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THE INFLATIONARY PROCESS IN OPEN ECONOMIES

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1. Introduction

While the concept of "imported inflation" and its relevance for open economies have received considerable attention in the policy-oriented literature, the theoretical underpinnings of this phenomenon have not been constructed as carefully as might be desirable in view of the controversial nature of the subject.[1] The inflationary process can be transmitted to a country by developments in international capital and money markets or through the interaction of goods markets in one country with those of the rest of the world.[2] The debate concerning the former transmission mechanism involves the difficulties in dichotomizing the balance of payments and the domestic money supply through sterilization of foreign exchange gains or losses.[3] In this paper, major emphasis will be given to the transmission of the inflationary process through the goods and services markets. Primarily, we are interested in investigating the determinants of the rate of inflation for a small country which, because of its size, is forced to accept certain conditions imposed by the external environment.

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1. For a recent survey of the literature see Logue (1969).

2. A similar distinction is made by Lutz and Sohmen (1965).

3. In a recent paper, Johnson (1971) implies that balance of payments theory should proceed on the assumption that sterilization does not take place.

II. The Theoretical Model

The essential focus of such an investigation is the distinction between tradable and non-tradable commodities. The framework for such an analysis is provided by McKinnon in his attempt to define optimum currency areas (McKinnon, 1963) and later, in his discussion of gliding parities in foreign exchange markets (McKinnon, 1971). A similar distinction based on sheltered and unsheltered industries served as a model for the explanation of inflationary pressures in Germany.[1]

II.1 The Assumptions

Let us first consider the outline of the model. Assume that the price of tradables is determined in world markets. That is to say, the country is sufficiently small so that a change in its supply of exportables or its demand for importables is too small in relation to world supply and demand to affect the price of these goods. Thus the relative price of exportables and importables is fixed and it is possible to think of only one price of tradable commodities. The price of non-tradables, on the other hand, is determined in the domestic economy and hence the relative price of tradables and non-tradables can be altered. Furthermore, assume initially that a fixed exchange rate exists so

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1. See for example (Council of Experts, 1967).

that it is a matter of indifference whether prices are measured in domestic or foreign currencies. This restriction will be dropped at a later stage. Finally, it is assumed that the production of tradables and non-tradables uses only primary factors to avoid the difficulties encountered when tradables are inputs for non-tradables and vice versa.

II.2 The Analysis

In this two-sector economy, it is easy to see that the rate of change of total output is a weighted average of the growth rate of prices in the tradable and non-tradable sectors. Thus we have the identity

$$g_p = \beta g_{p_t} + (1-\beta) g_{p_n} , \qquad (1)$$

where g represents the growth rate of the subscripted variable, p, p_t and p_n are the price indices of total output, tradables and non-tradables, respectively and $\beta = Q_t/Q$, the proportion of tradable output to total output.

The first question is whether the economy can be in equilibrium with differential rates of inflation in the two sectors. Empirical evidence shows that for most countries at most times, the price of tradables rises less than the price of non-tradables. In Table I it can be seen that for all 15 countries, the export price deflator, which is taken as a proxy for the price index of tradables, rose by a smaller amount than the GNP deflator which includes both tradables

TABLE I

Average Annual Rate of Change of Implicit Price Deflators for GNP and Exports of Goods and Services, 1955-68

Country	Average Annual Increase in GNP Deflator (percentages)	Export Deflator
Austria	3.4%	1.4%
Belgium	2.7	0.9
Canada	2.7	1.5
Denmark	4.7	1.2
Finland	5.6	4.3
France	4.8	2.7
Germany	2.9	0.7
Italy	3.3	-0.7
Japan	4.2	0.2
Netherlands	4.1	0.3
Norway	3.6	0.2
Sweden	3.9	1.1
Switzerland	3.6	2.2
United Kingdom	3.4	2.0
United States	2.3	1.3

Source: OECD, National Accounts of OECD Countries, 1950-68.

and non-tradables.[1]

The implication of this evidence is that the relative price p_t/p_n is falling. Hence one would expect inter-sector substitutions in both production and consumption. On the production side the economy will move along the production possibility curve shifting factors of production from tradables to non-tradables. At the same time on the consumption side as tradables become less expensive relative to non-tradables, consumers will reallocate their budgets towards increased consumption of tradables. Thus a stable equilibrium would appear to be possible only where the relative price p_t/p_n is constant which requires that, in absolute prices, $g_{p_t} = g_{p_n}$. Yet this is not an observable fact. What is observed is that while $g_{p_t} < g_{p_n}$, the proportion of total output devoted to tradables and non-tradables remains relatively constant. Table 2 shows the proportion of GDP made up of tradables in 1955-56 and 1967-68. While the classification of industries into the two sectors is somewhat arbitrary, expanding or reducing the scope of the tradable sector made little difference to the calculations. Of the 12 countries for which data are available, the relative size of the tradable sector changed by one percent or less for five countries. None of the countries showed a change

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1. McKinnon (1971) considers the wholesale price index to be the best available proxy for the price index of tradables.

TABLE 2

The Production of Tradables as a Proportion of Gross Domestic Product

Country	Tradables[1] as a Proportion of GDP 1955-56 (percentages)	1967-68
Austria	53.2%	50.9%
Belgium	41.4[2]	42.8
Canada	39.3	41.3
Denmark	50.6	47.3
Finland	48.4	47.5
France	47.7	47.6
Germany	49.3	50.3[3]
Italy	43.1	46.2
Norway	42.7	38.3
Sweden	37.1	40.2[3]
United Kingdom	43.4	43.7
United States	37.6	36.9

Source: OECD, National Accounts of OECD Countries, 1950-68.

[1]Tradables are defined as (1) Agriculture, forestry and fishing; (2) Mining and quarrying; (3) Manufacturing; and (4) Electricity, gas and water.

[2]Data for 1955 not available.

[3]Data for 1968 not available.

greater than three percent in either direction.

Thus in order to treat β as a constant in equation (1) it is necessary to show under what conditions a stable equilibrium can be reached with the price of tradables and non-tradables advancing at different rates. Let us first look at the supply side. In the tradable sector, price is given by external conditions. But p_t together with the marginal productivity of labour in the tradable sector, μ_t, determine the money wage rate. Assuming perfect labour mobility between the two sectors, money wages must be equal (or less stringently, the growth rates of wages in the two sectors are equal). In the non-tradable sector, the money wage rate together with the marginal productivity of labour in that sector determine the price of non-tradables. Thus in terms of growth rates, we have

$$g_w = g_{\mu t} + g_{pt} \qquad (2)$$

and

$$g_{p_n} = g_w - g_{\mu n} \ , \qquad (3)$$

where w represents the money wage rate, μ_t and μ_n are the marginal productivity of labour in the tradable and non-tradable sector respectively. Thus

$$g_{p_n} = g_{pt} + g_{\mu t} - g_{\mu n} \ . \qquad (4)$$

Again, empirical evidence seems to indicate that labour productivity increases faster in the tradable sector than in

the non-tradable sector. Unfortunately the data in Table 3 are not precise measures of g_{μ_t} and g_{μ_n}. In the first place the figures represent changes in average productivity rather than marginal productivity of labour. In the second place, output per employee is an inferior measure to output per man-hour. Using the former data has a tendency to underestimate the growth in productivity in the tradable sector and overestimate the increase in productivity in the non-tradable sector since the secular decline in hours worked per week appears to be greater in the former sector. But since a break-down by industry on hours worked was not available for most of the countries on a comparable basis no adjustments could be made. Nevertheless the evidence appears to favour the conclusion that $g_{\mu_t} > g_{\mu_n}$ which, according to equation (4) is consistent with $g_{p_n} > g_{p_t}$ and there will be no incentive for productive resources to move from one sector to the other.

On the demand side, the incentive to substitute tradables for non-tradables in the consumer's budget because of a declining p_t/p_n can be offset by a higher income elasticity for non-tradables than for tradables. The demand functions for the two commodities can be written as

$$Q_t = Q_t(\pi, Y, Y^*) \tag{5}$$

and

$$Q_n = Q_n(\pi, Y), \tag{6}$$

TABLE 3

Increase in Output per Employee, Tradable and Non-tradable Sector

Country	Period	Increase in Output per employee in Tradable Sector (percentages)	Non-tradable Sector
Austria	1955-68	4.6%[1]	2.8%[1]
Belgium	1956-68	4.8	1.6
Canada	1955-68	4.6	-0.1
France	1955-68	6.6	3.2
Germany	1957-68	6.6	3.2
Italy	1955-68	7.8	2.9
Norway	1955-68	5.2	3.3
Sweden	1961-67	6.0	1.0
United Kingdom	1955-68	3.6	1.0
United States	1955-68	3.6	1.4

Sources: OECD, National Accounts of OECD Countries, 1950-68; OECD, Manpower Statistics, 1954-1964; OECD, Labour Force Statistics, 1958-1969; U.S. Department of Commerce, Business Statistics, 1969.

[1] For Austria, data on total employment by sector were not available and hence figures for wage earners and salaried employees were used. This is likely to introduce a bias in the agricultural sector where a large fraction of total employment is usually composed of self-employed and unpaid family workers.

where $\pi = p_t/p_n$, Y and Y* are domestic and foreign income, respectively. In terms of growth rates equations (5) and (6) can be rewritten as

$$g_{Q_t} = \eta_{Q_t,\pi} g_\pi + \eta_{Q_t,Y} g_Y + \eta_{Q_t,Y^*} g_{Y^*} \qquad (7)$$

and

$$g_{Q_n} = \eta_{Q_n,\pi} g_\pi + \eta_{Q_n,Y} g_Y \qquad (8)$$

where $\eta_{Q_t,\pi}$ is the elasticity of Q_t with respect to π, etc. If in fact substitution does not take place (without denying the <u>possibility</u> of substitution) then $g_{Q_t} = g_{Q_n}$. Imposing this condition on equations (7) and (8) and from $g_\pi = g_{p_t} - g_{p_n}$, we can write

$$(g_{p_t} - g_{p_n})(\eta_{Q_t,\pi} - \eta_{Q_n,\pi}) + g_Y(\eta_{Q_t,Y} - \eta_{Q_n,Y}) + g_{Y^*}\eta_{Q_t,Y^*} = 0 \qquad (9)$$

Assuming all growth rates to be positive with $g_{p_n} > g_{p_t}$, $\eta_{Q_t,\pi} < 0$, $\eta_{Q_n,\pi} > 0$, and all income elasticities to be positive, then for equation (9) to hold, it is necessary (but not sufficient) that $\eta_{Q_n,Y} > \eta_{Q_t,Y}$. An interpretation of Houthakker's evidence for a number of countries seems to lead to that conclusion. (Houthakker, 1957).

Substituting (4) into (1), we obtain

$$g_p = g_{p_t} + (1-\beta)(g_{\mu_t} - g_{\mu_n}). \qquad (10)$$

Given the conditions analysed above, it appears appropriate

to treat β in equation (10) as a constant. In addition, for a small country, g_{p_t} is exogenous. Thus the overall rate of inflation is determined by the differential rate of growth of labour productivity in the two sectors. It is interesting to note that the higher the rate of growth of productivity in the tradable sector, the higher is the rate of inflation. This appears to be contrary to the notion that increases in productivity tend to hold down the rate of inflation. But this is not inconsistent with equation (10) which allows for the money wage rate to be determined in the sector with the higher growth rate in productivity.[1]

The rate of growth of the price of tradables, g_{p_t}, is only exogenous to the small country if it maintains a fixed exchange rate. If the exchange rate is allowed to float or is moved up or down, then we must distinguish between the price of tradables in the domestic currency and in a numeraire currency (such as the dollar). Under these conditions, the price of tradables in the numeraire currency is given to the country but the price of tradables in the domestic currency depends on the exchange rate. Thus

$$g_{p_t} = g_{p_t^*} + g_r \ , \qquad (11)$$

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1. Another interesting point is the fact that no matter how small the tradable sector, a given increase in g_{p_t} increases the overall rate of inflation by the same amount. This occurs because an increase in g_{p_t} increases money wages in both sectors which in turn leads to increases in g_{p_n}.

where $g_{p_t}^*$ is the growth rate of the price of tradables in the numeraire currency and g_r is the rate of change of the exchange rate ($g_r > 0$ implies a devaluation of the domestic currency in terms of the numeraire currency).

Substituting (11) into (10) yields

$$g_p = g_{p_t}^* + g_r + (1-\beta)(g_{\mu_t} - g_{\mu_n}). \qquad (12)$$

Now, it can be seen that devaluations tend to increase the rate of inflation and in fact there is a one-to-one relationship between the two variables.

Using equation (12), one can determine the optimum gliding parity of exchange rates (McKinnon, 1971) in order to obtain $g_p = 0$, namely

$$g_r = -g_{p_t}^* - (1-\beta)(g_{\mu_t} - g_{\mu_n}). \qquad (13)$$

Assuming for simplicity that $g_{p_t}^* = 0$, countries with a large differential in the growth of labour productivity between the tradable and non-tradable sector should appreciate their currencies over time ($g_r < 0$ implies a gliding appreciation). This conclusion differs somewhat from McKinnon's, who suggests, "...that countries with fast growth of productivity and only average tolerance for increases in the [Consumer Price Index] should appreciate their currency steadily under a gliding parity". (McKinnon, 1971, p. 24) In McKinnon's argument no explicit distinction is made between productivity in the tradable sector and in the non-tradable sector.

II.3 International Comparisons of the Rate of Inflation

Since $g_{p_t}^*$, the rate of change of the price of tradables in the numeraire currency is fixed for any small country, it serves to link all countries together. With this fact in mind it is possible to see how the overall rate of inflation in one country compares to the experience of the rest of the world.

Similar to equation (I) we can write

$$G_p = \tilde{\beta} g_{p_t}^* + (1-\tilde{\beta}) G_{p_n}, \tag{14}$$

where G is the growth rate of the subscripted variable for the world as a whole and $\tilde{\beta}$ is a weighted average of the β's. This can be translated into an equation analogous to (10) so that,

$$G_p = g_{p_t}^* + (1-\tilde{\beta})(G_{\mu_t} - G_{\mu_n}). \tag{15}$$

Rearranging equation (15) and substituting for $g_{p_t}^*$ in equation (12) results in

$$g_p = G_p - (1-\tilde{\beta})(G_{\mu_t} - G_{\mu_n}) + g_r + (1-\beta)(g_{\mu_t} - g_{\mu_n}). \tag{16}$$

For the average country, defined as $G_{\mu_t} - G_{\mu_n} = g_{\mu_t} - g_{\mu_n}$ and $\tilde{\beta}=\beta$, the rate of inflation will also be "average" as long as the exchange rate is fixed. For countries, where the differential in productivity growth is larger than the average, the rate of inflation will be higher and vice versa. Because of divergent trends in productivity, some countries will have

a higher rate of inflation than the average (i.e., $g_p > G_p$) while others will have a lower rate (i.e., $g_p < G_p$). To the extent that the authorities consider this undesirable, they can use the exchange rate to make the appropriate adjustment. Gliding appreciation would be appropriate for the former set of countries and gliding depreciation is the required reaction in the latter set of countries. Additionally, as can be seen from equation (16) the relation between $\bar{\beta}$ and β contributes to the determination of the rate of inflation for one country in relation to the world average.

III. Inflation and Money

So far nothing has been said about the monetary mechanism involved in the inflationary process. There are two important questions that have to be answered in this regard: (1) Is money the cause of inflation? and (2) Is money necessary for inflation to take place?

Let us deal with the first question. An inspection of equation (12) would indicate that there is little room for a monetary influence on the rate of inflation: $g_{p_t}^*$ is determined externally, g_r is a policy-determined variable in a fixed exchange rate or gliding system and β, g_{μ_t} and g_{μ_n} are mostly "real" variables. Thus an increase in the money supply is unlikely to increase the rate of inflation unless indirectly through the other variables. This conclusion is corroborated by Mundell's analysis of policy effec-

tiveness under different exchange rate regimes in small countries facing perfect capital mobility (Mundell, 1963). A small country not only takes the price of tradables as given but is assumed to be unable to maintain an interest rate different from that prevailing in world money markets. Under these conditions and assuming a fixed exchange rate, open-market purchases of securities by the central bank do not lead to an expansion of the money supply since the central bank will end up trading domestic assets for foreign assets. Hence it is impossible to say that an increase in the money supply will affect the rate of inflation since the money supply cannot be increased.

On the other hand under flexible exchange rates, Mundell found that monetary policy was effective. In this case, open-market purchases lead to an expansion of the money supply which puts downward pressure on the domestic interest rate. But the interest rate will move back to the world level through an outflow of capital which results in a depreciation of the exchange rate and thus directly increases the rate of inflation during the adjustment period. Hence it may be concluded that under a fixed exchange rate system, the monetary mechanism has no direct influence on the rate of inflation while under a flexible rate, a change in the money supply affects the rate of inflation through adjustments in the exchange rate.

The second question may be answered in a similar

fashion. First, let us consider a regime of freed exchange rates. Now assume that the money supply does not grow at a sufficient pace to allow for the rate of inflation as indicated in equation (10). It is also assumed that velocity remains constant. Thus g_{p_t} will be less than the world level and the country's exportables will be more attractive to the rest of the world, its importables more attractive to its own residents and its balance of payments will improve.[1] The resulting increase in holdings of foreign exchange provides the necessary expansion of the money supply. Equilibrium will again be established when $g_{p_t} = g_{p_t^*}$. Thus the required amount of money will always be available.

Next consider the case of flexible exchange rates. Again assume that the money supply grows at too slow a pace. Now in equation (12) $\hat{g}_{p_t^*} < g_{p_t^*}$ where $\hat{g}_{p_t^*}$ is the <u>actual</u> rate of growth of prices measured in the numeraire currency for the particular country during the disequilibrium period. This leads to a potential surplus in the balance of payments which is removed by an appreciation of the currency. Thus during the adjustment, the rate of inflation is reduced. Thus under a flexible rate system, the rate of inflation adjusts to the money supply. In that sense a small country has some power to influence the rate of inflation insofar as it is willing to see a continual appreciation of its exchange rate. In the past few years, Canada and Germany have allowed their exchange rate to appreciate, partly to stem the infla-

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1. A small country faces infinitely elastic demand for its exportables and importables.

tionary pressures emanating from abroad.

IV. Empirical Evidence

It would have been of some interest to test the predictive power of equations (10), (12) or (16), but unfortunately the data are so meagre as to make any tests unreliable. First of all, determining the price of tradables involves, at the present time, a number of arbitrary decisions as to whether a given commodity or service is a tradable or non-tradable. Secondly, the growth rates of labour productivity cited in Table 3 are suspect for reasons mentioned earlier. (Data compiled by the International Labour Organization are not much better suited for this purpose.) Thus it would appear that it is only prudent to hold in abeyance any empirical tests of the propositions in this paper until the concepts of tradables and non-tradables find their way into data-collection agencies around the world.

V. Conclusion

The small country is a theoretical fiction which has no counterpart in real life. It represents an assumption at one extreme end of the spectrum. Nevertheless it allows the analysis to proceed at a level of rigorousness which would be unattainable if repercussions from one country on the rest of the world were taken into account. For this reason, the conclusions derived in this paper should not be

interpreted as policy prescriptions. In addition, no claim is made that this paper presents a complete theory of inflation. The rate of change of the world price of tradables, a crucial element in the analysis, has not been investigated.

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