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## INFLATION IN THE OPEN ECONOMY: THE NORWEGIAN MODEL

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INFLATION IN THE OPEN ECONOMY: THE NORWEGIAN MODEL

1. INTRODUCTION

This paper, while obviously influenced by the purpose for which it was written, has been inspired largely by two considerations. The first is a recognition that the developments of prices and incomes in small and medium-sized economies is strongly affected by events in the outside world and that, for this reason, price theory, more than hitherto, should address itself explicitly to the problems of the open economy. The second is a belief that a disaggregated type of analysis is needed if we are to understand better the network through which exogenous price impulses, whether originating at home or abroad, are propagated through the economy.

The need for disaggregated analyses has been much stressed in recent years in work in the Nordic countries on problems of price trends and income distribution. Following some early Norwegian studies in the first part of the 1960's it has been recognized, in particular, that price impulses from abroad may affect individual industries very differently depending upon their ties with the international market. Consequently, a two-sector model distinguishing between "sheltered" industries and "exposed" (or "competitive") industries has been found indispensable even in the simplest of analyses aiming at understanding the price and income distribution mechanism. In more elaborated models further sub-classifications of these two industry categories have been found useful.

In what follows I shall start by outlining two variants of these models (a two-sector model for the long run and a multi-sector model for the short run) which have been in use in Norway since 1966 (section 2)<sup>1)</sup>. Some of the policy implications of these models, which may be applicable to other economies as well, are pointed out in section 3. Section 4 and 5 are devoted to a critical examination of their analytical power and the problem of subjecting them to empirical tests. Disaggregated models, similar in certain respect to the Norwegian models though different in others, have been developed in other countries. In section 6, a selection of these models are briefly examined for their content of ideas deserving attention in further work on disaggregated price models. The paper concludes by a listing of unresolved problems and suggestions for further research (section 7).

2. THE NORWEGIAN MODEL: A BRIEF PRESENTATION

2.1 Sheltered and exposed industries

In Norwegian thinking a fundamental distinction is drawn between sheltered and exposed industries. Exposed industries (E-industries) are those industries which are 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. Mining, most manufacturing industries, and shipping (in some countries also agriculture) are typical examples of this category.

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1) The ideas contained in these models grew out of research work undertaken at the Central Bureau of Statistics of Norway during the early 1960's. Thus, the distinction between sheltered and exposed industries was introduced for the first time in the Bureau's Economic Survey 1962. The models themselves were formulated and published in 1966 in two reports by a group of three economists who were called upon to provide background material for that year's round of negotiations on wages and agricultural prices. Members of the Committee ("Utredningsutvalget for inntektsoppjørelse 1966") were Associate Professor Fritz C. Holte, the Agricultural College of Norway, Professor Gerhard Stoltz, the Norwegian School of Economics and Business Administration and myself, acting as chairman. The Committee produced two reports. The first of these contained the multi-sector, short-term model summarized in section 2.3 below, see [14]. The second report, which was a study of the causes of long-run price developments in Norway, contained the two-sector, long-term model described in section 2.2, see [15].

Sheltered industries (S-industries), on the other hand, are those industries whose products are marketed at home under conditions such as to leave them relatively free of foreign competition.<sup>1)</sup> Building and construction, power generation, a few manufacturing industries and most service industries belong to this category. Admittedly, no clearcut line of division exists between exposed and sheltered industries. A certain amount of arbitrariness is unavoidable when it comes to drawing the line between the two groups in actual model-building. According to the classification used at present in Norway, the exposed industries contribute approximately 30 per cent of net national product and employ some 22 per cent of the labor force.<sup>2)</sup>

There are two reasons why a distinction between sheltered and exposed industries is crucial in an analysis of prices and incomes:

(i) First, we must expect the two groups of industries to show marked differences in price behaviour. The output prices of the exposed industries will be largely determined in the world market. These industries, therefore, cannot compensate for a cost increase through an upward adjustment of prices; if their costs increase, they must sustain the whole effect in the form of reduced profits and perhaps reduced production.<sup>3)</sup> The sheltered industries are in a different position. Since they do not risk losing their market to foreign competitors they tend to compensate for cost increases by raising output prices. There is considerable evidence that, in Norway at least, increasing costs (e.g. as a result of higher wages) are passed on quickly by the sheltered industries in such a way as to leave the share of profits in factor income largely unaffected.<sup>4)</sup> As is seen from diagram 1, for the sheltered industries taken as a group this share has fluctuated only moderately from one year to the next, following a downward trend which may be taken to reflect the decreasing number of employers and self-employed relative to the number of employees within the group.<sup>5)</sup> In the exposed industries, which are much more sensitive to the movements of the national cost level relative to that of other countries and also to the business cycle, the profit share has fluctuated much more violently.

1) Either because of the physical nature of their products or because of government protection. The fact that they are relatively free of foreign competition does not mean, of course, that firms within these industries do not compete on prices amongst themselves. It does mean, however, that as a group they may raise prices when costs go up without having to fear a loss of market to foreign firms.

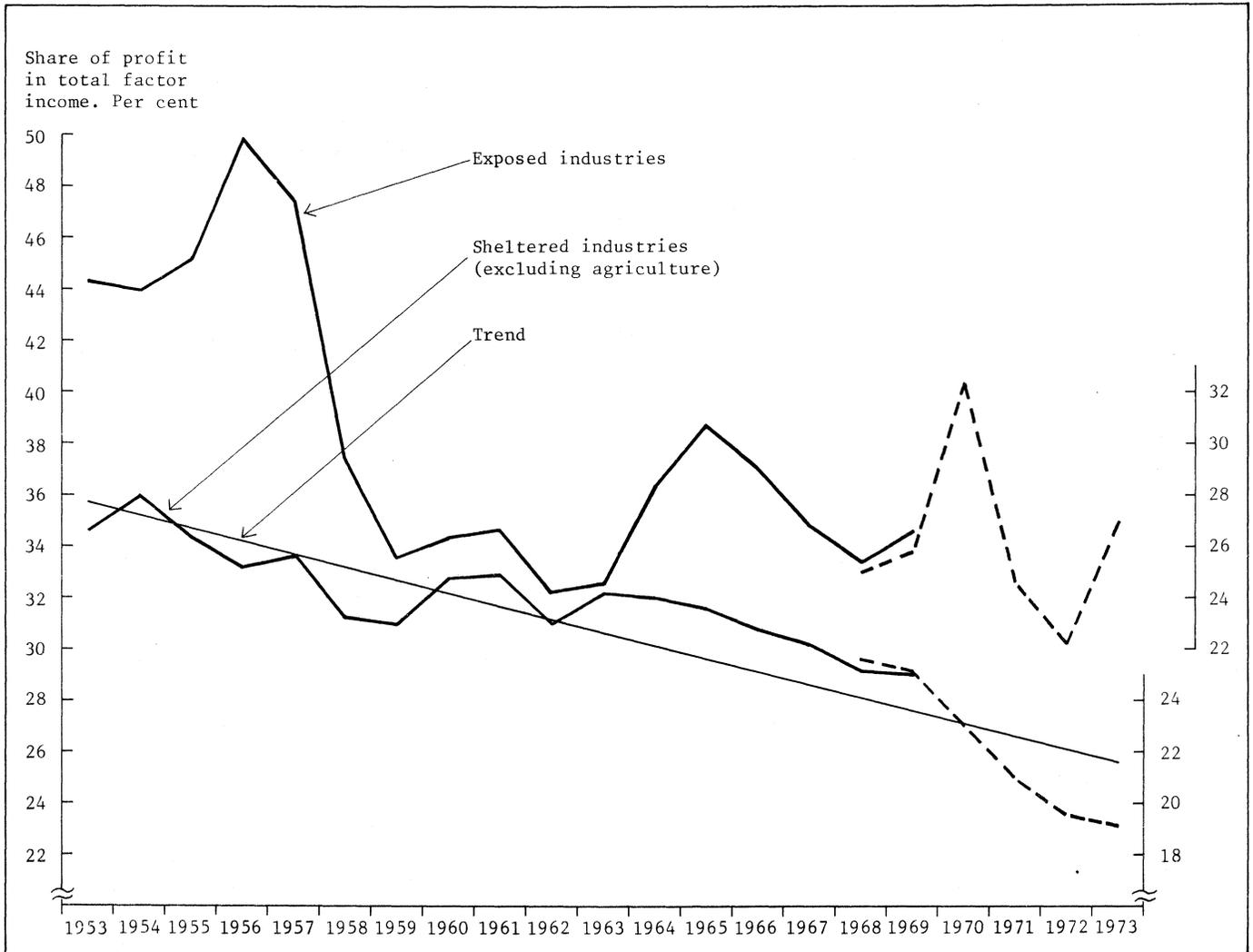
2) Since the exposed industries will consist, typically, of non-subsistence agriculture, mining, and part of manufacturing we may expect the contribution to total product of these industries in most developed and semi-developed economies to be of the order of magnitude of 30 per cent as was found for Norway. We would expect the share of the exposed industries in total employment to be about the same size. The much lower figure observed for the labor share in Norway probably is not typical since the exposed industries of Norway (including basic metals and shipping) happen to be rather capital intensive. Indeed, data for Sweden put the contribution of the exposed industries in 1967 to 28.5 per cent of total product and their share in total employment at 30 per cent. See [6].

3) Throughout this paper the word "profits" is used as a synonym for "operating surplus" as defined in the U.N. System of Standardized National Accounts. Hence, for any single industry (or group of industries), wages + profits = net value added = factor income originating in that industry (or group of industries).

4) The same observation has been made for Sweden, see [6], and for Finland, see [11]. Fluctuations of the profit share around the trend may be due to fluctuations in capacity utilization, a point which has been explicitly built into the Finnish model described in section 6.

5) However, when it comes to individual industries within the group the relationship no longer holds. Instead, national accounts data show considerable erratic movements of the relationship between profits and wages for most industries. In the light of this the remarkable stability of the relationship for the group of sheltered industries as a whole is difficult to explain. It may be that (i) fluctuations in output caused by the trade cycle, which cause profits to deviate from the trend, are not synchronized as between industries, and that (ii) though most firms apply some variant of the "cost plus" pricing principle, selling prices are not continuously corrected as direct costs change but rather are adjusted at long intervals and with random lags. (There is reluctance to change selling prices too frequently; it takes time for the firms even to realize that costs have changed; sometimes a small increase in costs may be used as an excuse for a long contemplated and considerable increase in prices, etc.) Such a mechanism of randomness would explain our observations in the past but would, of course, not guarantee indefinitely the future stability of the profit-wage ratio of the group of sheltered industries as a whole.

Diagram 1. The share of profits in total factor income (wages + profits). Per cent. Sheltered and exposed industries, Norway 1953-1973



(Fully drawn line: Old national accounts data 1953-1969, old sector classification (PRIM I), scale to the left. Dotted line: Revised national accounts data, revised sector classification (PRIM II), scales to the right.)

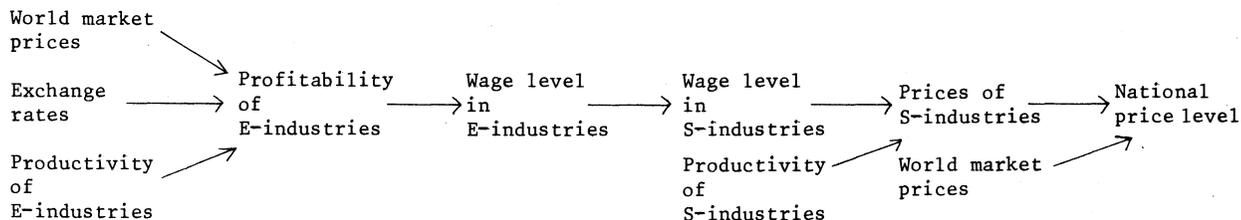
(ii) Secondly, for technological reasons, we must expect an important difference between the two industry groups also with respect to productivity trends. It has been found in Norway that output per man has gone up much more quickly within the exposed industries, which are typically capital intensive and mass producing, than within the sheltered industries where service industries weigh heavily. The difference is considerable: Over the period 1957-1969, product per man-year increased by approximately 7 per cent (annual average) within the exposed industries as a whole, but by no more than 2.5 per cent within the sheltered industries.<sup>1)</sup> (The picture would not change if product per man-hour was used as productivity measure.) This means that the exposed industries are much

1) In Sweden (1960-1968), product per man-hour (not man-year) increased by 8.2 per cent and 3.4 per cent (trend values) within the exposed and sheltered industries respectively, see [6]. The same source quote Finnish data (1960-1973) showing productivity increases of 4.6-5.0 and 3.0-3.3 per cent for exposed and sheltered industries respectively, (annual averages) and German data (1960-1965) showing labor productivity increases (annual averages) of 4.6 per cent for the "export sector" and 2.9 per cent for the total economy.

better placed than the sheltered industries to absorb wage increases without this having consequences for prices and/or profits.<sup>1)</sup>

## 2.2 The two-sector, long-run model

We shall start by outlining a simple two-sector model based on the characteristic properties of sheltered and exposed industries referred to above. The model purports to describe the mechanism which determines the long-term movement of wages and prices in an economy where, through foreign trade, national wage and price trends are subject to strong price impulses from abroad. The main argument may be sketched as follows:



Put into words the argument may be summed up in five propositions:

- (i) World market prices for products of the E-industries, together with existing foreign exchange rates, determine the output prices which the E-industries can ask, measured in national currency. These prices, together with the existing technology ("the productivity of E-industries") are key factors in determining "the profitability" of the E-industries, meaning by "profitability" the ability of the E-industries to earn a surplus available for distribution as wages and/or profits.
- (ii) The "profitability" of the E-industries is a key factor in determining the wage level of the E-industries: Mechanisms are assumed to exist which ensure that the higher the "profitability" of the E-industries, the higher their wage level; there will be a tendency for wages in the E-industries to adjust so as to leave actual profits within the E-industries close to a "normal" level.
- (iii) The wage level which establishes itself within the E-industries determines the wage level within the S-industries: Mechanisms are assumed to exist (e.g. solidaristic trade union policy under the centralized wage bargaining system existing in Norway, market forces) which tend to keep wages in the two industry groups in a "normal" relationship to each other.
- (iv) The wage level within the S-industries together with the existing technology ("productivity of S-industries") determines the output prices of these industries: Mechanisms (e.g. some type of cost-plus pricing) are assumed to exist which will cause the S-industries to adjust output prices in such a way as to keep their profits in a "normal" relationship to their wages.
- (v) Output prices of E-industries, output prices of S-industries, and world market prices for goods not produced at home, each weighted by their appropriate weights, determine the national price level.

Taken as a whole, then, the model explains national wage and price trends (the endogenous variables of the model) in terms of price trends in the world market, existing foreign exchange rates, and productivity trends within the sheltered and exposed industries respectively (the exogenous variables of the model). In a way, and apart from the explicit consideration of productivity trends, the basic idea of the Norwegian model is "the purchasing power doctrine" put into reverse: Whereas the purchasing power doctrine assumes floating exchange rates and explains exchange rate changes in terms of relative price trends at home and abroad, the present model assumes controlled exchange rates and uses exogenously given exchange rates and international prices to explain trends in the national price level. If exchange rates are floating the Norwegian model does not apply.

1) This statement holds as a generalization. However, it is not necessarily the case that the rate of productivity increase in exposed industries is uniformly high and in sheltered industries uniformly low. For instance, inland transport, while classified as sheltered industries, have productivity increases comparing favourably with those of many exposed industries.

Critical to the validity of the model are the controlling mechanisms postulated by propositions (ii), (iii) and (iv) above. Do such controlling mechanisms in fact exist, and how exact are the relationships dictated by them? In answer to these questions there is no need to say much about (iii) and (iv): There is plenty of evidence, both in Norway and Sweden, showing the relationship between wages in S-industries and E-industries to have remained remarkably stable through time (see e.g. [6] ch. 6), and the observed stability of the profit share within the S-industries (diagram 1) supports the view that some mechanisms of the kind assumed by propositions (iii) and (iv) do in fact exist.<sup>1)</sup>

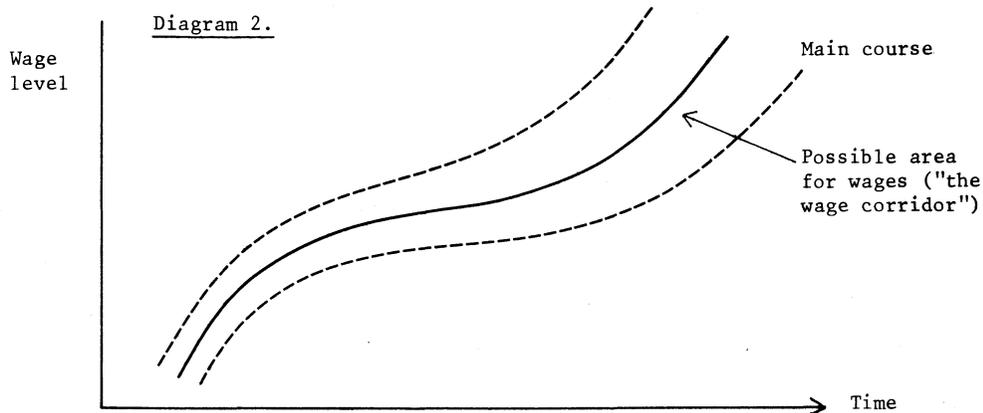
The truth of proposition (ii) - that wages in the E-industries tend to adjust so as to leave the E-industries with "normal" profits - is much more doubtful. In fact, historical data show profits of the E-industries to have fluctuated considerably (diagram 1). The relationship between "the profitability of E-industries" and "the wage level of E-industries" which the model postulates, therefore, is certainly not a relationship which holds on a year-to-year basis. At best, it is valid only as a long-term tendency and even so only with considerable slack. However, it is equally obvious that the wage level in the E-industries is not completely free to assume any value irrespective of what happens to profits in these industries. Indeed, if actual profits in the E-industries deviate much from "normal" profits, sooner or later forces must be expected to start working which will tend to close the gap. There are at least three correction mechanisms which may be counted upon to have this effect:

- (i) First, deviations will tend to be corrected through the system of wage negotiations. Abnormally high (low) profits will be taken as a sign by the trade unions to ask for larger (smaller) wage increases than usual and at the same time weaken (strengthen) the tendency of entrepreneurs to resist the claims. Therefore, negotiated wage increases will be higher (lower) the higher (lower) are the actual profits of the E-industries.
- (ii) Secondly, market forces will tend to work in the same direction as organized negotiations through the mechanism of the wage drift. Abnormally high (low) profits will motivate higher (lower) demand for labor by entrepreneurs for production and/or investment purposes. Therefore, high (low) profits will lead to a tighter (less tight) labor market and ultimately influence the size of the wage drift. In extreme situations, if actual wages are kept so low (e.g. through some "successful" incomes policy) as to cause extraordinarily high profits in the exposed industries and - in consequence of this - excess demand for labor, a "wage explosion" may follow with the effect of quickly bringing down profits to more normal levels.<sup>2)</sup>
- (iii) Thirdly, economic policy will aim to keep profits of the E-industries at a reasonable or "normal" level. In particular, economic policy tends to step in whenever wages become so high (and the competitiveness of E-industries so low) as to endanger full employment and the balance of payments. In such cases deflationary measures are resorted to, in order to slow down wage increases and thus restore profits to normal levels.<sup>3)</sup>

We are led to hypothesize that mechanisms exist which tend to make the national wage level follow a course through time set ultimately by price trends abroad, by the chosen exchange rates, and by the productivity trends of the E-industries. This course is referred to in Norwegian studies as the "main course" of wages. It is defined as the level of wages which is consistent, at any point of time, with "normal" profits of the E-industries. However, due to the slack in the system, wages

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- 1) Some of the models described in section 6 are explicit in suggesting mechanisms which may result in a "normal" level of relative profits establishing itself within sheltered sectors.
  - 2) One wonders whether economic events in the Netherlands during the early 1960's are not more easily explained through this mechanism than through some variant of a monetary theory, e.g. as contained in Holtrop [13]. The hypothesis is that the Dutch incomes policy, which had been successful for a number of years keeping the rate of increase in wages and prices in the Netherlands below the rates of other countries but which too long left the rate of the guilder unchanged, simply had to break down in the end because of tensions building up in the labor market.
  - 3) Caves, in [3] p. 15, points out, rightly in my mind, that this part of the model has the implication of making macro-economic policy (to a degree) endogenous.

are free to deviate, within bounds, to either side of the main course, but the further they deviate the stronger will be the forces pulling them back. To use a metaphor, wages are free to move within "a corridor with elastic borders" as illustrated by diagram 2. If wages are near the upper border of the corridor, profits of the E-industries will be abnormally low, and vice versa.



Corresponding to the main course of wages there will be a "main course" through time which the national price level will have to follow, again with an allowable margin of variations to either side ("a price corridor"). The main course of prices will depend, in part, on the factors determining the position of the main course of wages. But it will depend also on the productivity trend of the S-industries since this determines the extent to which S-industries have to raise output prices in response to higher wages in order to maintain a "normal" relationship between profits and wages.<sup>1)</sup>

So far, constant foreign exchange rates have been assumed. A devaluation will abruptly shift the "wage corridor" upwards and lead to a steeper rise of actual wages and therefore prices in the years following the devaluation. A revaluation, on the other hand, will shift the "wage corridor" downwards and cause the wage and price increase to slow down. We would expect therefore, that countries which have devalued their currencies (France, United Kingdom), will have witnessed higher price increases than others, while countries which have revalued (Western Germany, the Netherlands) will have had less inflation than others. (Of course, though no doubt some correlation exists between exchange rate changes and price trends the direction of causation may sometimes be a subject for dispute.)

### 2.3. The many-sector, short-run model PRIM

More insight into the mechanisms which determine price and income trends within an economy may be gained by disaggregating further the two-sector model sketched above. An example is the Norwegian multi-sector model PRIM (PRIM = PPrice Income Model).<sup>2)</sup> PRIM may be characterized, in brief, as a short-term, cost-push, input-output type model. It is short-term in that it takes wage rates to be given, i.e. fixed by negotiations; since the model does not attempt to explain wage trends, it is useless as a theory of long-term price movements. It is cost-push in that it explains prices entirely in terms of costs. There is no reference to demand as a possible source of price increases; the model derives changes in prices and income shares (the "unknowns") from changes in

- 1) Since productivity increases faster in the E-industries than in the S-industries the model implies that the national price level will tend to rise even though foreign trade prices keep constant. This does not mean, as is sometimes believed, that the country in question will have a quicker rate of inflation than her trading partners. The question of possible inter-country differences in inflation rates is discussed explicitly in section 4.6.
- 2) PRIM has been designed primarily as an instrument to help in negotiations about wages and prices. In Norway, such negotiations are strongly centralized and take place bi-annually. In advance of each round of negotiations the model is used to provide the negotiating parties with forecasts of the developments to be expected in the coming two years in prices and income shares. The forecasts are prepared in alternatives, each alternative representing one possible outcome of the negotiations which are about to start. The idea is, of course, that through such forecasts the negotiating parties will be in a better position to anticipate the consequences, for themselves and for the national economy, of alternative courses open to them.

wage rates, agricultural prices, productivities, world market prices and a few other "given" variables assumed to affect costs. It is of the input-output type in recognizing the fact that higher output prices in one industry mean higher input prices, i.e. higher costs, in other industries. This results in price interrelationships which can be studied through an input-output technique in much the same way as an input-output technique is used for the study of quantitative interrelationships.

The structure of PRIM in its early versions has been described by me in detail elsewhere [1] and need not be repeated here. Suffice it to say that the main endogenous variables of the model are the national price level and various categories of incomes such as total wages and profits of various industry groups. The model takes as exogenous variables which, within the time horizon of the model, are supposed to be important in influencing prices and/or incomes. They include the wage rate and agricultural prices (both assumed to be set through negotiations), prices of different categories of exported and imported goods as given in the world market, indirect taxes, and, finally, labor productivities and employment which together determine output. Repercussions on productivities and employment from incomes via demand are neglected. The model simply assumes that there is always sufficient demand somewhere for the products of the industries. The original version of PRIM (PRIM I, from 1966) distinguished six industry groups which were later (PRIM II, from 1972) extended to seven (see [14]): Three sheltered industry groups (agriculture, building and construction, other) and four exposed industry groups (fisheries, import-competing manufacturing, shipping, other export oriented industries).

Crucial to the working of the model are the assumptions made with respect to price behaviour:

- Output prices of agriculture and fisheries are assumed to be exogenous, stipulated through income settlements negotiated with the government.
- Output prices of sheltered industries apart from agriculture are assumed to be endogenous and determined through some variant of cost-plus pricing in such a way that the profit share in these industries (profits as a share of factor income) will assume a pre-determined value (either a trend value or, if a better guess is available, some other value stipulated by the user of the model).
- Import and export prices are supposed to be given, determined by the world market.
- Output prices of import-competing manufacturing are assumed to follow the (given) prices of similar imported goods. (In practical use of the model they may be considered exogenous and stipulated in some other way if a better guess is available.)
- Output prices of shipping and other export oriented industries are assumed to follow the (given) export prices.<sup>1)</sup>

Throughout, changes in output prices are assumed to be percentagewise the same for all deliveries from any one industry, e.g. the same for sales at home and on the export market.<sup>2)</sup>

- 1) To treat export prices as exogenously given, independently of costs, may be justifiable as a first approximation. However, even a small country like Norway obviously has price-setting power in certain industries, e.g. shipping. Therefore, if a set of national models of the PRIM type were to be combined into a world model a different solution would have to be chosen. In such a model world market prices would become endogenous variables to be determined through some price-setting mechanism, involving supply and demand relationships.
- 2) The description in the text applies to a version of PRIM which was in use until lately. In a more recent version, just completed, PRIM appears as an aggregated variant of the sub-model for prices contained in the much bigger and more general model MODIS IV. In this version of PRIM some new features have been added which complicate the model structure, but which do not change the basic ideas much:
  - The input-output structure of the model has been changed from a sector-by-sector to a commodity-by-sector basis.
  - The number of sectors has been kept flexible.
  - The price of a given commodity flow is no longer assumed to be the same in all uses but may differ depending on origin and destination; accordingly, each commodity may have one import price, one export price, and one domestic price.
  - Import and export prices are determined on the world market and therefore exogenous.
  - Domestic prices are either exposed or sheltered. If they are exposed, they are normally assumed to follow corresponding import prices. If they are sheltered, they are either regulated (subject to price control or stipulated by a publicity controlled enterprise) or negotiated (prices of agricultural products) or cost determined through cost-plus pricing.
 The new version of PRIM offers more flexibility than the old one in that it can handle more sophisticated hypotheses about price behaviour than the crude dichotomy between prices which are either sheltered or exposed. However, for the time being we know far too little about how prices are actually determined to be able to make much use of these potentialities of the model.

Table 1. Effects on prices, income and the distribution of income caused by changes of 1 per cent in wages, agricultural prices, productivity, foreign prices and the share of profits in other sheltered industries. ("Table of Effects".) 1967

Increase of 1 per cent in:	Prices (change in per cent)		Income (change in millions of kroner)									Income (change in per cent)						
	Prices of products from other sheltered industries	Consumer price level	Total factor income	Total wages <sup>1)</sup>	Income from agriculture	Income from fisheries	Other sheltered industries	Profits			Total factor income	Total wages <sup>1)</sup>	Income from agriculture	Income from fisheries	Profits			
								Import-competing manufacturers	Shipping	Other export-oriented industries					Other sheltered industries	Import-competing industries	Shipping	Other export-oriented industries
<b>WAGES AND SALARIES:</b>																		
All industries <sup>2)</sup>	0.68	0.47	270	307	-13	-3	94	-48	-27	-40	0.57	1.00	-0.61	-0.45	1.00	-3.54	-2.79	-2.05
Other sheltered industries	W <sub>2</sub> 0.68	0.47	270	217	-13	-3	94	-8	-4	-12	0.57	0.71	-0.61	-0.45	1.00	-0.62	-0.37	-0.64
Import-competing manufacturers	W <sub>3</sub> ..	..	..	40	..	..	..	-40	..	..	..	0.13	..	..	..	-2.92	..	..
Shipping	W <sub>5</sub> ..	..	..	23	..	..	..	..	-23	..	..	0.08	..	..	..	..	-2.43	..
Other export-oriented industries	W <sub>6</sub> ..	..	..	28	..	..	..	..	..	-28	..	0.09	..	..	..	..	..	-1.42
Agricultural prices	P <sub>1</sub> 0.03	0.08	37	..	39	-	..	-1	-	-1	0.08	..	1.76	-0.02	..	-0.05	-0.01	-0.06
Fish prices	P <sub>4</sub> 0.01	0.01	7	..	-1	13	..	-	-	-5	0.01	..	-0.04	1.77	..	-0.01	-0.02	-0.26
<b>PRODUCTIVITY IN:</b>																		
Agriculture	Z <sub>1</sub> ..	..	21	..	21	..	..	..	..	..	0.04	..	0.94	..	..	..	..	..
Other sheltered industries	Z <sub>2</sub> -0.83	-0.57	49	..	16	4	..	10	4	15	0.10	..	0.73	0.54	..	0.74	0.44	0.77
Import-competing manufacturers	Z <sub>3</sub> ..	..	59	..	..	..	..	59	..	..	0.12	..	..	..	..	4.34	..	..
Fisheries	Z <sub>4</sub> ..	..	11	..	..	11	..	..	..	..	0.02	..	1.50	..	..	..	..	..
Shipping	Z <sub>5</sub> ..	..	70	..	..	..	..	..	70	..	0.15	..	..	..	..	..	7.34	..
Other export-oriented industries	Z <sub>6</sub> ..	..	57	..	..	..	..	..	..	57	0.12	..	..	..	..	..	..	2.92
<b>TOTAL EMPLOYMENT IN:</b>																		
Agriculture	N <sub>1</sub> ..	..	21	..	21	..	..	..	..	..	0.04	..	0.94	..	..	..	..	..
Other sheltered industries <sup>3)</sup>	N <sub>2</sub> L <sub>2</sub> -0.15	-0.10	320	217	3	1	94	2	1	3	0.68	0.71	0.13	0.10	1.00	0.13	0.08	0.14
Import-competing manufacturers <sup>3)</sup>	N <sub>3</sub> L <sub>3</sub> ..	..	59	40	..	..	..	19	..	..	0.12	0.13	..	..	..	1.42	..	..
Fisheries	N <sub>4</sub> ..	..	11	..	..	11	..	..	..	..	0.02	..	1.50	..	..	..	..	..
Shipping <sup>3)</sup>	N <sub>5</sub> L <sub>5</sub> ..	..	70	23	..	..	..	..	47	..	0.15	0.08	..	..	..	..	4.91	..
Other export-oriented industries <sup>3)</sup>	N <sub>6</sub> L <sub>6</sub> ..	..	57	28	..	..	..	..	..	29	0.12	0.09	..	..	..	..	..	1.50
<b>EXPORT PRICES:</b>																		
Shipping	P <sub>5</sub> 0.01	0.01	106	..	-	-	..	-	107	-	0.22	..	-0.01	-0.01	..	-0.01	11.20	-0.01
Other export-oriented industries	P <sub>6</sub> 0.05	0.05	97	..	-3	-	..	-6	-1	108	0.21	..	-0.16	-0.04	..	-0.46	-0.08	5.56
<b>IMPORT PRICES:</b>																		
<b>Imported intermediate goods to:</b>																		
Agriculture	Q <sub>1</sub> ..	..	-2	..	-2	..	..	..	..	..	..	..	-0.07	..	..	..	..	..
Other sheltered industries	Q <sub>2</sub> 0.08	0.05	-5	..	-2	-	..	-1	-	-1	-0.01	..	-0.07	-0.05	..	-0.07	-0.04	-0.07
Import-competing manufacturers	Q <sub>3</sub> ..	..	-35	..	..	..	..	-35	..	..	-0.07	..	..	..	..	-2.53	..	..
Fisheries	Q <sub>4</sub> ..	..	-1	..	..	-1	..	..	..	..	..	..	-0.10	..	..	..	..	..
Shipping	Q <sub>5</sub> ..	..	-30	..	..	..	..	..	-30	..	-0.06	..	..	..	..	..	-3.19	..
Other export-oriented industries	Q <sub>6</sub> ..	..	-28	..	..	..	..	..	..	-28	-0.06	..	..	..	..	..	..	-1.42
Imported consumers' goods <sup>4)</sup>	P <sub>7</sub> ..	0.13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Competitive imports <sup>5)</sup>	P <sub>8</sub> =P <sub>3</sub> 0.05	0.12	106	..	-1	-1	..	112	-1	-3	0.22	..	-0.05	-0.07	..	8.20	-0.09	-0.17
Imported capital goods (excl. ships) <sup>6)</sup>	P <sub>10</sub> 0.05	0.03	-19	..	-4	-	..	-5	-	-10	-0.04	..	-0.18	-0.03	..	-0.36	-0.02	-0.51
Imported ships <sup>6)</sup>	S <sub>5</sub> ..	..	-38	..	..	..	..	..	-38	..	-0.08	..	..	..	..	..	..	-3.98
Percentage point change in share of profits in other sheltered industries <sup>7)</sup>	r <sub>2</sub> 1.00	0.68	393	..	-19	-5	453	-12	-5	-18	0.83	..	-0.88	-0.65	4.81	-0.90	-0.54	-0.92

- = negligible effect. .. = no effect.

Notes: 1) Excluding agriculture and fisheries.

2) This is to be understood as a proportional increase in  $W_j$  ( $j = 2, 3, 5, 6$ )

3) Proportional increase of 1 per cent in total employment (N) and number of wage and salary earners (L) implying a 1 per cent increase in the number of self-employed.

4) Import direct for consumption.

5) The price of imported goods which compete on the Norwegian market with products from "import competing manufacturers".

6) Increase in the price of capital goods leads to an increase in depreciation calculated in current prices. This immediately reduces income from agriculture and profits in the exposed industries and causes "other sheltered industries" to raise output prices.

7) The share of profits in "other sheltered industries" in 1967 was 30.3 per cent (of total factor income). The figures on this row show what the effects would have been if this share, ceteris paribus, rose by 1 percentage point, i.e. to 31.3 per cent.

Some of the light which PRIM sheds on the working of the economy is apparent from the "table of effects" shown as table 1.<sup>1)</sup> (The table reproduced here is for 1967. It was computed on the basis of PRIM I in which construction was included with "other sheltered industries", hence construction is not shown separately in the table.) At the left side of this table are listed a selected number of important exogenous variables of the model, and the income distribution parameter ( $r_2$ ) of "other sheltered industries". Selected endogenous variables are entered at the top. The table shows, along the rows, the effects which, according to PRIM, are to be expected from a partial one per cent change of the exogenous variable of that row on each one of the endogenous variables listed at the top. The effects are expressed partly as percentages and, in case of income variables, in kroner as well. Row 1 tells us for instance, that a 1 per cent increase in the wage level, *ceteris paribus*, may be expected to raise the level of consumers' prices by .47 per cent, to increase the total of nominal factor incomes by .57 per cent, to decrease income from agriculture by .61 per cent, to decrease profits of "import-competing manufacturers" by 3.54 per cent, etc. If read columnwise, the table gives, for each endogenous variable, information on the effect of changes in exogenous variables. All effects specified in the table can be considered as additive for small changes in the exogenous variables. Therefore, the combined effect of a simultaneous change in two or more exogenous variables may be gauged by adding together the effects of each variable taken separately. For instance, a parallel increase of all import prices by 1 per cent may be expected, *ceteris paribus*, to raise the level of consumers' prices by  $.05 + .13 + .12 + .03 = .33$  per cent (column 2).

### 3. SOME POLICY IMPLICATIONS

#### 3.1 The scope for a national price policy

Granted that our models give a reasonably accurate description of the price and income distribution mechanism of small to medium-sized open economies, what scope is there in such countries for a national price policy? To what extent, and through which instruments, can national price trends be influenced by government actions? The answers depend on the time horizon of the analysis.

In the very long run, say, periods of 5-15 years or more, according to the long-run model the trends of national wages and prices are determined by international trends modified by the exchange rate. If the model is correct, it is impossible for national prices, measured in international currency units, to move differently from world market prices. It is the up-shot of the long-term model that national authorities have little or no room for influencing the long run trend of the price level of their countries if foreign exchange rates are kept stable.<sup>2)</sup> Contrarily, manipulating the exchange rate (disregarding, for the moment, possible balance of payments problems) may be expected to be a very potent long run price policy instrument: A country which revalues (devalues) by 10 per cent is virtually guaranteed over the ensuing years to experience 10 per cent less (more) inflation than other countries and less (more) than it would otherwise have had. The trouble is, of course, that foreign exchange rates changes cannot always be manipulated freely, nor are they well suited as regular instruments of a price policy since exchange rate changes, when they are foreseen and expected, are bound to create unwanted speculation.

1) For a PRIM-type analysis of US-inflation 1970-1973 see [17].

2) In Norway, over the 20-year period 1951-1971, the level of wages (labor costs per man-year) increased by 7.9 per cent on an annual average. Prices, measured by the gross domestic product deflator, increased by 3.9 per cent a year during the same period. The model asserts that these wage and price increases were unavoidable, given world market price trends and the prevailing exchange rates. A different wage increase, say 8.9 per cent or 6.9 per cent a year instead of 7.9 per cent (which would have led to a somewhat higher or lower price increase than 3.9 per cent a year), if it had been possible, would have meant a wage level in 1971 some 20 per cent above or below the actual level. At a wage level 20 per cent above the actual, Norwegian industries would certainly not have remained competitive. At a wage level 20 per cent below the actual, E-industries in 1971 would have shown enormous profits. None of these could have happened without the correction mechanisms assumed by the long-term model having been brought to bear.

In the short run, say, over periods of 1-2 years lasting from the conclusion of one round of wage negotiations until the conclusion of the next, according to the short run model the ability of national authorities to influence price developments is again very limited. Under Scandinavian circumstances, where wage negotiations take place for most groups of wage earners simultaneously, the outcome of wage negotiations will determine the course of wages (apart from the wage drift) for a period ahead. What policy authorities can do under such circumstances is not much. They may try to slow down the wage drift through a policy of demand management or monetary policy, but such a policy is unlikely to have much effect in the short run. They may try to counter the price increases triggered off by the wage increases by resorting to the use of subsidies, price controls and similar policies. This will delay, but cannot indefinitely hold back, the price increases to be expected as a consequence of the wage settlement. Yet such a policy may have some limited success in cases where tariff settlement contains an escalation clause tying wages during the tariff period to the index of consumers' prices; if such a clause is part of the tariff agreement a slowing down of the price increase may serve to slow down the wage increase and thus result in an altogether smaller rise in wages and prices in the course of the tariff period.

In the medium run, however, say, over a period of 2-5 years, the scope for a national price policy should be considerable. According to the long-term model it is perfectly possible for wages, over such a period, to rise more or less steeply within the boundaries set by "the wage corridor": Actual wages may move from a position near the lower boundary of the corridor towards the upper boundary, or from the upper boundary towards the lower boundary, depending in part on the outcome of wage negotiations taking place during the period and in part on the size of the wage drift. Since the outcome of wage negotiations and the size of the wage drift presumably depends to some extent on the general economic climate (for instance, the tightness of the labour market) it should be possible for policy authorities to influence wage and price developments in the medium run through a policy of demand management or monetary policy, supplemented perhaps by an incomes policy. Note, however, that such a policy, to the extent that it succeeds in holding back price increases, will have achieved this through holding back wage increases, thus shifting the distribution of the national income in favour of the owners of enterprises in the E-industries. (This points to the existence of a latent conflict between price and income distribution targets, which is discussed further in the next subsection.) Observe, furthermore, that the scope for such a policy is limited by the need for actual wages to remain always within the boundaries of the wage corridor. In a world with rising prices, where the wage corridor will point steeply upwards at stable exchange rates, a national policy aiming at stable prices, however successful in the short and medium run, cannot succeed in the long run unless it is backed by repeated revaluations of the national currency.

### 3.2 Implications for an incomes policy

Our models, if correct, also hold a message of great relevance for the choice of targets for an incomes policy: According to the models, with foreign exchange rates given, the national price level is determined through simultaneous developments in wages, agricultural prices, indirect taxes and subsidies, prices of exports and imports and productivities. Since this is so, no simple formula can be laid down which will serve as a guide-post, once and for all, for an incomes policy aiming at stable prices. The assertion often heard, for instance, that a necessary and sufficient condition for price stability is that wages should rise in step with average productivity, is a false statement. An incomes policy adhering strictly to this principle might lead to a falling, stable or increasing national price level depending on what happens simultaneously to the other exogenous variables of the model; in particular, the resulting national price trend would depend strongly on the trend of world market prices (though price impulses from abroad might conceivably be counteracted through exchange rate adjustments).

According to PRIM, the national price level and the distribution of the national income are determined through the same set of exogenous variables. But the ways in which the price level and the individual income shares are affected by the exogenous variables are not identical (see the

entries in the columns of table 1 or the equations of PRIM on reduced form as reproduced in [1]. It is most improbable, therefore, that a set of values for the exogenous variables can be found which will result in a desired development of prices and at the same time in a desired distribution of incomes: Only by chance will world market prices and productivities (which society does not control) change in such a way that an incomes policy can be designed which will ensure stable prices without having undesired effects for the (pre-tax) distribution of income, or maintain the established distribution of income without allowing unwanted changes in the price level. In other words, society's targets for prices and for income distribution may very well be in conflict. An intelligent prices and incomes policy must start by facing this fact squarely.

Incidentally, we shall have to give up the popular belief that the struggle over income shares may be viewed simply as a confrontation of wage-earners and employers. Instead, wage-earners and owners of enterprises in the sheltered industries may well have a common interest in rising wages since, according to the model, a rise in wages will lead automatically, via price adjustments, to a proportionate increase in profits of the sheltered industries. Together these groups may be able to obtain a (short-run) gain in real incomes at the expense of other groups (farmers and owners of enterprises in the exposed industries). The parties confronting each other in the struggle over income shares, therefore, may be said to be (i) the farmers, (ii) the owners of enterprises in the sheltered industries and the wage-earners, (iii) owners of enterprises in the exposed industries.<sup>1)</sup>

Farmers can work actively to increase their share of the national income through demanding higher prices for agricultural output. Wage-earners and owners of enterprises in the sheltered industries can work actively to increase their share of the national income through demanding or allowing higher wages. Owners of enterprises in the exposed industries, on the other hand, can work actively to increase their share of the national income only through opposing the price and wage claims of the other groups. The implication is far-reaching: The whole burden of holding back on wage increases and avoiding cost-push inflation is seen to rest with a small group of enterprises in the exposed industries, since all other groups (wage earners, farmers, enterprises in the sheltered industries) may increase their income in the short run by allowing the national cost and price level to be inflated. Perhaps we should not be surprised that the modern society has shown herself to be rather inflation-prone.<sup>2)</sup>

#### 4. PROPERTIES OF THE NORWEGIAN MODEL FURTHER CONSIDERED

##### 4.1 General and national theories of inflation

In order for a body of ideas to qualify as "a theory of inflation" it must be able to explain both prices and wages; that is, prices and wages should both enter the reasoning as endogenous variables. Judged against this criterion it is clear that the Norwegian approach does not qualify as an inflation theory in the same sense as some competing approaches, e.g. the monetary approach or the Keynes-originating excess demand/Phillips curve approach.

This is quite obvious in the case of the short-run (PRIM) variant of the model. PRIM has got absolutely nothing to say on how the wage level is determined; it simply takes the wage level (or rather changes in it) as something given. What it purports to do is to describe in some detail how

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- 1) The reasoning in this paragraph is based on the short-run version of the Norwegian model and describes possible outcomes of the fight over income shares in the short run. In the long run we would expect a tendency for wages, profits in S-industries and profits in E-industries to remain in a "normal" relationship to each other, in conformity with the long-run model described in section 2.
  - 2) It is conceivable that entrepreneurs in E-industries might try to protect their interest by working to get the exchange rate changed rather than by opposing wage claims though this possibility has not been considered in the text. To the extent that they succeed in obtaining a devaluation of the national currency this will obviously have the effect of adding to the inflationary trend.

changes in national prices and income shares follow from ("are determined by") given changes in wages and other pre-determined variables such as world-market prices. Hopefully the model contributes to a better understanding of how inflationary impulses work their way through the economy but it has nothing to say on the origin of these impulses. It contributes nothing to an understanding of what the propelling forces of inflation are.

With respect to the long-run variant of the model the position is different. The key element here is a mechanism making the national wage level dependent mainly on international prices, the foreign exchange rate, and productivities of the exposed industries. Other components of the model are assumptions (the same as in PRIM) about the price behaviour of different categories of industries. The total outcome is a theory which, for an open economy, explains wages and prices in terms of technology (productivities), the use of policy instruments (choice of exchange rate, measures designed to influence the position of actual wages within the "wage corridor"), and factors outside national control (international prices). At the national level, therefore, the Norwegian model has the necessary formal properties of a theory of inflation. It is no theory of world inflation however, since it does not attempt to explain world market prices. Unlike the monetary and Keynes'ian approaches it is not a general theory capable of explaining the phenomenon of inflation as such.

#### 4.2 Some formal short-comings of the Norwegian model

From a formal point of view the Norwegian model suffer from weaknesses which limit its usefulness even at the national level. Two, in particular, should be noted:

- (i) Both the short-run and the long-run variants of the model, in their present formulation, are static rather than dynamic. Therefore, they have got nothing to say on the time dimension of the inflationary process.
- (ii) The long-run model is non-operative since, so far, no operational definition has been given of "normal profits" which is a key variable in the model. It follows that the concepts of "the main course of wages" and "the wage corridor" are non-operational concepts as well. Therefore, we may be unable to tell whether, at any particular point of time, actual wages are "high" or "low" in the wage corridor. Nor can we indicate by how much actual wages deviate from their main course. For this reason the model is not of much help when it comes to formulating quantitative statements about the implications of wage trends, past and present.

#### 4.3 The transmission mechanism of the inflationary process

According to the Norwegian model inflationary tendencies are imported into one country from others solely through foreign trade prices. These price effects are of various kinds. Three classes may be distinguished:

a. Direct import price effects, which may be sub-divided further: (i) Price increases on imported consumers' goods: Such price increases will be reflected rather immediately in the level of consumers' prices of the importing country. According to PRIM, a proportionate increase of 1 per cent in the prices of all imported consumers' goods may be expected, in Norway, to raise the level of consumers' prices ultimately by .13 per cent (table 1). (ii) Price increases on supplementary imports of raw materials and capital goods: Such price increases are passed on by the producers into prices of final goods, presumably with some time lag. The ultimate effect, according to PRIM, of a proportionate increase of 1 per cent in the prices of these goods will be, in Norway, a rise in the level of consumers' prices of .08 per cent. (iii) Price increases on competitive imports: Such price increases affect the national price level by inducing producers in the exposed industries to raise their selling prices for similar commodities. (If the goods in question are consumers' goods, the price increase will at the same time affect the national price level through the channel described under item (i) above.) Again some time-lag has to be reckoned with. Assuming that a 1 per cent increase in the prices of competitive imports will cause a 1 per cent increase in the selling prices of national producers of similar commodities the effect on the level of consumers' prices will be .12 per cent according to PRIM under Norwegian conditions. - Summing up, the total direct

import price effect to be expected, under Norwegian condition, from a proportionate increase of 1 per cent of all import prices can be put at  $.13 + .08 + .12 = .33$  per cent.

b. Direct export price effects. When exported goods become better paid on the world market, these higher prices will tend to be charged on the national market as well. Whether the goods in question are consumers' goods or intermediate goods the level of consumers' prices will be affected, possibly with a time lag. The direct export price effect to be expected, under Norwegian conditions, from a proportionate increase of 1 per cent of all export prices has been calculated by PRIM to be .06 per cent.

c. Indirect effects via the wage level. Under this heading comes the complex mechanism described in section 2.2 whereby rising export and import prices will lead, via improved profitability of the exposed industries, to a rise in the national wage level which, in turn, causes the sheltered industries to raise their selling prices. The magnitude of this effect is difficult to calculate exactly; however, we would expect it to result, in the long run, in national prices moving roughly parallel to prices in other countries. We must expect the time needed for this transmission mechanism to work to be rather long.

The contribution of the Norwegian model of inflation is the central role which the model ascribes to the transmission mechanism via the wage level, listed under c. above. The idea that the level of wages in a national economy is strongly related to events in other countries, and the far-ranging conclusions which follow from this, seems to have been overlooked or not given sufficient emphasis in the literature so far. The direct import and export price effects noted under (a) and (b), in contrast, have of course been well recognized.

While accentuating the transmission of inflationary impulses via foreign trade prices and wages, the Norwegian approach neglects the transmission mechanisms assumed by the monetarist and Keynesian approaches. According to the monetarist approach, inflationary tendencies are transmitted from one country to another chiefly through the liquidity effects arising from a surplus or a deficit on the current balance, plus or minus capital flows. According to the Keynesian approach the transmission mechanism is to be sought in the demand effects arising from increased exports to countries already experiencing demand inflation. The Norwegian approach tends to dismiss both of these effects as being of secondary order importance compared to the direct and indirect price effects.

It should be pointed out, perhaps, that although the monetarist, Keynesian and Norwegian approaches each stress different aspects of the transmission mechanism of inflation while suppressing others this does not make the three approaches mutually exclusive. Rather they are complementary in showing that inflation can travel along many routes.<sup>1)</sup> Within a more generalized framework all approaches could in principle be accommodated.

#### 4.4 The role of demand

In judging the role played by demand in the Norwegian approach a distinction should be made between commodity markets and the labor market.

In the commodity markets demand is not supposed to matter much (except indirectly through the effect which demand for commodities has on demand for labor as discussed below). PRIM, in its crudest formulation, assumes commodity prices to be either exogenous, or determined by costs through cost-plus-pricing. Thus, commodity prices are supposed to be completely unaffected by demand. However, in actual use of PRIM for prognostic purposes it is sometimes recognized, by ad hoc reasoning "outside the model", that the percentage mark-up may depend on the general state of demand. Of course, this reasoning could be made an inherent part of the model: Whereas the mark-up percentage at present is considered a parameter of the model it could be considered, alternatively, a variable whose magnitude would be related to some indicator of the pressure of demand through a new relationship to be added to the model.<sup>2)</sup>

1) For an attempt to give a complete list of possible routes, see the OECD-study in [18].

2) For example, see the way in which this was done in the Finnish companion to PRIM described in section 6.2 below.

In the labor market, in contrast, the Norwegian approach assumes the balance between supply and demand to play a crucial role. According to the long-term model this balance is a key element in the "correction mechanisms" which are supposed to guarantee that actual wages will not deviate far from the "main course" of wages. As pointed out in section 2, one such mechanism is the system of wage negotiations. There can be little doubt that the size of the wage increases which are demanded and granted during wage negotiations will be influenced i.a. by the state of labor market. A related correction mechanism is the phenomenon of the wage drift. There is plenty of evidence that the state of the labor market influences also the amount of the wage drift which will take place between wage negotiations.

There is no disagreement as to the ultimate effect which demand is supposed to have on prices, therefore, between the Norwegian approach on the one hand and the monetary and Keynes'ian approach on the other. They all agree that excess demand will cause commodity prices to rise. They do differ, however, in the assumptions made about the mechanism producing this result. The monetary and Keynes'ian approaches focus primarily on commodity markets and stress the pull on commodity prices exerted by excess demand for commodities. The Norwegian approach focuses on the labour market and stresses the pull which excess demand for labour exerts on wages, assuming rising wages, in turn, to exert a push effect on commodity prices. However, since all these mechanisms may be operating together and since excess demand for labor is hardly possible without excess demand for commodities the difference is more one of emphasis than of principle. Although the short-run model PRIM, which considers the wage level as exogenously given, may justly be referred to as a cost-push model, this description does not adequately describe the Norwegian approach as a whole: If we have excess demand pushing up wages, and then firms raising prices as a result of this, the whole situation may well be characterized as demand inflation.

The various approaches differ more fundamentally when it comes to listing and evaluating factors which may cause demand to become excessive. The monetary and Keynes'ian approaches tend to look for these causes in a faulty monetary and/or budgetary policy. The Norwegian approach allows in addition for another potent source of trouble: The possibility of a faulty combination of incomes policy and foreign exchange rate policy, resulting in the wage level being set too low relative to wages in other countries. This will cause abnormally high profits in the exposed industries and, as a result of this, induce these industries to expand their demand for commodities and labor.

Note one implication of what has just been said for the possibilities of testing the three approaches. We may find, and indeed many studies do show, a significant negative correlation between wage/price increases and the level of unemployment. Such findings do not necessarily confirm the validity of the Phillips curve, nor do they necessarily refute the thesis of the Norwegian approach: The observed fluctuations in prices/wages and in demand for labor may both have been caused by events abroad which have affected the economy in the manner assumed by the long-term Norwegian model.<sup>1)</sup>

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1) Caves makes the same point in [3] with the following words: "The structure of the Aukrust model indeed raises a statistical question about applying a simple Phillips-type relation to highly open economies. Suppose that the Aukrust model is correct about the prevalent source of price disturbances, namely movements in the world prices of traded goods. Suppose also that a nation manages its macroeconomic policy with one eye on external balance. An increase in traded goods prices raises profits and induces expansion and wage increases in this sector, and the fiscal authorities permit aggregate demand to expand and unemployment to fall because of the favourable external balance. The price increases thus leads to greater demand pressure and reduced unemployment, rather than the other way around! Faster wage increases and lower unemployment result from common ultimate causes. The curve-fitters should at least seek assurance that they have the direction of causation right" (p. 29). "The apparent prevalence of Phillips curve relations suggests the sufficiency of a closed-economy model of inflationary processes, but international linkages could generate a spurious Phillips relation with the causality reversed" (p. 31).

#### 4.5 Small and big economies

Two key assumptions of the Norwegian model are (i) the exposed industries are pace-setting in the wage determination process (ii) the exposed industries are price-takers and accept output prices as given on the world market and have no ability to influence these prices. These assumptions may be reasonably realistic in the case of a small economy with a relatively large exposed sector. Assumption (i), in particular, and perhaps assumption (ii) are less likely to hold in a relatively closed economy which is at the same time big enough for its demand and supply of some commodities to affect world market prices.

To such an economy the Norwegian model may not apply. Still the distinction between sheltered and exposed industries may help understanding the inflationary process though the chain of causation may be found to be very different from what it is in the small and open economy: Assume the pace-setting industries in the wage-determination process to be contained in the sheltered sector. Then the trend of national wages would be determined by national factors independently of developments abroad - for instance through some process consistent with, say, the monetarist approach or the Keynes'ian/Phillips curve approach. From the sheltered industries the wage increases would be passed on to the exposed industries. The end result might be a profit squeeze in the exposed industries and a deterioration of the trade balance. Or it might be the exactly opposite, depending on whether or not national wages went up more quickly or more slowly than wages of other countries. Then the wellknown adjustment processes of the monetarist/Keynes'ian approaches would begin to apply.<sup>1)</sup>

#### 4.6 Inter-country differences in rates of inflation

The implications of the Norwegian model for inter-country differences in rates of inflation should be clearly understood. They may be conveniently analyzed by means of a two-country, four-commodity model. Constant exchange rates are assumed.

Let the two countries be denoted countries  $i$  and  $j$ . For country no.  $i$ , the (percentage) rate of price inflation  $\dot{p}^i$  is

$$(1) \quad \dot{p}^i = \alpha^i \dot{p}_S^i + \beta^i \dot{p}_E^i + \gamma^i \dot{p}_E^j$$

where  $\dot{p}_S^i$  = rate of price inflation of (non-traded) output of country  $i$ 's S-industries

$\dot{p}_E^i$  = rate of price inflation of (home-consumed) output of country  $i$ 's E-industries

$\dot{p}_E^j$  = rate of price inflation of output of country  $j$ 's E-industries (country  $i$ 's import)

and  $\alpha^i, \beta^i$  and  $\gamma^i$  are appropriate weights reflecting the combination in which the three kinds of output are sold in country no.  $i$ .

Similarly, the rate of price inflation of country no.  $j$  is

$$(2) \quad \dot{p}^j = \alpha^j \dot{p}_S^j + \beta^j \dot{p}_E^i + \gamma^j \dot{p}_E^j$$

where  $\dot{p}_S^j$  = rate of price inflation of (non-traded) output of country  $j$ 's S-industries

and  $\alpha^j, \beta^j$  and  $\gamma^j$  are appropriate weights reflecting the combination in which the three kinds of output are sold in country no.  $j$ .

We assume for each country, in accordance with the long-run Norwegian model, that the wage level is determined by the productivity of the E-industries and the prices obtainable internationally for the output of the E-industries in such a way that the wage share of the E-industries remains constant. Then, as a long-run tendency<sup>2)</sup>,

1) I owe this point to Caves who suggests: "The model in this guise may hold some interest for explaining developments in the United States, where several large industries that appear to be important wage-setters are only marginally exposed to international competition". See [3], pp 16-17.

2) Here as well as in equations (5) and (6) we neglect the price effects of cross-deliveries of commodities (materials) between industries. To take such cross-deliveries into account would complicate the reasoning considerably without changing the conclusion much.

$$(3) \quad \dot{w}^i = \dot{p}_E^i + \dot{q}_E^i$$

$$(4) \quad \dot{w}^j = \dot{p}_E^j + \dot{q}_E^j$$

where  $\dot{w}^i$  and  $\dot{w}^j$  = rates of wage inflation in countries i and j respectively

$\dot{q}_E^i$  and  $\dot{q}_E^j$  = rates of productivity change in E-industries of countries i and j respectively

We assume furthermore, again in accordance with the Norwegian model, that prices in the S-industries are determined through cost-plus pricing. Then

$$(5) \quad \dot{p}_S^i = \dot{w}^i - \dot{q}_S^i$$

$$(6) \quad \dot{p}_S^j = \dot{w}^j - \dot{q}_S^j$$

where  $\dot{q}_S^i$  and  $\dot{q}_S^j$  = rates of productivity change in S-industries of countries i and j respectively

In general, the product (or product mix) of the E-industries in country no. i will be different from the product (or product mix) of the E-industries in country no. j. Therefore, the prices of these products will not, in general, have identical price trends. We shall assume, in a Marshall'ian way, that the prices of two goods will tend to move in inverse proportion to the productivities in the industries producing them. We then have, as a long-run tendency,

$$(7) \quad \dot{p}_E^i - \dot{p}_E^j = -(\dot{q}_E^i - \dot{q}_E^j)$$

Let us see where model (1) - (7) will lead us.

We note that, by definition, the difference in price inflation between countries i and j may be derived from (1) and (2) as

$$(8) \quad \dot{p}^i - \dot{p}^j = (\alpha^i \dot{p}_S^i - \alpha^j \dot{p}_S^j) + (\beta^i - \beta^j) \dot{p}_E^i + (\gamma^i - \gamma^j) \dot{p}_E^j$$

In order to simplify we shall assume that commodities are demanded in the same proportion in the two countries; this will approximately be the case in countries with reasonably similar income levels and standards of living. This means that  $\alpha^i = \alpha^j (= \alpha)$ ,  $\beta^i = \beta^j$  and  $\gamma^i = \gamma^j$ . Then (8) reduces to

$$(8') \quad \dot{p}^i - \dot{p}^j = \alpha(\dot{p}_S^i - \dot{p}_S^j), \text{ or} \\ = \alpha(\dot{w}^i - \dot{q}_S^i - \dot{w}^j + \dot{q}_S^j) \text{ because of (5) and (6)}$$

Inserting (3) and (4) in (8') and rearranging gives

$$(9) \quad \dot{p}^i - \dot{p}^j = \alpha | (\dot{p}_E^i + \dot{q}_E^i) - \dot{q}_S^i - (\dot{p}_E^j + \dot{q}_E^j) + \dot{q}_S^j | \\ = \alpha | (\dot{p}_E^i - \dot{p}_E^j) + (\dot{q}_E^i - \dot{q}_E^j) - (\dot{q}_S^i - \dot{q}_S^j) |$$

which because of (7) reduces to

$$(10) \quad \dot{p}^i - \dot{p}^j = -\alpha(\dot{q}_S^i - \dot{q}_S^j)$$

Equation (10) shows that, under the simplifying assumptions made, differences in the rates of price inflation among countries will reflect differences in the rate of productivity increases in their sheltered industries, and such differences only: The higher is the productivity increase in the sheltered industries of one country relative to that of other countries the lower, will be, relatively, the rate of price inflation of that country.

Note that rates of productivity increases in the exposed industries do not enter into equation (10). Therefore, differences in these rates cannot be a source of differences in rates of price inflation under the assumptions made in the model. We obtain this result because we have assumed, first, that different countries produce different commodities for export and, secondly, that the prices of these commodities change over time in inverse proportion to productivities; together, these two assumptions imply that wages have to change at the same rate in all countries. (Equations (3) and (4) together with (7) imply  $\dot{w}^i = \dot{w}^j$ .) If the model had been specified so as to allow nominal wages to

change at different rates in different countries (e.g. allowing countries to produce partly identical commodities for export and assuming productivities in the export industries to increase at different rates in different countries) the simple equation (10) would no longer hold.

## 5. TESTING THE NORWEGIAN MODEL

An economic model may be tested in various ways. One possibility is to study the validity of the individual behaviouristic relationships which are part of the model. Another possibility is to study the ability of the model to account for actual developments. This section reports on attempts along both these lines.

### 5.1 Testing the price behaviour relationships

The assumptions made in the Norwegian model about the price behaviour of industries were listed in section 2.3. An early attempt to confront these assumptions with facts have been reported in detail in [1]. Among the conclusions reached the following may be worth repeating here:

- The assumption made for the sheltered industries, namely that they tend to adjust output prices through some cost-plus pricing principle in such a way that the relationship between wages and profits conforms with a certain trend value, stood up well against the facts. However, it was noted that profits tended to fall short of the trend value in years when production was unfavourably influenced by the trade cycle. It was speculated that this was consistent with a pricing principle according to which the mark-up percentage was chosen so as to give the firm "normal" profits in years with "normal" output.
- The assumption made for competing manufacturers, namely that output prices tended to follow import prices to Norway of similar imported goods, appeared to be doubtful. During the 1960'es these industries seemed to have had considerably more scope for raising output prices than the model assumed.<sup>1)</sup>
- The assumption made that changes in output prices are always percentage-wise the same for all entries along one industry row of the input table (that is, for all deliveries of an industry irrespective of their uses) was clearly not consistent with the facts. Though this is a standard assumption in input-output analysis it may not be well founded when the model distinguishes only a small number of industries which each turn out a wide variety of products which are unlikely to be sold in the same proportions to all categories of users. However, the practical importance of this for the model was found not to be very serious.

A more rigorous testing of the price behaviour assumptions of the model has recently been undertaken by Vidar Ringstad. Ringstad applied econometric methods to Norwegian data in order to test a large number of alternative hypothesis about pricing behaviour of industries. The data available to him consisted of annual national accounts data 1961-1969 on prices and other relevant variables for about 120 individual industries classified according to market orientation. The data used and the results obtained are reported in great detail in [22].

It is impossible here to give more than a small sample of Ringstad's computations. Of particular interest is his attempt to estimate, for various industry groups, the parameters of the relation

$$(1) \quad P_H = aC + bP_E + cP_I + u$$

where  $P_H$  is sellers price of home-produced goods delivered to the home market,  $C$  is unit variable costs (actual costs, not normalized for business cycle effects),  $P_E$  is price of exports,  $P_I$  is the price of competing imports, and  $u$  is a residual error with zero mean and constant variance. On the

1) The explanation could be that the sector is "exposed" with respect only to some of its output and "sheltered" so far as other output prices are concerned. It appears that a Canadian model described by Gigantes and Hoffman has been constructed so as to allow for this possibility, see [9].

assumption that the Norwegian model is correct and that home market prices adjust to world market prices without time lag (an assumption not necessarily made by the model) we should expect to find: For sheltered industries  $a > 0$ ,  $b = c = 0$ ; for export-oriented industries  $b = 1$ ,  $a = c = 0$ ; for import-competing industries  $c = 1$ ,  $a = b = 0$ . These expectations are contradicted by Ringstad's findings, see table 2.

Table 2. Estimated parameters of a simple price behaviour relationship<sup>1)</sup>

Industry group	Number of industries in group	$\hat{a}$	$\hat{b}$	$\hat{c}$	$\sigma_u$
Sheltered industries .....	23	1.095 (.041)	.081 (.043)	.127 (.048)	.068
Export-oriented industries .....	16	.770 (.155)	.079 (.107)	.111 (.075)	.091
Import-competing industries .....	31	.854 (.056)	-.116 (.044)	.283 (.044)	.065

1) See text for symbols. Figures in brackets are standard errors of estimates.

Ringstad finds unit value costs to be the dominating explanatory variable for the home market price in all groups of industries. Prices of competing imports are found to have had a significant, but small, impact on home market prices of import-competing industries, which is an impact in the direction expected, and a slight positive impact also on home market prices of sheltered industries, which is understandable. The price of exports seems to have had a small positive impact in sheltered industries, a small negative impact in import-competing industries, and no significant impact what so ever on home market prices of export-oriented industries, which is surprising to say the least.

It is obvious that Ringstad's findings do not support the price behaviour assumptions of the Norwegian model. It is no great comfort that either have his attempts to test a large number of alternative hypotheses about price behaviour given more acceptable results. (One possible explanation could be that his various formulas have failed to capture properly the time structure of the price determination process.) Seen as a whole, Ringstad's findings are not encouraging. Perhaps the main conclusion we can draw is that the problem of how prices are actually determined in various industry groups cannot with any great hope of success be studied by the type of data available to him (implied price indices of the national accounts, annual data).

There are at least two possible sources of data error to be noted. First, the price data in question are strongly aggregated and there is no assurance that price indices observed for sales on the home market, for exports, and for competitive imports will refer to "identical commodities" (or a given commodity mix). Secondly, as Ringstad carefully points out, the alleged output price indices of the national accounts are in fact to a large degree based on cost indices, namely input price indices and wage indices.<sup>1)</sup> This means that there is an amount of spurious correlation between the observations available for the left-hand side variable  $P_H$  of equation (1) and its explanatory (right-hand side) variables.<sup>2)</sup>

1) Since this source of error may be important in other countries as well, Ringstad's figures deserve being quoted as a warning, especially since the national accounts data of Norway are presumably no worse than those of most other countries. He finds input price indices or wage indices to be the empirical basis of "output price indices" used to deflate no less than 43 per cent of total domestic output. Another 12 per cent of total domestic output was deflated by consumers' price indices and 17 per cent by wholesale price indices; these indices are based on directly observed prices for goods and services but are nevertheless unsuitable for the purpose since they reflect the prices of imported as well as domestically produced goods. Only for the remaining 28 per cent of total domestic output were price indices available which, though not always of good quality, were at least conceptually suited for the purpose. To this category belonged unit price indices, sector price indices constructed especially for the national accounts, and implicit sector price indices resulting from estimates at constant prices.

2) This could be a serious source of error. In order to minimize its effects Ringstad omitted from his calculations no less than 47 industries where he knew cost indices to dominate the empirical basis of the output price indices. However, to some extent the same source of error may have affected also the price indices of some of the 70 industries actually retained in his study.

## 5.2 Testing the wage relation

According to the Norwegian model the national wage level is determined by the profitability of the exposed industries (defined in section 2.2 as the ability of these industries to pay out wages and/or profits) which in turn depends on world market prices, foreign exchange rates, and productivities. Indirectly, therefore, the model assumes the national wage level to depend on world market prices expressed in the national currency. The precise form of this relationship has not been spelt out, however. It is therefore difficult to test this particular part of the model and no such test has been attempted in Norway.

However, the large amount of research undertaken during a number of years in many countries to determine a "wage relation" is clearly relevant to the issue. Studies which find wage changes to be related strongly to rates of profits in the exposed industries (or to total profits, since fluctuations in total profits tend to mirror fluctuations of profits in exposed industries) may be said to support the Norwegian hypothesis, while findings that changes in the wage level depend on past price changes and/or the balance of demand and supply in the labor market might seem to speak against it. However, the latter conclusion may not always be well founded since - as was pointed out above - observed price changes and the state of the labor market in the past may both have had a common root in developments abroad.

This is not the place to attempt a summary of the vast literature devoted to the wage relation, nevertheless reference should be made to the study by Nordhaus presenting estimates for seven countries of alternative wage equations based on competing theories of inflation. One of the alternatives studied is supposed to represent the Norwegian/Scandinavian approach which in Nordhaus's formulation is termed "the export-constrained theory" of wage determination.<sup>1)</sup> Nordhaus assumes wages  $w_t$  to be related to current and past import prices  $p_t$  by

$$(2) \quad \Delta \ln w_t = m_0 + m_1 (0.5 \Delta \ln p_t + 0.033 \Delta \ln p_{t-1} + 0.17 \Delta \ln p_{t-2})$$

He finds the import price coefficient  $m_1$  to be large and significant for Japan, Sweden and the United Kingdom "indicating that it could have a large effect on wages" but small and sometimes insignificant for Canada, France, West Germany and the United States. When comparing (2) with some other equations, including equations based on the monetarist viewpoint and the Phillips curve, Nordhaus finds the export-constrained theory of wage determination to out-perform the monetarist theory in all cases and the Phillips curve approach in all cases except Canada and the United States and possibly West Germany. For small to medium open economies, therefore, Nordhaus' study gives considerably support to a vital part of the Norwegian model.

## 5.3 Testing the model as a whole

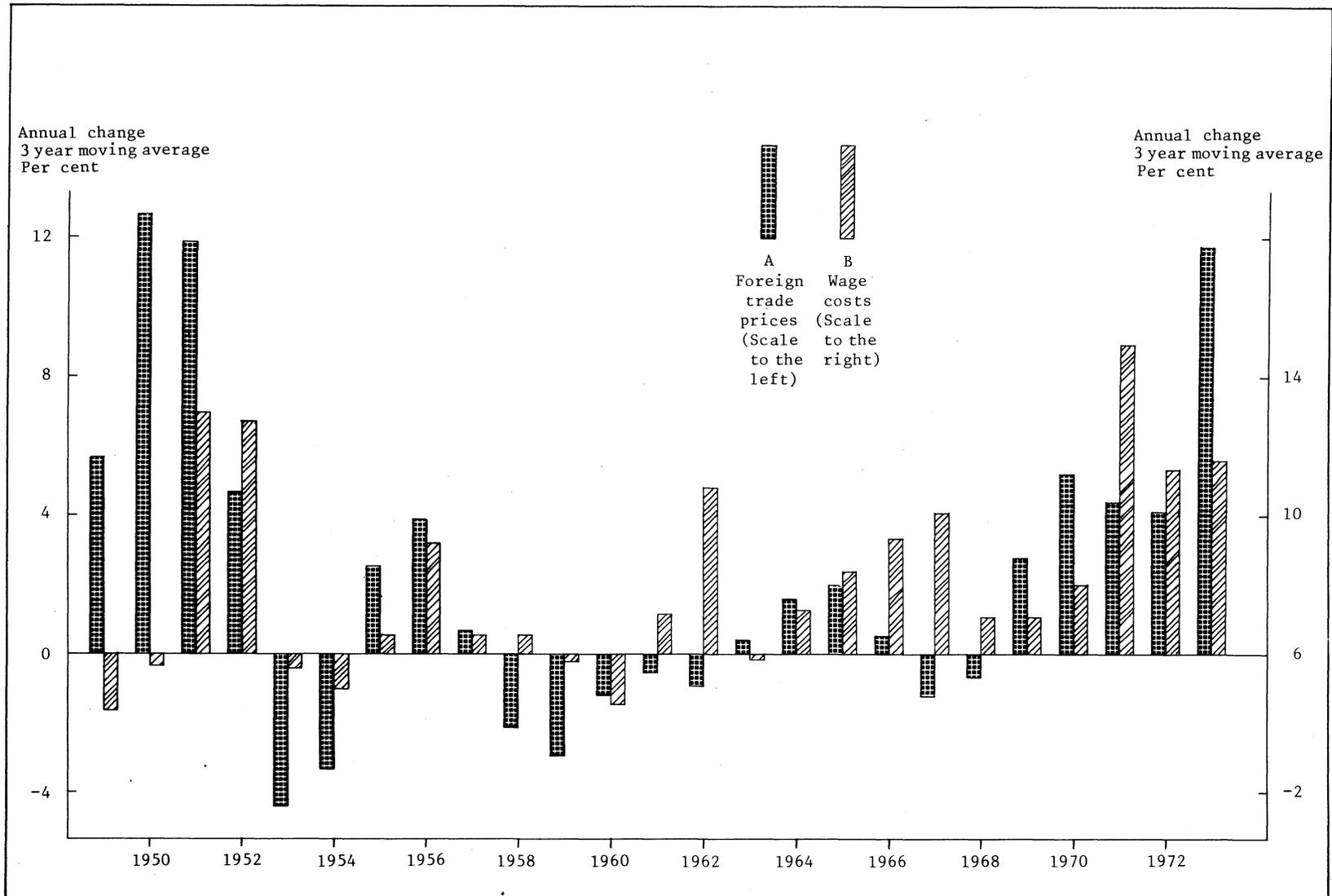
No attempt has been made, so far, to make the Norwegian long-run model as a whole the subject of a formal, econometric test. One reason for this is that the model has not been given the strict mathematical formulation required by such a test.<sup>2)</sup> In particular the wage equation implied by the model has not been explicitly spelled out. Furthermore, for the time being a test would be hampered by lack of data since an on-going revision of the national accounts has caused a serious break in all relevant time series in 1967.

However, the post-war Norwegian history of wages and prices seems to suggest that the model might be expected to survive an empirical test reasonably well. There are clear indications that the chain of causation in the past has run from world market prices and exchange rate policy, via the wage determination process, to the national price level. Thus, the assumed relationship between foreign trade prices and the wage level shows up quite well in diagram 3, and the relationship between wages and prices is obvious from other material. We note in particular:

1) Nordhaus [16] p. 451 ff.

2) The mathematical formulation of the long-run model given by Holte in [12] is intended to serve pedagogical purposes. It is too simplified to provide a starting-point for a serious testing of the Norwegian approach.

Diagram 3. Foreign trade prices and average wages. Norway 1949-1973



A: Annual percentage changes in prices of traded goods (average of export and import prices for commodities, 3 year moving average). Scale to the left.  
 B: Annual percentage changes in wage costs per man-year worked, national average. Scale to the right.

- The devaluation of the Norwegian krone in 1949, together with the international inflation following the Korean war shortly afterwards, caused Norwegian import and export prices for commodities, expressed in kroner, to rise some 40 per cent from 1949 to 1952. There seems to be an obvious link between these developments on the one hand and, on the other, the extremely high profits of the exposed industries in 1951 and 1952 and the steep rise of wages and prices (something like 13 and 10 per cent respectively, annual averages) during the 3 years following the devaluation.
- There has been only one period during the post-war years when the trend of export and import prices has been downward for any length of time. This happened in 1957-1963 when prices of commodity exports and imports fell by approximately 2 per cent a year on average. This was the period when the rate of post-war wage- and price-inflation was at its minimum (8 per cent and 2.5 per cent respectively, annual averages).
- After some years (1963-1970) of moderate increases in import and export prices and in the national wage and price level, world market prices rose more steeply in 1970 and 1971 and soared in 1973 and 1974; import and export prices, expressed in kroner, rose by 25-30 per cent from early 1973 to middle of 1974. The profitability of the exposed industries improved greatly and the wage- and price-inflation accelerated.<sup>1)</sup> On a year-to-year basis the wage increase is estimated at 13.5 per cent in 1974 and may reach close to 20 per cent in 1975; the corresponding figures for consumers' prices are 9.5 per cent for 1974 and 11-12 per cent for 1975 according to official forecasts. Yet the recent rate of inflation in Norway has been somewhat lower than in the majority of other European countries, a fact which may have been an effect of the appreciation since 1972 of the Norwegian krone relative to other currencies by somewhat more than 10 per cent.

The short-run model PRIM was tested against historical data 1961-1968 in Aukrust [1]. Since PRIM, to repeat, takes changes in the wage level to be given, a test of this model can neither confirm nor refute the central thesis of the Norwegian approach which is that world inflation is imported via the wage level. However, the tests did throw light on other aspects of the model: They showed, for instance, that PRIM tended systematically to underestimate the price increase from one year to the next by some tenths of a percentage. The reason for this was that prices of competing manufacturers did not in fact follow prices of similar imported goods, as is assumed by the model, but rose somewhat more steeply; this is consistent with Ringstad's later finding, quoted above, that output prices of competing manufacturers seem to depend as much, or more, on costs than on import prices. The tests showed also that non-negligible prediction errors resulted from the postulated stability of the ratio of profits to wages in the sheltered industries. These errors were not systematic, however, and may simply mean that the assumption made about cost-plus pricing in the sheltered industries could be represented in the model by a better operational specification.

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1) However, the chain of causation in this case has been disputed. It may be noted that OECD, in its country report on Norway published in 1973, concluded that the recent price history of Norway did not support the Norwegian theory of inflation as interpreted (much too restricted and simplified, I think) by OECD: "The analysis . . . . leads to the conclusion that, at least in the past two years, the rate of domestic cost and price inflation has been well in excess of anything that could be ascribed to import of inflation from abroad . . . . The explanation therefore needs to be sought primarily in domestic factors". [18], p. 14. However, in the OECD country report for Norway published in 1974 the authors seem to have come around to accept the view argued in the present paper, at least as far as 1973 is concerned: "Given the absence of excessive demand pressures and "aggressive" wage policies at home, it seems that the transmission of inflation from abroad was the key element behind the high rate of price and cost increases in 1973. . . . The strong inflationary tendencies abroad have, thus, not only directly raised the level of prices in Norway but could also indirectly have added to cost and, hence, price pressure through weakening the resistance of employers to higher wage claims in the export and import-competing industries and inducing higher wage demand in the sheltered sector of the economy. An important part of the 1973 wage drift can probably be explained by this form of international transmission of inflation". [19], pp. 15 and 19.

#### 5.4 Testing the model by data from other countries

A considerable amount of empirical data on which to test the Norwegian approach when applied to the Swedish economy is available in Edgren, Faxen and Odhner [6] and [7]. Their findings are not easily summarized. However, it is obvious that their study of the recent wage and price experiences of Sweden has convinced them that the approach has considerable explanatory power. Work to construct a model along the same lines as PRIM has been undertaken in Finland and some test results are reported in Halttunen and Molander [11], see section 6.2. It is known also that the research on the applicability of the Norwegian approach to other economies is under way in other small European countries. Results from these studies will be of great interest as they become available.

### 6. DISAGGREGATED MODELS OF OTHER COUNTRIES

Disaggregated models intended for the analysis of wages and prices, often with an input-output basis, have become available for many countries during the last few years. This section does not aim at a complete survey. It has a look at a few of them, the focus being on the assumptions which these models make with respect to price behaviours and wage determination.<sup>1)</sup>

#### 6.1 The Swedish EFO-model<sup>2)</sup>

In Sweden the well-known "EFO-model", named so after its authors, follows the Norwegian model by starting off from a two-way classification of industries into a "sheltered" and "exposed" sector with further sub-divisions.<sup>3)</sup> Output prices of the exposed sectors are assumed to follow world market prices although data shows the relationship not to be an exact one. Output prices of the sheltered sectors result from cost-plus pricing: "In industries sheltered against foreign competition, pricing is mainly determined by the developments of costs . . . . Our estimates show a striking constancy in the share of the operating surplus in the sector product of the sheltered sector as a whole." ([7], pp. 10-11). This constancy implies a constant rate of profit. An interesting suggestion, which we shall meet again in models for other countries, is that the "normal" rate of profit of the sheltered industries is the rate which is necessary to maintain investment, production and employment in these industries. See [7], pp. 22-23.

The wage level is assumed, as in the Norwegian model, to be determined through a mechanism geared to developments in other countries: "The industries exposed to competition have long been wage leaders in the Swedish labor market . . . . The whole wage level in the country therefore has depended strongly on what the competing industries have been able and willing to pay". . . . "From the competing sector wage impulses proceed to the sheltered industries, both through the market mechanism . . . . and through the wage policy based on the solidarity principle. The market mechanism makes itself felt both in wage negotiations and through wage drift . . . ." See [7], pp. 22. This description is very similar to the argument given in section 2.2 above. However, in its discussion both of the wage determination mechanism and of other parts of the model the Swedish study is much more elaborated than its Norwegian ancestor; in particular, fluctuations in quantities are considered explicitly. The Swedish study is very useful, therefore, in pointing out modifications which could be made to the basic assumptions of the two models.

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- 1) In addition to the models described in the text a disaggregated model intended for the study of intersectoral wage- and price interdependencies is being developed for the Netherlands by Driehuis and de Wolff, see [5]. Four sectors are distinguished, viz. manufacturing, services, building, and agriculture.
  - 2) In Sweden the work of the Aukrust-committee in Norway in 1966 soon inspired research along similar lines. A brief report by the chief economists of the labor market organizations, (Edgren, Faxen and Odhner) in 1969, see [6], was followed by a much extended report by the same authors in the form of a book in 1970, see [7].
  - 3) Within the sheltered sector group five sub-sectors are distinguished: 1. Sheltered goods production. 2. Government services or services under strict governmental control. 3. Building. 4. Private services. 5. Government sector. Within the exposed sector group there are four sub-sectors: 6. Raw material production exposed to competition. 7. Semi-manufactured goods production for export. 8. Import-competing production. 9. Finished goods production.

## 6.2 A quarterly model for Finland

A quarterly model for Finland, constructed at the Bank of Finland, contains as a central feature a production-price-income block built around an input-output framework, see Halttunen and Molander [11]. The structure of the block is similar to the structure of PRIM which inspired it. Four sectors are distinguished. Two of these are "sheltered" sectors: 1. Agriculture and 2. Non-competitive production (services, a few branches of manufacturing) and two are "exposed" sectors: 3. Forestry and 4. Competitive production (bulk of manufacturing). Agricultural prices are stipulated in income negotiations between organizations of farmers and government and are exogenous. Prices of non-competitive industries are endogenous and result from a mark-up policy: "In the non-competing industries it is assumed that the share of non-wage income of all factor incomes (read "share in total factor income", my remark) is left unchanged apart from the long-run decreasing trend and fluctuations caused by changes in capacity utilization" (p. 227).<sup>1)</sup> Prices of forestry are exogenous, reflecting world market conditions for wood products. Prices of competitive production are also assumed to be mainly determined by world market prices, i.e. export and import prices. However, no significant effect of import prices on the output price of this sector was found in the estimations attempted. On the other hand unit labor cost was found to have a positive effect, indicating - as was found by Ringstad for Norway - that the output prices of exposed industries even in a small country are influenced in part by costs and not entirely by prices given on the world market. - The wage relation of the Finnish model appears to rely on past prices and the unemployment rate in the tradition of the Phillips curve.

## 6.3 The French Fi-Fi model

In French planning a distinction between "sheltered" and "exposed" industries was introduced for the first time in 1965 by R. Courbis (who was obviously not aware that the same distinction was already in use in Norway). Since then, the distinction has been a permanent feature of French models.<sup>2)</sup>

The distinction is also made in the French planning model Fi-Fi which is used at present in preparing projections for the medium term. Fi-Fi distinguishes between seven sectors, classified into three broad groups which are supposed to differ with respect to determination of prices and production. The following assumptions are made about prices: Sectors under public control (agriculture, energy, transport, housing): Output prices are assumed to be exogenous to the model. They are fixed either as part of the agricultural policy of the European Common Market or as instruments of the economic policy of the French State. Sheltered sectors (agricultural and foodstuffs industries; building, services and trades): These sectors are subject to weak competition from abroad. Therefore, "production is determined by demand (which is, of course, a function of the price level) and prices adjust themselves to a level such that there is compatibility between available self-financing and the requisite investments" ([4], p. 36). There is an idea here which we noted already in the Swedish approach and which we shall meet again in Eichner's model for the US to be discussed shortly, namely that the profit rate (the percentage mark-up on costs) used by the sheltered industries in calculating their output prices depends, somehow, on the need of these industries to finance their investments.

1) Using the unemployment rate (LUR) as a rough indicator of capacity utilization the percentage share of non-wage income in factor income is expressed as a function of time (T) and LUR by the following equation

$$\frac{\text{non-wage income}}{\text{factor income}} = 45.693 - .160T - .507LUR$$

meaning that the non-wage share falls (and the wage share increases) when unemployment rises (implying lower capacity utilization). This may be an improvement compared with PRIM where the non-wage share is supposed to depend on time only. The Finnish refinement is possible since the Finnish model, in contrast to the early versions of PRIM, determines production and employment simultaneously with prices and incomes.

2) The literature on French planning and the models on which it is based is extensive. However, most of it is in French. The information given in the present paper is based on Raymond Courbis [4].

Exposed industries (the majority of manufacturing industries): "Domestic producers exposed to keen foreign competition must bring their prices into line with those of their keenest foreign competitors or lose their customers" ([4], p. 10). This being so, "price is a fixed datum for exposed enterprises; the latter have to fall into line with the prices laid down by their more competitive foreign rivals ([4], p. 39).

The rate of increase of the average wage level is supposed in Fi-Fi to depend on (i) the unemployment rate, (ii) the rate of rise in prices and (iii) something called, for short, "the financial situation of enterprises".<sup>1)</sup> Courbis ([4], p. 29), gives the following relationship estimated from annual data 1957-1967.

$$(3) \quad TXH_t = 8.10 + 0.53TPG_t - 0.15TPG_{t-1} - 3.68 \left( \frac{DENS}{PA_t} \right) \\ (1.22) \quad (0.09) \quad (0.12) \quad (1.61) \\ + 2.67RAP_t + 0.04 (A_{t-1} - \bar{A}_{t-1}) \\ (1.31) \quad (0.05) \quad r = 0.972$$

where TXH and TPG respectively stand for the growth rate (in per cent) of the hourly wage rate and for that of the general level of prices in relation to the previous year; DENS/PA is a measure of relative unemployment (DENS = number of job seekers, PA = total available working population); RAP is a dummy variable intended to take into account the arrival of repatriates from Algeria in 1962-63; and the last term represents the "financial situation of enterprises". (A is the effective rate of self-financing and  $\bar{A}$  the trend-oriented rate of self-financing of private-law corporations; and t is the year considered). Equation (3) indicates that the rate of growth of the wage level is sensitive to unemployment and past price changes and rather unaffected by "the financial situation of enterprises". It therefore seems to uphold the Phillips curve approach to inflation. However, unemployment may itself depend on wages since high wages may mean low competitiveness and a low demand for labor. The French approach, if I have understood it correctly, interprets (3) as part of a large equilibrium model establishing a link between the wage level and the given output prices of the exposed industries (and, of course, all other exogenous variables of the model).<sup>2)</sup>

#### 6.4 A three-sector model of the United States

The process of wage and price determination in a big economy with little dependence on foreign trade - the United States - is analysed in Eichner [8] in terms of three broad sectors called the competitive sector, the oligopolistic sector, and the (private and public) services sector respectively. Prices are assumed to be determined differently in the three sectors. In the competitive sector (agriculture and a minority portion of manufacturing) output prices are determined through the interplay of supply and demand. In this sector fluctuations in aggregate demand conditions are quickly reflected in fluctuations in prices. In the oligopolistic sector (comprising

- 1) This somewhat loose concept apparently plays about the same role in Fi-Fi as does the equally loose concept of "profitability" in the Norwegian long-run model.
- 2) "The French data thus confirm the results of Phillips analysis according to which there is a negative link between an increase in the wage rate and the unemployment rate. This assumed link, determined for high and low unemployment rates alike, expresses the fact that the labor market is not in equilibrium. It plays a part in regulating wages and the level of employment: any increase in unemployment tends to put a brake on wage growth; this lowers costs and consequently boosts the output of the "exposed" sectors, checks the rise in prices and increases the demand in "sheltered" sectors; the new jobs created by this additional activity counteract the upward trend of unemployment and the brake put on wages. The opposite effects occur where the trend is towards over-employment. Since the prices of "exposed" enterprises are dictated by more competitive foreign producers, the ex post wage trend is in fact determined by this price constraint, account being taken of vulnerable enterprises' costs other than wage costs; this being so, everything happens as though relation (1) given above did in fact determine the rate of unemployment in a state of equilibrium; if the unemployment rate was lower (higher) there would be a quicker (slower) rise in wages, which would weaken (strengthen) the competitive position of exposed enterprises and depress (stimulate) employment." See [4], p. 31.

industries dominated by a few large corporations) output prices are "administered prices": They are set by the producers so as to cover their costs as well as a certain margin above those costs. Costs generally depend on prevailing wage rates in the society. The margin above costs is chosen so as to generate an income high enough to cover dividend payments and, in addition, "the funds out of which the megacorp is able to finance its own internal rate of growth" (p. 81). Thus, as was the case with the sheltered sectors in the French model, the margin chosen depends on the amount of investment needed to allow the industry in question to expand as required by the general growth rate of the economy. Prices are virtually unaffected by short-run changes in aggregate demand conditions, contrary to what they are in the competitive sector. In the services sector, where inputs other than labor are likely to be insignificant, prices are determined largely by the prevailing wage rate: Again they are unaffected by aggregate demand conditions.

The model does not explicitly set out a wage relationship. Roughly the wage determination mechanism appears to work as follows: The oligopolistic sector is wage leader. In this sector "trade unions have the predominant voice in determining wage rates - at least in nominal terms" (p. 89) (steel, automobiles). The basic wage rate established by trade unions in the oligopolistic sector spills over to other sectors and govern the basic wage rate in the competitive and service sectors (p. 84). Taken as a whole, the model seems to consider the basic wage rate of the economy an "administered price" which is set at the discretion of the trade unions. There is nothing in the model to restrict the power of the trade unions either upwards or downwards since wage changes are passed on into prices by all sectors. As it stands at present, therefore, the model would seem to leave the level of wages and prices, and the rate of inflation as well, totally undetermined.

#### 6.5 A dynamic Australian model

All models considered so far have been static. A noteworthy attempt to construct a dynamic, disaggregated model of wages and prices has recently been made by B.D. Haig and M.P. Wood for the Australian economy and presented in [10]. The model is basically a closed input-output system which describes the transmission of price changes between different industry sectors and, in addition, relates changes in costs of production to changes in final prices. Prices are either exogenous or determined by a mark-up on historical costs of production, and prices of outputs of industries are, therefore, based on costs of production in a previous period. This results in a dynamic input-output system in which increases in costs are passed on as increases in selling prices of industries, after a delay. The model is closed by equations which relate changes in wages and profits to previous changes in prices of sales to final buyers. Some allowance is also made, however, for the influence of demand factors on wages and prices.

The model distinguishes between 23 industries which with respect to price behaviour are divided into four broad groups. In primary industries (agriculture, pastoral and mining), which in Australia are strongly export-oriented, output prices are assumed to be exogenous and "determined by world prices or seasonal conditions" (p. 5). In manufacturing industries prices are obtained by applying a constant per cent mark-up to the historical cost of the goods sold. Costs of material are assumed to be passed on by the period of stock turnover (estimated to 2-8 months for different industries) and costs of wages by the period of turnover of work-in progress (1-2 months). In trade selling prices are obtained by applying a constant per cent mark-up to the price of goods for resale. The turnover period for sales to final buyers (estimated at 2-8 months depending on the product) is assumed to represent the lag in passing on increases in costs to consumers. In other services output prices are also obtained by applying a constant mark-up on historical costs, assuming increases in costs to be passed on with a lag of 1 month<sup>1)</sup>.

1) In commenting on some of their test results the authors point out possibilities for improving the assumptions made. For instance, they make the point that since the transport industry is largely government owned, prices of this industry should perhaps be considered an exogenous variable determined by policy decisions. Similarly, they argue, the output prices of some manufacturing industries which in the 1970'es were subject to intense competition from overseas (e.g. household appliances) should perhaps also be considered exogenous variables, determined in this case by world market prices.

The model contains two equations which, together, determine the wage rate. One equation makes "nominal" (= negotiated) wages a function of prices and thus, according to the authors, complete the wage-price spiral; the best fit was obtained by assuming a two quarter lag between changes in retail prices and "nominal" wages. The second equation explains the wage drift (the excess of actual over "nominal", or negotiated wages) in terms of excess demand for final goods, thus introducing demand elements into the explanation of inflation. The reasoning, if I understand it correctly, is as follows: Assume an initial increase in "nominal" (= negotiated) wages. This will immediately increase the money value of the demand from employees for consumers' goods, but be reflected in the prices of such goods only with some delay. Therefore, real demand will have gone up, sales will increase in volume terms, producers will hire more labor and thereby perhaps (depending on the state of the labor market) bid up wages. The model therefore assumes the size of the wage drift to be positively related to the real wage in past quarters (representing demand for final goods) and negatively related to the unemployment rate (representing the state of the labor market). Actual wages are supposed to change at the same rate in all sectors. Apparently no sector is considered more important than any other in the wage determination process.

#### 6.6 A summary of assumptions on price behaviour

Before concluding this section it may be helpful to present a summary picture of the assumptions made about price behaviour in the various models which have been surveyed, see the exhibit below. The main impression that we are left with is one of considerable diversity. Yet certain noteworthy features stand out.

Perhaps the most striking fact is that in only one model - Eichner's for the United States - is it assumed that demand in commodity markets has a significant effect on output prices, and even in this model this is supposed to be the case for only a few of the industries. In the large majority of cases prices are assumed to be determined either on the world market, with no influence from the national

Assumptions made about price behaviour in selected disaggregated models

Model	Prices exogenous, given by:			Prices endogenous Type of relation:	
	World market	Oligopolistic pricing	Government agreement	Mark-up pricing	Domestic demand
PRIM (Norway)	Shipping Forestry Manufacturing <sup>1)</sup>		Agriculture Fishing	Sheltered (excl. agriculture)	
EFO (Sweden)	Manufacturing <sup>1)</sup>			Sheltered (incl. agriculture)	
Bank of Finland (Finland)	Forestry Manufacturing <sup>1)</sup>		Agriculture	Sheltered (excl. agriculture)	
Fi-Fi (France)	Manufacturing <sup>1)</sup>		Agriculture Energy Transport Housing	Sheltered (excl. agriculture)	
Eichner (US)		Oligopolistic sector <sup>2)</sup>		Services sector	Competitive sector (incl. agriculture)
Haig & Wood (Australia)	Primary sector <sup>3)</sup> (incl. agriculture)			Manufacturing Trade Services	

1) Mining included, but excluding a small part of manufacturing industries which is classified among sheltered industries.

2) Part of manufacturing, in other models classified as exposed.

3) Agriculture, forestry, mining incl. base metals.

economy, or through some process or mark-up pricing. Some of the models explicitly acknowledges the fact that the output prices of some industries - notably agriculture and government services - are fixed through a process of negotiations or by government decree and, consequently, treat these prices as exogenous whereas the same prices in most other models are treated as cost-determined. (However, this difference in approach is unlikely to be of importance in practice since these output prices will presumably be fixed with close reference to costs even though they are formally subject to negotiations or government decisions.)

Agricultural prices are treated as determined by market demand and supply forces only in two cases: By the models for the two countries, Australia and the United States, that are big exporters of agricultural products.

A point to be noted is, finally, the differences in assumptions made about the price behaviour of manufacturing in the model for the United States and the remaining models. In the model for the big, almost closed US-economy the output price of this sector is assumed to result from oligopolistic pricing, and there is no reference what-so-ever to the existence of a world market. For all the smaller, open economies (except Australia, where cost-plus pricing is taken to be the rule) the models assume the output prices of manufacturing to be determined mainly on the world market. In the models for these countries there is no reference to the possible oligopolistic power of national industries. We may assume this asymmetrical treatment of manufacturing to be more than accidental: Presumably the assumptions made are useful first-order approximations to reality in big and small economies respectively. Yet one suspects that, if a more realistic multi-national model is to be constructed, some assumption midway between the two extremes should be adopted.

## 7. SUGGESTIONS FOR FURTHER RESEARCH

No country can avoid being hit by price impulses from abroad. I have argued that these price impulses are sometimes so strong as to dominate the trend of wages and prices at the national level. The conclusion I draw is that future research on inflation should be oriented more explicitly towards the problems of the open economy and the transmission mechanism of international inflation. I believe, furthermore, that continued work based on highly aggregated models will give rapidly diminishing returns. A rather disaggregated approach seems to me to become a necessity if we are to gain a deeper insight into the inflationary process.

At the national level a natural point of departure for research on inflation may be to take international developments of wages and prices as a datum. The aim will be to design models which will explain national price trends in terms of national policies and price impulses reaching the economy from outside. At the international level this will of course not do. Instead, if we are to understand world inflation, we must develop models which reflect fully the interdependencies of the economies of the world and which will explain world prices in terms of policy decisions taken simultaneously, but independently, in many economies.<sup>1)</sup>

The ultimate goal of our endeavours might be, conceivably at least, to design a family of partly dependent, interlocked national models of inflation. Used separately, each model would allow partial analysis at the national level, assuming world market prices to be given. Used together, the models would form a world model allowing a general analysis of world prices as determined through independent national policy decisions. As I foresee them, the national models will all have to have some kind of an input-output basis.

1) Research along these lines has already started in some quarters. Particularly well known is the continuously developing project LINK on which quite a large literature exists. Two other projects, both explicitly addressing themselves to the problem of generation and international transmission of inflation and covering the member countries of the European Common Market, were reported at a conference organized in November 1974 in Wien by the Institut für Volkswirtschaftslehre, Technische Hochschule, Wien, see [2] and [23].

The present paper suggests three directions in which empirical research should proceed in order to allow the national models to be gradually improved:

a. Attempts to design a suitable sector-sector (or sector-commodity) classification for use in disaggregated price models. It may well be that the optimal classification of sectors will be different for different countries. There are a number of different considerations to be taken into account. For instance: (i) the sector classification should reflect existing differences in price behaviour amongst industries, in particular the varying degree to which industries are exposed to foreign competition, (ii) the sector classification should be suitable for an analysis of the wage determination process, e.g. industries considered wage leaders should be singled out for special study, (iii) the sector classification should be suitable for an analysis of the different routes (price effect, demand effect, liquidity effects) through which foreign inflation hits the economy, (iv) since the national model is to be part of a larger world model it may be useful to distinguish between, on the one hand, industries whose output prices are determined on the world market through forces of demand and supply and, on the other, industries characterized by oligopolistic pricing. - There is no guarantee that the various considerations are not conflicting. Consequently, an analytically suitable classification must be selected on the basis of experiments.

b. Empirical studies of price behaviour. Our understanding of how commodity prices are determined in the real world is insufficient at present. We do not know for sure the extent to which commodity prices are the result of forces of demand and supply operating "in a free market" and to what extent they are "administered", resulting from cost-plus pricing. Nor do we know, in the latter case, how prices are calculated. A realistic formulation of the price behaviour relationships require more research to provide the answers to these questions.

c. Empirical studies of the wage determining process. Perhaps the greatest hindrance at present for the construction of a realistic model of inflation is our inability to formulate a reliable wage relation (or set of wage relations). For reasons set out in the text I find the Phillips-type explanation of wages (linking wages to some employment indicator and, perhaps, past prices) highly unsatisfactory. If we are to be realistic, we must consider the wage rate to be determined, simultaneously with other variables amongst them employment, through a process which it would take some very complicated model to describe. At the national level the exogenous variables of such models, on which wages like everything else would be seen to depend, would include national policy variables and world market variables. Again a disaggregated approach could be attempted, focusing primarily on the forces operating within the wage leading industries.

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