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INFLATION IN A LARGE, OPEN ECONOMY: THE SCANDINAVIAN MODEL AND THE JAPANESE ECONOMY†

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The Scandinavian, or Norwegian, model of inflation, first formulated in the context of Norway, has been applied to a number of countries [Aukrust (1977)]. It assumes that the country in question has a "small economy," meaning by this that it is a price taker with respect to its tradeable goods. While this assumption is true for some countries, there are a number of countries for which this assumption is questionable in some respect or other. In particular, there are many countries which have a significant share of the world export trade in one or several commodities. For such countries, the assumption that they are price takers with respect to these commodities need no longer be valid. If, furthermore, these commodities are a significant part of their country's overall exports or imports, the overall price-taker or small country assumption would also be of questionable validity, so that the Scandinavian model cannot be applied to such countries without modifications. It seems interesting and instructive to examine at least one such country, the modifications that seem to be appropriate for it and then to test empirically the modified Scandinavian model. We do this for the case of Japan.

In terms of terminology, the term "small economy" has the established meaning of an economy which does not influence world prices and is thus a price taker in the world market for its exports and imports. We will take the term "large economy" to mean one which influences world prices, though it may also be influenced by them. This influence may occur even in relatively free world markets because the country in question is a relatively large exporter (or importer) of the relevant commodities so that changes in its exports (imports) will significantly alter the quantity supplied (demanded) and hence the world price. However, this does not preclude changes in other countries' supplies and demands from also affecting the world price. Japan has a large economy, under our definition of this term.

Once one steps outside the realm of the small economy, the relevant peculiarities of the economy have to be considered and incorporated into the model. Section I looks at the composition of Japan's exports and imports, and their shares in world trade, in order to focus on the peculiarities of the Japanese economy. Section II briefly sets out a bare-bones version of the Scandinavian model. Section III examines the modifications required in it to meet the peculiar nature of the Japanese economy. Section IV lists the data sources and presents the empirical estimates.

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I. *The Composition of Japan's Exports and Imports*

Japan has one of the relatively larger economies in the world, whether measured in terms of its total output or its total exports or total imports, relative to the values of the corresponding world variables. It has very significant shares of the world exports and imports in some of the major commodities entering into world trade. Table 1 illustrates this for the case of exports by presenting Japan's share of the world trade in various products. Japan is the world's largest exporter in the products classified in group 1. Its percentage share within this group ranges from 21.4% of world exports in "Instruments and Apparatus" to 41% in "Ships and Boats." It is the world's second or third largest exporter in a variety of other goods. Together, groups 1, 2 and 3 constitute 65% of Japan's exports. Thus, a large percentage of Japanese exports is in products in which it is one of the world's largest exporters. This degree of concentration indicates that Japan has significant scope for setting the prices of its exports and that it can influence world prices, rather than merely taking them as given. Further, 99.5% of Japanese exports are of manufacturing products, with only 0.4% of agricultural goods and 0.1% of minerals.

Table 2 shows Japan's imports. Here again, Japan is the world's largest importer of

TABLE 1. JAPAN'S EXPORT SHARE IN WORLD MARKETS

	% of Total Domestic Exports	Share of World Market	Rank in World	Next Largest Producer: Rank/Country/Share
Group 1				
1. Ships and Boats	10.1	41.0	1	2/Norway/8.3
2. Telecommun. Equip.	7.3	31.6	1	2/Germany/12.6
3. Iron, Steel, Univ, Plates, Sheet	5.6	34.2	1	2/Germany/14.8
4. Instruments, Apparatus	3.2	21.4	1	2/U.S. Puerto Rico/19.2
5. Iron, Steel Tubes, Pipes, etc.	2.9	26.9	1	2/Germany/22.1
6. Woven Textile, Non Cotton	2.5	21.5	1	2/Germany/14.7
7. Sound Recorders	2.4	38.1	1	2/U.S. Puerto Rico/12.8
8. Iron, Steel Primary Form	1.2	24.2	1	2/Germany/16.1
Sub-Total	35.2			
Group 2				
9. Road Motor Vehicle	17.8	18.2	2	3/U.S. Puerto Rico/15.2
10. Watches and Clocks	1.2	22.9	2	3/Hong Kong/12.6
11. Textile, Leather Machinery	1.0	14.2	2	3/Switzerland/13.9
Sub-Total	20.0			
Group 3				
12. Machines Nes Non-Electric	5.4	9.4	3	4/France/8.7
13. Electric Power Machines, Switchgear	2.2	13.0	3	4/France/7.6
14. Office Machine	1.4	9.7	3	4/U.K./9.4
15. Rubber Articles Nes	1.0	14.6	3	4/U.K./7.9
Sub-Total	10.0			
Sub-Total of Groups 1–3	65.2			
All other exports	34.8			
TOTAL	100.0			

Data used: annual, for the year 1977.
Source: *Yearbook of International Trade Statistics*, 1977, VII, United Nations.

TABLE 2. JAPAN'S MAJOR IMPORTS AND THEIR SHARES IN WORLD MARKETS

	% of Total Domestic Imports	Share of World Market	Rank in World	Next Largest Importer Rank/Country/Share
Group 1				
1. Crude petroleum	31.9	15.0	2	3/France/7.9
2. Petroleum products	4.7	9.6	3	4/Sweden/5.4
Sub-Total	36.6			
Group 2				
3. Coal, Cokes, Briquette	5.0	35.8	1	2/France/12.2
4. Wood, Rough	4.7	55.2	1	2/Korea/8.8
5. Iron Ore Concentrates	3.6	40.9	1	2/U.S.A./15.3
6. Fish, Fresh	2.9	29.1	1	2/U.S.A./25.4
7. Nonferous Base Metal Ore	2.7	29.1	1	2/U.S.A./13.2
8. Oil Seeds, Nuts, Kernels	2.2	21.6	1	2/Germany/20.3
9. Cotton	1.6	21.8	1	2/Germany/8.2
10. Maize, Unmilled	1.5	19.8	1	2/Netherlands/9.4
11. Cereal, Unmilled	0.9	36.6	1	2/Belgium-Lux/8.2
Sub-Total	25.1			
Group 3				
12. Gas, Natural & Manufactured	2.5	19.3	2	3/Germany/19.1
13. Sugar and Honey	1.2	16.1	2	3/U.K./12.2
14. Wheat, etc., Unmilled	1.1	12.6	2	2/U.K./7.1
Sub-Total	4.8			
Sub-Total of Groups 1–3	66.5			
All other imports	33.5			
TOTAL	100.0			

Data used: annual, for the year 1977.
Source: *Yearbook of International Trade Sta istics*, 1977, VII, United Nations.

a wide range of commodities from "rough wood," of which it accounts for 55.2% of the world imports, to "unmilled maize," of which it imports 19.8% of the world's imports. The commodities of which it is the world's first, second or third largest importer make up 66.5% of its total imports. Japan should then be suspected of having considerable power to set or influence the world prices of its imports. As against this, however, it should be noted that Japan is unlikely to affect the prices of imports in group 1. These are "crude petroleum" and "petroleum products," whose prices are mainly set by OPEC, a supply cartel. These account for 36.6% of Japan's imports. In Table 2, this group and "all other imports," which have only a small percentage of the world markets, account for 70% of total domestic imports. Japan's ability to influence the world prices of its imports is thus limited, and seems less than its ability to influence the prices of its exports.

As Table 2 shows, virtually all of Japan's imports are of food and raw materials. Of these, industrial raw materials account for 64.2%. The prices of these raw materials are an element of the cost of production of the manufactured goods exports in which Japan specializes, so that we would expect the world prices of raw materials to influence Japan's domestic price level.

II. *The Scandinavian Model*

The Scandinavian model divides an open economy into two sectors, the exposed and the sheltered sectors. The exposed sector produces commodities which are tradeable on world markets, so that, in a competitive world framework, their prices cannot deviate from the world ones. Hence, the rate of inflation ($\dot{P}_e$) of the exposed sector's prices equals the world rate of inflation ($\dot{P}_w$), which are assumed to be exogenously given. Workers in the exposed sector ask for, and get, nominal wage rate increases ($\dot{W}_e$) equal to the sum of this rate of inflation and the rate of productivity increase in this sector ($\dot{q}_e$). That is,

$$\dot{P}_e = \dot{P}_w$$
$$\dot{W}_e = \dot{P}_w + \dot{q}_e$$

and union bargaining practices and/or the competition between the exposed and the sheltered sectors for labor ensures that the nominal wage rate in the sheltered sector ($\dot{W}_s$) rises by the same rate as in the exposed sector. Assuming the sheltered sector to base its pricing policies on a full-cost or administered basis, since it largely consists of the service and government sectors, the rate of inflation in the sheltered sector ($\dot{P}_s$) will equal $\dot{W}_s$ ($=\dot{W}_e$) minus its rate of increase of productivity ($\dot{q}_s$). That is,

$$\dot{P}_s = \dot{P}_e + \dot{q}_e - \dot{q}_s$$

Designating the share of output of the sheltered sector in national output to be α_s, and that of the exposed sector as $(1-\alpha_s)$, the country's rate of inflation ($\dot{P}_d$) will be

$$\dot{P}_d = \dot{P}_w + \alpha_s(\dot{q}_e - \dot{q}_s) \qquad (1)$$

Equation (1) is stated for the fixed exchange rate case. Since we intend to estimate the model's equations for the period 1961–71, which covers both the fixed exchange rate and the flexible exchange rate episodes, (1) needs to be modified to

$$\dot{P}_d = (\dot{P}_w + \dot{\rho}) + \alpha_s(\dot{q}_e - \dot{q}_s) \qquad (2)$$

where ρ is the exchange rate defined as the amount of the domestic currency per U.S. dollar and $\dot{\rho}$ is its rate of change.

The symbols used so far and their explanations, are:

$\dot{P}_d$	Japan's rate of inflation
$\dot{P}_w$	world rate of inflation
$\dot{P}_s$	rate of inflation of the sheltered sector's products
$\dot{P}_e$	rate of inflation of the exposted sector's products
α_s	share of the sheltered sector's output in the national output
$\dot{W}$	rate of increase of the nominal wage rate
ρ	yen (units of the domestic currency) per U.S.$
$\dot{q}_s$	rate of increase of productivity in the sheltered sector
$\dot{q}_e$	rate of increase of productivity in the exposed sector.

The dot over a variable's symbol will indicate its rate of change.

III. *The Appropriate Model for Japan*

Once the analysis is extended outside the small economies category, a number of considerations that were not applicable to small economies have to be taken into account. We illustrate these by the following special cases.

Assume that the country in question is "large enough" to affect the world economy and be affected by it through its exports. Let its exports consist of agricultural products, produced by a large number of producers so that they can be assumed to be produced under perfect competition. Since there are a large number of domestic producers, none can be taken as setting the price. However, they are, as a whole, susceptible to the same set of cost factors. Among these are nominal wage rates, nominal capital costs and costs of their raw materials. These are affected by the aggregate domestic demand or, alternatively, the domestic rate of inflation, as well as other factors which affect productivity. Since costs are affected by these factors, so must be the supply behavior and the price determined in a competitive framework. Hence, the price which the country's producers try to get in the world market—or alternatively, the quantity they supply—is affected by the domestic aggregate demand. Since they collectively export enough to affect the world price, it follows that the country's aggregate demand and the domestic price level will affect the world price. The country's domestic price, and production, are, of course, also affected by the world price.

Now consider a second case where there are still a large number of domestic producers but they produce a manufactured product which is somewhat differentiated from that supplied by the other countries' producers, which also have large numbers of producers, so that the overall situation is one of monopolistic competition at the firms' level. However, since the country in question has a significant share of world markets, there are oligopolistic or monopolistic elements as far as the country as a whole vis-a-vis the world is concerned. Its domestic demand will again affect its prices and the world price level. But now, the degree of differentiation and the number of producers in the country could also affect the world price. However, the individual producers or any one country cannot be taken to be a price setter.

For a third case, assume that the country in question is again a large supplier in world markets, but there are only a few domestic suppliers, who are large enough to be oligopolistic in the world market as a whole. Since the country has a significant share of the world market, its domestic demand factors will affect the prices its producers charge on world markets. Further, since there is an oligopoly, the producers may set their prices on the basis of their costs or the traditional price pattern in the industry or on some other basis.[1] Producers then need not take the world price as given in the sense of the Scandinavian model, but may set their own prices. This is particularly true of industrial products, with extensive product differentiation. In this case, the proper hypothesis would seem to be that the country sets the prices of its exports rather than that it takes world prices as given, or that it influences them and is influenced by them. The prices that it sets would still be affected by the factors that affect the cost of production of exported goods. These would include domestic demand factors, as well as the prices of imported raw materials, if any.[2]

[1] The theory of oligopoly does not yield a single hypothesis for oligopolistic price determination. There are numerous possibilities. However, given that we are concerned with average oligopolistic behavior, with the average taken over a large number of industries, it seems reasonable to assume that such average oligopolistic behavior is pricing largely on the basis of cost considerations.

[2] The particular hypothesis that best seems to fit our arguments here is the fix-price one, advanced by Hicks (1974, pp. 23–29). Fix-prices are insulated from temporary deviations in supply and demand but are otherwise fixed to take account of the normal pattern of demand and cost of production.

The last case seems to be the pertinent one for Japan. Its exports are mostly of manufactured products. These command a leading position in many world markets. Further, there are only a small number of major industrial firms in each of the products in question. It should then be viewed as being largely a price setter in export products.

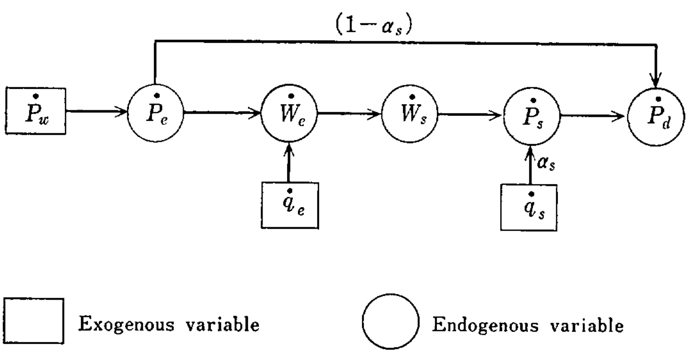
Assume that Japan is a price setter in exports. On what basis will its firms set their prices? Our earlier argument and the fix-price argument put forward by many economists for industrial corporations suggest that the prices will be set on the basis of labor costs—which in turn would depend, *inter alia,* upon domestic demand—and the costs of raw material imports, since these are common elements in the cost structure of each of the firms. The full-cost theory of prices would emphasize this in an even more rigid fashion than we have suggested.

Looking at imports of raw materials, Japan seems to trade in markets which are fairly competitive on the buyers' side, though they may not be so on the sellers' side of the market. Japan, then, would take the prices of raw materials as largely given, though with some likelihood that Japan's demand for their imports might affect their world price.

What is the role of domestic and international demand in this scenario? In espousing an oligopolistic full-cost or fix-pricing framework, we have assumed that the foreign demand for Japanese exports does not affect their prices. Similarly, domestic demand for these products does not affect their prices unless it leads to a general rise in costs, through a rise in nominal wages, or the expectation of such a rise. Now, wages can rise not only from demand pressures on the labor market, due to the state of aggregate demand in the economy, but also because workers may seek compensation, partly or wholly, for increases in the domestic price level due to any other causes, including among these the rise in the world prices of raw materials. Nominal wage rates then rise in the model directly due to aggregate demand pressures and indirectly due to increases in the prices of raw materials.

To summarize, our arguments suggest that the appropriate model for Japan seems to be one which takes the world prices of its raw materials' imports as given. These, along with the domestic aggregate demand, determine the prices of its exposed sector's products. The complete model is set out later in terms of its flow diagram.

The flow diagram of the Scandinavian model, for the fixed exchange rate case, is usually drawn (Frisch, 1977) as



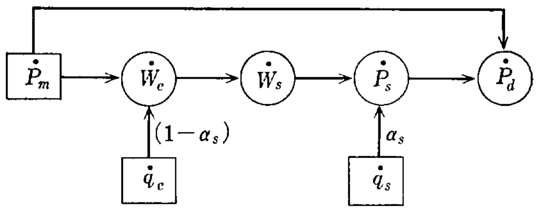
The determinants of $\dot{P}_d$ are specified by the general form of (1) as,

$$\dot{P}_d = \dot{P}_d(\dot{P}_w,\ \alpha_s(\dot{q}_e - \dot{q}_s)) \quad (1')$$

Allowing the domestic demand variable (D) to exert some independent influence on $\dot{P}_d$, in order to take account of the fact that Japan has a large economy, modifies (1) to

$$\dot{P}_d = \dot{P}_d(\dot{P}_w,\ \dot{D},\ \alpha_s(\dot{q}_e - \dot{q}_s)) \quad (3)$$

The hypothesis that Japan is a price setter for its manufactured goods in the context of the Scandinavian model yields the flow diagram,



where $\dot{P}_m$ is the domestic price of manufactured goods. It is taken to be exogenously set.

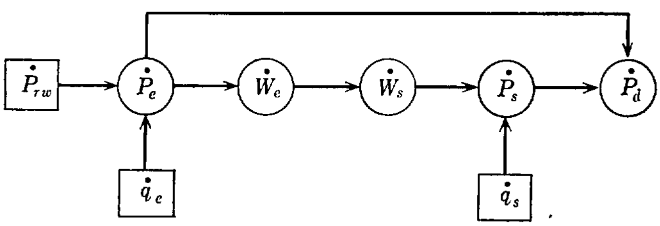
The equation for $\dot{P}_d$ for this hypothesis is

$$\dot{P}_d = \dot{P}_d(\dot{P}_m,\ \alpha_s(\dot{q}_e - \dot{q}_s)) \quad (4)$$

Allowing domestic demand variables to determine $\dot{P}_m$ modifies (4) to

$$\dot{P}_d = \dot{P}_d(\dot{D},\ \alpha_s(\dot{q}_e - \dot{q}_s)) \quad (5)$$

This hypothesis is hardly a very satisfactory one since it takes the prices of the exposed sector's products to be exogenously set and not try to explain their determination. One way of explaining them is to assume that they are fixed only on the basis of raw material costs. If the structure of the Scandinavian model was retained but it was assumed that the domestic exposed sector's prices are based on the world raw material prices, the flow diagram would become



where P_{rw} is the world price of raw materials.

The determinants of $\dot{P}_d$ are then

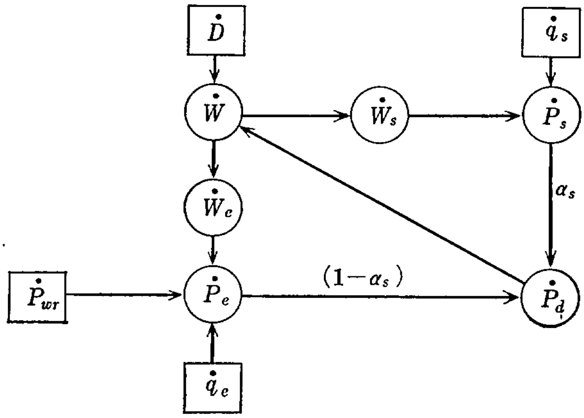
$$\dot{P}_d = \dot{P}_d(\dot{P}_{rw},\ \alpha_s(\dot{q}_e - \dot{q}_s)) \quad (6)$$

We have argued above that the prices of the exposed sector's products are likely to be determined by raw material prices and domestic cost factors, which depend on general demand conditions. The flow diagram specified by our arguments for this case is given below.

The equation for this hypothesis is,

$$\dot{P}_d = \dot{P}_d(\dot{P}_{rw},\ \dot{D},\ \alpha_w(\dot{q}_e - \dot{q}_s)). \quad (7)$$

It has been emphasized throughout that Japan is a large economy. As such, the world rates of inflation $\dot{P}_w$ and $\dot{P}_{rw}$ cannot be taken to be independent of $\dot{P}_d$ and $\dot{D}$. Estimating equations (3), (6) and (7) in their present form by ordinary least squares regressions would



yield biased and inconsistent estimates of the coefficients. It is also desirable to separate out the influence of the rest of the world from the Japanese rate of inflation. To do so, $\dot{P}_w$ and $\dot{P}_{rw}$ would be replaced by $\hat{\dot{P}}_{mw}$ and $\hat{\dot{P}}_{rw}$, where $\hat{\dot{P}}_{mw}$ is the estimated world rate of inflation in manufactured goods and $\hat{\dot{P}}_{rw}$ is correspondingly the estimated world rate of inflation in raw materials.

The world economy does not generate data on $\hat{\dot{P}}_{mw}$ and $\hat{\dot{P}}_{rw}$, so that such data has to be constructed. There is no perfect way of doing so. What we need is a hypothesis on their determination. We adopt a simple world monetarist hypothesis and assume that P_{mw} and P_{rw} are determined by the world rate of growth of the money supply, with a stepwise adjustment due to the rise in the price of oil in 1974. To calculate what P_{mw} and P_{rw} would have been if the Japanese money supply had been excluded, we estimated,

$$\dot{P}_{mwt}=a_{m0}+a_{m1}\dot{\bar{M}}_{wt-1}+a_{m2}\dot{M}_{t-1}+a_{m3}DV_t+u_{mt}$$

$$\dot{P}_{rwt}=a_{r0}+a_{r1}\dot{\bar{M}}_{wt-1}+a_{m2}\dot{M}_{t-1}+a_{r3}DV_t+u_{rt}$$

where $\bar{M}_w$ is the world money supply, excluding Japan's, M is Japan's money supply, DV is a dummy variable with a value of zero before 1974 and one after 1974, a_{mi} and a_{ri}, $i=0, 1, 2$, are constants and u_{mt} and u_{rt} are assumed to be white noise. The estimated $\hat{a}_{mi}$ and $\hat{a}_{ri}$ were then used to calculate

$$\hat{\dot{P}}_{mwt}=\hat{a}_{m0}+\hat{a}_{m1}\dot{\bar{M}}_{wt-1}+\hat{a}_{m2}\dot{M}_{t-1}+\hat{a}_{m3}DV_t$$

$$\hat{\dot{P}}_{rwt}=\hat{a}_{r0}+\hat{a}_{r1}\dot{\bar{M}}_{wt-1}+\hat{a}_{m2}\dot{M}_{t-1}+\hat{a}_{r3}DV_t$$

Replacing $\dot{P}_w$ by $\hat{\dot{P}}_{mw}$ and $\dot{P}_{rw}$ by $\hat{\dot{P}}_{rw}$ modifies equations (3), (6) and (7) to

$$\dot{P}_d=\dot{P}_d(\hat{\dot{P}}_{mw},\ \dot{D},\ \alpha_s(\dot{q}_e-\dot{q}_s)) \qquad (3')$$

$$\dot{P}_d=\dot{P}_d(\hat{\dot{P}}_{rw},\ \alpha_s(\dot{q}_e-\dot{q}_s)) \qquad (6')$$

$$\dot{P}_d=\dot{P}_d(\hat{\dot{P}},\ \dot{D},\ \alpha_s(\dot{q}_e-\dot{q}_s)) \qquad (7')$$

where $\hat{\dot{P}}_{mw}$ and $\hat{\dot{P}}_{rw}$ are independent of $\dot{P}_d$ and $\dot{D}$, as well as of $\alpha_s(\dot{q}_e-\dot{q}_s)$, so that the problems of multicollinearity and simultaneity which would have arisen with the earlier equation (3), (6) and (7) would no longer occur. The estimated coefficients would also measure the true impact of the world rates of inflation on the Japanese one. Our equations can now be estimated by one stage least squares regression.

The aggregate domestic demand variable D is not directly observable. We will assume that aggregate demand is determined in a reduced form equation by the domestic money supply M and domestic government expenditures G. That is, in terms of rates of growth,

$\dot{D}=f(\dot{M}, \dot{G})$

The general estimating equation would be:

$$\dot{P}_d=\dot{P}_d(\hat{\dot{P}}_{mw}, \hat{\dot{P}}_{rw}, \dot{M}, \dot{G}, \alpha_s(\dot{q}_e-\dot{q}_s)) \tag{8}$$

Table 6 in the next section presents the estimates of equation (8). Tables 3, 4 and 5 are estimates of some of the other equations considered in this section and can be taken to be the building blocks leading to Table 6.

IV. *Data Sources and Empirical Estimates*

A few general concepts used in our data calculations need to be specified. The exposed sector was defined as the mining and manufacturing sectors. The sheltered sector was defined as being composed of the following "industries": agriculture, forestry and fisheries, construction, electricity, gas water, communications and transportation, wholesale and retail trades, finance, insurance, real estate services and government. The "world," for calculating the world money supply and world rates of inflation, was defined as the ten industrial countries of USA, West Germany, United Kingdom, France, Italy, Canada, Switzerland, Netherlands, Belgium and Sweden.

The actual values of the various variables were then measured by,

- P_d GNP deflator
- $P^J{}_m$ unit value index of Japan's exports of manufactured goods.
- P_{mw} weighted unit value index of manufactured goods for the designated ten industrial countries, with the weights being the relative values of the exports of each country.
- $P^J{}_{rw}$ weighted unit value of Japan's industrial raw material, imports, including minerals but excluding food.
- α_s nominal value of the sheltered sector's output divided by nominal GDP.
- q_s nominal value of the sheltered sector's output (excluding that of the public sector) divided by the consumer price index and the number of workers employed in this sector.
- q_e productivity per worker in manufacturing and mining.
- M M_1 (currency in circulation plus demand deposits), or as M_2 (M_1 plus time deposits).
- $\bar{M}_w$ The sum of ten industrial countries' money supply, measured by M_1
- G government expenditures.
- ρ yen per U.S.$

Annual data for the period 1961 to 1977 was used for the regression estimates reported in this paper. The data was collected from a variety of Japanese, United Nations and other sources.

The regression equations were estimated using ordinary least squares and two-stage least squares. Several versions of the equations were estimated. Some of these did not have any lags while others had one-period lags in the productivity gap $\alpha_s(\dot{q}_e-\dot{q}_s)$ and in $\dot{M}$ and $\dot{\bar{M}}_w$, since these seemed to be plausible possibilities. Different alternative sets of regressions with the money supply being measured in turn by M_1 and by M_2, and other reasonable variations on measuring some of our other variables, were also tried. Our preferred estimates are reported in Tables 5 to 8. The parenthesis under each coefficient gives its standard error.

To give an overall view of the empirical results, the reported estimates in Tables 3 to 6 show that the most satisfactory hypothesis for the Japanese economy is that Japan is a price taker with respect to raw material imports. The second best set of estimates are for the hypothesis that Japan is a price setter with respect to its exports. The assumption that Japan is a price taker for its exports does the worst. These comments are based on the comparison of the estimated R^2, the significance and sign of the coefficients, and the comparison of the Durbin-Watson (DW) statistics.

Looking more closely at each of the estimated equations, Table 3 presents the estimates for the basic set of equations. Equation 3.2 in Table 3 for the standard price taker case has the lowest R^2 of the three equations in the table. The coefficients have the expected positive sign but the coefficient of the WPGG (weighted productivity growth gap term, $\alpha_s(\dot{q}_e-\dot{q}_s)$) term is not significant at the 95% level. The DW (Durbin-Watson) statistic at 1.11 indicates the possibility of autocorrelation.

Equation 3.1, for the price-setter case for exports, has a higher R^2 at 0.73. The coefficients have the right positive signs, but the coefficient of WPGG is again not significant at the 95% level. The DW statistic also indicates the possible existence of autocorrelation.

Equation 3.3, for the price-taker case with respect to raw material imports, has the highest R^2 (=0.81) in the table. Its coefficients have the correct positive signs and are both significant. Its DW statistic value at 1.67, while still inconclusive for autocorrelation, is the "best" among the three equations. These estimates had used Japan's raw material price index for imports for measuring $P^J{}_{rw}$. This equation, re-estimated with $P^J{}_{rw}$ being measured by the weighted average unit value of imports of the ten selected industrial economies is,

TABLE 3.

Case 1 — *Price Setter with respect to exports*

Dependent variable	Constant	$(p^J{}_m)_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)$	R^2	DW	
$\dot{P}_d$	5.29	0.33	0.20			
	(0.59)	(0.05)	(0.15)	0.73	1.20	(3.1)

Case 2 — *Price Taker with respect to exports*

Dependent variable	Constant	$(\dot{p}_{mw}+\dot{\rho})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	R^2	DW	
$\dot{P}_d$	4.68	0.34	0.37			
	(0.81)	(0.08)	(0.19)	0.56	1.11	(3.2)

Case 3 — *Price Taker with respect to imported industrial raw materials*

Dependent variable	Constant	$(\dot{P}^J{}_{rw})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	R^2	DW	
$\dot{P}_d$	5.12	0.13	0.27			
	(0.50)	(0.02)	(0.12)	0.81	1.67	(3.3)

Case 4

Dependent variable	Constant	$(\dot{P}_{mw}+\dot{\rho})_t$	$(\dot{P}^J{}_{rw})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)$	R^2	DW	
$\dot{P}_d$	5.21	−0.05	0.14	0.26	0.81	1.87	(3.4)
	(0.56)	(0.10)	(0.03)	(0.13)			

The parenthesis below each coefficient indicates its standard error. The data used in this and subsequent tables was annual, for the years 1961 to 1977.

$$\dot{P}_d = 5.01 + 0.13(\dot{P}^J{}_{rw} + \dot{\rho})_t + 0.27\alpha_s(\dot{q}_e - \dot{q}_s)_t \qquad R^2 = 0.80 \tag{3.3'}$$
$$(0.52)\ (0.08) \qquad\qquad (0.13)$$

Here, the R^2 value is quite respectable and the coefficients are both positive and significant. Equation 3.3′, therefore, clearly does the best among the three basic equations. That is, it is through the prices of imported raw materials rather than of its exports that the Japanese economy imports inflation from the world. This is further tested in equation (3.4) which includes both $(\dot{P}_{mw} + \dot{\rho})$ and $\dot{P}^J{}_{rw}$ as independent variables. Here, the coefficient of $(\dot{P}_{mw} + \dot{\rho})$ is not significant at the 1% level of significance. The coefficient of $(\dot{P}^J{}_{rw})$ is significant and has the right sign. We conclude, therefore, from the estimates presented in Table 3 that Japan imports inflation through the world prices of raw materials and exports it through the prices of its manufactures but does not take the prices of exports as given.

Table 4 presents the estimates for the case where the domestic demand variables have been added to the original set of equations estimated in Table 3. Here again, the best results are given by the assumption (equation 4.3) that Japan takes the prices of its raw materials as given by world prices. Equation 4.3 has the highest R^2 as well as the correct signs for each of its coefficients. The surprising result here is that while government expenditures have a positive significant coefficient, the money supply has an insignificant one. This may be due to the relatively stable growth rate of the money supply furnished by the Japanese monetary authorities after 1963 [(Friedman (1970)]. Our estimates contradict the contention of some Japanese economists [(for example, Komiya and Suzuki (1977); Arayasu, Kanishi and Ohira (1978)] that it was the excessive supply of money that caused the inflation in Japan.

Equation 4.1, for Japan as a price setter with respect to exports, has the next highest R^2 at 0.87. Equation 4.2, for Japan as a price taker, again does the worst of the three as-

TABLE 4.

Case 1 — *Price Setter with respect to exports*

Dependent variable	Constant	$(\dot{M}_2)_t$	$(\dot{G})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$		R^2	DW	
$\dot{P}_d$	−1.30	−0.25	0.66	0.36				
	(2.29)	(0.09)	(0.08)	(0.11)	0.87	1.90		(4.1)

Case 2 — *Price Taker with respect to exports*

Dependent cariable	Constant	$(\dot{P}_{mw}+\dot{\rho})_t$	$(\dot{M}_2)_{t-1}$	$(\dot{G})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	R^2	DW	
$\dot{P}_d$	−4.01	0.04	−0.08	0.63	0.47			
	(2.44)	(0.14)	(0.21)	(0.21)	(0.14)	0.83	1.37	(4.2)

Case 3 — *Price Taker with respect to imported industrial raw matetials*

Dependent variable	Constant	$(\dot{P}^J{}_{rw})_t$	$(\dot{M}_1)_{t-1}$	$(\dot{G})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	R^2	DW	
$\dot{P}_d$	−1.23	0.07	0.02	0.36	0.36			
	(1.78)	(0.02)	(0.05)	(0.13)	(0.10)	0.91	1.24	(4.3)

Case 4

Dependent variable	Constant	$(\dot{P}_{mw}+\dot{\rho})_t$	$(\dot{P}^J{}_{rw})_t$	$(\dot{M}_2)_{t-1}$	$(\dot{G})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	R^2	DW	
$\dot{P}_d$	−0.56	−0.15	0.09	−0.13	0.49	0.39	0.93	1.77	
	(1.96)	(0.10)	(0.03)	(0.15)	(0.14)	(0.10)			(4.4)

The parenthesis below each coefficient indicates its standard error.

sumptions. Further, its price variable, $(\dot{P}_{mw}+\dot{\rho})$, has an insignificant coefficient, while the corresponding coefficients in the other two cases in this table are both significant. There seems, then, to be little justification for assuming that Japan is a price taker for its exports or its manufactured goods sector. Its estimated contribution in the standard Scandinavian version, equation 3.2 in table 3, was in fact due to the exclusion of the domestic demand variables which, in the case of a large economy such as Japan's, should appropriately be included as independent variables in the estimating equation. Including these demand variables, as in equation 4.2, makes the estimated contribution of $(\dot{P}_{mw}+\dot{\rho})$ insignificant.

The monetary variable, in equations 4.2 and 4.3, has insignificant coefficients,[3] while fiscal expenditures have significant coefficients. Both these equations include a price variable, which is $(\dot{P}_{mw}+\dot{\rho})$ in equation 4.2 and $\dot{P}^J{}_{rw}$ in equation 4.3. However, equation 4.1, without a price variable, has a significant coefficient of the money supply variable. We conclude, therefore, that as long as the models allow for a price variable such as the ones included in our equations, as well as government expenditures, the money supply will not exert an independent and separate influence. Its role, then, may be as an endogenous variable, accomodating the Japanese price level to the appropriate world one. Comparing equations 4.2 and 4.3, 4.2 includes exchange rate adjustments while 4.3 does not explicitly show them. However, $P^J{}_{rw}$ in equation 4.3 implicitly includes exchange rate variations since it is the price in yen of the imported raw materials. The influence of the monetary growth rate, in so far as it might not be accomodative to the world price level, could be reflected in the exchange rate variations and through these in the domestic price level, as the monetarists have argued for open economies. Government expenditures, however, do seem to have an influence which is sufficiently independent of exchange rate adjustments to yield significant coefficients. These findings are confirmed by equation (4.4).

Table 5 shows the two stage least squares results when Japan is a price taker with respect to its exports or to its imports.[4] The other case in Tables 3 and 4, where Japan is a price setter, does not have an appropriate equation for estimation here. Our earlier estimates

TABLE 5. PRICE TAKER WITH RESPECT TO EXPORTS AND IMPORTS

Dependent variable	Constant	$(\dot{M}_w)_{t-1}$	$(\dot{M}_1)_{t-1}$	DV	R^2	DW	
$(\dot{P}_{mw})_t$	−1.24	0.46	0.07	7.70	0.39	1.94	
	(4.57)	(0.32)	(0.18)	(3.41)			(5.1)
Dependent variable	Constant	$(\dot{M}_w)_{t-1}$	$(\dot{M}_1)_{t-1}$	DV	R^2	DW	
$(\dot{P}^J{}_{rw})_t$	−23.51	2.47	0.34	29.01	0.39	2.02	
	(19.48)	(1.40)	(0.81)	(14.55)			(5.2)
Dependent variable	Constant	$(\dot{P}_{mw}+\dot{\rho})_t$	$(\dot{P}^J{}_{rw})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	R^2	DW	
$\dot{P}_d$	4.82	0.08	0.13	0.26	0.48	1.56	
	(0.96)	(0.15)	(0.06)	(0.22)			(5.3)

DV is a dummy variable for the increase in the price of petroleum in 1974.
The parenthesis below each coefficient indicates its standard error.

[3] The monetary variable is M_2 in equations 4.1 and 4.2, while being M_1 in 4.3, since we have chosen to report our preferred estimates of each equation.

[4] Table 5, just as Tables 3, 4 and 6, show our preferred estimates. In equations (5.1) and (5.2), the estimates using, for Japan, M_2 instead of M_1 did not perform at least as well as those using M_1. The Cochrane-Orcutt correction for autocorrelation did not yield any significant improvement in terms of R^2 and the DW statistics over the reported equations.

had strongly favored the assumption that Japan is a price taker with respect to its imports rather than with respect to its exports. This is also borne out by the estimates reported in Table 5.

Both of the first-stage equations (5.1) and (5.2) do poorly in terms of R^2 which is identical at 0.39. In equation (5.1) neither of the monetary variables—that is, the world money supply (excluding Japan's) and Japan's money supply—are significant. Hence, the world money supply, as defined here, does poorly in explaining the world price level. The dummy variable for the increase in petroleum prices in 1974 is significant in both equations. In equation (5.2), the coefficient of the world money supply is just significant at the 95% level of significance. Equation (5.3) presents the second-stage least squares estimates. Here the only significant coefficients are those of $\hat{\dot{P}}^J_{rw}$ and DV. Table 5 thus supports the conclusion derived from Tables 3 and 4 that Japan imports inflation from the prices of its imported raw materials rather than from the general world price level.

Table 6 goes further than Table 5 by including the domestic demand variables among the regressors. The conclusions derived from the estimates in the previous tables are again upheld. The hypothesis that Japan is a price taker with respect to its imports rather than with respect to its exports is again corroborated.

In equation 6.1, the coefficients of $\dot{M}_2$, although significant, is negative, against the prediction of the theory. Further, the coefficient of $(\dot{P}_{mw}+\dot{\rho})$ is not significant at the 95 percent level of confidence and has the wrong sign. To compare, the coefficient of $\dot{G}$ has the right sign and is significant. In equation (6.2), all the regressors, except for $\dot{M}_2$, have the right signs of the coefficients and these are significant. But the coefficient of $\dot{M}_2$ is not significant at the 95 percent level of confidence and has a negative sign. R^2 for both (6.1) and (6.2) are high ones, at 0.88 and 0.89 respectively.

Equation (6.3) brings together in two-stage least squares each of the independent variables considered in this paper. Both the values of R^2 (=0.90) and the DW statistic (=1.91) are quite satisfactory. $\hat{\dot{P}}^J_{rw}$, $\alpha_s(\dot{q}_e-\dot{q}_s)$ and $\dot{G}$ have significant coefficients. However, the coefficients of $(\hat{\dot{P}}_{mw}+\dot{\rho})$ and $\dot{M}$ are again not significant.

The estimates presented in Table 6 thus corroborate the conclusions derived from the estimates presented in Tables 3, 4, and 5. The basic conclusion derived from Table 3, with the initial estimating equations, was that Japan is a price taker with respect to its imports of raw materials and a price setter with respect to the prices of its exports. This conclusion has proved to very robust and has held through the modifications of the estimating equa-

TABLE 6.

Dependent variable	Constant	$(\dot{P}_{mw}+\dot{\rho})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	$(\dot{M}_2)_t$	$(\dot{G})_t$	R^2	DW	
$\dot{P}_d$	−0.83	−0.04	0.35	−0.28	0.62	0.88	2.14	
	(2.58)	(0.09)	(0.11)	(0.12)	(0.09)			(6.1)

Dependent variable	Constant	$(\dot{P}^J_{rw})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	$(\dot{M}_2)_{t-1}$	$(\dot{G}_t)$	R^2	DW	
$\dot{P}_d$	−3.88	0.07	0.40	−0.05	0.58	0.89	1.82	
	(1.94)	(0.03)	(0.10)	(0.10)	(0.09)			(6.2)

Dependent variable	Constant	$(\hat{\dot{P}}_{mw}+\dot{\rho})_t$	$(\hat{\dot{P}}^J_{rw})_t$	$\alpha_s(\dot{q}_e-\dot{q}_s)_t$	$(\dot{M}_2)_{t-1}$	$(\dot{G})_t$	R^2	DW	
$\dot{P}_d$	−3.12	−0.06	0.08	0.43	−0.11	0.06	0.90	1.91	
	(2.29)	(0.10)	(0.03)	(0.12)	(0.14)	(0.10)			(6.3)

The parenthesis below each coefficient indicates its standard error.

tions in Tables 4, 5 and 6. It is also consistent with our *a priori* reasoning on the nature of price determination in the Japanese economy.

Another conclusion derived from the estimates presented in Table 4 was that while the growth rate of the money supply is insignificant as an independent determinant of the domestic rate of inflation, the rate of growth of government expenditures has a significant effect on this rate of inflation. The former also tends to have an incorrect (negative) sign, while the latter always had the correct (positive) sign. This conclusion also proved to be robust and remained intact in Table 6.[5] This conclusion tends to upset some common beliefs about the effect of monetary growth on inflation, but could be justified, as discussed earlier in this paper.

Conclusion

The Scandinavian model of inflation was formulated for small economies. Its extension to the case of Japan, a large economy in our terminology, requires a careful and selective modification of this model. Our arguments indicated that the Japanese economy is a special case of a large economy in that virtually all of its imports are of food and raw materials and virtually all of its exports are of manufactured goods. The latter are differentiated from products of other countries and are often sold in oligopolistic markets. The most appropriate hypothesis in such a setting is that Japan is a price taker for raw materials and a price setter for exports of manufactured goods. This is consistent with a full-cost pricing hypothesis and its more general fixprice form.

The empirical estimates bear out this hypothesis. These estimates show that Japan takes its raw material prices as given and sets the prices of its manufactured goods exports. The world money supply proves to be a better explanatory variable of world raw material prices than of the world prices of manufactured goods. This suggests in a world context the hypothesis that manufactured goods prices should be taken as being set by the producers.

Our estimates also show that the domestic aggregate demand is a significant determinant of the domestic prices. We used both the domestic money supply and government expenditures as explanatory variables. Of these, only government expenditures had significant coefficients. This was consistently so in each of the estimated equations. Money supply had an insignificant coefficient in every equation except one. The exceptional case was that of the price setter hypothesis where the estimating equation—equation (4.1)—did not include an independent price variable. These variables in our other equations were $(\dot{P}_{mw}+\dot{\rho})$ and $(\dot{P}_{rw}+\dot{\rho})$, which include exchange rate changes. It is quite likely, then, that money supply variations play an endogenous role, adjusting to exchange rate changes and fiscal expenditures, or that whatever independent influence the money supply might have had on domestic prices is captured by exchange rate changes, for given world rates of inflation. However, fiscal expenditures maintain an independent influence on prices, whether

[5] In one of the variations of the equations reported in Tables 5 and 6, the Japanese money supply M was omitted from equations (5.1) and (5.2). The estimated values, $\hat{p}_{mw}$ and $\hat{p}_{rw}$, were then used in Table 6. This procedure excludes any direct impact of the Japanese money supply on the world prices and could have increased its impact on the domestic price level in equations (6.1), (6.2), and (6.3). However, its coefficient in re-estimates of these equations still did not become significant.

or not there is a price variable in the estimating equation.

The estimates thus clearly favor the hypothesis that prices of manufactured goods' exports should be taken as being set on the basis of raw material prices and domestic demand variables. This is a considerable deviation from the original Scandinavian model and its notion of a single world price for the exposed sector's products. The findings do substantiate the notion of a single world price for raw materials. However, Japan is able to influence these to some extent. The estimates substantiate the significance of productivity differences between the exposed and the sheltered sectors in explaining the domestic rate of inflation in Japan.

Although we have used the Scandinavian Model in our study of the Japanese economy, this procedure may not be fully justified without a further study comparing the different economic structures of these two different economies. This may necessitate some modification of the Scandinavian Model itself. However, we feel that this is beyond the scope of the present paper.[6]

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[6] This point was raised by the referee for this journal.