PRIM I: A MODEL OF THE PRICE AND INCOME DISTRIBUTION MECHANISM OF AN OPEN ECONOMY

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PRIM I is a numerical model which has been extensively used as a basis for an income policy in Norway in recent years. It is a static, cost-push, input-output model. Wage rates, agricultural prices, productivities and world market prices are treated as exogenous variables, and the model derives short-term changes in income shares and in the national price level from changes in these exogenous variables. A key feature of the model is a distinction between "exposed industries" which are subject to strong foreign price competition, and "sheltered industries" which are relatively free of such competition. These two groups of industries are found to react with very different pricing policies in response to increases in costs; furthermore, possibly for technological reasons, the export industries have greater scope than the majority of the sheltered industries for compensating cost increases through productivity gains. These two facts are shown to have important implications for a price and income policy. It is demonstrated, i.a. that the goal of a stable national price level is, in general, inconsistent with the maintenance of stable income shares when exchange rates are kept constant.

I. Introduction

1. The model PRIM I (PRIM = PRice-Income-Model) may be described, in brief, as a short-term, cost push, input-output type representation of the mechanism which determines prices and incomes distribution in the Norwegian economy. The model is *short-term* i.a. in that it takes wages and agricultural prices as given. This is an accurate description of reality, under Norwegian conditions, since wages and agricultural prices are fixed by negotiations and may be taken in the short run to follow a pre-determined course as set by these negotiations. The model is *cost push* in that it explains prices entirely in terms of costs. There is no reference to demand. The model is of the *input-output type* in recognizing the fact that higher output prices asked by one industry means higher input prices, i.e. higher costs, in other industries. This results in a price propagation process which can be studied through an input-output technique in very much the same way as input-output technique is used for the study of quantitative interrelationships.

2. The ideas contained in PRIM I have grown out of research work undertaken at the Central Bureau of Statistics over a number of years. The model itself was formulated in 1966 by a group of three experts ("The Reporting Committee for the Income Settlement 1966") who were called upon to provide background material for that year's round of negotiations on wages and agricultural prices, and it was published in their first report.[1] The experts intended the model

[1] *Innstilling fra Utredningsutvalget for inntektsoppgjørene 1966, avgitt 22. januar 1966* ("Report by the Reporting Committee for the Income Settlement 1966, of January 22nd 1966"), published 1966 by the Prime Minister's Office. Members of the Committee were myself (Chairman), Associate Professor Fritz C. *Holte*, the Agricultural College of Norway, and Professor Gerhard *Stoltz*, the Norwegian School of Economics and Business Administration. The Committee, known informally as "Aukrust-utvalget" (The Aukrust Committee) was asked

first and foremost as an instrument for forecasting the effects of changes in wages and agricultural prices on consumers' prices and income distribution.

3. While, naturally, PRIM I was designed for use under Norwegian circumstances the model contains features which may be applicable also in other countries. In order that the reader may be better placed to judge its usefulness elsewhere the following facts about Norway should be noted: (i) The Norwegian economy is an extremely open one, hence national prices are probably more directly influenced by prices abroad than they are in most other countries. (ii) Wage negotiations in Norway are strongly centralized. Typically, the wage level is negotiated for two-year periods with most wage- and salary-earners receiving wage increases simultaneously and by about the same percentage. (iii) Agriculture is heavily protected and subsidized. The prices of most agricultural products are fixed through negotiations between the farmers and the Government also for two-year periods, the negotiations taking place simultaneously with the negotiations over wages.

II. Sheltered and Exposed Industries

4. An important distinction in the model is between sheltered industries and exposed industries. *Exposed industries* are those which market their products abroad, or on the domestic market under strong foreign competition. For these exposed industries the model assumes prices of outputs to be determined on the world market. These industries, therefore, can not compensate for a cost increase through an upward adjustment of prices. If their costs increase, they must sustain the whole effect in the form of reduced profits (entrepreneurial incomes). The *sheltered industries*, on the other hand, are those industries whose products are marketed at home under conditions such as to leave them relatively free of foreign price competition.[2] The sheltered industries will tend to raise output prices when costs increase. Available statistics indicate that the sheltered industries tend to pursue a price policy such that, for the group as a whole, the ratio of profits to wages is left unchanged apart from a trend due to an increase in the relative number of employees (see section V).

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again later to continue its work and a second report on the causes of long-run price developments in Norway was published by the Prime Minister's Office in 1967: *Innstilling II fra Utredningsutvalget for inntektsoppghørene i 1966, avgitt 20. oktober 1966* ("Second Report of October 20th 1966 by the Reporting Committee for the Income Settlement 1966"). The present paper draws heavily on the first of these two reports, and the concluding paragraph below gives a hint about the content of the second. I am happy to have this opportunity to acknowledge my great debt to Professors Holte and Stoltz. In particular I owe the mathematical formulation of the model largely to Professor Holte, though the formulation of PRIM I as set out here does deviate somewhat from the original model. I am indebted, furthermore, to colleagues at the Central Bureau of Statistics, in particular to Mr. Per *Sevaldson* and Mr. Arne *Øien* who conducted the tests reported in section VI below and commented on a first draft of the paper, and to Mr. Erik *Homb* who guided the work needed to rearrange the national accounts data as required by the model.

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

5. The difference in price behaviour between the exposed and the sheltered industries is an important feature of the Norwegian economy, and it determines the mechanism of price and income distribution in the model. There is a difference between exposed and sheltered industries also in that labour productivity, in Norway at least, rises much quicker in the former than in the latter.[3] This fact, which is often overlooked, ought to have important implications for the formulation of the goals of an incomes policy, as we shall see later.

III. Description of the Model

6. In the model the following classification of industries is used:

1. agriculture (excluding forestry and fishing but including dairies)	sheltered industries
2. other sheltered industries	
3. import-competing manufactures	exposed industries
4. fisheries	
5. shipping	
6. other exportor-iented industries	

Within the sheltered industries agriculture is singled out as a separate group because of the special position of this industry in income negotiations. Among the exposed industries fisheries is specified for rather similar reasons, and shipping is treated separately because of its unique role in the Norwegian economy. The remaining exposed industries are divided into "import-competing manufacturers" and "other export-oriented industries."

7. An input-output table for the six industries is reproduced in Table 1. From this table input-output coefficients (columns 1–6) and the weights of the consumers' price index may be computed.

8. The following assumptions are made for wages and prices:

(i) The model assumes wages per man-year for any given year and any one industry to be given. Changes from one year to the next in wages per man-year may be in part due to a wage settlement, and partly due to a wage drift, but this is inessential for the argument.

(ii) The model assumes agricultural prices to be given, stipulated by the income settlement for farming.

(iii) The model assumes import and export prices to be given, determined by the world market.

(iv) Changes in output prices are percentagewise the same for all deliveries from any one industry, (that is, for all entries in any one row in the input-output table).

[3]The average labour productivity increase within the two groups of industries over the period 1951–1967 was 4.5–5.5 and 2–2.5 per cent a year respectively. Presumably the reasons for the difference were largely technological. We would expect the scope for technical progress to be much bigger within capital intensive industries such as manufacturing and shipping which constitute the core of the exposed industries, than within services which weigh heavily within the sheltered industries group. However, we cannot rule out the possibility that the exposed industries in part had a better productivity record precisely because they were exposed and therefore had to attend more to efficiency in order to stay competitive. In Sweden the average productivity increase over the period 1960–1967 was 3.6 per cent a year within the sheltered industries group and 7.5 per cent within the exposed industries group. See footnote to paragraph 45.

TABLE 1

INPUT–OUTPUT TABLE 1967. MILLIONS OF KRONER

Receiving Sector / Delivering Sector	Agri-culture	Other Sheltered industries	Import-Competing Manu-facturers	Fisheries	Shipping	Other Export-Oriented Industries	Private Con-sumption	Publ. Cons. + Gross Cap. Form.	Exports	Total
Agriculture	—	1,158	40	—	—	72	2,179	102	372	3,923
Other sheltered industries	1,363	—	1,120	86	514	1,651	23,230	23,555	2,997	54,516
Import-competing manufacturers	31	2,054	—	29	62	242	3,053	3,474	2,717	11,662
Fisheries	57	540	7	—	7	482	106	18	71	1,288
Shipping	—	362	—	—	—	0	125	15	10,184	10,686
Other export-oriented industries	251	2,283	563	8	53	—	660	409	6,670	10,897
Import	155	3,527	3,457	76	3,048	2,772	4,509	8,342	83	25,969
Dummy accounts	—	—	—	—	—	—	155	−2,193	2,038	—
Value added[a]	2,066	44,592	6,475	1,089	7,002	5,678	—	—	—	66,902
Total	3,923	54,516	11,662	1,288	10,686	10,897	34,017	33,722	25,132	185,843
[a]Of which:										
Wages	292	21,672	3,981	100	2,315	2,758				31,118
Profits	1,904	9,411	1,363	626	954	1,944				16,202
Ind. taxes	9	7,870	669	—	14	82				8,644
Subsidies	1,024	1,220	87	27	78	168				2,604
Depreciation	885	6,859	549	390	3,797	1,062				13,542

(v) The price of products from sheltered industries excluding agriculture ("other sheltered industries") are stipulated in such a way that profits in this industry have a fixed ratio to wage costs, determined (in normal years) by the trend value of the share of profits in factor income.

(vi) In the exposed industries excluding fisheries prices of goods are fixed to be consistent with foreign enterprises' prices of comparable products. The model, therefore, construes the prices of products of "import-competing industries" to follow the (given) prices of competing imports and the prices of products of export-oriented industries (including shipping) to follow the (given) export prices.

(vii) The model assumes output prices of the fishing industry to be given, stipulated through a government policy of price fixing (sales on the home market) or by world market prices (exports).

The realism of some of these assumptions is discussed in Section V below.

9. With respect to volumes PRIM I assumes:

(i) Changes in product volume may occur in all industries. Such changes may be due partly to changes in employment and partly to changes in productivity, i.e. production per man-year worked.[4]

(ii) It is assumed that changes in output neither alter the quantities of intermediate goods consumed per unit of output nor the total volume of depreciation; in other words, the model assumes constant input-output coefficients in volume terms for intermediate goods, and given volumes of depreciation (as determined by the volume of capital employed).

(iii) The model does not endeavour to explain how changes in wages, prices and productivities affect final demand, and figures relating to final demand are excluded from the model. The model simply assumes that there is always sufficient demand somewhere for the products of each of the industries.

10. For all industries except agriculture and fishing the model distinguishes between wages and profits. In agriculture and fishing wages and profits are combined into variables called "income from agriculture" and "income from fishing" respectively.[5] The *endogenous variables* or groups of variables of the model, (variables which the model tries to explain) therefore include i.a. the following price and income variables:

(a) price index of products of "other sheltered industries"
(b) price index for consumers' goods
(c) price indices for depreciation
(d) incomes (wages and profits) from agriculture and fishing, in nominal and real terms

[4]This is the only point where the model is dependent on volume flows. Changes in employment and productivity are important reasons why prices and/or profits in an industry may change. They must, therefore, be explicitly considered in a model designed for the study of price and income changes. It is assumed, in order to keep the model simple, that other possible interactions between volumes and prices may be neglected.

[5]The combination of wages and profits in agriculture and fishing is, of course, not essential to the model. It was made in order that the model should reflect as well as possible the issues discussed during income settlements where, in the case of farming, the focus is on total farming income.

(e) profits of industries other than agriculture and fishing, in nominal and real terms
(f) total wages, in nominal and real terms.

11. The variables which will influence prices and the distribution of income, i.e. the *exogenous variables* of the model, include *i.a.*:

(a) price indices of output from agriculture and fishing
(b) wage indices, by industries
(c) productivity indices, by industries
(d) employment indices, by industries
(e) price indices of exports and imports, specified as required by the model
(f) volume indices of depreciation, by industries.

12. The model assumes, i.a. the following *parameters* (structural coefficients) to be given:

(a) input-output coefficients, or inter-industry deliveries and imports of raw materials per unit of output, by industries
(b) a coefficient for the distribution of income (profits as a percentage of factor income) in "other sheltered industries"
(c) the weights in the price indices of depreciation, by industries
(d) the weights in the index of consumers' prices
(e) rates of net indirect taxation.[6]

Most of the structural coefficients used may be computed from an input-output table of a base year, e.g. Table 1.

13. One way of gauging the implications of the model is to study the system of equations in its "reduced form." Formulaes (for selected endogenous variables) are given in the appendix. However, the economic content of the model can also be illustrated by describing, in words, and by way of examples, the effects to be expected from partial changes in some of the exogenous variables.

14. For instance, a general rise in wages and salaries will, *ceteris paribus*, have the following effects:

(i) Prices of goods from "other sheltered industries" will rise because wage and salary costs increase and this leads to higher prices of goods in these industries.
(ii) Prices of goods from other industries will not be affected, but profits in these industries will be reduced (see (iv) below).
(iii) The rise in prices of goods from "other sheltered industries" will be reflected in a similar, but percentage-wise smaller rise in the level of prices of consumers' goods.
(iv) Total real income will not be affected. But the distribution of incomes will change in favour of wages and salaries and of profits in "other sheltered industries": Real wages will rise because the rise in consumers' prices will be smaller than the rise in the wage level. Profits in "other sheltered industries" will rise in proportion to wages (due to the assumed constancy of the profits-to-wages ratio of this industry). Income from agriculture and income from fishing will decline slightly

[6]Since indirect taxes and subsidies are represented in the model by a few strongly aggregated indices only, PRIM I is not really suited for an analysis of the effects on prices of changes in taxation. Such effects can be judged with greater accuracy by more direct methods.

in nominal terms because of the intermediate products bought by these industries from "other sheltered industries" become more expensive. Profits of other exposed industries will decline for the same reason, but also because of higher wage and salary costs.

15. A change in productivity, if it is the same in all industries, will affect prices and incomes in roughly the same way as would an equally big (percentage-wise) change in the wage-level, only with opposite sign, since a change in productivity means a change in the opposite direction of wage and salary costs per unit of output. One important difference is that in this case total real income would increase since output per man-year has increased. If a change in productivity is limited to a single industry, however, the effects depend on the industry affected:

(i) An increase in productivity in agriculture, or fishing, will, *ceteris paribus*, increase the incomes from the same industry, while prices and other incomes will remain unaffected. An increase in productivity in one of the exposed industries will, *ceteris paribus*, affect the profits of that industry only. In all these cases the gain in real income corresponding to the productivity increase will remain with income earners in the industry where the increase in productivity occurs.

(ii) The gain in real income originating from an increase in productivity in "other sheltered industries," on the other hand, will be shared, *ceteris paribus*, by all income groups. First, prices of goods from "other sheltered industries" must go down, according to the model, for the assumed constancy of the profits-to-wages ratio of that industry to be maintained. This means lower prices of consumers' goods and a proportional increase in all real incomes. In addition, nominal incomes from farming and fishing, and nominal profits in the exposed industries increase somewhat because the intermediate products they buy from "other sheltered industries" will have become cheaper.

It is rare, of course, that productivity increases uniformly in all industries and the above should serve as a reminder that the effects on prices and income distribution of productivity changes may be extremely complex and, I should add, extremely important in the context of an incomes policy. I shall have more to say on this in Section VII.

16. Also the effects of changes in foreign prices, to give one last example, depends much on the nature of the price changes. For instance:

(i) An increase in the prices of imported consumers' goods will, *ceteris paribus*, raise the costs of living but leave all other prices, and all nominal incomes, unaffected. In this case, therefore, the drop in real income, corresponding to the worsening of terms of trade, will be sustained by all income recipients in proportion to their consumption expenditures.

(ii) An increase in prices of imported intermediate inputs to the exposed industries and to agriculture will, *ceteris paribus*, lower the profits of these industries. All other prices, and all incomes, will remain unaffected. The loss in real income caused by the worsening of the terms of trade will be sustained wholly by the receivers of these profits.

(iii) An increase in the prices of imported intermediate inputs to "other sheltered industries" will, *ceteris paribus*, increase the prices of this industry. As a consequence the prices of consumers' goods will also rise. In this way the loss in real income due to the worsening of terms of trade will be split among all income recipients. However, there will be some secondary effects, resulting in smaller nominal incomes from farming and fishing and smaller nominal profits in the exposed industries, because the costs to all industries of intermediate inputs from "other sheltered industries" will have gone up.

(iv) An increase in the prices of competitive imports, according to the model, will, *ceteris paribus*, allow the "import-competing manufacturers" to raise their output prices. Since some of this output are consumers' goods, the prices of consumers' goods will also rise. Therefore, the real incomes of all other income groups will decline while profits of "import-competing manufacturers" will increase in real as well as in nominal terms. There will be some complex secondary effects because the costs to all other industries of intermediate inputs from "import-competing manufacturers" will have gone up. These secondary effects will result ultimately in a further rise in the prices of consumers' goods (via a rise in the price of products from "other sheltered industries") and a further decline both in nominal and real incomes from farming and fishing and in nominal and real profits in the exposed industries.

In an analogue way the effects of changes in export prices may be analyzed.

IV. Uses of the Model

17. The examples given have shown, I believe, that the effects of changes in factors affecting the income distribution and the national price level can be difficult to trace through verbal reasoning. This is so even though, so far, our concern has been only with *partial* changes of one factor at the time. The difficulties multiply if we are to study the effects of changes in two or more variables *simultaneously*, and especially if we are to state these effects quantitatively. It is for such purposes that a numerical model like PRIM I offers considerable help.

18. One important use of PRIM I—indeed, the one for which it was originally designed—has been to estimate the consequences to be expected for prices and income distribution of changes in the wage level and in agricultural prices. Such forecasts were made for the first time before the 1966 round of negotiations on wage and agricultural prices and again before the 1968 round, and their purpose was to form the basis for an incomes policy. In both cases a number of alternative forecasts were made. Each alternative related to one particular possible combination of changes in the wage level and the level of prices of agricultural output. The idea was that, through these forecasts, the negotiating parties could be brought into a better position to anticipate the consequences, for themselves and for the national economy, of alternative courses open to them. Since PRIM I has recently been programmed for a computer so that the solution for 50 alternative sets of values of exogenous variables can be provided

within 5 minutes of computing time, any number of alternatives which the negotiating parties might ask for can easily be presented to them.[7]

19. One convenient way of using the model is to compute a "table of effects" as reproduced (for 1967) in Table 2. At the left side of this table are listed a selected number of important exogenous variables of the model, and the income distribution parameter (r_2) of "other sheltered industries." Selected endogenous variables are entered at the top. The table shows, along the rows, the effects which, according to PRIM I, are to be expected from a partial one per cent change of the exogenous variable of that row on each one of the endogenous variables listed at the top. The effects are expressed partly as percentages and, in case of income variables, in kroner as well. Row 1 tells us, for instance, that a 1 per cent increase in the wage level, *ceteris paribus*, may be expected to raise the level of consumers' prices by 0.47 per cent, to increase the total of nominal factor incomes by 0.57 per cent, to decrease income from agriculture by 0.61 per cent, to decrease profits of "import-competing manufacturers" by 3.56 per cent, etc. If read columnwise, the table gives, for each endogenous variable, information about which exogenous variables are particularly influential on that variable.

30. All effects specified in the table are additive for small changes in the exogenous variables. Therefore, the combined effect of a simultaneous change in two or more exogenous variables may be gauged by adding together the effects of each variable taken separately. For instance, a parallel increase of all import prices by 1 per cent may be expected, *ceteris paribus*, to raise the level of consumers' prices by $0.05 + 0.13 + 0.12 + 0.03 = 0.33$ per cent (column 2). In this manner the table can help in providing quick estimates of the indirect effects to be expected on consumers' prices and incomes of any event or action whose direct impact on the exogenous variables of the model can be foreseen.

21. The model, or alternatively the "table of effects" computed from it, may be used equally well for historical analysis. We must start, in this case, from observed changes of the exogenous variables in a period of the past. With these changes given, the effects of each variable on prices and income distribution may be calculated by means of the "table of effects." Thus, we will be able to tell how much each exogenous variable has contributed, in some sense, to observed changes in prices and income distribution. If the total of the calculated effects equal the observed changes we will be able to claim that the actual movements of prices and incomes are "explained" as being generated by changes in

[7]Any forecast requires, of course, estimates of expected changes in a large number of exogenous variables (productivities, foreign prices, etc.) besides wages and agricultural prices. These estimates (or guesses) were provided in 1966, in one alternative, by independent experts. It was argued against this practice that, since the prognoses depend heavily on these estimates, the negotiating parties should have a chance to influence the assumptions made. As a result of this criticism the choice of values for all exogenous variables for the prognoses used in the 1968 negotiations was made by a group consisting of non-partisan experts in co-operation with representatives of the negotiating parties. The group chose to present its results in one "main alternative" supplemented by computations where the assumptions made with respect to the development of labour productivity and the value of the income distribution parameter (r_2) of "other sheltered industries" were different from the main alternative. See *Innstilling fra Det tekniske beregningsutvalg for inntektsoppgjørene 1968, avgitt 6. februar 1968* ("Report by the Reporting Committee for the Income Settlements 1968, of February 6th 1968"), published by the Ministry of Wages and Prices 1968, pp. 38–46.

TABLE 2

EFFECTS ON PRICES, INCOME AND THE DISTRIBUTION OF INCOME CAUSED BY CHANGES IN WAGES, AGRICULTURAL PRICES, PRODUCTIVITY, FOREIGN PRICES AND THE SHARE OF PROFITS IN OTHER SHELTERED INDUSTRIES. ("TABLE OF EFFECTS)" 1967

	Increase of 1 per cent in:	Prices (change in per cent)		Income (change in millions of kroner)			
		Prices of Products from Other Sheltered Industries	Consumer Price Level	Total Factor Income	Total wages[1]	Income from Agriculture	Income from Fisheries
WAGES AND SALARIES RATES:							
All industries[2]	W	0.68	0.47	270	307	−13	−3
Other sheltered industries	W_2	0.68	0.47	270	217	−13	−3
Import-competing manufacturers	W_3	..	..	..	40	..	..
Shipping	W_5	..	..	..	23	..	..
Other export-oriented industries	W_6	..	..	..	28	..	..
Agricultural prices	P_1	0.03	0.08	37		39	—
Fish prices	P_4	0.01	0.01	7		−1	13
PRODUCTIVITY IN:							
Agriculture	Z_1	..	..	21		21	..
Other sheltered industries	Z_2	−0.83	−0.57	49		16	4
Import-competing manufacturers	Z_3		..	59		..	..
Fisheries	Z_4		..	11		..	11
Shipping	Z_5	..	..	70	..	..	..
Other export-oriented industries	Z_6	..	..	57	..	..	..
TOTAL EMPLOYMENT IN:							
Agriculture	N_1	..	..	21		21	..
Other sheltered industries[3]	N_2L_2	−0.15	−0.10	320	217	3	1
Import-competing manufacturers[3]	N_3L_3	..	..	59	40	..	..
Fisheries	N_4	..	..	11	..	..	11
Shipping[3]	N_5L_5			70	23	..	..
Other export-oriented industries[3]	N_6L_6			57	28	..	..
EXPORT PRICES:							
Shipping	P_5	0.01	0.01	106	..	—	—
Other export-oriented industries	P_6	0.05	0.05	97	..	−3	—
IMPORT PRICES:							
Imported intermediate goods to:							
Agriculture	Q_1	..	..	−2		−2	..
Other sheltered industries	Q_2	0.08	0.05	−5	..	−2	—
Import-competing manufacturers	Q_3	..		−35	..	..	..
Fisheries	Q_4		..	−1		..	−1
Shipping	Q_5		..	−30		..	..
Other export-oriented industries	Q_6		..	−28	..	..	..
Imported consumers' goods[4]	P_7		0.13	..	..	..	..
Competitive imports[5]	$P_8=P_3$	0.05	0.12	106	..	−1	−1
Imported capital goods (excl. ships)[6]	P_{10}	0.05	0.03	−19		−4	—
Imported ships[6]	S_5	..	..	−38		..	..
Percentage point change in share of profits in other sheltered industries[7]	r_2	1.00	0.68	393	..	−19	−5

— = negligible effect. .. = no effect.

[1]Excluding agriculture and fisheries.

[2]W to be understood as a proportional increase in W_j ($j = 2, 3, 5, 6$).

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

[4]Import direct for consumption.

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

TABLE 2—continued

Income (change in millions of kroner)				Income (change in per cent)							
Profits								Profits			
Other Sheltered Industries	Import Competing Manufacturers	Shipping	Other Export Oriented Industries	Total Factor Income	Total wages[1]	Income *from* Agriculture	Income *from* Fisheries	Other Sheltered Industries	Import Competing Industries	Shipping	Other Export-Oriented Industries
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
..	−40	..	..	..	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	0.14	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

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

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

wages, productivities, etc., through a mechanism as described by the model. Alternatively, if there are discrepancies between calculated and observed values of the endogenous variables, the size of the discrepancies will indicate the extent to which the model fails in describing reality accurately. Examples of such historical calculations are given in Section VI.

V. Comments and Empirical Evidence on the Assumptions of the Model

22. The assumptions underlying PRIM I, or the economic theory inherent in it, cannot be expected to hold true in all circumstances. Some discussion of the realism of the model is, therefore, called for.

Assumptions on Volumes

23. One set of assumptions amounts to postulating that changes in volume flows are determined by changes in employment and productivity only, and that they are not influenced—neither through changes in demand nor otherwise—by changes in wages and prices. These are obvious, simplifying assumptions to make in a model designed primarily for the study of prices rather than quantities. Yet they must reduce the confidence which we should have in conclusions derived from the model:

(i) It is assumed that there is sufficient demand for the products of each individual sector of production and, furthermore, that employment in each sector in the short run will be uninfluenced by changes in other exogenous variables. This reduces the usefulness of the model in situations where wages and prices develop in such a way that the competitiveness of the export industries is threatened, and therefore their levels of output and employment.

(ii) It is assumed that productivity in the individual sectors of production is independent of changes in other exogenous variables. This cannot be expected to hold true if the changes in exogenous variables are big enough to cause considerable changes in market conditions.

24. It is assumed that input-output coefficients are stable in volume terms, even though labour productivities change. This is a standard assumption in input-output analysis. Data for the period 1961–1968 show that, for most coefficients, year-to-year changes—which is what matters in short-term forecasting—have in fact been small though some coefficients display a definite trend (Diagram 1). One remarkable exception is the coefficient b_{21} (inputs from other sheltered industries into agriculture) which is seen to have fluctuated considerably (minimum 0.277 in 1963, maximum 0.368 in 1967). The explanation obviously is that the size of the harvest does not depend primarily on current inputs, but is influenced equally much by climatic factors. Therefore, in the case of agriculture, the assumption of constant input-output coefficients is not strictly valid. It follows that the model must be expected to underestimate (net) income from agriculture in years with a better than normal harvest, and *vice versa.*

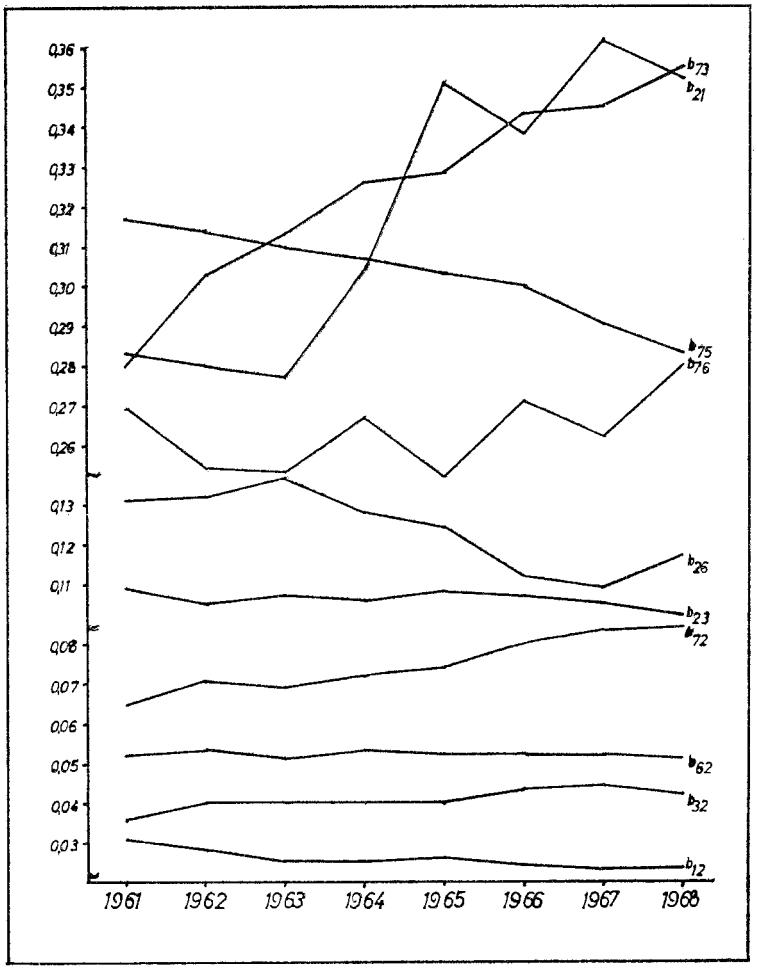

Diagram 1 Selected input-output coefficients b_{ij} (intermediate goods from industry i consumed in industry j per unit of output) in constant (1961) prices, 1961–1968

Assumptions on Prices

25. The really crucial assumptions of the model, however, is the group of assumptions relating to the "price behaviour" (the price generating process) of the individual sectors.

26. In the case of agriculture the model assumes that output prices are fixed by a price settlement between government and farmers independently of supply and demand. This assumption is realistic, under Norwegian conditions, for grains and for most animal products. It is unrealistic, however, for fruits and vegetables where prices are usually left free to be determined by market forces. It is known, for instance, that a bad harvest will raise prices of fruits and vegetables considerably and cause an increase in consumers' prices which the model cannot account for. Neither is the assumption realistic for the export part of agricultural output (mostly furs).

27. In the case of fishing the situation is similar. Again the model assumes that output prices are fixed largely through a price settlement between the government and the producers. This assumption is realistic for a great part of the deliveries out of the fishing industries. For other parts of the catch, however, including fish exported fresh, the fishing industry has to accept prices as determined by market forces.

28. In the case of the exposed industries other than fishing the model assumes that output prices are determined by world market prices and following the pattern of these:

(i) For the export-oriented industries (shipping, and "other export-oriented industries") output prices are assumed to follow prices of Norwegian exports. This obviously must hold true for that part of output which is actually exported (95 per cent in the case of shipping and 60 per cent in the case of "other export-oriented industries"). It does not necessarily follow, however, that prices of output sold on the home market, and therefore average output prices, will behave in the same way. For evidence on this, see paragraph 30.

(ii) For "import-competing manufacturers" output prices are assumed to follow import prices to Norway of similar imported goods ("competitive imports"). The assumption, which denies this industry group any price autonomy, is questionable and apparently does not stand up too well against the facts, see Diagram 2. The diagram suggests that import-competing manufacturers have had considerably more scope to raise prices, given the actual course of prices of imported goods, than is consistent with the assumption of the model. True, the discrepancy between the two price indices may well be spurious and due, wholly or in part, to differences in the weighting systems used in computing them.[8] Though this is probably so we may speculate, nevertheless, that the classification of industries into "sheltered" and "exposed" used in the model is not fine enough and that many firms or industries which are classified as exposed in PRIM I do not, in fact, feel foreign competition much.[9] If so, we must conclude that the model tends systematically to underestimate the ability of the import-competing manufacturers to compensate for cost increases. Therefore PRIM I tends to underestimate

[8]The weights are quantities produced in the case of "price index of output import-competing manufacturers" (P_3) and quantities actually imported in the case of the "price index of similar imported goods" (P_6). These two weighting systems may differ considerably (and probably do, though this has not been investigated) implying that the two price indices may show divergent movements even though, for identical commodities, national output prices follow import prices closely. This suggests that the model could be improved simply by altering the operational definition of P_6 to make it correspond better to the output mix of Norwegian producers.

[9]This suggests that the model could be improved by a more detailed and careful classification of industries into "sheltered" and "exposed". The classification of industries used in PRIM I is based on published national accounts data in which only 20 manufacturing industries are distinguished. Consequently, the whole of, e.g., the metal manufacturing industry has had to be classified as "import-competing" though many enterprises within this industry (e.g. repair shops) undoubtedly feel no foreign competition. A better classification could have been made starting from unpublished national accounts data where some 130 industries are specified but this, for the time being, would have made the practical use of the model more cumbersome.

the effects on prices of a rapidly rising national cost level, and at the same time it tends to overestimate the depressing effects which rising costs will have on profits of import-competing manufacturers.[10]

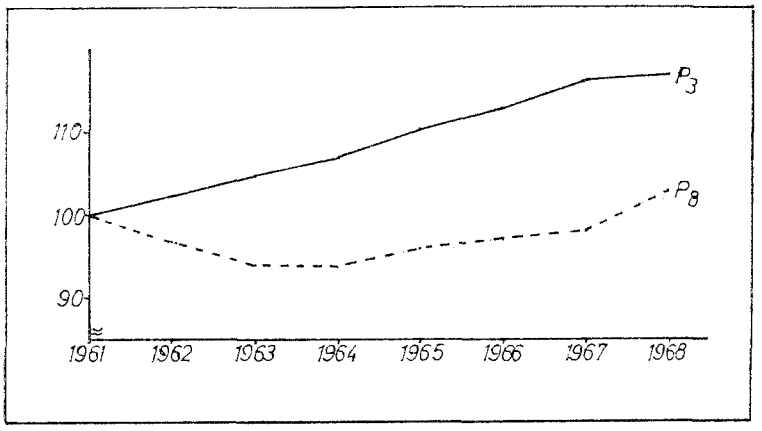

Diagram 2 Output prices of "import-competing manufacturers" (P_3) and prices of similar imported goods (P_8). Indices (1961 = 100), 1961–1968

29. In the case of sheltered industries excluding agriculture the model assumes that output prices are adjusted in such a way that, for the industry group as a whole, the relationship between wages and profits conforms with a certain trend value. This is a key assumption which has important consequences for the conclusions reached by the model. Pending more direct information on the actual price behaviour of enterprises it should be considered no more than a working hypothesis for the time being. The empirical basis for the assumption is annual data from the national accounts as reproduced in diagram 3. These data show that profits computed as a share of factor income in the sheltered industries (excluding agriculture) have moved close to a trend dropping from around 35 per cent in 1953 till around 30.5 per cent in 1967.[11] Deviations from this trend have been relatively small except for years when production, and therefore profits, were unfavourably influenced by the business cycle (1958, 1959, 1962). This is in marked contrast to the strong fluctuation of the corresponding share in the exposed industries which is also shown in Diagram 3. The assumption that the ratio between profits and wages in the group of sheltered industries excluding agriculture will follow the trend value may be useful as a working hypothesis, therefore, as long as the conditions of demand in these

[10]Once this bias of PRIM I is known it may be compensated for by assuming P_3 to increase more than P_8 whenever the model is used for forecasting purposes, superseding the postulated equation $P_3 = P_8$ by some other relationship which is held to be more realistic.

[11]Here and elsewhere in this paper factor income is defined, in any industry, as value added at factor cost (i.e. net of indirect taxes less subsidies) of that industry. Profits of an industry is defined, as in the new SNA, as factor income less wages and salaries. The trend is a fitted line estimated on 1952–1967 data by least squares as $r_2(t) = 0.355\text{–}0.0032t$ $(t = 1, 2, \ldots 16)$ where $r_2(t)$ is the profit share. (0.005)
The fact that the profit-share of the sheltered industry group has been declining may be explained as a consequence of a gradual shift within the social structure of the labour force of the group, with self-employment losing in relative importance.

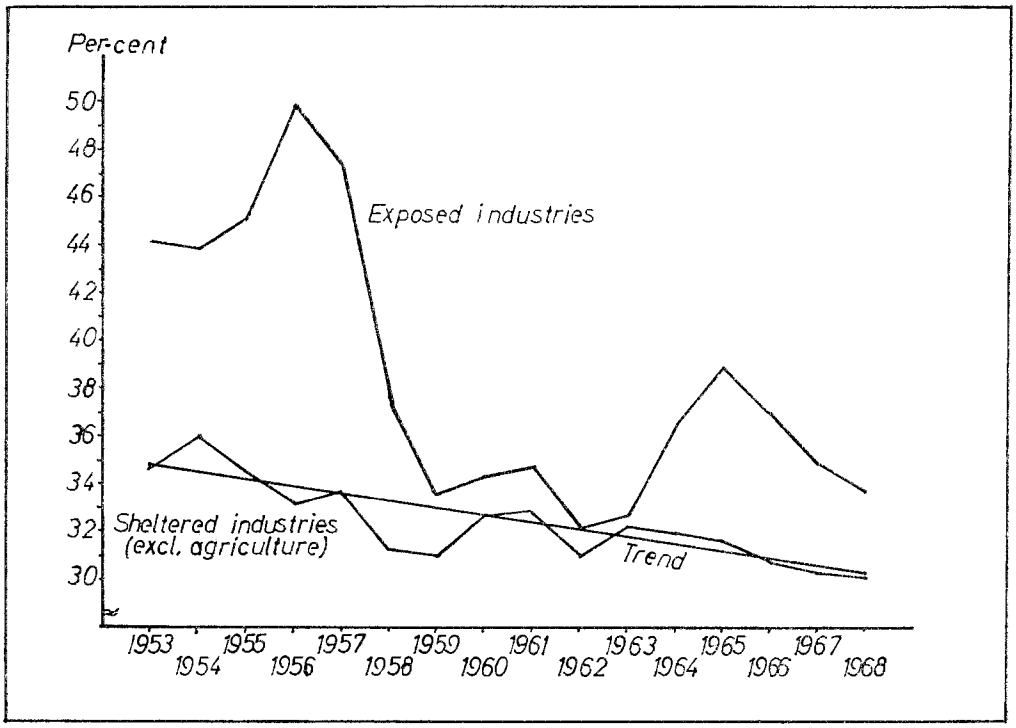

Diagram 3 Profits as per cent of factor income. Sheltered and exposed industries, 1953–1968

industries are "normal".[12] A possible theoretical basis for the assumption could be that most firms within the group calculate their selling prices on a "cost plus" principle, that is, by adding to direct costs of labour and materials a certain percentage for overheads and profits. If this pricing principle was in general use, and if the percentage was chosen so as to give the firm "normal" profits in years with "normal" output, we would expect to observe profits to move in a steady ratio to wages in "normal" years but to fall short of this value when production was less than "normal," and *vice versa.* This is precisely what our data show for the group as a whole.[13]

[12]When using PRIM I for forecasting purposes we will tend, of course, in order to improve the forecast, to choose a value of the profit share (the income distribution parameter r_2) different from the trend value whenever this is suggested by business cycle considerations.

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

30. The model assumes, finally, that changes in output prices are always percentagewise the same for all entries along one industry row of the input-output table, that is, for all deliveries of an industry irrespective of their uses. This is a standard assumption in inter-industry analyses. Though it may be justified in dis-aggregated models where industries are defined in such a way that each industry may be assumed to produce one homogeneous output, the assumption is much less well founded in the present case where each of the six industries distinguished obviously turn out a wide variety of products which are unlikely to be sold in the same proportions to all categories of users. The weakness of the assumption is clearly brought out when price indices 1961–1968 of deliveries to different categories of users are plotted for each of the industries (Diagram 4). Contrary to what is required by the assumption the emerging picture is one of diversity. We may note that, both in the case of "other sheltered industries" and "other export-oriented industries" (but surprisingly not in the case of "import-competing manufacturers"), prices for deliveries to export have gone up considerably less and prices for deliveries to consumers somewhat more than average output prices.[14] Apart from this no systematic pattern in the behaviour of prices is discernible. We shall have to conclude that the assumption at present under investigation lacks realism and is a possible source of errors in applications of the model, but that such errors as it may cause are not likely to be systematic.

VI. Application of PRIM I to Historical Data

31. The realism of the model may be tested by studying its ability to account for year-to-year changes in prices and incomes during a past period. A number of such tests, relating to the years 1961–1968, have been carried out. For lack of space only two of them are reported here in full (Tables 3 and 4).[15] An interesting by-product of these tests is that they offer an "explanation" of how changes in prices and incomes came about by providing, as it were, a decomposition of the observed changes "by causes."

32. Technically, the tests were prepared by feeding into the model correct historical values for year-to-year changes in (i) all exogenous variables, (ii) the trend value of the income distribution coefficient of "other sheltered industries" (r_2), and (iii) coefficients representing net indirect taxation. The hypothetical effects of these changes, individually and in total, on various endogenous variables were then estimated by means of the model (assuming other coefficients to have remained constant) and compared with actually observed changes in the way shown in Tables 3 and 4. The discrepancies between the estimated and the actually observed changes of the endogenous variables are indicative of the short-comings of PRIM I. They may be interpreted as measures of changes in prices and incomes caused by factors not accounted for in the model.

33. In general, the discrepancies are found to be small relative to actual changes in most cases, and they are nearly always random (see e.g. Table 4). The

[14]This is a further reminder that the model could perhaps be improved through a more careful classification of industries into "sheltered" and "exposed."

[15]Tables similar to Tables 3 and 4 have been computed also for income from agriculture, income from fisheries, profits of import-competing manufacturers and profits of shipping. These tables may be obtained from the author on request.

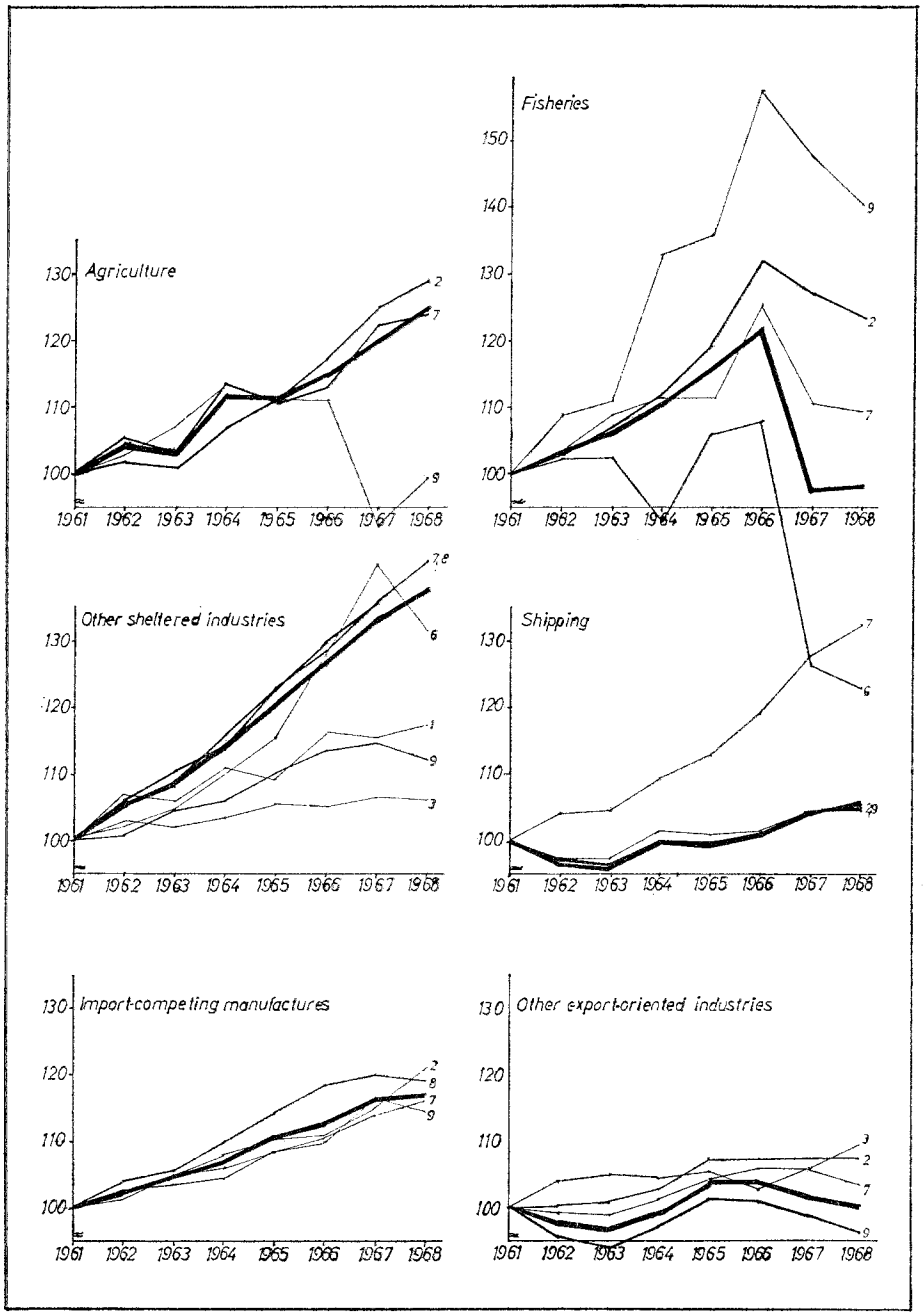

Diagram 4 Price indices of selected deliveries (output) by delivering industry and destination (1961 = 100)

NOTE: Heavy curves represent average output prices. Weights of other indices in the average are indicated through thickness of curves. Numbers indicate deliveries to (1) agriculture (2) other sheltered industries (3) import-competing manufacturers (4) fisheries (5) shipping (6) other export-oriented industries (7) private consumption (8) public consumption + capital formation (9) exports.

TABLE 3

ESTIMATED EFFECTS ON CONSUMERS' PRICES OF CHANGES IN EXOGENOUS VARIABLES AND ACTUALLY OBSERVED CHANGES. YEAR-TO-YEAR CHANGES 1961–1968. PER CENT

	1961–1962	1962–1963	1963–1964	1964–1965	1965–1966	1966–1967	1967–1968
Estimated effect of:							
Changes in wage rates (W_2, W_3, W_5, W_6)	5.02	2.50	3.08	3.72	4.23	4.50	2.54
Changes in agricultural prices (P_1)	0.40	−0.06	0.66	−0.03	0.25	0.36	0.30
Changes in productivity within "other sheltered industries" (Z_2)	−0.93	−1.55	−1.34	−0.86	−1.37	−1.54	−0.23
Changes in world market prices (P_5, P_6, P_7, P_8, P_{10}, S_5, Q_1, Q_2, Q_3, Q_4, Q_5, Q_6)	−0.61	−0.10	0.61	0.56	0.44	0.25	0.62
Changes in rates of indirect taxation (m_2, m_3, n_2, n_3)	0.10	−0.21	0.79	0.28	0.52	−0.05	−0.13
Changes in volume of depreciation in "other sheltered industries" (D_2)	0.54	0.59	0.62	0.73	0.56	0.59	0.53
Changes in share of profits in "other sheltered industries" (trend value) (r_2)	−0.57	0.39	−0.59	−0.59	−0.60	−0.27	−0.13
Changes in other exogenous variables	−0.05	−0.07	−0.09	−0.17	0.09	−0.26	−0.32
Discrepancy (= unexplained by PRIM I)	0.60	1.19	1.48	0.26	−0.62	1.12	0.44
Of which due to:							
Deviations of r_2 from trend	−0.62	0.41	0.40	0.42	0.14	−0.07	−0.07
Deviations of P_3 from P_8	0.85	0.72	0.32	0.13	0.09	0.29	−0.51
Other causes	0.37	0.06	0.76	−0.29	−0.85	0.90	1.02
Actually observed changes in consumers' prices	4.50	2.68	5.22	3.90	3.50	4.70	3.62

biggest errors are in profits of import-competing manufacturers which are seriously underestimated by the model in most years (not shown here). There are systematic errors also in the model's ability to account for changes in consumers' prices, the rise of which is underestimated by the model in six years out of seven as is shown by Table 3. There are smaller, but still note-worthy, discrepancies in some years also between hypothetical and actual changes in income from agriculture though the errors in this case are not systematic.

34. These results should not surprise us in light of the discussion of section V. We concluded there (paragraphs 28 and 29) that the two weakest points in the model presumably are the assumptions made with respect to (i) the tendency for output prices of import-competing manufacturers (P_8) to follow prices of competing imports (P_3) and (ii) the postulated stability of the ratio of profits to wages in "other sheltered industries" (r_2). We suspected that assumption (i), in particular, might lead to biased estimates.

35. It is of considerable interest to investigate the extent to which the errors noted above are due to these two assumptions. The bottom rows of

TABLE 4

ESTIMATED EFFECTS ON PROFITS IN OTHER EXPORT-ORIENTED INDUSTRIES OF CHANGES IN EXOGENOUS VARIABLES, AND ACTUALLY OBSERVED CHANGES. YEAR-TO-YEAR CHANGES 1961–1968. MILLIONS KRONER

	1961–1962	1962–1963	1963–1964	1964–1965	1965–1966	1966–1967	1967–1968
Estimated effect of:							
Changes in wage rates (W_2, W_3, W_5, W_6)	−224	−147	−182	−248	−327	−318	−221
Of which in export-oriented industries (W_6)	−141	−104	−125	−171	−235	−213	−154
Changes in productivities and employment (N_1, N_2, N_3, N_4, N_5, N_6, L_2, L_3, L_5, L_6, Z_1, Z_2, Z_3, Z_4, Z_5, Z_6)	208	214	528	405	185	363	362
Of which in export-oriented industries (N_6, L_6, Z_6)	191	184	497	381	155	325	346
Changes in output prices of other export-oriented industries (P_6)	−147	−72	201	366	39	−210	−162
Changes in other world market prices (P_5, P_7, P_8, P_{10}, S_5, Q_1, Q_2, Q_3, Q_4, Q_5, Q_6)	102	53	−58	−76	−19	16	−6
Of which imported intermediate goods to other export-oriented industries (Q_6)	56	28	−75	−33	10	39	89
Of which imported capital goods (P_{10})	38	21	20	−39	−24	−19	−82
Changes in volume of depreciation (D_1, D_2, D_3, D_4, D_5, D_6)	−6	−27	−42	59	−56	−84	−82
Of which in export-oriented industries (D_6)	3	−17	−31	74	−44	−70	−68
Changes in other exogenous variables	−37	2	−26	−12	−55	133	15
Discrepancy (= unexplained by PRIM I)	−45	−32	−22	−28	−33	34	216
Of which due to:							
Deviations of r_2 from trend	10	−7	−8	−10	−3	1	2
Deviations of P_3 from P_8	−12	−10	−5	−3	−2	−8	14
Other causes	−43	−15	−9	−15	−28	41	200
Actually observed changes in income from other export-oriented industries	−149	−9	399	466	−156	−66	122

Tables 3 and 4 (and similarly in other tables not reproduced here) were calculated for this purpose. It was found that the systematic tendency for the model to underestimate profits in import-competing manufacturers is due almost entirely to the lack of realism of assumption (i). Furthermore, the inherent weakness of the two assumptions taken together also go a long way towards explaining the inability of the model to account correctly for changes in consumers' prices (see Table 3).

36. On the other hand, it was also found that the discrepancies in some years between estimated and observed changes in income from agriculture could not be explained in this way. These discrepancies, therefore, must be due to other aspects of the model. We may speculate that they stem in part from the lack of stability of input-output coefficients in agriculture which violates one set of assumptions of the model (paragraph 24). They may be due also to the fact that contrary to what is assumed by the model (paragraph 30), the prices of intermediate input into agriculture from "other sheltered industries" have not moved in step with average output prices of that industry (see diagram 4).

37. Apart from the weaknesses just noted, however, PRIM I stands up well when applied to historical data. We may conclude that the model gives a reasonably realistic description of the price and income distribution mechanism of the Norwegian economy. Scope for improvements certainly exists, however, and the last two sections may serve to point out directions where improvements could be sought.

VII. Implications for an Incomes Policy

38. Granted that our model gives a reasonably accurate description of the price and income distribution mechanism of an economy, certain interesting propositions follow. Some are worth noting because they are of relevance for an incomes policy.

39. For one thing, we shall have to give up the popular belief that the struggle over income shares may be viewed mainly as a confrontation of wage-earners and employers. Instead, it has been argued here that wage-earners and owners of enterprises in the sheltered industries have a common interest in rising wages since, according to the model, a rise in wages will lead automatically, via price adjustments, to a proportionate increase in profits of the sheltered industries. Of course, any gain in real income obtained by these groups will be at the expense of other groups (farmers, and owners of enterprises in the exposed industries). The parties confronting each other in the struggle over income shares, therefore, may be said to be (i) the farmers, (ii) the owners of enterprises in the sheltered industries *and* the wage-earners, (iii) owners of enterprises in the exposed industries. (We are leaving aside here the factors determining the absolute level of real income, which in any case cannot be studied by means of the present model).

40. Farmers can work actively to increase their share of the national income through demanding higher prices for agricultural output. Wage-earners and owners of enterprises in the sheltered industries can work actively to increase their share of the national income through demanding, respectively 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. Therefore, the whole burden of avoiding cost-push inflation appears to rest with a small group of entrepreneurs in the exposed industries. This group of people is bound to be a minority in any society; no wonder that the modern society seems to have a strong tendency for inflation under conditions of full employment.

41. The national price level is determined, according to the model, through simultaneous developments in wages, agricultural prices, indirect taxes and

subsidies, prices of exports and imports, and productivities. Since this is so, no simple formula can be laid down which will serve as a guide-post, once and for ever, for an incomes policy aiming at stable prices. The assertion often heard, for instance, that a necessary and sufficient condition for price stability is that wages should rise in step with average productivity, is a false statement: An incomes policy adhering strictly to this principle might lead to a falling, stable or increasing national price level depending on what happens simultaneously to the other exogenous variables of the model.

42. According to the model, the national price level and the distribution of the national income are determined through the same set of exogenous variables. But the ways in which the price level and the individual income shares are affected by the exogenous variables are not identical (see the "reduced form" formulas of the appendix, or the entries in the columns of Table 2). It is most improbable, therefore, that a set of values for the exogenous variables can be found which will result at the same time in a desired development of prices and a desired distribution of incomes: Only by chance will world market prices and productivities (which society does not control) change in such a way that an incomes policy can be designed which will ensure stable prices without having undesired effects for the 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 be in conflict.

43. That this may be a serious conflict is illustrated by post-war Norwegian data: During the period 1951–1968 productivity increased by 2–2.5 per cent per year on the average in agriculture and other sheltered industries but by 4.5–5.5 per cent on the average in the exposed industries while export and import prices, by and large, remained stable. With import prices stable, wages would have had to follow (roughly) the weak productivity increase of the sheltered industries of 2–2.5 per cent a year if an increase in the national price level were to have been avoided. This would have resulted in a steadily increasing share of national income going to profits in the exposed industries. Conversely: If the share of profits were to have been kept constant, wages would have had to follow (roughly) the much stronger productivity increase of the exposed industries of 4.5–5.5 per cent a year. This would have been incompatible with a stable national price level. The figures quoted makes it very improbable that it would have been possible, or even wise, for Norway, to achieve price stability over the period in question, when a policy of stable ratios of foreign exchanges was maintained.[16]

VIII. Concluding Remarks

44. The realization that prices and income distribution targets may conflict, the discovery that productivities may develop very differently in the sheltered and in the exposed industries, and the understanding that this may cause the

[16]What happened in actual practice was that wages went up by no less than 7 per cent a year on the average during the 15-year period. This resulted in an average annual increase in consumers' prices of 3.2 per cent and a steady decrease in the share of profits in the exposed industries from 21.9 per cent of national income in 1951 (when profits were exceptionally high due to the Korean war) to 12.8 per cent in 1965.

national price level to move differently from prices on the world market, are conclusions which invite further research. In particular, they may serve as a starting point for an extension of the ideas set out in this paper into a theory which will explain the behaviour of prices and incomes not only in the short run, but in the long run as well.

45. In such a theory wages can no longer be treated as an exogenous variable. The long-run trend of wages must be explained by the theory. In recent Norwegian and Swedish research it has been assumed that, with constant exchange rates, wages in the long run must adjust in a way which leave the exposed industries "reasonably competitive". By assuming the existence of mechanisms which ensures this (in these mechanisms forces of supply and demand play important parts), models can be set up in which the long-term trend of wages in an open economy will depend ultimately on world market prices and productivity trends in the exposed industries, while the trend of the national price level is determined by the same variables and by productivity trends in the sheltered industries.[17]

APPENDIX I

Survey of Industry Classification

Agriculture

Agriculture (excl. forestry)
Dairies etc.

Other sheltered industries

Includes manufacturing groups food, beverages, wood and cork products, furniture and fixtures, printing and publishing, leather and leather products, non-metallic mineral products; furthermore i.a. building and construction, transport and communication except sea and air transport, and all other service industries.

Import-competing manufacturers

Includes manufacturing groups: tobacco, textiles, footwear, clothing and made-up textile goods, rubber and rubber products, products of coal and petroleum, iron-, metalware and machine industry, electrical machinery, transport equipment incl. shipbuilding, miscellaneous manufacturing.

Fisheries

Fishing except whaling.

Shipping

Ocean and coastal transport.

Other export-oriented industries

Forestry; whaling; mining and quarrying; manufacturing groups pulp and paper, chemicals, and basic metal industries; air transport.

[17] A model along this line was the main content of the second report of "The Reporting Committee for the Income Settlement in 1966", referred to in the footnote to paragraph 2. The ideas have been taken over and expanded in a recent Swedish report by three prominent labour market economists, *Lönebildning och samhällsekonomi* ("Wage Determination and the National Economy"), Report from a Group of Experts Appointed by SAF, LO and TCO.

APPENDIX II

Mathematical Formulation of the Model

1. *Classification of Indsutries*

1. Agriculture (including dairies) } sheltered industries
2. Other sheltered industries }
3. Import-competing manufacturers } exposed industries
4. Fisheries }
5. Shipping }
6. Other export-oriented industries }

2. *Endogenous Variables* — Number

Y_j	= Total delivery from sector j, measured in current prices ($j = 1, 2 \ldots 6$)	(6)
Y_{ij}	= Sector j's use of intermediate products from sector i, measured in current prices ($i = 1, 2 \ldots 6, j = 1, 2 \ldots 6, i \neq j$)	(30)
B_j	= Sector j's use of imported intermediate products, measured in current prices ($j = 1, 2 \ldots 6$)	(6)
E_j	= Profits in sector j ($j = 2, 3, 5, 6$)	(4)
J_1	= Sum of wages and profits in agriculture	(1)
J_4	= Sum of wages and profits in fishing	(1)
X	= Sum of wages paid by sectors 2, 3, 5, 6	(1)
P_2	= Price index of products from sector 2	(1)
P_3	= Price index of products from sector 3	(1)
P_9	= Consumer price index	(1)
T_2	= Net indirect taxes paid by sector 2	(1)
T_3	= Net indirect taxes paid by sector 3	(1)
S_j	= Price index of depreciation in sector j ($j = 1, 2, 3, 4, 6$)	(5)
	Total endogenous variables	(59)

3. *Exogenous Variables*

T_j	= Net indirect taxes paid by sector j ($j = 1, 4, 5, 6$)	(4)
L_j	= Number of wage and salary earners in sector j. Measured as an index ($j = 2, 3, 5, 6$)	(4)
N_j	= Total employment in sector j. Measured as an index. ($j = 1, 2, \ldots 6$)	(6)
Z_j	= Index of productivity for sector j ($j = 1, 2 \ldots 6$)	(6)
P_1	= Index of agricultural prices. The index is assumed to be determined by an income settlement	(1)

Stockholm 1968. Mimeographed. The Swedish report is known unofficially as the EFO-report, named after its authors Edgren, Faxén and Odhner. A summary in English of their ideas is available in Gösta Edgren, Karl-Olof Faxén, and Clas-Erik Odhner: Wages, Growth, and the Distribution of Income", *Swedish Economic Journal*, Sept. 1969, pp. 133–160.

P_4 = Price index of products from fisheries. The index is assumed to be determined partly by world market prices (for products exported), partly by prices fixed by government intervention as negotiated through an income settlement (for products sold on the home market) (1)

P_j = Price index of products from sector j ($j = 5, 6$). The index is assumed to be determined by prices obtained on the world market (2)

P_7 = Price index of imported consumer goods (1)

P_8 = Price index of competitive imports, that is, of imported goods comparable with products from the sector "import-competing manufacturers" (1)

P_{10} = Price index of imported capital goods (1)

W_j = Index of the wage and salary *rate* in sector j. Changes in W_j will partly be due to changes in wage agreements and partly to an exogenous wage drift ($j = 2, 3, 5, 6$) (4)

Q_j = Price index of imported intermediate goods to sector j ($j = 1, 2 \ldots 6$) (6)

S_5 = Price index of depreciation in shipping. The price index is assumed to be determined on the world market by prices of newly built ships (1)

D_j = Volume of depreciation in sector j ($j = 1, 2 \ldots 6$) (6)

Total exogenous variables (44)

4. *Structural Coefficients, or Parameters*

b_{ij} = Input-output coefficients that show the amount of the ith input required for each unit of the jth output ($i, j = 1, 2, 3, 4, 5, 6, i \neq j$)

b_{7j} = Input-output coefficients that show the amount of imported input required for each unit of the jth output ($j = 1, 2, \ldots 6$)

r_2 = Profits as a share of factor income (wages + profits) in sector 2

d_{2j}, d_{7j} = Weights in the price index of depreciation in sector j ($j = 1, 2, \ldots 6$)

a_j = Weights in the consumer price index ($j = 1, 2, \ldots 7$)

h_j = Total nominal wages in the base year in sector j ($j = 2, 3, 5, 6$)

c_j = Total production in the base year in sector j ($j = 1, 2, \ldots 6$)

m_2, n_2, m_3, n_3 = coefficients in the tax-equations.

5. *Equations*

Definitional equations ((1)–(15)):

$$(1) \qquad Y_1 = \sum_{i=1}^{6} Y_{i1} + B_1 + T_1 + J_1 + D_1 \cdot S_1$$

$$(2) \qquad Y_4 = \sum_{i=1}^{6} Y_{i4} + B_4 + T_4 + J_4 + D_4 \cdot S_4$$

$$(3)\text{–}(6) \quad Y_j = \sum_{i=1}^{6} Y_{ij} + B_j + L_j W_j h_j + T_j + E_j + D_j \cdot S_j \quad (j = 2, 3, 5, 6).$$

Each of the equations (1)–(6) gives, for a sector, a definitional relationship which shows that costs + profits equal the payments for the sector's deliveries. The h coefficients in equations (3)–(6) are those which must be introduced in order to coordinate the criteria chosen for wage levels, employment and wage costs. (Scale coefficients.) Y_{ij} is fixed by definition equal to 0 when $i = j$. The h coefficients must be estimated.

$$(7) \quad P_9 = \sum_{j=1}^{7} a_j P_j.$$

Equation (7) defines a consumer price index as weighted average of the price indices $P_1 \ldots P_7$.

The weights $a_1 \ldots a_7$ are assumed to be known figures.

$$(8)\text{–}(12) \quad S_j = d_{7j} P_{10} + d_{2j} P_2 \quad (j = 1, 2, 3, 4, 6).$$

Equations (8)–(12) define the price indices for depreciation as weighted averages of the price index of imported capital goods and the price of capital goods produced in sector 2. The weights d_{7j} and d_{2j} ($j = 1, 2, 3, 4, 6$) are assumed to be known.

$$(13) \quad X = \sum_{j} h_j L_j W_j \quad (j = 2, 3, 5, 6).$$

Equation (13) defines the sum of wages and salaries paid by sectors other than agriculture and fisheries. Total wages paid by any one sector j equals wages paid by that sector in the base year (h_j) multiplied by the index of the number of wage and salary earners in sector j (L_j) and multiplied further by the index of the wage and salary rate of sector j (W_j).

$$(14) \quad T_2 = m_2 Y_2 + n_2 \frac{Y_2}{P_2}$$

$$(15) \quad T_3 = m_3 Y_3 + n_3 \frac{Y_3}{P_3}.$$

Equation (14) expresses that the indirect taxes paid by sector 2 consist of one component which is proportional to the value of the sector's total deliveries and another component which is proportional to the volume of the sector's total deliveries. Equation (15) expresses a comparable situation for sector 3. m_2, n_2, m_3, n_3, must be estimated.

Input-output relationships ((16)–(51)):

$$(16)\text{–}(45) \quad \frac{Y_{ij}}{P_i} = b_{ij} \cdot \frac{Y_j}{P_j} \quad \begin{matrix} (i = 1, 2, \ldots 6) \\ (j = 1, 2, \ldots 6) \\ (i \neq j) \end{matrix}$$

(46)–(51) $\dfrac{B_j}{Q_j} = b_{7j} \cdot \dfrac{Y_j}{P_j} \quad (j = 1, 2, \ldots 6)$

Equations (16)–(51) indicate that the quantity a sector consumes of a certain type of intermediate goods is proportional to the magnitude of the sector's delivery measured in volume. (The figures for quantity are expressed by dividing the figures for value by prices.) The b coefficients must be estimated.

Production functions ((52)–(57)):

(52)–(57) $\dfrac{Y_j}{P_j} = c_j Z_j N_j \quad (j = 1, 2, \ldots 6).$

Equations (52)–(57) express the volume of the total delivery from a sector as a function of the product of employment in the sector and index of productivity for the sector. The c coefficients must be estimated.

Price behaviour equations ((58)–(59)):

(58) $\dfrac{E_2}{E_2 + W_2 L_2 h_2} = r_2.$

Equation (58) expresses the thought that enterprises in sector 2 (other sheltered industries) adjust their output prices (P_2) in such a way that the ratio of profits to factor income in sector 2 (the left-hand side of the equation) assumes a pre-determined value expressed by the coefficient r_2. The coefficient r_2 is supposed to follow a given trend.

(59) $P_3 = P_8.$

Equation (59) expresses the thought that enterprises in sector 3 (import-competing manufacturers) adjust their output prices in such a way that an index of these prices follow an index of prices of comparable imported products.

6. *The reduced Form of the Model*

The easiest way of solving the system is first to find the solution for P_2. We can then use this result to find the solution for the other endogenous variables.

Below we have listed the results for the endogenous variables of main interest.

$$P_2 = \frac{1}{1 - m_2 - d_{22}\dfrac{D_2}{c_2 N_2 Z_2}}\left[b_{12}P_1 + b_{32}P_8 + b_{42}P_4 + b_{52}P_5 + b_{62}P_6 + b_{72}Q_2 + n_2 + d_{72}\frac{D_2}{c_2 N_2 Z_2}P_{10} + \frac{1}{1 - r_2} \cdot \frac{h_2 L_2 W_2}{c_2 N_2 Z_2}\right]$$

$$P_9 = a_1P_1 + a_2P_2 + a_3P_8 + a_4P_4 + a_5P_5 + a_6P_6 + a_7P_7$$

$$E_2 = \frac{r_2}{1 - r_2} h_2 L_2 W_2$$

$$E_3 = c_3 N_3 Z_3 \left[P_8 - b_{13} P_1 - b_{23} P_2 - b_{43} P_4 - b_{53} P_5 - b_{63} P_6 - b_{73} Q_3 - n_3 - m_3 P_8\right] - \left[d_{23} P_2 + d_{73} P_{10}\right] D_3 - h_3 L_3 W_3$$

$$E_5 = c_5 N_5 Z_5 \left[P_5 - b_{15} P_1 - b_{25} P_2 - b_{35} P_8 - b_{45} P_4 - b_{65} P_6 - b_{75} Q_5\right] - S_5 D_5 - T_5 - h_5 L_5 W_5$$

$$E_6 = c_6 N_6 Z_6 \left[P_6 - b_{16} P_1 - b_{26} P_2 - b_{36} P_8 - b_{46} P_4 - b_{56} P_5 - b_{76} Q_6\right] - \left[d_{26} P_2 + d_{76} P_{10}\right] D_6 - T_6 - h_6 L_6 W_6$$

$$J_1 = c_1 N_1 Z_1 \left[P_1 - b_{21} P_2 - b_{31} P_8 - b_{41} P_4 - b_{51} P_5 - b_{61} P_6 - b_{71} Q_1\right] - \left[d_{21} P_2 + d_{71} P_{10}\right] D_1 - T_1$$

$$J_4 = c_4 N_4 Z_4 \left[P_4 - b_{14} P_1 + b_{24} P_2 - b_{34} P_8 - b_{54} P_5 - b_{64} P_6 - b_{74} Q_4\right] - \left[d_{24} P_2 + d_{74} P_{10}\right] D_4 - T_4.$$