may be asked if productivity is included in a too restrictive way in the error correction models as productivity growth is overcompensated in the case of a traditional error correction specification with a wedge variable and probably leads to a lasting gain in competitiveness in a specification where alternative wages are included. In table 4.3.14 specifications (1) and (3) represents estimations where productivity is separated from the other components in the error correction term for competitiveness. The results from these estimations are compared with specifications (2) and (4) where the effect from productivity is restricted.

In both (1) and (3) the coefficient for productivity is significant indicating that it is correct to include productivity in the error correction terms. In the alternative wage case (1), the error correction term for wage costs relative to import prices and the wedge variable become insignificant. However, a specification where only alternative wages and productivity are of importance in the long run seem somewhat strange, because productivity growth then means that relative wages change for ever.

A weakness with (1) compared to (2) is that the long term effect from productivity is even smaller (0.25 versus 0.35), and this more flexible model is thus of no help in attempts to avoid a possible lasting gain in competitiveness with an alternative wage specification. An F-statistics $F(1,13) = 0.79$ also indicates that the productivity restriction imposed in (2) (which is the same as (2) in table 4.3.3) may not be rejected.

A weakness with specification (3), where alternative wages is not included, is that the partial effect from prices on competing goods vanishes. Although the partial long term effect from productivity declines from 1 to 0.80, an increase in the indirect effect through consumer prices still makes a total effect of 1.36 against 1.49 in table 4.3.7. It is therefore only of minor importance which of the specifications (3) and (4) are chosen, but some concern for competitiveness may make (4) (which is the same as (3) in table 4.3.3) more satisfactory.

4.3.11. Effects of changes in the normal working hours and the wage and price regulation, 1978-1979

In the period of estimation main reductions in the normal working hours took place in 1968 (from 45 to 42.5 hours a week), in 1976 (from 42.5 to 40) and in 1987 (from 40 to 37.5). These reductions were in the same period followed by increases in hourly wage rates as the trade unions aimed at keeping up the wage earners yearly income. Because the shortenings of the normal working hours have taken place at sudden jumps it seems natural to think that this has caused larger wage growth in those years than indicated by prices and productivity. According to the Scandinavian theory of inflation one should however expect that wage growth caused by changes in normal working hours did not have an effect on the wage level in the long run. This should mean lower growth than

Table 4.3.14. Evaluation of separate effects from productivity[1)]

	Estimated coefficients[2)]			
	(1)	(2)	(3)	(4)
Constant	-1.24	-1.40	-1.30	-1.24
	(2.83)	(3.58)	(2.73)	(2.39)
$1/U^2_{t-1}$	0.072	0.069	0.082	0.091
	(2.73)	(2.67)	(2.92)	(3.45)
Δp_{t-1}	0.13	0.14	0.18	0.21
	(1.38)	(1.38)	(1.75)	(2.08)
$\Sigma\Delta p_I$	0.96	0.93	0.81	0.74
	(6.45)	(6.45)	(5.90)	(6.01)
$\Sigma\Delta z$	0.39	0.37	0.59	0.72
	(1.43)	(1.37)	(2.18)	(3.23)
Δh_t	-0.94	-0.92	-0.85	-0.85
	(6.14)	(6.12)	(5.36)	(5.05)
D79	-0.059	-0.054	-0.052	-0.054
	(5.17)	(5.47)	(4.43)	(4.21)
$w_{t-1} + s_{t-1} - p_{I,t-1} - z_{t-1}$	-	-0.164	-	-0.167
		(3.36)		(1.98)
$s_{t-1} - t_{t-1} + p_{t-1} - p_{It-1}$	0.101	0.164*)	0.184*)	0.136
	(1.20)	(3.56)	(2.33)	(2.55)
$w_{t-1} - \overline{w}_{t-1}$	-0.50	-0.311	-	-
	(1.90)	(2.06)		
z_{t-1}	0.150	-	0.147	-
	(3.05)		(2.76)	
$w_{t-1} + s_{t-1} - p_{I,t-1}$	-0.101	-	-0.184	-
	(1.20)		(2.33)	
Statistics				
DW	1.99	1.80	1.83	1.97
SER × 100	0.81	0.81	0.88	0.90
SSR × 1000	0.86	0.91	1.09	1.14

1) Left hand side variable Δw_t.
2) T-statistics in parenthesis.
*) Apriori restrictions imposed.
Estimation method: OLS. Estimation period: 1965-1987.

indicated by the growth in prices and productivity in the years after a shortening of normal working hours.

From the estimations presented in table 4.3.3 the error correction term for the Scandinavian theory of inflation is not significant or even of the wrong sign unless it is combined with a wedge term including consumer prices and taxes. In principle the normal working hours could be included among the wedge variables, and if the change in these variables contribute to explain why Norwegian manufacturing industries have lost competitiveness during the seventies and eighties, the shortening of normal working hours may also have had an effect. In a Phillips-curve specification the shortenings of normal working hours also may be expected to have a short run effect on wage growth, but this may be offset by lower growth in the years afterwards.

In the specifications presented in table 4.3.3 a shortening of the normal working hours by 1 per cent is estimated to have an immediate effect on wage growth of 0.70 to 0.92 per cent. This is in accordance with the results presented in NOU 1988:24, and indicate that the shortenings of the normal working hours are not fully compensated.

Based on the Phillips curve (column 7 in table 4.3.3) lags on the change in normal working hours are included to reflect possible smoothing out effects. The results presented in the second line of table 4.3.15 only give a weak indication of such effects. The total coefficient is reduced by only 0.1 percentage points, and the coefficient of the lagged variable is far from being significant. Experiments with further lags did not give any more smoothing effects. The direct compensation in wages as a result of the shortenings of the normal working hours in 1968 and 1976 does not seem to be balanced by lower growth in wage rates in the following years. The situation may be somewhat different in

Table 4.3.15. Effects of changes in the normal working hours and the wage and price regulations 1978-1979

Specification	Estimated coefficients 1965-1987[1]						SSR × 1000	DW
	$\Delta p(-1)$	Δh	$\Delta h(-1)$	$\Delta h(-2)$	D79	D80		
Dummy 78/79 and no lags on normal working hours	0.18 (2.56)	-0.70 (3.45)	-	-	-0.076 (6.81)	-	1.95	2.06
Lags on normal working hours	0.17 (2.22)	-0.70 (3.64)	0.11 (0.45)	-0.03 (0.11)	-0.076 (6.03)	-	1.92	2.10
Catch up effects in 1980/81	0.13 (2.06)	-0.58 (3.56)	-	-	-0.082 (8.14)	-0.033 (2.48)	1.41	2.10

1) T-values in parenthesis.

Δp - relative change in consumer prices

Δh - relative change in normal working hours

D79 - Dummy for wage and price regulation (0.25 in 1978 and 1 in 1979)

D80 - Catch up dummy (0.75 in 1980 and 0.5 in 1981)

1987 where the shortening of normal working hours was followed by a wage and income freeze in 1988 and 1989.

The wage and price regulations in 1978-1979 gave a sudden and significant reduction in wage growth. In the Phillips curve relations presented in table 4.3.3 the effect is estimated to be between 7 and 8 per cent per year, but in the error-correction specifications with a wedge term putting large weight on consumer prices, the direct coefficient is much smaller as the growth in consumer prices also was significantly reduced.

In a Phillips curve specification, where more weight is put on prices of competitive products, it is of interest to analyse if there is any catch up effects which is indicated by the Scandinavian theory of inflation. The last line of table 4.3.15 does not indicate any such effects in 1980 and 1981 implying that the wage level did not return to its old path after the abolishment of the regulations. On the contrary the estimation results show that wage growth is overpredicted even in 1980 and 1981.

The large growth in the international prices following from the shock in oil prices in 1980 and a rather tight labour market in Norway are the main explanatory factors behind the wage growth in the beginning of the eighties. The wage and price regulations may then have had a lasting effect on the wage level. The results may seem to be somewhat in contradiction with the results reported in Bowitz (1989) based on quarterly data. However, the transition from quarterly data to yearly averages means a smoothing of the time series. The wage regulations in 1979 have contributed to limit the growth in wage rates from 1979 to 1980 calculated as an yearly average. Although the ordinary explanatory factors overpredicts the average wage growth from 1979 to 1980 some catch up may have taken place during 1980 in accordance with Bowitz's results. Bowitz also concludes that the catch up is only one third of the immediate effect, indicating that the wage regulation have had a lasting effect on the wage level.

In an error correction model with a wedge variable opening for a lasting shift in the wage level after the wage and price regulations in 1978/79, this dummy-variable got a coefficient of -4 per cent with a t-statistics of 6.48. This indicates that the form the dummy-variable is included is of importance for the results in an error correction model.

4.3.12. Institutional factors behind wage formation

This section gives an overview of the institutional aspects behind wage formation. As no new experiments are carried out, the section is mainly a summary of the conclusions drawn in NOU 1988:24.

As presented in section 2.3.3 wage growth in manufacturing industries may be decomposed into central wage increases and wage drift, and the development in these two components has been analysed in a lot of earlier works (see e.g. NOU 1977:26, Hersoug (1983), Isachsen and Raaum (1983), Holden (1987 and 1989), Bowitz (1989) and Bruce (1989). Because of different explanatory factors and different periods of estimation the results differ quite a lot between the different works. In most of the works it has been quite more difficult to explain central wage increases than wage drift.

An improvement in Hersoug's (1983) analysis compared to the earlier contributions is the introduction of main and intermediate settlements. This seems to be important when explaining the central wage increases as they get significantly larger in the main settlements than in the intermediate. There may be a weakness in Hersoug's analysis that the two kinds of settlements (taking place each second year) are not seen in connection. A dummy variable introduced to capture the extra wage growth in the main settlements may then lead to an underestimation on the effects from the economic factors on the central wage increases. Few lags on the economic variables may also lead to an underestimation of the impacts from them because it may take some time before the variables have full impact on the wage rates.

The analysis made by Bruce (1989) thus indicates that the economic factors are of most importance leaving little room for significant effects of dummies for the different kinds of settlements. For the manufacturing sectors with the highest wage level Bruce finds that prices of competing products, productivity and the rate of unemployment may be important explanatory factors for the central wage increases although the effects from consumer prices may not be excluded. In industries with lower wages the general wage level in the aggregate manufacturing sector seems to be of great importance because of extra wage increases demanded for these sectors in the central agreements in order to keep up the relative wage position.

From figure 2.3.2 it is evident that wage drift follows a smoother path than the central wage increases, and the difference between main and intermediate settlements is not important. One main point in the analysis of wage drift has been to estimate the effect from the central wage increases on wage drift. Most of the works do not find any such effects indicating that central wage settlements have a considerable impact on aggregate wages in the short run. A decomposition in central wage increases and wage drift may then seem to be of great importance in explaining total wage growth for the manufacturing industries. Both Bruce (1989) and Bowitz (1989) found that prices and productivity might be important factors in determening wage drift. The results in Holden (1989) indicate that wage drift also depends negatively of the size of inventories. All these variables reflect that wage drift fluctuates over the cycle. Holden also points out that a higher rate of vacancies contributes to higher wage drift while both Bruce and Bowitz do not find any great effect from the pressure on the labour market. In fact Bruce concludes that the rate of unemployment seems to have had larger effects on the central wage increases than the wage drift indicating that LO may show more responsibility in the central settlements than the local trade unions if unemployment gets high.

A rather large constant term has been a common result in most of the analyses of wage drift indicating that wage drift may exist independent of changing economic factors. This result may be in conflict with the estimations for the aggregate wage growth presented in table 4.3.3 unless there is a large negative constant term in the relations for central wage increases. However, this may seem unrealistic as the equations for central wage growth then would indicate cuts in nominal wages under the central settlements in situations with low growth in prices and productivity and high unemployment.

A weakness with the estimations for wage drift indicating a rather large constant term is rather low coefficients for prices and productivity. Adding the equations for central wage increases and wage drift together then gives an aggregate wage equation with coefficients for prices and productivity far from 1, restrictions which could not be rejected according to the results presented in table 4.3.3. This indicates that the large constant term in the wage drift equations catches up effects from the economic variables. If economic variables are the most important factors explaining both central wage increases and wage drift, this also indicates that analyses of the two components separately may not give a more satisfactory explanation of total wage growth in the long run than the total wage equations presented in table 4.3.3. In the short run it may however be important to separate between the two components, but only the aggregation to yearly averages may smooth out much of the fluctuations in the central wage increases because of the central income settlements taking place in the spring. It therefore seems reasonably to conclude that high central wage increases in one period probably are offset by lower central wage increases in the next period or lower wage drift in the present or the next period. Especially main and intermediate settlements have to be evaluated together regarding the central wage increases.

A lot of other institutional factors than the ones already mentioned may also affect both equilibrium unemployment and wage formation. In their study Layard, Nickell and Jackman (1991) include the duration of unemployment benefits, the replacement ratio, the amount of active labour market spending and the degree of unionisation, centralisation and coordination in the wage settlements. These factors seem quite relevant in explaining differences between countries, but regarding wage formation in a single country it has proved difficult to collect time series data of good quality.

In 1984 the maximal period where unemployed were allowed to achive unemployment insurance increased, but as shown in table 4.3.8 it is not possible to find any significant effect from the share of long term unemployed on wage formation, although the coefficient is of the proper sign. From table 4.3.12 the share of unemployed on labour market programmes are found to have a positive but not significant partial effect on wage formation. As a part of the participants on labour market programmes are calculated as employed according to the Labour Force Sample Survey, some of this effect is included by use of this variable.

The importance of the degree of organization is discussed in NOU 1988:24 and the results seem to be rather mixed between industries. While the degree of organization is large in the public sectors, these sectors seem to have lost relative wage position compared to the private industries. On the other hand a large degree of organization in manufacturing industries has contributed to maintain the relative wage level in sectors facing falling demand.

Except from the central wage increases being higher in the main settlements, it is not possible to draw a clear conclusion about the effects from the degree of coordination in the settlements. The coordinated settlements in 1974 and 1986 seem to have given wage increases which were higher than explained by the economic factors, although a tight labour market and large strong growth in prices on competing products and productivity may explain most of the large central wage increases in those years. For the coordinated settlements in 1982 and 1984 however, wage growth did not seem to be higher than explained by the economic factors.

4.4. Wage formation in the different industries

4.4.1. Choice of specification and explanatory factors

The aim of this section is to present estimation results for wage equations for the most important sectors regarding employment according to the aggregation level of the macroeconomic model MODAG. The point of departure is the general wage equation (4.2.2) which postulates that wages in the different industries in the long run may move according to a weighted average of wage rates necessary to keep up relative wage position, competitiveness (only for competing industries) and real disposable income. Based on theoretical considerations it is reasonable to impose a homogeneity restriction on the nominal explanatory variables, indicating that the error-correction terms are specified in a way that secures the weights on the three factors to sum up to 1. With the specification (4.2.2) this is automatically fulfilled.

My approach is very close to the one presented by Eitrheim and Nymoen (1991) and Nymoen (1991), but instead of the error-correction term for real disposable wages they prefer a wedge variable catching up the effects from changes in taxes and the possibility of consumer prices developing differently compared to the sectors' product prices. Although this way of presentation is not inferior econometrically, it may cause some problems when interpreting why wage costs per unit produced in Norway increase more than competitive prices. As pointed out in section 4.3.3 a natural consequence is to estimate a relatively large weight for consumer prices for the exposed sectors, explaining the loss in competitiveness by the fact that consumer prices have increased more than prices on competing products, disregarding the simultaneity involved. This may be even more severe when such wedge-terms are used for sheltered industries, where wage growth are shifted over to product prices. However to check this problem Eitrheim and Nymoen (1991) perform a full dynamic simulation on the Bank of Norway macromodel where the wage equations are included. The fit does not deteriorate dramatically compared with the fit of the separate wage equations indicating that the model passes this test of consistency. But as pointed out by Eitrheim and Nymoen this test may be rather weak, and the way of specification may be of great importance when the model is used in policy simulations.

Another problem is that it is not obvious what variable should be chosen as an indicator for alternative wages. One possible approach chosen by Eitrheim and Nymoen (1991) is to define the alternative wages as a weighted average of the wages in the other three sectors. This is not obviously the best way of doing it in a more disaggregated model like MODAG. According to the Scandinavian theory of inflation wages in sheltered sectors follow the wages in the exposed sectors, i.e. manufacturing. It is also an institutional fact that the other sectors look at the results from the LO/NHO area (or some part of it) where wages normally are settled first. Average manufacturing wages may therefore be a relevant indicator for wage growth in the other sectors, and the results found by Eitrheim and Nymoen support this view. They do not find any indication of alternative wages being important for wage formation in production of export goods nor production of capital goods and service production. However, in Nymoen (1991) a significant coefficient for alternative wages is reported in the wage equation for the exposed sector. The different results indicate that the weights for the different nominal variables in such an equation may be quite sensitive to the way of specification reflecting the discussion in section 4.3.3.

In a disaggregated approach there may be possible wage effects between other sectors in addition to the effects between manufacturing and other industries. Based on the institutional arrangement of the income settlements in the public sector, Strøm (1991) finds support for wages in production of central government services influencing wages in local government services. Although some gain in tracking performance thus could be achieved by searching for the most relevant indicator(s) for alternative wages, this work is restricted to look at the effects from average manufacturing wages. As pointed out in chapter 2 wage growth is rather parallel in many sectors and there may be a tendency for multicolinearity problems although the analysis is restricted to include manufacturing wages, consumer prices and prices on competing products for the exposed sectors.

A special problem appears regarding alternative wages when estimating wage equations for the different manufacturing industries. As pointed out in chapter 2 wage growth has been rather parallel between these sectors. One view is that Production of fabricated metal products (which is the most important sector regarding employment) acts as a wage leader for the other sectors. However, the quality of data for competing prices and productivity seems to be much weaker for one disaggregated industry than for the whole manufacturing sector making this approach vulnerable to data quality. The strong coordination during the income settlements for manufacturing industries and high central wage increases for major sectors with the lowest wage level, and where wage drift is of minor importance, may be the main reason for the observed parallel development. Factors explaining wage formation for the average manufacturing industry may then be relevant when explaining wage formation for the different sectors. To avoid an otherwise obvious problem of simultaneity an instrument based on one of the preferred estimations from section 4.3 is used as an explanatory factor for wage formation in each of the disaggregated manufacturing sectors.

Another problem is how taxes ought to be included in the error-correction terms, reflecting the long term properties of the equations. From the economic theory outlined in chapter 3 it may seem relevant to include personal income taxes in the same way as consumer prices when real disposable income is held to be of concern for both unions and suppliers of labour. Pay-roll taxes are naturally included in the same way as productivity and prices on competing products.

As discussed in section 4.3 the functional form for the rate of unemployment only seems to be of minor importance for the tracking performance and the coefficients for the other variables. Concern for parameter stability and theoretical properties seem to favour the $1/U_{t-1}^2$ specification, and this variable is used for the disaggregated sectors without further discussion. For sectors where wages for average manufacturing are of great importance the direct effect of the unemployment term often vanishes.

According to the discussion above significant error-correction terms for competitiveness and real disposable income mean that relative wages may change in the long run. The term for real disposable income catches up different effects from consumer prices and income taxes across sectors, while the term for competitiveness catches up different effects and development in prices on competing products, productivity and pay-roll taxes. To reflect the possibility of different effects from productivity growth between manufacturing and the sheltered sectors an additional wedge term for productivity differences ($z/\bar{z}$) is included for these sectors.

When the rate of unemployment has a significant separate effect in the wage equations for the different sectors, shifts in this rate will shift the relative wage position. If none of the error-correction terms are significant, while the rate of unemployment is, we have a Phillips curve specification. A shift in the rate of unemployment may in this case cause a continuous change in the relative wages, and this may be troublesome if the equilibrium rates differ between sectors or if we choose a hysteresis specification for total manufacturing.

Different changes in the normal working hours between the sectors may also have caused shifts in relative hourly wage rates and the normal annual working hours relative to manufacturing ($h/\bar{h}$) has been included as an extra wedge term for all sectors.

Changes in the composition of employment in the different sectors may also cause changes in the average wages if the wage level differs between groups in a sector. Different changes in the composition may then also influence the relative wage position. Wages may differ both by gender, age, education, occupation and region. Due to lack of good data the analysis is restricted to look at the possible effects from shifts in the composition by gender. A variable specified on the form $(1-0.2LK)/(1-0.2\overline{LK})$ is included to catch up this effect. The variable LK is the share of man-hours done by women in each sector, and the whole term gets equal to one if the share of man-hours is equal to the share in average manufacturing ($\overline{LK}$). An increase in the share relative to manufacturing, may weaken the relative wage position. The coefficient 0.2 reflects the difference between women's wages and men's wages of 20 per cent in most sectors during the eighties. Although it is simplification to include this coefficient as a constant both over time and between sectors, the variable may catch up the most important effects from shifts in the composition of labour.

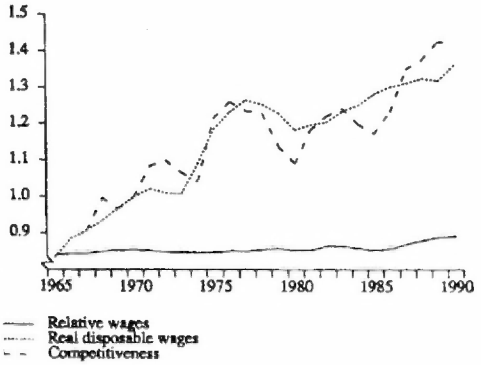
The general wage equation for the different industries is of the form:

$$
\begin{aligned}
\Delta w_t &= c_0 + c_1/U_{t-1}^2 + c_2\Delta\bar{w}_t + c_3(L)\Delta p_t(L) + c_4(L)\Delta p_I(L) + c_5(L)\Delta z(L) \\
&+ c_6\Delta s_t + c_7\Delta t_t + c_8\Delta h_t + c_9\Delta n_t + c_{10}D79 + c_{11}(w_{t-1} + \bar{w}_{t-1}) \\
&+ c_{12}(w_{t-1} - p_{t-1} - z_{t-1} + s_{t-1}) + c_{13}(w_{t-1} + h_{t-1} - p_{t-1} + t_{t-1}) \\
&+ c_{14}(z_{t-1} - \bar{z}_{t-1}) + c_{15}(h_{t-1} - \bar{h}_{t-1}) + c_{16}(lk_{t-1} - \overline{lk}_{t-1})
\end{aligned}
\tag{4.4.1}
$$

The variables are explained in section 4.2, and lower case letters mean they are in natural logaritms. $lk = \log(1 - 0.2LK)$.

As for the estimation of wage equations for average manufacturing presented in section 4.3, some restrictions have to be made apriori to obtain some degrees of freedom. A kind of iterative process has also been necessary. In the tables presenting the estimated wage equations for the different sectors the relevant variants regarding the error-correction specifications are shown irrespective of correct sign and significance while variables representing short run dynamics and shifts in the composition of labour are not presented if they showed up with a wrong sign or a low t-statistics.

Figure 4.4.1. Production of consumer goods. Wages relative to average manufacturing and indices for competitiveness and real disposable wages (1970=1)



4.4.2. Production of consumer goods

From figure 4.4.1 the level of hourly wage rates for Production of consumer goods was about 85 per cent of the wage level for total manufacturing during the sixties and seventies and has increased to about 89 per cent towards the end of the eighties.

The Dickey-Fuller tests reported in table 4.4.1 indicate that this relative wage has been stationary during the period of observation, but with a weak positive deterministic trend. The growth in wage rates has also been stationary. Because of the large growth in wages, the figure indicates that the sector has lost competitiveness (indicated by the increasing index), and the wage earners have experienced

Table 4.4.1. Dickey-Fuller tests for stationarity of variables regarding wage formation in Production of consumer goods

Variable	T-statistics	Constant	Trend	Period
Δw	-2.49	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.24	0	0	1967-1987
WR3	-3.21	+	+	1965-1987
ΔWR3/WR3(−1)	-3.14	0	0	1966-1987
COMP	-1.16	+	0	1965-1987
ΔCOMP/COMP(−1)	-2.35	0	0	1966-1987
WR	-2.32	+	+	1965-1987
ΔWR/WR(−1)	-1.97	0	0	1966-1987

w - Logarithm of nominal hourly wage rate according to the National Accounts
WR3 - Relative hourly wage rate compared to manufacturing industries
COMP - Indicator for competitiveness (hourly wage costs relative to import prices and productivity)
WR - Real disposable income (yearly wage rates corrected for taxes and divided by official consumer price index)

Table 4.4.2. Wage equations for Production of consumer goods[1)]

Variables[3)]	Estimated coefficients[2)]				
	(1)	(2)	(3)	(4)	(5)
Constant	-0.055 (0.30)	-0.117 (0.51)	-0.140 (2.24)	-0.120 (2.04)	-
$\Delta \overline{w}_t$	0.77 (6.35)	0.77 (6.14)	0.78 (6.63)	0.80 (7.03)	1.00 (36.70)
Δp_t	0.20 (1.53)	0.19 (1.35)	0.19 (1.48)	0.22 (1.86)	-
Δp_{t-1}	0.13 (1.04)	0.11 (0.89)	0.10 (0.94)	-	-
$\Sigma \Delta p$	0.33	0.30	0.29	0.22	-
Δh_t	-0.42 (2.03)	-0.39 (1.91)	-0.38 (2.05)	-0.38 (2.05)	-0.24 (1.30)
$w_{t-1} - \overline{w}_{t-1}$	-0.73 (1.47)	-0.86 (1.82)	-0.88 (2.30)	-0.77 (2.12)	-
$w_{t-1} + s_{t-1} - pI_{t-1} - z_{t-1}$	-0.026 (0.50)	-	-	-	-
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-	-0.00 (0.10)	-	-	-
<u>Statistics</u>					
DW	1.75	1.74	1.75	1.80	1.93
SER × 100	1.13	1.14	1.11	1.10	1.18
SSR × 1000	1.92	1.95	1.96	2.06	2.80

1) Left hand side variable Δw_t. Instrument used for $\Delta \overline{w}_t$. Period of estimation: 1966-1987.
2) Absolute t-values in parenthesis.
3) The variables are explained in section 4.2.1.

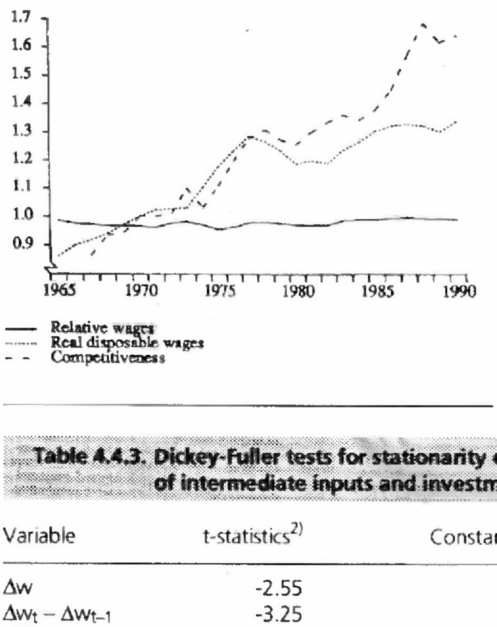
growth in real disposable incomes. In the table this shows up as a non-stationary term for competitiveness and a term for real disposable income with a deterministic trend.

From the time series properties outlined in table 4.4.1, it may seem necessary that some of the long-term variables integrated of order 1 (I(1)) or stationary with a deterministic trend may be cointegrated to explain the stationarity property of wage growth. The coefficient attached to competitiveness and real disposable income turn out to be small and insignificant.

The error-correction term for relative wages is significant when the other error-correction terms are omitted, and a rather large coefficient in absolute value indicate that wages in production of consumer goods move very close to wages in average manufacturing as reflected by figure 4.4.1. This is also evident from the rather large short term coefficient for Δw_3, and an F-observator $F(3,17)=2.03$ when testing (5), where the error-correction term is excluded, against (3) indicate that a parallel development even in the short run may not be rejected. A rather parallel development in normal working hours and a constant share of man-hours done by women resulted in no long-term effects from these variables which are excluded from the table.

Because of the significance of the coefficients (4) is the preferred relation. In addition to growth in average manufacturing wages, consumer prices and changes in the normal working hours have some effect in the short run. It may be noticed that neither the sector's competitive prices nor productivity seem to have an effect on wage growth. Neither unemployment, income and pay-roll taxes have any direct effect, but indirectly these variables work through the impact on wages for average manufacturing.

Figure 4.4.2. Production of intermediate inputs and investment goods. Wages relative to average manufacturing and indices for competitiveness and real disposable wages (1970=1)



4.4.3. Production of intermediate inputs and investment goods

From figure 4.4.2 the wage level in production of intermediate inputs and investment goods has been very close to the wage level for total manufacturing in the whole period since 1965, and the Dickey-Fuller tests for this relative wage reported in table 4.4.3 indicate that a non-stationary assumption is rejected. Because of the large correlation with wages in total manufacturing, also the growth in wage rates for this sector is stationary with a positive constant. From the figure it is also evident that the sector has lost competitiveness while the wage earners have experienced a growth in real disposable

Table 4.4.3. Dickey-Fuller tests for stationarity of variables regarding wage formation in production of intermediate inputs and investments goods

Variable	t-statistics[2)]	Constant	Trend	Period
Δw	-2.55	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.25	0	0	1967-1987
WR3	-3.37	+	0	1965-1987
ΔWR3/WR3(−1)	-2.90	0	0	1966-1987
COMP	-3.43	+	+	1965-1987
ΔCOMP/COMP(−1)	-3.13	+	0	1966-1987
WR	-2.69	+	+	1965-1987
ΔWR/WR(−1)	-2.88	+	0	1966-1987

1) The variables are explained in table 4.4.1.
2) A 5 per cent critical value for T=25 is reported to -1.95 in Fuller (1976).

income. In the table this is indicated by a deterministic trend for competitiveness and real disposable wages.

From the time series properties presented in table 4.4.3, it may seem relevant that wages in average manufacturing is a very important factor for wages in this sector in the long run. As both competitiveness and real disposable wages show a deterministic trend it is not surprising that error-correction terms for these variables reported in column (1) and (2) in table 4.4.4 turn out to be non-significant. The coefficient for relative wages is

Table 4.4.4. Wage equations for Production of intermediate inputs and investment goods[1]

Variables[3]	Estimated coefficients[2]				
	(1)	(2)	(3)	(4)	(5)
Constant	-0.010	-0.035	0.015	-0.006	0.013
	(0.15)	(0.24)	(1.39)	(0.40)	(0.92)
$\Delta\overline{w}_t$	0.74	0.74	0.74	0.69	0.73
	(6.37)	(6.36)	(6.59)	(6.26)	(6.13)
Δh_t	-0.33	-0.33	-0.34	-0.13	-0.34
	(1.60)	(1.58)	(1.69)	(0.60)	(1.62)
D79	-0.020	-0.020	-0.019	-0.014	-0.019
	(1.49)	(1.49)	(1.49)	(1.16)	(1.40)
$w_{t-1} - \overline{w}_{t-1}$	-0.51	-0.51	-0.56	-	-0.59
	(1.96)	(1.88)	(2.37)		(1.93)
$w_{t-1} + s_{t-1} - pI_{t-1} - z_{t-1}$	0.01	-	-	-	-
	(0.40)				
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-	0.01	-	-	-
		(0.35)			
$h_{t-1} - \overline{h}_{t-1}$	-	-	-	-9.58	-0.36
				(2.03)	(0.19)
$lk_{t-1} - \overline{lk}_{t-1}$	-	-	-	-4.67	-
				(2.11)	
Statistics					
DW	1.99	2.01	1.93	1.95	1.89
SER × 100	1.11	1.13	1.11	1.03	1.13
SSR × 1000	2.03	2.04	2.06	1.58	2.05

1) Left hand side variable Δw_t. Instrument used for $\Delta\overline{w}_t$. Period of estimation: 1966-1987.
2) Absolute t-values in parenthesis.
3) The variables are explained in section 4.2.1.

however significant, corresponding to the stationarity properties of both wage growth and relative wages over the period of estimation.

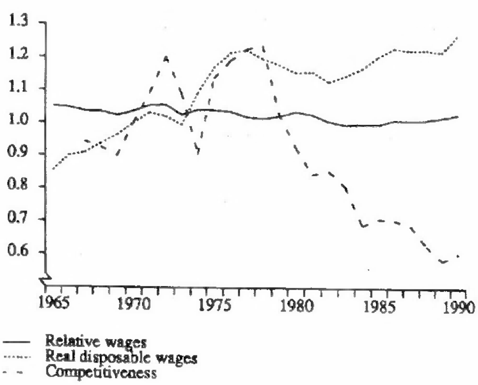
From specification (4) different changes in normal working hours and changes in composition of employment by gender also seem to have a significant effect. The coefficient for the "relative" share of women ($lk_t = \log(1 - 0.2LK_t)$) is however of the wrong sign reflecting an increasing share relative to average manufacturing at the same time as the relative wage shows a weak increasing trend. Compared to (3) an F-statistics F(2,15) = 2.28 indicates that (4) is not significantly better. The coefficient for relative working hours in (4) also indicate a long run elasticity of about 11 per cent which is very unlikely. When the relative share of women is excluded in specification (5), the long-run effect from relative normal working hours is very small and far from significant. The result reflects the fact that normal working hours in this sector has been moving very close to average manufacturing.

Specification (3) is thus the preferred equation, and in addition to growth in average manufacturing wages shortenings of the normal working hours and the price and income regulations in 1978/79 seem to have had an effect in the short run, although not quite significant. Competitive prices and productivity have not had any effect in this sector either, and are therefore omitted from the table. Unemployment, consumer prices, income taxes and pay-roll taxes have neither had any direct effect, but work through the impact on wages for average manufacturing.

4.4.4. Production of paper and paper products

In the sixties the wage level in Production of paper and paper products was about 5 per cent higher than for total manufacturing, but from figure 4.4.3 this difference has declined in the seventies and eighties. The Dickey-Fuller tests for the relative wage reported in table 4.4.5 indicate that this variable is stationary but with a negative deterministic trend. Because of a clear correlation with wages in total manufacturing, also the relative growth in wage rates in this sector has been stationary. However, because of a strong growth in both competitive prices and productivity the sector has gained competitiveness indicated by the falling curve in figure 4.4.3. The Dickey-Fuller test shows that competitiveness has been non-stationary. The growth in wages has however been strong enough to secure a growth in real disposable incomes, and this variable is in the table also found to be non-stationary.

Figure 4.4.3. Production of paper and paper products. Wages relative to average manufacturing and indices for competitiveness and real disposable wages (1970=1)



Because of the time series properties of the variables in table 4.4.5 all the coefficients for the error-correction terms reported in columns (1) and (2) in table

Table 4.4.5. Dickey-Fuller tests for stationarity of variables regarding wage formation in Production of paper and paper products

Variable	t-statistics[2)]	Constant	Trend	Period
Δw	-2.00	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.39	0	0	1967-1987
WR3	-2.84	+	-	1965-1987
ΔWR3/WR3(−1)	-4.23	0	0	1966-1987
COMP	-0.82	+	0	1965-1987
ΔCOMP/COMP(−1)	-2.84	0	0	1966-1987
WR	-1.85	+	0	1965-1987
ΔWR/WR(−1)	-2.03	+	0	1966-1987

1) The variables are explained in table 4.4.1.

4.4.6 are small and insignificant, but the term for relative wages gets the largest coefficient. When the other error-correction terms are excluded in specification (3) the coefficient for relative wages is still insignificant. Changes in manufacturing wages have a rather strong short term effect on wage growth in these relations, and specification (4) where all the error-correction terms are excluded and price homogeneity is imposed is not significantly weaker than the more general specifications (1) to (3). Changes in competitive prices also seem to have a significant effect, and although the effect is small compared to average manufacturing this variable may cause the wages in this sector to deviate somewhat. No other variables seem to have any direct effects on wage growth in specification (4).

While normal working hours have declined more in this sector relative to average manufacturing and relative wages also have declined, an error-correction term for relative working hours turned out to have the wrong sign, but was not significant. The share of man-hours done by women has also been constant, and has not had any effect on average wage growth in this sector. The effects from relative working hours and changes in composition of employment by gender are thus not reported in the table.

Specifications (5) and (6) where the short term effects from average wage growth is excluded in favour of longer lags on competitive prices and inclusion of unemployment, income regulations and error-correction terms, may however be alternatives to (4) as the tracking performance is improved although the Durbin- Watson statistics indicates misspecification. Also in these specifications the wage level for average manufacturing is the most important factor in the long run, but a small (and almost significant) weight is also put on real disposable income in specification (5). As the coefficients for the rate of unemployment are rather large in both (5) and (6), shifts in this variable may cause the wage level in Production of paper and paper products to deviate from average manufacturing according to these specifications. The rather low Durbin-Watson statistics in (5) and fewer explanatory variables in (4) makes (4) the preferred specification as the tracking performance is not much weaker.

As electricity is an important input in production of paper and paper products the change in the relative price on inputs compared to competitive prices is suggested as an

Table 4.4.6. Wage equations for Production of paper and paper products[1)]

Variables[3)]	Estimated coefficients[2)]						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.116	0.194	-0.001	-	0.556	0.039	-
	(1.26)	(0.89)	(0.06)		(2.01)	(3.38)	
$1/U^2_{t-1}$	0.060	0.044	0.044	-	0.171	0.165	-
	(1.36)	(1.01)	(1.04)		(3.13)	(3.38)	
$\Delta\overline{w}_t$	0.82	0.89	0.89	0.93	-	-	0.90
	(5.81)	(6.09)	(7.19)				
Δp_{It}	0.10	0.08	0.07	0.07	0.22	0.21	0.10
	(1.98)	(1.57)	(1.69)	(2.31)	(5.19)	(4.71)	(3.04)
Δp_{It-1}	-	-	-	-	0.13	0.11	-
					(3.11)	(2.61)	
Δp_{It-2}	-	-	-	-	0.16	0.11	-
					(2.88)	(2.48)	
$\Sigma\Delta p_I$	-	-	-	-	0.51	0.43	-
$\Delta(p_{Mt} - p_{It})$	-	-	-	-	-	-	0.08
							(1.54)
$\Delta(p_{Mt-1} - p_{It-1})$	-	-	-	-	-	-	0.06
							(1.18)
$\Sigma\Delta(p_M - p_I)$	-	-	-	-	-	-	0.14
Δh_t	-0.14	-0.14	-	-	-0.81	-0.70	-
	(0.53)	(0.50)			(3.08)	(2.78)	
D79	-	-	-	-	-0.038	-0.049	-
					(2.31)	(3.02)	
$w_{t-1} - \overline{w}_{t-1}$	-0.13	-0.36	-0.26	-	-0.75	-0.47	-
	(0.42)	(1.07)	(0.89)		(1.85)	(1.50)	
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	-0.03	-	-	-	-	-	-
	(1.27)						
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-	-0.03	-	-	-0.08	-	-
		(0.90)			(1.86)		
Statistics							
DW	2.05	1.98	1.82	1.90	1.13	1.13	1.80
SER × 100	1.37	1.40	1.36	1.29	1.38	1.44	1.25
SSR × 1000	2.80	2.95	3.14	3.50	2.44	3.14	2.96

1) Left hand side variable: Δw_t. Instrument used for $\Delta\overline{w}_t$. Period of estimation: 1966-1987.

2) Absolute t-values in parenthesis.

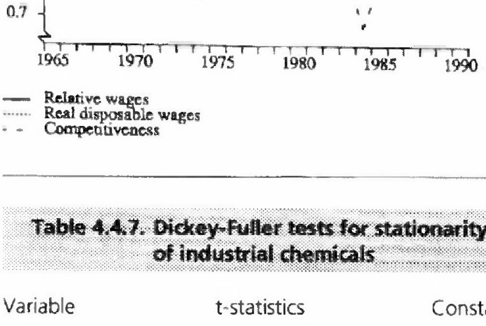
3) The variables are explained in section 4.2.1.

explanatory factor in relation (7). The effects on wages of changes in prices of other inputs are not quite certain from economic theory, but one should perhaps expect that higher prices should mean lower wages to keep up the share of profits. Although prices on material inputs have increased relative to competitive prices during the period of estimation this seems to have had no dampening effect on wage growth, and the coefficients are even of the wrong sign.

4.4.5. Production of industrial chemicals

According to figure 4.4.4 the wage level in Production of industrial chemicals has fluctuated between 10 and 25 per cent over the wage level for total manufacturing from the early sixties to the late eighties. The relative wage reached a temporary peak during the early eighties and has thereafter declined. The Dickey- Fuller tests reported in table 4.4.7 how ever indicate that relative wages are stationary with a deterministic trend. Also the relative growth in wage rates for this sector has been stationary over the period of observation, but in the same way as for production of paper products wage cost per unit produced has increased less than competitive prices implying a gain in competitiveness although the Dickey-Fuller tests in table 4.4.7 indicate that the index for competitiveness is stationary. From figure 4.4.4 the index for competitiveness shows great fluctuations reflecting fluctuations in productivity according to the national accounts. The growth in wage rates has also caused the wage earners to experience growth in real wages especially in the sixties and the first half of the seventies, and the Dickey-Fuller tests indicate that this variable is non-stationary.

Figure 4.4.4. Production of industrial chemicals. Wages relative to average manufacturing and indices for competitiveness and real disposable wages (1970=1)



As presented in relation (1) in table 4.4.8 an error-correction term for competitive-

Table 4.4.7. Dickey-Fuller tests for stationarity of variables regarding wage formation in Productin of industrial chemicals

Variable	t-statistics	Constant	Trend	Period
Δw	-2.39	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.04	0	0	1967-1987
WR3	-2.87	+	+	1965-1987
ΔWR3/WR3(−1)	-2.50	0	0	1966-1987
COMP	-2.66	+	0	1965-1987
ΔCOMP/COMP(−1)	-3.29	0	0	1966-1987
WR	-1.10	+	0	1965-1987
ΔWR/WR(−1)	-2.06	0	0	1966-1987

[1)] The variables are explained in table 4.4.1.

Table 4.4.8. Wage equations for Production of industrial chemicals[1)]

Variables[3)]	Estimated coefficients[2)]			
	(1)	(2)	(3)	(4)
Constant	0.215	0.031	0.052	0.049
	(2.69)	(0.11)	(2.85)	(2.63)
$\Delta\overline{w}_t$	0.57	0.73	0.73	0.65
	(3.50)	(4.41)	(4.57)	(3.86)
Δp_t	0.19	0.17	0.17	0.20
	(1.38)	(1.00)	(1.12)	(1.19)
Δp_{t-1}	0.27	0.16	0.16	0.15
	(2.00)	(1.15)	(1.18)	(0.94)
$\Sigma\Delta p$	0.46	0.43	0.43	0.35
Δp_{It}	0.10	0.07	0.07	0.12
	(3.08)	(2.00)	(2.20)	(2.74)
Δp_{It-1}	0.09	0.10	0.10	0.10
	(2.50)	(2.46)	(2.55)	(2.39)
$\Sigma\Delta p_I$	0.18	0.17	0.17	0.22
$\Delta(p_{Mt} - p_{It})$	-	-	-	0.07
				(1.61)
$\Delta(p_{Mt-1} - p_{It-1})$	-	-	-	0.04
				(0.83)
$\Delta(p_{Mt-2} - p_{It-2})$	-	-	-	0.02
				(0.37)
$\Sigma\Delta(p_M - p_I)$	-	-	-	0.13
Δs_t	-1	-1	-1	-1
Δh_t	-0.58	-0.30	-0.31	-0.36
	(1.70)	(0.75)	(0.89)	(0.81)
$w_{t-1} - \overline{w}_{t-1}$	-0.40	-0.34	-0.32	-0.30
	(4.74)	(1.82)	(3.82)	(3.48)
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	-0.04	-	-	-
	(2.08)			
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-	0.00	-	-
		(0.08)		
Statistics				
DW	1.88	2.23	2.23	2.37
SER × 100	1.10	1.27	1.22	1.21
SSR × 100	1.57	2.09	2.09	1.61

1) Left hand side variable: Δw_t. Instrument used for $\Delta\overline{w}_t$. Period of estimation: 1966-1987.

2) Absolute t-values in parenthesis.

3) The variables are explained in section 4.2.1.

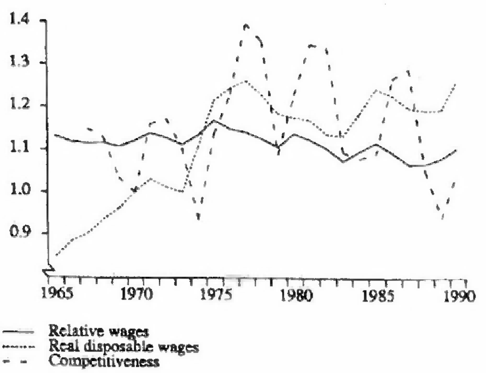
ness is significant reflecting the stationarity properties, although the coefficient is rather small. Although the Dickey-Fuller test indicates a positive deterministic trend, a rather large weight seems to be put on the wage level for total manufacturing also for this sector and this may be an important reason for the gain in competitiveness. An error-correction term for real wages, as in specification (2), seems to be of no importance reflecting the nonstationarity properties. Experiments with the prices on intermediate inputs in relation (4) were not successful.

Attempts to include the normal working hours relative to average manufacturing and the relative share of women did not give any significant effects and are not included in the table. The normal working hours in this sector has developed very close to average manufacturing, and although the share of manhours done by women have increased, this is not reflected in relative wages.

The error-correction specification (1) is preferred, indicating a large weight on the wage level in total manufacturing in the long run, but also some weight on the sector's competitiveness. The growth in wages for total manufacturing also seems to be of great importance in the short run, and in addition both consumer prices, import prices, payroll taxes and changes in the normal working hours have a direct effect. Unemployment, productivity and income taxes do not have any direct effects on wage formation in this sector in the short run and are not included in the table.

4.4.6. Production of primary metals

Figure 4.4.5. Production of primary metals. Wages relative to average manufacturing and indices for competitiveness and real disposable wages (1970=1)



According to figure 4.4.5 the hourly wage level in Production of primary metals has fluctuated between 6 and 17 per cent over the wage level for total manufacturing from the middle of the sixties to the end of the eighties. A peak was reached in 1975 while the sector has lost relative wage position during the eighties. Because of the rather strong correlation with the wage level for total manufacturing the Dickey-Fuller tests reported in table 4.4.9 indicate that growth in wage rates are stationary also in this sector. For relative wages an assumption of stationarity cannot be rejected. The competitiveness also seems stationary, but fluctuates quite a lot according to figure 4.4.5 as a result of large fluctuations in productivity

Table 4.4.9 Dickey-Fuller tests for stationarity of variables regarding wage formation in Production of primary metals

Variable[1)]	t-statistics	Constant	Trend	Period
Δw	-2.08	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.30	0	0	1967-1987
WR3	-0.93	+	0	1965-1987
ΔWR3/WR3(−1)	-3.85	0	0	1966-1987
COMP	-2.82	+	0	1965-1987
ΔCOMP/COMP(−1)	-5.09	0	0	1966-1987
WR	-1.87	+	0	1965-1987
ΔWR/WR(−1)	-1.85	0	0	1966-1987

1) The variables are explained in table 4.4.1.

Table 4.4.10. Wage equation for Production of primary metals[1)]

Variables[3)]	Estimated coefficients[2)]					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.784	1.134	0.696	0.18	0.033	0.567
	(5.84)	(12.27)	(4.29)	(0.48)	(1.13)	(3.60)
$1/U^2_{t-1}$	0.107	0.192	0.080	0.067	0.08	0.144
	(3.70)	(7.08)	(1.90)	(0.99)	(1.63)	(4.45)
$\Delta\overline{w}_t$	0.42	-	0.46	1.20	1.15	-
	(2.11)		(2.15)	(3.92)	(4.34)	
Δp_t	-	-	-	-	-	0.25
						(1.89)
Δp_{t-1}	0.43	0.57	0.35	-0.11	-0.12	0.64
	(2.77)	(6.59)	(1.84)	(0.47)	(0.56)	(5.37)
Δp_{It}	0.12	-	0.14	-0.01	0.00	0.13
	(2.52)		(2.53)	(0.12)	(0.05)	(2.37)
$\Delta(p_{Mt} - p_{It})$	-	-	0.04	-	-	-
			(0.74)			
$\Delta(p_{Mt-1} - p_{It-1})$	-	-	-0.03	-	-	-
			(0.56)			
$\Delta(p_{Mt-2} - p_{It-2})$	-	-	-0.03	-	-	-
			(0.63)			
Δz_t	-	-	-	-	-	0.13
						(2.34)
Δz_{t-1}	-	-	-	-	-	0.13
						(2.34)
Δs_t	-1	-1	-1	-1	-1	-1
Δt_t	-	-	-	-	-	-0.20
						(1.21)
Δh_t	-0.38	-0.86	-0.35	0.48	0.44	-1
	(1.25)	(4.02)	(1.03)	(0.94)	(0.92)	
D79	-0.025	-0.054	-0.025	-0.004	-0.013	-0.049
	(1.65)	(5.10)	(1.45)	(0.12)	(0.45)	(3.49)
$w_{t-1} - \overline{w}_{t-1}$	-0.38	-0.39	-0.24	-0.51	-0.54	-0.22
	(2.24)	(2.76)	(1.05)	(1.60)	(1.79)	(1.32)
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	-0.20	-0.29	-0.17	-	-	-0.15
	(5.64)	(11.51)	(4.22)			(3.79)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-	-	-	-0.02	-	-
				(0.39)		
$h_{t-1} - \overline{h}_{t-1}$	-	-1.46	-	-	-	-
		(3.52)				
Statistics						
DW	1.71	1.40	1.75	2.54	2.49	2.04
SER × 100	1.06	0.88	1.13	1.95	1.89	1.05
SSR × 1000	1.45	1.00	1.27	4.94	5.00	1.20

1) Left hand side variable: Δw_t. Instrument used for $\Delta\overline{w}_t$. Period of estimation: 1966-1987.

2) Absolute t-values in parenthesis.

3) The variables are explained in section 4.2.1.

and foreign prices. The growth in wages has been strong enough to give an increase in real disposable wages, especially in the sixties and the seventies, and the Dickey- Fuller test indicate that this variable is non-stationary. From the figure real disposable wages declined from 1977 to 1983.

From relation (1) in table 4.4.10 it is clear that relative wages and competitiveness are of significant importance for wage growth in this sector in the long run reflecting the stationarity properties in table 4.4.9. Because the larger weight is put on relative wages this may contribute to explain the fluctuations in competitiveness. During the eighties the sector has gained competitiveness and lost relative wage position. A large coefficient for the rate of unemployment which increased strongly in that period may be a possible explanatory factor. Considerations of real disposable income, which seems to be close to an I(2)-variable, are of no importance according to specification (4).

Although the share of man-hours done by women has increased, this does not seem to have a negative effect on relative wages. Changes in normal working hours relative to average manufacturing however seem to have an effect, and this variable is included in specification (2). The tracking performance is somewhat improved by including this variable, but the Durbin-Watson statistics is lower. A long term elasticity for normal working hours at 2.15 is also unlikely. The coefficient for the rate of unemployment and the short run effect of changes in normal working hours also get larger by including long run effects from relative working hours. As inputs of electricity and other intermediate products are important in this sector, growth in prices on these inputs could be relevant when explaining the low growth in wages. Although input prices have increased compared to import prices during the period of estimation it is however evident from relation (3) that input prices are of no importance, even in the short run.

In relation (1) growth in wages for total manufacturing seems to be an important explanatory factor in the short run. However, it may be relevant to exclude this variable and include growth in productivity, consumer prices and income taxes in the current period, as shown by relation (6). The tracking performance for this relation is better than for relation (1). Higher coefficients on the short term variables are balanced against a slower adaption to the long term solution which is about the same in the two specifications.

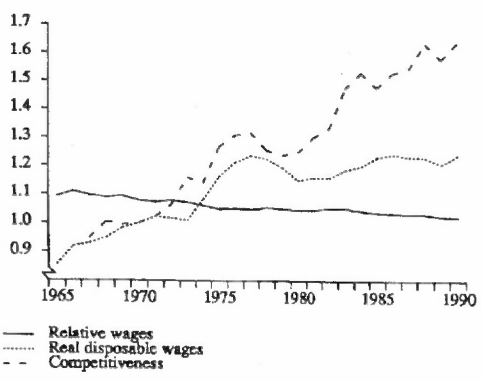
Although the tracking performance in (6) is better, the shorter lags in (1) to the long term solution, fewer explanatory factors, and a troublesome large coefficient of -1 for normal working hours in (6) makes (1) to the preferred equation. Both relative wages and competitiveness are of great importance in the long run in this specification. As mentioned above the rate of unemployment is also of great importance for the wage level in this sector in the long run. In the short run changes in consumer prices are important for changes in wage rates while the effect of import prices is rather small. Productivity is of no importance in the short run. Pay-roll taxes are fully shifted backwards at the wage earners in the short run while income taxes have no effect on wage growth. Changes in normal working hours are somewhat compensated in the short run.

4.4.7. Fabricated metal products

According to figure 4.4.6 the wage level in fabricated metal products compared to total manufacturing has declined from about 10 per cent higher in the middle of the sixties to about 2 per cent in the end of the eighties. Dickey-Fuller tests presented in table 4.4.11 also indicate that this relative wage is stationary with a negative deterministic trend. As the deviation from the development in wages for total manufacturing is not very large, the growth in wage rates is stationary also in this sector. The increase in wages has caused a loss in competitiveness while the wage earners have experiences growth in real wages as presented in figure 4.4.6. The Dickey-Fuller tests indicate that competitiveness is stationary with a positive deterministic trend while real disposable wages is stationary without a trend.

Because of the time series properties of the variables in table 4.4.11 one could expect that the coefficients for real disposable wages was significant. It could also be possible that the negative trend for relative wages balanced the positive trend for competitiveness. In fact this seems to be the case, and from the relations presented in table 4.4.12 it is evident that concern for relative wages is an important factor for wage growth in the long run, but some weight may be put on competitiveness and real disposable wages. When all the error-correction terms are included in specification (3), the t-statistics for real disposable wages is the lowest and (1) is the preferred specification.

Figure 4.4.6. Fabricated metal products. Wages relative to average manufacturing and indices for competitiveness and real disposable wages (1970=1)



The normal working hours have moved very close to average manufacturing and relative working hours gave no significant effect in the long run. Although the share of women has increased, there was only a small correlation with the fall in relative

Table 4.4.11. Dickey-Fuller tests for stationarity of variables regarding wage formation for Fabricated metal products

Variable	t-statistics	Constant	Trend	Period
Δw	-2.37	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.19	0	0	1967-1987
WR3	-3.48	+	-	1965-1987
ΔWR3/WR3(−1)	-2.37	0	0	1966-1987
COMP	-3.34	+	+	1965-1987
ΔCOMP/COMP(−1)	-3.20	+	0	1966-1987
WR	-2.21	+	0	1965-1987
ΔWR/WR(−1)	-2.04	0	0	1966-1987

1) The variables are explained in table 4.4.1.

Table 4.4.12. Wage equations for Fabricated metal products[1]

Variables[3]	Estimated coefficients[2]		
	(1)	(2)	(3)
Constant	0.382 (2.33)	0.797 (2.04)	0.736 (1.95)
$\Delta \overline{w}_t$	0.80 (9.24)	0.81 (8.45)	0.80 (9.20)
Δp_{t-1}	0.20 (1.84)	0.20 (1.78)	0.19 (1.75)
Δz_{t-1}	0.21 (1.91)	0.14 (1.16)	0.18 (1.56)
$\Sigma \Delta z$	0.21	0.14	0.18
Δh_t	-0.48 (2.37)	-0.34 (1.67)	-0.44 (2.15)
D79	-0.015 (1.41)	-	-
$w_{t-1} - \overline{w}_{t-1}$	-0.71 (2.16)	-0.61 (1.84)	-0.87 (2.41)
$w_{t-1} + s_{t-1} - pI_{t-1} - z_{t-1}$	-0.08 (2.41)	-	-0.06 (1.50)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-	-0.12 (2.06)	-0.07 (1.04)
Statistics			
DW	1.79	1.72	1.92
SER × 100	0.86	0.90	0.86
SSR × 1000	1.04	1.13	0.96

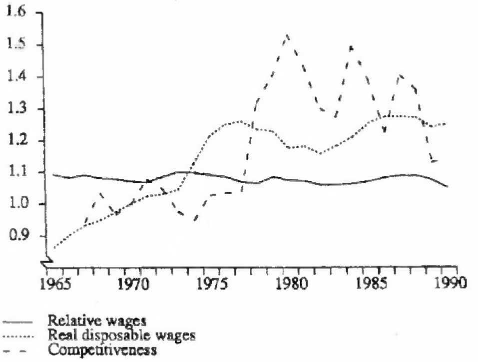
[1] Left hand side variable: Δw_t. Instrument used for $\Delta \overline{w}_t$. Period of estimation: 1966-1987.
[2] Absolute t-values in parenthesis.
[3] The variables are explained in section 4.2.1.

wages. In (1) average wage growth is of great importance also in the short run, and in addition growth in consumer prices and productivity and changes of the normal working hours have had some effects.

4.4.8. Production of ships and oil platforms

According to figure 4.4.7 the wage level in Production of ships and oil platforms has fluctuated about 5 to 10 per cent above the wage level for total manufacturing from 1965 to 1990 and the Dickey-Fuller tests reported in table 4.4.13 indicate that this relative wage is stationary. Because the deviation from total manufacturing is not very large the growth in wage rates is stationary also in this sector. From figure 4.4.7 it is clear that the increase in wage rates has caused a loss in competitiveness while the wage earners have experienced growth in real wages. The Dickey-Fuller tests indicate that

Figure 4.4.7. Production of ships and oil platforms. Wages relative to average manufacturing and indices for competitiveness and real disposable wages (1970=1)



competitiveness is stationary with a positive deterministic trend, while a non-stationary assumption for real disposable wages may not be rejected.

From relations (1) to (3) in table 4.4.14 it is clear that neither concern for relative or real disposable incomes nor competitiveness have been of importance in the long run for this sector as all the error-correction terms got the wrong sign. For relative wages this is somewhat in contradiction with the stationarity properties reported in table 4.4.13. A Phillips curve is not relevant either as the coefficient for the rate of unemployment and the constant term also became non-significant.

Table 4.4.13. Dickey-Fuller test for stationarity of variables regarding wage formation in Production of ships and oil platforms

Variable[1)]	t-statistics	Constant	Trend	Period
Δw	-2.02	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-2.48	0	0	1967-1987
WR3	-2.70	+	0	1965-1987
ΔWR3/WR3(−1)	-3.35	0	0	1966-1987
COMP	-2.39	+	+	1965-1987
ΔCOMP/COMP(−1)	-2.33	0	0	1966-1987
WR	-1.81	+	0	1965-1987
ΔWR/WR(−1)	-2.16	0	0	1966-1987

[1)] The variables are explained in table 4.4.1.

Growth in average wages for total manufacturing seems to be the most important factor behind wage growth also in this sector, but growth in consumer prices and lagged growth in import prices seem to have significant effects. Homogeneity restrictions on these variables imposed in specification (5) can not be rejected. In addition growth in productivity and changes in personal income taxes are of significant importance for wage growth in this sector. The changes in normal working hours have been very close to average manufacturing, and relative working hours gave no significant effects. Although the share of women has increased, this does not seem to have had any effect on average wages, and the share of women and relative working hours are not included in the table.

Table 4.4.14. Wage equations for Production of ships and oil platforms[1]

Variables[3]	Estimated coefficients[2]				
	(1)	(2)	(3)	(4)	(5)
Constant	-0.336	-0.169	0.001	-	-
	(2.42)	(0.79)	(0.04)		
$1/U^2_{t-1}$	0.085	0.043	0.021	-	-
	(2.30)	(1.02)	(0.66)		
$\Delta\overline{w}_t$	0.02	0.14	0.13	0.49	0.62*)
	(0.08)	(0.64)	(0.63)	(3.42)	
Δp_t	0.27	0.37	0.48	0.44	0.29
	(1.73)	(1.75)	(2.99)	(3.10)	(2.92)
Δp_{It-1}	0.06	0.03	0.02	-	-
	(1.52)	(0.64)	(0.44)		
Δp_{It-2}	0.24	0.19	0.20	0.13	0.09
	(4.58)	(2.91)	(3.35)	(2.73)	(2.25)
$\Sigma\Delta p_I$	0.30	0.22	0.22	0.13	0.09
Δz_t	0.16	0.17	0.16	0.15	0.15
	(4.68)	(3.70)	(3.78)	(3.69)	(3.53)
Δz_{t-1}	0.21	0.15	0.13	0.09	0.08
	(3.52)	(2.29)	(2.18)	(1.86)	(1.51)
Δz_{t-2}	0.26	0.21	0.22	0.19	0.16
	(4.70)	(3.10)	(3.44)	(3.19)	(2.77)
$\Sigma\Delta z$	0.63	0.53	0.51	0.43	0.39
Δt_t	-0.13	-0.16	-0.23	-0.35	-0.32
	(0.88)	(0.81)	(1.44)	(2.40)	(2.13)
$w_{t-1} - \overline{w}_{t-1}$	0.49	0.19	0.28	-	-
	(1.51)	(0.48)	(0.76)		
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	0.07	-	-	-	-
	(2.45)				
$w_{t-1} + t_{t-1} - p_{t-1}$	-	0.03	-	-	-
		(0.80)			
Statistics					
DW	2.74	2.16	2.07	2.32	2.37
SER × 100	0.81	0.98	0.97	1.02	1.06
SSR × 1000	0.65	0.98	1.04	1.57	1.79

1) Left hand side variable Δw_t. Instrument used for $\Delta\overline{w}_t$. Period of estimation: 1966-1987.
2) Absolute t-values in parenthesis.
3) The variables are explained in section 4.2.1.
*) Apriori restrictions imposed.

4.4.9. Building and construction

According to figure 4.4.8 the average hourly wage level in Building and construction according to preliminary statistics from the national accounts declined from 23 per cent above to 7 per cent below the wage level in total manufacturing from 1965 to 1990. The Dickey-Fuller tests reported in table 4.4.15 indicate that an assumption of non-station-

Figure 4.4.8. Building and construction Wages relative to average manufacturing and index for real disposable wages (1970=1)

arity for this relative wage is not rejected. The relative growth in wage rates is stationary in this sector too, and in spite of a lower growth in wages compared to total manufacturing, the wage earners have experienced a growth in yearly real disposable wages in the sixties and the seventies, but a fall in the eighties. Over the period 1965-1987 the Dickey-Fuller tests indicate that this variable is stationary.

From the time series properties presented in table 4.4.15 it is not surprising that the error-correction term for relative wages showed to be of no importance as may be seen from column (1) and (2) in table 4.4.16. The errorcorrection term for yearly real disposable wages is however very small and not significant even in specification (3) where the term for relative wages is excluded.

The normal annual working hours in building and construction has moved very close to average manufacturing and cannot explain the loss in relative wages. An increasing share of women and a lower growth in productivity could be possible candidates to explain the loss, but from specification (4) these variables turned out to be insignificant and of the wrong sign, (but of consistent correct sign in the specification as the coefficient for the error- correction term got the wrong sign).

An F-statistics F(3,14) = 1.12 indicates that the Phillips-curve specification (5) cannot be rejected against the more general specification (3). Price homogeneity imposed in specification (6) is neither rejected.

Table 4.4.15. Dickey-Fuller tests for stationarity of variables regarding wage formation in Building and construction

Variable[1]	t-statistics	Constant	Trend	Period
Δw	-2.52	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.47	0	0	1967-1987
WR3	-0.81	+	0	1965-1987
ΔWR3/WR3(−1)	-3.18	+	0	1966-1987
WR	-2.97	+	0	1965-1987
ΔWR/WR(−1)	-2.57	0	0	1966-1987

[1] The variables are explained in table 4.4.1.

Table 4.4.16. Wage equations for building and construction[1)]

Variables[3)]	Estimated coefficients[2)]						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.724 (1.33)	0.534 (1.17)	0.908 (1.32)	-0.164 (0.16)	-0.025 (2.62)	-0.028 (4.06)	-0.026 (3.80)
$1/U^2_{t-1}$	0.079 (2.09)	0.077 (2.38)	0.068 (2.94)	0.057 (1.80)	0.056 (2.48)	0.052 (2.53)	0.049 (2.34)
$\Delta\overline{w}_t$	0.27 (1.66)	0.29 (1.90)	0.31 (2.21)	0.38 (1.89)	0.46 (4.09)	0.49 *)	0.55 *)
Δp_t	0.53 (3.94)	0.52 (3.91)	0.53 (4.28)	0.49 (3.35)	0.49 (4.74)	0.51 (5.42)	0.45 (5.44)
Δp_{t-1}	0.19 (1.42)	0.21 (1.70)	0.21 (1.76)	0.15 (0.90)	-	-	-
$\Sigma\Delta p_t$	0.72	0.73	0.74	0.64	0.49	0.51	0.45
Δz_t	0.23 (2.08)	0.18 (2.14)	0.18 (2.20)	0.17 (1.27)	0.19 (2.20)	0.19 (2.37)	0.17 (2.10)
Δz_{t-1}	0.07 (0.70)	-	-	-	-	-	-
$\Sigma\Delta z_t$	0.30	0.18	0.18	0.17	0.19	0.19	0.17
Δs_t	-0.33 (0.64)	-	-	-	-	-	-
Δh_t	-0.92 (4.43)	-0.94 (4.85)	-0.95 (5.24)	-0.96 (3.84)	-0.89 (4.82)	-0.89 (4.91)	-0.65 *)
Δn_t	0.21 (2.55)	0.23 (2.87)	0.23 (3.15)	0.22 (2.47)	0.17 (2.48)	0.16 (2.50)	0.15 (2.37)
$w_{t-1} - \overline{w}_{t-1}$	-0.04 (0.55)	-0.03 (0.39)	- (0.45)	0.04	-	-	-
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.12 (1.40)	-0.09 (1.24)	-0.07 (1.40)	-	-	-	-
$z_{t-1} - \overline{z}_{t-1}$	-	-	- (0.14)	-0.02	-	-	-
$lk_{t-1} - \overline{lk}_{t-1}$	-	-	-	-0.23 (0.10)	-	-	-
<u>Statistics</u>							
DW	1.94	1.75	1.74	1.65	1.69	1.72	1.44
SER × 100	1.05	0.99	0.96	1.09	1.00	0.98	1.00
SSR × 1000	1.20	1.28	1.29	1.42	1.60	1.62	1.78

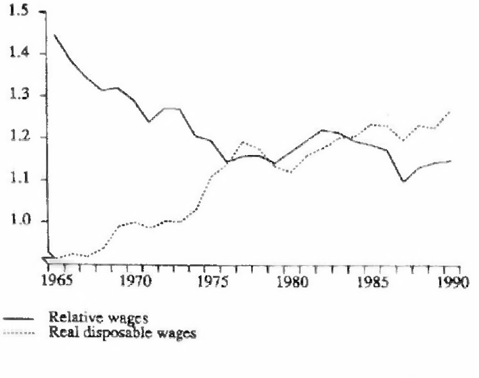
1) Left hand side variable: Δw_t. Period of estimation: 1965-1987.
2) Absolute t-values in parenthesis.
3) The variables are explained in section 4.2.1.
*) Apriori restrictions imposed.

The rate of unemployment is of great importance for wage growth in this sector, and the constant term and the unemployment coefficient taken together means that Building and construction may loose relative wage position even at low rates of unemployment. As a change in employment also has a significant effect the sector may keep its position in periods with strong growth in employment. A large weight for consumer prices also means that the sector may keep up its relative wage position in a situation where real wages decline. On the other hand the effect from changes in productivity is rather low. Changes in pay-roll taxes and personal income taxes seem to be of no direct importance for wage growth in this sector, and changes in normal annual hours are almost fully compensated, although the indirect effect via manufacturing wages is not taken into account. To avoid overcompensation restrictions is put on the coefficient for working hours in specification (7), but the Durbin-Watson statistics is lower as a result of this.

4.4.10. Financial services

According to figure 4.4.9 the relative average hourly wage level in financial services compared to total manufacturing declined from more than 50 per cent above in the beginning of the sixties to slightly above 10 per cent above at the end of the eighties. Still the Dickey-Fuller test reported in table 4.4.17 indicate that this relative wage is almost stationary. The growth in wage rates is also almost stationary, and in spite of lower growth than in total manufacturing the wage earners have experienced a growth in yearly real disposable wages, especially during the seventies. In table 4.4.17 this Dickey-Fuller tests indicate that real disposable wages are stationary, but with a positive deterministic trend.

Figure 4.4.9. Financial services. Wages relative to average manufacturing and index for real disposable wages (1970=1)



In the relations presented in table 4.4.18 both the error-correction terms for relative wages and real disposable wages are significant with the larger weight put on

Table 4.4.17. Dickey-Fuller tests for stationarity of variables regarding wage formation in Financial services

Variable[1]	t-statistics	Constant	Trend	Period
Δw	-1.91	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.11	0	0	1967-1987
WR3	-1.91	+	0	1965-1987
ΔWR3/WR3(−1)	-1.30	0	0	1966-1987
WR	-2.26	+	+	1965-1987
ΔWR/WR(−1)	-2.18	0	0	1966-1987

[1] The variables are explained in table 4.4.1.

Table 4.4.18. Wage equations for Financial services[1]

Variables[3]	Estimated coefficients[2]		
	(1)	(2)	(3)
Constant	1.94 (4.40)	2.05 (5.11)	0.571 (2.94)
$\Delta \overline{w}_t$	0.09 (0.61)	-	-
Δp_t	0.44 (2.02)	0.45 (2.13)	0.53 (1.89)
Δp_{t-1}	0.25 (1.64)	0.29 (2.06)	0.21 (1.14)
$\Sigma \Delta p$	0.69	0.74	0.74
Δs_t	-1	-1	-1
Δt_t	-0.22 (0.99)	-0.19 (0.92)	-0.23 (0.82)
Δh_t	-0.80 (1.63)	-0.79 (1.65)	-0.77 (1.21)
D79	-0.054 (2.99)	-0.058 (3.59)	-0.076 (3.30)
$w_{t-1} - \overline{w}_{t-1}$	-0.40 (3.60)	-0.42 (3.95)	-0.32 (2.23)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.29 (4.40)	-0.30 (5.07)	-
$z_{t-1} - \overline{z}_{t-1}$	-	-	0.078 (2.87)
Statistics			
DW	2.43	2.37	1.95
SER × 100	1.40	1.38	1.82
SSR × 1000	2.77	2.85	4.99

1) Left hand side variable: Δw_t. Period of estimation: 1966-1987.
2) Absolute t-values in parenthesis.
3) The variables are explained in section 4.2.1.

relative wages. However, wages for average manufacturing seem to have no significant effect in the short run as indicated by the preferred relation (2).

Changes in consumer prices are the most important explanatory factor in the short run. Personal income taxes may also have some effect, although not significant, and changes in pay-roll taxes are shifted completely backwards on wage-earners. Changes in normal working hours also seem to be of importance in the short run, and this is also the case for the wage and income regulations in 1978/79. The rate of unemployment and changes in productivity have no direct significant effect on wage formation in this sector.

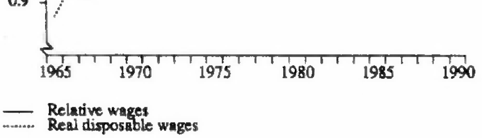
Smaller reductions in normal annual working hours than for average manufacturing, lower growth in productivity and an increasing share of women could be candidates for explaining the loss of relative wage position up to 1976. However, as the trends in these variables have continued after 1976 at the same time as the sector has maintained its relative wage position, makes it troublesome to include these variables as explanatory factors. Estimations when the error-correction term for real disposable wages was included gave significant coefficients and mostly of the wrong sign for both relative working hours, productivity and the share of women.

When the error-correction term for real disposable wages is excluded as in specification (3) relative productivity became significant, but the tracking performance in (3) is much weaker than in (2). Concern for real disposable wages therefore seems to be the main explanatory factor for the loss in relative wage position from 1965 to 1976.

4.4.11. Domestic transport

According to figure 4.4.10 the hourly wage level in domestic transport relative to total manufacturing declined from about 18 per cent higher from the beginning of the sixties to not more than 3 per cent higher in the end of the eighties. The Dickey-Fuller tests reported in table 4.4.19 indicate that the relative wage is a stationary variable, but with a negative deterministic trend. The growth in wage rates is stationary in this sector too, and especially in the sixties the wage earners experienced a growth in yearly real disposable wages. The Dickey-Fuller tests however indicate that a non- stationary assumption regarding real disposable wages has to be rejected.

Figure 4.4.10. Domestic transport
Wages relative to average manufacturing and index for real disposable wages (1970=1)



In accordance with the stationarity properties the estimation results presented in relation (1) in table 4.4.20 indicate that both the error-correction terms for relative wages and real disposable income are of significant importance where the larger weight is put on relative wages also for this sector. Growth in wages for average manufacturing is the main explanatory factor in the short run, but the effect from changes in consumer prices is also of rather large importance. Changes in personal income taxes have some short run effect, although not signiicant, and pay-roll taxes are only partly shifted backwards. Changes in the normal working hours also seem to have some effect, while unemployment and productivity have no direct effect in the short run and are therefore not included in the table.

Table 4.4.19. Dickey-Fuller tests for stationarity of variables regarding wage formation in Domestic transport

Variable[1)]	t-statistics	Constant	Trend	Period
Δw	-2.28	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.57	0	0	1967-1987
WR3	-2.20	+	-	1965-1987
ΔWR3/WR3(−1)	-3.52	+	0	1966-1987
WR	-2.14	+	0	1965-1987
ΔWR/WR(−1)	-1.92	0	0	1966-1987

1) The variables are explained in table 4.4.1.

Table 4.4.20. Wage equations for Domestic transport[1)]

Variables[3)]	Estimated coefficients[2)]		
	(1)	(2)	(3)
Constant	1.20	1.12	0.034
	(3.86)	(3.16)	(0.87)
$\Delta \overline{w}_t$	0.66	0.67	0.72
	(6.08)	(5.94)	(5.11)
Δp_t	0.37	0.34	0.20
	(2.52)	(2.16)	(1.05)
Δp_{t-1}	0.20	0.22	0.15
	(1.81)	(1.85)	(1.04)
$\Sigma\Delta p$	0.57	0.56	0.35
Δs_t	-0.47	-0.45	0.50
	(2.89)	(2.66)	(2.34)
Δt_t	-0.22	-0.17	-0.05
	(1.36)	(0.90)	(0.22)
Δh_t	-0.47	-0.39	-0.30
	(1.87)	(1.37)	(0.84)
$w_{t-1} - \overline{w}_{t-1}$	-0.30	-0.37	-0.19
	(1.72)	(1.68)	(0.70)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.19	-0.17	-
	(3.94)	(3.07)	
$lk_{t-1} - \overline{lk}_{t-1}$	-	0.88	3.26
		(0.56)	(1.88)
Statistics			
DW	2.15	2.24	1.92
SER × 100	1.02	1.06	1.34
SSR × 1000	1.48	1.45	2.50

1) Left hand side variable: Δw_t. Period of estimation: 1966-1987.
2) Absolute t-values in parenthesis.
3) The variables are explained in section 4.2.1.

Smaller growth in productivity than for manufacturing and an increasing share of women could be candidates for explaining the loss of relative wages also in this sector. None of these variables turned out to have significant effects. The relative share of man-hours done by women giving the best effect is included in specification (2). Relative productivity shows some fluctuations which are not reflected in relative wages, and the share of women has especially increased after 1975, without this being reflected in a steeper fall in relative wages.

When the error-correction term for real disposable wages was excluded as in specification (3) the relative share of women became almost significant, but the tracking performance in (3) is much weaker than in (2) and even the error- correction term for relative wages got insignificant. Concern for real disposable wages therefore seems to be the main explanatary factor for the loss in relative wage position.

4.4.12. Wholesale and retail trade

Figure 4.4.11. Wholesale and retail trade. Wages relative to average manufacturing and index for real disposable wages (1970=1)

According to figure 4.4.11 based on preliminary series from the national accounts the hourly wage level in wholesale and retail trade has fluctuated between 87 and 96 per cent of the wage level for total manufacturing from the middle of the sixties to the end of the eighties. The Dickey-Fuller tests reported in table 4.4.21 indicate that the relative wage is stationary with a positive deterministic trend. Not surprisingly the growth in wage rates proved to be stationary. A strong growth in yearly disposable wages especially in the seventies has caused this variable to be nonstationary.

In accordance with the stationarity properties it is not surprising that the error-correction term for relative wages is quite

Table 4.4.21. Dickey-Fuller tests for stationarity of variables regarding wage formation in Wholesale and retail trail

Variable[1]	t-statistics	Constant	Trend	Period
Δw	-2.17	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.33	0	0	1967-1987
WR3	-3.39	+	+	1965-1987
ΔWR3/WR3(−1)	-4.71	0	0	1966-1987
WR	-1.44	+	0	1965-1987
ΔWR/WR(−1)	-1.51	0	0	1966-1987

[1] The variables are explained in table 4.4.1.

Table 4.4.22. Wage equations for Wholesale and retail trade[1]

Variables[3]	Estimated coefficients[2] (1)	(2)	(3)	(4)
Constant	-0.16	-0.041	0.071	-0.018
	(1.48)	(5.62)	(1.04)	(1.76)
$1/U^2_{t-1}$	0.038	0.027	0.041	0.055
	(2.19)	(1.87)	(2.60)	(2.26)
$\Delta\overline{w}_t$	0.37	0.33	0.22	0.46
	(3.99)	(3.78)	(2.02)	(3.08)
Δp_t	0.29	0.40	0.37	0.23
	(2.46)	(5.16)	(5.15)	(1.84)
Δp_{t-1}	0.43	0.44	0.46	0.43
	(6.08)	(6.31)	(7.02)	(3.39)
$\Sigma\Delta p_t$	0.72	0.88	0.83	0.63
Δz_t	0.13	0.15	0.18	0.06
	(2.36)	(3.05)	(3.65)	(0.69)
Δz_{t-1}	0.22	0.22	0.22	0.20
	(4.32)	(4.71)	(4.94)	(2.39)
Δz_{t-2}	0.09	0.10	0.11	0.10
	(2.45)	(2.78)	(3.24)	(1.50)
$\Sigma\Delta z_t$	0.44	0.47	0.51	0.36
Δs_t	-0.22	-0.39	-0.57	-0.01
	(0.66)	(1.33)	(1.96)	(0.03)
Δt_t	-0.62	-0.68	-0.54	-0.80
	(5.81)	(7.22)	(4.66)	(4.95)
Δh_t	-0.39	-0.44	-0.43	-0.36
	(3.42)	(4.22)	(4.50)	(1.95)
D79	-0.062	-0.059	-0.062	-0.067
	(7.92)	(7.82)	(8.65)	(5.05)
$w_{t-1} - \overline{w}_{t-1}$	-0.38	-0.38	-0.48	-
	(5.12)	(5.04)	(5.21)	
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	0.02	-	-	-
	(1.11)			
$lk_{t-1} - \overline{lk}_{t-1}$	-	-	2.14	-
			(1.67)	
<u>Statistics</u>				
DW	2.72	2.75	2.64	1.52
SER × 100	0.47	0.48	0.44	0.85
SSR × 1000	0.20	0.23	0.17	0.80

[1] Left hand side variable: Δw_t. Period of estimation: 1966-1987.
[2] Absolute t-values in parenthesis.
[3] The variables are explained in section 4.2.1.

significant in the wage equations reported in table 4.4.22 while the error-correction term for yearly real disposable wages is insignificant and of the wrong sign. This reflects the close parallellity between wages in wholesale and retail trade and average manufacturing. Smaller shorterings of the normal working hours than for average manufacturing and lower growth in productivity should work in the opposite direction. A rather constant relative share of women should contribute to explain the rather constant relative wage. This variable is included in specification (3), but is not quite significant.

The Phillips curve in specification (4) is significantly inferior compared to the error-correction specification (2), which therefore is preferred. A high Durbin-Watson statistics may be a problem with specification (2). The Durbin-Watson statistics in the Phillips curve specification is somewhat improved, but as mentioned at the cost of a much weaker tracking performance.

The growth in consumer prices seems to have a rather large effect on growth in wage rates in the short run in this sector, and the impact from growth in wages in average manufacturing and productivity is also substantial. Changes in pay-roll taxes are in the short run shifted backwards by about 40 per cent while increases in personal income taxes are compensated by about 70 per cent. Both the rate of unemployment, the changes of the normal working hours and the price and income regulations in 1978/79 seem to have had a direct effect in the short run in excess of what follows through the effect via wages for average manufacturing.

4.4.13. Other private services

According to figure 4.4.12 the hourly wage level in Other private services relative to total manufacturing has declined from about 20 per cent above in the beginning of the sixties to about the same level in the end of the eighties. The decrease has however not been smooth with a rising relative wage in the beginning of the eighties and a new decrease thereafter. The Dickey-Fuller tests reported in table 4.4.23 indicate that this relative wage is non-stationary. The growth in wage rates is stationary in this sector too, while a growth in yearly disposable wages has caused the Dickey-Fuller tests to indicate stationarity with a deterministic trend.

Figure 4.4.12. Other private services. Wages relative to average manufacturing and index for real disposable wages (1970=1)

Table 4.4.23. Dickey-Fuller tests for stationarity of variables regarding wage formation in Other private services

Variable[1)]	t-statistics	Constant	Trend	Period
Δw	-2.57	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.38	0	0	1967-1987
WR3	-1.29	+	0	1965-1987
ΔWR3/WR3(−1)	-1.62	0	0	1966-1987
WR	-2.84	+	+	1965-1987
ΔWR/WR(−1)	-2.52	0	0	1966-1987

[1)] The variables are explained in table 4.4.1.

Table 4.4.24. Wage equations for Other private servides[1]

Variables[3]	Estimated coefficients[2]			
	(1)	(2)	(3)	(4)
Constant	1.235 (3.94)	0.946 (2.60)	0.008 (0.52)	0.000 (0.03)
$\Delta\overline{w}_t$	0.64 (7.67)	0.55 (5.36)	0.66 (5.81)	0.65 (5.81)
Δp_{t-1}	0.31 (2.91)	0.28 (2.57)	0.31 (2.14)	0.38 (3.21)
Δz_{t-1}	0.24 (2.20)	0.18 (1.52)	0.18 (1.21)	0.20 (1.37)
D79	-0.042 (4.00)	-0.047 (4.33)	-0.045 (3.17)	-0.043 (3.11)
$w_{t-1} - \overline{w}_{t-1}$	-0.34 (3.97)	-0.39 (4.32)	-0.05 (0.83)	-
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.19 (3.91)	-0.15 (2.70)	-	-
$h_{t-1} - \overline{h}_{t-1}$	-	-0.91 (1.44)	-	-
<u>Statistics</u>				
DW	2.53	2.76	1.94	2.01
SER × 100	0.87	0.84	1.19	1.71
SSR × 100	1.21	1.07	2.39	2.48

[1] Left hand side variable: Δw_t. Period of estimation: 1966-1987.
[2] Absolute t-values in parenthesis.
[3] The variables are explained in section 4.2.1.

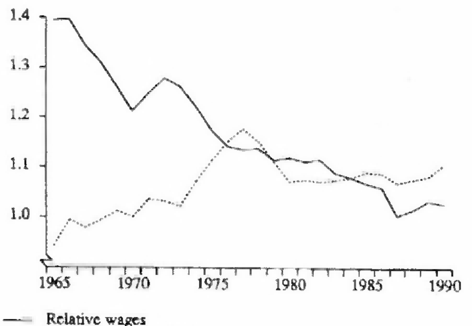
In contradiction to the time series properties the estimation results in table 4.4.24 indicate that both the error correction terms for relative wages and real disposable wages are significant, where the larger weight is put on relative wages. Smaller reductions in normal working hours, and lower growth in productivity could also be candidates when explaining the loss in relative wage position. The relative share of women has declined in this sector, and is therefore not a relevant factor in explaining the lower wage increases. As relative productivity shows great fluctuations which are not reflected in relative wages, also this variables is of no effect, and is excluded from the table. From specification (2) relative working hours may have some effect, but the variables is not significant, and the Durbin-Watson statistics gets weaker. A partial long run elasticity at 2 for changes in normal working hours is also unlikely. The Phillips curve specification (4) is significantly inferior compared to the preferred specification (1), although the Durbin-Watson statistics is better.

Growth in wage rates for average manufacturing is also the most important explanatory factor in the short run, but some weight is put on growth in consumer prices and productivity. Neither pay-roll taxes, personal income taxes, the rate of unemployment and shortenings of the normal working hours seem to have any direct effect on wage growth in the short run for this sector and are therefore excluded from the table.

4.4.14. Local government education

According to figure 4.4.13 the wage level in Local government education relative to average hourly wage rates for total manufacturing declined from about 40 per cent above in the middle of the sixties to only about 3 per cent above in 1990. Following growth in yearly real disposable wages during the sixties and the first part of the seventies, real disposable wages declined from 1977 to 1980 and have thereafter stayed almost constant. The Dickey-Fuller tests reported in table 4.4.25 indicate that relative wages have been stationary with a negative deterministic trend while real disposable wages may have been stationary from 1965 to 1987. The growth in wage rates has also been stationary, as for the other sectors.

Figure 4.4.13. Local government education. Wages relative to average manufacturing and index for real disposable wages (1970=1)



In spite of the stationarity properties none of the error-correction terms in specification (1) in table 4.4.26 were of importance, and the coefficient for relative wages is even of the wrong sign. When the error-correction term for relative wages, the rate of unemployment, and pay-roll taxes were excluded, as in specification (2), where a restriction of -1 on the coefficient for normal working hours also was imposed, the error-correction term for yearly real disposable wages got significant. The coefficient is however rather low indicating a very sluggish response.

Table 4.4.25. Dickey-Fuller tests for stationarity of variables regarding wage formation in Local government education

Variable[1)]	t-statistics	Constant	Trend	Period
Δw	-1.90	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-3.42	0	0	1967-1987
WR3	-2.90	+	-	1965-1987
ΔWR3/WR3(−1)	-3.70	-	0	1966-1987
WR	-2.45	+	0	1965-1987
ΔWR/WR(−1)	-1.90	0	0	1966-1987

[1)] The variables are explained in table 4.4.1.

Although the reductions in normal working hours have been smaller than for average manufacturing and the share of women has increased, none of these variables seem to be significant when explaining the loss in relative wage position. An increasing share of women may however have been of some importance as indicated by specification (4), but where the coefficient for relative wages is close to zero. Concern for real disposable wages therefore seems to be the main factor behind the fall in relative wage position.

Table 4.4.26. Wage equations for Local government education[1]

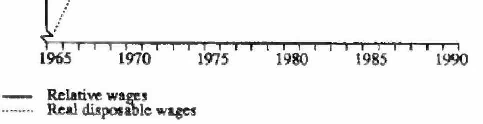
Variables[3]	Estimated coefficients[2]						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.49 (0.66)	0.86 (2.21)	-0.021 (0.81)	0.084 (0.55)	-0.009 (0.56)	-0.016 (1.82)	-
$1/U^2_{t-1}$	0.045 (0.79)	0.037 (0.68)	-	0.064 (1.96)	0.056 (1.90)	-	
$\Delta\overline{w}_t$	0.39 (2.33)	0.56 (4.29)	0.38 (2.30)	0.68 (3.18)	0.37 (2.30)	0.42*)	0.46*)
Δp_t	0.31 (1.16)	0.42 (2.47)	0.27 (1.07)	0.34 (1.88)	0.16 (0.99)	0.19 (1.35)	0.1[illegible] (1.28)
Δp_{t-1}	0.36 (2.27)	0.33 (2.40)	0.38 (2.45)	0.31 (2.02)	0.37 (2.47)	0.39 (2.62)	0.36 (2.93)
$\Sigma\Delta p$	0.67	0.75	0.65	0.65	0.53	0.58	0.54
Δs	-0.30 (1.26)	-	-0.29 (1.25)	-	-0.25 (1.15)	-0.20 (1.01)	-
Δt	-0.49 (2.02)	-0.51 (2.53)	-0.47 (1.98)	-0.44 (2.11)	0.40 (1.97)	-0.44 (2.26)	-0.44 (2.26)
Δh	-0.77 (1.54)	-1	-0.74 (1.51)	-1	-0.62 (1.42)	-0.67 (1.59)	-0.65 (1.67)
D79	-0.033 (1.34)	-	-0.041 (1.90)	-	-0.047 (2.60)	-0.044 (2.58)	-0.039 (2.66)
$w_{t-1} - \overline{w}_{t-1}$	0.01 (0.05)	-	0.05 (0.59)	-0.00 (0.02)	-	-	-
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.08 (0.69)	-0.14 (2.25)	-	-	-	-	-
$lk_{t-1} - \overline{lk}_{t-1}$	-	-	-	2.05 (0.81)	-	-	-
Statistics							
DW	1.93	2.30	1.97	2.33	1.79	1.86	1.64
SER × 100	1.44	1.38	1.42	1.48	1.38	1.36	1.41
SSR × 1000	2.51	3.25	2.62	3.52	2.69	2.76	3.57

[1] Left hand side variable: Δw_t. Period of estimation: 1966-1987.
[2] Absolute t-values in parenthesis.
[3] The variables are explained in section 4.2.1.
*) Apriori restrictions imposed.

A Phillips-curve specification as (5) may be relevant for this sector. Homogeneity restrictions imposed in specification (6) is not rejected. This specification is preferred for the error-correction specification (2) because of better tracking performance, a very sluggish response, no long run effects from wages in average manufacturing in the error-correction model, and problems with overshooting effects in the short run of changes in the normal working hours. A problem with the Phillips-curve specification is that it predicts a continuous fall in wages relative to average manufacturing when the rate of unemployment is higher than 2.0 per cent. Growth in real wages may however also lead to a continuous fall in relative wages according to the error-correction model (2). To avoid the problems with the unemployment term in the Phillips curve specification, this term is excluded in specification (7). The tracking performance in this specification is however clearly weaker than in (6).

Both growth in consumer prices and alternative wages are important factors for wage formation in this sector in the short run. Not surprisingly pay-roll taxes are only to a small degree shifted backwards while personal income taxes directly are compensated by as much as 44 per cent. The rate of unemployment, changes in normal working hours and the price and income regulations in 1978/79 seem to have had a lasting direct effect on wages in this sector in excess of what follows due to the effect on wages in average manufacturing.

Figure 4.4.14. Local government health and welfare services. Wages relative to average manufacturing and index for real disposable wages (1970=1)



4.4.15. Local government health and welfare services

According to figure 4.4.14 the hourly wage level in Local government health and welfare services has fluctuated around the wage level for total manufacturing the whole period from the middle of the sixties to the end of the eighties, but with a slight negative trend. The

Table 4.4.27. Dickey-Fuller test for stationarity of variables regarding wage formation in Local government health and welfare services

Variable[1]	t-statistics	Constant	Trend	Period
Δw	-3.21	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-5.29	0	0	1967-1987
WR3	-2.54	+	0	1965-1987
ΔWR3/WR3(−1)	-3.24	0	0	1966-1987
WR	-3.10	+	0	1965-1987
ΔWR/WR(−1)	-1.96	0	0	1966-1987

[1] The variables are explained in table 4.4.1.

Table 4.4.28. Wage equations for Local government health and welfare services[1]

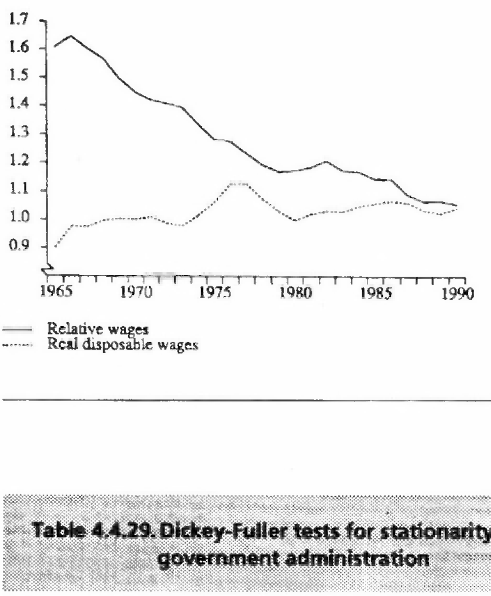
Variables[3]	Estimated coefficients[2]			
	(1)	(2)	(3)	(4)
Constant	-0.599	0.014	0.021	0.726
	(2.67)	(1.05)	(1.44)	(5.07)
$1/U^2_{t-1}$	0.037	0.097	0.097	-
	(1.07)	(3.20)	(2.84)	
$\Delta\overline{w}_t$	0.34	0.29	0.16	0.40
	(2.51)	(1.80)	(0.94)	(3.43)
Δp_t	0.43	0.11	0.14	0.50
	(2.52)	(0.97)	(0.91)	(3.75)
Δp_{t-1}	0.36	0.34	0.32	0.36
	(3.14)	(2.46)	(2.09)	(3.38)
$\Sigma\Delta p$	0.77	0.45	0.46	0.88
Δs	-0.18	-0.02	-0.12	-
	(0.64)	(0.06)	(0.36)	
Δt	-0.42	-0.16	-0.13	-0.47
	(2.26)	(0.82)	(0.61)	(3.18)
Δh	-0.68	-0.58	-0.70	-0.71
	(4.35)	(3.20)	(3.56)	(4.81)
D79	-0.048	-0.070	-0.071	-0.038
	(3.01)	(4.33)	(3.91)	(3.00)
$w_{t-1} - \overline{w}_{t-1}$	-0.18	-0.25	-	-0.17
	(1.80)	(2.21)		(1.82)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.10	-	-	-0.12
	(2.61)			(4.89)
<u>Statistics</u>				
DW	2.48	2.12	1.89	2.49
SER × 100	1.06	1.27	1.43	1.03
SSR × 100	1.34	2.10	2.90	1.50

[1] Left hand side variable: Δw_t. Period of estimation: 1966-1987.
[2] Absolute t-values in parenthesis.
[3] The variables are explained in section 4.2.1.

Dickey-Fuller tests reported in table 4.4.27 show that this relative wage is stationary. The wage earners in this sector have experienced a growth in real disposable wages over the whole period, and as in the other sectors, especially in the sixties and the first part of the seventies. The assumption of disposable real wages being non-stationary is rejected in a specification with a positive constant term, and the growth in wages is stationary also for this sector.

In accordance with the time series properties the results presented in table 4.4.28 indicates that the error-correction terms for both relative wages and real disposable wages may be of importance, but with low coefficients indicating a rather sluggish response. The larger weight is put on relative wages also in this sector although the effect from real disposable wages is more significant. Relative normal working hours and the relative share of man-hours done by women seem to be of no importance for the relative wage position in this sector, and the variables are not included in the table. The tracking performance for the Phillips curve specification reported in relation (3) is significantly weaker, favouring the general specification (1). As the effects from the rate of unemployment and pay-roll taxes are only small and insignificant these variables are excluded in the preferred specification (4).

Figure 4.4.15. Central government adminstration. Wages relative to average manufacturing and index for realisposable wages (1970=1)



In the short run wages in this sector are mainly determined by the development in consumer prices, but personal income taxes and wages for average manufacturing also seem to be of importance. Changes in the normal working hours and the price and income regulations have had a direct effect on wages in the short run in this sector in excess of what follows from the effect by manufacturing wages.

4.4.16. Central government administration

According to figure 4.4.15 the average hourly wage level in Central government administration compared with total manufacturing has declined from about 60 per cent above in the the sixties to

Table 4.4.29. Dickey-Fuller tests for stationarity of variables regarding wage formation in Central government administration

Variable[1)]	t-statistics	Constant	Trend	Period
Δw	-3.66	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-4.39	0	0	1967-1987
WR3	-2.84	+	-	1965-1987
ΔWR3/WR3(−1)	-1.54	0	0	1966-1987
WR	-3.67	+	0	1965-1987
ΔWR/WR(−1)	-2.97	0	0	1966-1987

[1)] The variables are explained in table 4.4.1.

Table 4.4.30. Wage equations for Central government administration[1)]

Variables[3)]	Estimated coefficients[2)] (1)	(2)	(3)	(4)
Constant	2.02	1.854	-0.001	2.03
	(4.61)	(5.03)	(0.00)	(4.97)
$\Delta\overline{w}_t$	0.51	0.47	-	0.51
	(3.44)	(3.46)		(3.62)
Δp_t	0.23	0.29	0.32	0.21
	(1.31)	(1.83)	(3.12)	(1.23)
Δp_{t-1}	0.32	0.36	0.45	0.31
	(2.17)	(2.63)	(4.76)	(2.14)
$\Sigma\Delta p$	0.55	0.65	0.77	0.52
Δs	-0.28	-0.32	-	-0.26
	(1.63)	(2.00)		(1.51)
Δt	-0.28	-0.30	-	-0.27
	(1.36)	(1.46)		(1.32)
D79	-0.022	-0.022	-0.052	-0.023
	(1.32)	(1.36)	(4.54)	(1.39)
$w_{t-1} - \overline{w}_{t-1}$	-0.03	-	-0.66	-0.06
	(0.73)		(6.03)	(1.02)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.32	-0.29	-	-0.32
	(4.62)	(4.96)		(4.97)
$h_{t-1} - \overline{h}_{t-1}$	-	-	-2.24	-0.06[*)]
			(8.58)	
$lk_{t-1} - \overline{lk}_{t-1}$	-	-	2.60	0.06[*)]
			(1.78)	
Statistics				
DW	1.75	1.69	1.98	1.77
SER × 100	1.37	1.36	0.94	1.35
SSR × 100	2.65	2.75	1.40	2.56

[1)] Left hand side variable: Δw_t. Period of estimation: 1966-1987.
[2)] Absolute t-values in parenthesis.
[3)] The variables are explained in section 4.2.1.

only 6 per cent above at the end of the eigthies. As a result of the weak growth in wages, yearly real disposable wages were only slightly higher in 1990 than in 1966. The Dickey-Fuller tests reported in table 4.4.29 indicate that the relative wage is stationary with a negative trend. For real disposable wages the non-stationarity assumption is clearly rejected, and wage growth shows up to be station- ary also for this sector.

In accordance with the Dickey-Fuller tests the wage equations (1) and (2) presented in table 4.4.30 indicate a significant error-correction term for real disposable wages, while the error-correction term for relative wages is of no importance. Smaller reductions in normal working hours and a growth of the relative share of man-hours done by women could be possible explanatory factors regarding the loss in relative wage position also for this sector. According to specification (3) this seems to be the case. Relative working hours are quite significant and the relative share of women also seems to be of some importance, although not significant. The tracking performance for (3) is also improved compared with (2).

A great problem with (3) is however that the elasticities for both the relative share of women and normal working hours are much greater than one and thus in contradiction with economic theory. The drop in wage position has been so large that it cannot be explained by changes in these variables alone. Attempts to restrict these coefficients to give more appropriate long term elasticities were however not successful. In specification (4) the error-correction term for relative wages got insignificant with such restrictions, and specification (2) is preferred. In this specification the long term elasticity of changes in normal working hours also is equal to -1.

In the short run both changes in consumer prices and alternative wages are important factors behind wage growth in this sector. Personal income taxes also seem to have some effect, but as expected the backward shift of pay-roll taxes is rather small. Because of small changes in the normal working hours in this sector, the coefficient has the wrong sign, and the variable is excluded from the results presented in the table. The rate of unemployment seems to have no direct effect on wages in this sector.

4.4.17. Local government administration

According to figure 4.4.16 the wage level in Local government administration has declined relative to total manufacturing from about 35 per cent above the average in the middle of the sixties to the same level in the end of the eighties. The growth in wage rates has thus been stronger than in the Central government, but the yearly real disposable wages have been about constant from 1975 to 1990. Dickey-Fuller tests reported in table 4.4.31 indicate that an assumption of non-stationarity for both relative wages and real disposable wages may not be rejected, but the t-value for relative wages is rather large.

Because of the time series properties relative wages and yearly disposable wages may cointegrate as the error-correction terms for both variables seem to have some effect in specifications (1) and (2) in table 4.4.32.

Figure 4.4.16. Local government administration. Wages relative to average manufacturing and index for real disposable wages (1970=1)

Smaller reductions in normal working hours and a growth in the relative share of man- hours done by women could be possible explanatory factors regarding the loss of relative wage position also for this sector. According to specification (4) the relative share of women is not significant, while the relative normal working hours is. The tracking performance in (4) is also improved compared to (2). A problem with (4) is however that the long run elasticities for relative working hours and the relative share of women are greater than 1 and thus in contradiction with economic theory.

The drop in relative wage position cannot be explained by these variables alone. When restricting the coefficients in (5), and in addition including the error-correction term for real disposable wages, the error-correction term for relative wages is still significant, and the term for real disposable wages is also about significant. The drop in relative wages in this sector may thus have been caused by both concern for real disposable wages, smaller reductions in normal working hours and an increase in the share of women. A significant coefficient for the rate of unemployment also means that the increase in this variable has contributed to the loss in relative wages. Because the tracking performance in (5) is not much stronger than in (2) and because the effect from the relative share of women is quite uncertain, (2) is the preferred equation.

Growth in wages for average manufacturing is the most important explanatory factor in the short run, but growth in consumer prices, and changes in personal income taxes also seem to have some effect. The price and income regulations in 1978/79 seem to have had a direct effect on the short run development of wages in this sector.

Table 4.4.31. Dickey-Fuller test for stationarity of variables regarding wage formation in Local government administration

Variable[1)]	t-statistics	Constant	Trend	Period
Δw	-3.30	+	0	1966-1987
$\Delta w_t - \Delta w_{t-1}$	-4.63	0	0	1967-1987
WR3	-1.54	+	0	1965-1987
ΔWR3/WR3(−1)	-3.43	-	0	1966-1987
WR	-1.90	+	0	1965-1987
ΔWR/WR(−1)	-2.12	0	0	1966-1987

[1)] The variables are explained in table 4.4.1.

Table 4.4.32. Wage equations for Local government administration[1]

Variables[3]	Estimated coefficients[2]				
	(1)	(2)	(3)	(4)	(5)
Constant	1.017	1.047	0.024	-0.012	1.004
	(1.56)	(1.73)	(1.40)	(0.17)	(2.00)
$1/U_{t-1}^2$	0.113	0.106	0.098	0.078	0.101
	(3.02)	(2.96)	(2.61)	(2.01)	(3.21)
$\Delta\overline{w}_t$	0.40	0.41	0.43	0.29	0.37
	(2.62)	(2.79)	(2.70)	(2.15)	(2.69)
Δp_{t-1}	0.22	0.23	0.21	0.34	0.26
	(1.67)	(1.74)	(1.48)	(2.75)	(2.17)
Δs	-0.33	-	-	-	-
	(0.77)				
Δt	-0.22	-0.19	-0.18	-0.13	-0.17
	(1.22)	(1.10)	(0.90)	(0.87)	(1.07)
D79	-0.044	-0.040	-0.048	-0.052	-0.044
	(2.42)	(2.34)	(2.74)	(3.51)	(2.75)
$w_{t-1} - \overline{w}_{t-1}$	-0.25	-0.27	-0.13	-0.47	-0.37
	(2.46)	(2.79)	(2.50)	(4.00)	(3.50)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.16	-0.17	-	-	-0.15
	(1.52)	(1.69)			(1.94)
$h_{t-1} - \overline{h}_{t-1}$	-	-	-	-1.39	-0.37*)
				(2.43)	
$lk_{t-1} - \overline{lk}_{t-1}$	-	-	-	0.73	0.37*)
				(0.42)	
Statistics					
DW	2.16	2.12	2.35	2.36	2.21
SER × 100	1.30	1.29	1.36	1.10	1.18
SSR × 1000	2.39	2.49	2.98	1.69	2.09

1) Left hand side variable Δw_t. Instrument used for $\Delta\overline{w}_t$. Period of estimation: 1966-1987.
2) Absolute t-values in parenthesis.
3) The variables are explained in section 4.2.1.
*) Apriori restrictions imposed.

4.5. Reestimated wage equations 1965 to 1990

Since the wage equations for the different sectors are used in the macroeconomic model MODAG with base year in 1990, it is convenient to reestimate the chosen specifications up to that year to use the most recent information and to get the residuals from 1988 to 1990 as low as possible. Problems with preliminary data for 1988 to 1990, which were revised during the work with the estimations, and a low wage growth caused by the wage and income regulations in 1988 and 1989 are the main reasons why the end of the estimation period was fixed to 1987 during the main estimations presented in section 4.3 and 4.4. Of course, it is possible that the period of estimation is of importance for the choice of specification, but it is not possible to perform a detailed discussion of this subject every year. If dummy-variables are necessary to explain the wage growth in 1988 and 1989 because of the regulations, inclusion of these years will be of no importance for the estimated coefficients. Inclusion of 1990 in the period of estimation may, however, influence the results. To decide if dummies for the income regulations in 1988 and 1989 ought to be included in the estimations up to 1990 estimations for the period 1965(6) to 1989, where these dummies are included, are presented in table 4.5.1.

4.5.1. Evaluation of the income regulations in 1988 and 1989

Based on the preferred specifications presented in section 4.4 and the main alternatives for aggregate manufacturing the estimates of the coefficients attached to the dummies for 1988 and 1989 are presented in table 4.5.1. These dummies only reflect the partial effect of the income regulations in excess of the other explanatory variables included in the specification. Some of the short run effects of the income regulations work through alternative wages and indirectly also through consumer prices.

As wage rates for the manufacturing sector are of great importance in many of the other sectors in the long run, the long run effects of the regulations depend on the chosen specification for manufacturing. According to the Phillips curve specification and the alternative wage specification the income regulation in 1988 only had a small, and far from significant, effect on wage growth in manufacturing. The error-correction specification and the factor income deflator specification indicate a significant effect in 1988. In 1989, however, the effect on manufacturing is significant in all specifications, and the divergence between the coefficients in the different specifications is much smaller than for 1988.

The results somewhat contradict the conclusions found by Eika and Johansen (1991). They conclude that only the regulation in 1988 was effective while the prolongation in 1989 had no positive effect. The main reason for this contradiction seems to be that the Eika and Johansen analysis is based on preliminary national accounts data, especially for prices on competing products and productivity. The preliminary figures from these series are rather uncertain, and the growth in these series seems to have been revised downwards in 1988 and upwards in 1989 and thus changing the conclusions made by Eika and Johansen on this point.

On the other hand the results confirm that the income regulations had a smoothing impact on the development of wages inside manufacturing. The regulations thus seem to have had a significant negative partial effect in Production of industrial chemicals and

Table 4.5.1. Coefficients for the dummy-variables in 1988 and 1989

Sector	1988	1989
3 Total manufacturing		
- Phillips curve	-0.014 (0.99)	-0.036 (2.60)
- Error correction	-0.028 (2.22)	-0.038 (3.27)
- Alternative wage	-0.014 (1.00)	-0.028 (2.30)
- Factor income deflator	-0.044 (4.16)	-0.037 (3.58)
15 Consumer goods	0.020 (1.21)	0.023 (1.17)
25 Intermediates and investments	-0.005 (0.32)	-0.010 (0.57)
34 Paper and paper products	0.005 (0.39)	0.006 (0.46)
37 Industrial chemicals	-0.056 (3.79)	-0.063 (3.53)
43 Primary metals	-0.038 (2.40)	-0.054 (3.09)
45 Fabricated metal products	-0.000 (0.03)	-0.000 (0.05)
50 Ships and oil platforms	-0.017 (1.20)	-0.007 (0.59)
55 Building and construction	0.020 (1.84)	0.026 (1.61)
63 Financial services	-0.017 (0.94)	-0.036 (2.02)
74 Domestic transport	-0.015 (0.99)	-0.010 (0.68)
81 Wholesale/retail trade	0.015 (2.36)	0.016 (2.37)
85 Other private services	-0.008 (0.71)	-0.002 (0.19)
93K Local government education	0.006 (0.38)	0.012 (0.80)
94K Local government health and social services	-0.034 (2.70)	-0.012 (0.91)
95S Central government administration	-0.016 (0.95)	0.004 (0.22)
95K Local government administration	-0.056 (3.32)	-0.034 (1.91)

1) Absolute t-values in parenthesis.

Production of primary metals. The large growth in prices on competing products and productivity in the actual and present years in these sectors should indicate higher wage growth if wages were not regulated.

Beside these sectors the income regulations seem to have had a clear effect on wages in Local government administration in 1988 and 1989, Local government health and social services in 1988 and Financial services in 1989. Also in accordance with the conclusions drawn by Eika and Johansen, the income regulations seem to have strenghtened the wage growth in Wholesale and retail trade and Building and construction. Significant coefficients for the dummy-variables may, however, be due to an unnormal decline in employment in these sectors which was most significant among the unskilled and the lowest paid employees resulting in rather large increases in the average wage level. The dummies for these sectors may thus reflect these composition effects and effects from higher growth in productivity.

In the specifications implemented in the model, dummies for the price and income regulations in 1988 and 1989 are only incorporated for Total manufacturing, Industrial chemicals, Primary metals, Financial services (1989), Local government health and social services (1988) and Local government administration. Because of the inclusion of 1988 and 1989 in the period of estimation, the coefficients in the preferred equations were modestly changed compared to the specifications presented in section 4.4. Although the coefficients were (almost) significant, but with a positive sign, the dummy variables for the price and income regulations in 1988 and 1989 in Building and construction and Wholesale and retail trade were not included in the model, resulting in a change in the coefficients mainly for productivity and the rate of unemployment. This decision may be discussed as it is difficult to know in advance if a significant dummy coefficient in a period is caused by a special event or a structural brake in some of the other coefficients.

4.5.2. Minor problems with some of the manufacturing sectors

As mentioned in section 4.4 the wage structure within manufacturing has been very stable and the wage growth is very parallel, even in the short run. In such a situation the error-correction term and the change in alternative wages may catch up almost the same effects giving a very unstable coefficient for the error-correction term.

By including 1988 and 1989 and excluding the dummy variables the error-correction coefficient is small and insignificant for both Production of consumer goods, Production of intermediates and investments and also to some degree for Production of fabricated metal products. The error-correction model thus degenerated, but excluding the error-correction terms caused problems in a dynamic simulation of the wage level for these sectors. This was also the case for Production of paper and paper products and Building of ships and oil platforms where no error-correction terms were included in the preferred specification reported in sections 4.4.4 and 4.4.8.

When the error-correction terms were excluded the equations were implemented on a growth form causing deviations in levels which lasted for several periods in a dynamic simulation. A main reason for this deviation is that the instrument used for the change in manufacturing wages in the estimations deviated somewhat from the actual change in some years.

To avoid these problems an estimation of the wage equation in these sectors on a level form was suggested. Although the coefficients for the explanatory variables were about the same a low Durbin-Watson statistics still indicated some problems, but for Production of consumer goods the estimations indicated that wages could be explained by wages for aggregate manufacturing alone with a coefficient close to one. No econometric specification is thus implemented for this sector.

It may be discussed if a specification in the sectors with the problems mentioned above ought to be implemented on a "change" form $\Delta w = \beta\Delta\overline{w}$ or a "level" form $w = \alpha + \beta\overline{w}$. The marginal properties of the model are not influenced by this. The "change-form" means that the relative wage level from the present period is assumed to be a "normal" level in the future, while a "level-form" means that the average relative level from the period of estimation is assumed to be normal.

To reduce the residuals in a dynamic simulation for Production of intermediates and investments, Production of paper and paper products and Building of ships and oil platforms, the actual value for the change in manufacturing wages was used as an explanatory factor rather than the instrument. While Production of paper and paper products and Building of ships and oil platforms only constitute a small part of total manufacturing, the simultaneity problem for these sectors is not so severe. More doubt may be raised for Production of intermediates and investments. As Production of fabricated metal products constitute a large part of total manufacturing the instrument was used as an explanatory variable, and the error-correction terms were included, although not significant.

4.5.3. Overview of the reestimated equations

Reestimations for the most important alternative wage equations for total manufacturing up to 1990 are presented in table 4.5.2, while reestimations of the preferred wage equations for the different sectors are presented in table 4.5.3. The long term weights on the different nominal variables based on these equations are shown in table 4.5.4, and actual and simulated wage growth up to 1991 for the presented equations is shown in figure 4.5.1. 1991 is here simulated post sample.

As discussed in section 4.3 no finite conclusion about the choice of specification for average manufacturing has been made, and five of the main alternatives are presented in table 4.5.2. From table 4.5.4 it is clear that the different specifications for average manufacturing differ quite a lot with regard to the long term weights on nominal variables. While the two alternative wage specifications put most of the weight on alternative wages, the factor income deflator specification puts most of the weight on the factor income deflator. The wedge variable specification puts most of the weight on consumer prices, while the Phillips curve specification puts most of the weight on prices of competing products. The Phillips curve specification is thus most in accordance with the Scandinavian theory of inflation, although the specification offers some concern for real disposable income, reflected by some weight on consumer prices. The factor income

Table 4.5.2. Main alternatives for total manufacturing[1)]

		Error correction models			
	Factor income deflator[3)]	Alt. wage fac. inc. def.[3)]	Alt. wage Import prices	Wedge variable	Phillips curve
Constant	1.814 (5.51)	-0.403 (4.91)	-0.304 (2.85)	-0.25 (3.11)	-0.009 (1.37)
$1/U_{t-1}^2$	0.119 (4.92)	0.130 (5.29)	0.100 (3.12)	0.111 (3.91)	0.063 (3.51)
Δp_{t-1}	0.37 (4.03)	-	0.30 (2.85)	0.31 (3.09)	0.23 (3.18)
Δp_{It}	0.36 (5.32)	0.16*	0.14*	0.12 *	0.15*
Δp_{It-1}		0.40*	0.35*	0.31 *	0.39*
Δp_{It-2}	-	0.24*	0.21*	0.18 *	0.23*
$\Sigma\Delta p_I$	0.36 (5.32)	0.80 (7.55)	0.70 (4.14)	0.61 (4.88)	0.77*
Δz_t	-	-	0.23*	0.30 *	0.33*
Δz_{t-1}	-	-	0.23*	0.30 *	0.33*
Δz_{t-2}	-	-	0.23*	0.30 *	0.33*
$\Sigma\Delta z_t$	-	-	0.70 (2.05)	0.91 (4.79)	1*
Δs_t	-0.56 (1.32)	-	-	-	-0.77*
Δt_t	-	-	-	-	-0.23*
Δh_t	-0.73 (4.14)	-0.67 (4.25)	-0.84 (4.30)	-0.78 (4.42)	-0.70 (3.52)
D79	-0.024 (1.84)	-0.025 (2.18)	-0.052 (4.16)	-0.054 (4.44)	-0.078 (6.42)
D88	-0.041 (3.74)	-0.044 (4.16)	-0.021 (1.64)	-0.023 (1.80)	-0.011 (0.85)
D89	0.024 (2.68)	-0.037 (3.58)	-0.032 (2.63)	-0.036 (3.22)	-0.040 (3.10)
$w_{t-1} - \overline{w}_{t-1}$	-0.129- (1.75)	0.269 (3.48)	-0.148 (0.78)	-	-
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	-0.420 (5.41)	-0.240 (5.13)	-0.173 (2.78)	-0.143 (2.98)	-
$s_{t-1} - t_{t-1} + p_{t-1} - p_{It-1}$	-	0.240* (5.13)	0.173* (2.78)	0.143 * (2.98)	-
<u>Statistics</u>					
DW	1.72	1.61	1.88	2.03	2.01
SER × 100	0.98	0.95	1.04	1.02	1.20
SSR × 1000	1.44	1.54	1.61	1.67	2.73
AUTO(1)	F(1,14)=0.09	F(1,13)=0.67	F(1,13)=0.00	F(1,14)=0.08	F(1,17)=0.05
ARCH(1)	F(1,13)=0.30	F(1,12)=0.04	F(1,12)=0.63	F(1,13)=0.84	F(1,16)=0.35
CHOWPS(1)	F(1,15)=0.34	F(1,14)=1.41	F(1,14)=0.24	F(1,15)=1.35	F(1,18)=0.08
FORECAST(1)	$\chi(1)$=0.53	$\chi(1)$=3.24	$\chi(1)$=0.56	$\chi(1)$=2.04	$\chi(1)$=0.11
NORMBJ	$\chi(2)$=0.78	$\chi(2)$=0.53	$\chi(2)$=0.21	$\chi(2)$=0.05	$\chi(2)$=0.77

1) Left hand side variable: Δw_t. Method of estimation: OLS. Period of estimation: 1965-1990.
Absolute t-values in parenthesis.

2) The variables are explained in section 4.2.1.

3) For this specification p_I denotes the factor income deflator.

*) Apriori restrictions imposed.

Table 4.5.3. Preferred wage equations for the different sectors[1])

Variables[2])	15 Consumer goods	25 Intermediates and investm.	34 Paper and paper products	37 Industr. chemicals	43 Primary metals
Constant	-	-	-	0.202 (2.67)	1.044 (14.40)
$1/U^2_{t-1}$	-	-	-	-	0.178 (9.23)
$\Delta\overline{w}_t$	1*	0.90 (20.65)	0.94 (43.60)	0.65 (4.14)	-
Δp_t	-	0.10*	-	0.20 (1.34)	-
Δp_{t-1}	-	-	-	0.23 (1.64)	0.51 (7.57)
$\Sigma\Delta p$	-	-	-	0.42	0.51
Δp_{It}	-	-	0.06*	0.11 (3.36)	0.15 (5.79)
Δp_{It-1}	-	-	-	0.06 (1.79)	-
$\Sigma\Delta p_I$	-	-	-	0.17	0.15
Δs_t	-	-	-	-1*	-1*
Δh_t	-	-0.35 (2.71)	-	-0.61 (1.74)	-0.68 (4.07)
D79	-	-	-	-	-0.057 (6.37)
D88	-	-	-	-0.049 (3.36)	-0.052 (4.78)
D89	-	-	-	-0.061 (3.59)	-0.062 (6.39)
$w_{t-1} - \overline{w}_{t-1}$	-	-	-	-0.36 (4.22)	-0.46 (3.57)
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	-	-	-	-0.04 (2.13)	-0.23 (13.17)
Statistics					
DW	-	1.63	1.64	2.07	1.56
SER × 100	-	0.65	0.99	1.17	0.81
SSR × 1000	-	0.99	2.35	1.92	0.97
AUTO(1)	-	$F(1,22)=0.71$	$F(1,23)=0.69$	$F(1,12)=0.26$	$F(1,12)=0.61$
ARCH(1)	-	$F(1,21)=0.80$	$F(1,22)=0.26$	$F(1,11)=0.07$	$F(1,11)=0.15$
CHOWPS(1)	-	$F(1,23)=0.01$	$F(1,24)=0.03$	$F(1,13)=0.77$	$F(1,13)=3.22$
FORECAST(1)	-	$\chi(1)=0.01$	$\chi(1)=0.03$	$\chi(1)=2.06$	$\chi(1)=5.63^*$
NORMBJ	-	$\chi(2)=4.82$	$\chi(2)=0.10$	$\chi(2)=0.65$	$\chi(2)=0.10$

Table 4.5.3. (cont.). Preferred wage equations[1]

Variables[2]	45 Fabricated metal prod.	50 Ships and oilplatf.	55 Building and construct.	63 Financial services	74 Domestic transport	81 Wholesale/ retail trade
Constant	0.158 (1.39)	-	-0.022 (4.31)	1.957 (5.24)	1.07 (4.09)	-0.017 (1.58)
$1/U^2_{t-1}$	-	-	0.044 (2.66)	-	-	-
$\Delta \overline{w}_t$	0.84 (9.31)	0.95*) (20.81)	0.48 (5.12)	-	0.69 (6.98)	0.29 (1.76)
Δp_t	-	0.05 (1.04)	0.52	0.61 (3.92)	0.38 (3.00)	0.33 (2.25)
Δp_{t-1}	0.29 (2.63)	-	-	0.28 (2.14)	0.17 (1.70)	0.44 (3.72)
$\Sigma \Delta p$	0.29	0.05	0.52	0.87	0.54	0.77
Δp_{It-2}	-	-	-	-	-	-
$\Sigma \Delta p_I$	-	-	-	-	-	-
Δz_t	-	-	0.17 (2.18)	-	-	0.19 (2.01)
Δz_{t-1}	0.30 (2.59)	-	-	-	-	0.22 (2.72)
Δz_{t-2}	-	-	-	-	-	0.06 (0.99)
$\Sigma \Delta z$	0.30	-	0.17	-	-	0.45
Δs_t	-	-	-	-1*)	-0.49 (3.53)	-
Δt_t	-	-0.29 (2.80)	-	-0.32 (1.82)	-0.25 (1.93)	-0.48 (2.82)
Δn_t	-	-	0.13 (2.58)	-	-	-
Δh_t	-0.54 (2.44)	-	-0.86 (4.72)	-0.90 (1.98)	-0.49 (2.26)	-0.34 (1.62)
D79	-0.016 (1.39)	-	-	-0.052 (3.51)	-	-0.059 (4.79)
D88	-	-	-	-	-	-
D89	-	-	-	-0.026 (1.72)	-	-
$w_{t-1} - \overline{w}_{t-1}$	-0.26 (0.84)	-	-	-0.35 (4.16)	-0.20 (1.86)	-0.32 (2.58)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-	-	-	-0.29 (5.19)	-0.167 (4.13)	-
$w_{t-1} + s_{t-1} - p_{It-1} - z_{t-1}$	-0.038 (0.96)	-	-	-	-	-
Statistics						
DW	1.78	2.12	1.58	2.35	2.18	1.24
SER × 100	0.95	0.87	0.99	1.34	0.96	0.97
SSR × 1000	1.54	1.75	1.96	3.07	1.56	1.41
AUTO(1)	F(1,16)=0.09	F(1,21)=0.98	F(1,19)=1.17	F(1,15)=0.90	F(1,16)=0.45	F(1,12)=0.91
ARCH(1)	F(1,15)=0.00	F(1,20)=0.16	F(1,18)=0.27	F(1,14)=0.30	F(1,15)=0.02	F(1,11)=0.04
CHOWPS(1)	F(1,17)=0.05	F(1,22)=1.56	F(1,20)=4.67*	F(1,16)=0.59	F(1,17)=4.66*	F(1,13)=0.89
FORECAST(1)	$\chi(1)$=0.07	$\chi(1)$=1.76	$\chi(1)$=6.12*	$\chi(1)$=3.32	$\chi(1)$=10.94*	$\chi(1)$=18.90*
NORMBJ	$\chi(2)$=2.09	$\chi(2)$=1.55	$\chi(2)$=0.60	$\chi(2)$=0.52	$\chi(2)$=0.22	$\chi(2)$=1.27

Table 4.5.3. (cont.) Preferred wage equations[1)]

Variables[2)]	85 Other private services	93K Local gov. education	94K Local gov. health and welfare	95S Central governm.	95K Local adm.
Constant	1.20 (4.14)	-0.010 (1.46)	0.763 (6.19)	1.890 (5.03)	0.624 (1.01)
$1/U^2_{t-1}$	-	0.037 (1.53)	-	-	0.100 (2.62)
$\Delta\overline{w}_t$	0.66 (9.59)	0.41 (3.69)	0.44 (3.98)	0.50 (4.67)	0.48 (3.09)
Δp_t	-	0.16 (1.17)	0.52 (4.93)	0.28 (1.96)	-
Δp_{t-1}	0.32 (3.59)	0.43*	0.35 (3.44)	0.33 (2.66)	0.27 (1.95)
$\Sigma\Delta p$	0.32	0.59	0.87	0.61	0.27
Δz_{t-1}	0.27 (3.02)	-	-	-	-
Δs_t	-	-	-	-0.35 (2.44)	-
Δt_t	-	-0.37 (2.11)	-0.48 (3.61)	-0.31 (1.72)	-0.25 (1.38)
Δh_t	-	-0.64 (1.67)	-0.71 (5.07)	-	-
D79	-0.040 (4.25)	-0.042 (2.82)	-0.034 (2.98)	-0.020 (1.37)	-0.039 (2.10)
D88	-	-	-0.029 (2.62)	-	-0.045 (2.64)
D89	-	-	-	-	-0.021 (1.23)
$w_{t-1} - \overline{w}_{t-1}$	-0.31 (4.18)	-	-0.16 (1.84)	-	-0.18 (2.02)
$w_{t-1} + h_{t-1} + t_{t-1} - p_{t-1}$	-0.19 (4.13)	-	-0.12 (6.13)	-0.30 (5.61)	-0.10 (0.98)
Statistics					
DW	2.49	2.07	2.64	1.71	2.02
SER x 100	0.81	1.27	0.99	1.30	1.39
SSR x 1000	1.24	3.10	1.56	3.04	3.06
AUTO(1)	F(1,18)=1.57	F(1,18)=0.06	F(1,15)=7.05*	F(1,17)=0.37	F(1,15)=0.29
ARCH(1)	F(1,17)=0.70	F(1,17)=0.00	F(1,14)=0.65	F(1,16)=0.41	F(1,14)=0.41
CHOWPS(1)	F(1,19)=1.44	F(1,19)=3,14	F(1,16)=3.10	F(1,18)=1.83	F(1,16)=0.08
FORECAST(1)	$\chi(1)$=1.90	$\chi(1)$=3.90*	$\chi(1)$=12.66*	$\chi(1)$=6.71*	$\chi(1)$=0.13
NORMBJ	$\chi(2)$=0.26	$\chi(2)$=0.39	$\chi(2)$=0.23	$\chi(2)$=0.42	$\chi(2)$=0.97

1)Left hand side variable: Δw_t. Method of estimation: 2SLS for disaggregated manufacturing industries, OLS for other sectors. Period of estimation: 1966-1990 for disaggregated manufacturing, 1965-1990 for other sectors. Absolute t-values in parenthesis.
2)The variables are explained in section 4.2.1.
*) for the estimation results means that apriori restrictions are imposed.
*) in the statistics means that H_0 is rejected.

Table 4.5.4. Long term weights on nominal variables

Sector[1]	Variables: Alternative wages	Consumer prices	Product prices[2]
3 Total manufacturing			
Factor income deflator	0.23	-	0.77
Alt. wage, fact. inc. def.	0.53	0.47	-
Alt. wage, import prices	0.46	0.54	-
Wedge	-	1	-
Phillips curve	-	0.23	0.77
15 Consumer goods	1	-	-
25 Intermediates and investments	0.90	0.10	-
34 Paper and paper products	0.94	-	0.06
37 Industrial chemicals	0.90	-	0.10
43 Primary metals	0.67	-	0.33
45 Fabricated metal products	0.87	-	0.13
50 Ships and oil platforms	0.95	0.05	-
55 Building and construction	0.48	0.52	-
63 Financial services	0.55	0.45	-
74 Domestic transport	0.55	0.45	-
81 Wholesale and retail trade	1	-	-
85 Other private services	0.62	0.38	-
93K Local gov. education	0.41	0.59	-
94K Local gov. health and welfare	0.57	0.43	-
95S Central administration	-	1	-
95K Local administration	0.64	0.36	-

1 For the sectors in MODAG not mentioned in the table, I have not estimated any wage equations, and wages in those sectors are assumed to develop according to wages for average manufacturing, or wages in a parallel sector.
2 In the factor income deflator specification and the alternative wage specification with factor income deflator product prices means the factor income deflator, in the other specifications prices on competing imported products.

deflator specification is also close to the Scandinavian theory of inflation when output prices move close to prices on competing products. The effects from productivity and taxes also favour the Phillips curve specification and the factor income deflator specification as discussed in section 4.3. In the other three error correction specifications it may seem surprising that output prices or prices on competing products have no weight at all in the long run.

Significant error correction terms and better tracking performance favour the error-correction models against the Phillips curve, although the alternative wage specification with factor income deflator seems to be somewhat weaker than the others regarding autocorrelation. Comparing the results in table 4.5.2 with the results in table 4.3.3 and 4.3.4, where the period of estimation ended in 1987, the estimated parameters in all specifications are quite stable, except for the alternative wage specification with import prices. In this specification the parameters changed substantially although dummies were used for 1988 and 1989 to catch up for the income regulations. Especially the error correction coefficient for alternative wages got low and insignificant. Also the long term weight on this variable decreased, with larger weight on the term for real disposable income. In addition to including 1990 in the period of estimation the changes in parameters seem to be caused by changes in the data for average productivity and average import prices due to shift in the base year of aggregation. Because of a rather parallel development in the nominal explanatory variables only small changes in data may lead to large changes in the long term weights.

The low parameter stability is of course a weakness with this alternative wage specification, and the difference from the simple wedge model in table 4.5.2 is rather small, although the long term weights differ. The parameters in the alternative wage specification with the factor income deflator did not change much as a result of extending the period of estimation to 1990. This specification is therefore still relevant. From the simulations presented in figure 4.5.1 and the post sample test statistics for 1991 (CHOWPS and FORECAST in table 4.5.2) all the error-correction models except the factor income deflator specification seem to be weaker than the Phillips curve in explaining wage growth from 1990 to 1991. While actual wage growth for average manufacturing based on the preliminary series in the national accounts is estimated to 4.4 per cent, the wedge model predicts 5.9, the alternative wage specification with the factor income deflator only 2.6 the factor income deflator specification and the Phillips curve equation 4.8. The forecast test also implies rejection of the alternative wage specification with the factor income deflator at a 10 per cent level, but not at 5. Closer correspondance to the Scandinavian theory of inflation may be the main reason why the Phillips curve and the factor income deflator model preform better, although too much weight should not be put on the results for 1991 as this is only one single year and data are preliminary. The low parameter stability for the alternative wage specifications extending the period of estimation from 1987 to 1990 is however a weakness.

The choice of specification for average manufacturing is also of great importance regarding the estimated impact from unemployment on wage formation. In the error-correction models there is no fixed equilibrium rate of unemployment, and the observed loss in competitiveness for manufacturing industries has to be explained by other factors. In the Phillips curve specification a great part of the loss in competitiveness may be explained by a rate of unemployment lower than the equilibrium rate during most of the period of estimation. In the specification presented in table 4.5.2 the average equilibrium rate is estimated to 2.6 per cent against 3.0 per cent in specification (7) in table 4.3.3. As discussed in section 4.3.6 there is some statistical uncertainty regarding this estimate and the decrease is not significant. From the structural analysis in section 2.2 a smaller shift in employment between industries may be an explanatory factor for the halting increase, and a possible decline in the equilibrium rate. Although it may be too strict to assume a fixed equilibrium rate over the whole period of estimation, the estimations on the period 1965-1990 indicate that the equilibrium rate has not changed much during the last 10 years.

As wages in average manufacturing are important in explaining wages in most of the other sectors, reflected by the weights in table 4.5.4, the choice of specification for average manufacturing is also of great importance for the other sectors in a reduced form. The impacts of the different explanatory variables in the wage block as a whole may thus be of help when evaluating the alternative specifications for total manufacturing, and this is further discussed in section 4.6.

Because of coordination of the central settlements for total manufacturing the wage structure seems to be quite stable, even in the short run. Rather simple wage equations with large weight on the growth in wages (or the instrument) for average manufacturing thus seem to be sufficient to catch up the wage growth in Production of consumer goods, Production of intermediates and investments, Production of paper and paper products and Building of ships and oil platforms. With some minor modifications wage growth in these sectors is explained by wages (or the factors determining wages) for average manufacturing. Although the specifications for these sectors are rather simple, it is evident from figure 4.5.1 that they also predict wage growth in 1991 rather well. From the summary statistics of the dynamic simulation presented in table 4.5.5 there is a minor deviation in the mean simulated level (especially for Production of paper and paper products and Building of ships and oil platforms) as these specifications are in growth form. This deviation is, however, not large, taken into consideration that the simulation was started in 1966. As discussed in section 4.5.2 attempts to avoid this by estimating on a level form gave problems with autocorrelation and were not successful.

The equations for Production of industrial chemicals, Production of primary metals and Production of fabricated metal products are error correction models, and also for these sectors a rather large weight is put on wages (or factors determining wages) for average manufacturing. Some weight is however put on prices on competing products in the traditional export industries and Fabricated metal products, and this variable is especially of importance in Production of primary metals. In Production of intermediates and investments and Building of ships and oil platforms on the other hand some concern seems to be given to the real disposable income in excess of what follows by wages for average manufacturing. The large coordination of wage settlements in manufacturing industries is probably the main explanation why wage costs per unit produced have increased less than prices on competing products for the traditional export industries, and why no significant effects are found from prices on electricity and other intermediate inputs. Except from Production of primary metals unemployment has no direct effect in any sector in excess of what follows from the impact through wages for average manufacturing. These error correction specifications also seem to perform quite well, but the forecast test indicates some minor problems in explaining wage growth in 1991 for Production of primary metals.

Wages for average manufacturing also seem to have a large impact on wages in the sheltered industries, but in these sectors concern for real disposable incomes is of some importance, except for Wholesale and retail trade. The concern for real disposable income especially seems to be large in Central administration, Public education, Building and construction and Financial services, reflecting the fact that these sectors have experienced the greatest loss in relative wage position compared to average manufacturing.

For Building and construction and Public education a Phillips curve seems to be the best specification. This may cause the wages in these sectors to deviate from average manufacturing in a situation where the rate of unemployment deviates much from the average during the period of estimation and may be one explanation why wage growth in 1991 is underestimated for these sectors.

Smaller reductions of normal working hours, smaller growth in productivity and an increasing share of women with lower pay than men, are possible factors when explaining the loss in relative wage position for private and public services. Little support for this view is found in the empirical analysis here, although the factors mentioned above may be of some importance in some sectors. Concern for real disposable wages rather than concern for relative wages seems to be the main factor behind the loss.

It is however striking that wage growth seems to be underestimated in 1991 for those sectors which have lost most of their relative wage position during the period of estimation (Public sectors, Domestic transport and Building and construction) and thus have a large weight on the concern for consumer prices in table 4.5.4. This seems to be the case irrespective of whether the equations are Phillips curves or error correction models, and may indicate a structural change. As the loss in relative wage position for these sectors has taken place for more than two decades, it may be argued that the wage levels now are so similar to manufacturing that the process cannot continue. As data for 1991 are preliminary, it is too early to draw a definite conclusion. Another possible explanation is the fact that the unusual problems on the labour market especially have hit temporary workers with low education and low wages, increasing the observed *average* wages in a sector more than what should follow from normal wage formation. This may also be the reason why wage growth in Wholesale and retail trade, Financial services and Other private services seem to be somewhat underestimated in 1990 and 1991. In Wholesale and retail trade wage growth where especially underestimated in 1990, explaining why the forecast test indicates a significant miss in the level for 1991.

Because average personal income taxes have fluctuated around a stable level from the beginning of the seventies it is not easy to estimate a clear effect of this variable. From economic theory even the sign of the effect is uncertain. When income taxes are estimated under a restriction together with pay-roll taxes in a Phillips curve specification for average manufacturing they turned out to have only a small effect. This is also the case in the factor income delfator specification. In the other error-correction specifications the symmetric treatment of taxes and consumer prices causes large effects as the effects from consumer prices are large. Because of the sluggish response in these models, the increase in income, pay-roll and value added taxes during the sixties and the first part of the seventies are important explanatory factors for the loss in competitiveness when believing in these specifications. In the sheltered sectors where consumer prices have a larger weight in the long run, income taxes also have a large effect due to the chosen error-correction specification. In sectors where consumer prices have a short term effect, the short term effect from personal income taxes is often smaller.

Irrespective of specification labour productivity has a large effect in the long run for Average manufacturing, Production of primary metals and in the short run for Wholesale and retail trade. Otherwise the direct productivity effects are rather small in all the disaggregated sectors. In addition to the indirect effect through average manufacturing

Figure 4.5.1. Actual and simulated wage growth for the different sectors. Per cent

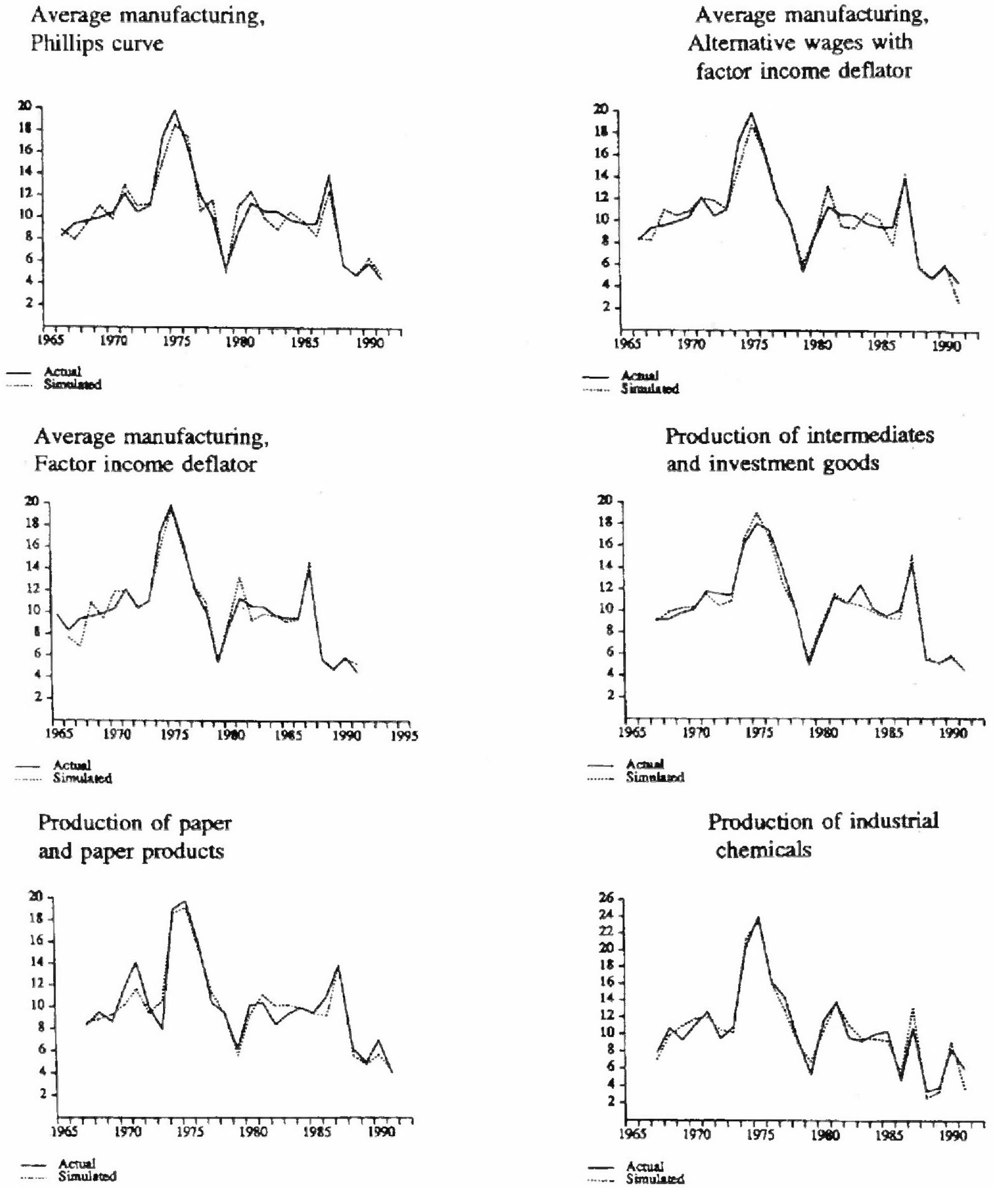
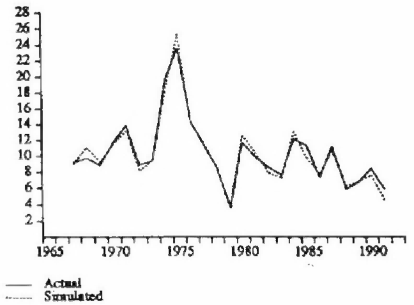
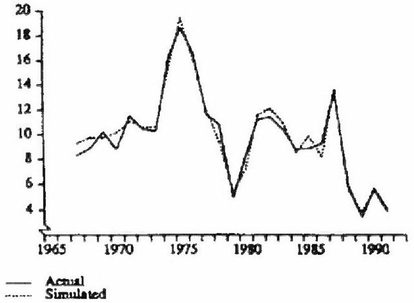


Figure 4.5.1. (cont.)

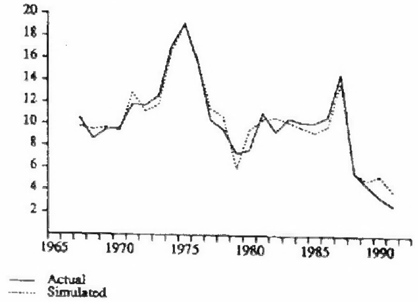
Production of primary metals



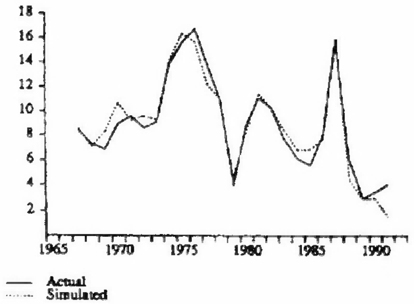
Production of fabricated metal products



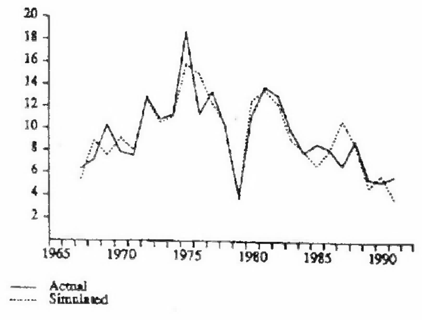
Building of ships and oil platforms



Building and construction



Financial services



Domestic transport

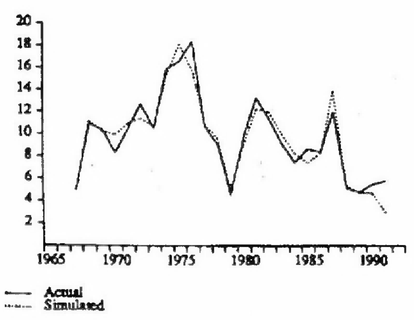
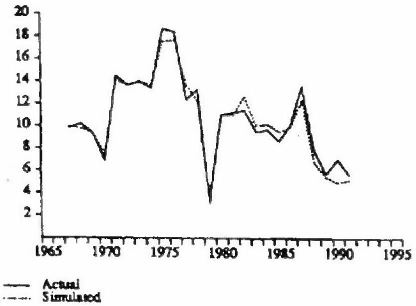
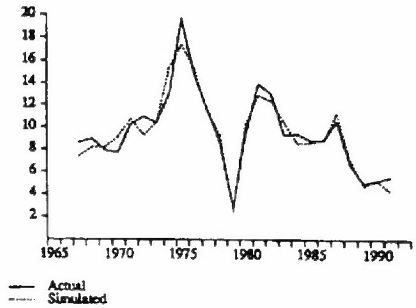


Figure 4.5.1. (cont.)

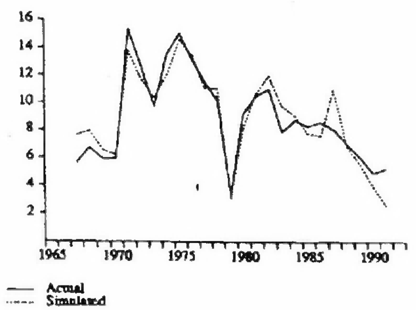
Wholesale and retail trade



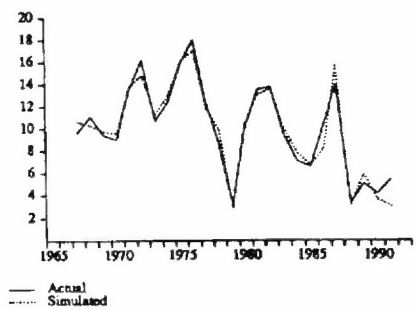
Other private services



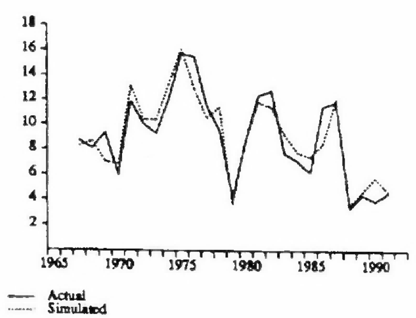
Local government education



Local government health and social services



Local government administration



Central government administration

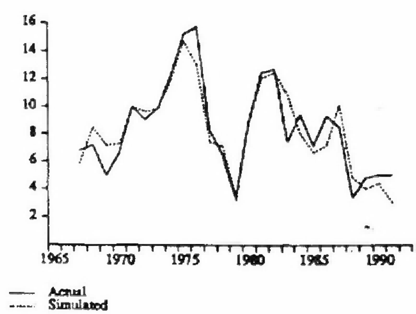


Table 4.5.5 Summary statistics for dynamic simulations on each equation 1965(6)[1] to 1991[2]

Sector	Mean deviation in per cent	Standard deviation on percentage deviation	RRMS[3]
3 Average manufacturing			
Factor income deflator	-0.02	0.84	0.67
Alt. wages with fact.inc.def.	-0.07	0.97	1.02
Wedge	-0.05	0.93	1.20
Phillips curve	0.97	1.09	1.41
25 Intermediates and investments	-0.15	1.06	1.53
34 Paper and paper products	-2.40	1.36	3.88
37 Industrial chemicals	0.01	0.93	1.26
43 Primary metals	-0.07	0.82	1.22
45 Fabricated metal products	0.31	0.67	0.59
50 Ships and oil platforms	1.27	1.07	2.44
55 Building and construction	0.80	1.48	2.18
63 Financial services	-0.08	1.11	1.43
74 Domestic transport	-0.21	0.92	1.39
81 Wholesale and retail trade	-0.05	1.13	2.09
85 Other services	-0.09	0.64	0.64
93K Local gov. education	-0.49	1.38	1.71
94K Local gov. health and welfare	-0.35	0.75	1.00
95S Central administration	-0.02	1.46	1.47
95K Local administration	-0.28	1.17	1.25

[1] 1966 for the specified manufacturing sectors, otherwise 1965.
[2] 1991 is post sample.
[3] Root mean square error in per cent of the actual mean wage level.

wages, the rate of unemployment has a direct effect on wage formation in Production of primary metals, Building and construction, Wholesale and retail trade, Local education and Local administration. The change in employment also has a significant effect on wage formation in Building and construction which is the sector where wages seem to be most influenced by the conditions on the labour market.

In the Phillips curve specification changes in the normal working hours and the price and income regulation in 1978/79 entail a lasting effect on the wage level for average manufacturing, and thus also indirectly on the other sectors. The error-correction specifications for average manufacturing on the other hand implicates that changes in normal working hours and price and income regulations only have a temporary effect. However, in sectors where concern for real disposable wages is of importance, normal working hours should be included in the same way as consumer prices and taxes, and should therefore have a long term effect on wage rates according to the theory for trade unions. In some sectors the short-run effects from these events differ from the ones in average manufacturing.

4.6. Impact analyses using the wage equations

In tables and figures 4.6.1 - 4.6.7 a set of impact analyses based on the wage block is presented using three alternative wage specifications for manufacturing, the Phillips

Table 4.6.1. Effects on wage rates in per cent from an increase in consumer prices by 1 per cent

Sector	Model	Years after change						
		1	2	3	5	10	15	20
3 Manufacturing	PH	0	0.23	0.23	0.23	0.23	0.23	0.23
	EC	0	0.45	0.53	0.66	0.84	0.93	0.97
	AW	0	0.32	0.60	0.85	0.98	1.00	1.00
25 Production of intermediates and investment good	PH	0.10	0.30	0.30	0.30	0.30	0.30	0.30
	EC	0.10	0.51	0.58	0.69	0.86	0.93	0.97
	AW	0.10	0.38	0.64	0.86	0.98	1.00	1.00
34 Production of paper and paper products	PH	0	0.21	0.21	0.21	0.21	0.21	0.21
	EC	0	0.43	0.50	0.62	0.79	0.87	0.91
	AW	0	0.30	0.56	0.80	0.92	0.94	0.94
37 Production of industrial chemicals	PH	0.20	0.49	0.38	0.27	0.21	0.21	0.21
	EC	0.20	0.64	0.60	0.61	0.74	0.83	0.87
	AW	0.20	0.55	0.63	0.75	0.88	0.90	0.91
43 Production of primary metals	PH	0	0.51	0.26	0.16	0.15	0.15	0.15
	EC	0	0.51	0.36	0.38	0.53	0.60	0.63
	AW	0	0.51	0.30	0.46	0.64	0.66	0.66
45 Fabricated metal products	PH	0	0.48	0.39	0.30	0.21	0.20	0.20
	EC	0	0.67	0.65	0.66	0.74	0.81	0.84
	AW	0	0.55	0.70	0.82	0.87	0.87	0.87
50 Building of ships and oil platforms	PH	0.05	0.26	0.26	0.26	0.26	0.26	0.26
	EC	0.05	0.48	0.55	0.67	0.85	0.93	0.97
	AW	0.05	0.35	0.62	0.86	0.98	1.00	1.00
55 Building and construction	PH	0.52	0.63	0.63	0.63	0.63	0.63	0.63
	EC	0.52	0.74	0.78	0.84	0.92	0.96	0.98
	AW	0.52	0.67	0.81	0.93	0.99	1.00	1.00

Table 4.6.1. (cont.)

Sector	Model	Years after change						
		1	2	3	5	10	15	20
63 Financial services	PH	0.61	0.79	0.65	0.59	0.58	0.58	0.58
	EC	0.61	0.79	0.73	0.77	0.89	0.95	0.98
	AW	0.61	0.79	0.68	0.82	0.98	1.00	1.00
74 Domestic transport	PH	0.38	0.73	0.67	0.62	0.58	0.58	0.58
	EC	0.38	0.89	0.87	0.88	0.93	0.97	0.98
	AW	0.38	0.79	0.92	1.00	1.00	1.00	1.00
81 Wholesale and retail trade	PH	0.33	0.74	0.57	0.39	0.25	0.23	0.23
	EC	0.33	0.80	0.71	0.67	0.78	0.89	0.95
	AW	0.33	0.76	0.70	0.76	0.93	0.98	1.00
85 Other private services	PH	0	0.66	0.59	0.54	0.52	0.52	0.52
	EC	0	0.81	0.79	0.81	0.90	0.96	0.98
	AW	0	0.72	0.83	0.93	0.99	1.00	1.00
93K Local government education	PH	0.16	0.68	0.68	0.68	0.68	0.68	0.68
	EC	0.16	0.77	0.81	0.86	0.93	0.97	0.99
	AW	0.16	0.72	0.83	0.96	0.99	1.00	1.00
94K Local government health and social services	PH	0.52	0.95	0.84	0.71	0.60	0.58	0.57
	EC	0.52	1.05	0.98	0.92	0.92	0.96	0.98
	AW	0.52	0.99	1.01	1.01	1.00	1.00	1.00
95K Local administration	PH	0	0.48	0.48	0.49	0.49	0.50	0.50
	EC	0	0.59	0.64	0.73	0.87	0.94	0.97
	AW	0	0.52	0.67	0.83	0.96	0.99	1.00
95S Central administration	PH	0.28	0.94	0.96	0.98	1.00	1.00	1.00
	EC	0.28	1.06	1.08	1.09	1.06	1.03	1.01
	AW	0.28	0.99	1.13	1.17	1.05	1.01	1.00

curve model (PH), the error correction model with a wedge variable (EC) and the alternative wage model with factor income deflator (AW) according to the estimations updated to 1990. From the long term weights on nominal variables presented in table 4.5.4 and the symmetric treatment of taxes and prices, it follows that the alternative wage specification with import prices is very close to the alternative wage specification with the factor income deflator. The marginal properties of shifts in the explanatory variables in the factor income deflator model are very close to the Phillips curve specification, with the exception from a shift in normal working hours and unemployment where the long term effects are close to the wedge model. Effects on wages of shifts in the explanatory variables based on the alternative wage model with import prices and the factor income deflator model are therefore not presented in this section. For some of the variables the macroeconomic effects based on the factor income deflator specification are discussed in chapter 5.

As wage rates in manufacturing seem to be an important explanatory factor in most sectors the tables show the direct effects of changes in the explanatory variables and the indirect ones working through manufacturing. In the Phillips curve model and the wedge model the effect from wages in average manufacturing is recursive while wages in average manufacturing and the other sectors are simultaneously given in the alternative wage model.

As discussed in section 4.3.2 the main difference between the Phillips curve model and the other two specifications is that the Phillips curve implies large weight on a tight labour market when explaining the loss in competitiveness for manufacturing during the seventies and partly the eighties (this subject is further analysed in section 4.7). This explanation is not possible in the other two specifications because an almost constant rate of unemployment cannot have contributed much to wage growth in a specification with a connection between the *level* of unemployment and the *level* of wages. The loss in competitiveness in these specifications is explained by increases in consumer prices, income taxes and pay-roll taxes.

The elasticities of wages with respect to consumer prices, using the wage block, are presented in table 4.6.1. While the elasticity for manufacturing is only 0.23 in the Phillips curve specification, the long run elasticity is close to 1 in the other specifications. However, in most of the sheltered sectors the long run elasticities of consumer prices are larger than for manufacturing, also in the Phillips curve model, as an independent long run weight on consumer prices is found to be relevant in these sectors.

Due to small error correction coefficients the responses from consumer prices are very sluggish in the error-correction model and the alternative wage model, and the effects are not completely exhausted before 15 to 20 years. According to these specifications the

Figure 4.6.1. Effects on wages in average manufacturing in per cent from an increase in consumer prices by 1 per cent from 1971

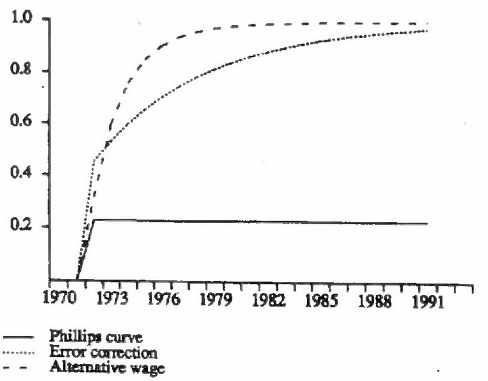
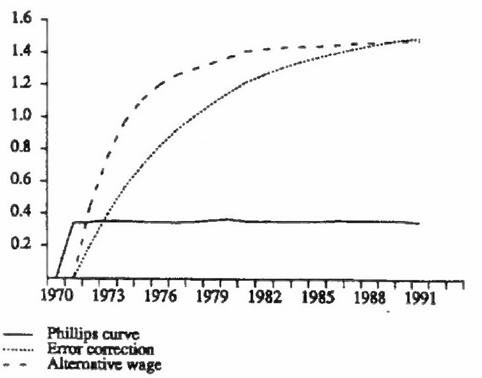


Figure 4.6.2. Effects on wages in average manufacturing in per cent from an increase in average income tax rate by 1 percentage point from 1971



introduction of the value-added tax in 1970 may explain some of the loss in competitiveness during the eighties. In the Phillips curve specification the effects are much more immediate with overshooting in the short run for some of the manufacturing sectors. The reason for this is that consumer prices seem to have a large short term effect on wages in Production of industrial chemicals, Production of primary metals and Fabricated metal products while wages for average manufacturing is the main explanatory factor in the long run. As prices on competing products are the main explanatory factor for average manufacturing wages in the Phillips curve model, this explains why consumer prices have a smaller effect in the long run than in the short run in some of the sectors.

Especially for Wholesale and retail trade the dynamics of changes in consumer prices is a bit strange in the wedge model and the alternative wage model, giving a strong short run effect, a more modest medium term effect and a strong long run effect. This is caused by a rather strong direct effect from consumer prices in the short run while wages for average manufacturing dominate in the medium term and the long run. As the change in manufacturing wages is rather sluggish in these two models, this explains the modest medium term effect.

In Central government administration, where the long run effect of a change in consumer prices is equal to 1 in all three specifications, the effect is greater than one in the wedge model and the alterna- tive wage model in the medium term. This is caused by a large short term effect from manufacturing wages, and from table 4.6.1 it is evident that the effect from consumer prices on wages in manufacturing is larger from the second year in the wedge model and the alternative wage model compared to the Phillips curve. It had been possible to avoid this overshooting by putting restrictions on the short run dynamics, but such restrictions are not necessary to prevent overshooting with the Phillips curve model.

Because of the symmetry restrictions between consumer prices and income taxes imposed in all three specifications the impact coefficients from changes in income taxes presented in table 4.6.2 and figure 4.6.2 follow the same pattern as the coefficients from changes in consumer prices. Although this symmetry restriction is not obvious as discussed in section 4.3.8, the restriction is in accordance with economic theory and cannot be rejected in an empirical test. As income taxes are included in the model on the form $(1-\bar{t})$ where $\bar{t}$ is the average tax rate, the shift is done for convenience by an increase in this tax rate by 1 percentage point from 1971. The impact coefficients cannot therefore directly be interpreted as elasticities. The change in $(1-\bar{t})$ is larger than 1 per cent and the relative change depend on the tax level each year.

While the effects from income taxes for manufacturing industries are almost immediate with the Phillips curve specification, the effects in the other two specifications are far more sluggish. Even after 20 years the effects are not exhausted and the specifications thus explain some of the loss in competitiveness for average manufacturing during the eighties with the increases in income taxes during the end of the sixties and the beginning of the seventies. As in the case with shift in consumer prices the long run effects from tax increases are far larger in the error-correction model and the alternative wage model than the Phillips curve model. In public sectors and some of the private services, the effects from tax increases are larger than for manufacturing industries, especially with the Phillips curve model. The reason for this is that a certain weight seems to be put on real disposable incomes in these sectors in the long run.

Especially for Wholesale and retail trade the dynamics of tax increases are a bit strange in the error-correction model and the alternative wage model, giving a strong short run effect, a more modest medium term effect and a large long run effect.

Regarding the effects from an overall growth in productivity presented in table 4.6.3 and figure 4.6.3 the Phillips curve specification and the wedge model give about the same

Table 4.6.2. Effects on wage rates in per cent from an increase in the average income tax rate by 1 percentage point from 1971

Sector	Model	Years after change						
		1	2	3	5	10	15	20
3 Manufacturing	PH	0.34	0.34	0.35	0.35	0.37	0.35	0.35
	EC	0	0.20	0.40	0.70	1.15	1.37	1.48
	AW	0	0.45	0.75	1.11	1.37	1.44	1.48
25 Production of intermediates and investment goods	PH	0.30	0.31	0.32	0.31	0.33	0.32	0.32
	EC	0	0.19	0.36	0.63	1.04	1.24	1.34
	AW	0	0.40	0.68	1.00	1.24	1.30	1.33
34 Production of paper and paper products	PH	0.32	0.32	0.33	0.33	0.34	0.33	0.33
	EC	0	0.20	0.37	0.66	1.08	1.29	1.40
	AW	0	0.42	0.71	1.04	1.29	1.36	1.39
37 Production of industrial chemicals	PH	0.22	0.26	0.29	0.30	0.33	0.32	0.32
	EC	0	0.14	0.28	0.55	0.99	1.22	1.33
	AW	0	0.29	0.54	0.88	1.21	1.31	1.34
43 Production of primary metals	PH	0	0.15	0.21	0.23	0.24	0.23	0.24
	EC	0	0	0.10	0.32	0.69	0.88	0.96
	AW	0	0	0.21	0.57	0.87	0.95	0.97
45 Fabricated metal products	PH	0.28	0.29	0.30	0.30	0.32	0.31	0.31
	EC	0	0.18	0.33	0.60	0.99	1.19	1.29
	AW	0	0.37	0.63	0.95	1.19	1.26	1.29
50 Building of ships and oil platforms	PH	0.75	0.77	0.79	0.78	0.82	0.79	0.79
	EC	0.43	0.64	0.83	1.11	1.57	1.76	1.87
	AW	0.43	0.87	1.17	1.51	1.78	1.83	1.86
55 Building and construction	PH	0.16	0.16	0.17	0.17	0.17	0.17	0.17
	EC	0	0.10	0.19	0.33	0.55	0.65	0.71
	AW	0	0.21	0.36	0.53	0.65	0.69	0.70

Table 4.6.2 (cont.)

Sector	Model	Years after change						
		1	2	3	5	10	15	20
63 Financial services	PH	0.48	0.73	0.84	0.88	0.92	0.90	0.91
	EC	0.48	0.61	0.75	0.95	1.29	1.43	1.51
	AW	0.48	0.61	0.83	1.15	1.44	1.49	1.51
74 Domestic transport	PH	0.61	0.71	0.79	0.85	0.92	0.90	0.91
	EC	0.37	0.64	0.83	1.08	1.38	1.47	1.53
	AW	0.37	0.80	1.07	1.39	1.49	1.50	1.52
81 Wholesale and retail trade	PH	0.80	0.68	0.59	0.45	0.40	0.35	0.35
	EC	0.70	0.56	0.53	0.57	1.01	1.27	1.42
	AW	0.70	0.63	0.68	0.86	1.28	1.41	1.45
85 Other private services	PH	0.22	0.50	0.65	0.76	0.81	0.81	0.82
	EC	0	0.42	0.68	0.99	1.31	1.44	1.52
	AW	0	0.58	0.92	1.32	1.44	1.49	1.52
93K Local government education	PH	0.68	0.70	0.72	0.71	0.75	0.72	0.72
	EC	0.54	0.65	0.74	0.85	1.07	1.14	1.19
	AW	0.54	0.74	0.89	1.02	1.16	1.17	1.19
94K Local government health and social services	PH	0.86	0.88	0.90	0.88	0.92	0.88	0.89
	EC	0.71	0.80	0.90	1.04	1.33	1.44	1.51
	AW	0.71	0.91	1.07	1.24	1.46	1.49	1.51
95K Local administration	PH	0.54	0.60	0.66	0.70	0.78	0.77	0.77
	EC	0.37	0.52	0.66	0.87	1.24	1.41	1.50
	AW	0.37	0.64	0.85	1.11	1.40	1.47	1.51
95S Central administration	PH	0.62	0.89	1.10	1.32	1.54	1.55	1.57
	EC	0.55	0.87	1.17	1.49	1.67	1.63	1.61
	AW	0.45	0.99	1.32	1.58	1.63	1.58	1.59

results indicating a long term coefficient for average manufacturing of about 1. In both models this follows from apriori restrictions, but free estimation gave results very close to the restrictions imposed. The effects are also exhausted in three years in both models, but the wedge model indicates a slight overcompensation in the medium term due to the dynamic specification.

The lower effects in the alternative wage model is caused by no direct short run effect on wages in average manufacturing of productivity changes and in the long run of smaller direct long run effects of productivity changes in public sectors and private services. According to table 4.5.4 alternative wages are important for wages in average manufacturing in this specification. Because of the importance of (factors determining) wages for aggregate manufacturing, the effects from productivity changes on wages in the single manufacturing industries are quite parallel. Due to direct effects, productivity growth is overcompensated in the medium term in Production of fabricated metals. Although the direct effects from productivity changes are lower in public sectors and private services, the total effects are relatively large in the Phillips curve specification and the wedge specification as large weight is put on manufacturing wages in the long run.

Because of the price homogeneity restrictions imposed in all the three specifications and all sectors in the long run, the long run effects on wage rates of an increase in prices on import-competing manufactured goods and the factor income deflator in the alternative wage case are equal to 1 - the long run effects from changes in consumer prices. While

Table 4.6.3. Effects on wage rates in per cent from an overall increase in productivity by 1 per cent

Sector	Model	Years after change						
		1	2	3	5	10	15	20
3 Manufacturing	PH	0.33	0.67	1.00	1.00	1.00	1.00	1.00
	EC	0.30	0.71	1.05	1.04	1.02	1.01	1.00
	AW	0	0.25	0.43	0.60	0.70	0.71	0.71
25 Production of intermediates and investment goods	PH	0.30	0.60	0.90	0.90	0.90	0.90	0.90
	EC	0.27	0.64	0.95	0.94	0.92	0.91	0.90
	AW	0	0.23	0.39	0.54	0.63	0.64	0.64
34 Production of paper and paper products	PH	0.31	0.62	0.94	0.94	0.94	0.94	0.94
	EC	0.29	0.66	0.99	0.98	0.96	0.95	0.94
	AW	0	0.24	0.41	0.57	0.65	0.67	0.67
37 Production of industrial chemicals	PH	0.22	0.50	0.80	0.93	0.99	1.00	1.00
	EC	0.20	0.53	0.83	0.96	1.01	1.01	1.00
	AW	0	0.20	0.37	0.56	0.71	0.73	0.74
43 Production of primary metals	PH	0	0.39	0.66	0.97	0.99	1.00	1.00
	EC	0	0.37	0.67	1.00	1.02	1.00	1.00
	AW	0	0.23	0.42	0.65	0.79	0.81	0.81
45 Fabricated metal products	PH	0.28	0.90	1.12	1.06	1.01	1.00	1.00
	EC	0.25	0.93	1.17	1.10	1.03	1.01	1.00
	AW	0	0.55	0.64	0.72	0.74	0.75	0.68
50 Building of ships and oil platforms	PH	0.32	0.63	0.95	0.95	0.95	0.95	0.95
	EC	0.29	0.67	1.00	0.99	0.97	0.96	0.96
	AW	0	0.24	0.41	0.57	0.66	0.67	0.68
55 Building and construction	PH	0.32	0.48	0.64	0.64	0.64	0.64	0.64
	EC	0.31	0.50	0.67	0.66	0.65	0.65	0.65
	AW	0.17	0.29	0.37	0.45	0.50	0.51	0.51

Table 4.6.3 (cont)

Sector	Model	Years after change						
		1	2	3	5	10	15	20
63 Financial services	PH	0	0.12	0.28	0.51	0.55	0.55	0.55
	EC	0	0.11	0.29	0.54	0.56	0.55	0.55
	AW	0	0	0.09	0.26	0.37	0.39	0.39
74 Domestic transport	PH	0.23	0.44	0.64	0.58	0.55	0.54	0.54
	EC	0.21	0.47	0.68	0.60	0.56	0.55	0.55
	AW	0	0.18	0.29	0.37	0.39	0.39	0.39
81 Wholesale and retail trade	PH	0.29	0.61	0.79	0.90	0.99	1.00	1.00
	EC	0.28	0.62	0.81	0.94	1.01	1.01	1.01
	AW	0.19	0.42	0.48	0.53	0.66	0.70	0.71
85 Other private services	PH	0.22	0.70	0.78	0.66	0.62	0.62	0.62
	EC	0.20	0.73	0.82	0.69	0.63	0.63	0.62
	AW	0	0.43	0.42	0.42	0.43	0.44	0.44
93K Local government education	PH	0.14	0.27	0.41	0.41	0.41	0.41	0.41
	EC	0.12	0.29	0.43	0.43	0.42	0.41	0.41
	AW	0	0.11	0.18	0.25	0.29	0.29	0.29
94K Local government health and social services	PH	0.15	0.30	0.46	0.51	0.54	0.55	0.55
	EC	0.13	0.32	0.49	0.53	0.56	0.56	0.55
	AW	0	0.11	0.20	0.30	0.37	0.39	0.39
95K Local administration	PH	0.16	0.34	0.52	0.58	0.64	0.64	0.64
	EC	0.15	0.35	0.55	0.61	0.65	0.65	0.65
	AW	0	0.12	0.22	0.34	0.43	0.45	0.46
95S Central administration	PH	0.17	0.28	0.36	0.18	0.03	0.01	0.00
	EC	0.15	0.31	0.39	0.18	0.03	0.00	0.00
	AW	0	0.13	0.18	0.16	0.05	0.01	0.00

the weight put on competing prices thus is equal to 0.8 for average manufacturing due to the Phillips curve specification, the effects are close to 0 in the other two specifications. There is, however, a rather large effect after three years also with the error-correction model and the alternative wage model.

As there are no direct effects from prices on import-competing manufactured goods on wages in private services and public sectors, the effects follow via manufacturing wages. In the wedge model and the alternative wage model there is thus a medium term effect on wages also in these sectors while the long term effects are close to zero. In the Phillips curve specification there is also a long run effect, but smaller than for manufacturing sectors as some weight is put on real disposable income in the long run in public and private services.

In Production of paper and paper products, Industrial chemicals, Primary metals and Fabricated metal products prices on competing goods have an independent impact in the long run according to table 4.5.4. Prices on competing goods thus have a long term effect in these sectors even in the wedge specification and the alternative wage specification.

The negative effect in the medium term in Central government administration is caused by the dynamics giving a short term effect on manufacturing wages, but not a long term effect. As the effect on manufacturing wages declines after the third year in the wedge model and the alternative wage model, this causes a negative effect which is greater than the small positive effect from the error-correction term.

Table 4.6.4. Effects on wage rates in per cent from an increase in product prices[1] by 1 per cent

Sector	Model	Years after change						
		1	2	3	5	10	15	20
3 Manufacturing	PH	0.15	0.54	0.77	0.77	0.77	0.77	0.77
	EC	0.12	0.41	0.53	0.39	0.18	0.08	0.04
	AW	0.16	0.50	0.55	0.23	0.04	0.01	0.00
25 Production of intermediates and investment goods	PH	0.14	0.49	0.69	0.69	0.69	0.69	0.69
	EC	0.11	0.37	0.48	0.35	0.16	0.08	0.03
	AW	0.14	0.45	0.51	0.21	0.03	0.01	0.00
34 Production of paper and paper products	PH	0.20	0.57	0.78	0.78	0.78	0.78	0.78
	EC	0.17	0.44	0.56	0.43	0.23	0.14	0.10
	AW	0.21	0.53	0.58	0.27	0.09	0.07	0.06
37 Production of industrial chemicals	PH	0.21	0.53	0.70	0.76	0.79	0.79	0.79
	EC	0.19	0.44	0.53	0.46	0.28	0.18	0.13
	AW	0.21	0.51	0.57	0.35	0.15	0.10	0.09
43 Production of primary metals	PH	0.15	0.35	0.59	0.82	0.85	0.85	0.85
	EC	0.15	0.33	0.52	0.64	0.49	0.41	0.37
	AW	0.15	0.35	0.57	0.60	0.38	0.34	0.34
45 Fabricated metal products	PH	0.13	0.49	0.72	0.75	0.79	0.80	0.80
	EC	0.10	0.38	0.52	0.44	0.28	0.20	0.16
	AW	0.13	0.46	0.53	0.30	0.16	0.14	0.13
50 Building of ships and oil platforms	PH	0.15	0.51	0.73	0.73	0.73	0.73	0.73
	EC	0.12	0.39	0.51	0.37	0.17	0.08	0.04
	AW	0.15	0.48	0.53	0.22	0.04	0.01	0.00
55 Building and construction	PH	0.07	0.26	0.37	0.37	0.37	0.37	0.37
	EC	0.06	0.19	0.25	0.19	0.09	0.04	0.02
	AW	0.08	0.24	0.26	0.11	0.02	0.00	0.00

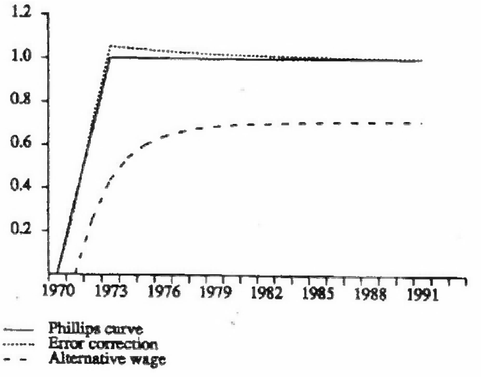
Table 4.6.4. (cont.)

Sector	Model	Years after change						
		1	2	3	5	10	15	20
63 Financial services	PH	0	0.05	0.21	0.39	0.42	0.42	0.42
	EC	0	0.04	0.16	0.25	0.13	0.06	0.03
	AW	0	0.06	0.20	0.22	0.04	0.01	0.00
74 Domestic transport	PH	0.11	0.36	0.50	0.45	0.42	0.42	0.42
	EC	0.08	0.27	0.34	0.22	0.09	0.04	0.02
	AW	0.11	0.34	0.35	0.11	0.01	0.00	0.00
81 Wholesale and retail trade	PH	0.05	0.29	0.37	0.58	0.74	0.77	0.77
	EC	0.04	0.15	0.27	0.35	0.25	0.13	0.06
	AW	0.05	0.18	0.30	0.29	0.10	0.03	0.01
85 Other private services	PH	0.10	0.35	0.50	0.48	0.48	0.48	0.48
	EC	0.08	0.27	0.34	0.24	0.11	0.05	0.02
	AW	0.11	0.33	0.36	0.14	0.02	0.00	0.00
93K Local government education	PH	0.06	0.22	0.32	0.32	0.32	0.32	0.32
	EC	0.05	0.17	0.22	0.16	0.07	0.03	0.02
	AW	0.07	0.21	0.23	0.09	0.02	0.00	0.00
94K Local government health and social services	PH	0.07	0.24	0.36	0.39	0.42	0.43	0.43
	EC	0.05	0.18	0.25	0.21	0.11	0.05	0.03
	AW	0.07	0.23	0.26	0.13	0.03	0.01	0.00
95K Local administration	PH	0.07	0.27	0.40	0.45	0.49	0.50	0.50
	EC	0.06	0.20	0.28	0.24	0.13	0.07	0.03
	AW	0.07	0.25	0.30	0.16	0.04	0.01	0.00
95S Central administration	PH	0.08	0.25	0.29	0.14	0.02	0.00	0.00
	EC	0.06	0.19	0.19	0.04	-0.05	-0.03	-0.01
	AW	0.08	0.23	0.18	-0.04	-0.05	-0.01	-0.00

1) In the alternative wage specification the table shows the effects from a change in the factor income deflator for average manufacturing. In the other specifications and for the single manufacturing sectors the table shows the effects from changes in prices on competing imported goods.

Because of the long run symmetry restriction in all the three specifications, the effects from changes in pay-roll taxes presented in table 4.6.5 correspond to the effects from changes in income taxes. Where the effects from income taxes on nominal wages are large the effects from pay-roll taxes are small and vice versa. Because of the symmetry restriction a shift from pay-roll taxes to income taxes have no effects on wage costs (including pay-roll taxes) or real disposable wages (after income taxes) in any of the three specifications and thus no real effects at all. The effect on wages actually paid may, however, differ between the specifications.

Figure 4.6.3. Effects on manufacturing wages in per cent from an overall increase in productivity by 1 per cent from 1971



While an increase in pay-roll taxes has a rather large and immediate negative effect on wage rates for average manufacturing in the Phillips curve specification there are no effects at all in the wedge model and the alternative wage model. As pay-roll taxes are assumed to have no direct long run effects in the sectors outside manufacturing these results are also reflected in those sectors. However, for Production of industrial chemi- cals, Production of primary metals and Production of fabricated metal products pay-roll taxes seem to have a direct long run effect. In some of the private services pay-roll taxes have a short run direct effect on wages.

The effects on hourly wages of an overall increase in normal working hours are presented in table 4.6.6 and figure 4.6.6. According to the Phillips curve specification where a change in normal working hours is assumed to have a lasting effect on hourly wage rates, the effect is about 70 per cent of the change. Based on an apriori restriction the wedge model shows no long run effects for average manufacturing. Specifications formulated as changes in wages for Production of intermediates and investment goods, Building and construction and Local government education may thus be troublesome in this case.

Figure 4.6.4. Effects on manufacturing wages in per cent from an increase in product prices by 1 per cent from 1971

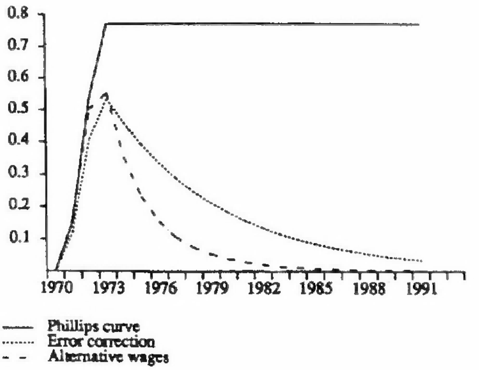
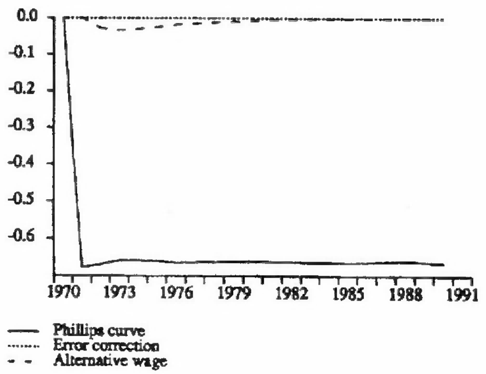


Figure 4.6.5. Effects on manufacturing in per cent from an increase in the pay-roll tax rate by 1 percentage point from 1971



In public sectors and most of the private services a symmetrical effect of consumer prices, income taxes and normal working hours are imposed regarding the concern for real yearly disposable incomes, and these restrictions may not be rejected. This is the reason why changes in normal working hours have long run effects in average manufacturing with the alternative wage specification. The effects of changes in normal working hours are almost immediate for most sectors with the Phillips curve specification. While the effects are smaller in the long run than in the short run for some of the manufacturing sectors, Financial services and Domestic transport, the opposite is the case for Wholesale and retail trade, Other private services and Central and Local administration. Except for Central administration the long run effects are smaller than the short run effects in all sectors with the error-correction model.

Table 4.6.5. Effects on wage rates in per cent from an increase in the pay-roll tax rate by 1 percenage pointfrom 1971

Sector	Model	Years after change						
		1	2	3	5	10	15	20
3 Manufacturing	PH	-0.68	-0.67	-0.66	-0.66	-0.66	-0.66	-0.67
	EC	0	0	0	0	0	0	0
	AW	0.00	-0.03	-0.03	-0.02	-0.01	0.00	0.00
25 Production of	PH	-0.61	-0.60	-0.59	-0.59	-0.60	-0.60	-0.60
intermediates and	EC	0	0	0	0	0	0	0
investment goods	AW	0	-0.03	-0.03	-0.02	-0.01	-0.00	-0.00
34 Production of	PH	-0.64	-0.63	-0.62	-0.62	-0.62	-0.63	-0.63
paper and	EC	0	0	0	0	0	0	0
paper products	AW	0	-0.03	-0.03	-0.02	-0.01	-0.00	-0.00
37 Production of	PH	-1.32	-1.06	-0.89	-0.76	-0.69	-0.69	-0.69
industrial chemicals	EC	-0.88	-0.55	-0.35	-0.18	-0.09	-0.08	-0.08
	AW	-0.88	-0.57	-0.38	-0.20	-0.09	-0.08	-0.08
43 Production of	PH	-0.88	-0.78	-0.74	-0.73	-0.73	-0.73	-0.73
primary metals	EC	-0.88	-0.46	-0.33	-0.30	-0.29	-0.29	-0.30
	AW	-0.88	-0.46	-0.35	-0.32	-0.30	-0.30	-0.30
45 Fabricated	PH	-0.57	-0.60	-0.61	-0.65	-0.68	-0.69	-0.69
metal products	EC	0	-0.03	-0.06	-0.08	-0.11	-0.11	-0.11
	AW	0	-0.06	-0.09	-0.10	-0.11	-0.11	-0.11
50 Building of ships	PH	-0.65	-0.64	-0.63	-0.63	-0.63	-0.63	-0.63
and oil platforms	EC	0	0	0	0	0	0	0
	AW	0	-0.03	-0.03	-0.02	-0.01	-0.00	-0.00
55 Building and	PH	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32
construction	EC	0	0	0	0	0	0	0
	AW	0	-0.01	-0.02	-0.01	-0.00	-0.00	-0.00

Table 4.6.5.(cont.)

Sector	Model	Years after change						
		1	2	3	5	10	15	20
63 Financial services	PH	-0.87	-0.54	-0.42	-0.37	-0.36	-0.36	-0.36
	EC	-0.87	-0.31	-0.09	-0.02	-0.00	-0.00	0.00
	AW	-0.87	-0.31	-0.11	-0.03	-0.00	-0.00	0.00
74 Domestic transport	PH	-0.87	-0.68	-0.55	-0.44	-0.37	-0.36	-0.37
	EC	-0.41	-0.26	-0.16	-0.06	-0.01	-0.00	0.00
	AW	-0.41	-0.26	-0.18	-0.08	-0.01	-0.00	0.00
81 Wholesale and retail trade	PH	-0.20	-0.35	-0.44	-0.56	-0.64	-0.66	-0.66
	EC	0	0	0	0	0	0	0
	AW	0	-0.01	-0.02	-0.02	-0.01	-0.00	0.00
85 Other private services	PH	-0.45	-0.43	-0.42	-0.41	-0.41	-0.41	-0.41
	EC	0	0	0	0	0	0	0
	AW	0	-0.02	-0.02	-0.02	-0.00	-0.00	0.00
93K Local government education	PH	-0.28	-0.28	-0.27	-0.27	-0.27	-0.27	-0.27
	EC	0	0	0	0	0	0	0
	AW	0	-0.01	-0.01	-0.01	-0.00	-0.00	0.00
94K Local government health and social services	PH		-0.30	-0.31	-0.33	-0.35	-0.36	-0.37
	EC	0	0	0	0	0	0	0
	AW	0	-0.01	-0.01	-0.01	-0.00	-0.00	0.00
95K Local administration	PH	-0.33	-0.36	-0.37	-0.40	-0.42	-0.43	-0.43
	EC	0	0	0	0	0	0	0
	AW	0	-0.01	-0.02	-0.01	-0.01	-0.01	-0.00
95S Central administration	PH	-0.63	-0.44	-0.36	-0.14	-0.03	-0.01	0.00
	EC	-0.29	-0.21	-0.14	-0.06	-0.01	-0.00	0.00
	AW	-0.29	-0.22	-0.06	-0.01	-0.00	0.00	0.00

In Production of industrial chemicals, Fabricated metal products and Building and construction large direct effects together with effects through manufacturing cause the hourly wages to change more than the normal working hours in the short run with the Phillips curve specification. In the error-correction model this is also the case for Production of intermediates and investments, Domestic transport and Local government health and social services as the short run effect from a shift in normal working hours for average manufacturing is larger in this model than in the Phillips curve model.

Table 4.6.7 and figure 4.6.7 show the effects on wages from an increase in the rate of unemployment from 3 to 5 per cent. In the Phillips curve model this means that wages may continue to decline for ever given the rate of unemployment, while wages will stabilize at a lower level with the other two specifications. Due to a rather sluggish response the wage level has, however, not stabilized after 20 years with those specifications. When the Phillips curve is incorporated in a model with a falling demand curve for labour and/or an increasing supply curve, the wage level may stabilize after some time even in such a model as the rate of unemployment returns to its equilibrium rate in the long run.

While the wage response is a bit larger in the short run with the wedge model compared to the Phillips curve, the two models give results which are very close up to 10 years. The alternative wage model also give about the same effects on wages as the other two models, up to 5 years, but thereafter lower effect than the wedge model, and quite lower than the Phillips curve. The effects on wages in each of the specified manufacturing

Table 4.6.6. Effects on wage rates in per cent from an increase in normal working hours by 1 per cent

Sector	Model	Years after change						
		1	2	3	5	10	15	20
3 Manufacturing	PH	-0.69	-0.69	-0.69	-0.69	-0.69	-0.69	-0.69
	EC	-0.77	-0.66	-0.57	-0.42	-0.19	-0.09	-0.04
	AW	-0.67	-0.53	-0.45	-0.39	-0.34	-0.33	-0.33
25 Production of intermediates and investment goods	PH	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96
	EC	-1.03	-0.94	-0.85	-0.72	-0.51	-0.42	-0.38
	AW	-0.94	-0.82	-0.75	-0.69	-0.65	-0.64	-0.64
34 Production of paper and paper products	PH	-0.65	-0.65	-0.65	-0.65	-0.65	-0.65	-0.65
	EC	-0.73	-0.62	-0.54	-0.39	-0.18	-0.08	-0.04
	AW	-0.63	-0.50	-0.42	-0.36	-0.32	-0.31	-0.31
37 Production of industrial chemicals	PH	-1.05	-0.88	-0.78	-0.68	-0.63	-0.63	-0.63
	EC	-1.10	-0.87	-0.71	-0.48	-0.21	-0.09	-0.04
	AW	-1.04	-0.77	-0.61	-0.43	-0.32	-0.30	-0.30
43 Production of primary metals	PH	-0.67	-0.52	-0.48	-0.46	-0.46	-0.46	-0.46
	EC	-0.67	-0.56	-0.48	-0.35	-0.16	-0.08	-0.04
	AW	-0.67	-0.51	-0.40	-0.29	-0.23	-0.22	-0.22
45 Fabricated metal products	PH	-1.11	-0.96	-0.85	-0.73	-0.62	-0.61	-0.60
	EC	-1.18	-0.94	-0.75	-0.41	-0.19	-0.08	-0.04
	AW	-1.09	-0.82	-0.65	-0.47	-0.32	-0.29	-0.29
50 Building of ships and oil platforms	PH	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66
	EC	-0.74	-0.63	-0.54	-0.40	-0.18	-0.09	-0.04
	AW	-0.64	-0.50	-0.43	-0.37	-0.33	-0.32	-0.31
55 Building and construction	PH	-1.18	-1.18	-1.18	-1.18	-1.18	-1.18	-1.18
	EC	-1.22	-1.16	-1.12	-1.05	-0.94	-0.89	-0.87
	AW	-1.17	-1.10	-1.06	-1.04	-1.01	-1.00	-1.00

Table 4.6.6 (cont.)

Sector	Model	Years after change						
		1	2	3	5	10	15	20
63 Financial services	PH	-0.89	-0.85	-0.83	-0.83	-0.83	-0.83	-0.83
	EC	-0.89	-0.88	-0.84	-0.74	-0.59	-0.51	-0.48
	AW	-0.89	-0.84	-0.77	-0.69	-0.64	-0.63	-0.63
74 Domestic transport	PH	-0.96	-0.91	-0.88	-0.84	-0.83	-0.83	-0.83
	EC	-1.02	-0.89	-0.80	-0.67	-0.54	-0.49	-0.48
	AW	-0.95	-0.80	-0.73	-0.66	-0.64	-0.63	-0.63
81 Wholesale and retail trade	PH	-0.54	-0.59	-0.62	-0.66	-0.69	-0.69	-0.69
	EC	-0.56	-0.60	-0.59	-0.52	-0.29	-0.14	-0.07
	AW	-0.53	-0.53	-0.51	-0.45	-0.37	-0.34	-0.33
85 Other private services	PH	-0.46	-0.63	-0.71	-0.78	-0.80	-0.80	-0.80
	EC	-0.52	-0.61	-0.64	-0.61	-0.49	-0.43	-0.40
	AW	-0.44	-0.52	-0.56	-0.59	-0.59	-0.58	-0.58
93K Local government education	PH	-0.92	-0.92	-0.92	-0.92	-0.92	-0.92	-0.92
	EC	-0.95	-0.91	-0.87	-0.81	-0.72	-0.67	-0.65
	AW	-0.91	-0.85	-0.82	-0.79	-0.78	-0.77	-0.77
94K Local government health and social services	PH	-1.00	-0.96	-0.92	-0.87	-0.83	-0.83	-0.82
	EC	-1.04	-0.95	-0.87	-0.74	-0.58	-0.50	-0.47
	AW	-1.00	-0.88	-0.81	-0.72	-0.65	-0.63	-0.62
95K Local administration	PH	-0.33	-0.46	-0.55	-0.67	-0.77	-0.79	-0.79
	EC	-0.37	-0.45	-0.50	-0.53	-0.47	-0.41	-0.37
	AW	-0.32	-0.38	-0.43	-0.50	-0.55	-0.56	-0.56
95S Central administration	PH	-0.35	-0.54	-0.67	-0.83	-0.96	-0.99	-0.99
	EC	-0.39	-0.52	-0.61	-0.74	-0.89	-0.45	-0.97
	AW	-0.33	-0.46	-0.58	-0.76	-0.94	-0.97	-0.99

sectors are very close to total manufacturing in all the three specifications. In Production of primary metals the rate of unemployment has an independent effect in excess of what follows from wages in average manufacturing giving a higher impact in the short run. The long run effect is, however, smaller than for average manufacturing as a relatively large weight is put on competitiveness in this sector.

Also in Building and construction, the rate of unemployment has a large direct effect, and this sector is the most sensitive for changes in the conditions in the labour market. In addition to the effects presented in the table the change in employment in the sector has an effect on wage formation.

Figure 4.6.6. Effects on manufacturing wages in per cent from an increase in normal working hours by 1 per cent from 1971

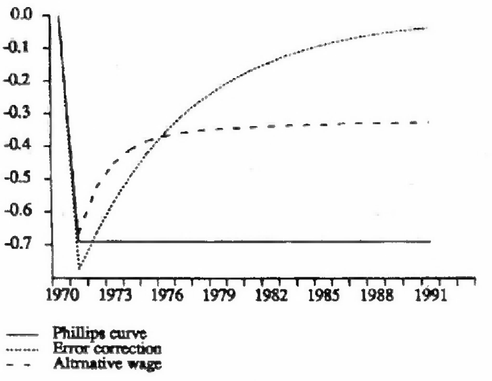


Figure 4.6.7. Effects on manufacturing wages in per cent from an increase in the rate of unemployment from 3 to 5 per cent

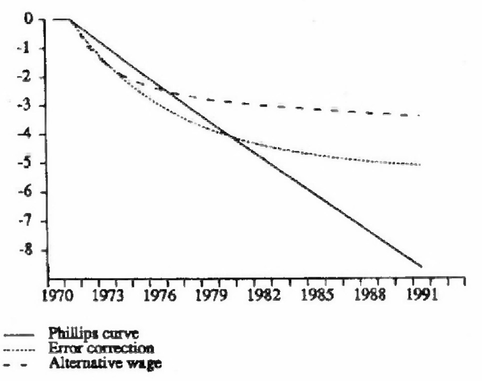


Table 4.6.7. Effects on wage rates in per cent from an increase in the rate of unemployment from 3 to 5 per cent

Sector	Model	Years after change: 1	2	3	5	10	15	20
3 Manufacturing	PH	0	-0.45	-0.89	-1.79	-3.98	-6.12	-8.21
	EC	0	-0.78	-1.45	-2.50	-4.04	-4.75	-5.08
	AW	0	-0.92	-1.51	-2.19	-2.88	-3.16	-3.37
25 Production of intermediates and investment goods	PH	0	-0.41	-0.81	-1.61	-3.59	-5.53	-7.44
	EC	0	-0.71	-1.31	-2.26	-3.65	-4.29	-4.59
	AW	0	-0.83	-1.36	-1.98	-2.60	-2.85	-3.04
34 Production of paper and paper products	PH	0	-0.42	-0.85	-1.68	-3.75	-5.77	-7.75
	EC	0	-0.74	-1.36	-2.35	-3.81	-4.47	-4.78
	AW	0	-0.86	-1.42	-2.07	-2.71	-2.97	-3.18
37 Production of industrial chemicals	PH	0	-0.29	-0.63	-1.38	-3.34	-5.30	-7.22
	EC	0	-0.51	-1.02	-1.96	-3.50	-4.23	-4.58
	AW	0	-0.60	-1.08	-1.76	-2.53	-2.83	-3.04
43 Production of primary metals	PH	0	-1.26	-1.85	-2.55	-4.01	-5.43	-6.83
	EC	0	-1.26	-2.00	-2.94	-4.23	-4.82	-5.09
	AW	0	-1.26	-2.06	-2.91	-3.60	-3.82	-3.04
45 Fabricated metal products	PH	0	-0.38	-0.76	-1.52	-3.42	-5.30	-7.15
	EC	0	-0.65	-1.22	-2.13	-3.49	-4.13	-4.42
	AW	0	-0.77	-1.27	-1.87	-2.49	-2.75	-2.94

Table 4.6.7 (cont.)

Sector	Model	Years after change						
		1	2	3	5	10	15	20
55 Building and construction	PH	0	-0.53	-1.06	-2.11	-4.70	-7.20	-9.65
	EC	0	-0.69	-1.33	-2.96	-4.73	-6.56	-8.19
	AW	0	-0.76	-1.36	-2.30	-4.17	-5.81	-7.41
50 Building of ships and oil platforms	PH	0	-0.43	-0.86	-1.70	-3.79	-5.84	-7.84
	EC	0	-0.75	-1.38	-2.38	-3.86	-4.53	-4.84
	AW	0	-0.87	-1.44	-2.09	-2.74	-3.01	-3.22
63 Financial services	PH	0	0	-0.16	-0.61	-1.82	-3.02	-4.21
	EC	0	0	-0.28	-1.22	-2.02	-2.53	-2.76
	AW	0	0	-0.32	-0.65	-1.10	-1.50	-1.70
74 Domestic transport	PH	0	-0.31	-0.60	-0.86	-2.35	-3.55	-4.73
	EC	0	-0.54	-0.96	-1.56	-2.34	-2.67	-2.83
	AW	0	-0.63	-0.99	-1.35	-1.63	-1.75	-1.87
81 Wholesale and retail trade	PH	0	-0.13	-0.37	-1.39	-3.03	-5.60	-7.29
	EC	0	-0.23	-0.60	-1.49	-3.38	-4.41	-4.92
	AW	0	-0.27	-0.65	-1.40	-2.53	-3.00	-3.27
85 Other private services	PH	0	-0.30	-0.59	-1.43	-2.53	-3.89	-5.22
	EC	0	-0.52	-0.94	-1.60	-2.55	-2.99	-3.19
	AW	0	-0.61	-0.99	-1.40	-1.80	-1.98	-2.11
93K Local government education	PH	0	-0.45	-0.89	-1.78	-3.96	-6.08	-8.17
	EC	0	-0.58	-1.12	-2.07	-3.98	-5.52	-6.89
	AW	0	-0.64	-1.15	-1.94	-3.50	-4.87	-6.20
94K Local government health and social services	PH	0	-0.20	-0.41	-0.86	-2.06	-3.26	-3.74
	EC	0	-0.35	-0.67	-1.22	-2.14	-2.59	-2.81
	AW	0	-0.41	-0.70	-1.08	-1.53	-1.73	-1.87
95K Local administration	PH	0	-0.93	-1.68	-2.81	-4.71	-6.20	-7.60
	EC	0	-1.09	-1.95	-3.21	-4.82	-5.47	-5.75
	AW	0	-1.15	-1.99	-3.06	-4.20	-4.49	-4.67
95S Central administration	PH	0	-0.23	-0.38	-0.57	-0.72	-0.75	-0.75
	EC	0	-0.39	-0.61	-0.75	-0.53	-0.27	-0.13
	AW	0	-0.46	-0.62	-0.59	-0.27	-0.12	-0.08

As wages in private services and public sectors to some degree are influenced by the concern for real disposable income, the indirect effect working through wages in manufacturing is smaller than in the other sectors. The rate of unemployment seems to have some direct effect on wages in Local government education and Local government administration. The effect on wages in Wholesale and retail trade is also substantial in the long run as wages in this sector are mainly dependent on manufacturing wages. The effect from the rate of unemployment on wages in Central government administration in the other hand is very small, as wages in this sector is mainly dependent on the concern for real disposable incomes.

4.7. Decomposition of factors behind loss in competitiveness

A decomposition of factors behind loss in competitiveness for average manufacturing during the period 1966 to 1990 is presented in table 4.7.1. Competitiveness is here defined as wage costs per unit produced relative to prices on competing products:

$$comp = w + s - p_I - z \qquad (4.7.1)$$

where lower case letters means that the variables are in natural logarithms.

w	-	nominal wage per man hour
s	-	logarithm of 1 + the pay-roll tax rate
p_I	-	prices on imported products
z	-	gross product per man hour

According to figure 2.5.6 this measure is highly correlated with the traditional measure calculated by relative wage cost per unit produced, where instead of calculating wage costs relative to foreign product prices measured in Norwegian currency, wage costs per unit produced are calculated relative to foreign wage costs per unit produced corrected for changes in the exchange rate.

The decomposition is based on four of the alternative wage equations with coefficients presented in table 4.5.2, the Phillips curve equation (PH), the traditional error-correction model with a wedge variable (EC), the alternative wage model with the factor income deflator (AW) and the factor income deflator model (PY). Because consumer prices, alternative wages and the factor income deflator are endogenous, it is appropriate to incorporate rather simplified equations for these variables in the decomposition to reflect the total effects of the more exogenous variables according to the discussion in section 4.3.4. In conformity with the price equations in the Norwegian macroeconomic model MODAG, cf. Cappelen (1992) and Stølen (1987) both wage costs and prices on imported goods have a long term weight of about 0.5 in determining consumer prices. With a somewhat sluggish response the simplified price equation may be written as:

$$p_t = \sum_{i=1}^{4} \beta_{1i}\, p_{I,t-1} + \sum_{i=1}^{4} \beta_{2i}\,(\overline{w}_{t-i} + s_{t-i} - \overline{z}_{t-i}) + 0.9t_{M,t} + p_{E,t} \qquad (4.7.2)$$

where

p	-	consumer prices
$\overline{w}$	-	wages in the sheltered sectors
$\overline{z}$	-	productivity in the sheltered sectors
t_M	-	logarithm of 1 + the value added tax rate
p_E	-	error term catching up other commodity taxes and wedges between competing import prices and import prices on consumer goods

Here the weights for import prices (β_{1i}) sum up to 0.5 and the weights for wage costs per unit produced in the sheltered sectors sum up to 0.5.

Almost the same approximation may be used for the factor income deflator. In spite of the fact that foreign prices only seem to have a small weight in determining Norwegian product prices compared to variable unit costs (see Cappelen, 1992), a large influence from import prices on these costs justifies the specification which may be written as:

$$q_t = \sum_{i=1}^{3} \gamma_{1i}\, p_{I,t-i} + \sum_{i=1}^{3} \gamma_{2i}\, (w_{t-i} + s_{t-i} - z_{t-i}) + q_{Et} \tag{4.7.3}$$

where q - factor income deflator
q_E - error term

Also in this equation, the weights for import prices (γ_{1i}) sum up to 0.5 and the weights for wage costs per unit produced sum up to 0.5.
A simplified equation for alternative wages in accordance with the results presented in table 4.5.3 may look like:

$$\begin{aligned} \Delta \overline{w}_t = {} & \delta_1\, \Delta w_t + \sum_{i=1}^{2} \delta_{2i}\, \Delta p_{t-i} - \delta_3\, \Delta s_t - \delta_4\, \Delta \overline{t}_t \\ & - \delta_5\, \Delta \overline{h}_t - \delta_6\, D79 - \delta_7\, (\overline{w}_{t-1} - w_t) \\ & - \delta_8\, (\overline{w}_{t-1} + \overline{h}_{t-1} + \overline{t}_{t-1} - p_{t-1}) + \overline{w}_{Et} \end{aligned} \tag{4.7.4}$$

where $\overline{t}$ - logarithm of 1 - the average income tax rate
$\overline{h}$ - normal working hours in the sheltered sector
$D79$ - dummy for price and income regulations in 1979
$\overline{w}_E$ - error term in the alternative wage equations

Together with the four alternative wage equations for average manufacturing (4.7.2) - (4.7.4) constitute a simple wage and price model where wages in average manufacturing, wages in sheltered sectors, consumer prices and the factor income price deflator are endogenous variables. In this model the rate of unemployment, productivity (in average manufacturing and sheltered sectors), normal working hours, import prices, the pay-roll rax rate, the income tax rate and the value added tax rate are treated as exogenous. By looking at the changes over the period 1966 to 1990 in each of these variables it is possible to calculate the contribution to loss in competitiveness. An overview of this for five periods is presented in table 4.7.1. In addition to the factors mentioned above, the income regulations in 1978/79 and 1988/89 have had some effect, and there have also been effects from other factors reflected by the error terms in equations (4.7.2) to (4.7.4). Especially the error term in equation (4.7.2) catching up the effects from other commodity taxes and a different development in import prices decisive for competitiveness and consumer prices is important. Although homogeneity restrictions in all equations mean that a change in import prices have no effect on competitiveness in the long run, irrespective of the chosen wage specification, the effect in the short run may bee substantial due to the sluggish response in both wage and price formation.

Measured by wage costs per unit produced relative to prices on competing products the loss in competitiveness for average manufacturing was about 45 per cent from 1966 to 1990. The loss was substantial in the first half of the seventies with more than 15 per cent, but there was a significant loss also in the first half of the eighties. During the period 1975 to 1980 average manufacturing gained competitiveness.

Table 4.7.1. Contributions to loss in competitiveness[1] for average manufacturing based on different wage equations. Total contribution in periods of 5 years in per cent (a negative sign indicates contribution to loss)

	1966-1970				1970-1975				1975-1980			
	PH	EC	AW	PY	PH	EC	AW	PY	PH	EC	AW	PY
Divergence from equilibrium rate of unemployment	-6.2	-	-	-	-10.5	-	-	-	-6.5	-	-	-
Changes in unemployment	-	-1.7	-1.3	-0.9	-	-5.1	-4.6	-4.2	-	1.6	3.3	3.5
Pay-roll taxes	-1.1	-4.7	-5.6	-0.9	-1.5	-7.6	-8.7	-0.9	-0.1	-1.7	-2.0	0.5
Income taxes	-0.1	-2.4	-4.4	-0.7	-2.0	-4.7	-7.3	-1.1	-1.2	-3.6	-3.9	-0.3
Value added tax, 1970	0.0	0.0	0.0	0.0	-1.3	-4.1	-6.1	-1.8	0.0	-1.3	-1.2	0.6
Other commodity taxes and price-wedges	-0.4	-1.2	-7.4	-6.9	-0.7	-2.7	-7.0	-17.8	-0.4	-2.8	1.7	-4.7
Sluggish effects from import prices	6.0	5.6	5.9	4.7	3.9	7.1	12.1	8.9	4.6	8.9	7.7	5.9
Sluggish effects from productivity and over/undercomp.	-3.1	-9.9	7.5	3.1	-2.6	-12.4	-3.3	2.2	-3.5	-11.7	-13.2	-6.4
Productivity sheltered sector	1.9	4.9	6.8	3.3	1.8	8.0	12.0	1.6	1.9	8.7	10.9	1.6
Normal working hours	-4.2	-4.1	-4.6	-3.7	-1.5	-0.4	-1.8	0.3	-3.8	-2.3	-3.1	-1.1
Income regulations	-	-	-	-	-	-	-	-	10.4	6.0	4.1	3.1
Error in the alt. wage equation	-0.1	-0.4	-1.6	-0.7	0.2	0.4	1.9	1.1	0.1	0.3	1.3	0.4
Cross effects and unexplained effects in the beginning	-1.5	5.2	-6.2	-7.2	0.3	5.3	-2.0	-2.3	-0.8	1.6	1.6	-0.6
Simulated loss	-8.8	-8.7	-10.9	-9.9	-13.9	-16.2	-14.8	-14.0	0.7	3.7	4.0	2.5
Error in the wage equation	-1.1	1.2	1.0	0.0	-1.7	0.6	-0.8	-1.6	2.5	-0.5	-0.8	0.7
Actual loss			-9.9				-15.6				3.2	

1) Competitiveness is here defined as wage costs per unit produced relative to prices on competing products $W(1 + s)/(Z \cdot P_I)$.

Table 4.7.1 (cont.)

	1980-1985				1985-1990			
	PH	EC	AW	PY	PH	EC	AW	PY
Divergence from equilibrium rate	-2.4	-	-	-	-0.6	-	-	-
Changes in unemployment	-	8.9	9.7	8.3	-	7.2	4.1	3.5
Pay-roll taxes	0.1	-0.8	-0.2	0.5	0.0	-0.7	-0.1	0.1
Income taxes	0.8	-3.4	-3.3	-0.2	-0.1	-2.8	-2.2	-0.2
Value added tax, 1970	0.0	-0.9	-0.3	0.2	0.0	-0.5	0.0	0.0
Other commodity taxes and price-wedges	-4.1	-12.1	-19.1	-14.0	-1.0	-8.4	-8.9	-7.8
Sluggish effects from import prices	-7.3	-5.1	-9.5	-10.9	-4.7	-3.4	-3.5	-5.2
Sluggish effects from productivity and over/undercomp.	1.8	-7.0	0.6	7.0	-1.1	-8.5	-5.4	-0.1
Productivity sheltered sector	1.0	8.8	10.4	-0.3	0.8	7.1	6.1	0.1
Normal working hours	-1.6	-0.2	-0.9	0.1	-3.9	-2.2	-2.8	-1.7
Income regulations	0.8	-1.8	-1.1	-1.9	5.5	3.6	4.1	3.5
Error in the alt. wage equation	0.2	0.8	3.5	1.4	0.1	1.0	3.2	1.0
Cross effects and unexplained effects in the beginning	0.3	0.9	-2.1	-1.3	0.1	0.4	0.7	-0.2
Simulated loss	10.4	-11.9	-12.3	-11.1	-4.9	-7.2	-6.1	-7.0
Error in the wage equation	-0.1	1.4	1.8	0.6	-2.1	0.2	-0.9	0.0
Actual loss			-10.5				-7.0	

All the four different wage equations are able to explain the loss quite well, but according to the impact analyses presented in section 4.6 and the discussion in section 4.3.3 it is not surprising that the contributions from the different factors differ substantially across the models. Because of the large simultaneity in the error-correction models the multipliers are larger than in the Phillips curve case, giving higher gross effects of the exogeneous variables like tax changes, price wedges and productivity growth in the sheltered sectors. The Phillips curve model on the other hand puts larger weight on a tight labour market, and shows larger gross effects from changes in normal working hours and income regulations.

The contribution from a tight labour market according to the Phillips curve is due to the actual rate of unemployment being lower than the equilibrium rate of unemployment estimated to an average of 2.6 per cent during the period 1965 to 1990. As the rate of unemployment was almost constant during the sixties and the seventies this factor is not able to explain very much of the wage development and the loss in competitiveness during this period according to the error correction models. The increase in unemployment during the eighties has, however, according to these models contributed to improve competitiveness.

The growth in pay-roll taxes, income tax rates and the value added tax in 1970 have contributed to loss in competitiveness during the second half of the sixties and the first part of the seventies according to all four specifications. But as discussed in section 4.3.3 and 4.6 the impact of these tax increases are much smaller with the Phillips curve specification and the factor income deflator specification than with the other two specifications. The large simultaneity and a rather sluggish response in wage equations cause tax increases in the sixties and the first part of the seventies to explain some of the loss in competitiveness in the second half of the seventies and the eighties according to the wedge model and the alternative wage model.

Other commodity taxes and a wedge between the development in import prices decisive for competitiveness and import prices decisive for output prices and consumer prices, respectively, have also been important in explaining the loss in competitiveness. This factor is quite important in the wedge model and the alternative wage model and the most important in the factor income deflator model. This factor is important in the wedge model and the alternative wage model as consumer prices are far more decisive when explaining wage growth with these models than with the Phillips curve. The wedge on consumer prices thus seems to be the most important factor when explaining the loss in competitiveness during the eighties according to these models, but also explains some of the loss according to the Phillips curve.

To get a better understanding of the wedge term in the factor income deflator model, it is necessary to discuss the simplifications done in the price equation (4.7.3). The gross factor income deflator (inclusive consumption of fixed capital) is defined by

(4.7.5) $$P_q = P_Q - \frac{T}{Q},$$

where P_q - the gross factor income deflator (q in (4.7.3) is equal to log(p_q))
P_Q - deflator for gross product
T - net indirect taxes paid by the firms
$T = T_S + T_C$, where T_S is net sector taxes and T_C net commodity taxes
Q - gross product in fixed prices.

From the definitions in the National accounts the gross factor income deflator may further be expressed as

(4.7.6) $$P_q = \frac{P_X X - P_M M - T}{Q}$$

where X - gross output in fixed prices
P_X - the corresponding price index
M - intermediate consumption in fixed prices
P_M - the corresponding price index.

The price on gross output is assumed to be a weighted average of variable unit costs and prices on competing products as in (4.7.7), although this also represents some kind of simplification compared with the price part of the macroeconomic model MODAG

$$(4.7.7) \qquad P_X = \left(\frac{W \cdot L + P_M M + T_C}{X} \right)^{\alpha} P_I^{\,1-\alpha}$$

where L - number of man-hours
W - wage costs per man-hour.

(4.7.7) corresponds to (4.7.3).

From (4.7.6) and (4.7.7) it is evident that the price wedges in the factor income deflator model may be caused by changes in net indirect taxes, prices on intermediate consumption and shifts in the composistion of labour and intermediates in gross output. Except from net sector taxes T_S, changes in the other variables which influence the gross factor income deflator through (4.7.6) are almost balanced by an opposite effect on prices on gross output through (4.7.7) as the main weight is put on variable unit costs. This is confirmed in figure 4.7.1 by performing a cut in electricity taxes in MODAG corresponding to a reduction in electricity prices of 1 per cent and a provenu effect in the first year of 1/3 bill. N.kr.

Because of the effect through prices on gross output the effect on manufacturing wages is rather small with the factor income deflator model, but somewhat larger than with the Phillips curve model. As a reduction in electricity prices works to reduce consumer prices which are of some importance for wage formation according to the Phillips curve equation in section 4.5, one should have expected that wages should have decreased with this specification. This is not the case because, according to MODAG, lower electricity prices may cause a rise in labour productivity through a substitution effect which is not included in the calculations behind table 4.7.1.

Based on an assumption that net sector taxes are approximately lump-sum taxes/or transfers, they are not included among the variable unit costs in equation (4.7.7). An increase in sector taxes then work to reduce the factor income deflator according to (4.7.6). This has a negative effect on wages according to the factor income deflator specification in section 4.5, which cause prices to decline further according to (4.7.7). Because of the large simultaneity between wages and prices with the factor income deflator specification, there is a large multiplier of this change. This is shown in figure 4.7.2 where net sector taxes for manufacturing industries are increased by 1 bill. N.kr.

Figure 4.7.1. Effects on wages in average manufacturing of a reduction in electricity taxes corresponding to a reduction in electricity prices of 1 per cent from 1992

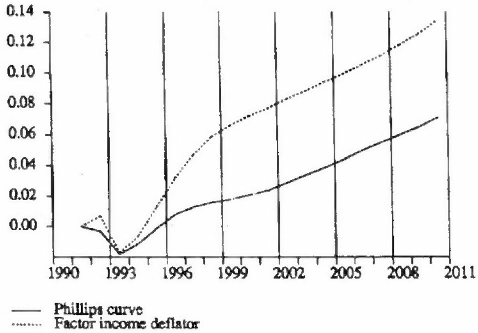
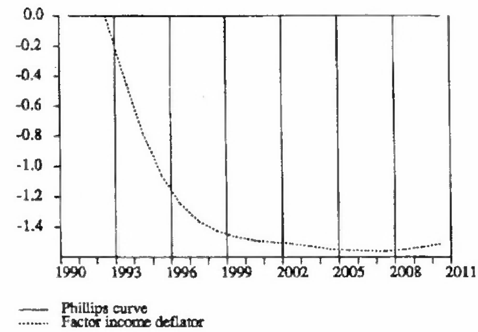


Figure 4.7.2. Effects on wages in average manufacturing of an increase in net sector taxes of 1 bill. N.kr. from 1992



If the factor income deflator specification gives the most correct description of the functioning of wage formation in manufacturing industries, this means that an increase in sector taxes may reduce wage growth by a large extent. Because of the large simultaneity with prices, wages will be reduced to such an extent that manufacturing industries gain competitiveness and increase production according to this specification. This is probably too good to be true, but the assumption that sector taxes/subsidies mainly are lump-sum may be discussed, indicating that the price equations eventually should have been reevaluated.

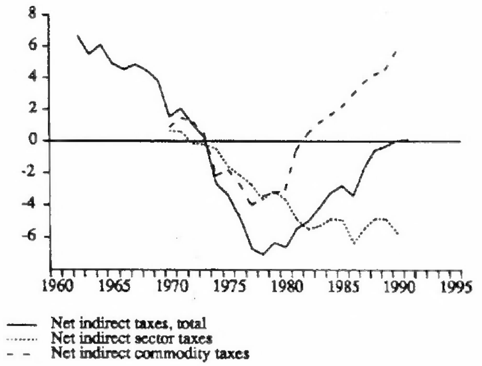
From figure 4.7.3 it is also evident that net sector taxes for manufacturing industries have declined (especially in the 1970s, but probably also in the 1960s). These reductions are probably the main reason behind the effects from the wedge variables in the factor income deflator model according to table 4.7.1 and are thus the main reason why Norwegian manufacturing industries have lost competitiveness according to this specification.

Turning to the sluggish effects from import prices in table 4.7.1, these prices increased strongly in 1969 and 1970, especially in 1974 as a result of OPEC I, and in the years 1977 to 1980 (the last year as a result of OPEC II). The sluggish response in wage equations contributed to a gain in competitiveness as a result of this in the three first periods in the table according to all four specifications. In the eighties where the growth in import prices has diminished, the sluggish response in wage formation has contributed to loss in competitiveness.

Import prices could have been decomposed in the exchange rate and foreign prices

(4.7.8) $\quad p_I = v + p^*$

Figure 4.7.3. Net indirect taxes in per cent of gross product. Manufacturing industries excluding oil refineries



where v - denotes the exchange rate
p^* - foreign prices.

From figure 2.5.7 the Norwegian currency appreciated in the period 1973 to 1976 and this contributed to reduce the high growth in import prices. On the other hand depreciation of the currency in the period 1978 to 1987 contributed to strengthen the growth in import prices, but in spite of this, growth in import prices has been rather low since 1981. Because of the sluggish response in wage formation, the appreciation in the seventies contributed to worsen competitiveness in that period, while the depreciations from 1978 to 1987 contributed to improve competitiveness in that period. This conclusion is in accor- dance with Rødseth and Holden (1990). But as price homogeneity is a relevant restriction, and is also imposed in the simple model in this section, a depreciation or an appreciation are of no importance for competitiveness in the long run.

Because of a sluggish response changes in growth in productivity in average manufacturing have influenced competitiveness in the same way as import prices. Because the direct and indirect effects lead to a clear overcompensation of productivity growth in the wedge model, the contribution to competitiveness has been most negative with this specification. A slowdown in productivity growth, especially in the second half of the seventies, but partly also for the second half of the eighties has contributed to loss in competitiveness in those periods according to all specifications.

As productivity growth in the sheltered sectors are of great importance in limiting the growth in consumer prices, which are of great importance for wage formation in the wedge model and the alternative wage model, this factor has contributed to improve competitiveness with these specifications.

The three major shortenings of normal working hours in 1968, 1976 and 1987 have together with some minor shortenings contributed to loss in competitiveness. Because of smaller effects in the long run than in the short run with the error correction specifications, the contribution to loss is greatest with the Phillips curve model.

The income regulations in 1978/79 and 1988/89 have contributed to improve competitiveness according to all four specifications. As income regulations only are assumed to have temporary effects in the error correction specifications, the contribution of this factor has also been strongest with the Phillips curve. Together with the sluggish response from growth in import prices the price and income regulation in 1978/79 is the reason why manufacturing industries gained competitiveness in the period 1975 to 1980.

Because of the sluggish response in the error-correction models some of the loss in competitiveness during the second half of the sixties and the first half of the seventies may be explained by factors influencing wage and price formation at the end of the fifthies and the beginning of the sixties. As the data basis for this work starts in 1962 it has been impossible to correct for this, giving an unexplained contribution in the line above summation.

5. The labour market in the macroeconomic model MODAG

5.1. Introduction

The macroeconomic model MODAG developed in in the Statistics Norway is a disaggregated input-output based model intended for use in medium term macroeconomic planning and policy analysis. The Norwegian national accounting system forms the conceptual framework and the empirical basis for the model where the input-output structure is combined with certain elements from the Scandinavian model of inflation and Keynesian macro theory.

The model is rebased and the econometric parameters are reestimated every year, adding one more observation to the estimation period. The specifications in the model are also continually improved. A presentation of the version from 1990 with base year in 1988 is given by Cappelen (1992). Besides the input-output kernel and the definitions from the national accounts this version contains econometric relations for prices, wages, private consumption, private investments, exports, import shares, factor demand, supply of labour, transfers from the public sector and some financial variables. In the most recent version the wage equations are improved according to the discussion in section 4.5 and modified equations for private consumption, demand for labour and supply of labour are implemented in the model. Supply of and demand for labour together with the wage equations close the labour market in the model and contribute to a strong simultaneity between prices and quantities.

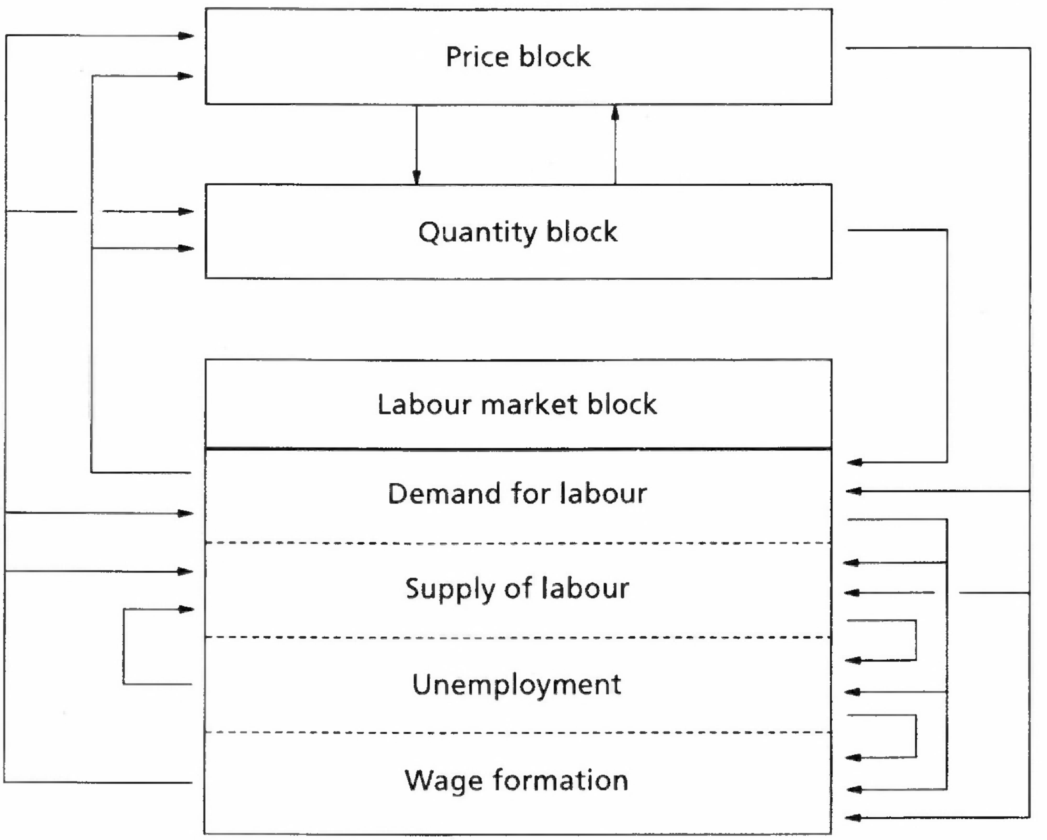
The aim of this chapter is to present the main structure of the labour market in MODAG and to describe the most important links with the rest of the model. Section 5.2 contains a short description of the main features of MODAG, while the structure in the equations and the main explanatory factors for demand and supply of labour are presented in section 5.3. In this section the impacts of wages on demand and supply of labour is also discussed based on an impact analysis of a version where wages are assumed to be exogenous. The macroeconomic implications of choice of wage equations are discussed in section 5.4, drawing connections to the economic theory presented in chapter 3. The functioning of MODAG with a main weight on the labour market block is further discussed in section 5.5 by a set of impact analyses.

5.2. Main features of MODAG

In spite of a strong simultaneity between prices and quantities in MODAG, it may be convenient to separate between three main blocks in the model; the price block, the quantity block and the labour market block. In the short run there is only a weak degree of simultaneity between wages and prices on the one hand and quantities on the other, because wage formation reacts with a lag to a change in unemployment. An overview of the connections between the three blocks is illustrated in figure 5.2.1.

In the *price block* of MODAG commodity prices, price indices for various final demand groups and gross operating surplus margins are determined. As Norwegian and foreign goods are treated as heterogeneous in MODAG each commodity may in principle have three different prices; an import price, a price for the domestically produced commodity sold on the domestic market and an export price. The price block is mainly supply or cost oriented. Apart from exogenous prices given by government regulations and export prices on crude oil, natural gas and services from ocean transport, most of the prices are determined endogenously in the price block as functions of unit costs and prices on

Figure 5.2.1. The main structure of MODAG



competing foreign products. Unit costs are defined as the sum of labour, energy and material input costs calculated per unit produced.

A main result is that domestic costs play an important role in determining Norwegian prices, especially in the domestic market. Foreign prices play a minor role but influence domestic prices indirectly via the input-output structure and unit costs. Changes in competitive prices are more important in the determination of export prices, but domestic costs are also the most important factor for these prices. The price equations in MODAG are thus not quite in accordance with the Scandinavian model of inflation, which assumes that prices in the exposed sectors mainly are determined from abroad.

The estimated effects from capacity utilization on prices are only modest, and the effects from labour productivity is dampened by the sluggishness of price adjustment. Apart from wage formation the main impacts thus run from the price block to the quantity block where the effects are strong even in the short run.

In the *quantity block* supply and demand for the different commodities are determined. Supply of products come from Norwegian production and imports, where Norwegian production mainly is determined from the demand side. Government consumption and investments are exogenous in the model while exports, import shares, private consumption and private investments are endogenous.

Prices, wages and operating surplus are of great importance for the development in the households' real disposable income, and thereby private consumption, and do also have some direct impact on private investments. Private consumption is also found to be dependent on the real rate of interest and in the short run the level of unemployment may influence the level of private consumption relative to real disposable incomes. An increase in government consumption and investments or private consumption as a result of an increase in real incomes will influence production through a traditional Keynesian multiplier mechanism and this will also contribute to a positive effect on investments through a traditional accelerator mechanism.

On the other hand, a growth in domestic wages and prices relative to wages and prices abroad will have a negative impact on Norwegian market shares both for export competing and home competing industries. While effects from real wages on private consumption are of some importance even in the short run, the effects on market shares are more sluggish. Thus supply factors will affect output more strongly in the longer run.

Demand for labour, supply of labour, unemployment and wage rates are determined in the *labour market block*. Output is the main explanatory factor for labour demand in different industries, but the estimated relations also include substitution between labour and intermediate goods as well as capital. Supply of labour depends on the size of population and the participation rates. Expansion in private and public service sectors and unemployment are important factors in the determination of labour participation, especially for married women, youths and pensioners. The discouraged worker effects for these groups are substantial. Apart from youths and pensioners a change in the real wage rate has only a modest impact on labour supply. Unemployment is defined as the difference between the labour force and the number of persons employed, and in addition to prices and productivity, unemployment is an important factor behind wage formation. However, as unemployment from the past period seems to be most relevant in the wage equations presented in chapter 4, there is only a weak effect from unemployment to wage formation in the short run.

5.3. The labour market in MODAG

5.3.1. Demand for labour

MODAG distinguishes between wage earners and self-employed persons. The number of persons in the latter group is exogenously given. Apart from Local and Central government, Crude oil and natural gas extraction and Agriculture, employment of wage earners is determined endogenously. Man hours, L, is split into number of employees, N, and number of hours worked per employee, H, $L = NH$.

For given production (X) and capital stock (K), demand for man hours in each industry is modelled by assuming that industries minimize their short-run variable costs for labour and materials. Short run demand for man hours is thus given by

$$(5.3.1) \qquad L = C_0 \, (W/P_M)^{c_1} X^{c_2} K^{c_3} e^{c_4 t}$$

where W is the wage rate and P_M the price index for material inputs. c_2 represents the inverse of the short run returns to scale coefficient regarding labour and materials. c_1 and c_3 may reflect scale and substitution effects, while c_4 accounts for Hicks neutral technical progress.

In the analysis of short term demand for labour it is often usual to assume that the number of hours worked per worker is more flexible in the short run than the number of persons employed. Firms are assumed to balance the costs of extra overtime agains the costs of a rapid change in the number of persons employed. As a result of this an adjustment equation between the number of persons employed, man hours and normalized working hours, H^N, is modelled.

$$(5.3.2) \qquad N_t = (L_t/H_t^{\,N})^{\lambda} \cdot N_{t-1}^{\;1-\lambda}$$

In an earlier version of MODAG, documented in Cappelen and Longva (1987), the impact from normalized hours was incorporated directly in the demand for man years. As both man hours and number of persons employed are included in the new employment series from the national accounts, it has been convenient to make this distinction also in MODAG. The adjustment parameters λ are now much higher than in the earlier versions of the model and are not significantly less than one in any sector. This reflects that the amount of overtime in the new employment series in the national accounts is only weakly influenced by fluctuations in the demand for man hours and by a change in normalized working hours.

Earlier estimations indicated increasing returns to scale in most sectors both in the short as well as in the long run when capital also is variable. Without any restrictions on the parameters c_2 and c_3 in (5.3.1) there is generally a tendency for obtaining unrealistically high levels of returns to scale. The parameter c_2 is therefore restricted to one when estimating the other parameters and the other short run effects when (5.3.1) is specified as an error correction model. Most manufacturing sectors, Domestic transport, Construction and some other minor sectors show increasing returns to scale when the effect from capital is included, while for most of the service sectors there are constant returns to scale. Because of the lagged response of employment to a change in production there is still increasing returns to scale with respect to labour in the short run for almost all industries. Thus the pro-cyclical character of productivity is an important short-run aspect of the model.

According to the discussion by Manning (1990 and 1992) presented in section 3.5.6, this may cause multiple equilibria. But, as discussed in section 3.5.5, it may be too simple to assume a unique connection between price formation and demand for labour in a macroeconomic context as done by Manning in figure 3.5.9. The effects on demand for labour in MODAG as a result of a change in wage rates are further discussed in section 5.3.3.

The estimation results indicate some possibilities for substitution between labour and material inputs in some of the manufacturing industries, and particularly in private services. Negative elasticities of labour demand with respect to capital in several sectors indicate substituability between labour and capital in the long run. The estimation results also indicate a significant term for technical progress in most sectors. Especially in Production of paper and paper products, Production of industrial chemicals, Building of ships and oil platforms and Ocean transport the technical progress is large indicating a Hicks neutral productivity growth of 5 to 6 per cent a year.

5.3.2. Supply of labour

The participation rates, and thereby the number of persons in the labour force, are determined for eight different groups by sex, age, educational and marital status, cf. Lindquist et al (1990). The model is a logit-analogy which secures that the participation rates YP_j are limited to the interval between 0 and 1. The equations are of the following form:

$$(5.3.3) \qquad YP_j = \frac{e^{X_j'\beta_j}}{1 + e^{X_j'\beta_j}}$$

X_j' denotes the explanatory factors and β_j the corresponding coefficients where the elasticity of factor number i on the participation rate for group j is given by $\beta_{ji}(1 - YP_j)$.

To secure consistency with the model block for disabled persons achieving pensions, the participation rates for the population groups between 25 and 66 years are defined as the ratio between the labour force and the population exclusive disabled persons. For some groups it has also been found convenient to restrict the maximal participation rate to less than 100 per cent (cf. Bowitz (1992)).

The relevant explanatory factors differ between different groups. Except for people under education in the group 16-19 years and pensioners the wage elasticities turned out to be very small giving a rather steep aggregate supply curve in the model. For married women their own real wage elasticity and the cross elasticity with respect to their husbands' income seem to outweigh each other, and the participation rate for men in the age group 25-54 years has been almost constant the last 20 years.

The situation in the labour market seems to be the most important explanatory factor for labour participation in almost all groups. For youths and women a variable representing growth in demand for labour in private and public sectors seems to be the main factor, indicating that these groups partly are rationed in the labour market. A significant effect of the rate of unemployment on the participation rates for middle aged men and pensioners indicate that a discouraged worker effect is important for these groups. As an average for all groups a negative shift in demand for labour moves the supply curve to the left, increasing the number of unemployed more than one half of the reduction in employment.

In addition to growth in service sectors a decreasing number of children per married woman has been the main factor behind the growth in the participation rate for married women, while expansion in the school system has lowered the participation rate for youths. A shortening of the pension age has lowered the participation rate for the oldest group.

5.3.3. The functioning of the labour market block

From figure 5.2.1 and the presentation of the different parts of the labour market block it is evident that demand for labour, supply of labour, unemployment and wage formation are closely interrelated both directly and indirectly via effects through the price and quantity block. Especially regarding labour demand it is necessary to take these indirect effects into account to get the total effect of a wage increase on labour demand. Both the direct substitution effect between labour and material inputs and the change in production in the different sectors as a result of growth in real disposable income and loss in competitiveness are of importance in a macroeconomic context.

The effects on macroeconomic variables of a reduction in all wage rates by 2 per cent relative to the reference scenario in a version of MODAG where wages are exogenously given are presented in table 5.3.1. The elasticities on consumer prices, the total number of persons employed, the number of persons employed in manufacturing and gross product in manufacturing and mainland Norway are further illustrated in figure 5.3.1. The effects on the rate of unemployment in percentage points and the balance of payments and government budget surplus are also illustrated in the figure.

Table 5.3.1. Effects of a permanent reduction in hourly wage rates by 2 per cent relative to the reference scenario from 1992

Impacts on	1992	1995	2000	2005	2010
Constant prices, per cent					
Private consumption	-0.52	-1.01	-0.80	-0.83	-0.83
Gross investments, industries, mainland Norway	-0.27	-1.24	-0.17	-0.44	-0.12
Exports, traditional commodities	0.14	0.51	0.59	0.59	0.68
GDP, mainland Norway	-0.09	-0.23	-0.01	-0.02	0.07
- Manufacturing	0.18	0.39	0.86	1.06	1.28
Price indices, per cent					
Private consumption	-0.58	-0.80	-0.88	-0.87	-0.93
Labour market, 1000 persons					
Labour force	-0.13	-1.43	0.91	2.29	2.78
Employment, total	0.71	-0.73	3.57	4.76	5.15
- Manufacturing	0.51	1.56	2.98	3.34	3.56
- Other industries	0.20	-2.29	0.60	1.42	1.58
Unemployment	-0.84	-0.70	-2.66	-2.47	-2.37
Current prices, Bill N.kr.					
Balance of payments	0.8	3.5	5.6	9.1	14.4
Govt. budget surplus	1.4	2.1	4.6	8.0	14.1

A reduction in wage rates has three main impacts on employment in MODAG, the income effect, the market share effect and the factor substitution effect. The income effect of a reduction in wage rates is caused by a redistribution of income from labour to capital. Such a redistribution of income will decrease private consumption and investments in dwellings. On the other hand, an increase in profitability has a positive effect on investments and the self-employeds' demand for consumer goods. The effect of profitability on investments is rather weak in MODAG, and as the marginal propensity to consume of wage incomes is much higher than from operating surplus, this redistribution of income causes a reduction in domestic demand and thereby in production in those industries producing for the domestic market. The negative effects on private connsumption is modest in the short run as a result of sluggish adjustment to lower real incomes.

Reduction in domestic costs also tend to decrease prices on Norwegian products competing with similar foreign products. As a result of this competing industries gain market shares both in the domestic market and the export market, and production and employment in these industries increase. The demand effect from the increase in net exports outweighs the negative effects from lower domestic demand mentioned above, and the total effect on gross domestic product for mainland Norway is negligible. A reduction in wage rates has a positive effect on production in manufacturing industries.

Prices on consumer goods are lowered as a consequence of lower wages, and real wages decline only less than one per cent in the long run. The long run elasticity of consumer prices with respect to a change in wages is thus close to 0.5 which seems to be a stylized fact in the Norwegian economy, also reported in Aukrust (1970).

As labour gets relatively cheaper compared to other inputs, production becomes more labour intensive in several industries, especially in private services. In spite of a sluggish effect from production on employment, total employment increases relatively more than production for mainland-Norway, even after the second year. In the first years employment is roughly unchanged increasing to about 5000 persons, relative to the referance scenario efter 15 to 20 years. This corresponds to a total elasticity of demand for labour in private industries with respect to a change in nominal wage rates of -0.2 indicating that the aggregate demand curve for labour is rather steep in MODAG. The curve will also be steep as a function of real wages. An elasticity of consumer prices with regard to wages of about 0.5, means that the macro real wage elasticity in private industries is about -0.4.

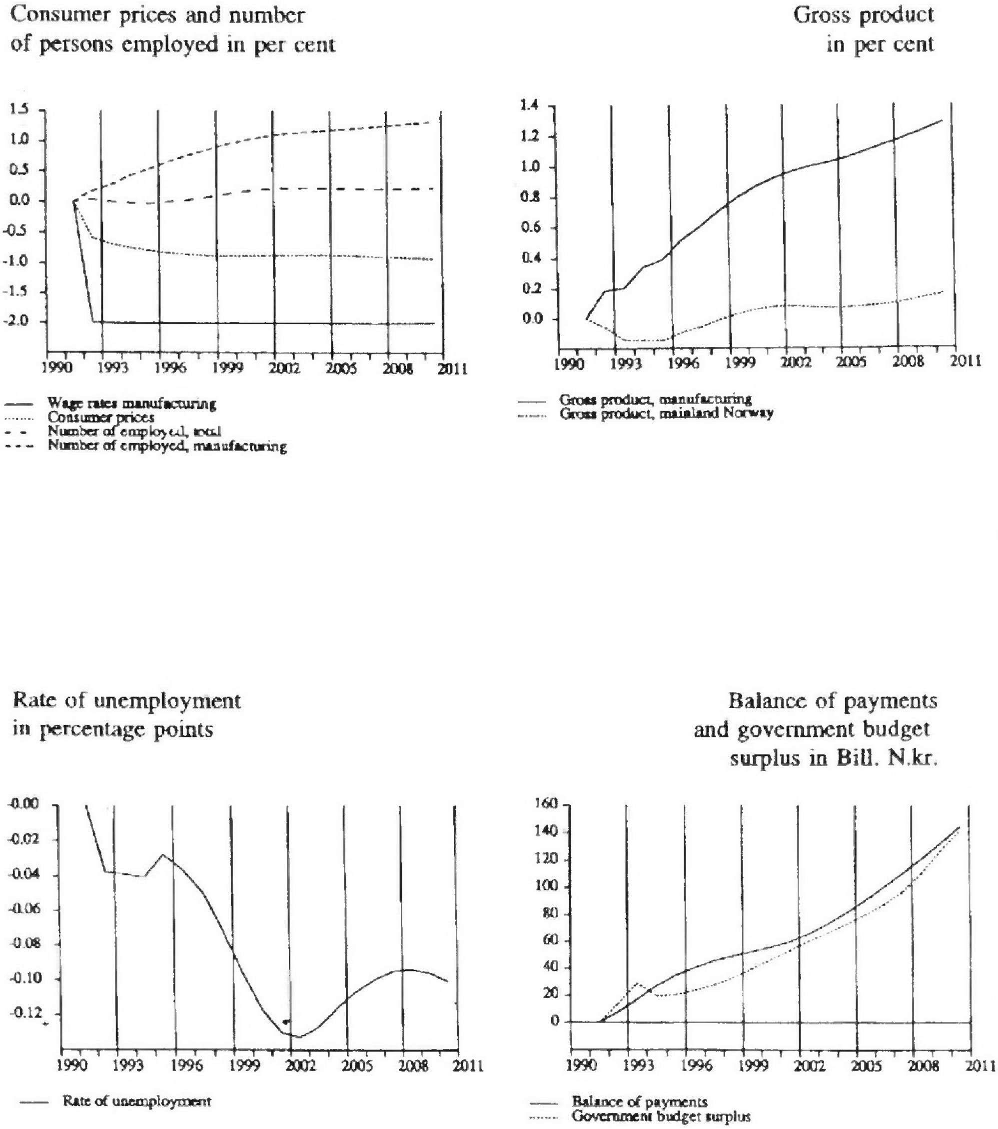
The real wage elasticity is about the same as reported in Stølen (1987). An important reason for the relatively low elasticity is the fact that a large part of the Norwegian exporting industries (especially the oil industries) are rather capital intensive and mostly based on natural resources. Wage costs constitute only a small part of total costs in these industries, and the effect on employment of a decrease in wage costs is only modest. The open character of the Norwegian economy also implies relatively small effects on consumer prices of a decrease in wage rates compared to larger countries where foreign trade is of less importance.

From the brief presentation of the supply of labour in section 5.3.2 it appears that there is only a weak direct effect of a change in wages (real wages after tax) to supply of labour measured in number of persons indicating that the supply curve for labour is rather steep. However, since supply of labour is dependent on growth in service industries and unemployment, a shift in the demand curve will move the supply curve in the same direction, and about half the way of the shift in the demand curve. This explains the effects on the labour force of a reduction in wage rates in table 5.3.1. A negative direct effect of lower wages is in the long run more than balanced by a positive shift in demand for labour and a reduction in unemployment. In the short run the labour force declines, but increases after 10 to 20 years due to growth in employment. Unemployment is thus reduced by about 2500 persons in the long run as a result of the wage reduction.

Both the balance of payments and the government budget surplus improve as a consequence of reduction in wage rates. A reduction in domestic demand, and thereby imports, and a gain in market shares on the domestic market and the export market are the main reasons for the growth in the balance of payments, although lower export prices, partly dependent on domestic costs, work in the opposite direction.

The government budget surplus improves because public sector expenditures are more sensitive to growth in domestic nominal variables than incomes. As the Norwegian public sector has been in a net credit position interest incomes have been rather large. In addition a significant part of the tax incomes are based on extraction of crude oil and

Figure 5.3.1. Effects of a reduction in hourly wage rates by 2 per cent from 1992 relative to the reference scenario



natural gas and refined petroleum products, where prices are independent of Norwegian costs, and on commodities mainly imported as cars, tobacco and alcoholic beverages. A great part of the expenditures on the other hand are payments for commodities and services and transfers where growth in domestic costs and prices are of great importance. Although a reduction in wages means lower taxes as a result of redistribution from wage income to capital income, with lower tax rates, and lower private consumption, the effect on expenditures is much larger. Growth in employment, lower unemployment and fewer persons achieving disability pensions may also contribute to improve the government budget balance.

An improvement in the export surplus and the government budget surplus make room for a reduction in taxes and/or an increase in services. This may increase employment by more than the direct effect of a reduction in wages, and is illustrated in the report from the Norwegian Employment Commission (NOU 1992:26).

5.4. Macroeconomic implications of choice of wage equation

5.4.1. Choice of wage equation and economic theory

As pointed out in section 4.3 and 4.5 no finite conclusion about the choice of specification for average manufacturing was made. As wages in manufacturing industries are found to be of great importance for wages in other sectors, the choice of specification probably will have macroeconomic consequences, both in forecasting and in policy analysis. It is therefore of interest to discuss these consequences and evaluate them against economic theory.

Important aspects for the discussion of choice of specification may be found in the presentation of the model by Layard, Nickell and Jackman (1991) in section 3.5.4 and in the discussion of hysteresis in a macroeconomic context in section 3.5.5. An essensial point in the LNJ model is that the long run equilibrium rate according to (3.5.34) only depends on *structural* conditions regarding wage and price formation. According to the conclusions made by LNJ (pp. 508-509) a more expansionary economic policy, reductions of the normal working hours and policies which aim to reduce the supply of labour will only have *short term* effects on the rate of unemployment in this model. In the *long run* the rate of unemployment will return to the equilibrium rate. This does not mean that the equilibrium rate is a constant. Changes in the institutional arrangements influencing wage formation as the replacement ratio, the duration of unemployment benefit, the degree of centralization and coordination and the level of labour market programmes aiming at reducing mismatch problems may influence the equilibrium rate.

Although LNJ opens for some hysteresis in the sense that changes in the rate of unemployment may influence wage and price setting, these hysteresis effects are only temporary in their model as discussed in section 3.5.5. As also discussed by Kolsrud and Nymoen (1992) there is a contradiction between such a model and a hysteresis model where the equilibrium rate according to Phelps (1972) partly may depend on the actual rate of unemployment (cf. the discussion in section 3.5.3). Hysteresis effects may be caused by lack of physical capital (cf. Drèze and Sneessens (1986)), loss of human capital among the long term unemployed (cf. Hargreaves Heap (1980)) and insidiers which do not care about the long term unemployed in the wage bargaining (cf. Lindbeck and Snower (1989)). Also Johansen (1982) expressed sceptisism to a high degree of automatic stabilization and pointed out that unemployment probably easier would increase than decrease.

As discussed in section 3.5.5 the contradiction between the hysteresis view and the LNJ model may be explained by simplifications done in this model when ending up with the price and wage equations determining equilibrium unemployment and the equilibrium real wage. The crucial point is the correspondence, or rather the lack of correspondence, between these two curves and the more traditional curves for demand and supply of labour. From LNJ's view that economic policies affecting demand or supply for labour only have short term effects on the rate of unemployment, it looks like they mean that the equilibrium rate only depends on the structural parameters in wage and price formation. While the correspondence between the wage formation curve (3.5.32) and an ordinary supply curve for labour is very unclear, the basic assumption of monopolisitc competition makes a clear correspondence between the price equation (3.5.31) and demand for labour. However, (3.5.31) may be too simple to account for all the factors affecting demand for labour in a macroeconomic context. From a traditional IS-LM model it may be relevant to include economic policy in addition to real wages as done in (3.5.41). In a macroeconomic model like MODAG, demand from the world market and normal working hours may also affect demand for labour. From the supply side it may also be relevant to include population and exogenous factors affecting the participation rates.

The situation where a positive connection between the level of unemployment and wages caused by demand and supply of labour is combined with a negative connection between the *level* of wages and the level of unemployment is shown in figures 3.5.7 and 3.5.8 and is denoted partial or pure hysteresis. This situation corresponds to the error correction specifications for wage formation in section 4.3. A more expansive economic policy, shortenings of the normal working hours and policies which aim to reduce the supply of labour will in this case have *long term* effects on the rate of unemployment.

In the case of temporary hysteresis or no hysteresis at all, the long term real wage equation is vertical as shown in figure 3.5.6. This is the case when the wage equation is a Phillips curve and gives a connection between the *change* in real wages and the deviation in unemployment from the equilibrium rate. As discussed in section 3.5.1 this connection may be in accordance with classical price dynamics tending to eliminate a divergence between supply and demand for labour. A negative shock increasing the rate of unemployment will also in this model cause a fall in real wages, but unemployment will in this model return to its original equilibrium U^*.

The arguments for hysteresis moving the equilibrium rate of unemployment outwards as a consequence of a negative shock, seem rather facinating and are important reasons why Kolsrud and Nymoen (1992) among others prefer an error-correction model for wage formation. From (3.5.43), however, a weakness with such a specification is that the variables influencing U only by luck will cointegrate indicating that unemployment is not a stationary variable, but showing a random walk with drift. Although the model implies a technical equilibrium, it is more correct to say that there is *no equilibrium* in such an economy as claimed by Layard, Nickell and Jackman (1991, pp. 374-375) and the works by Blanchard and Summers (1987 and 1988) discussed in section 3.5.3.

As the rate of unemployment is a measure of imbalances in the labour market it is hard to believe that a situation with a rate of unemployment less than 1 per cent or greater than 10 can be stable equilibria in the long run. Lindbeck (1992) also argues that concern for stability in the long run is a strong support for the Phillips curve specification. The problem is also recognized by Coe and Krueger (1990) in discussing the development in the equilibrium rate of unemployment in Western Germany during the 1970s and the 1980s. Coe and Kreuger claim that "it is difficult to identify structural changes in the labour market that would have increased the natural rate of unemployment from less than 1 per cent in the 1960s and early 1970s to 7 to 8 per cent in the 1980s". Coe and Kreuger therefore try to identify the structural factors and the other factors influencing the rate of unemployment.

To conclude this section: Although the equilibrium rate of unemployment may change somewhat as a consequence of the situation at the labour market it may cause troubles to assume that this process lasts for ever as a consequence of a sequence of shocks moving the rate of unemployment in the same direction. Arguments for stability regarding the rate of unemployment in the long run supports the Phillips curve specification. This is further discussed in section 5.4.2 by constructing reference scenarios for MODAG based on four alternative wage equations for manufacturing industries.

5.4.2. Consequences for reference scenarios in MODAG

Based on the four alternative wage specifications for total manufacturing (the Phillips curve model (PH), the error correction model with a wedge variable (EC), the factor income deflator model with large weight on alternative wages (AW) and the model with a large weight on the factor income deflator (PY)), the development in some main variables for the period 1991 to 2010 in reference scenarios constructed with the macroeconomic model MODAG is presented in table 5.4.2 and figure 5.4.1. All the other equations and the development in the exogenous variables are equal in the four alternatives. Differences in the reference scenarios are thus caused by different properties regarding the wage equations for average manufacturing.

Based on the preliminary National accounts for 1990 and 1991, all the four model versions are calibrated in these years to reproduce history. Based on assumptions of an international upswing and increasing growth in private consumption and private investments, growth in production increases in the first half of the 1990s. As a result of a preliminary higher growth in productivity, demand for labour will be almost constant from 1991 to 1992, but will grow about 1 per cent a year towards 2000. Because of growth in the labour force of about 0.7-0.8 per cent a year, unemployment may decline 0.3-0.4 percentage point each year. More modest economic growth for some time may cause the rate of unemployment to stabilize or increase again after 2000, but there is of course a lot of uncertainty regarding this baseline scenario.

The main differences between the four model versions first show up in the development in wages for total manufacturing. Due to changes in relative prices and large simultaneity between wages and products prices, price-wedges cause the factor income deflator model to show the greatest growth in wage rates. Prices on investments tend to grow faster than other prices, especially import prices, although wages in building and construction grow slower than other wages due to the high rate of unemployment.

Corresponding to the post sample simulations for 1991 presented in figure 4.5.1 wage growth is relatively high with the wedge model. Wage growth is lowest with the alternative wage model, and the Phillips curve gives a wage growth somewhere in between. Although cuts in income taxes contribute to reduce wage growth in the alternative wage equation in the first year, this factor is not the main explanation since cuts in income taxes also have a clear effect on wages in the wedge model according to table 4.6.2. Prices on most imports are assumed to grow at a rate slightly above 2 per cent a year, and as pay-roll-tax rates, the value added tax rate and other taxes are assumed to be held constant these taxes may not explain the differences. Normal working hours in the different sectors are also assumed to be constant, and from table 4.6.7 the increase in unemployment the last years has about similar partial effects in all models.

From the discussion in section 4.3.3 and in connection with table 4.6.3 different impacts from growth in productivity is the main explanatory factor why wage growth in the wedge model and the alternative wage model deviates from the Phillips curve. As shown in section 4.3.3 productivity growth in manufacturing is overcompensated in the wedge model due to a direct effect of 100 per cent and an indirect effect working through wages in sheltered sectors and consumer prices. This is also a minor problem with the present Phillips curve version as the direct effect now is estimated close to (and may be wrongly restricted to) 100 per cent while there is a modest indirect effect working through consumer prices. The alternative wage equation makes the wage and price equations far more simultaneous than in the Phillips curve model and the wedge model. Because large weight is put on the conditions in the sheltered sectors, real wages in manufacturing grow less than productivity. In the error correction models the long run effects of productivity are restricted to be equal to the effects from product prices and pay-roll taxes also influencing profitability. Attempts to relax on this restriction gave even smaller productivity effects in the alternative wage model and was not successful. In the wedge model the effect from productivity was not substantially reduced.

The different development in manufacturing wages also leads to highest growth in gross product for manufacturing with the alternative wage equation, lowest growth with the wedge equation while the Phillips curve is somewhat between. Due to fluctuating price wedges the fluctuations in growth in production are relatively larger with the factor income deflator model than the other models. As growth in wages according to the discussion in section 5.3.3 has the opposite effect on production and employment in sheltered industries the difference between the four models regarding GDP mainland Norway, total employment and the labour force is negligible. However, as higher wages have a small positive effect on unemployment, the rate of unemployment is lowest with the alternative wage specification and highest with the wedge specification and the factor income deflator specification.

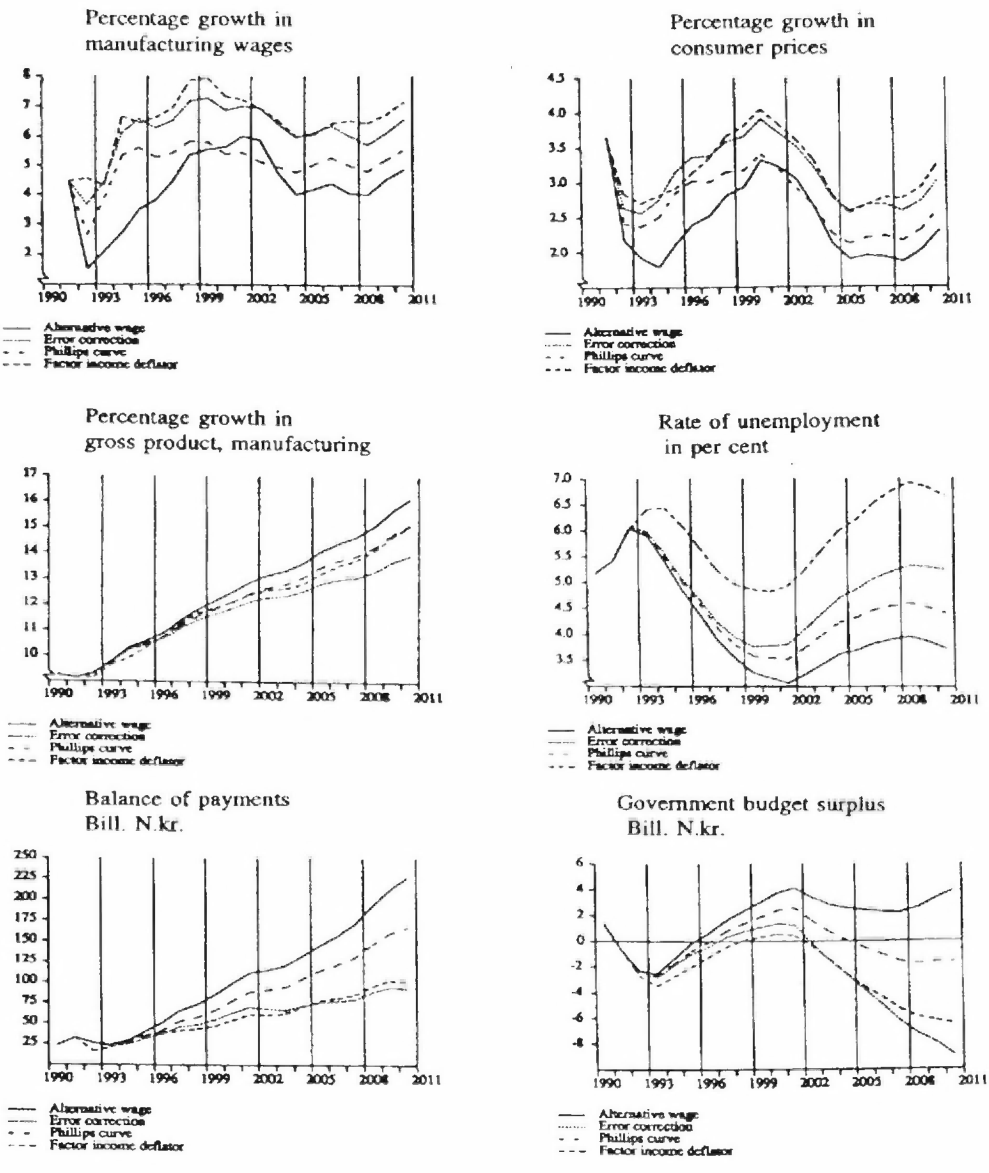
Table 5.4.2. Reference scenarios from 1991 to 2010 based on MODAG with four alternative wage equations

	Model	1991	1992	1995	2000	2005	2010
Constant prices, average percentage growth							
GDP mainland Norway	PH	0.1	1.7	3.3	2.6	2.3	2.4
	EC	0.1	1.7	3.3	2.7	2.3	2.4
	AW	0.1	1.7	3.1	2.6	2.3	2.4
	PY	0.1	1.7	2.9	2.8	2.2	2.5
Gross product, manufacturing	PH	-1.0	1.8	4.0	3.0	2.1	2.3
	EC	-1.0	1.7	3.9	2.7	1.6	1.6
	AW	-1.0	1.9	4.3	3.4	2.4	2.7
	PY	-1.0	0.1	4.1	3.3	1.7	2.7
Prices and wages, average percentage growth							
Consumer prices	PH	3.7	2.4	2.6	3.2	2.6	2.3
	EC	3.7	2.6	2.8	3.6	3.2	2.8
	AW	3.7	2.2	1.9	2.8	2.6	2.0
	PY	3.7	2.8	2.8	2.8	3.2	2.9
Wages, manufacturing	PH	4.5	2.6	4.9	5.6	5.1	5.2
	EC	4.5	3.7	5.7	6.8	6.5	6.2
	AW	4.5	1.5	2.8	5.0	5.0	4.4
	PY	4.5	4.6	5.8	7.3	6.6	6.6
Labour market, 1000 pers. average percentage growth							
Labour force	PH	-0.8	0.7	0.7	0.8	0.6	0.4
	EC	-0.8	0.8	0.7	0.8	0.5	0.4
	AW	-0.8	0.7	0.7	0.8	0.6	0.5
	PY	-0.8	0.3	0.6	0.8	0.5	0.4
Employment, total	PH	-1.0	-0.1	1.1	1.1	0.4	0.5
	EC	-1.0	-0.1	1.1	1.1	0.3	0.3
	AW	-1.0	-0.0	1.1	1.2	0.5	0.5
	PY	-1.0	-0.3	0.6	1.0	0.2	0.3
Rate of unemployment, per cent	PH	5.4	6.2	5.0	3.5	4.1	4.1
	EC	5.4	6.2	5.1	3.7	4.7	5.0
	AW	5.4	6.1	4.9	3.1	3.5	3.5
	PY	5.4	6.0	6.1	4.8	6.2	6.7
Current prices Bill N.kr.							
Balance of payment	PH	32.4	26.0	34.2	77.0	114.5	167.3
	EC	32.4	25.7	31.3	62.3	76.1	93.1
	AW	32.4	26.4	40.2	98.2	145.1	226.4
	PY	32.4	15.9	35.7	53.8	77.7	100.7
Government budget surplus	PH	-7.2	-23.6	-7.9	23.9	-4.3	-16.9
	EC	-7.2	-24.0	-10.4	13.5	-38.3	-89.9
	AW	-7.2	-23.0	-2.3	37.4	23.7	38.0
	PY	-7.2	-26.8	-20.1	5.2	-35.6	-64.2

As discussed in section 5.3.3, the growth in wages is also of great importance for the balance of payments and government budget surplus. The surpluses on each of these balances are thus highest with the alternative wage specification and lowest with the wedge specification and the factor income deflator specification.

The divergence between the specifications gets larger and larger as time elapses. Although the economic development is dependent on exogenous assumptions made, there is a tendency for the alternative wage specification to end up in a situation with low unemployment and a large positive balance of payments and government budget sur-

Figure 5.4.1. Reference scenarios from 1991 to 2010 based on MODAG with four alternative wage equations



plus, while the wedge model and the factor income delfator specification end up in high rates of unemployment and large deficits regarding government budget surplus. The problem was more evident in an earlier version of the model, but are to some degree liminated by lower real wage elasticities and probably an improved reference scenario giving a smaller up-swing in the beginning of the nineties than in the earlier version.

Although error correction models in principle also could be in accordance with the Scandinavian theory of inflation there is a problem that manufacturing industries have lost competitiveness of about 45 per cent from 1966 to 1990 as discussed in section 4.7. If this is explained by factors which may continue to indicate loss, as overcompensation for productivity in the wedge model or price wedges in the factor income deflator model, we get in trouble. On the other hand the alternative wage model seem to put so much weight on tax increases and price wedges that productivity is undercompensated. The Phillips curve version assumes that a large part of the loss in competitiveness is caused by a lower rate of unemployment than the equilibrium rate, and is thus far more robust. When the actual rate is close to the equilibrium rate, wages move close to the Scandinavian theory of inflation, and departure from this equilibrium rate will cause wages to deviate from the Scandinavian theory of inflation until equilibrium is restored.

The results found by Coe (1990), Rødseth and Holden (1990, ch. 4) and Johansen (1991), all based on error correction models where wage costs per unit produced move close to product prices in the long run, are often held as evidence that wage formation behave according to the Scandinavian theory of inflation. However, these studies only point at one element in Scandinavian theory of inflation and do not explain why Norwegian product prices have increased relative to prices on goods produced abroad. The close correspondance between wage costs per unit produced and product prices may, according to the presentation in Cappelen (1992), be due to price formation and not vice versa.

A close correspondance with the Scandinavian theory of inflation favours the Phillips curve specification. Although the reference scenarios seem to be quite similar in the short run, the long run properties favour this specification. It is hard to defend that large and lasting imbalances in both the labour market, the balance of payments and the government budget surplus represent equilibria in the Norwegian economy. One equilibriating force may work through wage formation, but it is also possible with equilibrium forces in the financial market influencing the rate of interest as a result of imbalances in the government budget and the balance of payments. Because of the regulations of financial markets up to the middle of the eighties the treatment of these markets is rather weak in MODAG, almost neglecting them, and exchange rates are exogenous in the model. Improved specifications in these respects could have made the error-correction models in wage formation less problematic, but it is not obvious that all weaknesses would be eliminated. As discussed in section 5.5 the equilibrium forces in the labour market may also be rather weak, even with a Phillips curve specification.

5.5. The macroeconomic properties of MODAG with regard to the labour market

5.5.1. Properties of MODAG which cause slow decreases in unemployment irrespective of choice of wage equation

Although choice of wage equation for average manufacturing is of some importance for the macroeconomic properties of MODAG, other properties of the model may cause slow decreases in unemployment after it has reached a high level.

The first point to mention is that MODAG is a disaggregated model with different wage equations across sectors. From the overview in section 4.5.3, the rate of unemployment has an independent long term effect on the wage level in Production of primary metals and Local government administration. Even with a Phillips curve in total manufacturing there are weak hysteresis effects which slows down the equilibriating process in the labour market. Large long run effects of consumer prices in many sectors may also be of importance, but as pointed out in section 5.2 the effects from capacity utilization on prices are rather weak. Based on the discussion in section 5.4.2 it may be asked how smart it is to open for independent level effects in the single wage equations, but it is worth noticing that a situation with different wage formation in the different sectors may cause hysteresis.

In an earlier version of the model an equilibrium rate of unemployment like the one estimated for average manufacturing was also imposed for the other sectors. A clear weakness with such a specification was that the increase in unemployment from what has been common during most of the period of estimation caused a large deviation in relative wages. But the property of a given equilibrium rate in the whole model was then more evident.

On the other hand it has proved difficult to find stable error correction models for wage formation in Building and construction and Local government education. This may cause stabilizing effects even if an error correction specification is implemented for total manufacturing. As mentioned in section 4.5.3 these Phillips curves, which differ from average manufacturing, may cause some deviations in relative wages over some years, and this may influence the macroeconomic properties of the model.

A second point also mentioned by LNJ (1991) and discussed in section 3.5.5 is *temporary hysteresis* effects as there may be a link between changes in unemployment and inflation. As discussed in section 4.3.3 such effects may be present in the wage formation for average manufacturing, but as the effect was not quite significant and caused problems for other parameters, it is not implemented. In Building and construction a temporary hysteresis effect caused by the change in employment was found to be significant and is incorporated in the model. In MODAG as a whole these effects are only of minor importance.

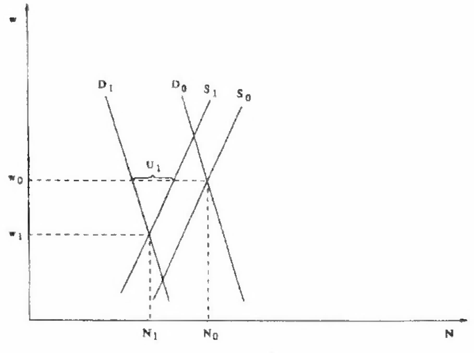
A third point regarding real wage flexibility is, however, more important. Based on the discussion in section 4.3.6 and Johansen (1991) it looks like the wage equations for average manufacturing are highly non-linear regarding unemployment. The real wage flexibility in wage formation measuring the effect from the rate of unemployment on real wages is thus high with low unemployment and low with high unemployment. A low real wage flexibility at high rates of unemployment means that the reduction in real wages is very sluggish keeping unemployment high for a long time. In the Phillips curve specification this also shows up as a low constant term in absolute value indicating only small reductions in real wages (corrected for productivity) even though unemployment is high. Reluctance by the trade unions to accept a large reduction in real wages is probably the main explanation for this.

A fourth point is that there is only a weak effect from real wages on demand and supply for labour in MODAG. As mentioned in section 5.3.3 the real wage elasticity regarding supply of labour is rather small and the macro wage elasticity for demand for labour in private sectors is as small as -0.4. With such low elasticities in combination with low real wage flexibility at high rates of unemployment it is clear that it may take several years to restore equilibrium in the labour market, even if the Phillips curve were the most relevant description of wage formation. The choice of wage equation in analysing the effects of an expansionary shock affecting demand/supply of labour is thus of minor importance in a situation where the rate of unemployment is high. This is further discussed in section 5.5.3.

A fifth point which makes it difficult to reduce unemployment with an expansionary economic policy, but limits the growth in unemployment as a consequence of a negative shock, is the fact that supply of labour is very sensitive for shifts in demand for labour and unemployment even in the long run. The consequences of a steep supply and demand curve for labour and the effects of a shift in demand for labour are illustrated in figure 5.5.1.

At the starting point the two curves are denoted respectively S_0 and D_0 and the labour market is in equilibrium at the real wage rate w_0 and employment N_0. It is not assumed to be any unemployment in this situation except from frictional unemployment. (The figure is too simple to deal with heterogeneity and frictions in the labour market.)

Figure 5.5.1. Illustration of the long term supply and demand curve for labour in MODAG



We then assume a negative shift in the demand for labour as a result of an international slow-down or a tightening of the domestic economy. The supply curve moves to the left about half the way of the shift in the demand curve, and determine a new equilibrium at the wage rate w_1 and employment N_1 which are both lower than at the starting point.

Due to the steep supply curve even modest shift in the demand curve will imply a large reduction in real wages to restore equilibrium in the labour market. All the actual wage equations relevant for MODAG imply only a modest change in wage rates in the first year and the unemployment increases to U_1. Although real wages start to decrease the low demand elasticity causes the effects on demand for labour to be only modest. If a negative shock took place at a high level of unemployment the low real wage flexibility would cause real wages to move only by small steps on its way towards equilibrium. Even with a Phillips curve and a fixed equilibrium rate it is possible that the shift in the supply curve and effects through wages may create an equilibrium where both employment and the labour force are lower as a result of the negative shift.

The discussion in this section has shown that even if long run hysteresis effects are not present, a steep supply and demand curve for labour and a low real wage flexibility at the present level of unemployment cause the economy to need many years to restore equilibrium in the labour market when left to itself. Hysteresis, indicating that the equilibrium in the labour market may move as a consequence of a negative shock will strenghten the problems further. By simulations of shifts in some of the exogeneous variables using the macroeconomic model MODAG these problems are further discussed in section 5.5.2 to 5.5.8.

5.5.2. Impacts on labour market from a change in government policy

To shed further light on the functioning of the Norwegian labour market and evaluate the properties of the different wage equations I have looked at the effects of a shift in government consumption, a cut in pay-roll taxes, personal income taxes and value added taxes, reductions of the normal working hours, a negative shift in supply of labour caused by a lower growth in population in working age and finally a devaluation. As the whole model is used in these calculations, the effects will partly be due to other parts of the model than the labour market block. These effects are mainly caused by the traditional multiplier and accelerator effects and effects from wages on personal incomes and market shares for competing goods.

However, MODAG is not a complete model of the Norwegian economy. The treatment of financial markets is rather weak, and some variables partly under government control and treated as exogenous may also be influenced. This means that the results from the model calculations have to be interpreted with care. The calculations only illustrate the functioning of the model and certain important aspects of the working of the Norwegian economy.

When analysing the effects of a change in government policy in a non-linear and dynamic model as MODAG, the impact coefficients are dependent on the reference scenario used for the calculations. Especially the non-linearity from the rate of unemployment in wage formation is of great importance. The net financial balances between different sectors and the level of real interest in the reference scenario are also of some importance. As a result of the non-linearity between unemployment and wages the impact coefficients from an increase in a variable which affects unemployment may differ from a reduction in the variable by the same amount.

5.5.3. Effects from an increase in government consumption

Tables 5.5.1a-5.5.1c show the effects from a sustained increase in government consumption (employment and goods and services) of 5 bill. 1990 kr. from 1992 and afterwards. In the first years this corresponds to a growth in public employment of 20 thousand persons declining to 18 thousand in 2010 due to increased productivity. The shift is quite parallel to the shift in table 3.2 in Appendix 1 for the Norwegian Employment Commission (NOU 1992:26). The growth in government consumption cause traditional multiplier and accelerator effects which tend to increase private consumption and investments and production in sheltered industries. Due to an increase in labour productivity in the short run consumer prices decline compared to the reference scenario as the immediate effect of lower unemployment on wages is very small at a level of unemployment of 6 per cent, irrespective of the chosen wage specification.

The increased demand for labour has a strong direct effect on labour supply, as the possibilities for married women and youths for getting work improve. The fall in unemployment also has a positive effect on labour supply from men and old age pensioners.

The fall in unemployment and growth in productivity cause an increase in wage rates compared to the reference scenario. The wage pressure of a permanent shift in government employment would, however, have been larger than shown in the tables if the

Table 5.5.1a. Effects of an increase in public consumption from 1992 by 5 bill. 1990-kr. relative to the reference scenario. Phillips curve model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices, Bill. N.kr						
Private consumption	2.0	2.5	2.6	1.8	3.8	5.1
Gross investments, industries, mainland Norway	0.5	1.9	1.6	0.2	1.2	0.9
Exports, traditional commodities	-0.0	-0.1	-0.1	-0.3	-0.4	-0.8
GDP, mainland Norway	5.9	7.1	6.8	5.6	6.9	6.7
- Manufacturing	0.3	0.5	0.4	0.0	-0.0	-0.5
Price indices, per cent						
Consumer prices	-0.09	-0.04	0.07	0.12	0.34	0.56
Wages, total	0.07	0.15	0.28	0.60	1.16	1.48
- Manufacturing	0.03	0.12	0.30	0.64	1.28	1.64
Labour market, 1000 persons						
Labour force	11.1	13.8	16.1	13.9	14.1	13.9
Employment, total	22.6	25.8	27.0	21.0	21.3	19.6
- Manufacturing	0.4	0.7	0.7	-0.2	-0.8	-1.5
- Other industries	2.4	5.4	6.9	2.3	3.6	3.1
- Public sector	19.8	19.7	19.5	19.0	18.6	18.1
Unemployment	-11.5	-12.0	-10.9	-7.1	-7.2	-5.7
Current prices, Bill N.kr.						
Balance of payments	-1.7	-2.7	-3.3	-3.7	-7.7	-12.9
Government budget surplus	-1.8	-1.1	-1.8	-5.7	-9.7	-17.4

Table 5.5.1b. Effects of an increase in public consumption from 1992 by 5 bill. 1990-kr. relative to the reference scenario. Wedge model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices. Bill N.kr.						
Private consumption	2.0	2.5	2.7	2.0	3.7	4.2
Gross investments, industries, mainland Norway	0.5	1.9	1.6	0.3	1.3	0.8
Exports, traditional commodities	-0.0	-0.1	-0.1	-0.3	-0.5	-0.7
GDP, mainland Norway	5.9	7.1	6.9	5.7	6.9	6.6
- Manufacturing	0.3	0.5	0.4	-0.0	-0.0	-0.3
Price indices, per cent						
Consumer prices	-0.08	-0.03	0.09	0.17	0.31	0.37
Wages, total	0.08	0.16	0.32	0.67	0.99	0.96
- Manufacturing	0.04	0.14	0.36	0.74	1.10	1.04
Labour market, 1000 persons						
Labour force	11.1	13.8	16.1	13.8	13.7	13.5
Employment, total	22.6	25.8	27.0	21.0	21.4	20.1
- Manufacturing	0.4	0.7	0.6	-0.3	-0.7	-1.0
- Other industries	2.4	5.4	6.9	2.3	3.5	3.0
- Public sector	19.8	19.7	19.5	19.0	18.5	18.1
Unemployment	-11.5	-12.0	-10.9	-7.2	-7.7	-6.6
Current prices, Bill N.kr.						
Balance of payments	-1.7	-2.7	-3.3	-4.0	-8.0	-12.3
Government budget surplus	-1.9	-1.1	-1.9	-6.0	-9.9	-16.7

unemployment along the references scenario had been lower. Although prices increase after some years, the positive shift in demand for labour causes an increase in real-wages which also contributes to an increase in labour supply.

The increase in wage rates contributes to a loss in market shares both for exporting and home competing industries. After some years this will induce a significant negative effect on production and employment in these industries. Negative multiplier effects as a result of this and factor substitution also reduce employment in sheltered industries.

According to tables 5.5.1a-c and figure 5.5.2 the effect on wage rates and real variables are quite similar in the different specifications of the wage equation. The different effect from productivity growth discussed in section 5.4.2 causes highest wage growth in the wedge specification in the short run and lowest wage growth in the alternative wage specification. In the medium term higher short and medium term wage flexibility in the error correction models according to table 4.6.7 cause higher wage growth in these specifications than the Phillips curve. In the long run wages increase most in the Phillips curve, and a lower rate of unemployment in the reference scenario for the alternative wage model also has to be taken into account when comparing this model. The low and

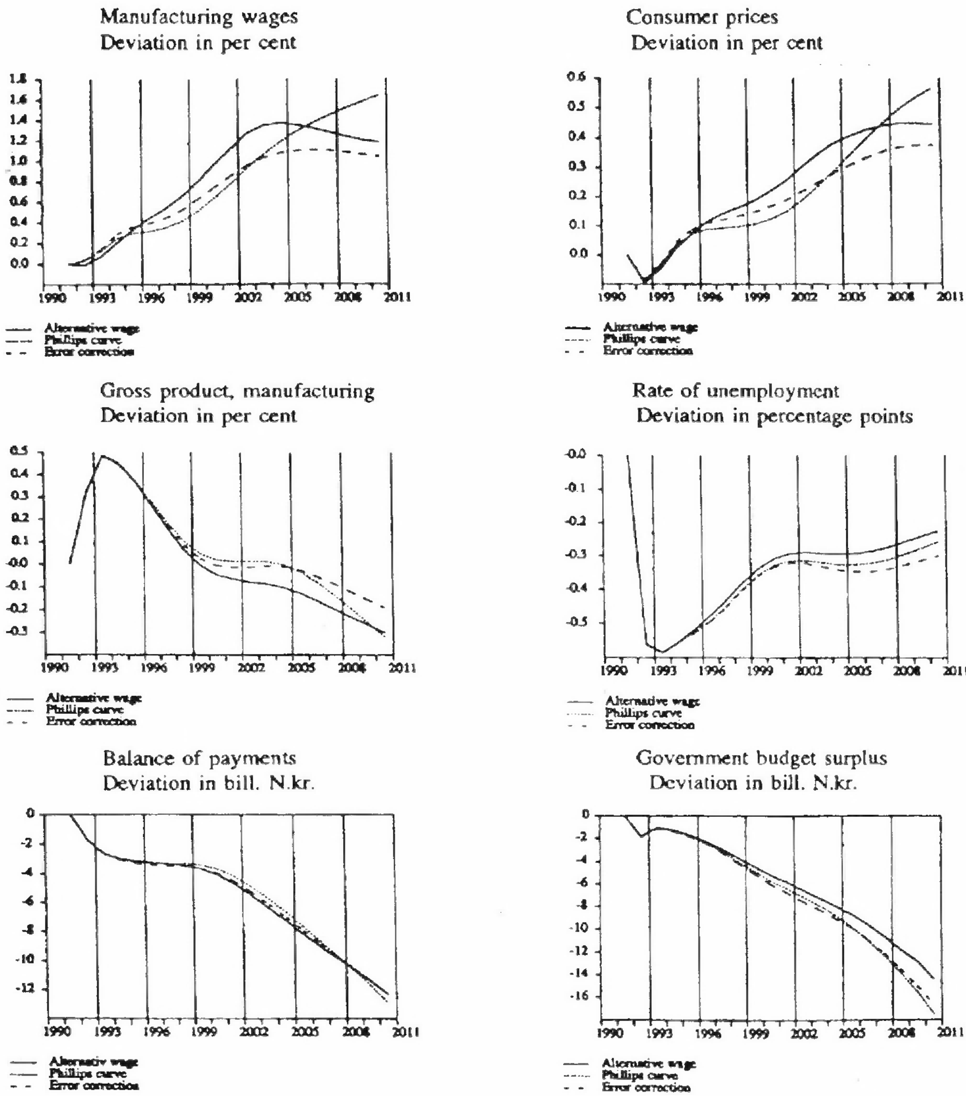
Table 5.5.1c. Effects of an increase in public consumption from 1992 by 5 bill. 1990-kr. relative to the reference scenario. Alternative wage model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices, Bill. N.kr.						
Private consumption	2.0	2.5	2.5	2.2	3.9	4.1
Gross investments, industries, mainland Norway	0.5	1.9	1.5	0.3	1.2	0.6
Exports, traditional commodities	-0.0	-0.1	-0.1	-0.4	-0.7	-0.9
GDP, mainland Norway	5.9	7.1	6.8	5.7	6.8	6.2
- Manufacturing	0.3	0.5	0.4	-0.1	-0.2	-0.5
Price indices, per cent						
Consumer prices	-0.10	-0.05	0.07	0.22	0.40	0.44
Wages, total	0.04	0.11	0.31	0.88	1.28	1.19
- Manufacturing	-0.01	0.08	0.33	0.96	1.35	1.18
Labour market, 1000 persons						
Labour force	11.0	13.8	16.3	14.2	14.3	13.9
Employment, total	22.6	25.8	27.0	20.9	20.8	18.9
- Manufacturing	0.4	0.7	0.7	-0.5	-1.2	-1.6
- Other industries	2.4	5.4	6.8	2.4	3.5	2.5
- Public sector	19.8	19.7	19.5	19.0	18.6	18.1
Unemployment	-11.6	-12.0	-10.7	-6.7	-6.5	-5.0
Current prices, Bill N.kr.						
Balance of payments	-1.7	-2.7	-3.2	-4.1	-8.2	-12.3
Government budget surplus	-1.8	-1.0	-1.7	-5.2	-8.6	-14.4

sluggish response from wages to unemployment, however, causes the crowding out effects to be stronger with the alternative wage model than the Phillips curve even in 2010. The high rate of unemployment in the reference scenario causing low real wage flexibility is the main reason why the three specifications look similar. With a lower unemployment the crowding out effects in all models, and especially the Phillips curve, would have been stronger. This was the case in an earlier version of the model presented in Stølen (1990). Another reason why the crowding out effects now seem to be low is the low real wage elasticity in demand for labour at -0.4 in private industries against -0.6 in an earlier version.

Because of the growth in labour supply, we would probably not get a full crowding out of the increase in government employment even if the rate of unemployment should return to its original level. The main conclusion of these calculations is that all the three versions implies significant effects on the rate of unemployment in the short run, but more neoclassical effects in the long run. With a high rate of unemployment, all the three versions give very similar effects on almost all macroeconomic variables of an increase in government consumption.

Figure 5.5.2. Effects of an increase in public consumption from 1992 by 5 bill. 1990-kr. relative to the reference scenario



5.5.4. Effects of a reduction in pay-roll taxes

Tables 5.5.1a-5.5.1d show the effects from a reduction in pay-roll tax rates of 5 bill. 1990-kr. from 1992 corresponding to a cut in tax rates of above 1½ percentage point relative to the reference scenario every year. The tables for the Phillips curve version and the alternative wage version are very close to tables 3.1.a and 3.1.b in Appendix 1 to the Norwegian Employment Commission (NOU 1992:26), but the short run dynamics of a change in this tax rate has been somewhat modified in the Phillips curve version giving a more sluggish response. Compared to the results presented in table 4.5.2, the elasticity in the first year is now 0.27 against earlier 0.77.

Although the different versions are almost equal regarding the effects of a shift in public consumption, they show quite different effects with respect to a reduction in pay-roll taxes. As taxes and price wedges are treated symmetrically in the wage equations in all versions, these differences also will show up when looking at changes in income taxes, the value added tax rates and other commodity taxes and price wedges influencing consumer prices. Different effects in other parts of the model may cause the results to differ somewhat, and this is further discussed in section 5.5.5.

The main reason for the divergence between the model versions is due to the different weights given to respectively alternative wages, real disposable income (consumer prices), and the firms' profitability (product prices) presented in table 4.5.4, and this is

Table 5.5.2a. Effects of a reduction in pay-roll taxes from 1992 corresponding to 5 bill. 1990-kr. relative to the reference scenario. Phillips curve model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices, Bill. N.kr.						
Private consumption	-0.0	0.8	3.4	4.9	5.6	7.9
Gross investments, industries, mainland Norway	0.0	0.4	1.8	1.9	2.1	2.7
Exports, traditional commodities	0.0	0.1	0.1	0.0	0.1	0.2
GDP, mainland Norway	0.1	1.1	3.6	4.9	6.0	8.0
- Manufacturing	0.1	0.3	0.6	0.7	0.8	1.0
Price indices, per cent						
Consumer prices	-0.34	-0.44	-0.37	-0.33	-0.34	-0.26
Wages, total	0.38	0.33	0.69	0.96	1.11	1.32
- Manufacturing	0.56	0.72	1.17	1.39	1.63	1.89
Labour market, 1000 persons						
Labour force	0.7	1.8	4.1	6.0	5.4	5.9
Employment, total	1.0	2.5	7.1	9.3	7.1	8.3
- Manufacturing	0.3	0.6	1.2	1.2	0.7	0.4
- Other industries	0.6	1.9	5.8	8.1	6.4	7.9
Unemployment	-0.3	-0.7	-3.0	-3.3	-2.7	-2.6
Current prices, Bill N.kr.						
Balance of payments	0.1	-0.5	-2.2	-4.3	-6.0	-10.6
Government budget surplus	-3.6	-3.7	-3.2	-4.8	-8.2	-13.8

Table 5.5.2b. Effects of a reduction in pay-roll taxes from 1992 corresponding to 5 bill. 1990-kr. relative to the reference scenario. Wedge model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices, Bill. N.kr.						
Private consumption	-0.8	0.1	1.6	2.4	2.9	4.6
Gross investments, industries, mainland Norway	-0.1	0.3	1.4	1.5	1.8	2.4
Exports, traditional commodities	0.1	0.2	0.4	0.6	0.9	1.3
GDP, mainland Norway	-0.0	0.9	3.0	4.7	6.1	8.3
- Manufacturing	0.2	0.3	0.9	1.3	1.8	2.4
Price indices, per cent						
Consumer prices	-0.42	-0.64	-0.80	-0.97	-1.06	-1.07
Wages, total	0.09	-0.27	-0.44	-0.51	-0.47	-0.40
- Manufacturing	0.17	-0.08	-0.22	-0.30	-0.28	-0.19
Labour market, 1000 persons						
Labour force	0.6	1.5	3.5	6.1	6.5	7.4
Employment, total	1.0	2.6	7.2	11.1	10.7	12.3
- Manufacturing	0.4	0.9	2.1	3.1	3.1	3.0
- Other industries	0.6	1.7	5.1	8.0	8.0	9.2
Unemployment	-0.4	-1.1	-3.7	-5.0	-5.0	-4.9
Current prices, Bill N.kr.						
Balance of payments	0.3	-0.1	-0.8	-0.6	-0.3	-1.0
Government budget surplus	-3.4	-3.1	-2.0	-2.2	-3.0	-3.7

also discussed in connection with the impact tables in section 4.6. Because a weight of 80 per cent is estimated on competitiveness in the Phillips curve version, a reduction in pay-roll taxes gives room for higher wages. This is also the case in the error correction model based on the factor income deflator giving results quite identical to the Phillips curve. In the wedge model and the alternative wage model on the other hand, the estimations gave no role for competitiveness meaning that a reduction in pay-roll taxes has no direct effects in these two versions. As the concern for competitiveness is assumed to be of no direct importance in the long run for sectors outside manufacturing, a reduction in pay-roll taxes neither has a direct effect on wages in these sectors. On the other hand consumer prices are affected as a consequence of lower unit costs. This causes the nominal wages to decline in these models and improves competitiveness even more. As wages in total manufacturing are of great importance for wages in the sheltered sectors, these wages will also increase in the Phillips curve model and the factor income deflator model causing a lower reduction in consumer prices than in the other models.

Because of the improvements in competitiveness in the wedge model and the alternative wage model a reduction in pay-roll taxes leads to a gain in market shares both in the export markets and the domestic markets and thereby causes growth in exports and production in the manufacturing industries. These effects are only modest in the Phillips curve version and the factor income deflator model due to a lower wage cost response.

Table 5.5.2c. Effects of a reduction in pay-roll taxes from 1992 corresponding to 5 bill. 1990-kr. relative to the reference scenario. Alternative wage model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices, Bill. N.kr.						
Private consumption	-0.8	-0.1	0.9	1.9	2.5	3.7
Gross investments, industries, mainland Norway	-0.1	0.3	1.3	1.5	1.6	2.1
Exports, traditional commodities	0.1	0.2	0.5	0.7	1.0	1.6
GDP, mainland Norway	-0.0	0.8	2.8	4.7	6.0	8.3
- Manufacturing	0.2	0.4	1.0	1.5	2.1	2.9
Price indices, per cent						
Consumer prices	-0.44	-0.71	-0.96	-1.07	-1.13	-1.17
Wages, total	0.00	-0.51	-0.90	-0.68	-0.61	-0.59
- Manufacturing	0.06	-0.39	-0.78	-0.48	-0.48	-0.47
Labour market, 1000 persons						
Labour force	0.6	1.5	3.4	6.8	7.7	9.0
Employment, total	1.1	2.8	7.4	12.1	12.1	13.8
- Manufacturing	0.5	1.1	2.5	3.9	4.0	4.3
- Other industries	0.6	1.7	4.9	8.2	8.1	9.6
Unemployment	-0.5	-1.3	-4.0	-5.3	-4.4	-4.8
Current prices, Bill N.kr.						
Balance of payments	0.3	-0.0	-0.2	0.3	0.9	1.7
Government budget surplus	-3.2	-2.7	-1.3	-1.6	-2.0	0.2

On the other hand, the growth in real wages is much higher in the Phillips curve version and the factor income deflator model causing a much higher effect on private consumption than in the wedge model and the alternative wage model. Although the effects across the different industries differ, the total effect for GDP mainland Norway is quite independent of the model used in the calculation. Lower growth in labour costs causes the effect on employment to be larger in the wedge model and the alternative wage model than in the Phillips curve model and the factor income deflator model as a result of factor substitution.

Higher demand for labour and higher real wages stimulate supply of labour in the same way as in the case of an increase in government consumption and counteract the effects caused by higher employment. The total effect on employment and unemployment is of course quite lower in the case of a reduction in pay-roll taxes compared to an increase in public consumption which has a direct effect on employment. The consequences for government budget surplus and balance of payments is, however, quite different. In the alternative wage model a reduction in pay-roll taxes even seems to be self-financing in the long run (2010). The reason for this compared to the Phillips curve version and the factor income deflator model is mainly the different development in nominal wages. As discussed in section 5.3.3 government budget surplus is very dependent on the growth in wages, and the reduction in wages in the wedge model and the alternative wage model versus the large increase in the Phillips curve version is quite decisive.

Table 5.5.2d Effects of a reduction in pay-roll taxes from 1992 corresponding to 5 bill. 1990-kr relative to the reference scenario. Factor income deflator model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices. Bill. N.kr.						
Private consumption	-0.4	0.9	3.1	5.1	5.6	7.9
Gross investments, industries, mainland Norway	0.0	0.4	1.8	2.1	2.2	2.9
Exports, traditional commodities	0.1	0.1	0.2	0.1	0.4	0.6
GDP, mainland Norway	0.0	1.1	3.5	5.3	6.4	8.6
- Manufacturing	0.1	0.3	0.7	0.8	0.9	1.3
Price indices, per cent						
Consumer prices	-0.30	-0.44	-0.46	-0.39	-0.46	-0.46
Wages, total	0.51	0.31	0.47	0.83	0.85	0.97
- Manufacturing	0.75	0.69	0.90	1.30	1.32	1.46
Labour market, 1000 persons						
Labour force	0.7	1.8	4.1	6.0	5.4	5.7
Employment, total	0.9	2.5	6.9	9.7	7.7	8.9
- Manufacturing	0.3	0.6	1.3	1.2	0.8	0.7
- Other industries	0.6	1.9	5.6	8.4	6.9	8.2
Unemployment	-0.2	-0.7	-2.8	-3.7	-2.7	-3.2
Current prices, Bill N.kr.						
Balance of payments	0.1	-0.6	-1.9	-4.3	-5.9	-10.0
Government budget surplus	-3.7	-3.9	-3.1	-5.9	-9.9	-15.7

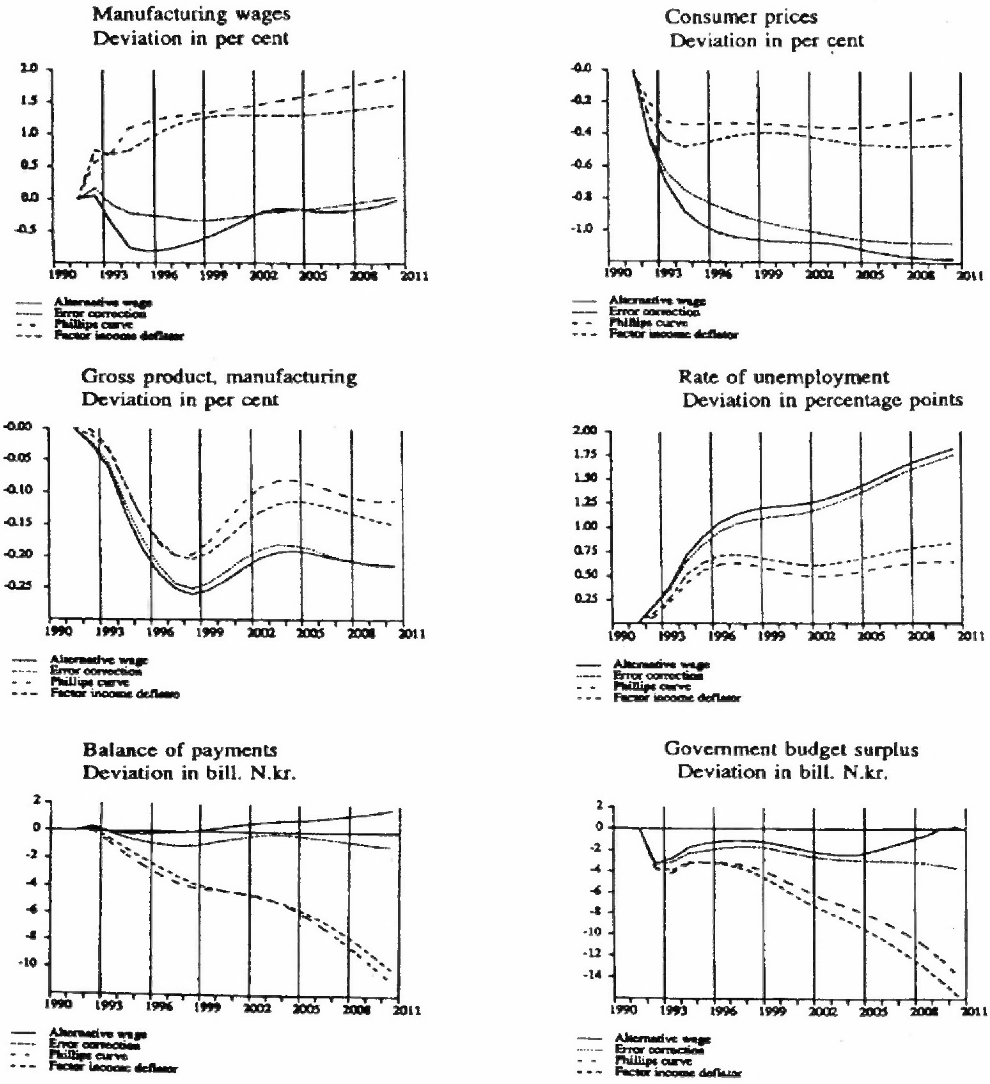
The balance of payments also worsens less in the wedge model and the alternative wage model than the Phillips curve model and the factor income deflator model due to a larger gain in market shares, lower domestic demand and lower growth in wages. In the alternative wage model the balance of payments is also improved in the long run.

According to the wedge model and the alternative wage model a reduction in pay-roll taxes (and also other taxes) is a very effective tool in increasing employment when the net cost regarding government budget surplus is taken into account. In these models a reduction in pay-roll taxes will lead to a large improvement in competitiveness, stimulate production and employment in manufacturing industries and have no negative effect on the balance of payments. The crucial assumption for these results is that no (or little) concern is left for competitiveness and the firms' profitability in wage formation. This is very much in contradiction with the Scandinavian theory of inflation.

5.5.5. Effects of a reduction in personal income taxes and value added taxes

Because taxes and prices are treated symmetrically in the wage equations in the different model versions, the effects of a reduction in personal income taxes and value added taxes are almost the same as the effects of a reduction in pay-roll taxes in the respective versions of the model discussed in section 5.5.4. In a macroeconomic model

Figure 5.5.3. Effects of a reduction of pay-roll taxes from 1992 corresponding to 5 bill. 1990-kr. relative to the reference scenario



like MODAG the effects are, however, not quite as symmetrical as shown by the simple calculations in table 4.3.7 because:

- The tax basis for the different taxes is not equal. While pay-roll taxes are based on wage payments only, self employed and pensioners also pay income taxes. The value added tax are based on most of the goods sold domestically.
- The tax rates also differs, and together with a different basis the revenues of the taxes are not equal. A cut in the revenues of i.e. 5 bill. N.kr. then has a larger marginal effect on the tax rate for a tax where the rate is low or the basis is narrow compared to a tax where the tax rate is high or the tax basis is wide.
- A change in taxes and the following change in wages cause indirect effects on productivity and unemployment not taken into consideration in the calculations in table 4.3.7.

The effects of a reduction in personal income taxes and value added taxes by 5 bill. 1990-kr. from 1992 are compared with a corresponding cut in pay-roll taxes by use of the Phillips curve version and the alternative wage version in tables 5.5.3a and 5.5.3b. Because of the symmetry in the wage equations, shift-analyses show almost identical

Table 5.5.3a. Effects in 2010 of a reduction in pay-roll taxes, personal income taxes and value added taxes from 1992 corresponding to 5 bill. 1990-kr. relative to the reference scenario. Phillips curve model

Impacts on	Pay-roll taxes	Income taxes	Value added taxes
Constant 1990 prices. Bill. N.kr.			
Private consumption	7.9	7.1	8.4
Gross investments, industries, mainland Norway	2.7	2.4	3.0
Exports, traditional commodities	0.2	0.3	0.6
GDP, mainland Norway	8.0	7.5	8.8
- Manufacturing	1.0	1.1	1.3
Price indices, per cent			
Consumer prices	-0.26	-0.29	-1.33
Wages, total	1.32	-0.25	0.17
- Manufacturing	1.89	0.35	0.70
Labour market, 1000 persons			
Labour force	5.9	5.7	4.8
Employment, total	8.3	7.8	6.7
- Manufacturing	0.4	0.4	0.2
- Other industries	7.9	7.4	6.5
Unemployment	-2.6	-2.1	-1.7
Current prices, Bill. N.kr.			
Balance of payments	-10.6	-9.4	-10.7
Government budget surplus	-13.8	-17.3	-11.9

Table 5.5.3b. Effects in 2010 of a reduction in pay-roll taxes, personal income taxes and value added taxes from 1992 corresponding to 5 bill. 1990-kr. relative to the reference scenario. Alternative wage model

Impacts on	Pay-roll taxes	Income taxes	Value added taxes
Constant 1990 prices, Bill. N.kr.			
Private consumption	3.7	2.4	4.6
Gross investments, industries, mainland Norway	2.1	1.7	2.4
Exports, traditional commodities	1.6	2.6	1.6
GDP, mainland Norway	8.3	7.8	8.9
- Manufacturing	2.9	3.3	3.2
Price indices, per cent			
Consumer prices	-1.17	-1.36	-1.95
Wages, total	-0.59	-2.47	-1.46
- Manufacturing	-0.47	-2.36	-1.27
Labour market, 1000 persons			
Labour force	9.0	8.9	7.0
Employment, total	13.8	14.4	11.2
- Manufacturing	4.3	4.9	3.5
- Other industries	9.6	9.6	7.7
Unemployment	-4.8	-5.5	-4.2
Current prices, Bill. N.kr.			
Balance of payments	1.7	3.0	-1.4
Government budget surplus	0.2	-1.7	-1.7

effects on the volume variables, and only the long term effects in 2010 (although all effects are not exhausted until then) are presented in the tables.

Of course the effects on prices and wages differ. A reduction in pay-roll taxes has the smallest negative effect on wages and leads to higher wages with the Phillips curve model. As a reduction in personal income taxes has a direct negative effect on wages irrespective of the chosen model, but most evidently with the alternative wage model, the effects on wages are most negative with this reduction. But as a result of higher productivity and lower unemployment wages in manufacturing industries increase in the long run with the Phillips curve specification. The effect on the price level is of course largest when there is a reduction in the value added tax rate.

Because a reduction in income taxes also is beneficial for self-employed and pensioners, the effect on real disposable wages is smaller with this policy than the others, irrespective of the chosen model. A reduction in pay-roll taxes also seems to have a somewhat larger effect on real disposable wages than a reduction in the value added tax. Because a reduction in the value added tax also is beneficial for self-employed and pensioners, the positive effect on private consumption is largest when there is a reduction in this tax. In spite of the beneficial effects for self-employed and pensioners of a reduction in income taxes, the lower effect on real disposable wages makes the effect on private consumption smallest with a reduction in this tax rate.

In the Phillips curve specification the effects on competitiveness and exports seem to be largest with the cut in value added taxes while the effects of a reduction in income taxes are largest with the alternative wage model. Because of the effects via private consumption the impact on GDP, mainland Norway, is largest with a reduction in value added taxes and smallest with a reduction of income taxes in both versions of the model. Because of substitution effects, both regarding demand for products and demand for inputs, the effect on employment and unemployment is somewhat smaller with a reduction in value added taxes than a corresponding reduction in pay-roll taxes or income taxes. The difference is, however, rather small, especially with the Phillips curve version (cf. table 3.5 in Appendix 1 to The Norwegian Employment Commission, NOU 1992:26). Even a substantial shift from pay-roll or income taxes to value added taxes, will only lead to a small reduction in unemployment.

5.5.6. Effects of a reduction in normal working hours

Tables 5.5.4 and 5.5.5 show the effects from an overall reduction in normal working hours of 1 per cent from 1992. For a given demand for man-hours the immediate effect from this reduction is higher demand for persons which lead to higher employment and lower unemployment. As hours worked are somewhat more flexible in the short run

Table 5.5.4. Effects of a reduction in normal working hours from 1992 by 1 per cent relative to the reference scenario. Phillips curve model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices, per cent						
Private consumption	0.70	0.63	0.45	0.29	0.52	0.62
Gross investments, industries, mainland Norway	0.22	1.35	0.31	-0.26	0.07	-0.06
Exports, traditional commodities	-0.06	-0.13	-0.24	-0.31	-0.46	-0.60
GDP, mainland Norway	0.23	0.32	0.10	-0.09	-0.07	-0.12
- Manufacturing	0.01	0.09	-0.19	-0.52	-0.72	-1.03
Price indices, per cent						
Consumer prices	0.16	0.27	0.43	0.59	0.82	0.96
Wages, total	0.81	0.92	1.11	1.46	1.90	2.08
- Manufacturing	0.91	0.92	1.03	1.36	1.81	1.99
Labour market, 1000 persons						
Labour force	7.9	10.5	11.9	10.4	11.2	11.3
Employment, total	19.1	21.0	20.1	16.5	17.3	16.9
- Manufacturing	2.7	2.7	2.1	1.0	0.3	-0.4
- Other industries	10.4	12.2	11.7	8.8	9.5	9.2
- Public sector	6.0	6.1	6.3	6.8	7.5	8.0
Unemployment	-11.2	-10.5	-8.2	-6.1	-6.1	-5.6
Current prices, Bill N.kr.						
Balance of payments	-1.1	-1.6	-1.7	-2.3	-5.3	-9.4
Government budget surplus	0.6	0.5	-0.4	-2.5	-5.1	-9.8

Table 5.5.5. Effects in 2010 of a reduction in normal working hours from 1992 by 1 per cent relative to the reference scenario. Different versions of the model

Impacts on	Phillips curve	Wedge variable	Alternative wage	Factor income deflator
Constant 1990 prices, per cent				
Private consumption	0.62	0.29	0.49	0.20
Gross investments, industries, mainland Norway	-0.06	-0.22	-0.22	-0.23
Exports, traditional commodities	-0.60	-0.38	-0.53	-0.28
GDP, mainland Norway	-0.12	-0.13	-0.17	-0.12
- Manufacturing	-1.03	-0.73	-0.95	-0.48
Price indices, per cent				
Consumer prices	0.96	0.60	0.85	0.47
Wages, total	2.08	1.25	1.82	0.91
- Manufacturing	1.99	1.00	1.61	0.67
Labour market, 1000 persons				
Labour force	11.3	11.1	11.6	10.5
Employment, total	16.9	18.0	16.6	18.2
- Manufacturing	-0.4	0.6	-0.2	1.0
- Other industries	9.2	9.4	8.0	9.7
- Public sector	8.0	8.0	8.0	7.5
Unemployment	-5.6	-6.9	-5.0	-7.7
Current prices, Bill. N.kr.				
Balance of payment	-9.4	-6.9	-8.6	-5.5
Government budget surplus	-9.8	-7.2	-7.7	-5.0

than the number of persons employed (cf. (5.3.2)), the amount of overtime increases in the instant period, and the number of persons employed reacts with a lag. Due to the estimation results the adaption of employment occurs rather fast and implies an increase in employment corresponding to the reduction in the normal working hours.

As the estimation results indicate that hourly wages increase when normal working hours are reduced, this reduction has an immediate effect on hourly wage rates. Lower unemployment and effects via higher prices also indirectly cause wages to increase. The indirect effects are about the same as discussed in section 5.3.3. Although yearly real wages per person at work decline in this case, more persons employed lead to higher real disposable incomes and higher private consumption. On the other hand higher wage rates contribute to loss in market shares and substitution from employment to other inputs, and these negative effects of higher wages dominate the positive indirect effects.

Higher wages as a result of the shortening of the normal working hours thus lead to crowding out effects of the same kind as discussed in section 5.5.3 when the effects from an increase in government consumption was analysed. The long term effects on wages and the long term crowding out effects differ between the different versions of the model. As discussed in section 4.6 (cf. figure 4.6.6 and table 4.6.6) a reduction in normal working hours is assumed to have a lasting effect on hourly wage rates for manufacturing industries in the Phillips curve specification. Based on apriori assumptions the error-correction model with a wedge variable and the factor income deflator model have no long run direct effect on wages in total manufacturing. In public sectors and most of the private services a symmetrical effect of consumer prices, income taxes and normal working hours is imposed, and normal working hours therefore have long run effects on wages in total manufacturing with the alternative wage specification. Although the different specifications show significant short run direct effects of changes in normal working hours on wage rates, the long run effects are somewhat arbitrary.

From table 5.5.5 the effects on wage rates are highest in the Phillips curve case, both because the long run direct effect in total manufacturing is assumed to equal the short run effect and because the effects through unemployment are more lasting in the Phillips curve case than the error correction models. The effects on wages in the long run (2010) are smaller in the error correction models because of smaller direct effects in the long run in these models. In spite of this the effects on wages in the alternative wage model is not much smaller than for the Phillips curve model, while the error correction model with a wedge variable and the factor income deflator model show smaller effects.

As analysed in section 5.3.3 the real effects on the macroeconomic variables of a change in wage rates are not large, and therefore the effects on GDP, mainland Norway, total employment and unemployment do not deviate much between the four model versions, not even in the long run. The factor income deflator model and the error correction model with a wedge variable have the largest effects on unemployment, and the Phillips curve version gives a weakly higher effect than the alternative wage model probably because the rate of unemployment is lowest in the reference scenario with the alternative wage model.
Because of the direct effect on employment the reduction in normal working hours reduces unemployment even in the long run. Total production in mainland Norway, and especially production in manufacturing decline and the balance of payments is weaker. Although lower payments to unemployed improve the government budget surplus in the short run higher wage rates cause a detoriation in the long run along the same mechanisms as discussed in section 5.3.3.

Homogeneous labour is probably a simplification in MODAG which makes the model exaggregate the positive effects on employment of reductions in normal working hours. With heterogeneous labour it is not obvious that the unemployed or people not in the labour force have the proper qualifications to fill up the increased demand for persons.

5.5.7. Effects of a reduction in supply of labour

Table 5.5.6 shows the effect from a sustained reduction in exogenous factors affecting supply of labour corresponding to 30 000 persons from 1992 based on the Phillips curve model. This reduction can be the result of lower population growth due to lower immigration or higher emigration or lower growth in participation rates due to a shortening of the retirement age, increased propensity to get disability pensions or an expansion in the eduction system increasing the share of youths under education and consequently out of the labour force.

Table 5.5.6. Effects of a negative shift in supply of labour from 1992 by 30 000 persons relative to the reference scenario. Phillips curve model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices. Bill. N.kr.						
Private consumption	3.8	1.7	-1.6	-3.0	0.3	0.9
Gross investments, industries, mainland Norway	0.3	2.1	-0.8	-1.5	-0.3	-0.9
Exports, traditional commodities	0.0	0.0	-0.0	-0.1	-0.7	-1.4
GDP, mainland Norway	2.6	2.5	-1.4	-3.3	-2.4	-3.5
- Manufacturing	0.2	0.3	-0.2	-0.6	-0.9	-1.7
Price indices, per cent						
Consumer prices	-0.12	-0.01	0.13	0.30	0.79	1.04
Wages, total	0.00	0.09	0.21	0.78	1.71	2.08
- Manufacturing	0.01	0.14	0.29	0.87	1.85	2.21
Labour market. 1000 persons						
Labour force	-26.0	-21.2	-19.1	-20.5	-16.3	-16.2
Employment, total	2.0	4.4	-0.8	-8.2	-3.5	-6.1
- Manufacturing	0.3	0.5	-0.3	-1.4	-1.9	-2.9
- Other industries	1.7	3.9	-0.5	-6.9	-1.6	-3.2
Unemployment	-28.0	-25.6	-18.3	-12.3	-12.8	-10.1
Current prices. Bill N.kr.						
Balance of payments	-1.8	-1.6	0.8	2.7	-0.6	-2.5
Government budget surplus	3.9	4.6	2.2	0.4	0.5	-2.2

A reduction in supply of labour will have an immediate effect on the rate of unemployment of the same magnitude. However, the fall in unemployment has a positive effect on labour participation for men and pensioners which will somewhat counteract the reduction. In MODAG demand for durable consumer goods is directly dependent on the rate of unemployment catching up increased optimism which reduces the household's saving ratio in the short run when unemployment declines. Although this seems to be a relevant effect when unemployment declines as a result of an increase in demand for labour, the effect may be discussed when unemployment is reduced as a consequence of lower supply, as this may not create the same kind of optimism. The present version of MODAG may therefore not be quite relevant on this point when analysing the effects of a reduction in supply of labour.

As a result of the short term effect on demand for durable consumer goods, private consumption increases, especially in the first year. This has a positive effect on gross investments, production and employment in the short run. As the demand effect for durable consumer goods only is temporary, the positive effects on employment only last for a couple of years.

The main effect of the fall in unemployment is higher wages and the further effects of this are almost the same as analysed in section 5.5.3 when unemployment is reduced as a consequence of an increase in government consumption. A main difference compared to that analysis is that a reduction in supply of labour has no direct effect on the government budget surplus in excess to lower payments to unemployed. This is however unrealistic when the supply of labour is reduced as a result of lower retirement age, increased propensity to get disability pensions or with an expansion in the education system. The reduction in supply of labour neither has a direct effect on production and demand for labour in excess of the short run effect through private consumption. As the effects on wage rates of lower unemployment are quite similar in the different model versions in section 5.5.3, only the results from the Phillips curve version is presented here to illustrate the effects from this supply shock.

The increase in wage rates causes a loss in market shares both on the export market and the domestic market which has a negative impact on production and employment in manufacturing industries. Factor substitution also contributes to lower employment. Negative effects on investments and deliveries of intermediate outputs also have a small negative effect on production and employment in sheltered industries, and in the medium term lower employment also causes lower private consumption. In the long run private consumption increases again as a result of higher real wages, but the effect on GDP, mainland Norway, is of course negative.

As in the case of an increase in government consumption the rate of unemployment has not returned to its original level in 2010. The high rate of unemployment during the reference scenario causing low real wage flexibility and a low real wage elasticity in demand for labour are the main reasons for the sluggish crowding out effects. Because of a fall in employment it would probably not be a full crowding out of the reduction in supply of labour even if the rate of unemployment should return to its original level.

The balance of payments worsens in the short run as a result of higher demand, improves in the medium term because of lower demand, but deterioriates in the long run because of loss in market shares and higher demand caused by higher wages. In the simple calculations here not taking into account that reduced supply of labour may be followed by higher government expenses, the government budget surplus improves in the short and medium term as a result of lower unemployment, but worsens in the long run as a result of higher wages.

The main conclusion of this section is that a reduction in supply of labour causes lower unemployment for several years. However, total production and total employment also decline.

5.5.8. Effects of a devaluation

As the Norwegian economy may be characterized as small and open it may be reasonable to assume that no change in foreign prices, measured in foreign currency, will take place due to a change in the Norwegian exchange rates. In the analysis by Fehr (1987) there may however be some indications that prices on Norwegian imports to some degree may depend on Norwegian costs, and these prices may not shift completely the first years as a result of a change in the Norwegian exchange rate. While a devaluation therefore is assumed to lead to a similar increase in foreign competitive prices, a short

Table 5.5.7. Effects on manufacturing wages of a devaluation from 1992 by 1 per cent relative to the reference scenario. Different versions of the model. Effects in per cent

	1992	1993	1995	2000	2005	2010
Phillips curve	0.18	0.63	1.02	1.01	1.03	1.04
Wedge variable	0.15	0.60	0.97	0.92	0.94	0.98
Alternative wage	0.02	0.26	0.82	0.91	0.94	0.97
Factor income deflator	0.02	0.39	0.80	0.96	1.00	1.03

run effect of only 0.8 is assumed for the import prices which are exogenous in the model. Because domestic costs increase, the devaluation is addumed to have a full effect on import prices after 3 years. Prices on agricultural products are also exogenous in the model. These prices are probably mainly dependent on domestic costs. Because of a sluggish response in these costs the short run effect on agricultural prices is only assumed to be 0.3, while the full effect is assumed to appear in the fifth year.

As discussed in section 4.3.4 the long term effects of a change in the exchange rates ought to be the same irrespective of the chosen wage specification because of the homogeneity restrictions imposed. The short run dynamics may however differ, and because of the numerically low error correction coefficients one should expect the wage response in the error correction models to be more sluggish than in the Phillips curve model.

From table 5.5.7 this also shows up to be the case. In the Phillips curve specification, the homogeneity property appears in the fourth year, while this property has not appeared until 20 years in the wedge and alternative wage specifications. The short run effects of a change in exchange rates are also very small with the alternative wage and the factor income deflator specifications. The reason for this is that import prices are assumed to be of no direct importance in these specifications while the effects mainly work through the factor income deflator, where the response is sluggish. The dynamics in the error correction specification with a wedge variable is very similar to the Phillips curve specification, but the effects from 5 to 15 years are a bit smaller than in the fourth year as a result of strong immediate effects from import prices, but numerically low error correction coefficients.

Although the response through wages thus are a bit more sluggish in the alternative wage and the factor income deflator specifications the effects on the most important macroeconomic variables are quite similar due to the discussion in section 5.3.3. Only the effects of a devaluation in the Phillips curve case are therefore presented in table 5.5.8.

Because of the sluggish response in wages a devaluation means an improvement in competitiveness for manufacturing industries in the short run. Manufacturing industries therefore improve their market shares both on the export market and the domestic market, and this leads to higher production and higher employment.

Table 5.5.8. Effects of a devaluation from 1992 by 1 per cent relative to the reference scenario. Phillips curve model

Impacts on	1992	1993	1995	2000	2005	2010
Constant prices, per cent						
Private consumption	0.26	0.24	0.18	-0.04	-0.00	-0.01
Gross investments, industries, mainland Norway	0.17	0.35	0.28	-0.14	0.02	-0.08
Exports, traditional commodities	0.12	0.05	0.02	-0.03	0.04	0.01
GDP, mainland Norway	0.17	0.18	0.15	-0.01	0.02	-0.01
- Manufacturing	0.32	0.30	0.24	0.04	0.07	0.03
Price indices, per cent						
Consumer prices	0.30	0.53	0.80	0.94	0.98	1.01
Wages, total	0.19	0.59	0.96	1.00	1.02	1.02
- Manufacturing	0.18	0.63	1.02	1.01	1.03	1.04
Labour market, 1000 persons						
Labour force	0.5	0.9	1.4	0.2	0.0	0.0
Employment, total	1.4	2.1	2.3	-0.2	0.0	-0.1
- Manufacturing	0.5	0.5	0.5	0.1	0.1	0.0
- Other industries	0.9	1.6	1.8	-0.3	-0.1	-0.1
Unemployment	-0.9	-1.2	-0.9	0.4	0.0	0.1
Current prices, Bill N.kr.						
Balance of payments	-0.1	0.1	0.4	1.4	1.7	2.5
Government budget surplus	0.9	0.8	0.3	-0.2	-0.6	-1.1

Except from the first years the response on wages appears well as fast as consumer prices giving a small growth in real disposable incomes and private consumption. Private consumption also increases in the short run as a result of a somewhat higher employment and lower unemployment caused by the positive effect on manufacturing industries. A devaluation thus has a positive effect on employment until 8 years almost independent of the chosen wage specification, but this effect is quite small. After 8 years a devaluation has no effects on real variables at all, but only leads to higher nominal wages and prices.

The effects on the balance of payments and the government budget surplus are also only modest, both in the short run and the long run. Mainly because of surplus in the balance of payments in the reference scenario, the effect on the variable is weakly positive. The effects on these balances are a bit more positive with the error correction models than with the Phillips curve.

5.6. Conclusions

From the discussion in the preceding sections the choice of wage equation for manufacturing industries has macroeconomic consequences. At first it may be discussed if there is an equilibrium rate of unemployment depending only on structural characteristics or if there are hysteresis effects. From the analysis of the shift in government consumption in section 5.5.3 it is evident that this question is of minor importance at the present (1992) high rate of unemployment, which according to the reference scenarios may last into the next century. In this situation a more expansionary fiscal policy, a reduction in normal working hours or a reduction in supply of labour may be effective policies in reducing the rate of unemployment irrespective of which wage specification which is most relevant. Higher inflation, loss of competitiveness and a crowding out of production and employment in the exposed industries follow as negative consequences of the above policies, which also have negative impacts on the balance of payments and the government budget surplus in most cases.

In a situation with a low rate of unemployment the non-linear effect from the rate of unemployment to wages would make the negative effects of the above policies more evident with all specifications. This would especially be the case with the Phillips curve specification implying a fixed equilibrium rate of unemployment, while the error correction models corresponding to hysteresis would mean a new equilibrium at a lower rate of unemployment.

The arguments for hysteresis are quite relevant, but when the rate of unemployment is high, it is difficult to distinguish between *partial permanent hysteresis* and a rather sluggish movement towards an equilibrium determined by structural characteristica. In addition to the low real wage flexibility at high rates of unemployment, the effects from real wages on demand and supply of labour are also found to be weak. It may therefore take several years to restore equilibrium in the labour market even with the Phillips curve model.

The assumption of permanent hysteresis may be problematic in a situation where the rate of unemployment is low. According to the error correction specifications, the labour market thus was in equilibrium in the sixties and the seventies, while the Phillips curve specification explains the loss in competitiveness in that period with a rate of unemployment lower than the equilibrium rate. If the low unemployment in the period 1985 to 1987 had lasted a couple of years more, wage growth would have declined according to the error correction models, giving an equilibrium at a rate of unemployment of about 2 per cent. There is also a problem with the error correction specifications that some of the exogenous variables affecting the rate of unemployment in a macroeconomic model like MODAG may grow or decline for several years. In this situation it is only by coincidence that the rate of unemployment is a stationary variable with these specifications.

While the estimated Phillips curve indicates that wage growth for manufacturing industries in the long run behave according to the Scandinavian theory of inflation (when the rate of unemployment is close to the equilibrium rate) this is not the case with the error correction models. The main reason is that the loss in competitiveness during the last decades according to these models is caused by tax increases and exogenous price wedges, partly working through output prices, consumer prices or wages in alternative employment. The factor income deflator specification has however marginal properties which for most variables are almost identical to the Phillips curve specification as this model is based on the assumption of an almost constant share of wage costs out of gross factor income. This is one of the main elements in the Scandinavian theory. A weakness with the factor income deflator specification is that wedges between wage- and price-formation as a result of large simultaneity may cause the model to deviate substantially from theory.

As a consequence of the different correspondance with the Scandinavian theory, the effects on wages and other macroeconomic variables of a reduction in pay-roll taxes, income taxes and value added taxes differ quite a lot between the wedge model and the alternative wage model on the one hand and the Phillips curve model and the factor income deflator model on the other. Regarding total employment and unemployment the effects are rather modest in all cases, although the wedge model and the alternative wage model give the most positive effects. As reductions in taxes to a higher degree reduce wages in these two models the positive effects on exports and domestic market shares are larger while the effects on private consumption are smaller compared to the Phillips curve model and the factor income deflator model. This gives a rather large positive effect on production and employment in manufacturing industries with the wedge model and the alternative wage model while the effects on production and employment in service industries are relatively higher with the Phillips curve and the factor income deflator model. The largest differences show up for the balance of payments and the government budget surplus. These balances are only to a small degree weakened as a result of the tax cuts according to the wedge model and the alternative wage model while the effects are quite negative according to the Phillips curve specification and the factor income deflator specification.

Although the wedge model and the alternative wage model give results which are quite in contradiction with the Scandinavian theory of inflation, it is difficult to conclude which is the preferred model from these impact analyses. An obvious weakness with the error correction specifications is that they may indicate gain or loss in competitiveness for manufacturing industries which last for ever. This is obviously the case for the error correction model with a wedge variable where growth in productivity in manufacturing industries leads to a deterioration of competitiveness. The specification with alternative wages on the other hand indicates that productivity growth is undercompensated because weight is given to wages in alternative employment. As long as there are no increase in taxes or wedges between Norwegian consumer prices and foreign prices, competitiveness may improve for ever according to this specification. With reasonable assumptions about oil prices the Norwegian economy may in the next century end up in a situation with rather low unemployment, low inflation and large surplus both on the balance of payments and government budget balances (cf. table 5.4.2). It is hard to think that this may represent a stable equilibrium of the Norwegian economy. Wage formation may react to eliminate this imbalances according to the Phillips curve specification, but exogenous exchange rates and a weak treatment of financial variables may also explain why MODAG ends up in this situation.

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