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**INFLATION IN THE
OPEN ECONOMY:
A NORWEGIAN MODEL**

By Odd Aukrust

**INFLASJON I EN ÅPEN ØKONOMI:
EN NORSK MODELL**

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PREFACE

This paper was written in 1975 at the invitation of Brookings Institution, Washington D.C., as part of a research program on world-wide inflation. The paper was discussed at a conference which took place at Brookings the same autumn. The proceedings from this conference are now available in a volume published by Brookings. The Central Bureau of Statistics of Norway is grateful to Brookings Institution for permission to reprint this paper.

The ideas contained in the models of this paper grew out of research work undertaken at the Central Bureau of Statistics of Norway during the early 1960s. 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 inntektsoppkjørene 1966) were Chairman Odd Aukrust, Fritz C. Holte, Agricultural College of Norway, and Gerhard Stoltz, Norwegian School of Economics and Business Administration. The committee produced two reports. The first of these contained the multisector, short-term model summarized on pages 113-117 (see also note 16). 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 on pages 117-122 (see also Innstilling II fra Utredningsutvalget for inntektsoppkjørene i 1966, avgitt 20. oktober 1966 [Second Report of October 20, 1966, by the Reporting Committee for the 1966 Income Settlement] Oslo: Office of the Prime Minister, 1967).

Central Bureau of Statistics, Oslo, 23 June 1977

Odd Aukrust

FORORD

Denne artikkelen ble skrevet i 1975 på oppdrag fra Brookings Institution, Washington D.C., som ledd i et forskningsprogram om inflasjonsproblemet i verden. Artikkelen ble lagt fram på en konferanse ved Brookings samme høst. Referat fra konferansen foreligger nå i bokform. Statistisk Sentralbyrå uttrykker sin takk til Brookings Institution for tillatelse til å trykke opp igjen artikkelen.

De modeller som blir diskutert i dette arbeid inneholder ideer som opprinnelig ble utviklet i Statistisk Sentralbyrå tidlig i 1960-årene. Den grunnleggende sontring mellom skjermede og konkurranseutsatte sektorer ble således brukt for første gang i Økonomisk utsyn 1962. Selve modellene ble formulert og publisert i 1966 av Utredningsutvalget for inntektsoppgjørene 1966, et utvalg som hadde i oppdrag å legge til rette bakgrunnsmateriale for inntektsoppgjørene i 1966. Medlemmer av utvalget var Odd Aukrust (formann), dosent Fritz C. Holte, Norges Landbrukshøgskole og professor Gerhard Stoltz, Norges Handelshøyskole. Utvalget leverte to rapporter. Den første av disse (Innstilling fra Utredningsutvalget for inntektsoppgjørene 1966, avgitt 22. januar 1966. Statsministerens kontor 1966) inneholdt korttidsmodellen PRIM, som er beskrevet i sammendrag på sidene 113-117 i det følgende. Den andre rapporten (Innstilling II fra Utredningsutvalget for inntektsoppgjørene i 1966, avgitt 20. oktober 1966. Statsministerens kontor 1967) var en analyse av årsakene til prisutviklingen i Norge på lengre sikt; denne rapporten inneholdt den langsiktige to-sektor-modellen beskrevet på sidene 117-122.

Statistisk Sentralbyrå, 23. juni 1977

Odd Aukrust

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Odd Aukrust, Statistisk Sentralbyrå, points out that the ideas contained in the models of this paper grew out of research work undertaken at the Central Bureau of Statistics of Norway during the early 1960s. 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 inntektsoppgjørene 1966*) were Chairman Odd Aukrust, Fritz C. Holte, Agricultural College of Norway, and Gerhard Stoltz, Norwegian School of Economics and Business Administration. The committee produced two reports. The first of these contained the multisector, short-term model summarized on pages 113–17 (see also note 16). 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 on pages 117–22 (see also *Innstilling II fra Utredningsutvalget for inntektsoppgjørene i 1966, avgitt 20. oktober 1966* [Second Report of October 20, 1966, by the Reporting Committee for the 1966 Income Settlement] Oslo: Office of the Prime Minister, 1967).

TWO CONSIDERATIONS have determined the direction of this paper. One is a recognition that the developments of prices and incomes in small and medium-sized economies are 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 open economies. The other is a belief that a disaggregated type of analysis is needed if one is to understand better the network through which exogenous price impulses, whether originating at home or abroad, are propagated through the economy.

Work in the Nordic countries on problems of price trends and income distribution has recognized the need for disaggregating the analyses and, 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 mechanism of price and income distribution.

The Norwegian Model: A Brief Presentation

I shall begin by outlining two variants of such disaggregated models—a two-sector version for the long run and a multisector version for the short run—that have been in use in Norway since 1966. The ideas contained in these models grew out of research undertaken at the Central Bureau of Statistics of Norway during the early 1960s.

Sheltered and exposed industries

In Norwegian economic thought a fundamental distinction is drawn between sheltered and exposed industries.

Exposed industries (E industries) are those that 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 for-

eign competition. Mining, most manufacturing industries, shipping, and, in some countries, agriculture are typical examples of this category.

Sheltered industries (S industries), on the other hand, are those whose products are marketed at home under conditions that leave them relatively free of foreign competition.¹ Building and construction, power generation, a few manufacturing industries, and most service industries belong to this category. Because no clear-cut line of division exists between exposed and sheltered industries, arbitrary decisions are unavoidable when distinguishing between the two groups in actual model building. According to the classification used at present in Norway, the exposed industries contribute approximately 30 percent of net national product and employ some 22 percent of the labor force.²

There are two reasons why a distinction between sheltered and exposed industries is crucial in an analysis of prices and incomes. First, the two groups of industries show marked differences in price behavior. 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 absorb the whole effect in the form of reduced profits and perhaps reduced production.³ The sheltered industries are in a different position. Because 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 (for example, as a result of higher wages) are passed on quickly by the sheltered industries in a way that leaves the share of profits

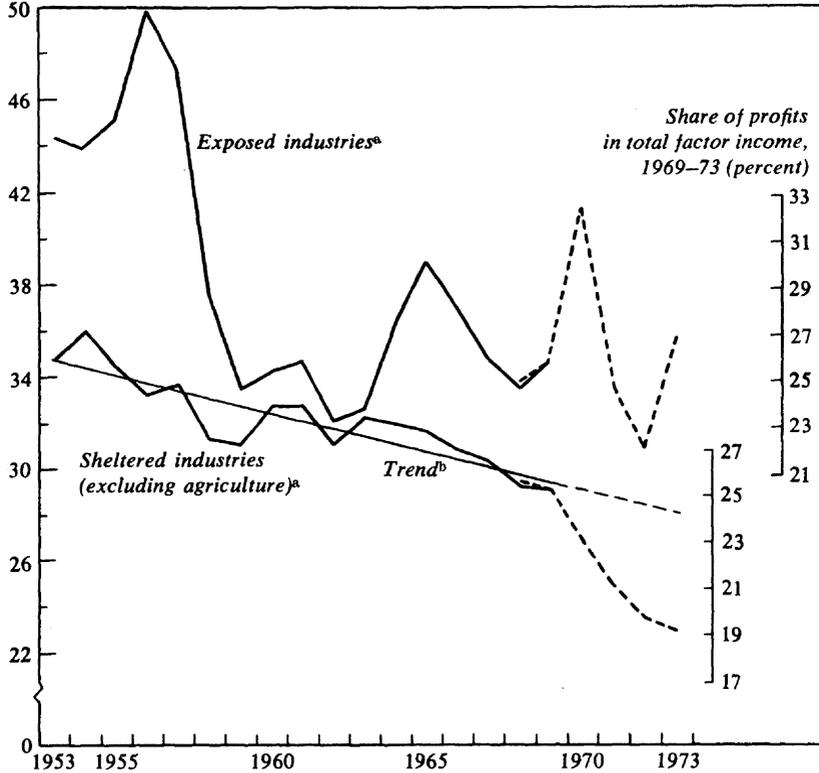
1. Either because of the physical nature of their products or because of government protection. The fact that they are relatively free of foreign competition does not mean, of course, that firms within these industries do not compete on prices among themselves. It does mean, however, that as a group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

2. Because the exposed industries will typically consist of nonsubsistence agriculture, mining, and part of manufacturing, the contribution to total product of these industries in most developed and semideveloped economies may be expected to be of the order of magnitude of 30 percent, as was found for Norway. One would expect the share of the exposed industries in total employment to be about the same size, whereas in Norway it is in fact significantly smaller; this is probably because the exposed industries in 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 at 28.5 percent of total product and their share in total employment at 30 percent. (See Gösta Edgren, Karl-Olof Faxén, and Clas-Erik Odhner, "Wages, Growth and the Distribution of Income," *Swedish Journal of Economics*, vol. 71 [September 1969] pp. 133-60.)

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

Figure 1. *The Share of Profits in Total Factor Income (Wages plus Profits), Norway, 1953-73*

Share of profits in total factor income, 1953-69 (percent)



Source: Adapted from Odd Aukrust, "PRIM I: A Model of the Price and Income Distribution Mechanism of an Open Economy," *Artikler*, no. 35 (Oslo: Statistisk Sentralbyrå), p. 25.

a. Solid line: data based on the old national accounts data for 1953-69 and the old sector classification used in PRIM I (scale to the left). Broken line: revised national accounts data and modified sector classification used in PRIM II (scale to the right).

b. The trend line is estimated from the old national accounts data and is based on the old sector classification used in PRIM I. The dotted line is an extrapolation of this trend.

in factor income largely unaffected.⁴ It can be seen from figure 1, that for the sheltered industries as a group this share has fluctuated only moderately from one year to the next, following a downward trend that may be taken to reflect

4. The same observation has been made for Sweden (Edgren and others, "Wages, Growth and the Distribution of Income"), and for Finland (Hannu Halttunen and Ahti Molander, "The Input-Output Framework as a Part of a Macroeconomic Model: Production-Price-Income Block in the Bank of Finland Quarterly Econometric Model," *Kansantaloudellinen aikakauskirja [Finnish Economic Journal]*, vol. 68, no. 3 [1972], pp. 219-39.) Fluctuations of the profit share around the trend may be due to fluctuations in capacity utilization, a point that has been explicitly built into the Finnish model.

the decreasing number of employers and self-employed relative to the number of employees within the group.⁵ 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.

Second, for technological reasons, another important difference between the two industry groups exists with respect to productivity trends. It has been found in Norway that output per man has risen much more rapidly 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 1957–69, product per man-year increased by 6.3 percent (annual average) within the exposed industries as a whole, but by no more than 2.4 percent within the sheltered industries.⁶ (The picture would not change if product per man-hour were used as the productivity measure.) This means that the exposed industries are better able to absorb wage increases without affecting prices and profits than the sheltered industries.⁷

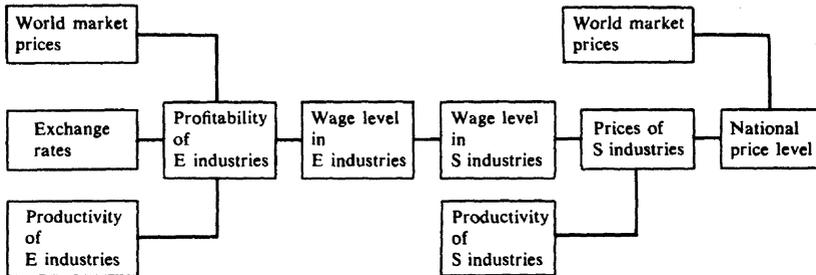
5. In regard, however, to individual industries within the group the relation no longer holds. Instead, national accounts data show considerable erratic movements of the relationship between profits and wages for most industries. In this light the remarkable stability of the relationship for the group of sheltered industries as a whole is difficult to explain. It may be that (1) fluctuations in output caused by the trade cycle, which cause profits to deviate from the trend, are not synchronized between industries, and that (2) although 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. (Firms may be reluctant to change selling prices too frequently; it may take time for them 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; and so on.) Such randomness would explain observations made in the past but would not, of course, guarantee indefinitely the future stability of the profit-wage ratio of the group of sheltered industries as a whole.

6. In Sweden (1960–68) product per man-hour (not man-year) increased by 8.2 percent and 3.8 percent (trend values) within the exposed and sheltered industries, respectively (see Gösta Edgren, Karl-Olof Faxén, and Clas-Erik Odhner, *Wage Formation and the Economy* [London: Allen and Unwin, 1973], p. 74). The same source quotes Finnish data (1960–68) showing productivity increases of 4.6 and 3.0 percent for exposed and sheltered industries, respectively (annual averages), and German data (1960–65) showing labor productivity increases (annual averages) of 4.6 percent for the export sector and 2.9 percent for the total economy.

7. This statement holds as a generalization. It is not necessarily the case, however, that the rate of productivity increase in exposed industries is uniformly high and in sheltered industries uniformly low. For instance, inland transport, although classified as a sheltered industry, has productivity increases comparing favorably with those of many exposed industries.

The two-sector, long-run model

A simple two-sector model based on these characteristic properties of sheltered and exposed industries purports to describe the mechanism determining the long-term movement of wages and prices in an economy where, because of 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:

1. World market prices for products of the E industries, together with existing foreign exchange rates, determine the output prices 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 or profits.

2. 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 (for which, however, there is no formal definition).

3. The wage level that establishes itself within the E industries determines the wage level within the S industries: mechanisms are assumed to exist (for example, market forces or the solidaristic trade union policy under the centralized wage bargaining system of Norway) that tend to keep wages in the two industry groups in a normal relation to each other.

4. The wage level within the S industries together with the existing technology (productivity of S industries) determines the output prices of these

industries: mechanisms (for example, some type of cost-plus pricing) are assumed to exist that will cause the S industries to adjust output prices so that a normal relation between wages and prices is maintained.

5. Output prices of E industries, output prices of S industries, and world market prices for goods not produced at home, each appropriately weighted, 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" in 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, this 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.

Critical to the validity of the model are the controlling mechanisms postulated by propositions (2), (3), and (4) 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 (3) and (4): there is plenty of evidence, both in Norway and Sweden, that the relation between wages in S industries and E industries have remained remarkably stable through time,⁸ and the observed stability of the profit share within the S industries (figure 1) supports the view that some mechanisms of the kind assumed by propositions (3) and (4) do in fact exist.⁹

The truth of proposition (2)—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 (figure 1). The relation between "the profitability of E industries" and "the wage level of E industries" that the model postulates, therefore, is certainly not a relation that 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. It is equally obvious, however, that the wage level in the E industries is not com-

8. See, for example, Lars Calmfors's paper in this volume, and Edgren and others, *Wage Formation and the Economy*, chap. 6.

9. Some of the models described in the last section are explicit in suggesting mechanisms that may result in a normal level of relative profits establishing itself within sheltered sectors.

pletely 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, it must be expected that sooner or later forces will be set in motion that will tend to close the gap.

There are at least three corrective mechanisms that may be counted upon to have this effect:

First, the system of *wage negotiations* will tend to correct deviations. Abnormally high, or low, profits will be taken as a sign by the trade unions to ask for larger, or smaller, wage increases than usual and at the same time weaken, or strengthen, the tendency of entrepreneurs to resist the claims. Negotiated wage increases will therefore be higher, or lower, the higher, or lower, the actual profits of the E industries.

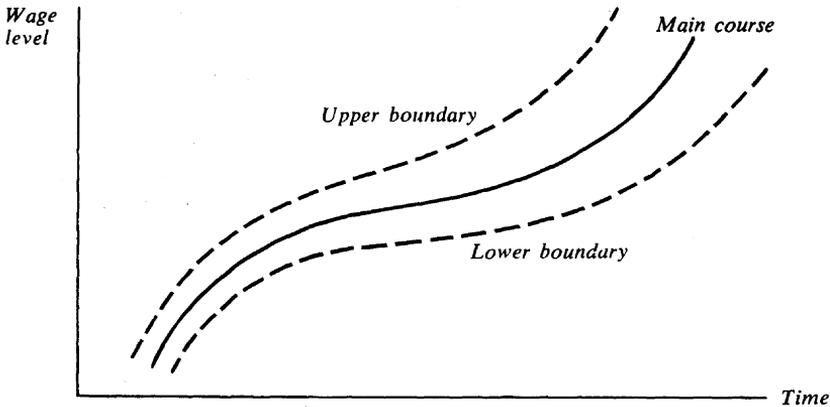
Second, *market forces* will tend to work in the same direction as organized negotiations through the mechanism of the wage drift. Abnormally high, or low, profits will motivate higher, or lower, demand for labor by entrepreneurs for production and investment purposes. High, or low, profits will therefore lead to a tighter, or less tight, labor market and ultimately influence the size of the wage drift. In extreme situations, if actual wages are kept low enough (for example, through some "successful" incomes policy) to generate extraordinarily high profits in the exposed industries, and consequently excess demand for labor, a wage explosion may follow that will quickly reduce profits to more normal levels.¹⁰

Third, *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.¹¹

This leads to the hypothesis that mechanisms exist which tend to make the

10. One wonders whether economic events in the Netherlands during the early 1960s are not more easily explained through this mechanism than through some variant of a monetary theory such as that of M. W. Holtrop (in "On the Effectiveness of Monetary Policy: The Experience of the Netherlands in the Years 1954-69," *Journal of Money, Credit, and Banking*, vol. 4 [May 1972] pp. 283-311). The hypothesis is that the Dutch incomes policy, which had been successful for a number of years in 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.

11. Richard E. Caves points out (in "Looking at Inflation in the Open Economy," in David A. Belsley and others, eds., *Inflation, Trade and Taxes* [Ohio State University Press, 1976], p. 84), rightly in my mind, that this part of the model has the implication of making macroeconomic policy to some degree endogenous.

Figure 2. *The "Wage Corridor"*

Source: See text for explanation.

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. Such a course is referred to in Norwegian studies as the "main course" of wages. It is defined as the level of wages consistent, at any point of time, with normal profits of the E industries. Because of the slack in the system, however, wages are free to diverge, within bounds, from either side of the main course, but the further they diverge the stronger will be the forces pulling them back. Wages are in fact free to move within "a corridor with elastic borders" as illustrated by figure 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 that the national price level will have to follow, again with an allowable margin on 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 relation between profits and wages.¹²

12. Inasmuch as 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 remain constant. This does not mean, as is sometimes believed, that the country in question will have a higher rate of inflation than its trading partners. The question of possible intercountry differences in inflation rates is discussed later in this paper.

So far, constant foreign exchange rates have been assumed. A devaluation will abruptly shift the wage corridor upward 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 downward and cause the wage and price increase to slow down. Therefore, other things being equal, countries that have devalued their currencies (France and the United Kingdom) would be expected to have witnessed higher price increases than others, whereas countries that have revalued (West Germany and the Netherlands) would be expected to have had less inflation than others. (Of course, although some correlation undoubtedly exists between exchange rate changes and price trends, the direction of causation may sometimes be subject to dispute.)

The many-sector, short-run model

More insight into the mechanisms that 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 multisector price income model.¹³ PRIM may be characterized briefly as a short-term, cost-push, input-output model. It is *short term* in that it takes wage rates to be given, that is, fixed by negotiations; because 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 wage rates, agricultural prices, productivities, world market prices, and a few other given variables assumed to affect costs. It is an *input-output* type of model in that it takes into account that higher output prices in one industry mean higher input prices, that is, higher costs, in other industries. Price interrelationships can therefore be examined using an input-output technique somewhat similar to that used in the study of quantitative interrelationships.

The structure of PRIM in its early versions has been described in detail

13. PRIM has been designed primarily as an instrument to help in negotiations on wages and prices. In Norway, such negotiations are strongly centralized and take place biennially. 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 that are about to start. Through such forecasts, it is intended that the negotiating parties be in a better position to anticipate the consequences, for themselves and for the national economy, of alternative courses open to them.

elsewhere.¹⁴ All that needs to be repeated here is that the main endogenous variables of the model are the national price level and various categories of income such as total wages and the profits of various industry groups. The model takes as exogenous those variables that, 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, two variables that together determine output: labor productivities and employment. Repercussions on productivities and employment from incomes through 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, 1966) distinguished six industry groups that were later extended to seven (PRIM II, 1972):¹⁵ three sheltered industry groups (agriculture, building and construction, other) and four exposed industry groups (fisheries, import-competing manufacturing, shipping, other export-oriented industries).¹⁶

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

- Output prices of the agricultural and fishing industries 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 predetermined 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 the practical use of

14. Odd Aukrust, "PRIM I: A Model of the Price and Income Distribution Mechanism of an Open Economy," *Review of Income and Wealth*, series 16 (March 1970), pp. 51–78; also published, with additional statistical material, as *Artikler*, no. 35 (Oslo: Statistisk Sentralbyrå [Central Bureau of Statistics], 1970).

15. Vidar Ringstad, "PRIM II: A Revised Version of the Price and Income Model," published as *Artikler*, no. 44 (Oslo: Statistisk Sentralbyrå, 1972).

16. *Innstilling fra Utredningsutvalget for inntektsoppgjørene 1966, avgitt 22. januar 1966* [Report by the Reporting Committee for the 1966 Income Settlement, January 22, 1966] (Oslo: Office of the Prime Minister, 1966).

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.¹⁷

Throughout, percentage changes in output prices are assumed to be the same for all deliveries from any one industry, for example, the same for sales at home and on the export market.¹⁸

One way in which PRIM can be used to shed light on the working of the economy appears in table 1.¹⁹ A selected number of important exogenous variables of the model are listed vertically on this table along with the share of profits earned in sheltered industries other than agriculture. The table

17. To treat export prices as exogenously given, independently of costs, may be justifiable as a first approximation. Even a small country like Norway, however, obviously has price-setting power in certain industries, for example, shipping. If, therefore, 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.

18. The description in the text applies to a version of PRIM which was in use until lately. The more recent version, termed PRIM II, appears as an aggregated variant of the submodel for prices contained in the much bigger and more general model MODIS IV. In this version of PRIM some new features have been added that complicate the model structure but do not change much the basic ideas:

- 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 are 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 publicly 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 behavior than the crude dichotomy between prices that are either sheltered or exposed. For the time being, however, far too little is known about how prices are actually determined to be able to make much use of these potentialities of the model.

19. The table of effects reproduced here is for 1967. It was computed on the basis of PRIM I in which construction was included with "sheltered industries other than agriculture," and is not shown separately in the table. A PRIM type of analysis of U.S. inflation for the 1970-73 period is presented by William Nordhaus and John Shoven in "Inflation 1973: The Year of Infamy," *Challenge*, vol. 17 (May/June 1974), pp. 14-22.

Table 1. *Effects of a 1 Percent Change in Wages, Agricultural Prices, Productivity, Other than Agriculture on Prices, Income, and the Distribution of Income, 1967*

Exogenous variable that is increased 1 percent	Price changes (percent)		Income changes			
	Products from sheltered industries ^a	Consumer price level	Total factor income	Total wages income ^b	Income from	
					Agriculture	Fisheries
<i>Wages and salaries</i>						
All industries ^d	0.68	0.47	270	307	-13	-3
Sheltered industries ^a	0.68	0.47	270	217	-13	-3
Import-competing industries	...	...	...	40	...	...
Shipping	...	...	...	23	...	...
Export-oriented industries ^c	...	...	...	28	...	...
<i>Prices</i>						
Agricultural	0.03	0.08	37	...	39	e
Fish	0.01	0.01	7	...	-1	13
<i>Productivity</i>						
Agriculture	...	...	21	...	21	...
Sheltered industries ^a	-0.83	-0.57	49	...	16	4
Import-competing industries	...	...	59	...	...	...
Fisheries	...	...	11	...	...	11
Shipping	...	...	70	...	...	...
Export-oriented industries ^c	...	...	57	...	...	...
<i>Total employment</i>						
Agriculture	...	...	21	...	21	...
Sheltered industries ^{a,f}	-0.15	-0.10	320	217	3	1
Import-competing industries ^f	...	...	59	40	...	...
Fisheries	...	...	11	...	...	11
Shipping ^f	...	...	70	23	...	...
Export-oriented industries ^{c,f}	...	...	57	28	...	...
<i>Export prices</i>						
Shipping	0.01	0.01	106	...	e	e
Export-oriented industries ^c	0.05	0.05	97	...	-3	e
<i>Sector prices of imported intermediate goods</i>						
Agriculture	...	...	-2	...	-2	...
Sheltered industries ^a	0.08	0.05	-5	...	-2	e
Import-competing industries	...	...	-35	...	...	...
Fisheries	...	...	-1	...	...	-1
Shipping	...	...	-30	...	...	...
Export-oriented industries ^c	...	...	-28	...	...	...
<i>Sector prices for imported final goods</i>						
Imported consumer goods ^e	...	0.13	...	...	...	...
Competing imports ^b	0.05	0.12	106	...	-1	-1
Imported capital goods (excluding ships) ^l	0.05	0.03	-19	...	-4	e
Imported ships ^e	...	...	-38	...	...	...
<i>Share of profits</i>						
Effect of a percentage-point change in share of profits in sheltered industries (r_2) ⁱ	1.00	0.68	393	...	-19	-5

Source: Odd Aukrust, "PRIM I: A model of the Price and Income Distribution Mechanism of an Open Economy," *Artikler*, no. 35 (Oslo: Statistisk Sentralbyrå, 1970), pp. 18-19.

a. Excluding agriculture.

b. Excluding agriculture and fisheries.

c. Excluding shipping.

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

e. Negligible effect.

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

Employment, Foreign Prices, and the Share of Profits in Sheltered Industries

<i>(millions of kroner)</i>				<i>Income changes (percent)</i>							
<i>Profits</i>				<i>Profits</i>							
<i>Shel- tered indus- tries^a</i>	<i>Import- compet- ing indus- tries</i>	<i>Ship- ping</i>	<i>Export- orient- ed indus- tries^c</i>	<i>Total factor income</i>	<i>Total wages income^b</i>	<i>Income from</i>		<i>Shel- tered indus- tries^a</i>	<i>Import- compet- ing indus- tries</i>	<i>Ship- ping</i>	<i>Export- orient- ed indus- tries^c</i>
						<i>Agri- culture</i>	<i>Fisher- ies</i>				
94	-48	-27	-40	0.57	1.00	-0.61	-0.45	1.00	-3.54	-2.79	-2.05
94	-8	-4	-12	0.57	0.71	-0.61	-0.45	1.00	-0.62	-0.37	-0.64
...	...	...	...	...	0.13	...	...	...	-2.92	...	...
...	...	-23	...	...	0.08	...	...	...	...	-2.43	...
...	...	...	-28	...	0.09	...	...	...	...	...	-1.42
...	-1	*	-1	0.08	...	1.76	-0.02	...	-0.05	-0.01	-0.06
...	*	*	-5	0.01	...	-0.04	1.77	...	-0.01	-0.02	-0.26
...	...	...	...	0.04	...	0.94	...	...	...	...	...
...	10	4	15	0.10	...	0.73	0.54	...	0.74	0.44	0.77
...	59	...	...	0.12	...	...	...	...	4.34	...	...
...	...	...	...	0.02	...	...	1.50	...	...	...	...
...	...	70	...	0.15	...	...	...	...	...	7.34	...
...	...	...	57	0.12	...	...	...	...	...	...	2.92
...	...	...	...	0.04	...	0.94	...	...	...	...	...
94	2	1	3	0.68	0.71	0.13	0.10	1.00	0.13	0.08	0.14
...	19	...	...	0.12	0.13	...	...	...	1.42	...	...
...	...	...	...	0.02	...	...	1.50	...	...	...	...
...	...	47	...	0.15	0.08	...	...	...	...	4.91	...
...	...	...	29	0.12	0.09	...	...	...	...	...	1.50
...	*	107	*	0.22	...	-0.01	-0.01	...	-0.01	11.20	-0.01
...	-6	-1	108	0.21	...	-0.16	-0.04	...	-0.46	-0.08	5.56
...	...	...	...	...	...	-0.07	...	...	...	...	...
...	-1	*	-1	-0.01	...	-0.07	-0.05	...	-0.07	-0.04	-0.07
...	-35	...	...	-0.07	...	...	...	...	-2.53	...	...
...	...	...	...	...	...	...	-0.10	...	...	...	...
...	...	-30	...	-0.06	...	...	...	...	...	-3.19	...
...	...	...	-28	-0.06	...	...	...	...	...	...	-1.42
...
...	112	-1	-3	0.22	...	-0.05	-0.07	...	8.20	-0.09	-0.17
...	-5	*	-10	-0.04	...	-0.18	-0.03	...	-0.36	-0.02	-0.51
...	...	-38	...	-0.08	...	...	...	...	...	-3.98	...
453	-12	-5	-18	0.83	...	-0.88	-0.65	4.81	-0.90	-0.54	-0.92

g. Goods imported directly for consumption.

h. The price of imported goods that compete on the Norwegian market with products from "import-competing industries."

i. 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 "sheltered industries other than agriculture" to raise output prices.

j. The share of profits in "sheltered industries other than agriculture" in 1967 was 30.3 percent (of total factor income). The figures in this row show what the effects would have been if this share, other things being equal, had risen by 1 percentage point, that is, to 31.3 percent.

shows the expected effects of a partial 1 percent change of the exogenous variable of each row on each of the endogenous variables listed at the top. The effects are expressed partly as percentages and, in the case of income variables, in kroner as well. The first row indicates, for instance, that a 1 percent increase in the wage level, other things being equal, may be expected to raise the level of consumer prices by 0.47 percent, to increase the total of nominal factor incomes by 0.57 percent, to decrease income from agriculture by 0.61 percent, and to decrease profits of "import-competing industries" by 3.54 percent. If one reads down the columns, on the other hand, table 1 gives information for each endogenous variable on the effect of changes in exogenous variables. All effects specified in the table may be considered as additive for small changes in the exogenous variables. The combined effect, therefore, of a simultaneous change in two or more exogenous variables may be gauged by adding the effects of each variable taken separately. For instance, a parallel increase of all import prices by 1 percent, if other factors remain the same, may be expected to raise the level of consumer prices by 0.33 percent ($0.05 + 0.13 + 0.12 + 0.03$, second column).

Some Policy Implications

Some of the policy implications of these models, which may be applicable to other economies as well, are pointed out below. The models, if correct, hold a message of great relevance to the choice of targets for an incomes policy.

The scope for a national price policy

Granted that the 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 what 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, for periods of from five to fifteen 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 deviate from world market prices. The conclusion drawn

from the long-term model is 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.²⁰ 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; for example, a country that revalues by 10 percent is virtually guaranteed over the ensuing years to experience 10 percent less inflation than other countries, and less than it would otherwise have had. The trouble is that foreign exchange rate changes cannot always be manipulated freely, nor are they well suited as regular instruments of a price policy because exchange rate changes, when they are foreseen and expected, are bound to create unwanted speculation.

In the short run, say, over periods of from one to two years, lasting from the conclusion of one round of wage negotiations until the conclusion of the next, the short-run model suggests that 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 the negotiations will determine the course of wages (apart from the wage drift) for a period ahead. The authorities can do little under such circumstances. They may try to slow down the wage drift through a policy of demand management or monetary policy, but such measures will probably be ineffective in the short run. They may try to counter the price increases triggered by the wage increases by resorting to the use of subsidies, price controls, and similar devices. These may delay—but cannot indefinitely hold back—the price increases to be expected as a consequence of the wage settlement. Yet such policies may have limited success in cases where tariff settlement contains an escalation clause tying wages during the tariff period to the index of consumer prices; should an escalation clause be part of the tariff agreement, a slowing down of the price increase

20. In Norway, over the period 1951–71, the level of wages (labor costs per man-year) increased by 7.9 percent on an annual average. Prices, measured by the gross domestic product deflator, increased by 3.9 percent a year. 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 percent or 6.9 percent a year instead of 7.9 percent (which would have led to a somewhat higher or lower price increase than 3.9 percent a year), if it had been possible, would have meant a wage level in 1971 some 20 percent above or below the actual level. At a wage level 20 percent above the actual, Norwegian industries would certainly not have remained competitive. At a wage level 20 percent below the actual, E industries in 1971 would have shown enormous profits. None of these could have happened without triggering the correction mechanisms assumed by the long-term model.

may serve to slow down the wage increase and thus reduce the rise in wages and prices in the course of the tariff period.

In the medium run, however, say, over a period of from two to five years, the scope for a national price policy should be considerable. According to the long-term model, it is perfectly possible for wages 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 toward the upper boundary, or from the upper boundary toward 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. Because the outcome of wage negotiations and the size of the wage drift presumably depend to some extent on the general economic climate (for instance, the tightness of the labor market) it should be possible for policy authorities to influence wage and price developments in the medium run through demand management or monetary policies, supplemented perhaps by an incomes policy. Note, however, that such a course of action, 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 favor of the owners of enterprises in the E industries. (This points to the existence of a latent conflict between price and income distribution targets, a subject discussed further below.) Observe, moreover, 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 upward 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.

Implications for an incomes policy

The Norwegian models, if correct, also hold a message of great relevance for the choice of targets for an incomes policy: 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 serve as a guidepost, 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 vari-

ables of the model; in particular, the resulting national price trend would depend strongly on the trend of world market prices (although 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, as is seen in the entries in the columns of table 1 or the equations of PRIM in reduced form.²¹ It is most improbable, therefore, that a set of values for the exogenous variables can be found that 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 that will ensure stable prices without having undesired effects for the (pretax) 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. Those who aspire to an intelligent price and incomes policy must start by facing this fact squarely.

Incidentally, one has to give up the popular belief that the struggle over income shares may be viewed simply as a confrontation between 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, by means of 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 (1) the farmers, (2) the owners of enterprises in the sheltered industries and the wage earners, and (3) owners of enterprises in the exposed industries.²²

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

21. Reproduced in Aukrust, "PRIM I," pp. 77-78.

22. 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 one would expect a tendency for wages, profits in S industries, and profits in E industries to remain in a normal relation to each other, in conformity with the long-run model described above.

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. It should perhaps not be surprising that modern society has shown itself prone to inflation.²³

Properties of the Norwegian Model

A number of questions about the Norwegian model need further consideration. To what extent does it provide a theory of inflation? What are its shortcomings? By what mechanism are inflationary pressures transmitted from abroad? What is the role of demand in the model? What light does it throw on the differences in rates of inflation among countries?

General and national theories of inflation

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 by this criterion it is clear that the Norwegian approach does not qualify as an inflation theory in the same sense as some competing approaches, such as the monetary approach or the excess demand-Phillips curve approach originated by Keynes.

This is quite obvious in the case of the short-run (PRIM) variant of the model. PRIM says nothing about how the wage level is determined; it simply takes the wage level (or rather changes in it) as given. What it purports to do is to describe in some detail how changes in national prices and income shares follow from ("are determined by") given changes in wages and other predetermined variables such as world market prices. Although the model may contribute to a better understanding of the way in which inflationary

23. It is conceivable that entrepreneurs in E industries might try to protect their interests by working to get the exchange rate changed rather than by opposing wage claims, although this possibility has not been considered in the text. To the extent that they succeed in obtaining a devaluation of the national currency the inflationary trend will be increased.

impulses work their way through the economy, it has nothing to say about 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 behavior of different categories of industries. The total outcome is a theory that, 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, because it does not attempt to explain world market prices. Unlike the monetary and Keynesian approaches it is not a general theory capable of explaining the phenomenon of inflation as such.

Shortcomings of the Norwegian model

From a formal point of view the Norwegian model suffers from weaknesses that limit its usefulness even at the national level. Two in particular should be noted. First, both the short-run and long-run variants of the model, in their present formulation, are static rather than dynamic. Therefore they ignore the time dimension of the inflationary process. Second, the long-run model is nonoperative since, so far, no operational definition has been given of "normal profits," a key variable in the model. It follows that the concepts of "the main course" of wages and "the wage corridor" are also nonoperational concepts. It may not be possible, therefore, to tell whether, at any particular point of time, actual wages are "high" or "low" in the wage corridor. Nor can the degree to which actual wages deviate from their main course be indicated. For this reason the model is not helpful in the formulation of quantitative statements about the implications of wage trends, past and present.

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.

DIRECT EFFECTS OF IMPORT PRICES. The effects under this heading are the following:

1. Price increases of imported consumer goods. Such increases will almost immediately be reflected in the level of consumer prices of the importing country. According to PRIM, a proportionate increase of 1 percent in the prices of all imported consumer goods may be expected in Norway ultimately to raise the level of consumer prices by 0.13 percent, as table 1 indicates.

2. Price increases of supplementary imports of raw materials and capital goods. Such 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 percent in the prices of these goods will be in Norway a rise in the level of consumer prices of 0.08 percent.

3. Price increases of competitive imports. Such 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 consumer goods, the price increase will at the same time affect the national price level through the channel described under (1) above.) Again some time lag has to be reckoned with. Assuming that a 1 percent increase in the prices of competitive imports will cause a 1 percent increase in the selling prices of national producers of similar commodities, the effect on the level of consumer prices will be 0.12 percent, according to PRIM, under Norwegian conditions.

To summarize, the total direct price effect to be expected, under Norwegian conditions, from a proportionate increase of 1 percent of all import prices can be put at 0.33 percent ($0.13 + 0.08 + 0.12$).

DIRECT EXPORT PRICE EFFECTS. When prices of exported goods rise on the world market, prices charged for these goods on the national market will also tend to rise. Whether the goods in question are consumer goods or intermediate goods, the level of consumer prices will be affected, possibly with a time lag. The direct price effect to be expected, under Norwegian conditions, from a proportionate increase of 1 percent of all export prices has been calculated by PRIM to be 0.06 percent.

INDIRECT EFFECTS THROUGH THE WAGE LEVEL. Under this heading comes the complex mechanism described above whereby rising export and import prices will lead, as a result of improved profitability of the exposed industries, to a rise in the national wage level that in turn causes the sheltered industries to raise their selling prices. The magnitude of this effect is difficult to calculate exactly; however, in the long run, national prices might be expected to

move roughly parallel to prices in other countries. The time needed for this transmission mechanism to work will be rather long.

The direct effects of changes in import and export prices have been well recognized in the literature. Less attention has been given to what may be the main contribution of the Norwegian model: the central role that it ascribes to the wage level in the transmission mechanism. This role is derived from the view that changes in the level of wages in a national economy are strongly related to economic developments in other countries. Not only this idea but the far-reaching conclusions that follow from it appear to have been overlooked or given insufficient emphasis in the literature so far.

While emphasizing the transmission of inflationary impulses through foreign trade prices and wages, however, the Norwegian approach neglects the transmission mechanisms assumed by the monetary and Keynesian approaches. According to the monetary 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 net 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 of secondary importance compared with the direct and indirect price effects.

It should be pointed out, perhaps, that although the monetary, Keynesian, and Norwegian approaches each stresses different aspects of the transmission mechanism of inflation while suppressing others, the three approaches are not mutually exclusive. Rather they are complementary in showing that inflation can travel along many routes.²⁴ Within a more generalized framework all approaches could, in principle, be accommodated.

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 that 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 cost-plus pricing. Thus, these are supposed to be completely unaffected by demand. In actual use of PRIM for prognostic purposes, however, it is sometimes recognized,

24. For an attempt to give a complete list of possible routes, see "The International Transmission of Inflation," *OECD Economic Outlook*, no. 13 (July 1973), pp. 81-96.

by ad hoc reasoning "outside the model," that the percentage markup may depend on the general state of demand. Of course, this reasoning could be made an inherent part of the model: whereas the markup 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 relation to be added to the model.²⁵

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 that are supposed to guarantee that actual wages will not deviate far from the main course of wages. I have already mentioned that one such mechanism is the system of wage negotiations. There can be little doubt that the size of the wage increases that are demanded and granted during wage negotiations will be influenced, among other things, by the state of the 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 also influences the amount of the wage drift that will take place between wage negotiations.

There is no disagreement, therefore, as to the ultimate effect that demand is supposed to have on prices between the Norwegian approach on the one hand and the monetary and Keynesian approaches on the other. All agree that excess demand will cause commodity prices to rise, but they differ in the assumptions made about the mechanism producing this result. The monetary and Keynesian 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 labor market and stresses the pull that excess demand for labor exerts on wages, assuming rising wages, in turn, to exert a push effect on commodity prices. Since all these mechanisms, however, 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, such a description is inadequate to the Norwegian approach as a whole: if there is excess demand pushing up wages, with firms raising prices as a result, the situation may well be characterized as demand inflation.

The various approaches differ more fundamentally when it comes to listing and evaluating factors that may cause demand to become excessive. The monetary and Keynesian approaches tend to look for these causes in faulty monetary or budgetary policies. The Norwegian approach in addition allows

25. For example, see the way in which this was done in the Finnish companion to PRIM described below.

for another potent source of trouble, that is, the possibility of a faulty combination of incomes policy and foreign exchange rate policy, causing the wage level to be set too low relative to wages in other countries. The result will be abnormally high profits in the exposed industries, inducing them to expand their demand for commodities and labor.

Note one implication of these remarks for the possibilities of testing the three approaches. One may find, and indeed many studies 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 and wages on the one hand and in demand for labor on the other may both have been caused by events abroad that have affected the economy in the manner assumed by the long-term Norwegian model.²⁶

Small and large economies

Two key assumptions of the Norwegian model are, first, that exposed industries are pacesetter in the wage determination process, and, second, that exposed industries are price takers and accept output prices as given on the world market and have no ability to influence them. These assumptions may be reasonably realistic in the case of a small economy with a relatively large exposed sector. Assumption (1), in particular, and perhaps assumption (2) are less realistic in a relatively closed economy that 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 dis-

26. Caves makes the same point in 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 the 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 favorable external balance. The price increase 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. . . . 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." ("Looking at Inflation in the Open Economy," pp. 94, 95; see note 11 for full citation.)

inction between sheltered and exposed industries may help to explain the inflationary process, although 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 independent of developments abroad, for instance, through some process consistent with, say, the monetarist approach or the Keynesian-Phillips curve approach. From the sheltered industries the wage increases would be passed on to the exposed industries. The result might be a profit squeeze in the exposed industries and a deterioration of the trade balance. Or it might be exactly the opposite, depending on whether national wages went up more quickly or more slowly than wages in other countries. Then the well-known adjustment processes of the monetarist-Keynesian approaches would begin to apply.²⁷

Intercountry differences in rates of inflation

The implications of the Norwegian model for intercountry 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 i and j . For country i the (percentage) rate of price inflation p^i is:

$$(1) \quad p^i = \alpha^i p_S^i + \beta^i p_E^i + \gamma^i p_E^j,$$

where

p_S^i = the rate of price inflation of (nontraded) output of country i 's S industries

p_E^i = the rate of price inflation of (home-consumed) output of country i 's E industries

p_E^j = the rate of price inflation of output of country j 's E industries (country i 's import)

α^i , β^i , and γ^i = the appropriate weights reflecting the combination in which the three kinds of output are sold in country i .

Similarly, the rate of price inflation of country j is:

$$(2) \quad p^j = \alpha^j p_S^j + \beta^j p_E^j + \gamma^j p_E^i,$$

27. 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." (Ibid., p. 85.)

where

p_S^j = the rate of price inflation of (nontraded) output of country j 's S industries

α^j , β^j , and γ^j = the appropriate weights reflecting the combination in which the three kinds of output are sold in country j .

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,²⁸

$$(3) \quad \dot{w}^i = p_E^i + q_E^i$$

and

$$(4) \quad \dot{w}^j = p_E^j + q_E^j,$$

where

\dot{w}^i and \dot{w}^j = the rates of wage inflation in countries i and j , respectively
 q_E^i and q_E^j = the rates of productivity change in E industries of countries i and j , respectively.

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

$$(5) \quad p_S^i = \dot{w}^i - q_S^i$$

and

$$(6) \quad p_S^j = \dot{w}^j - q_S^j,$$

where

q_S^i and q_S^j = the 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 i will be different from the product (or product mix) of the E industries in country j . Therefore, the prices of these products will not, in general, have identical price trends. I assume, in a Marshallian way, that the prices of two goods will tend to move in inverse proportion to the productivities in the industries producing them. Then, as a long-run tendency,

28. Here, as well as in equations 5 and 6, I 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 much changing the conclusion.

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

Where do equations 1 to 7 lead?

Note that, by definition, the difference in price inflation between countries i and j may be derived from equations 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, 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 equation 8 is reduced to

$$(8a) \quad \dot{p}^i - \dot{p}^j = \alpha (\dot{p}_S^i - \dot{p}_S^j),$$

or, because of equations 5 and 6,

$$= \alpha (\dot{w}^i - \dot{q}_S^i - \dot{w}^j + \dot{q}_S^j).$$

Inserting equations 3 and 4 in equation 8a and rearranging gives

$$(9) \quad \begin{aligned} \dot{p}^i - \dot{p}^j &= \alpha [(\dot{p}_E^i + \dot{q}_E^i) - \dot{q}_S^i - (\dot{p}_E^j + \dot{q}_E^j) + \dot{q}_S^j] \\ &= \alpha [(\dot{p}_E^i - \dot{p}_E^j) + (\dot{q}_E^i - \dot{q}_E^j) - (\dot{q}_S^i - \dot{q}_S^j)] \end{aligned}$$

which because of equation 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 only such differences. The higher the productivity increase in the sheltered industries of one country relative to that of other countries, the lower relatively will be 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. This result was obtained because it was assumed, first, that different countries produce different commodities for export and, second, that the prices of these commodities change over time in inverse proportion to productivities. Together these 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 (for example, 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.

Testing the Norwegian Model

An economic model may be tested in various ways. One possibility is to study the validity of the individual behavioral relations that are part of the model. Another possibility is to study the ability of the model to account for actual developments. Attempts along both these lines are described below.

Testing the price behavior relations

The assumptions made in the Norwegian model about the price behavior of industries are listed on pages 113–14. My early attempt to compare these assumptions with facts has been reported in detail.²⁹ 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 relation between wages and profits conforms with a certain trend value, stood up well against the data. It was noted, however, that profits tended to fall short of the trend value in years when production was unfavorably influenced by the trade cycle. This seemed consistent with a pricing principle according to which the markup 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 of similar goods imported by Norway, appeared to be doubtful. During the 1960s these industries seemed to have had considerably more scope for raising output prices than the model assumed.³⁰

- The assumption made that percentage changes in output prices are 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, as in table 1) was clearly not consistent with the data. Although 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, each of them turning out a wide variety of prod-

29. Aukrust, "PRIM I." (See note 14 for full citation.)

30. 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 to allow for this possibility. (See T. Gigantes and R. Hoffman, "A Price-Output Nucleus for Simulation Models," in A. Brody and A. P. Carter, eds., *Input-Output Techniques* [Amsterdam: North-Holland, 1972; distributed in the United States and Canada by American Elsevier], pp. 319–39.)

ucts that are unlikely to be sold in the same proportions to all categories of users. The practical importance of this for the model, however, was not found to be serious.

A more rigorous testing of the price behavior assumptions of the model was recently undertaken by Vidar Ringstad. Ringstad applied econometric methods to Norwegian data in order to test a large number of alternative hypotheses about pricing behavior of industries. The data available to him consisted of annual national accounts data for the 1961–69 period on prices and other relevant variables for about 120 individual industries classified according to market orientation.³¹

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

$$(11) \quad P_H = aC + bP_E + cP_I + u,$$

where P_H is the seller's price of home-produced goods delivered to the home market, C represents the unit variable costs (actual costs not normalized for business cycle effects), P_E is the 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 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) it might be expected that for sheltered industries

$$a > 0, b = c = 0;$$

for export-oriented industries

$$b = 1, a = c = 0;$$

and for import-competing industries

$$c = 1, a = b = 0.$$

These expectations are not supported by Ringstad's findings, as table 2 shows. 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, an impact in the direction expected

31. Vidar Ringstad, *Prisutvikling og prisatferd i 1960-årene: En presentasjon og analyse av nasjonalregskapets prisdata, 1961–1969* [*The Development and Behaviour of Prices in the 1960's: Presentation and Analysis of the Price-Data of the Norwegian National Accounts, 1961–1969*], Samfunnsøkonomiske Studier no. 23 (summary in English) (Oslo: Statistisk Sentralbyrå [Central Bureau of Statistics], 1974).

Table 2. *Estimated Parameters of a Simple Price Behavior Relation, by Industry Group^a*

<i>Group</i>	<i>Number of industries in group</i>	\hat{a}	\hat{b}	\hat{c}	$\hat{\sigma}$
Sheltered industries	23	1.095 (0.041)	0.081 (0.043)	0.127 (0.048)	0.068
Exported-oriented industries	16	0.770 (0.155)	0.079 (0.107)	0.111 (0.075)	0.091
Import-competing industries	31	0.854 (0.056)	-0.116 (0.044)	0.283 (0.044)	0.065

Source: Vidar Ringstad, *The Development and Behaviour of Prices in the 1960's*, tables 4.1, A.2, B.2, C.2, pp. 166, 171-73. (See note 31 for full citation.)

a. The numbers in parentheses are standard errors of estimates.

and, understandably, a slight positive impact also on home market prices of sheltered industries. The price of exports seems to have had a small positive impact on sheltered industries, a small negative impact on import-competing industries, and no significant impact whatsoever on home market prices of export-oriented industries, which is indeed surprising.

It is obvious that Ringstad's findings do not support the price behavior assumptions of the Norwegian model. His attempts to test many alternative hypotheses about price behavior, however, have not 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 to be drawn is that the problem of how prices are actually determined in various industry groups cannot be studied successfully using the kind of data available to him (annual data for implied price indexes of the national accounts).

At least two possible sources of data error are to be noted. First, the price data in question are aggregated to such a degree that there is no assurance that price indexes observed for sales on the home market, for exports, and for competitive imports refer to "identical commodities" (or a given commodity mix). Second, as Ringstad carefully points out, the alleged output price indexes of the national accounts are in a large measure based on cost indexes, namely, input price indexes and wage indexes.³² This means that

32. Because this source of error may be important in other countries as well, Ringstad's figures deserve to be 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 indexes or wage indexes to be the empirical basis of "output price

there is spurious correlation between the observations available for the variable P_{it} of equation 11 and its explanatory variables.³³

Testing the wage relation

According to the Norwegian model the national wage level is determined by the profitability of the exposed industries (defined above as the ability of these industries to pay out wages and 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 relation has not been spelled out, however. It is difficult, therefore, to test this particular part of the model and no such test has been attempted in Norway.

But the extensive research undertaken for a number of years in many countries to determine a "wage relation" is clearly relevant to the issue. Studies that find wage changes to be strongly related 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, whereas findings that changes in the wage level depend on past price changes, the balance of demand and supply in the labor market, or both might seem to speak against it. The latter conclusion, however, may not always be well founded since, as it was pointed out above, observed price changes and the state of the labor market in the past may 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 equa-

indexes" used to deflate no less than 43 percent of total domestic output. Another 12 percent of total domestic output was deflated by consumer price indexes and 17 percent by wholesale price indexes; these indexes are based on directly observed prices for goods and services but are nevertheless unsuitable for the purpose because they reflect the prices of imported as well as domestically produced goods. Only for the remaining 28 percent of total domestic output were price indexes available which, although not always of good quality, were at least conceptually suited for the purpose. To this category belonged unit price indexes, sector price indexes constructed especially for the national accounts, and implicit sector price indexes resulting from estimates at constant prices.

33. This could be a serious source of error. To minimize its effects Ringstad omitted from his calculations no less than forty-seven industries where he knew cost indexes to dominate the empirical basis of the output price indexes. To some extent, however, the same source of error may also have affected the price indexes of some of the seventy industries actually retained in his study.

tions based on competing theories of inflation.³⁴ 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.³⁵ Nordhaus assumes wages, w_t , to be related to current and past import prices, p_t , by

$$(12) \quad \Delta \ln w_t = m_0 + m_1(0.5 \Delta \ln p_t + 0.33 \Delta \ln p_{t-1} + 0.17 \Delta \ln p_{t-2}).$$

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,"³⁶ but small and sometimes insignificant for Canada, France, West Germany, and the United States. When comparing equation 12 with some other equations, including those based on the monetarist viewpoint and the Phillips curve, Nordhaus finds the export-constrained theory of wage determination to outperform 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's study gives considerable support to a vital part of the Norwegian model.

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 is that the model has not been given the strict mathematical formulation required by such a test.³⁷ 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 ongoing revision of the national accounts has caused a serious break in all relevant time series in 1967.

The postwar Norwegian history of wages and prices, however, 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, by means of the wage determination process, to the national price level. Thus the assumed

34. William D. Nordhaus, "The Worldwide Wage Explosion," *Brookings Papers on Economic Activity*, 2:1972, pp. 431-64.

35. *Ibid.*, pp. 451-55.

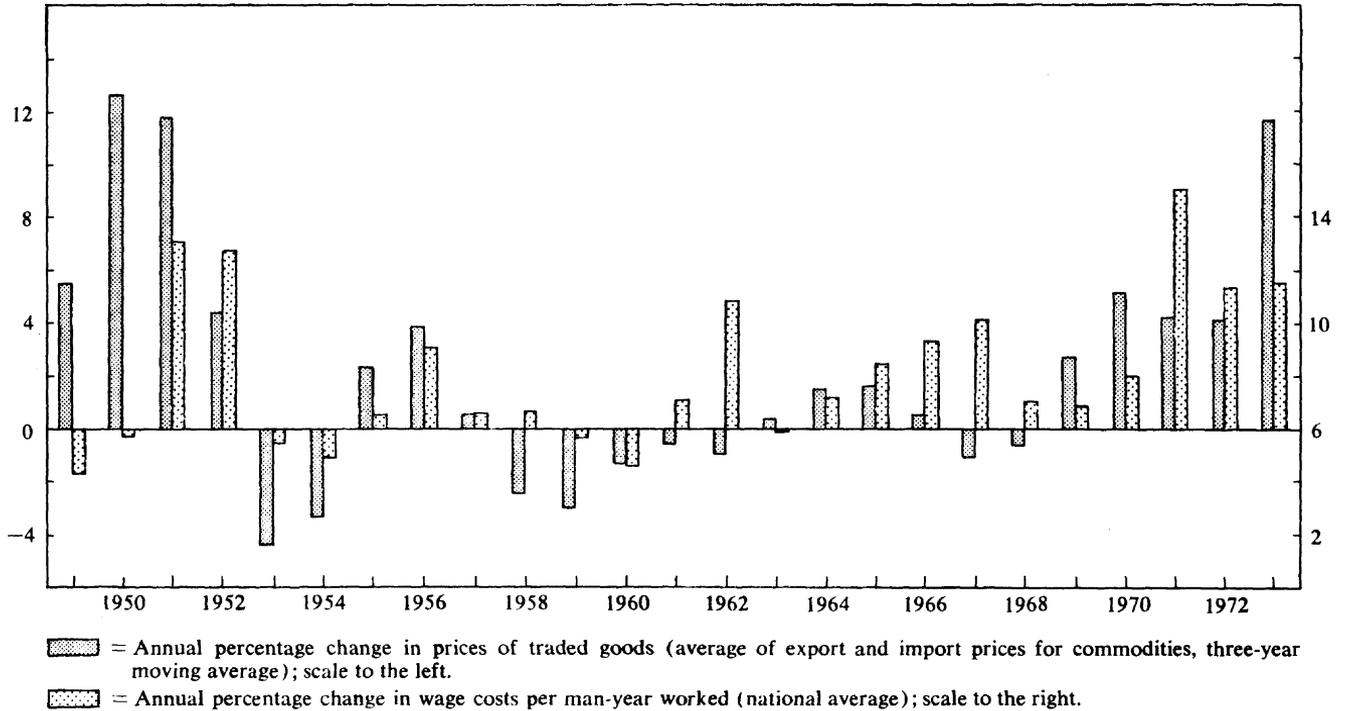
36. *Ibid.*, p. 454.

37. The mathematical formulation of the long-run model given by Holte is intended to serve pedagogical purposes. It is too simplified to provide a starting point for a serious testing of the Norwegian approach. (See Fritz C. Holte, "A Model for Estimating the Consequences of an Income Settlement," *Economics of Planning* [Oslo], vol. 8, no. 1-2 [1968], pp. 57-69.)

Figure 3. *Foreign Trade Prices and Average Wages, Norway, 1949–73*

Three-year moving average of annual percentage change in prices of traded goods

Annual percentage change in wage costs



Sources: Computed from national accounts data, various sources; 1947–53, Central Bureau of Statistics, *National Accounts 1865–1960* (Oslo: Statistisk Sentralbyrå, 1965); 1954–70, *National Accounts 1954–1970* (1972); 1971–73, unpublished data from the Central Bureau of Statistics.

relation between foreign trade prices and the wage level shows up quite well in figure 3, and the relation between wages and prices is obvious from other material. Of particular note are:

- 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 percent 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 (annual averages of approximately 13 and 10 percent, respectively), during the three years following the devaluation.

- In only one period during the postwar years has the trend of export and import prices been downward for any length of time and that was in 1957–63 when prices of commodity exports and imports fell by approximately 2 percent a year on average. During this period the rate of postwar wage and price inflation was at its minimum (annual averages of 8 percent and 2.5 percent, respectively).

- After some years (1963–70) 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 25 to 30 percent between early 1973 and the middle of 1974. The profitability of the exposed industries improved greatly and the wage and price inflation accelerated.³⁸ On a year-to-year basis

38. But the chain of causation in this case has been disputed. The Organisation for Economic Co-operation and Development, 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 (in a much too restricted and simplified way, 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." (*OECD Economic Surveys: Norway* [Paris: OECD, 1973], p. 14.) However, in the OECD country report for Norway published in 1974 the authors seem to have come around to 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 have indirectly 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 wagedrift can probably be explained by this form of international transmission of inflation." (*OECD Economic Surveys: Norway* [Paris: OECD, 1974], pp. 15, 19.)

the increase in wage costs (the average for all industries) was 13.5 percent in 1974 and reached 18.1 percent in 1975; the corresponding figures for consumer prices were 9.4 percent for 1974 and 12.2 percent for 1975, according to the national accounts. Yet the recent rate of inflation in Norway has been somewhat lower than in the majority of European countries, a fact that may have been an effect of the appreciation since 1972 of the Norwegian krone by somewhat more than 10 percent relative to other countries.

The short-run model PRIM was tested against historical data for 1961–68 in my previous study.³⁹ Because PRIM 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 by means of the wage level. The tests did throw light, however, 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 1 percent. The underestimation occurred because 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 were the result of 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.

Testing the model in other countries

A considerable amount of empirical data on which to test the Norwegian approach when applied to the Swedish economy is available in the two publications of Edgren, Faxén, and Odhner.⁴⁰ Their findings are not easily summarized. It is obvious, however, that their study of recent wage and price experience in 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 results are reported in Halttunen and Molander⁴¹ (see below). It is also known that research on the applica-

39. Aukrust, "PRIM I." (See note 14 for full citation.)

40. "Wages, Growth and the Distribution of Income," and *Wage Formation and the Economy*. (See notes 2 and 6 for full citations.)

41. "The Input-Output Framework." (See note 4 for full citation.)

bility 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.

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. Although not a complete survey, this section reviews a few of the models, focusing on the assumptions that they make with respect to price behavior and wage determination.⁴²

*The Swedish EFO model*⁴³

In Sweden the well-known EFO model follows the Norwegian precedent of a two-way classification of sheltered and exposed industries, with further subdivisions.⁴⁴ Output prices of the exposed sectors are assumed to follow world market prices although data show the relation 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 development 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."⁴⁵ This constancy implies a constant rate of profit. An interesting suggestion, which is also seen in models for other countries, is that the

42. 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. (See W. Driehuis and P. de Wolff, "A Sectoral Wage Price Model for the Netherlands' Economy," in H. Frisch, ed., *Inflation in Small Countries* [Springer-Verlag, 1976], pp. 283-339.) Four sectors are distinguished, namely, manufacturing, services, building, and agriculture.

43. In Sweden the work of the Aukrust Committee in Norway in 1966 soon inspired research along similar lines. The brief 1969 report by the chief economists of the labor market organizations, Edgren, Faxén, and Odhner, "Wages, Growth and the Distribution of Income," was followed by the extended report by the same authors in their 1970 book, *Wage Formation and the Economy*.

44. Within the sheltered sector group, five subsectors are distinguished: (1) sheltered goods production, (2) government services or services under strict governmental control, (3) building, (4) private services, and (5) government sector. Within the exposed sector group there are four subsectors: (6) raw material production exposed to competition, (7) semimanufactured goods production for export, (8) import-competing production, and (9) finished goods production.

45. Edgren and others, *Wage Formation and the Economy*, pp. 10-11.

normal rate of profit of the sheltered industries is the rate necessary to maintain investment, production, and employment in these industries.

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 labour 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."⁴⁶ This description is very similar to the argument above (pages 113–17). But in its discussion both of the wage determination mechanism and of other parts of the model, the Swedish study is much more detailed than its Norwegian predecessor; in particular, fluctuations in quantities are considered explicitly. The Swedish study is very useful, therefore, in pointing out modifications that could be made to the basic assumptions of the two models.

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.⁴⁷ The structure of the block is similar to the structure of PRIM, which inspired it. Two of the four sectors distinguished are sheltered sectors: agriculture and noncompetitive production (services, a few branches of manufacturing); two are exposed sectors: forestry and competitive production (bulk of manufacturing). Agricultural prices are stipulated in income negotiations between organizations of farmers and government and are exogenous. Prices of noncompetitive industries are endogenous and result from a markup policy: "In the non-competitive industries it is assumed that the share of nonwage income of all factor incomes [my phrase, 'share in total factor income'] is left unchanged apart from the long-run decreasing trend and fluctuations caused by changes in capacity utilization."⁴⁸

46. *Ibid.*, p. 22.

47. Halttunen and Molander, "The Input-Output Framework."

48. *Ibid.*, p. 227. Note that if the unemployment rate (LUR) is used as a rough indicator of capacity utilization, the percentage share of nonwage income in factor income is expressed as a function of time (T) and LUR by the equation in Halttunen and Molander (*ibid.*):

$$\frac{\text{nonwage income}}{\text{factor income}} = 45.693 - 0.160T - 0.507LUR,$$

which means that the nonwage share falls (and the wage share increases) when unemployment rises (implying lower capacity utilization). This may be an improvement

Prices of forest industries are exogenous, reflecting world market conditions for wood products. Prices of competitive production are also assumed to be mainly determined by world market prices, that is, export and import prices. No significant effect, however, 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 Ringstad found 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.

The French Fi-Fi model

In French planning a distinction between sheltered and exposed industries was introduced for the first time in 1965 by Raymond Courbis (who was obviously not aware that the same distinction was already in use in Norway). Since then it has been a permanent feature of French models.⁴⁹

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 seven sectors, classified in three broad groups that 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."⁵⁰ There is an idea here that is in the Swedish approach and that

compared with PRIM in which the nonwage share is supposed to depend on time only. The Finnish refinement is possible because the Finnish model, in contrast to the early versions of PRIM, determines production and employment simultaneously with prices and incomes.

49. The literature on French planning and the models on which it is based is extensive, most of it, however, in French. The information given in the present paper is based on Raymond Courbis, "The Physio-Financial Medium-Term Economic-Projection Model Fi-Fi" (paper presented at the First Seminar on Mathematical Methods and Computer Techniques, Varna, Bulgaria, 1970; United Nations, Economic Commission for Europe [MATHECO 1970/s—1/VAR/C.2]).

50. *Ibid.*, p. 36.

is also present in Eichner's model for the United States, discussed below, namely, that the profit rate (the percentage markup on costs) used by the sheltered industries in calculating their output prices depends, somehow, on the need of these industries to finance their investments.

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."⁵¹ 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."⁵²

The rate of increase of the average wage level is supposed in Fi-Fi to depend on (1) the unemployment rate, (2) the rate of rise in prices, and (3) something called, for short, "the financial situation of enterprises."⁵³ Courbis gives the following relation, estimated from annual data 1957-67:

$$(13) \quad TXH_t = 8.10 + 0.53 TPG_t - 0.15 TPG_{t-1} - 3.68 \left(\frac{DENS}{PA_t} \right) \\ + 2.67 RAP_t + 0.04 (A_{t-1} - \bar{A}_{t-1}), \\ (1.22) \quad (0.09) \quad (0.12) \quad (1.61) \\ (1.31) \quad (0.05)$$

$r = 0.972$; numbers in parentheses are standard errors.

where TXH and TPG , respectively, stand for the growth rate (in percent) 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 ($DENS$ is the number of job seekers, PA is the 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).⁵⁴

Equation 13 indicates that the rate of growth of the wage level is sensitive to unemployment and past price changes and little affected by the financial situation of enterprises. It therefore seems to uphold the Phillips curve approach to inflation. But unemployment may itself depend on wages because high wages may mean low competitiveness and a low demand for labor. The French approach, if I have understood it correctly, interprets equation 13 as

51. *Ibid.*, p. 10.

52. *Ibid.*, p. 39.

53. 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.

54. Courbis, "Fi-Fi," p. 29.

part of a larger 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).⁵⁵

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 analyzed by Eichner⁵⁶ 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 industries dominated by a few large corporations) output prices are “administered prices”; they are set by the producers to cover their costs as well as a certain margin above those costs. Costs generally depend on prevailing wage rates. The margin above costs is chosen 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.”⁵⁷ 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

55. “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.” (Ibid., p. 31.)

56. Alfred S. Eichner, “Price Policies of Oligopolistic Companies,” in *OECD Regional Trade Union Seminar on Prices Policy*, November 1972. Final Report (Paris: OECD, 1974).

57. Ibid., p. 81.

unaffected by short-run changes in aggregate demand conditions, contrary to the situation 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" (for example, in steel and automobile production).⁵⁸ The basic wage rate established by trade unions in the oligopolistic sector spills over to other sectors and governs the basic wage rate in the competitive and service sectors.⁵⁹ Taken as a whole, the model seems to consider the basic wage rate of the economy an administered price that is set at the discretion of the trade unions. There is nothing in the model to restrict the power of the trade unions either upward or downward since wage changes are reflected in the prices of 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.

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 Haig and Wood for the Australian economy.⁶⁰ The model is basically a closed input-output system that 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 markup 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, after a delay, as increases in selling prices of industries. The model is closed by equations that 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 twenty-three industries that, with respect to price

58. *Ibid.*, p. 89.

59. *Ibid.*, p. 84.

60. B. D. Haig and M. P. Wood in Karen R. Polenske and Jiri V. Skolka, eds., *Advance in Input-Output Analysis* (Ballinger, forthcoming).

behavior, are divided into four broad groups. In primary industries (agriculture, pastoral and mining industries), which in Australia are strongly export-oriented, output prices are assumed to be exogenous and determined by world prices or seasonal conditions. In manufacturing industries prices are obtained by applying a constant percentage markup on the historical cost of the goods sold. Costs of material are assumed to be passed on by the period of stock turnover (estimated at from two to eight months for different industries) and costs of wages by the period of turnover of work-in-progress (one to two months). In trade selling prices are obtained by applying a constant percentage markup on the price of goods for resale. The turnover period for sales to final buyers (estimated at from two to eight 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 markup on historical costs, assuming increases in costs to be passed on with a lag of one month.⁶¹

The model contains two equations that together determine the wage rate. One equation makes "nominal" (that is, negotiated) wages a function of prices and thus, according to the authors, completes 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, as I understand it, is along the following lines. Assume an initial increase in nominal (negotiated) wages. This will immediately increase the money value of the demand from employees for consumer 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 consequently 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

61. 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 1970s were subject to intense competition from overseas (for example, household appliances), should perhaps also be considered exogenous variables, determined in this case by world market prices.

Table 3. *Assumptions about Price Behavior in Selected Disaggregated Models*

<i>Model</i>	<i>Country</i>	<i>Prices exogenous, and given by:</i>			<i>Prices endogenous, and related to:</i>	
		<i>World market</i>	<i>Oligopolistic pricing</i>	<i>Government agreement</i>	<i>Markup on costs</i>	<i>Domestic demand</i>
PRIM	Norway	Shipping Forestry Manufacturing ^a	...	Agriculture Fishing	Sheltered (excluding agriculture)	...
EFO	Sweden	Manufacturing ^a	...	...	Sheltered (including agriculture)	...
Bank of Finland	Finland	Forestry Manufacturing ^a	...	Agriculture	Sheltered (excluding agriculture)	...
Fi-Fi	France	Manufacturing ^a	...	Agriculture Energy Transport Housing	Sheltered (excluding agriculture)	...
Eichner	United States	...	Oligopolistic sector ^b	...	Services sector	Competitive sector (including agriculture)
Haig and Wood	Australia	Primary sector (including agriculture) ^c	...	...	Manufacturing Trade Services	...

Source: See text for explanation.

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

b. Part of manufacturing, in other models classified as exposed.

c. Agriculture, forestry, mining including base metals.

supposed to change at the same rate in all sectors. No sector, apparently, is considered more important than any other in the wage determination process.

Summary of assumptions on price behavior

Table 3 presents in summary form the assumptions made about price behavior in the various models that have been surveyed. The main impression is of considerable diversity, yet certain features are noteworthy.

Most striking, perhaps, is the fact 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 it is supposed to be the case for only a few of the industries. In the majority of cases prices are assumed to be determined either on the world market and not influenced by the national economy or through some process of markup pricing. Some of the models explicitly acknowledge that 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. (This difference in approach, however, is unlikely to be of importance in practice inasmuch as 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 in only the models for Australia and the United States, which are big exporters of agricultural products.

A final point is the differences in assumptions made about the price behavior of manufacturing in the model for the United States and the remaining models. In the model for the large, almost closed, U.S. economy the output price of this sector is assumed to result from oligopolistic pricing, and there is no reference whatsoever 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. This asymmetrical treatment of manufacturing may be assumed to be more than accidental. Presumably the assumptions made are useful first-order approximations to reality in large and small economies, respectively. Yet one suspects that, if a more realistic multinational model is to be constructed, some assumption midway between the two extremes should be adopted.

Suggestions for Further Research

No country can avoid being affected 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 toward 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. Rather, a disaggregated approach seems a necessity if a deeper insight into the inflationary process is to be gained.

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 that will explain national price trends in terms of national policies and price impulses reaching the economy from outside. At the international level, however, this will not do. Instead, to understand world inflation, one must develop models that reflect fully the interdependencies of the economies of the world and that explain world prices in terms of policy decisions taken simultaneously, but independently, in many economies.⁶²

The ultimate goal might conceivably be 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 incorporate an input-output element.

Empirical research should be undertaken in the following three areas so

62. Research along these lines has already begun 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 held in November 1974 in Vienna by the Institut für Volkswirtschaftslehre [Institute for Advanced Studies], Technische Universität. (See Guy Carrin and A. P. Barten, "International Aspects of Cost Push Inflation," in H. Frisch, ed., *Inflation in Small Countries*, pp. 243-81, and Jean Waelbroeck and A. Dramais, "DESMOS: A Model for the Coordination of Economic Policies in the ECE Countries" in Albert Ando, Richard Herring, and Richard Marston, eds., *International Aspects of Stabilization Policies*, Federal Reserve Bank of Boston, Conference Series 12 [June 1974 conference], pp. 285-347.)

that national models can be gradually improved and international comparisons made easier.

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 considerations to be taken into account. Some are: (1) the sector classification should reflect existing differences in price behavior among industries, in particular, the varying degree to which industries are exposed to foreign competition. (2) It should be suitable for analysis of the wage determination process (for example, those industries considered wage leaders should be singled out for special study). (3) It should be suitable for analysis of the different routes (price effect, demand effect, liquidity effects) through which foreign inflation hits the economy. And (4), since the national model is to be part of a larger world model it may be useful to distinguish in the national model 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, those characterized by oligopolistic pricing. There is no guarantee that these considerations do not conflict. Consequently, an analytically suitable classification can be selected only after much experimentation.

Empirical studies of price behavior. Current understanding of how commodity prices are determined in the real world is insufficient. It is not certain, for instance, to what extent 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 is it known, in the latter case, how prices are calculated. A realistic formulation of price behavior relationships requires more research to provide the answers to these questions.

Empirical studies of the wage-determining process. Perhaps the greatest hindrance at present for the construction of a realistic model of inflation is the inability to formulate a reliable wage relation (or set of wage relations). For reasons set out in the text I find the Phillips curve explanation of wages (linking wages to some employment indicator and, perhaps, past prices) highly unsatisfactory. If one is to be realistic, one must consider the wage rate to be determined, simultaneously with employment and other variables, through a process that only a very complicated model could 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, with the focus primarily on the forces operating within the wage leading industries.

Comments by Johan Myhrman

AUKRUST'S PAPER is a good example of very scholarly work and the best presentation I have seen of this type of model.

I like, too, the honesty of the author when he says that he has no full theory of inflation. To have a full theory of inflation a theory of a dominant impulse is needed, and a transmission mechanism. What he has is one type of transmission mechanism, putting aside the explanation of the dominant impulse that determines world prices.

It is important to distinguish between the short-run and long-run uses of this model. I shall discuss, first, the long-run use, which is said to produce a cost-push theory of the transmission of international inflation. The cost-push comes about by assuming that prices in the sheltered sector are markups on the wage increases.

Although Aukrust asserts that this is a cost-push model, there are statements in the paper about demand influences. I refer to one on page 130: "In the labor market, in contrast, the Norwegian approach assumes the balance between supply and demand to play a crucial role." That brings me to an important question, the definition of cost-push. I would like to define a pure cost-push situation where wages, for instance, are increased independently of market conditions. If wages react to supply and demand, I would not call that cost-push.

Then there is a second question relating to the distinction between demand and cost-push theories of inflation. I do not find that classification very useful. Essentially, demand for labor is a derived demand from the commodity market. If it is said that an excess demand for labor pushes up wages, and that firms then mark up prices because their costs have risen, it is more useful to characterize the whole situation as a demand inflation.

Still another question is: what is the difference between this model and other types of models, such as the monetary theory of the balance of payments? Here, Aukrust has taken one point of mine by admitting that there is no inconsistency between the two. Everything in the Norwegian model might be explained as the long-run monetary theory of the balance of payments, if one does not insist on saying that it is cost-push. If the model is expressed in equations and the prices in the sheltered sector are set by markup it can be said that those prices are raised by cost-push, but the inflation itself is not cost-push because the following might be another interpretation. Assume that one starts with an increase in world demand that raises world

prices. Then demand for the products of the exposed sector increases, their prices increase, profits increase, demand for labor increases, and wages increase. But at the same time, if one begins from an equilibrium in the balance of payments, there is money coming into the economy as a result of the balance of payments surplus. That will increase domestic demand. It will increase demand for sheltered sector products and will increase prices and wages in the sheltered sector. As far as I can see, the same result would be obtained by that kind of experiment. That is why I do not object to the form of the model. I really object more to some of the interpretations.

So much for the long-run model. Aukrust also has a short-term model, which is an input-output, cost-push model that he thinks is a reasonable explanation of what goes on in the short run. I am not sure that I would agree with that, either, unless there is a perfectly accommodating monetary policy, for instance, such as there may be in Norway, but which there certainly is not in Sweden. As a short-run explanation demand policy, whether fiscal or monetary policy, must be taken into account. It seems obvious that the developments in Sweden between 1971 and 1973 would be very difficult to explain without taking into consideration monetary and fiscal policy actions.

It is of interest to note, incidentally, that Aukrust suggests that demand management has the greatest effect over a period of between two and five years, whereas Faxén, in the Swedish version of this model, says that there is no use in formulating demand policy for less than five years.

Another point raised in the paper, and which is not part of the model, concerns the formulation of wage behavior in an open economy, especially in the form of a Phillips curve. It seems to me that, in the long run, the Phillips curve in a small open economy would be reduced to a dot. In the short run, however, in the specification of equations that are to be estimated for the Phillips curve, information on the behavior of international wages and prices must be considered. That is one of the points I think Aukrust wants to take up.

Finally, in the discussion of the income distribution between sectors a number of important factors are not considered. I have read no comment, for example, on automatic forces working to adjust sectors over time, through different price elasticities in the two sectors and through entry and exit of different firms between the two sectors. For instance, in Sweden, in a situation of excess demand, there would be a more rapid rise in wages and prices in the sheltered sector. If those wage increases were forced into the exposed sector, firms would fail and have to leave the sector. That is a kind of natural economic adjustment.

Comments by Charles S. Maier

AS A HISTORIAN I am not sure that I shall be able to give Aukrust's paper the technical economic commentary that it deserves. But as a historian who has been concerned with inflation, not as Public Enemy No. 1 but as an index of social conflict and as a means of expressing collective preferences, I find this paper useful. Furthermore, since social scientists in America rarely think about small countries, it has been doubly useful.

Let me spotlight both what I believe are Aukrust's contributions and those questions that I think he left unanswered. The major argument in the paper is that the Norwegian model shows the transmission of inflation in an economy that is buffeted by the general currents of the world market and world pricing. According to the paper, the exposed industries in Norway produce 30 percent of the net national product and engage 22 percent of the labor force. That does not seem to me an inordinately large sector oriented toward exports or the world market, especially for a small open economy like that of Norway.

My major question in looking at figure 1, which illustrates a causal chain for price increases, relates to the mechanism by which wages in the exposed industry sector, employing 22 percent of the labor force, actually become the accepted wage standard for the sheltered activities as well. From the point of view of social factors, I think that link is obviously very important. Perhaps it is the system of highly centralized wage bargaining in Scandinavia that is crucial. Still, the government must face some different constituencies in negotiating wages. I am surprised that the sheltered sector wages become so readily determined by the wages in the exposed industries.

According to this model there is obviously an upward bias for prices. It must lead to inflation because of the difference in productivity of the two sectors. Aukrust points out that productivity has risen more than twice as fast in the exposed industries, thus allowing wage increases without inflationary pressure, but that the wage increases are transmitted to the sheltered industries. Because these tend to operate on a cost-plus pricing basis, the effort to keep a "normal" relation between profits and wages will tend to raise output prices (see page 116, note 12).

I do have a further question about the tendency for wages in the exposed industries to adjust so as to maintain or restore profits in these industries to a normal share of factor income. Aukrust admits that such a tendency is hard to demonstrate in view of the oscillation of the percentage from year to year

(see figure 1). Nonetheless, the existence of the trend is crucial to his explanation of how price impulses are transmitted in the Norwegian economy, for the model postulates that the wage level in the exposed industries, and thereafter in the sheltered industries, tends to follow the productivity gains in the most efficient sector of the economy. I would like to know more about this tendency to move toward normal profits and the justification for the argument.

It would also be informative to specify further how wage increases slacken when profitability falls. (The greatest slowdown in wage inflation that has been adduced for Norway in this paper occurred in the 1950s, when wage demands moderated during a period of slowdown in world commodity prices.) The only way to hold down wage increases, Aukrust suggests, is by general deflationary measures applied to the economy as a whole. Is there no chance for selective wage stabilization or even a reduction in the relative share of wages to respond to declining sectoral profitability without a general deflationary policy?

The model also presents testing difficulties, as Aukrust admits. One possibility for testing would be to look at how wages follow prices in the world sector. This generally confirms the model. On the other hand, according to Ringstad, whom Aukrust cites, the parameters of table 2—especially the second row of the table relating to export industry prices at home—do not apparently yield the sensitivity to export prices abroad or to import-competing prices that the model would warrant. A problem arises with autocorrelation, which is detailed in the paper and which I am not qualified to resolve. Nonetheless, the result is that the Aukrust model tests positively by one method and indeterminately by another.

Aukrust's model has been termed a "third" causal model to place alongside the monetarist and the Keynesian models, although Aukrust himself has not made that claim. Is one not dealing, though, with a Keynesian model that has certain limiting conditions created by the large export sector? I am not sure that this affects the validity of the model, but it may affect the way causal typologies of inflation are considered. Aukrust discusses the difficulty (on pages 124–26) of finding any economic policy that can simultaneously solve two different dilemmas, that can deal with the price pressures imposed by the world market and yet not prevent a regressive distribution of income on behalf of those in the exposed industries. Is not this argument just a restatement under Norwegian conditions of the general Phillips curve dilemma, if instead of considering the trade-off as one of unemployment against inflation, it is seen as one of income or sectoral factor shares against inflation?

Perhaps this dilemma represents part of the more general trade-off faced in the West. As I have said, my own major interest in inflation centers on its role in revealing and defining group conflict. The paper suggests that 30 percent of the economy has an interest in price stability, while the 70 percent in sheltered industries has a virtual interest in creeping inflation. Thus an open economy may produce social divisions along different lines than those suggested, say, by Bach and Stephenson who divide economic interests between households and corporations and examine the transfer of incomes and assets from the former to the latter.⁶³ Does the Norwegian type of open economy thus tend to crystallize different constellations of interests or classes from the large and more self-sufficient economy? This is the kind of question that Aukrust's paper poses for noneconomists.

It further raises the issue of how bargaining actually occurs in society. Why does the government supervise a process by which the wages of the sheltered industries so ineluctably follow the wages of the exposed industries? Is it a question of public employees? If the country under discussion were Sweden, I would look to see whether state bargaining with public employees forms a major contribution to the inflationary tendency in the sheltered sector. But the state seems to play a smaller role as employer in the Norwegian model, and thus perhaps its role in inflationary wage settlements matters less in proportion to the influence of the exposed sector, as stressed by Aukrust.

Aukrust invites further thought on the political economy of world market-oriented systems. Both the left and the right in today's policy debates converge on the role of the state in trying to mediate between the needs of capital accumulation on one side and the demands of social peace—to be secured through irreversible wage increases and extensive welfare provisions—on the other. The Norwegian case suggests that these countervailing pressures force crucial domestic decisionmaking, even when an economy seems dependent upon the larger price movements of the world economy. At the very least, adjustment of the exchange rate will have great sociopolitical consequences: too great a revaluation may increase unemployment; even an adjustment that does not inhibit exposed-industry competitiveness and manages to slow inflation may have undesirable redistributive effects. Resolution of the trade-offs will ultimately require political as well as economic bargaining. Here Aukrust underlines the need to study not only the international economic determinants but the social forces within the individual country to probe how bargains are struck, to learn who is supervising them, and how the responsible authority answers to different constituencies.

63. G. L. Bach and James B. Stephenson, "Inflation and the Redistribution of Wealth," *Review of Economics and Statistics*, vol. 56 (February 1974), pp. 1–13.

General Comments

Wynne Godley noted that a key mechanism in the Aukrust model is the increase of wages in export industries associated with the receipt of higher prices by producers for export. This sequence should be easy to observe, but Aukrust's paper does not say whether larger-than-average wage increases in the export sector associated with big increases in profit shares were actually observed.

John Pinder questioned why trade unions in the sheltered industries limited their demands to what was required for parity with wages in the exposed industries: if they had enough power to push for parity why did they not push for more? One answer is that they might expect pushing for more to cause a balance of payments deficit and could foresee, looking two or three years ahead, that this would make everyone worse off. But if these trade unions are so enlightened when the circumstances create risk of a balance of payments deficit, why do they continue to be so restrained when everyone in the rest of the world is pushing as hard as possible, so that an equally strong push by them would not cause such a deficit? Has the current freedom of a country to float its currency not altered the situation from that described in the Aukrust paper, so that the threat of a deficit would cease to be an inhibition on the trade unions in the sheltered industries? Furthermore, the prospect that Norway will become an oil exporter has also changed the situation by making it unnecessary for Norway to have any other export industries, so one could say that workers in the sheltered industries would be doing their patriotic duty if they drove other export industries into bankruptcy. In other words, why do they not push harder than they do, now that the patriotic incentive not to push too hard has been removed? The question of why they do not push harder is worth study; so, too, is the behavior of workers in the sheltered industries with respect to wages, if such a review is not already being undertaken.

Giorgio Basevi questioned whether the assumed causal relation between the increase of wage levels in the exposed sector of the economy and the wage level in the sheltered sector is valid generally. For some countries, such as Switzerland, the sheltered sector has an elastic supply of labor arising from the availability of foreign labor. For that reason, wages in the sheltered sector were kept lower than they would be if immigrant labor were not available, with the result that the general price level in such a country is lower, or rises less than it otherwise would. Caution is therefore indicated in the use of

models like the Aukrust model for countries other than those, such as Norway or Sweden, where foreign labor is not available.

Helen Junz considered the basic assumption of the Norwegian model to be that the markets are free so that in the long run the sheltered sector is just as exposed as the so-called exposed sector. The structure of markets probably has much to do with the creation of an inflationary climate, and the proposed future work on this point, referred to in the Aukrust paper, should not be confined to study of commodity markets.

Robert Gordon questioned Aukrust's statement that the monetary theory of the balance of payments took no account of the wage level. That theory has been worked out in detail for a two-sector economy with a special assumption that there is only one wage rate and labor is mobile between sectors. This assumption is well borne out in American statistics; they show that no matter how the labor force is disaggregated, whether demographically, industrially, or by occupation, wages have accelerated and decelerated together, so that the assumption of high substitutability across all these sectors dominates any other assumption, even in periods as short as one year or so. The only exception to this is that there has been some divergence between the wage rates of experienced adult males on the one hand, and teenagers on the other. Also, even if it is conceded that nominal wages in the traded and non-traded goods sectors do move together, it is cause for concern that the model attempts to determine how an impulse toward higher prices in the traded goods sector will affect nominal prices in the nontraded goods sector without specifying anything about policy, especially monetary policy. Without such a specification anything can be obtained, from no response in nontraded goods prices to complete elimination of the initial fall in their relative prices, depending on whether the balance of payments surplus is raising the domestic money supply (it may or may not be), on whether sterilization is possible, and on whether the country is large enough to control its own money supply. It is not useful, therefore, to talk about the nominal prices of traded goods and the overall rate of inflation without specifying some monetary constraints.

George Perry, referring to the treatment of wages in the Aukrust model, thought it was very similar to the old American idea that wage changes were led by a strong, presumably unionized, sector that was the first to raise wages, either autonomously or in response to demand, and then dragged other wages up with it. But this view of wage developments in the United States has not been supported by research. There are systematic differences in the timing of wage changes in the United States. Wages in the highly unionized sectors lag rather than lead other wages in response to unemployment or other measures of labor market tightness. An expansion of demand in the sector where

people prefer to work at the given wage, generally the unionized sector, results in an expansion of output in that sector and an expanding demand for labor in it. Because these are preferred jobs, this labor is readily available and prices and wages do not rise in this sector. But the process does bid labor away from other industries, causing wages and prices to rise in them. Thus while the preferred sector is central in this explanation, just as in the Aukrust model, its wage changes do not lead wage changes in other sectors. This view provides a plausible linkage and might be more consistent with the empirical evidence in Norway, which Aukrust states is inconsistent with his own model.

James Duesenberry noted that the trade union explanation of inflation is more incomplete than incorrect in that it centers on one out of a number of possible initiating sectors. Analysis of wage making has to take account of the basic structure of the labor market and of forces that might disrupt it. The fundamental idea is that the labor market structure is tightly knit and has several sectors, of which unions are only one. A second sector is the large part of the labor force that is not unionized but has a highly structured and classified compensation system in which relative wages are always monitored very closely to maintain or attain specified relations between grades of labor, skills, and other characteristics. Because there are many such relations and they interlock in a complicated way, it is a whole structural network. A third sector is a secondary labor market consisting of people in more or less casual employment. Fourth, and at the other end of the scale, is what might be called a free professional market with high mobility consisting of professors, accountants, lawyers, and others who may be employed sometimes in one of the above-mentioned systems but for whom there is a separate market that operates in a different manner from the labor markets in general. The two largest of these four sectors are the union markets and the classified employees' markets, the latter including the federal, state, and local government labor force, and almost every employer with more than 500 employees. Those systems are not rigid, but they move slowly.

Given that kind of structure, the initiating force that can start the whole process in motion and produce secondary reactions will be different at different times. In 1955, which was a good automobile year, people thought the process began with the United Automobile Workers' settlement. But in 1966, when no contracts were coming up for renewal, the big wage pressure was on the bottom of the labor market, with people being drawn out of gas stations and warehouses into factories at higher wages, which pulled up the wage structure. At the same time, there was a shortage of skilled workers in the markets where wages could rise with relative freedom, so those wages went up, and later the unions tried to restore their previous relative wages. At still

other times there was a construction boom and construction workers were able to raise wages, at least in some trades, and these spread from one trade to another throughout the industry, and finally into other industries.

There is no general rule as to where impulses that will initiate a general wage movement will originate. They are generally associated with increased profits and higher employment somewhere but not always in the same sector. Nevertheless, the original notion that there is an initiating sector is a powerful one, and the Aukrust paper shows that there are countries other than the United States that have a highly structured and interconnected wage system. It is not entirely independent of supply and demand but operates in ways different from what would be expected from such forces; wages can go up within a sector despite the presence of much unemployment in it. The total system also has a positive correlation of responses to supply and demand conditions.

What is really needed is a general approach, which must then be supplemented by drawing on particular characteristics of the wage structure of a given country, and some indication of where the initiating forces will most probably occur.

George Perry, in agreeing with the above analysis, said that he had intended to distinguish between wage increases that are independent of expansion of aggregate demand and those resulting from such expansion. If a rise in world market prices raised export prices and this, in turn, directly raised wages in the export sector, then policy could not be blamed for the domestic inflation; in that case world prices would cause domestic price and wage increases without raising domestic aggregate demand. But if, instead, the expanded demand for exports operated through raising aggregate demand and the wage responses followed from that, then domestic policy would be much more responsible for the rise in the wage level because policy could have offset the expansion in demand for exports. The contrast was between a shift in the Phillips curve and a movement along it.

William Branson noted that although the national price level is a weighted average of prices of sheltered and exposed goods, nothing is said about where the weights come from. In the model, the price of sheltered goods is always rising in relation to the price of traded goods, but this would imply a downward trend in their output unless one made some special assumptions about price and income elasticities of demand. Such assumptions are not stated. Also, it is ambiguous whether the assumption that income shares are constant in the short run is intended to be simply an instrument to help in negotiation about wages and prices by telling labor and others how wage and price decisions would affect their shares, or whether it is a theory about why shares will

in fact remain constant. If it is the latter, something should be said about production functions, elasticities of substitution, and similar factors, and also about whether the theory is true. In the latter connection, there has been substantial fluctuation of shares in Sweden and also trends in the profit share in the United States, as shown by William Nordhaus (see page 139, note 34). Finally, the statement in Aukrust's paper that "in the commodity markets, demand is not supposed to matter much" is surprising, because it runs counter to the general tendency of the paper to discuss only supply-side or cost conditions, holding demand constant. This partial equilibrium analysis is different from a general equilibrium analysis in which it is also assumed that demand does not matter.

Assar Lindbeck observed that Aukrust offered an explanation not only of why countries have similar rates of inflation but a framework for discussing differences in their rates of inflation. These differences could be accounted for by three factors: first, differences in the rate of productivity growth in the exposed sectors of two countries that have the same exposed industries; second, differences in the rate of productivity growth in the sheltered sectors of the two countries; and third, differences in the behavior of export prices in the two countries owing to differences in the composition of their exports.

It has often been said, especially with reference to the United Kingdom, that inflation should be fought by increasing the relative importance of manufacturing because productivity increases are most rapid in that sector. The Aukrust model comes to the opposite conclusion; if productivity increases more in the exposed sector while it remains unchanged in the sheltered sector, inflation would accelerate because wage rates would increase more rapidly and cause greater cost-push in the sheltered sector.

The model demonstrates why the exchange rate is the only instrument that permits a country to determine its own price trend. The short-term part of the model also gives some explanation, or at least a framework for discussion, of what determines variation in the profit share of national income. The profit share of the exposed sector is determined approximately by the relations between international prices and unit labor costs. If variations in the profit margins of the sheltered sector are very small, it is basically the relation between world market prices and unit labor costs in the exposed sector that determines the distribution between profits and labor in the country as a whole. This inference from the model is realistic for small countries. In Finland, for example, which has more rapid inflation than the outside world, the profit share goes down when it revalues its currency. A period of unemployment follows, it devalues, and the profit share goes up. Further inflation reduces the share again. Its behavior is like that of a seesaw. Thus the short-

term behavior of the model gives some indication of the determination of distribution of income between labor and capital not only in the exposed sector but in the economy as a whole.

One difficulty with the model, however, is that it is hard to distinguish between the exposed and sheltered sectors; nearly all sectors are exposed to some extent, even building activity. Where the line is drawn is important because different predictions for the aggregate price trend can be made depending on whether it is assumed that the sheltered sector is very small or very large. The group working on a similar model for Sweden has been very indecisive about the fraction of the Swedish economy that is exposed, sometimes saying it was one-third sheltered and sometimes that it was one-third exposed. This decision greatly affects the forecast of the price trend.

Alexander Swoboda agreed that the model did not specify what determined aggregate demand for nontraded goods and therefore did not enable one to derive the average price of nontraded goods from the average price of traded goods. To determine their relative prices some hypothesis about monetary portfolio equilibrium is necessary as well as some assumptions about the nature of fiscal policy and monetary policy in relation to the demand for traded and nontraded goods. Without that, what is happening to prices cannot be determined, and only with such knowledge, supplemented by what is known about productivity, can the demand for labor in the two sectors be derived. Then, to derive wages, some kind of supply curve for labor is needed, either a neoclassical curve or something else. This would give a more complete model, but that model would be indistinguishable from the Australian model of traded and nontraded goods, which incorporates money and specifies the production sectors, for example, by postulating that capital is specific to each of the two sectors and that labor moves between them.

It is both important and difficult to know how to distinguish between sheltered and nonsheltered goods. The analytical purpose of making the distinction is essentially to identify goods that respond quickly and those that respond more sluggishly to excess demand or supply. The distinction is useful in accounting for facts in the short run, even though what is not traded becomes tradable in the long run or has a high degree of substitution with tradable goods. But it is difficult to apply to actual statistics.

Gerhard Fels noted that the Aukrust model is in many respects similar to a model used by the German Expert Council on Overall Economic Development during the 1960s. That model operated by means of an increase in export demand, an increase of profits in the export sector, a wage increase in that sector, and a consequent wage and price increase in the domestic sector. It explained the economy fairly well up to the end of the 1960s, espe-

cially of how inflation came in from abroad. But in the early 1970s the conditions upon which the model was based changed. For instance, several revaluations of the deutsche mark dampened export demand and increases in export prices. Inflation was still imported, but mainly by inflows of liquidity that were often encouraged by expectations of changes in the exchange rate. Another change was the shift in wage leadership from the export sector to the public sector. The domestic sector continued to inflate whereas in the export sector the rate of price increase was rather moderate because of the direct price stabilizing effects of the revaluations. The terms of trade of the export sector vis-à-vis the domestic sector deteriorated.

Walter Salant remarked that the model is referred to as a two-sector model and exposed industries are treated as one sector. This raises the question whether the model makes any distinction between exports and import-competing industries. To treat them as part of a single sector prevents the model from dealing with the impact on the domestic economy of a change in the terms of trade. That might be why the model broke down in 1973-74; the rise in food and oil prices involved the very deterioration in the terms of trade which, if he understood it correctly, the model could not take into account. An adverse change in the terms of trade is equivalent to a fall in the productivity of the export sector, and perhaps could be worked into the model by treating it in that way. Such a change is like a fall in the productivity of the export sector because it reduces the quantity of goods available for consumption and investment per unit of domestic output; if aggregate nominal demand were to remain unchanged, the reduction in output available for consumption and investment would be inflationary. If the model cannot currently take into account a change in the terms of trade, it should be modified, either in the way suggested or in some other way, to enable it to deal with such changes. Perhaps a modification of this kind would give better results for the last few years.

Odd Aukrust, confining his response to a few general remarks, suggested first that the model might work better for countries like Sweden and Norway than for others because the former have a very centralized trade union movement and centralized wage negotiations that take place more or less at the same time for all workers. That partly explains why the wage level spills over so easily from the exposed to the sheltered industries. The trade union leadership, which negotiates on behalf of both groups, is responsible and does not want to destroy the firms that employ the workers. The union leaders tend to look at the profitability of the exposed industries.

As to the many questions raised about the role of demand, it is agreed that the "real" side of the economy is not spelled out in the Norwegian model and

that it presupposes that demand adapts itself. But this is basically what happens; the only ultimate prices found that explained the movement of prices and wages in Norway over a twenty-year period have been world market prices and the exchange rate, which had been kept stable. That is a cost-push type of explanation. When wage negotiations had been concluded—and it was reasonably well known what the wage level would be over the next two years—prices during those two years could be forecast by applying some of the principles relating to cost-push pricing. Within such a two-year period one had to consider labor market developments to explain wage drift, that is, the portion of the wage change that was not negotiated and which might be 4 percent, more or less. Demand did not have to be taken into consideration anywhere else to explain price developments over such a period. In explaining what would happen over a five-year period, however, during which a number of wage negotiations occur, demand management would be important because it would influence the demand for labor in two years' time, which in turn would influence wage negotiations at that time and have further effects on price trends.

As to whether the model is a third explanation of inflation, that is, in addition to the monetary and Keynesian explanations, there is no way to respond except to say that it does point to certain aspects of inflation not highlighted in alternative explanations. Moreover, this difference in diagnosis might on occasion lead to different remedies. Although the reasoning in each instance is in different modes, each seems to come to similar conclusions. It might be that the monetary theory is the most useful to explain the very long-run trend of the world price level, that the Aukrust model is an important explanation of the mechanism that operates to tie things together in a short period, and that there is plenty of room for the Phillips curve.

In regard to the statement that foreign exchange rates cannot be manipulated freely and that they are not well suited for use as regular instruments of price policy, there is at least one difficulty: every time a change in exchange rates is proposed, there are pressure groups that oppose it. The effect of currency appreciation on exposed industries is immediately seen by everyone, and these groups are strong and put pressure on the policymakers. If the world comes to expect a change in Norway's exchange rate every year or two, the resulting unfavorable speculation might cause trouble.

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