SWEDEN'S CHOICE OF A CURRENCY REGIME: ITS EFFECTS ON THE TERMS OF TRADE AND THE UNEMPLOYMENT-INFLATION TRADEOFF

by

WILLIAM ABDOLLAH DELLALFAR

B.A., SWARTHMORE COLLEGE

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Signature Redacted

Signature of Author..
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Signature Redacted

Certified by...
Thesis Supervisor

Signature Redacted

Accepted by..
Chairman, Department Committee

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ABSTRACT

This thesis examines the decision of Sweden to join the EEC joint currency float in 1973 even though it was and is not a member of the Common Market. The thesis seeks to apply the theory of optimum currency areas to determine the benefits and costs of this decision and its impact on the Swedish economy.

A theoretical and empirical analysis of the behavior of Sweden's terms of trade shows that the decision to tie to a larger currency bloc could and did reduce fluctuations in the terms of trade induced by exogenous price and exchange rate movements abroad. The decision to join the joint float also reduces pressure on the exchange rate by reducing short-term capital flows through leads and lags in the balance of payments.

The decision to join the joint float means, however, that the Swedish price level cannot vary systematically from the bloc price level. An examination of the Keynesian mechanism for the transmission of inflation under fixed exchange rates reveals that the transmission is fairly rapid and short-run discrepancies between the price levels do not exist very long before inducing either changes in the price levels or changes in the exchange rate. The constraint on the price level in Sweden also implies a constraint on the Swedish government's ability to manipulate the unemployment rate, even in the short run. An examination of the inflation-unemployment tradeoff in Sweden reveals that the long-run Phillips Curve is vertical and the short-run curve is fairly flat. The analysis also reveals that expectations adapt fairly rapidly to changes in the actual rate of inflation. The decision to join the joint float implies a constraint on the level or domestic prices and wages at the long-run rate of unemployment.

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CHAPTER 1

INTRODUCTION

Introduction

Since the advent of floating exchange rates after the collapse of the Smithsonian Agreements in early 1973, several European countries have maintained parities between their exchange rates within a 4.5 percent margin. (Internal parities were realiged in 1976.) These currencies float against the currencies of countries not in the joint float. While the joint float was originally meant to include all EEC countries, this is not the case at present. The nucleus of the joint float is composed of EEC countries, but Sweden and Norway--who are not members of the European Community--participate in the joint float. The rules of intervention are slightly different for EEC members as opposed to nonmembers. While EEC members can settle any currency obligations that arise due to intervention in the currency markets to maintain parities in a mixture of member country currencies at the creditor's exchange rate, nonmembers are constrained to using U. S. dollars valued at the creditor's exchange rate to settle such obligations. Presumably nonmembers do not benefit from any of the political benefits to be derived from maintaining a common currency area among members of customs union. What are the benefits for a small country such as Sweden in joining the joint float? What are the disadvantages? What does this decision reveal about Swedish policy makers' tradeoffs among various constraints and benefits?

Chapter 2 is a theoretical analysis of the policy choices open to a small country facing two large trading partners whose exchange rates are floating against each other. As far as the small home country is concerned, it cannot affect the common rate between these two blocs. We assume that each country produces one good and the price of this commodity is constant in domestic currency units. This means that the relative exchange rates are also the relative prices and the terms of trade. We also assume that domestic monetary policy is used to maintain a constant price for the home good or that excess capacity exits. Changes in relative prices do not affect real domestic aggregate expenditure. Furthermore, we assume that the exchange rate between the two "large" countries fluctuates randomly around its mean and is independent of the policies pursued by the "small" home country.

Three choices are open to the home country in this situation. It can allow its exchange rate to float. The exchange will then be determined in the market for foreign exchange. Since we assume that there are no capital flows in the model--or that capital flows are constant at some level--the exchange rate is such that there is equilibrium in the trade account and the value of exports equals the value of imports. (We can speak of the exchange rate for the home country since the exchange rate between the two other countries is given exogenously.) Since the other exchange rate is random, the home country rate also varies. In this case, however, domestic income in the home country is constant. Income is determined by the Keynesian equilibrium condition that income equals aggregate domestic expenditure plus the balance-of-trade surplus. Since the balance of trade is identically zero by virtue of the floating rate and aggregate expenditure is not a function of relative prices--no Laursen-Metzler effect--domestic income is unaffected by exchange rate fluctuations. The random variation in the exchange rate between the two large countries is reflected in the fluctuation of relative prices in the home country. The other options open to the home country are to tie its currency to one or the other large country. In this case, prices will vary as the random changes in the exchange rate take place. Domestic income in the home country will also fluctuate as the trade account in the home country need not clear.

This chapter indicates that the home country will want to tie its currency to that of its major trading partner. In this case, the variability of prices will decrease from that of the pure floating case. This decrease in variability is compensated for by an increase in the variability of domestic income which is zero in the floating case. If the policy authorities have a loss function that includes the variability of both income and prices, an intermediate situation where they have a little of each may allow them to increase their welfare. The greatest reduction in the variance of prices is achieved by tying to the currency of the dominant trading partner although tying to the minor partner may still reduce price fluctuations.

Chapter 3 is an empirical analysis of the effects of foreign exchange rate changes on the Swedish terms of trade. A small country has to take the prices of most traded commodities as given. The prices may be determined in markets where the home country does not even trade. We examine the effects of exchange rate, changes among several countries after adjusting them for relative rates of inflation on the Swedish terms of trade. If exchange rates exactly offset the differences in national rates of inflation, there would be no terms-of-trade effect from exchange rate changes. The crucial assumption behind this analysis is that the price of a commodity is determined by domestic supply and demand in one country and that other countries are very small participants in this market who cannot affect this domestic price. Insofar as the price of a particular commodity is determined by supply and demand in several countries, relative growth rates and dissimilar demand function across countries will be important in determining the effect of an exchange rate change on the domestic currency price of a particular commodity.

Assuming that commodity prices are determined in a national market, we find that the small country assumption does not hold exactly. A devaluation of the Swedish kronor against all the currencies in the model results in a deterioration of the Swedish terms of trade. Swedish exports are affected by the development of prices in Sweden. This is equivalent to the "Keynesian" small country assumption that a small country cannot affect the price of its imports but has some monopoly power in its export markets. The empirical work also indicates that a country's share in Sweden's trade is not representative of the effect of a change of that country's exchange rate with respect to the rest of the world on Sweden's terms of trade. The main example is the United States. The share of the United States in Swedish trade is around 6 percent, far lower than West Germany which has a share of over 20 percent. It turns out, however, that a change in the exchange rate between the dollar and all other currencies and the Deutsche mark and all other currencies has the same order of magnitude effect on Swedish terms of trade. The share of the United States in Swedish trade is not indicative of the effect of developments in the United States on prices of international goods imported or exported by Sweden. The prime example is petroleum whose price is denominated in dollar terms.

Given the above assumptions, the empirical work rejects the hypothesis that the Swedish terms of trade were constant over the period from 1973 through 1975. In the context of the model used here, this implies that exchange rate changes were not only compensating for relative price changes between countries, but that there was a "random" component to these changes. It is this random fluctuation that the home country seeks to minimize. The results do indicate, however, that exchange rates compensated sufficiently for price changes that the variables constructed by subtracting percentage price changes from percentage changes in the exchange rate are highly collinear among countries. The collinearity problem results in very wide confidence intervals on the estimated coefficients. Using the estimated results, we can construct terms-of-trade indices for Sweden under different assumptions about the country to which it ties its exchange rate. (We assume that there is no margin of fluctuation. The European joint float allows for some fluctuation in parity between member currencies. It is virtually impossible to predict what fluctuation would have occurred if we were to allow a band for such fluctuations.)

For the period from the beginning of 1973 to the end of 1975, tying the Swedish kronor to the pound Sterling would have given the smallest fluctuation in the Swedish terms of trade.

The Deutsche mark tie would have given a larger variance to the terms of trade than the pound tie but less than a dollar tie.

This result indicates that a major shortcoming of the analysis in Chapter 2 is that it ignores trend movements of the exchange rate. During this period, the pound was depreciating and the mark appreciating. The decision to tie the kronor to the Deutsche mark implies that the Swedish authorities prefer the price policy followed by Germany to that followed by the United Kingdom. This decision dominates the decision to stabilize the terms of trade. As Chapter 5 indicates, the decision to tie the exchange rate means that price developments are dictated abroad.

The empirical evidence in Chapter 3 indicates that exchange rate fluctuations do not only offset price fluctuations. Short-term changes in the exchange rates since 1973 have been caused by flows of short-run capital. In Sweden international capital flows are tightly controlled. Short-run capital movements can still occur through leads and lags in payments for commercial trade. Interest differentials or expectations of change of the exchange rate can cause these movements. In this chapter, we study the financial structure of commercial trade. Among the issues analyzed are the scope for short-run capital flows through leads and lags in payments, the magnitude of such movements, and the exposure of Swedish traders to foreign exchange risk. The analysis indicates that the structure of payments permits short-run capital flows through leads and lags of sufficient magnitude to swamp official holdings of foreign exchange. By joining the joint European float, Sweden inhibits short-run capital movements induced by expectations of exchange rate changes between the joint float currencies. (This is strictly true only as long as the possibility of the realignment of rates within the currency bloc is ignored. Since realignment is possible, such short-run movements can occur when traders feel that governments will no longer honor the present margins for currency fluctuation within the bloc.) Furthermore, this currency arrangement reduces the foreign exchange risk faced by traders. (Again, the same caveat applies.) While traders will still be subject to the risk of changes in the exchange rates between bloc countries when disturbances and economic developments between countries make it difficult to maintain the bloc currency fluctuation margins, disturbances outside the bloc will have a much smaller effect on bloc exchange rates. Such rates can only vary within the prescribed margin. Much of Sweden's trade is conducted with the other participants in the joint float. This is the prime consideration in the conclusion that in joining the joint float, the government's currency support inhibits the effect of these short-term capital movements and reduces exchange risk for Swedish traders. Although capital flows are not free, leads and lags can cause movements in the exchange rate.

Chapter 5 discusses the short-run and long-run policy constraints imposed by the decision to join the joint float on the government's freedom to choose an inflation-unemployment mix. In the long-run, under fixed rates, inflation rates will converge across countries. This occurs in both monetarist and Keynesian one-good models. Allowing for non-traded goods does not change this conclusion. In the short run, a country can choose an unemployment-inflation tradeoff different from the world rate of inflation. This is not sustainable in the long run as balance-of-payments surpluses or deficits mount, forcing domestic authorities to expand domestic demand and output to deal with the pressure of increased reserves--this will probably occur automatically as sterilization of foreign exchange earnings is quite difficult in the long run--or to dampen domestic absorption to curtail the loss of exchange reserves. The same arguments imply that a country joining a currency bloc has to have the same long-run rate of inflation as its partners although it may have some short-run flexibility.

Having defined a foreign rate of inflation for Sweden, we examine the relationship between this foreign rate and the domestic rate on a quarterly basis from 1966 on. We find that the domestic rate of inflation moves quite closely with the foreign rate, even in the short run. This conclusion implies that either short-run policy flexibility does not exist or is not used. Short-run policy flexibility may not be used either because domestic authorities accept the foreign rate of inflation or because the costs of having a short-run domestic inflation rate different from the foreign one are quite high. (The costs can be measured in terms of increased unemployment for a lower domestic inflation rate or of foreign exchange losses for a higher domestic rate.)

Empirical work done by others indicates that the short-run Phillips curve in Sweden is quite flat and that increases in foreign prices have a large effect on domestic wages. We estimate a model in which the wage increase is determined by labor market conditions while the unemployment rate is determined by aggregate demand, domestic absorption plus foreign demand. Prices are determined by a constant markup over wage costs. Other empirical work has proceeded on the assumption that the unemployment rate is exogenous. The Keynesian model of the transmission of inflation shows that unemployment rates will adjust as rates of inflation converge across countries. Increases in foreign demand lead to increased output and a falling unemployment rate if domestic policy measures are held constant. The endogeneity of the unemployment rate means that estimates that do not allow for it will have a coefficient for the inverse of the employment rate that is biased downwards in estimated Phillips curves. In other words, the Phillips curve will appear flatter than it actually is.

Our estimates indicate that the short-run Phillips curve is still quite flat even when we allow for the endogeneity of the unemployment rate. The long-run curve is virtually vertical. Using adaptive expectations, it appears that expectations of inflation adjust fairly rapidly. This information and the result that domestic rates do not diverge sharply from foreign rates suggest that it would take an inordinately large amount of unemployment to force down the rate of inflation below the foreign rate of inflation. To sustain this lower rate for an appreciable period of time, accelerating doses of deflation are necessary.

These results indicate that the domestic authorities agree with the foreign rate of inflation that is imposed on them by the currency arrangements. The foreign rate of inflation acts as a constraint on the domestic rate of inflation. The anti-inflationary discipline imposed by fixed exchange rates is often decided as meaningless as a country on floating rates can, at least theoretically, choose any domestic rate of inflation. The balance-of-payments deficits resulting from a higher rate of inflation than the one abroad act as a useful constraint on aggregate demand policies. (Inflation is not necessarily evil. This is especially the case if some of the distributional issues raised by sustained inflation can be resolved. If this is the case, the discipline imposed by fixed rates is of no value. The costs of inflation are, however, for the domestic authorities to judge.)

These chapters indicate that a small country engaged in international trade may be able to reduce the variability of its terms of trade by tying its exchange rate to that of a larger trading bloc, preferably one with which it conducts most of its trade. The empirical evidence suggests that even a small country has some monopoly power in trade and can affect its terms of trade. The terms of trade for Sweden are affected by changes in the exchange rates between large countries like the United States and Germany. For Sweden in the post-1973 period, the tie to the United Kingdom would have been superior to a tie to any other country in terms of reducing the variability of the terms of trade. This partially fixed rate currency arrangement also gives domestic traders some protection against exchange rate changes that result from disturbances outside the currency bloc. Finally, implicitly the Swedish authorities accept the bloc rate of inflation that they have to conform to as they have little short-run policy flexibility in choosing a different rae of inflation given the rather flat short-run curve they face. Their decision to accept German policy on price developments as opposed to United Kingdom policy means that their tie to the mark does not give the lowest attainable variance in the terms of trade.

CHAPTER 2

THE EFFECTS OF CURRENCY REGIMES ON DOMESTIC PRICE AND INCOME FLUCTUATIONS: A THEORETICAL DISCUSSION

The world has moved from a system of fixed exchange rates to a system of flexible exchange rates to what is now a system of currency blocs. The rates within each bloc are fixed while the rates between the blocs are flexible. The major blocs are, of course, the United States, Japan, and the EEC, with the German mark dominating the latter. France and Britain are floating against all their trading partners.

This situation raises the issue of optimum currency areas. There is a vast literature on the subject, but no operational theorems have emerged. In a recent survey of the literature, Ishiyama (25) proposes a cost-benefit approach to the issues of optimum currency areas. He concurs that a comprehensive approach to the problem should compare the costs, such as loss of monetary freedom and the possibility of higher inflation and unemployment rates, with the benefits, such as exchange reserve savings, reduced speculation against the currency, and greater price stability. This type of approach is also discussed by Grubel (21). He enumerates many of the factors that affect social welfare and their behavior under various systems of regional association. Implicitly using this approach, Ishiyama states. "... One cannot escape the conclusion that a member of the EEC at the present stage can only incur very high costs by committing itself to schemes such as the currency "snake"." (25, p. 370) He is asserting that the

EEC is not an optimum currency area but that each country alone is.

In 1973 Sweden joined the EEC "snake" even though it was not a member of the EEC. Sweden has remained in the "snake" with the kronor effectively tied to the mark and floating against other currencies. Sweden is under no political or institutional obligation to remain in the currency "snake" but has done so. Sweden does not benefit from any of the supranational fiscal actions of the EEC such as the Common Agricultural Policy which induce it to remain in the currency arrangement. This fact indicates that there are benefits to joining a common currency area which, in this case, must outweigh the costs. Can any theories of common currency areas account for this behavior?

The traditional theory of optimum currency areas as expounded by Mundell (42), McKinnon (34), Grubel (20,21), and Kenen (27) seeks to isolate a dominant characteristic of optimum currency areas. The economic arguments entering the government's welfare functions are static, and, generally consist of full employment, price stability, and balance-of-payments equilibrium. One or more of these elements may be emphasized by a particular author. The government is generally attempting to maximize its welfare given micro-economic disturbances such as demand shifts. Macro-economic considerations are also discussed. Some authors are interested in the differential effects of government stabilization policies under various currency arrangements. Some models deal with macroeconomic instability which may be either domestic or foreign in origin. The dynamic conflict between rates of inflation between countries, and the tradeoffs between unemployment and inflation as represented by the Phillips curve have also been used to show the necessary characteristics and boundaries of common currency areas. What are the characteristics of an optimum currency area?

It is important to point out what is meant by "optimality" in this context. Grubel (20) considers the issue and states that he is analyzing optimality from the perspective of the regions forming the currency bloc. Kenen (27) considers optimality from a world-wide perspective. McKinnon (34) considers the welfare of the area that decides to fix the value of its currency or to let it float. Mundell (42) is concerned with world welfare. In his model, the system that increases the welfare of one currency bloc increases the welfare of the other, and hence, the world.

In considering the case of a "small" country, we are led to analyze the "optimality" of the choice of an exchange rate system from the perspective of its own welfare. By definition, a small country has a negligible influence on world welfare.

Regardless of whether the rest of the world is on floating or on fixed rates, its decision will have no bearing on world welfare. The small country assumption implies that a country's decision to float its currency will not affect the decisions of others as to a choice of a currency regime.

In his original paper, Mundell (42) takes the chief characteristic of a common currency area, a "region", to be the presence of intra-regional labor mobility but the absence of inter-regional labor mobility. Labor mobility within a region allows the economy of the region to adjust to micro-economic shifts in demand while maintaining full employment and price stability. Labor is immobile between currency areas. If a shift in demand occurs between two areas, flexible exchange rates will allow both to maintain full employment and balance-of-payments equilibrium. Under fixed rates, government policies to affect the level of employment will affect the price level, assuming the latter in rigid downwards. Kenen (27) points out that Mundell, in addition to mobility, is implicitly assuming that different compositions of labor input do not cause problems as demand patters shift and labor moves.

McKinnon (34) emphasizes the goal of price stability as it determines the value of the monetary unit. A country is interested in maintaining the value of its monetary unit.

The more open an economy is, the more variations in exchange rates will affect the domestic price level and the stability of the monetary unit. Openness is defined in terms of the ratio of the production (or consumption) of tradables to non-tradables. The prices that a country faces are determined on international markets for tradable goods. The more open an economy is, the more it should move towards a system of fixed rates to maintain the value of its monetary unit to avoid having to undertake price stabilizing macro policies with a detrimental effect on employment.

Kenen (27) is more interested in the adjustment needed to absorb microeconomic shifts in demand that emanate abroad. He concludes that the more diversified export production is the better a country can deal with problems of demand shifts under a fixed exchange rate system.

He is also concerned with the efficacy of fiscal policy in dealing with problems of localized unemployment under various exchange rate regimes. The scope of the power of the policy authorities is important. Fiscal authorities can redistribute income. A supranational fiscal authority may undertake a similar function. Unless such a body exists, countries joining a fixed rate regime may suffer from the loss of policy instruments. Under flexible rates, on the other hand, a supranational authority would face problems of assessment and distribution relating directly to the flexibility of rates between regions. In Kenen's analysis, the scope of the fiscal authorities helps delineate the boundaries of a common currency area.

Grubel (20) studies the question of an optimum currency area with three arguments in the social welfare function; the level of income, the stability of income, and the level of national economic independence. He explicitly considers a three-region model and concludes. "In sum, pegging of the exchange rate between Countries A and B tends to raise the level of income, to decrease or increase the stability of income through time and to decrease national economic independence."[1/] (20, p. 323.) A and B will form a common currency area if the positive gains outweigh the losses.

Grubel does not ignore the increased price stability resulting from the formation of a common currency area. He includes the gain from increased price stability and the

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1/ "Stability is more likely to increase the smaller the correlation of random disturbances in each of the previously independent currency areas, and the smaller the constraints on government stabilization policy due to the given level of flexibility in domestic prices, resource mobility between countries and industries, and the stock of the currency area's international reserves." (20, p. 322.)

increased use of money associated with this under the rubric of increased real income. Indeed, given the stock of resources, real income increases only if productivity increases given full employment. Productivity increases with increased price stability and the increased use of money. Implicitly, Grubel assumes full employment. If full employment exists, the effectiveness of government macroeconomic policy is of no consequence. If full employment is not automatic, this efficacy under various exchange rate regimes assumes far more importance. These issues are identified but not analyzed in his second article (21).

Friedman (10) and Sohemn (51) do not explicitly discuss the characteristics of an optimum currency area in their extensive discussions of flexible exchange rates. Friedman implicitly assumes that an optimum currency area exhibits external labor immobility. This assumption can be inferred from Friedman's argument that a deflationary adjustment to a balance-of-payments deficit will cause unemployment if prices are rigid downwards.

He is very concerned about the ability of a currency area to conduct independent fiscal and monetary policies. This concern may be based on an implicit assumption of the need for these policies as stabilization tools. In this case, it is important to distinguish between internal and external instability for a particular area and the currency regime that maximizes welfare given the nature of the disturbances. On the other hand, the need for independent monetary policies may be related to issues of the optimum level of the interest rate and growth for the economy.

Sohmen (51) makes and stresses the distinction between fixed rate regimes and common currency areas. For common currency areas and fixed-rate regimes to be equivalent, two conditions must hold: 1) full currency convertibility; and, 2) all spot and forward rates are fixed at the same value. If these conditions are not met, there is an expectation that the exchange rates might change in the future. Speculation, expectations, and forward markets all enter the analysis. Sohmen states (51, p. 167). "It is the combination of high interest-elasticity of interregional capital flows and relatively high labor mobility between regions that guarantees comparatively painless adjustment of regional disequilibria within countries (for which currency unification has now become the universal rule.)" Sohmen worries about the efficiency and allocative effects of monetary and fiscal policies. With different countries and fixed exchange rates, the effects of these policies may be quite different depending on the scope and authority of a supranational fiscal authority, if it exists.

The traditional approaches to the optimum currency area issue have concentrated on the question of when various countries or regions will form a currency area. From an operational perspective, it is important to investigate the issue of which currency area a country should join, if any, when it is faced with several blocs whose currencies are floating against each other. Should a particular country float freely against all currencies? Should it stabilize the value of its exchange rate in terms of one currency or perhaps an average of major currencies? In the latter case, what are the relevant weights to be applied to each currency? These issues are crucial in deciding why Sweden decided to join the EEC "snake". Here, we present a model which deals with the issues of internal income stability and price stability in the context of currency areas.

To study the problems associated with a small country like Sweden when it is faced by two or more large trading partners whose currencies are floating against each other, we have to go beyond the two-country model. Even in considering a small country, we have to allow for the existence of more than one exchange rate.

Two models are used extensively to discuss problems in the field of balance-of-payments issues with more than two countries. The Keynesian model with constant exchange rates is used to discuss foreign trade multipliers. This is analyzed extensively by Metzler (36, 37, 38, 39). We also have models where income does not enter explicitly and the balance of payments is a function for flexible prices at constant exchange rates. This model is used by Mundell to find the effects of tariffs in customs unions as well as the effects of other exogenous shifts (41, 43, 44). Under suitable assumptions this model is easily transformed to a model with flexible rates and constant product prices.

In the Keynesian system, exogenous shocks cause variations in income while prices remain constant. Exchange rates are assumed fixed and product prices are inflexible. This, of course, implies that excess capacity exists in the various countries. In the flexible exchange rate model, on the other hand, incomes are held constant while the changes in exchange rates compensate for exogenous shocks.

The two models differ in where the compensating changes occur after an exogenous shock to the system. The Keynesian system has income variability but no exchange rate variability. The flexible rate system has exchange rate variability but no income variability. In the Keynesian model, the trade balance is not necessarily zero after incomes return to equilibrium following an exogenous shock. Flexible rates force the trade balance in each country to equal zero both before and after the shock. In both systems we are completely ignoring capital flows and the balance of payments is equivalent to the balance on current account.

For a country interested in stabilizing both income and prices, the two systems represent the two extremes of income variability with no exchange rate variability and exchange rate variability with no income variability. Assuming that the price of each country's export good is fixed in terms of the home currency, exchange rate flexibility implies price instability. The importance of this price instability depends on how large a proportion of expenditure is on imported goods. This is quite similar to the "openness" criterion of McKinnon. If the government has a loss function in the instability of both income and prices, it may increase its welfare by trading some instability of either kind for the other at the intermediate position between the extremes where all the instability is either in prices or incomes. It may be possible to do so by moving from a system of complete flexible rates to a system of partially fixed rates--forming a currency area with a subset of countries in the world.

Partially flexible rates for the home country when Countries 1 and 2 are jointly floating can mean fixing the exchange rate with that of one of the other countries. For a small country, the value of the exchange rate between the two other countries is given so fixing one rate sets the other.

The home country may also try to stabilize some weighted average of the rate it faces.

It is important to point out that in the Keyesian system with exchange rates held constant, the trade balance is not necessarily equal to zero after all incomes have adjusted to an exogenous shock to an initial equilibrium. Interest rates and capital flows do not enter this very simple model. We are assuming that foreign exchange reserves are large enough to finance the trade deficits of various countries until the original equilibrium is restored or that compensating capital flows occur.

We may have the type of situation that Ingram (24) analyzes in his discussion of the relationship of Puerto Rico and the United States. Puerto Rico uses the same currency as the United States. Capital movements offset any current account movements since all assets held in Puerto Rico are tradable in the United States. A concomitant of this situation is the inability of Puerto Rico to pursue an independent monetary policy. We will concentrate on the issues of income and price stability in the absence of government action to offset these fluctuations. We will not analyze secular movements in the exchange rate.

The remainder of this chapter analyzes the income and price consequences of particular currency regimes for a small country. The appendix develops a more general model. While it is still true that a currency regime between flexible and fixed rates still allows a tradeoff between price and income stability, it is not clear which groups of countries should form a currency bloc.

I. The Model

We consider the case of a small country that faces two trading partners.

Y=domestic income of the home country in terms of its own currency and price level

g^*=price of country 1's currency in the home country

g=price of country 2's currency in the home country

$g^*/g=r$=the price of country 2's currency in country 1

M=value of imports of the home country in terms of its own currency

m=marginal propensity to import of the home country

X=value of exports of the home country in terms of its own currency

$T=X-M$=current account surplus in the home country

$C(Y)$=the value of the home country's induced spending

$1-C'=s$=the marginal propensity not to spend in the home country

γ = autonomous expenditure in the home country, including autonomous investment and government spending

β = a shift parameter for r with $r' > 0$. For example let β equal time. If country 1 is inflating more rapidly than country 2 and their currencies are floating, $r' > 0$.

θ = a shift parameter for T with $\frac{\partial T}{\partial \theta} > 0$; for example, a shift in demand towards the home country's goods

P = an index of exchange rates faced by the home country

Before analyzing the case where β and θ are let us look at the model in a deterministic framework.

(1) $Y = C(Y) + \gamma + T(g^*, g, Y, \theta)$.

This is the classic Keynesian income equilibrium condition. We are assuming that the domestic price level is constant and that excess capacity exists in the economy. Note that exchange rates do not enter the domestic expenditure function. This implies money illusion with respect to changes in prices resulting from changes in exchange rates.

Foreign incomes do not enter the trade balance term. We assume that foreign incomes are constant. For a small country they are exogenous. If they are not constant, we can include the effect of changes in foreign income through the disturbance term. We also assume that $\frac{\partial T}{\partial g^*} > 0$ and $\frac{\partial T}{\partial g} > 0$.

(2) $g^* = gr(\beta)$.

Equation (2) states that the ratio of the two exchange rates that the home country faces is given exogenously.

In this model, the equilibrium level of income changes if T changes or γ changes. With fluctuating exchange rates such that T=0, the equilibrium level of income is unaffected by changes in θ or β. If the home country does not allow the exchange rates to float freely - for example, g^* is fixed and g is set according to (2), fluctuations in β and θ will affect the equilibrium level of income.

If r is constant, and g^* is held constant, g is also constant. Here, fluctuations in θ affect the level of income. If r is constant and g^* and g are allowed to change proportionately so T=0, income does not change but exchange rates do.

To proceed to a stochastic framework, we assume the following specifications.

(3) $M=Bg^{*b_2}g^{d_2}y^h$: value of imports

$b_2<0, d_2<0$

(4) $P=g^{1-\zeta}g^{*\zeta}$: index of exchange rates with ζ = to the proportion of trade with country 1

(5) $X=Ag^{*b_1}g^{d_1}\eta$: value of exports

$b_1>0, d_1>0$

η is a random variable

(6) $\frac{g^*}{g} = r\xi$: exchange rate between country 1 and country 2

ξ is a random variable

Taking logarithms of all the equations and letting the letters now stand for the natural logarithms of the variables, we have.

(3) $M=B+ b_2g^* +d_2g+hy$

(4) $P= (1-\zeta)g + \zeta g^*$

(5) $X=A+b_1g^*+d_1g+\eta$

(6) $g^{*}=g+r+\xi$

(7) $\eta \sim N(0,\sigma_{\eta}^{2})$

(Note that this implies that the disturbance in (5) is log-normal.)

(8) $\xi \sim N(0,\sigma_{\xi}^{2})$

(Note that this implies that the disturbance in (6) is log-normal.)

We also assume that η and ξ are independently distributed.

II) Flexible Rates

Examining the case where flexible rates continuously balance the current account, we see that the equilibrium level of income is not affected by the disturbances since

(1) $Y = C(Y) + \gamma$.

Balancing of the current account implies

(2) $X = M$

(2') $A+b_1g^{*}+d_1g+\eta = B+b_2g^{*}+d_2g+hy$

We know that

(3) $g^{*} = g+r+\xi$.

Solving for g,

(4) $g = \frac{k}{\theta} - \frac{\psi}{\theta} g^{*} - \frac{\eta}{\theta}$.

Where k=constant term

$\theta = d_1-d_2=$ elasticity of export revenue of the home country with respect to g plus the absolute value of the elasticity of its import expenditure with respect to g.

$\Psi = b_1 - b_2$ is the same as θ but with g^* substituted for g.

Using (3) and (4),

$$(5) \quad \frac{k}{\theta} - \frac{\psi}{\theta} g^* - \frac{\eta}{\theta} = g^* - r - \xi$$

$$(5') \quad g^*(1+\frac{\psi}{\theta}) = k_2 + \xi - \frac{\eta}{\theta}$$

where k_2 is a constant.

$$(5'') \quad g^* = k_3 + \left(\frac{\theta}{\theta+\psi}\right) \xi - \frac{1}{\psi+\theta} \eta$$

where k_3 is a constant.

$$(6) \quad \text{var } g^* = \left(\frac{\theta}{\psi+\theta}\right)^2 \sigma_\xi^2 + \left(\frac{1}{\psi+\theta}\right)^2 \sigma_\eta^2$$

Solving for g,

$$(7) \quad g = k_5 \quad \frac{\psi}{\psi+\theta} - \xi - \frac{1}{\psi+\theta} \eta; \; k_5 = \text{constant}$$

$$(8) \quad \text{var } g = \left(\frac{\psi}{\psi \;\; \theta}\right)^2 \sigma_\xi^2 + \left(\frac{1}{\psi \;\; \theta}\right)^2 \sigma_\eta^2$$

We also need to know the covariance of g and g* to solve for the variance of P.

$$(9)\quad \operatorname{cov}(g,g^*) = E\left(-\frac{\psi}{\psi+\theta}\xi - \frac{1}{\psi+\theta}\eta\right)\left(\frac{\theta}{\psi+\theta}\xi - \frac{1}{\psi+\theta}\eta\right)$$

$$= -\frac{\psi\theta}{(\psi+\theta)^2}\sigma_\xi^2 + \frac{1}{(\psi+\theta)^2}\sigma_\eta^2$$

$$(10)\quad \operatorname{var} P = \zeta^2 \operatorname{var} g^* + (1-\zeta)^2 \operatorname{var} g + 2(1-\zeta)\zeta \cdot \operatorname{cov}(g,g^*)$$

$$= \zeta^2 \left[\frac{\theta^2}{(\psi+\theta)^2}\sigma_\xi^2 + \left(\frac{1}{\psi+\theta}\right)^2 \sigma_\eta^2\right]$$

$$+ (1-\zeta)^2 \left[\frac{\psi^2}{(\psi\ \theta)^2}\sigma_\xi^2 + \left(\frac{1}{\psi+\theta}\right)^2 \sigma_\eta^2\right]$$

$$+ 2(1-\zeta)\zeta\left[-\frac{\psi\theta}{(\psi+\theta)^2}\sigma_\xi^2 + \left(\frac{1}{\psi+\theta}\right)^2\sigma_\eta^2\right]$$

$$(10')\quad \operatorname{var} P = \sigma_\xi^2 \left(\frac{1}{\psi+\theta}\right)^2 + \sigma_\xi^2\left(\frac{1}{\psi+\theta}\right)^2 (\zeta\theta-(1-\zeta)\psi)^2$$

Equation (10') tells us that the variability of the price index is due to two sources; 1) the disturbance unique to the home country η, and 2) the variability of the exchange rate between countries 1 and 2.

If the weights attached to g* and g are equal and the elasticities of the import expenditure and export revenue functions are equal for g* and g (that is $\theta = \psi$), the variability of P due to the variability of g*/g goes to zero. In other words, the effects of the fluctuations in g*/g on P depend on the home-country weights of these currencies and the response of its trade balance to changes in them.

III) g* is kept constant

In this case, the home country does not allow g* to vary. g is determined by the exogenous relationship between g* and g.

(1) $g = g^* - r - \xi$

The home country's currency is tied to country 1.

(2) $\operatorname{var} g = \sigma_{\xi}^{2}$

(3) $\operatorname{var} P = \operatorname{var}(g^* + (1-\zeta)g)$

$$= (1-\zeta)^2 \sigma_{\xi}^{2}$$

The equilibrium level of income is a random variable in this case since T is not identically equal to zero. Notice that P is not affected by η. The variability of the exchange rates is due solely to the variability of the rate between country 1 and country 2. The disturbance which affects the home country affects the variability of income but not of the exchange rate index. There are two sources of variability of the equilibrium level of income. Trade shifts η unique to the small country and distrubance of g^*/g both affect the equilibrium level of income.

Given the specification of the trade balance as log-linear, it is difficult to solve for the variance of the equilibrium level of income, but we know that it is greater than zero.

IV) g is kept constant

In this case, the home country is tied to country 2.

(1) $g^* = g + r + \xi$

(2) $\text{var } g^* = \sigma_\xi^2$

(3) $\text{var } P = \text{var } (\zeta g^* + (1-\zeta)g)$

$= \zeta^2 \sigma_\xi^2$

In this case as well, the equilibrium level of income will have some positive variance.

V) Evaluation

Does price variability decrease as we move from a system of flexible rates to a system where one of the exchange rates faced by the home country is held constant?

Let us compare the case of flexible rates to the case where g^* is held constant.

$$\text{var } P\Big|_{\substack{\text{flexible}\\ \text{rates}}} - \text{var } P\Big|_{\substack{g\\ \text{constant}}}$$

$$= \sigma_{\xi}^{2}\ [(\frac{1}{\psi+\theta})^{2}(\zeta\theta-\ (1-\zeta\ )\psi)^{2}-\zeta^{2}]\ +\sigma_{\eta}^{2}(\frac{1}{\psi+\theta})^{2}$$

[from (II.10') and (IV.3)]

$$= \sigma_{\xi}^{2}(\frac{1}{\psi+\theta})^{2}\ \ [\psi^{2}[1-2\zeta]\ -\ 2\zeta\theta\psi]\ +\sigma_{\eta}^{2}\ (\frac{1}{\psi+\theta})^{2}$$

If $\sigma_{\eta}^{2} = 0$, that is, the only variability comes from the fluctuation of g^*/g, and $\zeta > 1/2$, that is, trade with country 1 is more important than trade with country 2 (ζ is a trade weight), then

$$\psi^{2}[1-2\zeta]-2\zeta\theta\psi<0$$

This means that price variability is not decreased if the home country fixes the exchange rate of the country with which it trades less when the only variability is due to the fluctuations of the exchange rate between its trading partners. In this case, welfare decreases because both income variability and price variability rise when the home country moves to fix the exchange rate with its smaller trading partner.

If g^* is held constant and $\zeta > 1/2$, then

$$\text{var } P|_{\text{flexible rates}} \ - \ \text{var } P|_{g^* \text{ constant}}$$

$$= \sigma_{\eta}^{2}(\frac{1}{\psi+\theta})^{2}\ +\sigma_{\xi}^{2}\ ((\frac{1}{\psi+\theta})^{2}\ (\zeta\theta-\ (1-\zeta)\psi)^{2}\ -\ (1-\zeta)^{2})$$

$$= \sigma_\eta^2 \left(\frac{1}{\psi+\theta}\right)^2 + \sigma_\xi^2 \left(\frac{1}{\psi+\theta}\right)^2 (\theta^2(\zeta^2-(1-\zeta)^2) + 2\psi\theta(-(1-\zeta)^2 -$$

$$\zeta(1-\zeta))$$

$$= \sigma_\eta^2 \left(\frac{1}{\psi+\theta}\right) + \sigma_\xi^2 \left(\frac{1}{\psi+\theta}\right)^2 (\theta^2(\zeta^2-(1-\zeta)^2) - 2\psi\theta(1-\zeta))$$

If $\sigma_\eta^2 = 0$, then

$\text{var } P|_{\text{flexible rates}} - \text{var } P|_{g^* \text{ constant}} > 0$ if

[sufficient condition]

$$(\theta^2(\zeta^2-(1-\zeta)^2) - 2\psi\theta(1-\zeta)) > 0$$

or

$$\theta(\zeta^2 - (1-\zeta)^2) - 2\psi(1-\zeta)\theta > 0$$

$$\theta > \frac{2\ (1-\zeta)}{\zeta^2-(1-\zeta)^2} - \frac{2\ (1-\zeta)}{(\zeta-1+\zeta)(\zeta+1-\zeta)}$$

$$= \frac{2\psi(1-\zeta)}{2\zeta-1}$$

A sufficient condition is:

$$\theta > \left(\frac{1}{2\zeta - 1} - 1 \right) \psi$$

Therefore, the variance of P, the exchange rate index, is smaller when g* is held constant as opposed to the flexible rate case if the weight attached to g* is greater than the weight attached to g and the elasticity of the home country's trade with respect to g* is larger than the elasticity with respect to g. This is true when the only disturbance in the system is from the variation in g*/g. In this case we have traded-off increased income variability for decreased price variability.

If σ_η^2 is large enough with respect to σ_ξ^2 to render the cov(g*,g) term positive, we will get decreased price variability regardless of whether we fixed g* or g. Of course, we could obtain decreased variability of the exchange rate index P even if the covariance term is negative if the negative covariance term does not swamp the positive variance $(1-\zeta)^2$ var(g) in the flexible rate case.

From the equation for the cov(g*,g) we see that

$$\sigma_\eta^2 \geq \psi\theta \ \sigma_\xi^2$$

for this term to be positive. This condition can be relaxed somewhat if we require that the variance of P be smaller in the intermediate stage than in the flexible rate case. The condition reduces to (assuming that $\zeta > 1/2$).

$$\sigma_\eta^2 > \sigma_\xi^2 \,(2\psi\theta\zeta \;-\; \psi^2(2\zeta-1))$$

Assuming that fixing either exchange rate gives the home country a smaller variability in P than the flexible case, we see that fixing the rate of the major partner reduces the index variability over the case of fixing the rate of minor partner since

$$\text{var } P|g^* \text{ constant} - \text{var } P|g \text{ constant} = \sigma_\xi^2 \,((1-\zeta)^2-\zeta^2)$$

$$= \sigma_\xi^2 \,(1-2\zeta\,) < 0 \text{ if } \zeta > 1/2$$

VI. Income Variability

To measure both income and price variability, we have to use semi-logarithmic specifications for the export and import functions.

$$(1) \quad X = k_1 + \hat{b}_1 \ln g^* + \hat{d}_1 \ln g + \hat{h} \ln \eta; \quad \hat{b}_1 > 0, \; \hat{d}_1 > 0$$

As before, X is the value of exports in domestic currency. $\ln\eta$ is a random variable with variance σ_η^2 and mean zero. $\hat{h}$ is a constant term of the same order of magnitude as $\hat{b}_1$ and $\hat{d}_1$. It is necessary to introduce this term so σ_η^2 and σ_ξ^2 are of the same "size". In this specification

$$\hat{b}_1 = \frac{\partial X}{\partial g^*} g^* = b_1 \cdot X$$

where b_1 = elasticity of export revenue with respect to g*.

(2) $M = k_2 - mY + \hat{b}_2 \ln g^* + \hat{d}_2 \ln g$; $\hat{b}_2 < 0$, $\hat{d}_2 > 0$

This is the equation for the value of imports in domestic currency where m is the marginal propensity to import.

(3) $T = X - M = k_3 - mY\hat{\psi} + \hat{\theta} \ln g^* + \hat{\theta} \ln g + \hat{h} \ln \eta$

where $\hat{\psi} = \hat{b}_1 - \hat{b}_2 > 0$

$\hat{\theta} = \hat{d}_1 - \hat{d}_2 > 0$

(4) $\ln g^* = \ln g + \ln r + \ln \xi$

This equation determines the exogenous, random value of g*/g. $\ln\xi$ is a random variable with variance σ_ξ^2 and mean zero, independent of $\ln\eta$.

The income-equilibrium condition is

(5) $Y = (1-s)Y + \gamma + T$

where s is the savings rate.

Substituting in the income-equilibrium condition, we obtain

(5) $Y = \frac{1}{s+m} [kY + \hat{\psi} \ln g^* + \hat{\theta} \ln g + \hat{h} \ln \eta]$

If the home country fixes the value of g*,

$Y = \frac{1}{s+m} [k_5 + (\hat{\theta} + \hat{\psi}) \ln g^* + \hat{h} \ln \eta - \hat{\theta} \ln \xi]$

and

(6) $\text{var } Y|_{g^* \text{ constant}} = \frac{\hat{h}^2}{(s+m)}{}^2 \sigma_\eta^2 + \frac{\hat{\theta}^2}{(s+m)}{}^2 \sigma_\xi^2$

If the home country fixes the value of g

(7) $\text{var } Y|_{g \text{ constant}} = \frac{\hat{h}^2}{(s+m)^2} \sigma_\eta^2 + \frac{\hat{\psi}^2}{(s+m)^2} \sigma_\xi^2$

From (6) and (7), we obtain

$$(8)\quad \text{var } Y|_{g^* \text{ constant}} - \text{var } Y|_{g \text{ constant}}$$

$$= \sigma_\xi^2 \left(\frac{\hat{\theta}^2 - \hat{\psi}^2}{(s+m)^2} \right)$$

$$= \left(\frac{1}{s+m}\right)^2 \sigma_\xi^2 \, (\hat{\psi}+\hat{\theta}) \, (\hat{\theta}-\hat{\psi})$$

$$\gtreqless 0 \text{ as } \hat{\theta} - \hat{\psi} \gtreqless 0$$

Now $\hat{\theta} = \hat{d}_1 - \hat{d}_2 = d_1X - d_2M$

$\hat{\psi} = \hat{b}_1 - \hat{b}_2 = b_1X - b_2M$

If $d_1 \geq b_1$ and $-d_2 \geq -b_2$, $\hat{\psi} < \hat{\theta}$. A change in the exchange rate with respect to which exports and imports have a larger elasticity, keeping the other exchange-rate constant, causes a larger variability in income. If the current-account balance T responds "more" to g than to g*, a system that keeps g constant has a smaller income variability than a system that keeps g* constant.

VII. Price Variability with the Semi-logarithmic specification

The equations for variability in the index of exchange-rates are the same as those in the previous case with a double-logarithmic specification for exports and imports but with hatted values substituted for un-hatted values of the parameters. For convenience, these equations are presented here.

$$(1)\quad P = g^{*\zeta} g^{1-\zeta}$$

This is the index of exchange-rates. ζ is a trade-weight.

Assume that $\zeta > 1/2$!

$$(1) \quad \ln P = \zeta \ln g^* + (1-\zeta)\ln g$$

If g is held constant,

$$(2) \quad \operatorname{var} \ln P = (1-\zeta)^2 \sigma_\xi^2$$

If g is held constant,

$$(3) \quad \operatorname{var} \ln P = \zeta^2 \sigma_\xi^2$$

Therefore,

$$(4) \quad \operatorname{var} \ln P\big|_{g^* \text{ constant}} - \operatorname{var} \ln P\big|_{g \text{ constant}}$$

$$= (1-\zeta)^2 - \zeta^2 = 1-2\zeta < 0.$$

The index has a smaller variability in the case where the exchange-rate assigned the largest weight is held constant.

Under flexible rates,

$$(5) \quad T = 0 = k_4 + \hat{\psi}\ln g^* + \hat{\theta}\ln g + \hat{h} \ln\eta = 0$$

$$(5') \quad k_5 + \hat{\psi}\ln g + \hat{\psi}\ln\xi + \hat{\theta}\ln g + \hat{h} \ln\eta = 0$$

$$(6) \quad \ln g = -\frac{k_5}{\hat{\psi}+\hat{\theta}} - \frac{\hat{\psi}}{\hat{\theta}+\hat{\psi}}\ln\xi - \frac{\hat{h}}{\hat{\theta}+\hat{\psi}}\ln\eta$$

$$(7)\quad \ln g^* = k_6 - \frac{\hat{\psi}}{\hat{\psi}+\hat{\theta}}\ln\xi - \frac{\hat{h}}{\hat{\theta}+\hat{\psi}}\ln\eta + \ln\xi$$

$$= k_6 + \frac{\hat{\theta}}{\hat{\theta}+\hat{\psi}}\ln\xi - \frac{\hat{h}}{\hat{\theta}+\hat{\psi}}\ln\eta$$

We obtain

$$(8)\quad \text{var}\ln g = \frac{\hat{\psi}^2}{(\hat{\theta}+\hat{\psi})^2}\sigma_\xi^2 + \frac{\hat{h}^2}{(\hat{\theta}+\hat{\psi})^2}\sigma_\eta^2$$

$$(9)\quad \text{var}\ln g^* = \frac{\hat{\theta}^2}{(\hat{\theta}+\hat{\psi})^2}\sigma_\xi^2 + \frac{\hat{h}}{(\hat{\theta}+\hat{\psi})^2}\sigma_\eta^2$$

Since $\text{cov}(\ln g^*, \ln g) = E\left[-\frac{\hat{\psi}}{\hat{\theta}+\hat{\psi}}\ln\xi - \frac{\hat{h}}{\hat{\theta}+\hat{\psi}}\ln\eta\right]\left[\frac{\hat{\theta}}{\hat{\theta}+\hat{\psi}}\ln\xi - \frac{\hat{h}}{\hat{\theta}+\hat{\psi}}\ln\eta\right]$

$$= -\frac{\hat{\theta}\hat{\psi}}{(\theta+\psi)^2}\sigma_\xi^2 \frac{\hat{h}}{(\theta+\psi)^2}\sigma_\eta^2$$

$$(10)\quad \text{var}\ln P\Big|_{\text{flexible rates}}$$

$$= \sigma_\eta^2\frac{h}{(\hat{\theta}+\hat{\psi})}^2 + \sigma_\xi^2\frac{1}{(\hat{\theta}+\hat{\psi})}^2\left(\left(\frac{1}{\hat{\theta}+\hat{\psi}}\right)^2(\zeta\hat{\theta} - (1-\zeta)\hat{\psi})^2\right)$$

Equation (10) is analogous to equation (II.10').

VIII. Conclusion

If $\sigma_\xi^2 = 0$, the rest of the world is on fixed rates. The small home country has the choice of being on purely flexible rates where

$$\text{var } Y = 0 \text{ but var ln } P = \sigma_\eta^2 \quad \frac{\hat{h}^2}{(\hat{\theta}+\hat{\psi})^2}$$

or on fixed rates where

$$\text{var } Y = \frac{\hat{h}^2}{(s+m)^2}\sigma_\eta^2 \quad \text{but var ln } P = 0$$

When there is an added disturbance in the system and $\sigma_\eta^2 \neq 0$, the home country has other options open. It fixes the value of one exchange rate and float against the other. In this intermediate situation, it trades off price and income instability.

APPENDIX

CHAPTER 2

We will deal with a three country, three good model. We assume that each country is specialized in production, but that it consumes all three goods. The assumption of specialized production helps avoid problems of definition of income when prices are changing. We will assume that each of the sub-models, incomes variable but exchange rates fixed, and exchange rates variable with incomes constant, is stable. The intermediate model will be a mixture of the two systems. One of the exchange rates will be held constant while the other is changing to maintain the trade balance of the non-partner country equal to zero. We will examine the behavior of prices, incomes, and trade balances in the intermediate model.

The Model

Y_i = national income of country i in terms of 3's currency and prices; i=1,2,3

P_i = price of good i in country i in terms of 1's currency; country i exports good i and P_i is assumed constant; i=1,2,3

e^* = the price of country 1's currency in terms of country 3's currency

e = the price of country 2's currency in terms of country 3's currency

T_i = the current account balance of payments of country i measured in terms of country 3's currency; i=1,2,3

$C_i(Y_i)$ = the value of country i's consumption of all commodities valued in terms of country 3's currency and prices. We do not allow for the Laursen-Metzler effect. A change in an exchange rate changes real income and has an effect on savings. This effect is ignored. i=1,2,3,

$s_i = 1 - C_i'$ = the savings rate in country i; i=1,2,3,

m_{ij} = the marginal propensity to import of country i from j

$m_j = \sum_i m_{ij}$ = the total marginal propensity to import of country j; j=1,2,3,

I_{ij} = the physical imports of country j from country i of good i; i=1,2,3; j=1,2,3,

γ_j = the autonomous expenditures of country i (government spending plus autonomous investment) in terms of country 3's currency and prices; i=1,2,3

θ = a demand shift parameter. An increase in θ increases T_1 and decreases T_2 by the same amount.

(1) $Y_1 = C_1(Y_1) + \gamma_1 + T_1(e^*, e, Y_1 Y_2, Y_3)$

(2) $Y_2 = C_2(Y_2) + \gamma_2 + T_2(e^*, e, Y_1, Y_2, Y_3)$

(3) $Y_3 = C_3(Y_3) + \gamma_3 + T_3(e^*, e, Y_1, Y_2, Y_3)$

(4) $T_1 + T_2 + T_3 = 0$

Equations (1) - (3) are the Keynesian equilibrium conditions that aggregate spending equals income. We assume that the domestic prices of all three export commodities $P_1, P_2, P_3 = 1$ by appropriate choice of units. We also assume that in the initial equilibrium with $T_1 = T_2 = T_3 = 0$, e^* and e are equal to 1 by appropriate choice of units. Equation (4) is an identity stating that the sum of the currenct account balances equals zero.

Keeping income constant, we assume that the goods are gross substitutes:

$$\frac{\partial T_1}{\partial e^*} < 0, \quad \frac{\partial T_2}{\partial e^*} > 0, \quad \frac{\partial T_3}{\partial e^*} > 0.$$

$$\frac{\partial T_1}{\partial e} > 0 \quad \frac{\partial T_2}{\partial e} < 0 \quad \frac{\partial T_3}{\partial e} > 0.$$

Since $T_3 = -(T_1 + T_2)$

$$\frac{\partial T_3}{\partial e^*} > 0 \text{ implies } \frac{\partial T_1}{\partial e^*} + \frac{\partial T_2}{\partial e^*} < 0$$

$\frac{\partial T_3}{\partial e} > 0$ implies $\frac{\partial T_1}{\partial e} + \frac{\partial T_3}{\partial e} < 0.$

What we are assuming is that a devaluation of 3's currency in terms of 1's currency, keeping the exchange rate and all incomes constant, leads to an improvement in the trade balances of 2 and 3. (The price of 1's currency in terms of 2's currency is e^*/e.) The rise in e^* raises the relative price of 1's commodity relative to the commodities exported by 2 and 3 causing a shift to the consumption of these goods. The movement of T_2 and T_3 imply that $\frac{\partial T_1}{\partial e^*} < 0$. Similar statements hold for a change in e.

If the adjustment rules are

(1) $$\frac{de^*}{dt} = k_1 T_1 (e^*, e)$$

(2) $$\frac{de}{dt} = k_2 T_2 (e^*, e)$$

then a sufficient condition for (local, linear) stability of the exchange rate system is that the matrix

$$\begin{bmatrix} \frac{T_1}{e^*} & \frac{T_1}{e} \\ \frac{\partial T_2}{\partial e^*} & \frac{\partial T_2}{\partial e} \end{bmatrix}$$

be Hicksian (principal minors alternate in sign). Since we have assumed that the off-diagonal elements are positive and that the column sums are negative, this matrix is indeed Hicksian.

Under a flexible rate system, $T_1=T_2=0$. The system is written as

(1) $Y_1 = C_1(Y_1) + \gamma_1; \quad \frac{dY_1}{de^*} = 0, \quad \frac{dY_1}{de} = 0;$

(2) $Y_2 = C_2(Y_2) + \gamma_2; \quad \frac{dY_2}{de^*} = 0 \quad \frac{dY_2}{de} = 0;$

(3) $Y_3 = C_3(Y_3) + \gamma_3; \quad \frac{dY_3}{de^*} = 0, \quad \frac{dY_3}{de} = 0;$

(4) $T_1(e^*,e,Y_1,Y_2,Y_3) = 0;$

(5) $T_2(e^*,e,Y_1,Y_2,Y_3) = 0.$

An increase in γ_3, autonomous expenditures in country 3 does not affect Y_1 or Y_2; $\frac{dY_1}{d\gamma_3}=\frac{dY_2}{d\gamma_3}\ 0$. The government spending multiplier in country 3 is $\frac{dY_3}{d\gamma_3}=\frac{1}{s_3}$, the closed economy government spending multiplier. From equations (4) and (5), we can find the required change in the exchange rates to keep $T_1=T_2=0$ following a change in γ_3.

Differentiating (4) and (5) with respect to γ_3 and solving simultaneously for $\frac{de^*}{d\gamma_3}, \frac{de}{d\gamma_3}$ we obtain

$$\frac{\partial T_1}{\partial e^*}\frac{de^*}{d\gamma_3} + \frac{\partial T_1}{\partial e}\frac{de}{d\gamma_3} + \frac{\partial T_1}{\partial Y_3}\frac{dY_3}{d\gamma_3} = 0$$

$$\frac{\partial T_2}{\partial e^*}\frac{de^*}{d\gamma_3} + \frac{\partial T_2}{\partial e}\frac{de}{d\gamma_3} + \frac{\partial T_2}{\partial Y_3}\frac{dY_3}{dY_3} = 0$$

$$\begin{bmatrix} \frac{\partial T_1}{\partial e^*} & \frac{\partial T_1}{\partial e} \\ \frac{\partial T_2}{\partial e^*} & \frac{\partial T_2}{\partial e} \end{bmatrix} \begin{bmatrix} \frac{de^*}{d\gamma_3} \\ \frac{de}{d\gamma_3} \end{bmatrix} = \begin{bmatrix} -\frac{m_{13}}{s_3} \\ -\frac{m_{23}}{s_3} \end{bmatrix}$$

(6) $$\frac{de^*}{d\gamma_3} = \frac{1}{\Delta^*}\left[-\frac{m_{13}}{s_3}\frac{\partial T_2}{\partial e} + \frac{m_{23}}{s_3}\frac{\partial T_1}{\partial e}\right] > 0$$

(7) $$\frac{de}{d\gamma_3} = \frac{1}{\Delta^*}\left[\frac{-m_{23}}{s_3}\frac{\partial T_2}{\partial e} + \frac{m_{13}}{s_3}\frac{\partial T_2}{\partial e^*}\right] > 0$$

where $\Delta^* = \frac{\partial T_1}{\partial e^*}\frac{\partial T_2}{\partial e} - \frac{\partial T_1}{\partial e}\frac{\partial T_2}{\partial e^*} > 0$

by assumption.

An increase in government spending in country 3 leads to a devaluation of 3's currency with respect to both countries 1 and 2. The increase in government spending increases income in country 3, thus leading to increased imports from 1 and 2. The incipient surpluses in countries 1 and 2 are eliminated by an appreciation of their exchange rates.

We can also examine the Metzleric system for the effects of parameter changes while exchange rates are held constant. We can solve for Y_1,Y_2, and Y_3 as functions of the exchange rates, the autonomous spending parameters, and the shift parameter. The matrix

$$[A] = \begin{bmatrix} s_1+m_1 & -m_{12} & -m_{13} \\ -m_{21} & s_2+m_2 & -m_{23} \\ -m_{31} & -m_{32} & s_3+m_3 \end{bmatrix}$$

will enter into all the comparative statistics. The matrix [A] is Hicksian (in this case, all principal minors are positive) since all off-diagonal elements are negative, diagonal elements are positive, and the column sums are positive

$(\sum_{i \neq j}((s_j + m_j) + (-m_{ij})) = s_j > 0)$.

This implies that the income system is stable.

Let us look at various multipliers that emerge from the income system. Using Cramer's Rule we see that

$$(1) \quad \frac{\partial Y_j}{\partial \zeta} = \sum_{1}^{3} \frac{A_{ij}}{A} \quad \frac{\partial T_i}{\partial \zeta} \; ;$$

$\zeta = e^*, e, \theta$;

$A = \det[A], A_{ij}$ = ijth cofactor of $[A]$.

$$\frac{\partial Y_j}{\partial Y_i} = \frac{A_{ij}}{A} \; ; \; i,j = 1,2,3.$$

Let $M_i^j = \dfrac{\partial Y_i}{\partial j}$ after the income system has returned to equilibrium. That is M_i^j is the change in the equilibrium value of Y_i following a change in j. We see that

$$(1) \quad M_1^{Y_3} = \frac{A_{13}}{A} > 0; \text{ since } A > 0$$

and $A_{ij} > 0$ [Metzler's Theorem].

(1) $M^{Y}_{2}3 = \frac{A_{23}}{A} > 0;$

(2) $M^{Y}_{3}3 = \frac{A_{33}}{A} > 0.$

At constant exchange rates, an increase in government spending in country 3 increases incomes in all countries as the increase in government spending leaks abroad. It is interesting to note, as Metzler has shown, that the government spending multiplier is smaller in country 3 with fixed exchange rates as opposed to flexible rates. Some of the expansion leaks abroad under fixed rates and does not return as other countries have positive savings.

The flexible rate government spending multiplier in country 3 is $\frac{1}{s_3}$ and the fixed rate government spending multiplier is $M^{Y}_{3}3$.

$$A = \det[A] = A_{13}(-m_{13}) + A_{23}(-m_{23}) + A_{33}(s_3 + m_3)$$

$$M^{Y}_{3}3 = \frac{A_{33}}{A} = \frac{A_{33}}{A_{13}(-m_{13}) + A_{23}(-m_{23}) + A_{33}(s_3 + m_3)}$$

$$= \frac{A_{33}}{s_3 A_{33} + m_{13}(A_{33} - A_{13}) + m_{23}(A_{33} - A_{23})}$$

$$= \frac{1}{s_3 + m_{13}\dfrac{(A_{33} - A_{13})}{A_{33}} + m_{23}\dfrac{(A_{33} - A_{23})}{A_{33}}}$$

Now, $A_{33} > 0; A_{33} - A_{13} > 0; A_{33} - A_{23} > 0$. (In a Hicksian matrix, the principal cofactors dominate their subfactors. $A_{33} > A_{23}$ implies $\frac{A_{33}}{A} > \frac{A_{23}}{A}$. But this inequality only states that $\frac{\partial Y_3}{\partial \gamma_3} > \frac{\partial Y_3}{\partial \gamma_2}$, or; that an increase in government spending in country 3 is more powerful in its effect on income in country 3 than an increase in government spending in country 2 is in its effect on country 3.) This shows that $\frac{1}{s_3} > M_3^{\gamma_3}$.

We can also analyze the movements in the trade balances.

(3) $T_i = Y_i - C_i(Y_i) - \gamma_i \quad i = 1,2,3$

(1) $\frac{\partial T_1}{\partial \gamma_3} = s_1 M_1^{\gamma_3} > 0;$

(2) $\frac{\partial T_2}{\partial \gamma} = s_2 M_2^{\gamma_3} > 0;$

(3) $$\frac{\partial T_3}{\partial \gamma_3} = s_3 M_3^{\gamma}3 - 1 > 0 \text{ since } M_3^{\gamma}3 < \frac{1}{s_3}.$$

(Note that we can reduce that $m_3 A_{33} = A_{13}(m_{13}+s_1) + A_{23}(m_{23}+s_2)$.)

The country in which government spending increases has a trade deficit while the two other countries have trade surpluses.

Incomes are implicit functions of the exchange rates as well. Changes in exchange rates change the equilibrium level of national income. Let us look at the exchange rate multipliers for a change in e*.

(4) $$M_1^{e*} = \frac{\partial Y_1}{\partial e^*} = \frac{\partial T_1}{\partial e^*}\frac{A_{11}}{A} + \frac{\partial T_2}{\partial e^*}\frac{A_{21}}{\partial e^*} + \frac{\partial T_3}{\partial e^*}\frac{A_{31}}{A}$$

$$= -\left(\frac{\partial T_2}{\partial e^*} + \frac{\partial T_3}{\partial e^*}\right)\frac{A_{11}}{A} + \frac{\partial T_2}{\partial e^*}\frac{A_{21}}{A} + \frac{\partial T_3}{\partial e^*}\frac{A_{31}}{A}$$

$$= \frac{\partial T_2}{\partial e^*}\left(\frac{A_{21}-A_{11}}{A}\right) + \frac{\partial T_3}{\partial e^*}\left(\frac{A_{31}-A_{11}}{A}\right) < 0$$

Since $A_{21} < A_{11}$ and $A_{31} < A_{11}$

An appreciation of country 1's currency reduces its equilibrium income. Aggregate spending which equals $C_1(Y_1) + T_1 + \gamma_i$. falls as the rise in e* reduces T_1. This precipitates a fall in income. We can compute the change in T_1 at the equilibrium levels of income.

(5) $T_1 = Y_1 - C_1(Y_1) - \gamma_1$

(6) $$\frac{dT_1}{de^*} = s_1 M_1^{e^*} < 0.$$

The appreciation of 1's currency leaves it with a balance-of-payments deficit in the new equilibrium. This implies that the sum of the changes in the balance-of-payments of countries 2 and 3 in the new equilibrium must be positive.

The effects of a change in e* on the equilibrium vales of Y_2 and Y_3 are more ambiguous.

(1) $$M_2^{e^*} = \frac{\partial Y_2}{\partial e^*} = \frac{\partial T_1}{\partial e^*}\frac{A_{12}}{A} + \frac{\partial T_2}{\partial e^*}\frac{A_{22}}{A} + \frac{\partial T_3}{\partial e^*}\frac{A_{32}}{A}$$

$$= \left(-\frac{\partial T_2}{\partial e^*} - \frac{\partial T_3}{\partial e^*}\right)\frac{A_{12}}{A} + \frac{\partial T_2}{\partial e^*}\frac{A_{22}}{A} + \frac{\partial T_3}{\partial e^*}\frac{A_{32}}{A}$$

$$= \left(-\frac{\partial T_2}{\partial e^*} - \frac{\partial T_3}{\partial e^*}\right)\frac{A_{13}}{A} + \frac{\partial T_2}{\partial e^*}\frac{A_{23}}{A} + \frac{\partial T_3}{\partial e^*}\frac{A_{33}}{A}$$

$$= \frac{\partial T_2}{\partial e^*}\left(\frac{A_{23} - A_{13}}{A}\right) + \frac{\partial T_3}{\partial e^*}\left(\frac{A_{33} - A_{13}}{A}\right)$$

(3) $T_2 = Y_2 - C_2(Y_2) - \gamma_2$

(4) $T_3 = Y_3 - C_3(Y_3) - \gamma_3$

(5) $$\frac{dT_2}{de} = s_2 M_2^{e^*}$$

(6) $$\frac{dT_3}{de^*} = s_3 M_3^{e^*}$$

(7) $$\frac{dT_1}{de^*} = s_1 M_1^{e^*} = -\left(\frac{dT_2}{de^*} + \frac{dT_3}{de^*}\right) = s_2 M_2^{e^*} - s_3 M_3^{e^*} < 0.$$

Equation (7) implies that $M_2^{e^*}$, $M_3^{e^*}$ cannot both be negative. Let us assume that both $M_2^{e^*}$ and $M_3^{e^*}$ are positive. That is, an appreciation of 1's currency increases incomes in 2 and 3 and gives them both trade surpluses. Sufficient conditions to ensure that $M_2^{e^*}>0$ and $M_3^{e^*}>0$ are, from (1) and (2), that $A_{12} \leq A_{32}$ and $A_{13} \leq A_{23}$ respectively. These conditions imply that $M_2^{\gamma}1 \leq M_2^{\gamma}3$ and $M_3^{\gamma}1 \leq M_3^{\gamma}2$ respectively. We are assuming that an increase in autonomous expenditures in country 1 causes income in country 2 to rise less than does an increase in autonomous spending in country 3. Similarly we assume that an increase in autonomous spending in country causes income in country 3 to rise less than does an increase in autonomous spending in country 2. In this sense we can say that countries

2 and 3 are more open with respect to each other than they are with respect to country 1. Countries 2 and 3 are more affected by a change in government spending in each other than they are by a change in government spending in the rest of the world as represented by country 1. ($A_{12} \leq A_{32}$ implies $m_{21}s_3 \leq m_{23}s_1$ and $A_{13} \leq A_{23}$ implies $m_{31}s_3 \leq m_{32}s_1$. If we assume that savings rates are the same everywhere, then the previous assumptions are equivalent to $m_{21} \leq m_{23}$ and $m_{31} \leq m_{32}$. The marginal propensity of 3 to import from 2 is larger than the marginal propensity of 3 to import from 1. Similarly, the marginal propensity to import of 2 from 3 is larger than the marginal propensity to import of 1 from 3.)

We can do a similar analysis for a change in e.

$$(1) \quad M_2^e = \frac{\partial T_1}{\partial e}\frac{A_{12}}{A} + \frac{\partial T_2}{\partial e}\frac{A_{22}}{A} + \frac{\partial T_3}{\partial e}\frac{A_{32}}{A}$$

$$= \frac{\partial T_1}{\partial e}\frac{A_{12}}{A} + \left(-\frac{\partial T_1}{\partial e} - \frac{\partial T_2}{\partial e}\right)\frac{A_{22}}{A} + \frac{\partial T_3}{\partial e}\frac{A_{32}}{A}$$

$$= \frac{\partial T_1}{\partial e}\left(\frac{A_{12}-A_{22}}{A}\right) + \frac{\partial T_3}{\partial e}\left(\frac{A_{32}-A_{22}}{A}\right) < 0$$

$$\frac{dT_2}{de} = s_2 M_2^e < 0.$$

An appreciation of 2's currency causes its income to fall and the surplus on the current account to decrease.

$$M_1^e = \frac{\partial Y_1}{\partial e} = \frac{\partial T_1}{\partial e} \frac{A_{11}}{A} + \frac{\partial T_2}{\partial e} \frac{A_{21}}{A} + \frac{\partial T_3}{\partial e} \frac{A_{31}}{A}$$

$$= \frac{\partial T_1}{\partial e} \frac{A_{11}}{A} + \left(-\frac{\partial T_1}{\partial e} - \frac{\partial T_3}{\partial e}\right) \frac{A_{21}}{A} + \frac{\partial T_3}{\partial e} \frac{A_{31}}{A}$$

$$= \frac{\partial T_1}{\partial e} \left(\frac{A_{12} - A_{22}}{A}\right) + \frac{\partial T_3}{\partial e} \left(\frac{A_{31} - A_{21}}{A}\right)$$

(2) $$\frac{dT_1}{de} = s_1 M_1^e$$

(3) $$M_3^e = \frac{\partial Y_3}{\partial e} = \frac{\partial T_1}{\partial e} \frac{A_{13}}{A} + \frac{\partial T_2}{\partial e} \frac{A_{23}}{A} + \frac{\partial T_3}{\partial e} \frac{A_{33}}{A}$$

$$= \frac{\partial T_1}{\partial e} \frac{A_{13}}{A} + \left(-\frac{\partial T_1}{\partial e} - \frac{\partial T_3}{\partial e}\right) \frac{A_{23}}{A} + \frac{\partial T_3}{\partial e} \frac{A_{33}}{A}$$

$$= \frac{\partial T_1}{\partial e} \left(\frac{A_{13}}{A} - \frac{A_{23}}{A}\right) + \frac{\partial T_3}{\partial e} \left(\frac{A_{33}}{A} - \frac{A_{23}}{A}\right)$$

(4) $$\frac{dT_3}{de} = s_3 M_3^e$$

Once again,

$$\frac{dT_2}{de} = -\left(\frac{dT_1}{de} + \frac{dT_3}{de}\right) = -s_1 M_1^e - s_3 M_3^e < 0.$$

At least one of the two income multipliers M_1^e, M_3^e must be positive. The condition that $M_3^e > 0$ makes M_3^e of indeterminate sign. A sufficient condition to make $M_1^e > 0$ is $A_{21} \leq A_{31}$ or $M_1^Y 2 \leq M_1^Y 3$. (With savings rates constant across countries, this implies that $m_{12} \leq m_{13}$.) We can interpret this to mean that country 1 is more open with respect to 3 than it is with respect to 2.

Limited Exchange-Rate Flexibility

Let country 3 by the home country. It can choose to remain on fixed rates, flexible rates, or partially fixed rates. If it remains on fixed rates, government spending will be less powerful than under flexible rates. Under fixed rates, there is no price variability. Let

$$\bar{P}_3 = \beta e^* + (1-\beta)e, \quad 0<\beta<1, \qquad \beta=\beta_3$$

be an index of its import prices. Under fixed rates

$$\frac{d\bar{P}_3}{d\gamma_3} = 0.$$

Under flexible rates,

$$P_1 = \frac{dP_3}{d\gamma_3} = (\beta)\frac{de^*}{d\gamma_3} + (1-\beta)\frac{de}{d\gamma_3} \quad .$$

Country 3 can choose to form a common-currency area with either country 2 or country 1 as a partner. If 2 is the partner, e is held constant while e* changes to force $T_1=0$ in the new equilibrium after the change in γ_3. If 1 is the partner, e* is held constant while e changes to force $T_2=0$ in the new equilibrium. The common currency area is in balance-of-payments equilibrium with the rest of the world.

Define

$$P_2 = \left.\frac{d\bar{P}_3}{d\gamma_3}\right|_{e \text{ constant}} = \beta \left.\frac{de^*}{d\gamma_3}\right|_{\substack{T_1=0 \\ e \text{ constant}}}$$

$$P_3 = \left.\frac{d\bar{P}_3}{d\gamma_3}\right|_{e^* \text{ constant}} = (1-\beta)\left.\frac{de}{d\gamma}\right|_{\substack{T_2=0 \\ e^* \text{ constant}}}$$

If $T_1=0$, $dY_1=0$. $Y_1=Y_1(e^*,e,\gamma_1,\gamma_2,\gamma_3)$.

(1) $dY_1=0=M_1^{e^*}de^*+(M_1^{\gamma_3})d\gamma_3$

(2) $$\left.\frac{de^*}{d\gamma_3}\right|_{\substack{T_1=0\\ e\text{ constant}}} = -\frac{M_1^{\gamma_3}}{M_1^{e^*}} > 0$$

If $T_2=0$, $dY_2=0, Y_2=Y_2(e^*,e,\gamma_1,\gamma_2,\gamma_3)$

(1) $dY_2=0=M_2^{e}de+M_2^{\gamma_3}d\gamma_3$

(2) $$\left.\frac{de}{d\gamma_3}\right|_{\substack{T_2=0\\ e^*\text{ constant}}} =-\frac{M_2^{\gamma_3}}{M_2^{e}} > 0$$

Under flexible rates, both $T_1=0$ and $T_2=0$. Thus $dY_1=0$ and $dY_2=0$. This implies

(3) $0=M_1^{e^*}\frac{de^*}{d\gamma_3}+M_1^{e}\frac{de}{d\gamma_3}M_1^{\gamma_3}$ (4) $0=M_2^{e^*}\frac{de^*}{d\gamma_3}+M_2^{e}\frac{de}{d\gamma_3}+M_2^{\gamma_3}$

Solving these equations simultaneously, we observe that

(5) $$\frac{de^*}{d\gamma_3} = \frac{-M_1^{\gamma_3}M_2^{e}+M_2^{\gamma_3}M_1^{e}}{M_1^{e^*}M_2^{e}-M_1^{e}M_2^{e^*}}$$

(6) $$\frac{de}{d\gamma_3} = \frac{-M_2^{\gamma_3}M_1^{e^*}+M_1^{\gamma_3}M_2^{e^*}}{M_1^{e^*}M_2^{e}-M_1^{e}M_2^{e^*}}$$

From the stability conditions, we have shown that $\frac{de^*}{d\gamma_3} > 0$ and $\frac{de}{d\gamma_3} > 0$. (p.). Under the assumed conditions on M_1^e and M_2^{e*}, the numerators are positive in equations (5) and (6). This implies that the denominator is positive. (That is, $M_1^{e*} \cdot M_2^e - M_1^e M_2^{e*} > 0$.)

Does the formation of a common-currency area reduce country 3's import price variability? Is $P_1 > P_2$? Is $P_1 > P_3$?

$$(7) \quad P_1 - P_2 = \beta\frac{de^*}{d\gamma_3} + (1-\beta)\frac{de}{d\gamma_3} - \beta\frac{de^*}{d\gamma_3}\Big|_{e\ \text{constant}}$$

$$= \beta\left(\frac{-M_1^{\gamma_3}M_2^e + M_2^{\gamma_3}M_1^e}{M_1^{e*}M_2^e - M_1^eM_2^{e*}}\right)$$

$$+ (1-\beta)\left(\frac{-M_1^{e*}M_2^{\gamma_3} + M_2^{e*}M_1^{\gamma_3}}{M_1^{e*}M_2^e - M_1^eM_2^{e*}}\right) + \beta\frac{M_1^{\gamma_3}}{M_1^{e*}}$$

$$= \frac{1}{M_1^{e*}(M_1^{e*}M_2^e - M_1^eM_2^{e*})} \quad -\beta M_1^{\gamma_3}M_2^eM_1^{e*}$$

$$+ \beta M_2^{\gamma_3}M_1^eM_1^{e*} - (1-\beta)(M_1^{e*})^2 M_2^{\gamma_3}$$

$$+ (1-\beta)M_2^{e*}M_1^{\gamma_3}M_1^{e*} + \beta M_1^{\gamma_3}M_2^{e}M_1^{e*}$$

$$- \beta M_1^e M_2^{e*} M_1^{\gamma_3} \Big\} > 0.$$

$$P_1 - P_2 > 0$$

since the denominator is negative and each term in the bracketed expression is negative. A partnership with country 2 reduces country 3's price variability.

$$\text{(1)} \quad P_1 - P_3 = \beta \frac{de^*}{d\gamma_3} + (1-\beta)\frac{de}{d\gamma_3} - (1-\beta)\frac{de}{d\gamma_3}\Big|_{e^* \text{ constant}}$$

$$= \frac{1}{M_2^e(M_1^{e*}M_2^e - M_1^e M_2^{e*})} \Big\{ - \beta M_1^{\gamma_3}(M_2^e)^2$$

$$+ \beta M_2 M_1^e M_2^e - (1-\beta)M_1^{e*}M_2^e M_2^{\gamma_3}$$

$$+ (1-\beta)M_2^{e*}M_1 M_2^e + (1-\beta) M_2^{\gamma_3}M_1^{e*}M_2^e$$

$$- (1-\beta)M_2^e M_1^e M_2^{e*} \Big\} > 0$$

$$P_1 - P_3 > 0$$

A partnership between country 3 and country 1 also reduces 3's price variability.

Indeed, the stronger conditions

(2) $$\left.\frac{de^*}{d\gamma_3}\right|_{\substack{T_1=0\\T_2=0}} > \left.\frac{de^*}{d\gamma_3}\right|_{\substack{T_1=0\\e\text{ constant}}} ;$$

(3) $$\frac{de}{d\gamma_3}\ {\substack{T_1=0\\T_2=0}} > \left.\frac{de}{d\gamma_3}\right|_{\substack{T_2=0\\e^*\text{ constant}}}$$

hold.

We can show these ideas diagramatically. Solving the income system, we obtain implicit functions for the equilibrium levels of income in each country.

(4) $Y_1=Y_2(e^*,e,\gamma_1,\gamma_2,\gamma_3)$

(1) $Y_2=Y_2(e^*,e,\gamma_1,\gamma_2,\gamma_3)$

(2) $Y_3=Y_3(e^*,e,\gamma_1,\gamma_2,\gamma_3)$

We also know that $T_i=Y_i-C_i(Y_i)-\gamma_i$

In (e^*,e) plane, we can graph the lines $T_1=0$ and $T_2=0$. Note that at each point in this space, internal equilibrium holds for each of the three countries.

(3) $dT_1=s_1dY_1-d\gamma_1$

$$0 = s_1(M_1^{e^*}de^*+M_1^e de);$$

(4) $$\left.\frac{de^*}{de}\right|_{T_1=0} = -\frac{M_1^e}{M_1^{e^*}} \quad .$$

(5) $dT_2 = s_2 dY_2 - d\gamma_2$

$$0 = S_2(M_2^{e^*}de^* + M_2^e de);$$

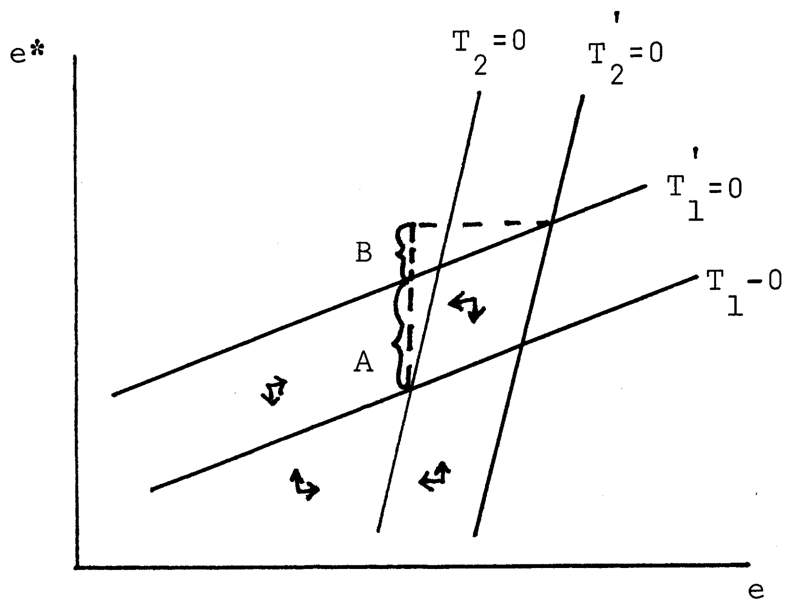
(6) $$\left.\frac{de^*}{de}\right|_{T_2=0} = -\frac{M_2^e}{M_2^{e^*}}$$

Our assumptions that $M_1^e > 0$ and $M_2^{e^*} > 0$ ensure that both the $T_1=0$ and $T_2=0$ loci have positive slope in (e*,e) space when internal equilibrium is being maintained. Furthermore, it has been pointed out that under the assumptions on M_1^e and $M_2^{e^*}$, $M_1^{e^*}M_2^e - M_1^e M_2^{e^*} > 0$. Directly, we see that

$$-\frac{M_2^e}{M_2^{e^*}} > -\frac{M_1^e}{M_1^{e^*}} \ ;$$

or;

(7) $$\left.\frac{de^*}{de}\right|_{T_1=0} < \left.\frac{de^*}{de}\right|_{T_2=0}$$



To the right of $T_2=0$ and below it, $T_2<0$. Above and to the left of $T_1=0$, $T_1<0$. We still assume that $\frac{de}{dt}=k_1T_2$ and $\frac{de^*}{dt}=k_2T_1$. The arrows indicate the directions of change of the exchange rates. Let γ_3 increase. Both $T_1=0$ and $T_2=0$ shift out and away from the origin.

(1) $$\left.\frac{dT_1}{d\gamma_3}\right|_{\substack{e^*,e\\ \text{constant}}} = s_1(M_1^{\gamma}3) > 0;$$

(2) $$\left.\frac{dT_2}{d\gamma_3}\right|_{\substack{e^*,e\\ \text{constant}}} = s_2(M_2^{\gamma}3) > 0.$$

The new loci are marked $T_1'=0$ and $T_2'=0$. (At the old exchange rates both country 1 and country 2 would be running trade surpluses.)

The diagram shows that

(1) $$\left.\frac{de^*}{d\gamma_3}\right|_{\substack{T_1=0\\T_2=0}} = A+B > A = \left.\frac{de^*}{d\gamma_3}\right|_{\substack{T_1=0\\ e\ \text{constant}}}$$

Similarly,

(2) $$\left.\frac{de}{d\gamma_3}\right|_{\substack{T_1=0\\T_2=0}} > \left.\frac{de}{d\gamma_3}\right|_{\substack{T_2=0\\ e^*\ \text{constant}}}$$

The formation of a common-currency area also affects the variations of income in the home country.

(3) $Y_3=Y_3(e^*,e,\gamma_1,\gamma_2,\gamma_3)$;

(4) $dY_3=M_3^{e^*}de^*+M_3^e+M_3^{\gamma_1}d\gamma_1+M_3^{\gamma_2}d\gamma_2+M_3^{\gamma_3}d\gamma_3$.

Following a change in γ_3, under fixed rates we have

(5) $$\left.\frac{dY_3}{d\gamma_3}\right|_{e^*,e\ \text{constant}} = M_3^{\gamma_3}$$

$$(6)\quad \frac{dY_3}{d\gamma_3} = M_3^{e*}\frac{de*}{d\gamma_3} + M_3^{e}\frac{de}{d\gamma_3} + M_3^{\gamma_3} = \frac{1}{s_3}\ .$$

In a partnership with country 2 with de=0, we have

$$(7)\quad \left.\frac{dY_3}{d\gamma_3}\right|_{\substack{e\\ \text{constant}}} = M_3^{e*}\frac{de*}{d\gamma_3} + M_3^{\gamma_3} > M_3^{\gamma_3} \quad \text{since } \frac{de*}{d\gamma_3} > 0,$$

and $M_3^{e*} > 0.$

In a partnership with country 1 with de*=0, we have

$$(8)\quad \left.\frac{dY_3}{d\gamma_3}\right|_{\substack{e*\\ \text{constant}}} = M_3^{e}\frac{de}{d\gamma_3} + M_3^{\gamma_3}.$$

As we remarked earlier, M_3^e may be negative under the assumed conditions. If M_3^e is negative, government spending in country 3 has a reduced effect under a partnership with country 1 than it does under completely fixed rates.

The home country is also interested in the behavior of its trade balance under a common-currency regime. In a partnership with country 2, e* is allowed to vary so $T_1=0$.

$$(1)\quad \frac{dT_2}{d\gamma_3}\Bigg|_{e\ \text{constant}} = s_2\left(M_2^{\gamma_3} + M_2^{e*} \frac{de*}{d\gamma_3}\Bigg|_{e\ \text{constant}}\right)$$

We have assumed that $M_2^{e*} > 0$ and we have shown that $\frac{de*}{d\gamma_3}\Big|_{e\ \text{constant}} > 0$.

These conditions imply that the current account surplus in country 2 has increased after the formation of a common-currency area with country 3 as compared to situation that prevailed under fixed rates. Under flexible rates, all the trade balances are zero at equilibrium levels of income.

Two issues arise. First, what happens to the combined balances of the partner-country and the home-country as we move from a system of fixed rates to a system of partially flexible rates? Under fixed rates, since $-T_1 = T_2 + T_3$,

$$(2)\quad -\frac{dT_1}{d\gamma_3}\Bigg|_{e*,e\ \text{constant}} = \frac{dT_2}{d\gamma_3}\Bigg|_{e*,\ e\ \text{constant}} + \frac{dT_3}{d\gamma_3}\Bigg|_{e*,\ e\ \text{constant}}$$

$$(3)\quad \frac{dT_1}{d_3}\Bigg|_{e*,\ e} = S_1 M_1 3 > 0$$

Under fixed rates, after a change in government spending in country 3, the home-country and the partner-country are running a combined trade deficit against the rest of the world represented by country 1. Under partially flexible rates where e^* is allowed to vary to force $T_1=0$, the home-country and the partner country are in balance with respect to the rest of the world, but are in imbalance among themselves.

The second issue is the change in the trade balance of the home country under the two regimes. Under fixed rates

$$(4) \quad \left.\frac{dT_3}{d\gamma_3}\right|_{e^*,e} = s_3 M_3^{\gamma_3} - 1 < 0.$$

When e^* is allowed to vary to make $T_1=0$,

$$(1) \quad \left.\frac{dT_3}{d\gamma_3}\right|_{e \text{ constant}} = M_3^{\gamma_3} s_3 - 1 + s_3 M_3^{e^*} \frac{de^*}{d\gamma_3}$$

Since we have assumed that $M_3^{e^*} > 0$,

$$(2) \quad \left.\frac{dT_3}{d\gamma_3}\right|_{e^*,} < \left.\frac{dT_3}{d\gamma_3}\right|_{e \text{ constant}}$$

Recall that if $M_3^{\gamma_1} \leq M_3^{\gamma_2}$, $M_3^{e^*} > 0$. If country 3 is more open with respect to country 2 than it is with respect to country 1, a partnership with country 2 reduces its trade balance deficit as compared to the case of fixed rates.

Since country 2 is running a payments surplus in the currency area with country 1, country 1 must be running a deficit. This says, from equation (1), that

(3) $s_3 M_3^{\gamma_3} - 1 + s_3 M_3^{e^*} \dfrac{de^*}{d\gamma_3} < 0$

or,

(4) $M_3^{e^*} \dfrac{de^*}{d\gamma_3} + M_3^{\gamma_3} < \dfrac{1}{s_3}$

Equation (4) states that the total rise in Y_3 is still less than the rise under flexible rates when γ_3 is increased. There is still some leakage of spending abroad.

It is notable that as we go from flexible rates to fixed rates, under the assumed conditions, the effect of a change in autonomous expenditures in the home country on home country income decreases. If a country is interested in minimizing the effects of random shifts in domestic autonomous investment, it should proceed in the direction of fixed rates. Flexible rates isolate the economy. Under fixed rates, however, some of the exogenous shock is transfered abroad.

The effects of a common currency area between countries 1 and 3 can be examined in the same manner. Since

$$(1)\quad \left.\frac{dT_1}{d\gamma_3}\right|_{\substack{e^*,\ e \\ \text{constant}}} = s_1 M_1^{\gamma_3}$$

and

$$(2)\quad \left.\frac{dT_1}{d\gamma_3}\right|_{\substack{e^* \\ \text{constant}}} = S_1\left(M_1^{\gamma_3} + M_1^{e} \left.\frac{de}{d_3}\right|_{e^*\ \text{constant}}\right)$$

the partnership between 1 and 3 increases the payments surplus in country 1. Before the formation of the currency area, the combined trade balance of 1 and 3 was in deficit. After the formation of a currency area, the combined balance is zero. These results are analogous to the ones discussed previously. (Assuming $M_1^e > 0$).

What happens to the trade balance in the home country?

$$(3)\quad \left.\frac{dT_3}{d\gamma_3}\right|_{\substack{e^*,\ e \\ \text{constant}}} = s_3 M_3^{\gamma_3} - 1$$

$$(4)\quad \left.\frac{dT_3}{d\gamma_3}\right|_{\substack{e^* \\ \text{constant}}} = s_3 M_3^{\gamma_3} - 1 + S_3 M_3^{e} \left.\frac{de}{d\gamma_3}\right|_{e^*\ \text{constant}}$$

$$(5)\quad \left.\frac{dT_3}{d\gamma_3}\right|_{\substack{e^*,\, e\\ \text{constant}}} - \left.\frac{dT_3}{d\gamma_3}\right|_{\substack{e^*\\ \text{constant}}} = -S_3 M_3^e \left(\left.\frac{de}{d\gamma_3}\right|_{\substack{e^*\\ \text{constant}}} \right).$$

If $M_3^e > 0$, country 3 has a smaller deficit after the partnership with 1. If $M_3^e < 0$, country 3 has a larger deficit after the partnership. The assumptions we have made do not give a particular sign for M_3^e.

Country 1 is running a surplus in the partnership with 3. This implies that 3 must be running a deficit since they are in balance with respect to the rest of the world. From equation (4), we see that

$$(6)\quad s_3 M_3^{\gamma}3 + s_3 M_3^e \left.\frac{de}{d\gamma_3}\right|_{\substack{e^*\\ \text{constant}}} -1 < 0$$

$$(1)\quad M_3^{\gamma}3 + M_3^e \left.\frac{de}{d\gamma_3}\right|_{\substack{e^*\\ \text{constant}}} < \frac{1}{s_3}$$

This equation says that the effect of increased government spending in country 3 on its equilibrium level of income is still less than the effect under flexible rates. This result is true regardless of the sign of M_3^e.

The assumptions we have made, other than the stability of the exchange rate system and the income system, are:

(1) $M^{Y}_{21} \leq M^{Y}_{22}; (A_{12} \leq A_{32})$

(2) $M^{Y}_{31} \leq M^{Y}_{32}; (A_{13} \leq A_{23})$

(3) $M^{Y}_{12} \leq M^{Y}_{13}; (A_{21} \leq A_{31})$

We have spoken of a country i as more open with respect to that country where an increase in government spending causes a larger income increase in country i. Conditions (1) and (3) enabled us to show that the variation in a weighted average of the exchange rates for country 3, the home country, is smaller under a partnership with either country than under a system of flexible rates when government spending increases in country 3. Condition (1) states that country 2 is more open with respect to the home country, country 3, than it is with respect to country 1. Condition (3) states that country (1) is also more open with respect to the home country than it is with respect to country 2.

Condition (2) states that country 3 is more open with respect to country 2 than country 1. Using this condition we were able to show that a partnership of countries 3 and 2 enabled the home country to increase the efficacy of its government spending and to reduce its trade deficit. We were unable to give difinitive answers about a partnership between countries 3 and 1.

CHAPTER 3

THE EFFECTS OF FOREIGN PRICE AND EXCHANGE RATE DEVELOPMENTS ON THE SWEDISH TERMS OF TRADE

We have seen that a small trading country may join a currency bloc to minimize fluctuations in prices transmitted through exchange rate changes. Here we will look at the empirical evidence of fluctuations in the terms of trade of Sweden as a function of variations in exchange rates of large foreign countries such as the United States and Germany. The empirical evidence shows that fluctuations in the Swedish terms of trade are affected by currency arrangements and that the small country assumption does not hold exactly, as a change in parity of the Swedish kronor against all other currencies holding all cross rates constant does affect the Swedish terms of trade. The specific issues that are investigated are: a) What are the effects of exchange rate fluctuations abroad on the Swedish terms of trade; and b) What currency arrangements should Sweden choose? The first section develops the regression model that is used to investigate the effects of foreign price and exchange rate changes on the Swedish terms of trade. The model essentially consists of a regression of the terms of trade on foreign prices and exchange rates. The empirical evidence is presented in the second section.

DEVELOPMENT OF THE REGRESSION MODEL

In considering the problems of a small country in international trade, we usually assume that its terms of trade are determined abroad. This implies that a change in the exchange rate of the small country does not change its terms of trade. The effects of a devaluation or a revaluation of the currency do not operate through the channel of changing the relative prices of importables to exportables. The price of all tradeables change with respect to nontraded goods. There also are numerous distributional effects of a change in the exchange rate.

In considering the problems of a small open economy, we have to go beyond the simple dichotomy of the home country versus the rest of the world. This is especially true in today's world where the rest of the world is composed of large blocs whose currencies are floating with respect to each other. In such a world, the terms of trade of the home country may indeed be independent of the absolute level of its exchange rate with respect to the rest of the world. The terms of trade may, however, not be independent of the exchange rate.

Let us assume that there are three countries in the world. The home country is a "small" country in the sense that it cannot affect its terms of trade by selling or buying more on the world market. The other two countries are not "small". We denote the home country as Country H and the foreign countries as Countries A and B.

The mix of products traded by the home country is also traded by the other two countries. The home country cannot change the foreign prices of its tradable products. In a general equilibrium framework, the foreign prices of its tradables are determined by supply and demand equations in both foreign countries.

We want to analyze the short-run fluctuations in the terms of trade of the "small" home country when the terms of trade are subject to shocks. These shocks are the changes in the exogenous exchange rate between Countries A and B. We assume that Countries A and B are floating with respect to each other, and that the exchange rate between them changes in response to the considerable capital movements that occur between them. The small country assumption for the home country implies that its decisions cannot affect the exchange rate between A and B.

In a general equilibrium framework, the prices of all products, national incomes for A and B, and the exchange rate between A and B are determined simultaneously. To simplify matters, we assume that X and M, the commodities that the <u>home country</u> respectively exports and imports can be treated in a partial equilibrium framework with reference to Countries A and B. That is, a change in the price of X or M, will not have large repercussions in A and B. We are interested in the effects of a change in r, the price of a unit of A's currency in terms of B's currency, on P_x/P_m, the terms of trade for the home country. Even in a partial equilibrium framework, the effects of a change in r on P_x or P_m cannot be evaluated without consideration of supply and demand effects in both foreign countries. To simplify the analysis further, we assume that X and M are each "A-products" or "B-products". An "A-product" is a commodity whose price is constant in A-currency terms when the exchange rate between A and B changes, given that other prices and incomes are constant in both A and B. "B-products" are similarly defined. Even if prices and incomes change in A and B when r changes, we assume that these changes are small and have negligible effects on the local currency prices of X and M.

A sufficient condition for a product to be an "A-product" in this context is for the amount supplied and demanded in A to be much larger than the amount supplied and demanded in B and that the elasticities of demand and supply be roughly of the same size in both countries. The assumption that other prices and incomes are constant is, to say the least, heroic. The critical assumption is that a change in r, the exchange rate, does not affect the A-currency price of an A-product or the B-currency price of a B-product.[1/]

1/ Algebraically, we can point out these simplifications in the following way:

P^X_A = price of X in A

P^B_X = price of X in B = rP^A_X; r = price of a unit of A's currency in terms of B's currency

D^i_X = demand for X in i

Q^i_X = supply of X in i

$E_{X_i, P_{X_i}}$ = demand elasticity for X in i (this is a negative quantity and is the total demand elasticity).

ZX_i, P_{X^i} = supply elasticity for X in i

(1) $D^A_x(P^A_x) + D^B_x(P^B_x) = Q^A_x(P^A_x) + Q^B_x(P^B_x)$

Total demand in A and B = total supply in A and B differentiating (1) with respect to r and solving for

$\frac{dP_X^A}{dr}$, we obtain

$$\frac{Z_{X_B,P_X^B}\,\frac{Q_X^B}{P_X^B}\,P_X^A - E_{X_B,P_X^B}\,\frac{D_X^B}{P_X^B}\,P_X^A}{E_{X_A,P_X^A}\,\frac{D_X^A}{P_X^A} + E_{X_B,P_X^B}\,\frac{D_X^B}{P_X^A} - Z_{X_A,P_X^A}\,\frac{Q_X^A}{P_X^A} + Z_{X_B,P_X^B}\,\frac{Q_X^B}{P_X^A}}$$

Let $Q = Q_X^A + Q_X^B = D_X^A + D_X^B$

$dP_X^A \rightarrow 0$ as $\frac{Q_X^B}{Q} \rightarrow 0$ **and** $\frac{D_X^B}{Q} \rightarrow 0$

In other words, X is an A-product when Country B is an atomistic partipant in the market for X in both Countries A and B. The price is set in local currency in A. A change in the exchange rate between A and B will affect the local currency price of X in B and will change B's net participation in the X market. This change will not affect the price of A as it is an infinitesimal change in the market.

Our assumption about "A-products" amounts to the assumption that an "A-product" is a commodity in whose market both the home country and Country B are very small participants and price takers.

The terms of trade for the home country are P_x/P_m. Let us assume that the X-product is an "A-product" and the M-product is a "B-product". This means that $P_x/P_m = P_x^a g^a / P_m^b g^b$ where g^i is the number of units of home currency per unit of currency i. Since g^a/g^b equals r,

$P_x/P_m = P_x^a/P_m^b \cdot r,$

$$(1) \quad \frac{P_x \; P_m}{P_x \; P_{m\,T}} \cdot 100 = \frac{P_x^a \; P_m^b}{P_x^a \; P_{m\,T}^b \cdot r_T} \cdot 100$$

$$= \frac{P_x^a \; P_m^b}{P_x^a \; P_{m\,T}^b} \cdot \frac{r}{r_T} \cdot 100$$

The subscript T indicates the value of the variable at time T.

Note x and m are lower case:

Taking logarithms in equation (1), we obtain

$$(2)\quad \ln I_{tot} = k + \ln (P^a_x/P^b_m) + \ln r$$

$$k = \ln (^{100}/(P^a_x/P^b_m)\cdot r_T) = \text{constant}$$

(Note that P^a_x/P^b_m is not unit free. P^a_x is in A-currency units while P^b_m is in B currency units.) There are two sources of movements in the terms of trade index I_{tot}, movements in relative prices P^a_x/P^b_m, and movements in the exchange rate. In the long run, we expect pruchasing-power-parity to hold (see the evidence presented for this in Chapter 5). In this case, changes in the exchange rate between A and B will offset movements in the relative prices. The exchange rate moves to offset variations in inflation rates between A and B. There are, however, also short-run variations in the exchange rate around the long-run movement. The short-run fluctuations are caused by the movements of short-run capital. Thus, in the longrun,

$$(3)\quad \ln r = - \ln (^{P^a}x/P^b_x) + \xi$$

Where ξ is a random variable with mean 0. In the short run, the exchange rate may not be at the purchasing-power-parity level. The equation for the terms of trade of the home country is now

$$(4)\quad \ln I_{tot} = k + h \ln (P^a_x/P^b_m \cdot r) + \varepsilon$$

$$= k + h \ln \xi + \varepsilon$$

where $h \ln \xi$ is the effect of short-run departures in the exchange rate from purchasting power parity while ε is a random variable representing other non-identified effects on the terms of trade. If the exchange rate does not follow the purchasing-power-parity rate, there will be another effect on the terms of trade beyond the short-run fluctuation affect. If X in an A-product and M is a B-product, then $h = 1$. If X is a B-product while M is an A-product, then $h = -1$. If X and M are both A-products, or if they are both B-products, $h = 0$ and the exchange rate between A and B has no effect on the terms of trade of the home country.

Before proceeding to empirical estimation, three issues have to be resolved. First, more than one commodity is traded on the export side and similarly on the import side. Second, there are more than two "large" foreign countries facing the home country. Third, price changes in the home country--or a change in the exchange rate between the home country and all other countries holding cross rates constant may also affect the terms of trade if the small country assumption does not hold exactly. We may have a "Keynesian small country" assumption for the home country. Some of the home country's exports may be specialized products whose price is determined in terms of the domestic home currency and is not affected by external developments.

We will initially deal with the problems of multiple commodities and the price setting power of the home country. Assume there are still two foreign countries A and B, but three export products X_A, X_B, X_H and two import products M_A and M_B. (The subscript i means that the commodity is an 'i-product' whose price is determined in terms of the i^{th} currency. H refers to the home country.) The terms of trade are now

$$(5) \quad TOT = \frac{a_1 P_{X_A} g_A + a_2 P_{X_B} g_B + a_3 P_{X_H}}{b_1 P_{M_A} g_A + b_2 P_{M_B} g_B}$$

Taking logarithms

$$(6) \quad \ln TOT = a_1 \ln P_{X_A} - b_1 \ln P_{M_A} + a_2 \ln P_{X_B} - b_2 \ln P_{M_B} + a_3 \ln P_{M_B} + \varepsilon_t$$

If we assume that one price level P_i represents both P_{x_i} and P_{M_i}, we can rewrite (2) as

$$(7) \quad \ln TOT = (a_1 - b_1) \ln g_A + (a_2 - b_2) \ln g_B + (a_1 - b_1) \ln P_A + (a_2 - b_2) \ln P_B + a_3 \ln P_H + \varepsilon_t$$

(That is the prices of any "i-country" products are represented by the price level in Country i. Note that taking P_{X_i} and P_{M_i} to be represented by the same price level P_i does not imply that the terms of trade are fixed for the i^{th} country. X_i and M_i are not the export and import goods of Country i.

They are export and import goods of the home country whose prices are determined in Country i.)

The coefficients on the exchange rates and the price levels may not be the same. If exchange rate changes are random and are likely to be revised, traders may not change the prices of commodities in response to what is originally perceived as a short-term reversible change. A change in prices is likely to persist and traders will change prices. In other words, the variables which should be included are the expected price level and the expected exchange rate. Traders set prices on the basis of these expected levels. Since the exchange rate fluctuates more than the price level, the expected change in the exchange rate is different from the actual change. The same nominal change in the price level and the exchange rate will translate into different expected sustained changes and the response coefficient will different. If the exchange rate and the price level do have the same effect, equation (7) becomes

$$(8)\quad \ln TOT = (a_1-b_1)(\ln g_A + \ln P_A)+(a_2-b_2)(\ln g_B + \ln P_B) + a_3 \ln P_H + \varepsilon_t$$

A change in the prices of Country i, or of the home country price of its currency will have no effect on the terms of trade if $a_i = b_i$. In this case, the prices of both importables and exportables change by the same amount. A rise in prices in country i accompanied by a devaluation against both other countries in the same amount will have no effect since

$$\frac{dg_A}{g_A} + \frac{dP_A}{P_A} = 0$$

A devaluation of the home country against both foreign countries is equivalent to a rise in g_a and g_b in the same proportion. If $\gamma_i = a_i - b_i$, then the effect of a devaluation on the terms of trade is $\Sigma\gamma_i$. As before, this may be different from the effect of a price fall in the home country. If we constrain the regression, these effects are equal, we can rewrite it as,

$$\text{(8)}\quad \ln TOT = (\gamma_1 + \gamma_2)(\ln g_A + \ln P_A - \ln P_H) + \gamma_2(\ln g_B + \ln P_B - \ln g_A - \ln P_A) + \varepsilon_t$$ 1/

1/ Allowing the home country to have some influence on its terms of trade complicates the regression analysis. This departure from the classical small country analysis implies that a devaluation of the domestic currenty against the rest of the world will cause a deterioration in the terms of trade since the foreign exchange prices of some domestic exportables will decline. This will increase the demand for these products and will eventually cause a rise in domestic prices which might offset the original devaluation. This implies that there is some simultaneity between domestic prices and the terms of trade. In an ordinary least squares regression of the terms of trade on prices and exchange rates, the coefficients will be biased. The coefficient of domestic prices will be biased downwards. (A random positive increase in the terms of trade will lead to an increase in the balance-of-payments surplus and to an increase in domestic prices. The regression of TOT on the negative of P_H will show a negative correlation.

In going from equation (6) to equation (7), we assume that the price level in Country i is representative of the price of all that country's goods.

We can proceed on a slightly different assumption. Differentiating (3) totally, we obtain

$$(9)\quad \frac{dTOT}{TOT} = (a_1-b_1)\frac{dg_A}{g_A} + (a_2-b_2)\frac{dg_B}{g_B} + a_1\frac{dP_{X_A}}{P_{X_A}} - b_1\frac{dP_{M_A}}{P_{M_A}} + a_2\frac{dP_{X_B}}{P_{X_B}} - b_2\frac{dP_{M_B}}{P_{M_B}} + a_3\frac{dP_H}{P_H}$$

All variables are now rates of change (henceforth denoted by $\hat{a}$). We can assume that the rate of change of both P_{X_i} and P_{M_i} are similar and equal to P_i. Using this assumption, we can rewrite (9) as

$$(10)\quad \hat{TOT} = (a_1-b_1)\hat{g}_A + (a_1-b_1)\hat{P}_A + (a_2-b_2)\hat{P}_B + (a_2-b_2)\hat{g}_B + a_3\hat{P}_H$$

Constraining the exchange-rate coefficient to be the same as the price coefficient for all countries, we get

$$(11)\quad \hat{TOT} = (\sum_1^2 \gamma_i)(\hat{g}_A+\hat{P}_A-\hat{P}_H) + \gamma_2(\hat{g}_B+\hat{P}_B-\hat{g}_A-\hat{P}_A)$$

Using a discrete approximation to the infinitesimals such that $\hat{X} = \frac{Xt - Xt-1}{Xt}$, we can estimate these equations.

We can also constrain the equations to satisfy the small country assumption that a change in the exchange rate of the home country against all other countries has no effect on the terms of trade.

The other problem that arises in actual empirical estimation is that there are more than two "large" foreign countries facing the home country. In the case of Sweden, these large countries can be considered as the United States, Germany, France, the United Kingdom, and Japan. The trade shares of Japan and France in trade with Sweden are not very large. Their exchange rates should, however, be included in the analysis as they may help determine the prices of some of Sweden's exports and imports even though they do not trade directly with Sweden in these products. Including these countries in the regression analysis is a straight-forward extension of the two-country case. For example, with n foreign countries and a constraint that the price effect is equal to the exchange rate effect for every foreign country, the level equation is

$$(12)\quad \ln TOT = K + \gamma_1[\ln g_1 + \ln P_1] + \ldots + \gamma_n[\ln g_n + \ln P_n] + \gamma_{n+1}\ln P_H + \varepsilon_t$$

Equation (12) points out some of the difficulties that will be encountered in regression analysis. If exchange rates do not depart significantly from purchasing power parity, then $\ln g_i + \ln P_i$ will be very close to a constant. There will be very significant multicollinearilty problems. The estimates will not be very accurate in the sense of having small confidence intervals.

Empirical Results

We examine the effects of changes in the exchange rate between Sweden, the home country, and five other countries: The United States, the United Kingdom, Japan, Germany and France, on the Swedish terms of trade. Three sets of data are used. With quarterly observations, we consider the period from 1961 to the end of the first quarter of 1975. The exchange rates are end of period rates, the price levels are consumer prices in each country (likely to contain errors since import prices also enter these indices.) The terms of trade are the ratio of the price of export index to the price of imports index for Sweden. The base of the price indices is 1970 = 100. The base of the terms of trade index is 1959 = 100. Discrepancies in the base years of the indices do not matter for the rate of change formulation and affect the constant term in the level formulation.

For the period from 1973 to 1975 (December 1975 is not included in the data), we use monthly observations. In one set, we have end-of-the month exchange rates, while in the other set we use monthly average exchange rates. The terms of trade are a ratio of the monthly export to import components of the wholesale price index with 1963 = 100. The national price indices are national consumer price indices with 1970 = 100.

TABLE 1

LHS Form Period	kr/$	Pus	kr/ P	Puk	kr/mark	P ger
1) $\widehat{TOT}$ 72:4	-0.293	.539	-.035	-.507	.0097	.378
Q, 61:2	(.200)	(.217)	(.052)	(.117)	(.062)	(.114)
r.o. change	[-1.47]	[2.48]	[-.68]	[-4.34]	[.16]	[3.30]
2) $\widehat{TOT}$	-.268	.547	-.024	-.443	-.032	.314
Q, 61:3-72:4	(.193)	(.203)	(.051)	(.117)	(.064)	(.126)
r.o. change	[-1.39]	[2.70]	[-.46]	[-3.79]	[-.49]	[2.49]
3) Ln(TOT)	-.350	.645	-.014	-.277	-.106	-.295
Q, 61:1-72:4	(.191)	(.134)	(.045)	(.107)	(.068)	(.152)
levels	[-1.83]	[4.81]	[-.31]	[-2.59	[-1.55]	[-1.94]
4) Ln(TOT)	-.276	.578	-.042	-.427	-.029	.359
Q, 61:2-72:4	(.195)	(.152)	(.051)	(.105)	(.066)	(.127)
levels	[-1.42]	[3.81]	[-.82]	[-4.05]	[-.44]	[2.82]
5) $\widehat{TOT}$	-.061	-.009	-.124	.159	.044	.167
Q, 61:1-75:1	(.090)	(.272)	(.075)	(.114)	(.076)	(.178)
r.o. change	[-.68]	[-.03]	[-.164]	[1.39]	[.58]	[.94]
6) $\widehat{TOT}$	-.056	-.0036	-.112	.182	.036	.116
Q, 61:1-75:1	(.089)	(.269)	(.076)	(.117)	(.077)	(.184)
Rate of Change	[-.63]	[-.01]	[-1.48]	[1.56]	[.47]	[.63]
7) Ln(TOT)	.092	-.201	-.150	.187	-.035	-.264
Q, 61:1-75:1	(.098)	(.143)	(.069)	(.139)	(.088)	(.243)
levels	[.93]	[-1.41]	[-2.18]	[1.33]	[-.40]	[-1.09]
8) Ln(TOT)	-.046	.171	-.137	..139	.027	.162
Q, 61:2-75:1	(.091)	(.310)	(.080)	(.119)	(.076)	(.179)
levels	[-.50]	[.55]	[-1.71]	[1.17]	[.36]	[.90]

(continued)

TABLE 1

LHS Form Period	ks/Franc	P frnc	kr/Yen	P/japan	Pswed	C
1) $\widehat{TOT}$ 72:4	.557	.0057	-.287	-.614	.138	-
Q, 61:2	(.211)	(.061)	(.181)	(.117)	(.137)	
r.o. change	[2.64]	[-.09]	[-1.59]	[-5.24]	[1.01]	
2) $\widehat{TOT}$	.0048	.476	-.244	-.547	.116	
Q, 61:3-72:4	(.062)	(.211)	(.184)	(.119)	(.136)	
r.o. change	[.08]	[2.26]	[-1.32]	[-4.57]	[.86]	
3) Ln(TOT)	-.028	.120	-.289	-.393	.048	2.03
Q, 61:1-72:4	(.072)	(.150)	(.191)	(.117)	(.116)	(.878)
levels	[-.35]	[.81]	[-1.51]	[-3.37]	[.41]	[2.32]
4) Ln(TOT)	-.0026	.361	-.274	-.551	.160	1.83
Q, 61:2-72:4	(.067)	(.167)	(.188)	(.107)	(.117)	(.91)
levels	[-.04]	[2.16]	[-1.46]	[-5.16]	[1.37]	[2.01]
5) $\widehat{TOT}$	.067	.755	-.091	-.910	-.57	-
Q, 61:1-75:1	(.079)	(.315)	(.091)	(.171)	(.189)	
r.o. change	[.85]	[2.40]	[-1.00]	[-5.32]	[-.08]	
6) $\widehat{TOT}$	.074	.697	-.116	-.876	.014	-
Q, 61:1-75:1	(.079)	(.323)	(.091)	(.175)	(.190)	
Rate of Change	[.94]	[2.16]	[-1.26]	[-5.01]	[0.07]	
7) Ln(TOT)	-.130	.501	-.248	-.769	.581	3.64
Q, 61:1-75:1	(.077)	(.228)	(.093)	(.162)	(.151)	(.85)
levels	[-1.67]	[2.20]	[-2.68]	[-4.73]	[3.84]	[4.28]
8) Ln(TOT)	.059	.564	-.117	-.914	.062	3.66
Q, 61:2-75:1	(.080)	(.334)	(.088)	(.177)	(.180)	.78
levels	[.74]	[1.69]	[-1.33]	[-5.18]	[.35]	[4.59]

(continued)

TABLE 1

LHS Form Period	SSR	S.E.E.	No. Obs.	ρ	D.W.	$\overline{LHS}$
1) $\widehat{TOT}$ 72:4 Q, 61:2- r.o. change	22.06	.783	47	-	-	.0234
2) $\widehat{TOT}$ Q, 61:3-72:4 r.o. change	21.31	.780	46	-.25 (.14) [-1.76]	-	-.0018
3) Ln(TOT) Q, 61:1-72:4 levels	.0020	.0075	48	-	1.47	4.61
4) Ln(TOT) Q, 61:2-92:4 levels	.0017	.0070	47	.49 (.13) [3.84]	1.94	4.61
5) $\widehat{TOT}$ Q, 61:1-75:1 r.o. change	71.32	1.26	56	-	-	-.061
6) $\widehat{TOT}$ Q, 61:1-75:1 Rate of Change	70.70	1.27	55	-.09 (.13) [-.65]		-.044
7) Ln(TOT) Q, 61:1-75:1 levels	.0079	.013	56	-	1.55	4.61
8) Ln(TOT) Q, 61:2-75:1 levels	.0063	.012	55	.89 (.07) [13.1]	1.97	4.60

(continued)

TABLE 1

rog = rate of change

Q = quarterly

LHS = mean of the LHS variable

The price indices and the terms of trade are both period averages. This implies that the correct variables to use are period average exchange rates. For the period prior to 1973, the infrequent changes in parity imply that the use of end-of-period rates does not severely bias the results. For the period from 1973 on, the frequent changes in exchange rates imply that the use of end-of-period rates will bias the regression coefficients.

Quarterly Data

The first hypothesis tested on the quarterly data is the hypothesis that all coefficients for each variable are the same for both the period preceeding and the period following 1973; the advent of floating rates. Using a Chow test, we are able to reject at the 5 per cent significance level the null hypothesis that all the coefficients have remained the same over the entire period in both the rate of change and the level formulation (See regression results Table 1).

Rate of change: $F_{(9,36)} = 8.93$

Level: $F_{(9,36)} = 10.47$

Next we test the hypothesis that in the first sub-sample, each exchange rate coefficient is equal to the corresponding price coefficient. Using Chow tests, we are able to reject the null hypothesis of equality at the 5 per cent level in both the rate of change and the level formulation:

Rate of change: $F_{(6,36)} = 6.98$

Level: $F_{(6,36)} = 8.32$

The appropriate regressions which allow all price and exchange rate coefficients to vary over the first sub-sample are (1) and (4) Table 1. We are, of course, unable to do a similar test for the second sub-sample, as there are insufficient degrees of freedom. Table 2 shows the regression results of constraining the price and exchange rate variables for each country to have the same effect. Table 3 shows the difference between the price and exchange rate effect for each country when they are allowed to vary.

Looking at regressions (1) and (4) we notice that all the coefficients (with the exception of the coefficient of the French price level which is very close to zero in both cases) are of the same sign and magnitude in the level and rate of change formulations. This implies that the assumption used to derive the level specification, that the price level in country i is representative of the price of all goods, works fairly well.

In both equations we see that a change in any of the five exchange rates considered has no effect on the terms of trade which is significantly different form zero. The sum of the exchange rate coefficients which is the effect on the terms of trade of an equiproportional devaluation of the kronor against

TABLE 2

LHSV Period Form	kr/$ + Pus	kr/P + Puk	kr/franc + Pfr	kr/mark+Pgrm	-Pswed
1) $\widehat{TOT}$	-.013	-.061	.042	.072	-.232
61:]-72:4	(.106)	(.061)	(.077)	(.073)	(.135)
Rate of Change	[-.12]	[-0.99]	[.54]	[.99]	[-1.72]
2) $\widehat{TOT}$	.0013	-.045	.032	-.015	-.155
61:3-72:4	(.08)	(.055)	(.070)	(.072)	(.136)
Rate of Change	[.02]	[-.81]	[.46]	[-.20]	[-1.14]
3) Ln(TOT)	0.046	-.159	-.126	.233	-.154
61:1-72:4	(.044)	(.050)	(.049)	(.061)	(.110)
level	[1.04]	[-3.18]	[-2.56]	[3.82]	[-1.39]
4) Ln(TOT)	-.021	-.109	.125	-0.82	-.207
61:2-72:4	(.065)	(.060)	(.073)	(.067)	(.132)
level	[-.32]	[-1.81]	[1.71]	[-1.23]	[-1.56]

(continued)

TABLE 2

	C	ρ	DW	s.e.e.	SSR	No. obs.	$\overline{LHS}$	kr/yen + Pjap
1) $\hat{TOT}$ 61:2-72:4 Rate of Change				1.07	47.7	47	-.023	-0.272 (0.120) [-2.26]
2) $\hat{TOT}$ 61:3-72:4 Rate of Change	-	-.42 (.13) [-3.22]	-	.998	40.85	46	-.0018	-.130 (.091) [-1.42]
3) Ln(TOT) 61:1-72:4 level	4.24 (.20) [21.2]	-	1.23	.011	.0052	48	4.61	-.148 (.109) [-1.36]
4) Ln(TOT) 61:2-72:4 level	4.38 (.29) [15.2]	.54 (.12) [4.41]	2.11	.010	.0041	47	4.61	-.119 (.008) [-1.45]

TABLE 3

Rate-of-Change

1) United States $\alpha_1 - \alpha_6 = -0.832$
(0.325)
[-2.56]

2) United Kingdom $\alpha_3 - \alpha_7 = 0.471$
(0.121)
[3.89]

3) Germany $\alpha_2 - \alpha_8 = -0.369$
(0.130)
[-3.00]

4) France $\alpha_4 - \alpha_9 = 0.563$
(0.220)
[-2.56]

5) Japan $\alpha_5 - \alpha_{10} = 0.328$
(0.198)
[1.65]

$\Sigma\alpha_i = -0.611$
(0.345)
[-1.77]

$\hat{\alpha}Pswed = .138$
(.137)
[1.01]

(continued)

TABLE 3

$\Sigma\alpha_i + \hat{\alpha}Pswep = -.473$

(.361)

[-1.31]

LEVELS

1) United States $\alpha_1 - \alpha_8 = -0.854$

(0.152)

[-5.62]

2) United Kingdom $\alpha_3 - \alpha_6 = 0.385$

(0.106)

[3.63]

3) Germany $\alpha_2 - \alpha_9 = -0.388$

(0.140)

[-2.76]

4) France $\alpha_4 - \alpha_{10} = -0.364$

(0.177)

[-2.05]

(continued) TABLE 3

5) Japan $\alpha_5 - \alpha_9 = .277$

(.195)

[1.42]

$\Sigma\alpha_i = -0.623$ $\hat{\alpha P}swed = .160$

ex. rt(0.364)

[-1.71]

$\Sigma\alpha_i + \hat{\alpha P}swed = -.0463$

(0.357)

[-1.30]

all currencies considered is not significantly different from zero either, although the point estimate is negative. (See Table 3 for point estimates.) The very large variances on these estimates may very well be due to the small variation in these exchange rates in the period under consideration.

The price coefficients for all five foreign countries are significantly different from zero in both formulations. This suggests that price developments abroad that are different across countries affect the Swedish terms of trade. The own price coefficient is positive as expected but not significantly different from zero in either the rate of change or the level formulation.

The price and exchange rate coefficients are significantly different from each other (independent 5 per cent tests) for all countries except Sweden, the home country, and Japan. (See Table 3.) It is interesting to note that the exchange rate coefficients are either negative or close to zero even when the price coefficient is positive and large. This suggests that while a price rise in Country i means that Swedish exports to Country i increase in price and improve the Swedish terms of trade, a devaluation of the kronor against Country i raises the prices of its imports but not of its exports. Price developments are passed through to a greater extent than exchange rate developments. (Another problem may be that there is a lagged adjustment to exchange rate changes but not prices. This is not allowed for in this formulation and means the coefficients of the exchange rates are too low.)

Looking at the regressions, we note that the price levels in the United States, Germany, and France have positive coefficients. Positive coefficients mean that Sweden's export goods are commodities that are primarily produced and traded by these countries. Japan and the United Kingdom have negative coefficients meaning that these countries determine the prices of Sweden's import goods. The price level in Sweden has a positive coefficient and the effect of a devaluation of the Swedish kronor on the terms of trade is negative. This suggests that Sweden has some monopoly power in trade and that some of its exports are Swedish products in the sense enunciated earlier. The stronger the feedback from the terms of trade to the price level and exchange rate, the stronger is the bias in the estimated coefficient. Since the bias is negative, the degree of monopoly power for Sweden is overestimated.

For the period from the first quarter of 1973 through the first quarter of 1975, we start estimation forcing all price and exchange rate coefficients to be equal for each foreign country, but allowing them to vary for Sweden. The results are indicated in regressions (1) through (4) in Table 4.

TABLE 4

LHS Period Form	kr/$+Pus	kr/mark+Pger.	kr/P+Puk	kr/franc+Pfrn	Sum α_i	Pswed	C
1) $\hat{TOT}$	-0.167	-.325	.209	.572	.036	-.20	-
Q, 73:1-75:1	(0.288)	(.395)	(.479)	(.508)	(.55)	(.77)	
rog	[-0.58]	[-.82]	[.437]	[1.13]	[.07]	-.26]	
2) $\hat{TOT}$	.358	.684	.984	-.516	-.011	.33	-
Q, 73:2-75:1	(.154)	(.202)	(.192)	(.252)	(.171)	(.24)	
rog	[2.33]	[3.39]	[5.15]	[-2.04]	[-.07]	[1.37]	
3) Ln(TOT)	-.516	-.229	.611	.686	.567	-.44	3.39
Q, 71:1-75:1	(1.06)	(.536)	(.642)	(.776)	(.946)	(.74)	(5.71)
Level	[-.48]	[-.42]	[.951]	[.88]	[.60]	[-.60]	[0.59]
4) Ln(TOT)	≠ 0 equation blows up						
Q, 73:2-75:1	insufficient degrees of freedom						
					α_i-Pswed		
5) $\hat{TOT}$	-.173	-.323	.265	.537	.052		-
Q, 73:1-75:1	(.251)	(.346)	(.379)	(.430)	(.478)		
rog	[-.69]	[-.93]	[.70]	[1.25]	[.11]		
6) $\hat{TOT}$	.480	.669	.685	-.345	-.071		-
Q, 73:1-75:1	(.230)	(.286)	(.165)	(.311)	(.241)		
rog	[2.09]	[2.34]	[4.15]	[-1.10]	[-.29]		
7) LnTOT	-.335	-.182	.458	.641	.412		3.34
Q, 73:1-75:1	(.656)	(.417)	(.189)	(.628)	(.603)		(4.74)
Levels	[-.51]	[-.44]	[2.42]	[1.02]	[.68]		[.70]
8) LnTOT	1.23	1.04	.526	-.909	-.588		-9.13
Q, 73:1-75:1	(.51)	(.36)	(.081)	(.576)	(.482)		(4.04)
Levels	[2.38]	[2.93]	[6.47]	[-1.58]	[-1.22]		[-2.26]

(continued)

TABLE 4

LHS Period Form	ρ	DW	SEE	SSR	NO OBS	$\overline{\text{LHS}}$	kr/yen + PJap
1) TOT Q, 73:1-75:1 rog	-	-	3.57	38.2	9	-.26	-.252 (.346) [-.73]
2) TOT Q, 73:2-75:1 rog	-.73 (.24) [-3.04]		1.12	2.51	8	-.19	-1.52 (.25) [-6.02]
3) LnTOT Q, 71:1-75:1 Level	-	2.75	.027	.0015	9	4.58	0.014 (1.28) [.01]
4) LnTOT Q, 73:2-75:1							
5) TOT Q, 73:1-75:1 rog	-	-	3.13	39.1	9	-.26	-.254 (.298) [-.85]
6) TOT Q, 73:1-75:1 rog	-.67 (.26) [-2.53]	-	1.5	6.71	8	-.19	-1.56 (.367) [-4.25]
7) LnTOT Q, 73:1-75:1 Levels	-	2.59	.023	.0015	9	4.58	-.170 (.862) [-.20]
8) LnTOT Q, 73:1-75:1 Levels	-.77 (.22) [3.51]	2.43	.011	.0002	8	4.58	-2.43 (.747) [-3.26]

(continued)

TABLE 4

LHS Period Form	kr/$+Pus	kr/mark+Pger	kr/P+Puk	kr/franc+Pfrn	Pswed	C
9) TOT Q, 73:1-75:1 rog	-.178 (.222) [-.80]	-.400 (.279) [-1.22]	.238 (.255) [.94]	.527 (.375) [1.40]	0	-
10) TOT Q, 73:1-75:1 rog	.444 (.190) [2.34]	.633 (.235) [2.69]	.699 (.139) [5.01]	-.279 (.206) [-1.36]	0	-
11) LnTOT Q, 73:1-75:1 Level	-.147 (.554) [-.27]	-.086 .365 [-.23]	.427 (.171) [2.49]	.279 (.312) [.89]	0	1.85 (3.91) [.47]
12) LnTOT Q, 73:1-75:1 Level	.706 (.316) [2.23]	.704 (.237) [2.97]	.502 (.086) [5.80]	-.232 (.169) [-1.3]	0	-4.89 (2.29) [-2.14]

rog = rate of change, Q = quarterly
(S.E.) [t-stat]

(continued)

TABLE 4

LHS Period Form	ρ	DW	SEE	SSR	NO OBS	$\overline{\text{LHS}}$	Kr/yen + PJap
9) TOT Q, 73:1-75:1 rog	-	-	2.80	39.3	9	-.26	-.247 (.263) [-.94]
10) TOT Q, 73:1-75:1 rog	.68 (.25) [-2.64]	-	1.31	6.83	8	-.19	-1.497 (.289) [-5.18]
11) LnTOT Q, 73:1-75:1 Level	-	2.60	.021	.0018	9	4.58	-.473 (.686) [-.69]
12) LnTOT Q, 73:1-75:1 Level	-.76 (.23) [-3.29]	2.83	.011	.0004	8	4.58	-1.68 (.40) [-4.19]

The correct results are from regression (2), the rate-of-change equation corrected for autocorrelation. (Given the similarity between regression (1) and regression (3), we can see that the level formulation should yield similar results when corrected for autocorrelation. This correction could not be carried out due to insufficient degrees of freedom.)

Comparing these results to those for the pre-1973 results, we see that the coefficient of the United Kingdom is now positive and significant at 5 per cent. The coefficient for Japan is negative and significant at 5 per cent. The sum of the coefficients and the Swedish price level have the correct sign. A devaluation of the kronor or a fall in the Swedish price level causes a fall in the terms of trade. The devaluation coefficient and the price coefficient are not significantly different from each other. Constraining these coefficients to be the same and re-estimating yields regressions (5) through (8). The results here are not very different from those obtained earlier. Finally, seeing that the devaluation effect for Sweden is not significantly different from zero, we constrain this coefficient to be equal to zero. The constrained equations are regressions (9) through (12). The results are again quite similar to the earlier ones. (Starting from the hypothesis that the devaluation coefficient and Swedish price level are different, we are unable to reject the null hypothesis that the devaluation coefficient and the price level coefficient are both equal to zero. This is true of both the level and rate of change formulations.)

Monthly, Period Average Data, 1973-1975

Looking at the period from January, 1973 through November, 1975, using monthly data we estimate the terms of trade regressions in both level and rate of change formulations initially allowing the exchange rate and price coefficients to vary for each country. The estimated regressions are (1) through (4) Table 5. (Appendix I gives the percentage change in the price levels and the exchange rates, their means, standard deviations, and correlation matrix.) We initially test the hypothesis that all the exchange rate coefficients are equal to their respective price coefficients except for the home country. The constrained equations are equations (5) through (8) in Table 5. Using a Chow test at the 5 per cent significance level, we are unable to reject the null hypothesis that the exchange rate coefficients are equal to the price coefficient for each foreign country.

Rate of Change: $F_{(5,23)} = 0.98$

Level: $F_{(5,22)} = 1.53$

Looking at the restricted regressions, we find that we can reject, using a test with 5 per cent significance, the hypothesis that the devaluation coefficient for Sweden, which is the sum of the foreign country exchange rate coefficients, is equal to the negative of the price coefficient for Sweden in the level formulation. (A devaluation should have the same effect as a fall in the domestic price level.) In regression (8), $\Sigma\gamma_i + \text{Pswed} = \underset{\substack{(.050)\\ [-4.34]}}{-\ .208}$. We cannot reject this null hypothesis in the rate of change specification either. In regression (5), $\Sigma\gamma_i + \text{Pswed} = \underset{\substack{(.247)\\ [-1.77]}}{-\ .439}$ .1/

Comparing the rate-of-change specification with the level specification, we see that the rate-of-change specification does not perform very well in terms of the s.e.e. All the coefficients, with the exception of that for the United States, have the same signs in the rate of change and level specification; but the magnitudes differ.

1/ Various other constrained equations are estimated. In equations (9) through (12) in Table 5, we constrain the devaluation effect to be equal to the price effect for Sweden. In equations (13) through (16) in Table 6, we constrain the devaluation effect and the price effect to be equal to zero. This is constraining the regression to obey the traditional small country assumption that a devaluation will not affect the terms of trade. While the signs do not change, the magnitude of the coefficients changes and the standard errors are large, even for the level formulation.

TABLE 5

Monthly, Period Average
73:1-75:11

	kr/$	Pus	kr/P	Puk	kr/mark	Pger.
1) TÔT	.143	.249	-.400	.140	-.443	-.033
Monthly	(.142)	(1.03)	(.263)	(.345)	(.557)	(.128)
rog	[1.01]	[.24]	[-1.52]	[.41]	[-.79]	[-.26]
2) TÔT	.190	.072	-.417	.131	-.028	-.464
Monthly	(.154)	(1.06)	(.273)	(.354)	(.129)	(.565)
rog	[.124]	[.07]	[-1.53]	[.37]	[-.22]	[-.82]
3) LnTOT	-.101	+.269	-.424	-.065	-.190	-.688
Monthly	(.106)	(.445)	(.175)	(.181)	(.128)	(.526)
Level	[-.95]	[.60]	[-2.41]	[-.01]	[-1.49]	[-1.30]
4) LnTOT	.139	.032	-.386	.231	-.08	-.678
Monthly	(.149)	(1.16)	(.228)	(.299)	(.13)	(.558)
Level	[.93]	[.03]	[-1.69]	[.77]	[-.63]	[-1.21]

	kr/$ + Pus	kr/P + Puk	kr/mark + Pger.
5) TÔT	.0016	-.141	-.101
Monthly	(.123)	(.197)	(.112)
rog	[.01]	[-.71]	[-.90]
6) TÔT	.061	-.102	-.096
Monthly	(.138)	(.208)	(.110)
rog	[0.44]	[-.49]	[-.87]

(continued)

TABLE 5

	kr/frn	Pfr	kr/yen	Pjap	Pswed	C
1) $\widehat{TOT}$	-.128	.112	-.178	-.010	-.52	-
Monthly	(.125)	(.118)	(.162)	(.300)	(.36)	
rog	[-.101]	[.95]	[-1.10]	[-.03]	[-1.44]	
2) $\widehat{TOT}$	.095	.095	-.197	-.051	-.55	-
Monthly	(.119)	(1.30)	(.164)	(.310)	(.37)	
rog	[.79]	[.07]	[-1.20]	[-.17]	[-1.49]	
3) LnTOT	.375	0	-.193	-.004	-.224	8.43
Monthly	(.113)	0	(.123)	(.265)	(.330	(2.04)
Level	[3.35]	0	[-1.57]	[-.01]	[-.68]	[4.14]
4) LnTOT	.170	.071	-.327	-.186	-.433	8.57
Monthly	(.125)	(1.36)	(.173)	(.327)	(.367)	(2.12)
Level	[1.36]	[.15]	[-1.89]	[-.57]	[-1.18]	[4.04]

	kr/frn + Pfrce	$\Sigma\alpha_i$	Pswed	C
5) $\widehat{TOT}$	.087	-.29	-.15	-
Monthly	(.114)	(.16)	(.27)	
rog	[.77]	[-1.85]	[-.56]	
6) $\widehat{TOT}$	.054	-.26	-.21	-
Monthly	(.116)	(.15)	(.28)	
rog	[.46]	[-1.71]	[-.75]	

(continued)

TABLE 5

	ρ	DW	S.E.E.	SSR	NO. OBS.	$\overline{\text{LHS}}$	$\Sigma\alpha_i$
1) $\hat{\text{TOT}}$ Monthly rog	-	-	1.49	50.8	34	-.058	
2) $\hat{\text{TOT}}$ Monthly rog	.05 (.17) [.30]	-	1.50	49.5	33	-.062	
3) LnTOT Monthly Level	-	1.62	1.62	.0048	35	4.53	
4) LnTOT Monthly Level	.56 (.14) [3.92]	1.80	.014	.0041	34	4.53	

	ρ	DW	S.E.E.	SSR	NO. OBS	LHS	kr/yen+PJap
5) $\hat{\text{TOT}}$ Monthly rog	-	-	1.48	61.7	34	-.058	-.136 (.117) [-1.17]
6) $\hat{\text{TOT}}$ Monthly rog	.15 (.17) [.87]	-	1.50	60.4	33	-.062	-.172 (.121) [-1.42]

(continued)

TABLE 5

	kr/$ + Pus	kr/P + Puk	kr/mark + Pger.
7) LnTOT	-.185	-.238	-.215
Monthly	(.111)	(.145)	(.111)
Level	[-1.67]	[-1.64]	[-1.95]
8) LnTOT	-.220	-.276	-.228
Monthly	(.086)	(.126)	(.108)
Level	[-2.57]	[-2.18]	[-2.11]
9) $\hat{TOT}$	.012	-.080	-.085
Monthly	(.128)	(.020)	(.116)
rog	[.08]	[-.40]	[-.73]
10) $\hat{TOT}$	.0795	-.036	-.090
Monthly	(.146)	(.215)	(.113)
rog	[.55]	[-.17]	[-.79]
11) LnTOT	-.0015	-.266	.0124
Monthly	(.089)	(.161)	(.119)
Level	[-.01]	[-1.65]	[.10]
12) LnTOT	0.0025	-.098	-.084
Monthly	(.136)	(.202)	(.111)
Level	[.02]	[-.48]	[-.75]

(continued)

TABLE 5

	kr/fr+ Pfrce	$\Sigma\alpha_i$	Pswed	C
7) LnTOT Monthly Level	0.391 (0.089) [4.39]	-.42 (.19) [-2.22]	.22 (.19) [1.15]	5.76 (1.07) [5.35]
8) LnTOT Monthly Level	0.426 (0.075) [5.69]	-.43 (.19) [-2.3]	.23 (.19) [1.20]	6.09 (.89) [6.86]
9) $\widehat{TOT}$ Monthly rog	.066 (.118) [.56]	-.239 (.159) [-1.50]		-
10) $\widehat{TOT}$ Monthly rog	0.028 (.113) [.24]	-.193 (.148) [-1.30]		-
11) LnTOT Monthly Levels	.333 (.092) [3.62]	-.297 (.239) [-1.24]		3.66 (.89) [4.13]
12) LnTOT Monthly Levels	.092 (.119) [.77]	-.264 (.168) [.02]		4.09 (.95) [4.32]

(continued)

TABLE 5

	P	DW	S.E.E.	SSR	NO. OBS	LHS	Kr/yen + Jap.
7) LnTOT Monthly Level	.18 (.17) [1.08]	1.81	.014	.0055	34	4.53	-.174 (.148) [-1.17]
8) LnTOT Monthly Level	-	1.77	.014	.0056	35	4.53	-.136 (.108) [-1.26]
9) TOT Monthly rog	-	-	1.53	68.6	34	-.058	-0.152 (0.120) [-1.26]
10) TOT Monthly rog	.20 (.17) [1.16]	-	1.54	66.8	33	-.062	-.175 (.125) [-1.40]
11) LnTOT Monthly Levels	-	1.10	.018	.0096	35	4.53	-.374 (.118) [-3.17]
12) LnTOT Monthly	.81 (.10) [8.08]	1.69	.015	.0062	34	4.53	-.176 (.245) [-.72]

TABLE 6

Monthly Averages

	kr/$ + Pus	kr/P + Puk	kr/mk + Pger.	kr/frn + Pfr.	C
13) $\hat{TOT}$	.057	.049	-.033	.097	-
Monthly	(.127)	(.186)	(.113)	(.118)	
rog	[.45]	[.26]	[-.29]	[.82]	
14) $\hat{TOT}$	.135	.097	-.071	.037	-
Monthly	(.148)	(.20)	(.111)	(.118)	
rog	[.91]	[0.49]	[-.64]	[.26]	
15) LnTOT	.054	-.123	.123	.393	2.88
Monthly	(.077)	(.114)	(.097)	(.079)	(.63)
Levels	[.70]	[-1.08]	[1.55]	[5.00]	[4.55]
16) LnTOT	.051	.049	-.028	.121	3.57
Monthly	(.135)	(.185)	(.108)	(.120)	(.89)
Levels	[.38]	[.26]	[-.26]	[1.01]	[4.02]

1/ Multicollinearity problems Pus, Puk, Pfr. Pger,Pjap., Pswed are the price level indices in the United States, Britain, Germany, France, Japan, and Sweden. Kr/$, kr/P, kr/U.K., kr/fr., kr/yen are the kronor/dollar, kronor/pound, kronor/mark, kronor/franc and kronor/yen rates

(continued)

TABLE 6

	ρ	DW	S.E.E.	SSR	NO. OBS.	$\overline{\text{LHS}}$	kr/yen+PJap.	$\Sigma\alpha_i=0$
13) $\hat{TOT}$ Monthly rog			1.57	74.0	34	-.058	-.170 (.122) [-1.39]	
14) $\hat{TOT}$ Monthly rog	.27 (.17) [1.63]	-	1.56	70.56	33	-.062	-.192 (.124) [-1.55]	
15) LnTOT Monthly Levels	-	1.24	.018	.010	35	4.53	-.447 (.103) [-4.32]	
16) LnTOT Monthly Levels	.83 (.10) [8.68]	.63	.015	.0067	34	4.53	-.193 (.139) [-1.39]	

It appears that regression (8) is the most informative regression in terms of the effect of exchange rates on the terms of trade in Sweden. Three characteristics of regression (8) attract attention. The first characteristic is that the standard errors of the coefficients are not very large. The variables are price movements net of exchange rate changes. There will be a significant fluctuation in these variables when the exchange rate fluctuates from its purchasing-power parity level. This condition is fulfilled for the period from 1973 to 1975 when analyzed on a monthly basis. The exchange rate fluctuations are sufficiently frequent and uncorrelated that multicollinearity is not a serious problem for efficient estimation.

The second characteristic is that the small country assumption does not hold very well, and that a devaluation of the Swedish kronor against all currencies will have a depressing influence on the terms of trade. This is not very surprising as all countries probably have some monopoly power in terms of their specialized exports. This consideration has further implications for the specification of the regression. The other "small" countries that Sweden trades with should also have some monopoly power in trade. The exchange rate of their currencies vis-a-vis the Swedish kronor and their price levels also have a significant effect on the Swedish terms of trade.

Since these variables are excluded but should actually be included, the estimates of other coefficients are biased and inconsistent.[1/]

The principal "small" trading partners of Sweden are the other Scandinavian countries, Norway, Denmark, and Finland. All these countries are members of the European joint float. This implies that the movement of their currencies is similar to the movement of the Deutsche mark against the Swedish kronor. The float implies that the value of the participating currencies fluctuates within 2.5 percent for all participating currencies. The development of prices within these countries must be fairly similar, on the average, with that of the other countries of the float. A very different movement and development of the price levels of the countries within the float would make it increasingly difficult to maintain parity between the currencies. This situation has arisen and the Danish kronor has dropped to the floor of the float several times while being supported by the other members. (In the fall of 1976, the internal rates of the float were realigned.)

1/ The five countries included in the regression, the United states, the United Kingdom, France, Germany, and Japan accounted for 52 percent of the Swedish trade in 1973. (Average trade is the average of imports and exports.) Denmark, Norway, and Finland account for another 29 percent of the Swedish trade.

If the development of prices within Norway, Denmark, and Finland were exactly the same as the movement of prices in Germany and the movement of the Swedish kronor against their currencies were the same as the movement of the kronor-mark rate, the absence of these countries would not bias the regression results. The only effect would be that the coefficient appearing before the Deutsche mark is an indication of the effect of the change in the rate of the kronor against all these countries. Since these countries have some monopoly power in their exports, Sweden's imports, the coefficient in equation (8) is an underestimate of the extent to which a change in the prices of German products affects the prices of Swedish exports. Insofar as the deviations of the price levels and the exchange rate of Norway, Finland, and Denmark from those of Germany are random or constant, the estimates in regression (8) are still unbiased. This is not the case if the deviations depend in some manner on any of included variables. It is difficult to see why this should be the case.

The third remarkable characteristic of equation (8) is that the devaluation coefficient and the price coefficient differ for Sweden, the home country, whereas the exchange rate coefficient and the price coefficients of the other countries are constrained to be the same. Furthermore, the exchange rate coefficient is larger in magnitude than the price coefficient in the case of Sweden. The 95 percent confidence intervals for the exchange rate and price coefficients are respectively,

$-0.41 \leq$ exchange rate coefficient $\leq -.83$

and

$-.62 \leq$ price coefficient $\leq .16$.

The interval for the exchange rate coefficient is fairly narrow while that of the price coefficient is fairly wide and spans 0. A one percent devaluation for the kronor against all currencies leads to a 0.43 percent decline in the terms of trade. A one percent decline in the Swedish price level leads to a 0.23 percent decline in the terms of trade.

The difference between the exchange rate and the price coefficient implies that traders react differently to an appreciation of the Swedish kronor with respect to other currencies as opposed to a rise in Swedish prices. One possibility is in lagged adjustment. Foreign prices of Swedish goods rise immediately in response to an appreciation of the kronor but adjust over time to an increase in prices.

Looking at regression (8), we see that prices in the United States, the United Kingdom, Germany, and Japan determine the prices of Swedish imports more so than the prices of its exports. Prices in France determine the prices of its exports.

Regression (12) which constrains the devaluation coefficient to equal the price coefficient for Sweden differs in that prices in the United States have a negligible effect on the Swedish terms of trade.[1/]

1/ Use of monthly data with end of period exchange rates for the period 1973-1975 yields results significantly different from those obtained using other sets of data. If end-of-period observations on price levels and the terms of trade were available, these could be used with the end of period exchange rates to yeild theoretically correct results. The use of period average price series and end-of-period exchange rates can be analyzed using either errors in variables or specification analysis. The conclusion is that these estimates are biased. These can be seen by looking at the results of these estimation procedures. Starting from the general hypothesis that all exchange rate and price coefficients are different, we are unable to reject the null hypothesis that the price coefficient and the exchange rate coefficient are equal for all foreign countries. (This is true of both level and rate of change specifications at the 5 percent.) The exchange rate and price coefficient for Sweden, however, have the wrong sign. The regression implies that a devaluation of the Swedish kronor which corresponds to a fall in the Swedish price level causes an improvement in the Swedish terms of trade. This result suggests that the coefficients are biased upwards as a consequence of using this particular set of data. These regressions are presented in Tables II.1 and II.2 of Appendix II. Regressions (5) through (8) present the results when the exchange rate coefficient is constrained to equal the price coefficient for all foreign countries. In regressions (6) and (8) where the correction for serial correlation has been made, the exchange rate and price coefficient for Sweden still have the wrong sign and the standard errors on most of the coefficients are quite large. (The regression results appear to show problems of collinearity between the independent variables which can cause the large standard errors to appear.) In both the rate-of-change and level formulation, we are unable to reject the null hypothesis that the exchange rate and price coefficients for Sweden are equal. Imposing this constraint and reestimating, we obtain regressions (9) through (12) on Table II.1. In regressions (10) and (12), where the correction for serial correlation has been made, we are able to reject the null hypothesis that the devaluation coefficient for Sweden, which still has the wrong sign, is equal to zero. The wrong sign on the devaluation coefficient leads us to constrain it to equal zero. The results are presented in regressions (13) through (16) on Table II.2. Once again problems of collinearity between the independent variables give large standard errors and imprecise estimates of most of the coefficients. It is interesting to note that only in these constrained equations is there any correspondence between the results using end-of-period exchange rates and those using period average exchange rates. In both sets, the United States, the United Kingdom, and France determine the cost of Swedish exports while Germany and Japan determine the cost of its imports. In the quarterly data from 1973 to 1975, Germany and France switch positions

These results indicate that the terms of trade in Sweden are affected by exchange rate developments and price developments abroad that differ between the large trading countries of the world. This implies that the choice of an exchange rate regime will have implications for the behavior of the terms of trade under different currency arrangements.

The Behavior of the Swedish Terms of Trade under Alternative Currency Arrangements

Using the results obtained on the behavior of the terms of trade, we can compare the behavior of the terms of trade under various currency arrangements. The kronor can be tied to the Deutsche mark, the British pound or the U. S. dollar. During this interval, the Swedish kronor fluctuated within 2.5 percent of the Deutsche mark. To make the results comparable, we compute the percentage changes that would have occurred each month in the terms of trade if either the kronor-mark rate, the kronor-dollar rate, or the kronor-pound rate had remained constant. If either of these rates had remained constant during this period, then the value of the other currencies in terms of the kronor would have been different. We calculate in each case what the value of the other four currencies would have been in Swedish kronor. We are assuming that the exchange rate between any of these two currencies would not have been affected by Swedish actions. We also assume that the behavior of prices in these countries would not have been different.

The behavior of Swedish prices is more problematic. The currency arrangements have strong implications for the price behavior of a small country that is tied to larger country. Price developments in the small country and the country to which its currency is tied cannot be vastly different if the arrangement is not to be subject to severe strains. Initially, we allow the price level to change in Sweden as it actually did change since there is some short-run flexibility in the choice of an inflation rate, even within a currency bloc. We also consider the alternative that the changes in the price level in Sweden have to equal those of the country to which it has tied its currency.

The home country is interested in minimizing the variance of the changes in terms of trade. This variance is a function of the variance in all the price and exchange rate changes and their covariances. Looking at the results for 1973-1975 under different currency regimes, we obtain the following results. (See Appendix III for the actual and simulated behavior the Swedish terms of trade for the period 1973-1975 under different currency arrangements.) Table 7 gives the rankings in terms of the variance of the terms of trade. Note that the conclusions are not independent of the regression coefficients used or of the assumption about the differential effect of the price and exchange rate coefficients of the home country. The assumption about the behavior of Swedish prices does not appear to change the rankings. These results indicate that tying to the pound Sterling would have reduced the variance in the terms of trade over that obtained from tying to the Deutsche mark.1/

The variance of the terms of trade is not the only consideration in deciding which currency to tie to. Although tying to the pound Sterling might have reduced fluctuations in the terms of trade for Sweden, it would also have involved a depreciation of the kronor and a larger deterioration in the terms of trade. (Some deterioration in the terms of trade results in all circumstances. This is probably due to the increase in oil prices.) As we show later, a decision to fix the exchange rate implies constraints on the domestic price level. The expected direction of movement of the exchange rate--which is determined by the rate of inflation of the country with respect to whom the parity is maintained--is also a consideration in deciding what currency to tie to.

1/ The actual variance of the Swedish terms of trade is much larger than almost all the simulated series. During this period, the kronor was within a 2.5 percent of the mark. It is difficult to say what the variance would have been if it were not supported within this margin. Presumably, it would have been greater.

TABLE 7

Ordering by standard deviation (increasing order)[1/]

Using actual Swedish prices

1) Level, price coefficient not equal to devaluation coefficient:dollar, pound, mark
2) Level, price coefficient equal to devaluation coefficient: dollar, pound, mark
3) Rate of change, price coefficient not equal to devaluation coefficient: dollar, pound, mark
4) Rate of change, price coefficient equal to devaluation coefficient: dollar, pound, mark.

Using prices of country to whose currency kronor is tied:

1) Level, price coefficient not equal to devaluation coefficient: dollar, pound, mark
2) Level, price coefficient equal to devaluation coefficient: dollar, pound, mark
3) Rate of change, price coefficient not equal to devaluation coefficient: dollar, pound, mark
4) Rate of change, price coefficient equal to devaluation coefficient: dollar, pound, mark.

1/ Level or rate of change refers to the regression from which the coefficients are drawn.

Appendix IV derives the behavior of the terms of trade under different currency regimes with different national rates of inflation and exchange rates that are free to move in maintaining purchasing power parity. If all exchange rates are moving in this manner, different rates of inflation will have no effect on the domestic terms of trade regardless of whether or not the home country has some effect on its terms of trade. If the home country does not have some degree of monopoly power in trade, its decision to tie to another country's currency may not affect its terms of trade. If it pursues an inflationary policy different from that of the country to which it is tied, the relative price of tradables to non-tradables will change. In the long run, the price level in the small home country will have to adjust to that of the larger country to which it is tied. If the home country has some monopoly power in trade, the gap between the domestic rate of inflation and that of the partner country will have an effect on the terms of trade.

In the period from January, 1973, to November, 1975, the mark was appreciating relative to the dollar and the dollar relative to the pound. Looking at the means of the changes in the terms of trade under alternative tying assumptions, we find that tying to the mark would have given the smallest deterioration in the terms of trade, while tying to the pound would have a larger deterioration.

The decision of the Swedish authorities to join the European joint float and essentially tie the kronor to the Deutsche mark reflects the desire to reduce the variance of the terms of trade and to follow the price policy being pursued by Germany.

APPENDIX I 1/

TABLE 1

% change in prices	Sweden	Germany	Japan	France	United Kingdom	United States
period	....	....	....	....	....	....
732	0.840	0.679	0.856	0.259	0.731	0.633
733	0.0	0.674	2.261	0.515	0.324	0.896
734	0.833	0.586	1.647	0.682	2.141	0.712
735	0.0	-1.878	1.779	0.929	0.708	0.619
736	1.639	0.930	0.322	0.755	0.470	0.702
737	0.813	0.755	0.800	0.334	0.468	0.175
738	0.0	0.167	0.872	1.157	0.543	1.724
739	0.0	.083	2.474	0.900	0.616	0.429
7310	0.806	0.748	-0.700	1.053	1.965	0.766
7311	0.800	1.231	1.306	0.883	0.675	0.760
7312	0.793	0.895	2.910	0.638	0.819	0.588
741	1.562	0.726	4.080	1.648	1.827	0.833
742	2.290	0.880	3.120	1.773	1.653	1.315
743	0.757	0.239	0.757	0.689	0.925	1.138
744	-0.763	0.555	2.939	1.582	3.239	0.646
745	-0.769	0.631	0.133	1.191	1.426	1.118
746	0.763	0.393	0.662	1.104	1.008	1.027
747	0.757	0.235	1.885	1.236	0.932	0.784
748	0.751	0.156	0.645	0.793	.066	1.239
749	0.746	0.312	1.776	1.070	0.988	1.148
7410	2.898	0.543	2.172	1.198	2.065	0.759
7411	1.428	0.693	0.616	0.908	1.713	0.828
7412	0.0	0.307	0.429	0.831	1.438	0.673

(continued)

TABLE 1

% change in prices	Sweden	Germany	Japan	France	United Kingdom	United States
period						
751	0.0	0.913	0.367	1.096	2.500	0.447
752	0.709	0.530	0.365	0.748	1.678	0.739
753	0.704	0.452	1.025	0.809	1.882	0.368
754	0.0	0.748	2.414	0.869	3.737	0.513
755	1.388	0.595	0.991	0.730	4.021	0.437
756	0.689	0.738	.058	0.725	1.918	0.796
757	1.360	0.0	0.174	0.719	1.002	1.074
758	1.342	-0.147	0.408	0.650	0.577	0.285
759	0.0	0.515	1.947	0.838	0.832	0.497
7510	1.324	0.293	1.578	0.767	1.385	0.565
7511	0.657	0.292	-0.566	0.635	1.216	0.632

1/ [Monthly, Monthly Average Rates]

TABLE 2

Swedish Terms of Trade

732	.090	751	2.516
733	-0.625	752	0.899
734	0.835	753	-.046
735	0.805	754	-0.497
736	0.748	755	1.415
737	-1.292	756	-0.521
738	2.739	757	0.0
739	0.693	758	-2.403
7310	-1.258	759	-0.469
7311	-1.194	7510	-0.855
7312	-3.010	7511	0.495
741	0.989		
742	-4.690		
743	-2.742		
744	-0.831		
745	2.185		
746	0.543		
747	1.128		
748	-0.313		
749	1.041		
7410	1.158		
7411	-0.420		
7412	0.921		

TABLE 3

Percentage change in Kronor Rates	Dollar	Yen	Franc	Mark	Pound
Period	....	....	....	....	....
732	-3.514	1.728	2.899	2.540	-0.527
733	-2.300	7.181	2.891	3.919	-0.193
734	0.775	0.775	0.183	1.126	1.015
735	-1.712	-1.712	-0.104	-0.846	0.216
736	-5.291	-5.014	0.111	2.775	-3.452
737	2.159	2.159	6.692	11.454	0.850
738	-3.833	-4.107	-8.672	-7.748	-6.557
739	1.355	1.355	0.960	1.274	-0.926
7310	-0.622	-0.887	0.487	-0.165	-0.332
7311	3.754	-0.515	5.284	-2.867	2.223
7312	4.171	3.412	-6.042	1.347	1.237
741	5.525	-0.716	-3.512	-0.256	1.489
742	-2.478	-.075	-0.990	-0.765	-0.181
743	-2.407	0.754	0.321	2.891	0.395
744	-3.792	-2.102	-4.589	-.030	-1.663
745	-3.090	-3.164	-3.175	-0.315	-1.980
746	2.287	1.163	1.524	-0.375	1.306
747	0.137	-1.637	3.579	-0.970	.053
748	0.995	-3.050	.074	-1.486	-0.777
749	1.272	0.742	0.756	-0.424	-.059
7410	-1.865	-1.831	-0.401	0.736	-1.166
7411	-1.829	-2.034	-0.582	1.349	-2.004
7412	-2.954	-3.068	0.297	-0.685	-2.932

TABLE 3

Percentage Change in Kronor Rates	Dollar	Yen	Franc	Mark	Pound
Period					
751	-3.769	-3.551	-.060	0.145	-2.279
752	-1.486	1.106	0.477	.040	-0.159
753	-1.491	-0.634	0.400	-1.051	-0.491
754	1.293	-0.108	1.403	-1.068	-0.676
755	-1.091	-0.848	2.563	.019	-3.194
756	-0.385	-1.119	0.644	-.039	-2.118
757	4.946	4.075	-0.317	-0.317	0.695
758	4.481	3.933	1.074	0.228	1.300
759	2.840	2.272	0.724	1.339	1.536
7410	-1.067	-1.985	0.324	0.261	-2.567
7511	-0.203	-0.255	-0.103	-0.354	-0.471

TABLE 4 1/

	MEANS	STANDARD DEVIATIONS	
DPSWED	0.739	0.757	
DPGERM	0.455	0.502	
DPJAPAN	1.226	1.115	
DPFRANCE	0.903	0.326	
DPUK	1.397	0.922	73:2-75:11
DPUS	0.761	0.316	
DTOT	-0.578	1.549	
DDOLLAR	-0.270	2.792	
DYEN	-0.211	2.550	
DFRANC	0.150	2.837	
DMARK	0.354	2.710	
DPOUND	-0.657	1.775	

1/ DP indicates percentage rate of change of prices and DK indicates percentage rate of change of kronor rates.

(continued)

CORRELATION MATRIX

	DTOT	DDOLLAR	DYEN	DFRANC	DMARK	DPOUND
DPSWED	-0.289	0.175	0.358	0.153	0.120	0.137
DPGERM	-0.161	- .020	- .035	.084	0.180	- .020
DPJAPAN	-0.178	0.189	0.147	-0.213	.074	0.228
DPFRANCE	.063	- .085	-0.423	-0.463	-0.464	- .099
DPUK	0.136	-0.174	-0.243	- .097	-0.146	-0.221
DPUS	.074	-0.186	-0.214	-0.465	-0.511	-0.263
DTOT	1.000	-0.260	-0.442	-0.127	-0.293	-0.461
DDOLLAR	-0.260	1.000	0.531	0.169	.071	0.716
DYEN	-0.442	0.531	1.000	0.307	0.413	0.645
DFRANC	-0.127	0.169	0.307	1.000	0.519	0.406
DMARK	-0.293	.071	0.413	0.519	1.000	0.339
DPOUND	-0.461	0.716	0.645	0.406	0.339	1.000

1/ DP indicates percentage rate of change of prices and DK indicates percentage rate of change of kronor rates.

TABLE 5[1]

CORRELATION MATRIX

	DPSWED	DPGERM	DPJAPAN	DPFRANCE	DPUK	DPUS
DPSWED	1.000	0.176	.060	.063	-.045	.039
DPGERM	0.176	1.000	0.628	0.479	0.260	-0.265
DPJAPAN	0.600	0.628	1.000	0.469	0.153	0.151
DPFRANCE	0.634	.047	0.469	1.000	0.310	0.401
DPUK	- .045	0.260	0.153	0.310	1.000	-0.249
DPUS	- .039	- .026	- .015	0.401	-0.249	1.000
DTOT	-0.289	-0.161	-0.178	.063	0.136	.074
DDOLLAR	0.175	- .020	0.189	- .085	-0.174	-0.186
DYEN	.035	- .035	0.147	-0.423	-0.243	-0.214
DFRANC	0.153	.084	-0.213	-0.463	- .097	-0.465
DMARK	0.120	0.180	.074	-0.464	-0.146	-0.511
DPOUND	0.137	- .020	0.228	- .099	-0.221	-0.263

APPENDIX II

Monthly, with end of
Period Exchange Rates
73:1-75:11

TABLE II.1

LHS Period	kr/$	Pus	kr/£	Puk	kr/mark	Pger.
1) $\widehat{TOT}$	.308	1.78	.187	.726	.277	-.754
Monthly	(.145)	(1.03)	(.194)	(.329)	(.128)	(.561)
73:2-75:11	[2.12]	[1.72]	[.96]	[2.21]	[2.16]	[-1.34]
rog						
2) $\widehat{TOT}$	.369	1.89	.220	.807	.364	-.853
Monthly	(.151)	(1.03)	(.186)	(.373)	(.188)	(.570)
rog	[2.43]	[1.84]	[1.19]	[2.16]	[1.94]	[-1.50]
3) LnTOT	.131	.484	.090	2.53	.148	.134
Monthly	(.145)	(.316)	(.225)	(1.24)	(.155)	(.586)
Level	[.91]	[1.53]	[.40]	[2.04]	[.95]	[.228]
4) LnTOT	.283	1.98	.203	.747	.260	-.753
Monthly	(.149)	(1.19)	(.202)	(.309)	(.157)	(.577)
Level	[1.90]	[1.66]	[1.00]	[2.42]	[1.65]	[-1.35]

(continued)

TABLE II.1

	kr/Fr	Pfrn.	kr/yen	Pjap.	Pswed	C
1) $\widehat{TOT}$	.224	-1.29	-.504	-.354	-.786	-
Monthly	(.142)	(1.29)	(.177)	(.268)	(.337)	
73:2-75:11	[1.58]	[-1.00]	[-2.86]	[-1.32]	[-2.32]	
rog						
2) $\widehat{TOT}$	.213	-1.45	-.52	-.293	-.789	
Monthly	(.146)	(1.32)	(.17)	(.264)	(.368)	
rog	[1.46]	[-1.10]	[-3.11]	[-1.10]	[-2.14]	
3) LnTOT	.432	-2.17	-.618	-.511	-.422	1.40
Monthly	(.151)	(1.45)	(.224)	(.318)	(.320	(2.54)
Level	[2.87]	[-1.50]	[-2.76]	[-1.61]	[-1.32]	[.55]
4) LnTOT	.257	-1.49	-.532	-.345	-.76	4.36
Monthly	(.148)	(1.37)	(-1.88)	(.295)	(.36)	(2.45)
Level	[1.73]	[-1.08]	[-2.82]	[-1.17]	[-2.11]	[1.78]

(continued) TABLE II.1

LHS Period	ρ	DW	SEE	SSR	NO. OBS	$\overline{LHS}$	$\Sigma\alpha_i$
1) $\widehat{TOT}$ Monthly 73:2-75:11 rog	-	-	1.40	45.3	34	-.058	
2) $\widehat{TOT}$ Monthly rog	.31 (.17) [1.87]	-	1.38	41.9	33	-.062	
3) LnTOT Monthly Level	-	1.57	.015	.0055	35	4.53	
4) LnTOT Monthly Level	.81 (.10) [8.16]	1.54	.014	.0042	34	4.53	

(continued)

TABLE II.1

	kr/$+Pus	kr/P+Puk	kr/mark+P ger	kr/Frn+P fr
5) $\hat{TOT}$	.165	.27	.162	.248
Monthly	(.121)	(.16)	(.114)	(.131)
rog	[1.37]	[1.66]	[1.42]	[1.89]
6) $\hat{TOT}$	.232	.320	.130	.161
Monthly	(.120)	(.146)	(.140)	(.132)
rog	[1.94]	[2.19]	[.93]	[1.22]
7) LnTOT	.025	-.060	.064	.638
Monthly	(.114)	(.157)	(.123)	(.089)
Level	[.22]	[-.38]	[.52]	[7.18]
8) LnTOT	.150	.271	.104	.298
Monthly	(.125)	(.163)	(.123)	(.130)
Level	[1.20]	[1.66]	[.84]	[2.29]
9) $\hat{TOT}$	.176	.290	.166	.255
Monthly	(.119)	(.157)	(.133)	(.130)
rog	[1.48]	[1.84]	[1.46]	[1.96]
10) $\hat{TOT}$	.243	.328	.133	.166
Monthly	(.117)	(.143)	(.136)	(.130)
rog	[2.08]	[2.29]	[.98]	[1.28]
11) LnTOT	.268	-.053	.237	.495
Monthly	(.117)	(.192)	(.141)	(.100)
rog	[2.29]	[-.28]	[1.69]	[4.99]

APPENDIX II

(continued)

TABLE II.1

	$\Sigma\alpha_i$	Pswed	C	ρ	DW	SEE	SSR	NO OBS	$\overline{LHS}$
5) $\hat{TOT}$ Monthly rog	.460 (.192) [2.40]	-.66 (.28) [-2.39]	-	-	-	1.41	56.0	34	-.058
6) $\hat{TOT}$ Monthly rog	.441 (.223) [1.97]	-.62 (.32) [-1.99]	-	.36 (.16) [2.24]	-	1.38	51.3	33	-.062
7) LnTOT Monthly Level	.27 (.20) [1.32]	-.466 (.211) [-2.21]	3.97 (1.26) [3.14]		1.71	.016	.0067	35	4.53
8) LnTOT Monthly Level	.419 (.204) [2.06]	-.620 (.236) [-2.63]	2.96 (1.34) [2.20]	.84 .09 [9.03]					
	$\Sigma\alpha_i$-Pswed								
9) $\hat{TOT}$ Monthly rog	.492 (.187) [2.63]		-	-	-	1.41	57.4	34	-.058
10) $\hat{TOT}$ Monthly rog	.470 (.214) [2.19]		-	.38 (.16) [2.36]		1.36	52.0	33	-.062

(continued)

APPENDIX II

TABLE II.1

	$\Sigma\alpha_i$-Pswed	C	ρ	DW	SEE	SSR	NO OBS	$\overline{\text{LHS}}$
11) LnTOT	.257	1.37	–	1.16	.019	.010	35	4.53
Monthly	.249	(1.32)						
rog	[1.03]	[1.04]						

APPENDIX II

TABLE II.1

(continued)

	kr/yen + PJap
5) $\widehat{TOT}$	-.381
Monthly	(.137)
rog	[-2.79]
6) $\widehat{TOT}$	-.402
Monthly	(.146)
rog	[-2.75]
7) LnTOT	-.397
Monthly	(.173)
Level	[-2.29]
8) LnTOT	-.403
Monthly	(.142)
Level	[-2.82]
9) $\widehat{TOT}$	-.367
Monthly	(.135)
rog	[-2.72]
10) $\widehat{TOT}$	-.402
Monthly	(.124)
	[-3.23]
11) LnTOT	-.690
Monthly	(.192)
rog	[-3.59]

(continued)

APPENDIX II

TABLE II.1

	kr/$ + Pus	kr/P + Puk	kr/mark + Pger.	kr/Frn + Pfr
12) LnTOT	.169	.283	.159	.268
Monthly	(.123)	(.162)	(.111)	(.130)
rog	[1.37]	[1.75]	[1.43]	[2.05]

APPENDIX II

(continued)

TABLE II.1

	$\Sigma\alpha_i$-Pswed	C	ρ	DW	SEE	SSR	NO OBS	$\overline{LHS}$
12) LnTOT	.479	1.90	.87	1.51	.014	.0053	34	4.53
Monthly	(.194)	(.91)	(.08)					
rog	[2.47]	[2.09]	[10.39]					

(continued)

APPENDIX II

TABLE II.1

	kr/yen + PJap
12) LnTOT	-.400
Monthly	(.141)
rog	[-2.83]

APPENDIX II

TABLE II.2

	kr/$+Pus	kr/F+Puk	kr/mark+PGer.	kr/franc+PFr.
13) $\hat{TOT}$	.084	.088	.00008	.083
Monthly	(.125)	(.150)	(.103)	(.123)
rog	[.67]	[.58]	[.0007]	[.68]
14) $\hat{TOT}$	.217	.186	-.085	.052
Monthly	(.126)	(.140)	(.108)	(.119)
rog	[1.72]	[1.33]	[-.79]	[.43]
15) LnTOT	.203	-.194	.116	.441
Monthly	(.098)	(.135)	(.078)	(.084)
rog	[2.06]	[-1.44]	[1.50]	[5.24]
16) LnTOT	.092	.088	-.003	.114
Monthly	(.130)	(.154)	(.097)	(.118)
rog	[.71]	[.57]	[-.03]	[0.96]

APPENDIX II

(continued)

TABLE II.2

	C	ρ	DW	SEE	NO OBS	SSR	kr/yen+PJap.
13) $\hat{TOT}$ 1/ Monthly rog	-	-	-	1.54	34	71.1	-.254 (.135) [-1.89]
14) $\hat{TOT}$ 1/ Monthly rog	-	.27 (.17) [1.62]	-	1.44	33	60.1	-.370 (.134) [-2.77]
15) LnTOT Monthly 1/ rog	2.37	-	1.20	.019	35	.011	-.566 (.149) [-3.79]
16) LnTOT Monthly rog	3.01 (.86) [3.49]	.83 (.09) [8.77]	1.62	.015	34	.0065	-.290 (.146) [-1.98]

1/ $\Sigma\alpha_i = 0$

APPENDIX III

TABLE 1

	DTOT (Actual)
732	100.000
733	-0.625
734	0.835
735	0.805
736	0.748
737	-1.292
738	2.739
739	0.693
7310	-1.258
7311	-1.194
7312	-3.010
741	0.989
742	-4.690
743	-2.742
744	-0.831
745	2.185
746	0.543
747	1.128
748	-0.313
749	1.041
7410	1.158
7411	-0.420
7412	0.921

	DTOT (Actual)
751	2.516
752	0.899
753	- .046
754	-0.497
755	1.415
756	-0.521
757	0.0
758	-2.403
759	-0.469
7510	-0.855
7511	0.495

7

TABLE 2

Percent Change in TOT;Fixing Under Alternative Assumptions[1/]

	MARKL1	MARKL2	MARKD1	MARKD2
732	2.262	0.250	0.221	-0.717
733	1.124	-0.782	-0.369	-0.749
734	-0.869	-0.718	-0.668	-0.620
735	0.588	- .021	- .036	- .021
736	3.653	1.226	1.368	0.955
737	4.481	2.028	2.245	1.650
738	-2.078	-0.868	-0.774	-0.696
739	0.214	-0.243	-0.770	-0.222
7310	0.373	- .043	-0.107	- .067
7311	0.126	-0.630	-0.709	-0.592
7312	-4.241	-1.778	-1.502	-1.436
741	-3.187	-1.507	-1.335	-1.229
742	- .056	-1.424	-1.127	-1.281
743	0.905	.024	0.137	- .013
744	-1.405	-0.420	-0.531	-0.345
745	-0.223	0.495	0.309	0.433
746	-0.483	-0.594	-0.559	-0.518
747	1.516	- .080	- .063	-0.132
748	0.228	.086	.090	.073
749	-0.350	-0.661	-0.538	-0.579
7410	0.987	-0.751	-0.451	-0.706
7411	1.085	0.118	0.237	.061
7412	1.543	0.557	0.501	0.433

(continued)

Percent Change in TOT; Fixing Under Alternative Assumptions

	MARKL1	MARKL2	MARKD1	MARKD2
751	1.382	0.582	0.431	0.445
752	0.123	-0.523	-0.461	-0.483
753	.096	-0.608	-0.570	-0.558
754	-0.965	-0.740	-0.813	-0.646
755	1.521	-0.210	-0.109	-0.252
756	0.674	.086	0.105	.037
757	-1.845	-1.219	-0.968	-1.007
758	-0.895	-0.921	-0.710	-0.776
759	-1.136	-0.624	-0.564	-0.524
7510	1.244	- .044	0.133	- .081
7511	.050	-0.139	-0.141	-0.130

(continued)

	POUNDL1	POUNDL2	POUNDD1	POUNDD2
732	0.818	-0.851	-0.741	-0.866
733	-0.791	-1.945	-1.647	-1.804
734	-0.918	-0.748	-0.701	-0.648
735	1.038	0.251	0.264	0.235
736	0.810	-0.499	-0.527	-0.610
737	-0.654	-1.089	-1.179	-1.177
738	-1.640	-0.602	-0.482	-0.455
739	-0.753	-0.831	-0.722	-0.755
7310	0.300	- .087	-0.155	-0.107
7311	2.230	0.646	0.693	0.565
7312	-4.328	-1.831	-1.560	-1.484
741	-2.632	-1.170	-0.965	-0.924
742	0.178	-1.282	-0.971	-1.151
743	-0.274	-0.692	-0.649	-0.663
744	-2.146	-0.870	-1.026	-0.753
745	-0.957	.050	-0.179	.029
746	0.232	-0.160	- .082	-0.124
747	1.956	0.186	0.229	0.109
748	0.512	0.259	0.280	0.229
749	-0.179	-0.557	-0.423	-0.485
7410	0.147	-1.261	-1.011	-1.168
7411	-0.388	-0.776	-0.745	-0.750
7412	0.574	- .030	-0.144	- .099

(continued)

	POUNDL1	POUNDL2	POUNDD1	POUNDD2
751	0.303	- .072	-0.287	-0.148
752	.027	-0.581	-0.525	-0.536
753	0.334	-0.463	-0.411	-0.427
754	-0.817	-0.650	-0.714	-0.564
755	0.136	-1.051	-1.033	-1.015
756	-0.225	-0.465	-0.494	-0.457
757	-1.572	-1.053	-0.786	-0.857
758	-0.490	-0.675	-0.440	-0.553
759	-1.058	-0.577	-0.512	-0.481
7510	.022	-0.786	-0.681	-0.755
7511	- .051	-0.170	-0.175	-0.158

(continued)

	DOLLARL1	DOLLARL2	DOLLARD1	DOLLARD2
732	-0.433	-1.611	-1.576	-1.556
733	-1.684	-2.488	-2.243	-2.297
734	-1.023	-0.812	-0.771	-0.705
735	0.215	-0.248	-0.284	-0.217
736	.052	-0.959	-1.033	-1.027
737	- .073	-0.737	-0.792	-0.858
738	-0.501	.089	0.276	0.171
739	0.250	-0.222	- .053	-0.202
7310	0.175	-0.163	-0.239	-0.176
7311	2.920	1.065	1.153	0.945
7312	-2.999	-1.024	-0.674	-0.752
741	-0.779	- .044	0.270	.096
742	-0.794	-1.873	-1.619	-1.687
743	-1.462	-1.413	-1.441	-1.317
744	-3.037	-1.411	-1.619	-1.244
745	-1.424	-0.233	-0.490	-0.227
746	0.668	0.104	0.208	0.115
747	1.992	0.208	0.254	0.129
748	1.289	0.731	0.798	0.657
749	0.383	-0.216	- .048	-0.175
7410	-0.149	-1.442	-1.210	-1.332
7411	-0.313	-0.730	-0.695	-0.709
7412	0.565	- .036	-0.150	-0.104

(continued)

	DOLLARL1	DOLLARL2	DOLLARD1	DOLLARD2
751	-0.318	-0.450	-0.702	-0.491
752	-0.539	-0.926	-0.903	-0.849
753	- .092	-0.722	-0.696	-0.662
754	.048	-0.124	-0.136	- .087
755	1.039	-0.503	-0.431	-0.518
756	0.524	- .010	.051	- .045
757	0.368	0.124	0.507	0.211
758	0.954	0.201	0.522	0.242
759	-0.476	-0.223	-0.124	-0.160
7510	0.666	-0.395	-0.252	-0.400
7511	0.115	-0.100	- .097	- .094

TABLE 3

	MEAN	STANDARD DEVIATION
MARKL1	0.189	1.672
MARKL2	-0.303	0.742
MARKD1	-0.217	0.709
MARKD2	-0.283	0.611
POUNDL1	-0.300	1.216
POUNDL2	-0.601	0.564
POUNDD1	-0.544	0.494
POUNDD2	-0.553	0.500
DOLLARL1	-0.113	1.167
DOLLARL2	-0.488	0.728
DOLLARD1	-0.420	0.743
DOLLARD2	-0.450	0.678
DTOT	-0.062	1.60

TABLE 4

	MEAN	STANDARD DEVIATION
MARKLP1	0.124	1.667
MARKLP2	-0.229	0.731
MARKDP1	-0.175	0.707
MARKDP2	-0.216	0.602
DOLLLP1	-0.108	1.132
DOLLLP2	-0.494	0.727
DOLLDP1	-0.423	0.745
DOLLDP2	-0.456	0.673
POUNLP1	-0.148	1.198
POUNLP2	-0.775	0.613
POUNDP1	-0.643	0.532
POUNDP2	-0.710	0.543

TABLE 5

CORRELATION MATRIX

	MARKL1	MARKL2	MARKD1	MARKD2	POUNDL1	POUNDL2
MARKL1	1.000	0.839	0.878	0.808	0.682	0.196
MARKL2	0.839	1.000	0.983	0.998	0.437	0.377
MARKD1	0.878	0.983	1.000	0.977	0.404	0.240
MARKD2	0.808	0.998	0.977	1.000	0.404	0.387
POUNDL1	0.682	0.437	0.404	0.404	1.000	0.655
POUNDL2	0.196	0.377	0.240	0.387	0.655	1.000
POUNDD1	0.123	0.235	0.114	0.242	0.679	0.975
POUNDD2	.060	0.262	0.118	0.276	0.577	0.990
DOLLARL1	0.349	0.204	0.178	0.189	0.741	0.609
DOLLARL2	-0.198	.048	- .049	.074	0.216	0.703
DOLLARD1	-0.296	-0.106	-0.177	- .081	0.138	0.572
DOLLARD2	-0.297	- .044	-0.142	- .015	0.141	0.660

	POUNDD1	POUNDD2	DOLLARL1	DOLLARL2	DOLLARD1	DOLLARD2
MARKL1	0.123	.060	0.349	-0.198	-0.296	-0.297
MARKL2	0.235	0.262	0.204	.048	-0.106	- .044
MARKD1	0.114	0.118	0.178	- .049	-0.177	-0.142
MARKD2	0.242	0.276	0.189	.074	- .081	- .015
POUNDL1	0.679	0.577	0.741	0.216	0.138	0.141
POUNDL2	0.975	0.990	0.609	0.703	0.572	0.660
POUNDD1	1.000	0.979	0.682	0.731	0.639	0.698
POUNDD2	0.979	1.000	0.580	0.747	0.630	0.718
DOLLARL1	0.682	0.580	1.000	0.693	0.692	0.643
DOLLARL2	0.731	0.747	0.693	1.000	0.976	0.994
DOLLARD1	0.639	0.630	0.692	0.976	1.000	0.984
DOLLARD2	0.698	0.718	0.643	0.994	0.984	1.000

	MARKLP1	MARKLP2	MARKDP1	MARKDP2	DOLLLP1	DOLLLP2
732	2.225	.067	0.246	- .033	-0.481	-1.557
733	1.279	-0.960	-0.471	-0.911	-1.478	-2.725
734	-0.925	-0.653	-0.631	-0.562	-1.051	-0.780
735	0.156	0.474	0.245	0.436	0.357	-0.411
736	3.490	1.413	1.474	1.124	-0.162	-0.712
737	4.468	2.043	2.253	1.664	-0.220	-0.568
738	-2.040	-0.912	-0.799	-0.736	-0.105	-0.366
739	0.234	-0.266	- .089	-0.242	0.349	-0.335
7310	0.359	- .028	- .098	- .053	0.166	-0.153
7311	0.226	-0.744	-0.774	-0.696	2.911	1.075
7312	-4.218	-1.805	-1.518	-1.460	-3.046	-0.970
741	-3.379	-1.286	-1.210	-1.030	-0.946	0.147
742	-0.380	-1.052	-0.916	-0.944	-1.018	-1.615
743	0.786	0.161	0.215	0.110	-1.374	-1.513
744	-1.101	-0.768	-0.729	-0.660	-2.713	-1.783
745	.098	0.125	.099	.098	-0.990	-0.731
746	-0.568	-0.497	-0.504	-0.430	0.729	.034
747	1.396	.057	.015	- .075	1.998	0.201
748	.091	0.244	0.179	0.215	1.401	0.602
749	-0.450	-0.547	-0.472	-0.475	0.475	-0.322
7410	0.446	-0.130	- .098	-0.143	-0.641	-0.878
7411	0.916	0.312	0.347	0.236	-0.451	-0.572
7412	1.614	0.476	0.455	0.360	0.720	-0.214

	MARKLP1	MARKLP2	MARKDP1	MARKDP2	DOLLLP1	DOLLLP2
751	1.592	0.341	0.294	0.227	-0.216	-0.568
752	.082	-0.476	-0.434	-0.440	-0.532	-0.934
753	.038	-0.541	-0.533	-0.498	-0.169	-0.634
754	-0.793	-0.937	-0.925	-0.825	0.166	-0.259
755	1.339	- .013	.092	- .063	0.820	-0.252
756	0.685	.067	.097	.025	0.548	- .038
757	-2.158	-0.860	-0.764	-0.682	0.302	0.200
758	-1.238	-0.527	-0.487	-0.420	0.711	0.480
759	-1.018	-0.760	-0.641	-0.647	-0.361	-0.355
7510	1.007	0.227	0.288	0.164	0.491	-0.195
7511	- .033	- .043	- .086	- .043	0.109	- .093

	DOLLDP1	DOLLDP2	POUNLP1	POUNLP2	POUNDP1	POUNDP2
732	-1.545	-1.507	0.793	-0.822	-0.724	-0.840
733	-2.377	-2.511	-0.716	-2.031	-1.696	-1.882
734	-0.753	-0.676	-0.617	-1.094	-0.897	-0.960
735	-0.377	-0.365	1.201	.064	0.157	.066
736	-0.892	-0.803	0.541	-0.190	-0.352	-0.330
737	-0.696	-0.705	-0.733	-0.998	-1.127	-1.095
738	.018	-0.240	-1.515	-0.745	-0.564	-0.585
739	-0.117	-0.304	-0.611	-0.994	-0.815	-0.902
7310	-0.233	-0.166	0.567	-0.393	-0.329	-0.384
7311	1.159	0.954	2.201	0.678	0.711	0.595
7312	-0.643	-0.703	-4.322	-1.837	-1.564	-1.490
741	0.379	0.270	-2.572	-1.240	-1.005	-0.987
742	-1.473	-1.454	.032	-1.114	-0.875	-0.999
743	-1.498	-1.408	-0.236	-0.736	-0.674	-1.703
744	-1.831	-1.581	-1.226	-1.927	-1.626	-1.710
745	-0.774	-0.679	-0.452	-0.529	-0.508	-0.495
746	0.168	.052	0.289	-0.225	-0.119	-0.183
747	0.250	0.123	1.996	0.140	0.203	.067
748	0.725	0.541	0.355	0.440	0.383	0.393
749	-0.109	-0.271	-0.123	-0.621	-0.460	-0.543
7410	-0.889	-0.821	- .043	-1.042	-0.886	-0.969
7411	-0.605	-0.565	-0.322	-0.851	-0.788	-0.818
7412	-0.251	-0.265	0.905	-0.410	-0.360	-0.443

	DOLLDP1	DOLLDP2	POUNLP1	POUNLP2	POUNDP1	POUNDP2
751	-0.770	-0.597	0.878	-0.732	-0.662	-0.745
752	-0.908	-0.856	0.250	-0.837	-0.670	-0.768
753	-0.646	-0.582	0.605	-0.774	-0.588	-0.709
754	-0.213	-0.210	.042	-1.636	-1.274	-1.457
755	-0.288	-0.291	0.742	-1.746	-1.428	-1.644
756	- .010	- .070	.057	-0.789	-0.678	-0.751
757	0.550	0.279	-1.655	-0.959	-0.732	-0.771
758	0.681	0.494	-0.666	-0.473	-0.326	-0.370
759	-0.198	-0.279	-0.867	-0.797	-0.637	-0.680
7510	-0.138	-0.218	.036	-0.802	-0.690	-0.769
7511	- .093	- .088	0.127	-0.318	-0.258	-0.292

1/ The symbols are: I) Using Swedish prices

1) L1: Using coefficients from the level regression with the price and devaluation coefficients not equal.
2) L2: Using coefficients from the level regression with the price and devaluation coefficients equal.
3) D1: Using coefficients from the rate-of-change regression with the price and devaluation coefficients not equal.
4) D2: Using coefficients from the rate-of-change regression with the price and devaluation coefficients not equal.

II) LP1,...,DP2 indicate that the price level used is that of the country to which the kronor is tied.

III) The currency name indicates the currency to which the kronor is tied.

TABLE 6 CORRELATION MATRIX

	MARKLP1	MARKLP2	MARKDP1	MARKDP2	DOLLLP1	DOLLLP2
MARKLP1	1.000	0.868	0.891	0.838	0.300	-0.152
MARKLP2	0.868	1.000	0.986	0.998	0.287	.084
MARKDP1	0.891	0.986	1.000	0.981	0.216	- .094
MARKDP2	0.838	0.998	0.981	1.000	0.281	0.109
DOLLLP1	0.300	0.287	0.216	0.281	1.000	0.773
DOLLLP2	-0.152	.084	- .094	0.109	0.773	1.000
DOLLDP1	-0.281	- .056	-0.136	- .029	0.738	0.980
DOLLDP2	-0.255	- .095	-0.103	.018	0.726	0.994
POUNLP1	0.650	0.481	0.405	0.452	0.703	0.233
POUNLP2	0.243	0.388	0.296	0.398	0.731	0.637
POUNDP1	0.146	0.269	0.170	0.279	0.759	0.663
POUNDP2	0.118	0.283	0.187	0.298	0.711	0.671

	DOLLDP1	DOLLDP2	POUNLP1	POUNLP2	POUNDP1	POUNDP2
MARKLP1	-0.281	-0.255	0.650	0.243	0.146	0.118
MARKLP2	- .056	- .095	0.481	0.388	0.269	0.283
MARKDP1	-0.136	-0.103	0.405	0.296	0.170	0.187
MARKDP2	- .029	.018	0.452	0.398	0.279	0.298
DOLLLP1	0.738	0.726	0.703	0.731	0.759	0.711
DOLLLP2	0.980	0.994	0.233	0.637	0.663	0.671
DOLLDP1	1.000	0.990	0.119	0.580	0.622	0.631
DOLLDP2	0.990	1.000	0.159	0.598	0.634	0.644
POUNLP1	0.119	0.159	1.000	0.613	0.617	0.541
POUNLP2	0.580	0.598	0.613	1.000	0.988	0.991
POUNDP1	0.622	0.634	0.617	0.988	1.000	0.993
POUNDP2	0.631	0.644	0.541	0.991	0.993	1.000

APPENDIX IV

Denote Percentage Change: "^"

R_i = units of Kronor per unit of i

i=1,...,5 foreign countries

i=6 home country

$\sum_{1}^{5} a_i$ = devaluation effect of the home country

(1) $\hat{TOT} = a_i(\hat{R}_i + \hat{P}_i) + a_6\hat{P}_j$

$\hat{P}_i = \hat{P}_i$ rate of inflation in i

$\frac{R_i}{R_j} = r_i^j$ = units of j per unit of i

Assume that purchasing power parity holds in the steady-state with flexible rates so the price of i is constant in j or rises at the rate of inflation in j.

$\hat{r}_i^j P_i = \hat{P}_j$

$\hat{r}_i^j + \hat{P}_i = \hat{P}_j$

(2) $\hat{r}_i^j = \rho_j - \rho_i$

and

$\hat{r}_i^j = \hat{R}_i - \hat{R}_j$

given the five rates of inflation abroad, we can find the four independent cross rates from (2) $i, j \neq i$, $j=1,\ldots,5$.
Once we fix $\hat{R}_i$, all the rates $\hat{R}_j$ are also fixed. Suppose $\hat{R}_i$ is set so that the prices of i in the home country rise at the domestic rate of inflation.

$\hat{R}_i = \rho_6 - \rho_i$

(3) $\hat{R}_j = \hat{R}_i + \rho_i - \rho_j = \rho_6 - \rho_j$

Equation (3) shows that under these circumstances, the prices of all foreign goods rise at the domestic rate of inflation. Substituting in (1), we obtain

(4) $\hat{TOT} = \sum_1^5 a_i(\rho_6 - \rho_i + \rho_i) + a_6\rho_6$

$= \rho_6(a_6 + \sum_1^5 a_i)$.

If $a_6 = -\sum_1^5 a_i$, that is, the effect of a devaluation of the home country is the same as the effect of a fall in prices of the home country, the terms of trade do not change. In the steady state, $a_6 = -\sum_1^5 a_i$.

Another way to set $\hat{R}_i$ is to suppose that the home country ties its currency to country i so $\hat{R}_i=0$. In this case, substituting in (1), we obtain

$$(5)\quad \hat{TOT}_i = \sum_{\substack{h=1\\h\neq 1}}^{5} a_h(\rho_i-\rho_n+\rho_n) + a_i\rho_i + a_6\rho_6$$

$$= \rho_i\sum_1^5 a_h + \rho_6 a_6,$$ where $\hat{TOT}_i$ is the change in the terms of trade when the home country is tied to country i.

If $\sum_1^5 a_h = -a_6$, then

$$(5')\quad \hat{TOT}_i = (\rho_i-\rho_6)\sum_1^5 a_h.$$

$\sum_1^5 a_h$, the effect of a devaluation on the terms of trade is

negative.

$$\hat{TOT}_i \lesseqgtr 0 \text{ as } \rho_i-\rho_6 \gtreqless 0.$$

If the home country ties to a country which is inflating more rapidly than itself, the terms of trade will deteriorate. This is independent of how large an effect prices in country i have on the home country's terms of trade. Since the home country's currency is depreciating at the same rate as country i's currency which is $\rho_i>\rho_6$, the relative price of Sweden's specialized exports fall and the terms of trade deteriorate. If country i has a rate of inflation lower than the home country when the home country is tied to it, the home country's terms of trade will improve.

If, as our data suggests, the price and devaluation effects are not of the same size, we can have a gap between the rate of inflation of the home country and the country to which it tied without having a change in the terms of trade. In our case $-a_6 > \sum_1^5 a_h$. From equation (5), it is clear that the home country can have a domestic rate of inflation lower than the country to which it is tied without having its terms of trade deteriorate. If the "small country" assumption holds and the home country cannot affect its terms of trade, the currency arrangement will have no effect on the terms of trade.

Consider the difference between tying to country i or to country j. From (5')

$$(6) \quad \hat{TOT}_j - \hat{TOT}_i = (\rho_j - \rho_i)(\sum_1^5 a_h) = (\sum_1^5 a_h)\hat{r}_i^j.$$

If $\rho_j > \rho_i$, then j's currency - and the home country's currency is depreciating relative to i, $\hat{r}_i^j > 0$, so the terms of trade deteriorate relative to a currency tie to i. This is independent of the home country's rate of inflation. The home country thus should tie to the country which has a lower rate of inflation than the others and whose currency is hence appreciating.

CHAPTER 4

LEADS & LAGS IN SWEDISH TRADE:

A SOURCE OF SHORT-RUN CAPITAL MOVEMENTS

Short term capital flows can and do occur through leads and lags in commercial payments are a source of short term flows. Most trade is conducted on credit and payments and deliveries do not coincide. This allows changes in the timing of payments for goods and services to exploit interest rate differentials across countries and to speculate on exchange rate changes. The large volume of outstanding commercial credit at any one time makes large movements of these funds quite significant from the perspective of their effect on exchange reserves, exchange rates, and the domestic money and credit market.

Leads and lags in commercial payments affect foreign exchange reserves and exchange rates as do any short term capital movements. Governments have to contend with these flows and their effects on the foreign exchange market. Leads and lags in commercial payments are unique in that they are quite difficult to control via exchange controls. As the Bank of England recognizes:

> Leading and lagging are not illegal activities; they are limited but not prevented by the United Kingdom Exchange Control regulations; this, because of the desirability of giving a reason-ble degree of freedom of traders for fixing the terms of their contracts, while restricting opportunities for speculation. (31, p. 21)

Credit is often used as a sales element. Attempts to control the terms of credit offered by exporters could discriminate against a country's products in competitive world markets.

Businessmen making or receiving payments in foreign currency are subject to exchange rate risk. Theoretically, traders can cover themselves through forward market exchange operations or through spot operations. Such cover might be difficult to obtain because of the thinness of forward exchange markets in particular currencies or because of liquidity constraints faced by traders. The capital constraint faced by speculators is discussed at length by McKinnon (34) who attributes the lack of "stabilizing speculation" in the floating exchange rate markets to this constraint. Even if forward cover were available, there might be some welfare loss from the larger premiums and discounts on forward rates which seem to characterize exchange markets today. (McKinnon, 34)

In such circumstances, the government might seek to minimize the exchange rate risk faced by traders. One policy designed to do this is to tie the exchange rate in terms of some foreign currencies. Sweden has effectively done so by joining the European "snake". We will look at possible effects of joining the "snake" on leads and lags in Sweden's commercial trade payments. Joining a currency bloc will minimize leads and lags initiated to exploit changes in rates between member countries--insofar as the commitment to fixed parities between partner currencies is believed--but will subject each member country to outside pressures that are directed towards any other member country. The Bank of England pointed this out in 1961 in remarks about the Sterling Area.

> The stability of exchange rates and the great degree of freedom for capital movements within the area mean less need for displacing the time of trade settlements. Trade between countries inside the Sterling area and those outside it can be subject to leads and lags which affect the United Kingdom reserves in much the same way as those occuring in the trade of the United Kingdom itself. (31, p. 21-22)

After a discussion of leads and lags in general and the incentives for the movements of commercial funds, we will proceed to look at forward exchange markets and their effects on leads and lags. Finally, we will look at the commercial credit picture for Sweden in its international trade. This empirical work rests solidly on the analysis of the 1968 customs survey data in Sweden by Sven Grassman in his book _Exchange Reserves and the Financial Structure of Trade_ (17). Hansen (23) was one of the first to analyze and point out the significant of leads and lags. Any figures and statistics concerning the structure of Sweden's foreign trade credits are derived from Grassman's book.

Leads and Lags

In Sweden, interest in leads and lags has always followed dramatic swings in both the errors and omissions items in the balance of payments accounts and the foreign exchange reserves. Swings in trade payments can have dramatic effects on foreign exchange reserves. By 1968, the sum of both outstanding trade credits and liabilities in Sweden was approximately 10 billion kronor while its foreign exchange reserves stood at 5.7 billion kronor. (18, p. 72) Grassman focuses on the effect of trade payments on reserve behavior.

> ...If one keeps in mind that foreign trade amounts to about 3/4 of the total transactions in the balance of payments, and that interest arbitrage and other capital movements not connected with goods transactions are largely prevented by currency regulations, it should be clear that foreign trade payments have been decisive in determining the behavior of reserves from month to month. (18, p. 71)

In 1967, 1968, and 1969 Sweden experienced very rapid changes in exchange reserves. Grassman attributes these swings to shifts in payments following the unsettled currency markets in the wake of the 1967 sterling devaluation.

Hansen and Grassman have tried to look at the effects of leads and lags by looking at the behavior of the errors and omissions item in the balance of payments. From 1956 to 1966, there was a string of positive residuals while the residuals for the period from World War II to 1956 canceled out. (Hansen considers the period from World War II until 1958 in (23) while Grassman looks at the postwar period to 1967 in (17).Grassman points out that there are systematic errors in the residual item since it does not cancel out over all countries. This suggests that something other than swings of short term capital is occurring. He hypothesizes that the tendency towards positive residuals in Sweden during this period is due to a positive tendency in the balance of payments while the fluctuations are due to leads and lags in payments. There are two possible sources of error in the current account. Errors may be due to measurement problems (valuation errors) or time payment problems. Using the results of two surveys of the balance of payments in 1965, Grassman (17) concludes that the measurement problem is serious, that credits and debits appear to cancel out, but that large swings are possible.[1/]

1/ The Bank of England is less sanguine about using the balance of payments residual as an indicator of leads and lags. "The figures comprised in the balance of payments estimates...give little clue to the extent or even the occurence of leads and lags except in the broadest way." (31, p. 23)

Leads and lags refer to the shape and characteristics of the time profiles of payments for exports and imports in the broadest way. They are analyzed theoretically (in terms of somewhat abstract models) by Hansen (23) Paul Einzig considers them more exhaustively in his book Leads and Lags:

The Main Cause of Devaluation.

Usually leads and lags are taken to refer to changes in the timing of payments for exports and imports. The timing of such payments has immediate repercussions on the state of the foreign exchange markets and the exchange rate. The main considerations that cause these fluctuations in payments are changes in interest rate differentials between countries and expectations of change in exchange rates. Paul Einzig maintains, "The basic cause of leads and lags is distrust in the currency, distrust which is justified if it is due to disequilibrium." (9, p. 104)[1/] In countries such as Sweden where the interest rate is somewhat sticky and not used extensively for stabilization purposes, the state of credit conditions (in the sense of the difficulty of obtaining credit) will also affect the time profile of payments. Credits and

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1/ Throughout the book, Enzig emphasizes this point. He does not, however, give an operational definition of disequilibrium.

exchange rate considerations may lead to changes in the timing of exports and imports and of payments of goods. Hansen includes both elements in his analysis by considering the period between delivery and payment.

In general, higher interest rates abroad will induce domestic importers to speed up their payments. This implies that pressure on the spot exchange rate will be higher than it would have been otherwise. This is equivalent to a short-term capital outflow. Both increase the demand for foreign exchange. A similar move by foreign importers to slow down their payments serves to emphasize this movement of short-term funds.

A belief that the domestic currency is going to be devalued or that it will depreciate will induce domestic importers to speed up their payments of foreign currency while foreign importers slow down their payments of domestic currency. Domestic and foreign exporters can also exert some influence on the timing of payments for goods and services. This depends on the form of payment and will be discussed later. The move by domestic importers to speed up payments while foreign importers slow down payments implies an increase in the demand for foreign exchange and a decrease in its supply which contributes to the depreciation of the currency or to pressure against it under fixed rates.[1/]

1/ Hansen points out that these results should be used cautiously. His theoretical analysis indicates that the movements might not always be in these directions.

> Intuitively, it might be expected that higher interests at home and/or lower interests abroad would always lead to increased import of trade capital, or decreased export of trade capital. This is what we believe will generally happen with capital movements, whatever their nature may be. ...This simple result cannot in general be expected to hold. ...With deferred payments we found everywhere in the models studied that with changes in domestic or foreign interest rates the above-mentioned intuitively expected simple results follow unambiguously. This holds both for the effects through induced changes in the value of exports and imports and through induced changes in the length of the credit period. But when payment in advance is considered and the effect of changed periods of advance payment upon the value of exports and imports is taken into account, the simple results break down. In countries like Sweden this must be taken into account for all practical purposes.
>
> From a more general point of view it could be said that the reason why the simple, intuitively natural result does not always hold is that the aim of an exporter or importer is not that of minimizing his net interest costs (or maximizing his net interest income) but rather to maximize his total profits upon the export or import trade deal considered as a whole. And this latter aim is--apart from very special cases--something different from minimizing interest costs. (23, pp. 114-115)

In the very short run when all things other than the timing of the payment are determined, minimization of interest costs or maximization of interest income may indeed be the firms policy. Furthermore, as the empirical evidence indicates, most trade is done on credit with advance payments being less common except for high cost capital goods. This implies that the intuitively expected results should hold.

Leads and lags are more general than just changes in the timing of payments. They also include changes in the currency of invoice, in the form of payment as regards to its elasticity with respect to final payment date, changes in the financial center in which the trade credit is financed, and changes in the forward market cover for payments. All these elements have a direct bearing on how much pressure leads and lags in payments can exert on the exchange rate or foreign exchange reserves. A subtle distinction has to be made between the commercial (trader) aspect and the larger financial aspects of these decisions. We are speaking about decisions dealing solely with the payments for goods and services. An exporter who discounts a bill on a foreign importer with his domestic bank is not engaging in leads and lags, if leads and lags are defined operationally as changes in payments which have effects on the foreign exchange market. The effect on the foreign exchange market comes from the domestic bank either holding the bill until maturity or discounting it abroad with its correspondents. This is where the effect on the foreign exchange market emerges, but this is a pruely financial arbitrage or speculative operation on the part of the bank. On the hand, if the trader were to discount the bill with a foreign bank, the effect on the foreign exchange market is immediate and he is engaged operationally in leading or lagging. Most international financial operations are conducted through domestic banks so it will be difficult to distinguish effectively between the above courses of action and both will be referred to, admittedly somewhat unclearly, as "leads and lags".

How much leading or lagging can occur through these elements, such as changes in the center where trade is financed or the currency of invoice, is a longer run affair. These are factors that help determine the initial form of the contract. Once the contract is signed, then with deferred payment the buyer can change the timing of his payments given the flexibility built into the contract or his ability to circumvent the terms of the contract. In the very short-run the goods have already been shipped or delivered and the best the exporter can do is to threaten action in future contracts. With advanced payments, once part of the payment has been made, the exporter can change the delivery time of the commodities in relation to the remaining payments.

In the long run, changes in the structure and composition of trade can also be seen as a form of leading and lagging in that they change the nature of the relationship between deliveries of goods and the point of time in which these transactions exert an effect on the foreign exchange market. Generally speaking, different goods are traded on very different credit terms. Large cost capital items are usually paid for in advance while small manufactured articles are paid for with a deferred payment. A change in a country's trade from manufactured exports towards large capital goods exports is a change from deferred payments for exports to advance payments or a long-run "lead" in export earnings.

The longer run considerations are decided by the buyer and seller within the institutional framework of trade and the market conditions for the products. Easy credit is a sales incentive to be used in a buyer's market.[1/]

1/ In his book International Financial Decisions, Sune Carlson examines the problem of export credit from the exporting firm's perspective and points out that it is a sales tool.

> ...The exporter may have to extend his credit both because such an action is directly required by the importer and because other suppliers offer more favorable credit terms. The granting of credit has become an integrated part of the competitive situation. For the individual exporter it may, indeed, be a very serious problem, since his competitors may have the advantage of government credit subsidies. A few examples from the electronic and the ship-building industries may illustrate the point. The L. M. Ericsson Company, which gets no credit subsidies, has had to compete with West German offers, in the case of telephone plan in Nigeria, of a credit period of 40 years at 3 percent interest, with American offers, financed by the AID, also of a credit period of 40 years, both with only 1 percent interest during the first 10 years and 2 1/2 percent thereafter, and with British offers of a credit period of 25 years, of which the first 5 years were exempted from

The long-term institutional characteristics should not be ignored. Participants in the market who continually break contracts will find it difficult to obtain credit in future periods. Access to a supplier for a long period can outweigh the less beneficial credit terms he offers.

Long-run credit market considerations of both cost and availability will dictate the length of the credit offered and where it is financed. These considerations also affect the choice of the currency of financing given the development of the Euro-currency market. (Einzig emphasizes that this is a choice distinct from that of the currency of invoicing.)

For institutional reasons, credit is usually extended to the buyer by the seller while partial advances are the rule in heavy capital equipment. Credit periods differ between commodities. For Sweden, the average credit period for

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amortization and interest payments. Japanese, Canadian and French competitors give similar advantages to their foreign customers. In the ship-building industry the credit terms have extended from 50 percent credit over 5 years to 80 percent over 8-10 years. Also here German, British and Japanese firms are able to offer low interest terms because of government subsidies. (4, pp. 88-89).

imports is 65 days and that for exports is 78 days. (17, p. 63).[1/]

1/ Looking at the period until 1958, Hansen comments, that the results

> ...point to the export (import) market conditions as being the decisive determinant of the direction of foreign trade credits. Had the credit market conditions, at home and abroad, been decisive one should expect to find either export or import of trade capital in both exports and imports. But, as a matter of fact, import of goods seems to be followed by import of trade capital, export of goods by export of trade capital. (23, p. 121)

His remarks are based on annual data. The credit terms could fluctuate in one direction or the other in the short-run but still average out to the long-term pattern over a year. This is highly plausible given the approximately nine week credit period in Sweden.

Long-run trends will still exert their influence within these institutional bounds. Long-run expectations of a tighter monetary policy at home will induce domestic exporters to offer credit for shorter periods of time than foreign exporters. Tighter monetary policy at home will also induce domestic exporters to find foreign financing, exchange regulations permitting, leading to a short-term inflow of capital. Multinational firms might be able to circumvent the exchange regulations through internal allocation of credit. Higher interest rates in the home country will induce foreign buyers to use local credit as opposed to using credit offered by the exporter. This is the equivalent of shorter payments periods from the home country perspective since the effect of payments on the foreign exchange markets is accelerated.

Long-run considerations have some bearing on credit period arrangements and the implicit cost of credit that is extended. Short-run movements of funds through leads and lags depend crucially on the form of payment. The larger the elasticity with respect to time in making payments, the more the transactor making the payment (in the case of a positive credit period) is able to exploit this advantage to profit from unexpected movements in interest rates and exchange rates.

The most elastic form of payment, and also the most prevalent, is the open account. On open account, no documents specify the credit and conditions of sale stipulate only the final date by which payment has to be made. The more decumentation is needed, the more rigid and inflexible the form of payment is.

TABLE 1

Foreign Trade in 1968 by Forms of Payment

Form of Payment	Exports Kronor (millions)	Exports %	Imports Kronor (millions)	Imports %
Open account	13,513	55.0	18,369	70.2
whereof consignment	516	2.1	451	1.7
Advance(whole amount)	146	0.6	600	2.3
Cash Against Documents	5,214	21.2	2,741	10.5
Acceptance	1,194	4.9	1,635	6.3
Sight Documentary Credit	829	3.4	418	1.6
Time Documentary Credit	283	1.2	419	1.6
Contractual quotas	2,894	11.8	1,580	6.0
whereof more than 50 per cent in advance	172	0.7	304	1.2
Free Deliveries	507	2.1	401	1.5
TOTAL	24,580	100	26,163	100

Source: From Grassman (17, p. 28)

Payments which go through banks may require the consent of the bank before they can be altered. Table 1 indicates the form of payment used in Swedish trade. The prevalence of open account payment should be noted. "It should be emphasized, however, that, regardless of the form of payment involved, payments can always be altered if all parties - buyer, seller, and banks - agree." (17, p. 30)

Institutional considerations also bear on the choice of the form of payment. Difficulty in collecting will bias the choice towards immediate payment. International affiliates with internal accounting will have very open, flexible arrangements. The cost and availability of insurance against default by the debtor will also influence the choice of a form of payment.

The choice of the currency of invoice has a profound effect on the behavior of leads and lags given the institutional characteristics of the form of payments. Invoicing in the currency of the participant who has the freedom of changing the timing of payments will minimize leads and lags in anticipation of exchange rate movements. A domestic importer paying the foreign exporter in domestic currency has no incentive to accelerate his payments because of expectations of a devaluation or depreciation of the domestic currency. (We ignore the possibility of hedging.) The exporter, on the other hand who is getting paid in the domestic currency of the importer, has an incentive to demand quicker payment in the face of expectations of a devaluation of that currency. Insofar as the exporter succeeds in obtaining faster payment, the supply of the importer's domestic currency on the foreign exchange markets increases and exerts a downwards pressure on that exchange rate. The importer will have an incentive to accelerate payments invoiced in foreign currency in face of expectations of a devaluation of his domestic currency while the exporter has no incentive to act. This acceleration of payments increases the demand for foreign exchange and exerts a downwards pressure on the exchange rate. Actions by domestic exporters and foreign importers will have parallel effects on the exchange rate regardless of the currency of invoice. What the currency of invoice does determine is how much flexibility there is for changes in the timing of payments. Insofar as the buyer has more flexibility in short-run, invoicing in the currency of the buyer will mean less movement in timing of payments in response to changes in expectations about the exchange rate.

The currency of invoice determines which transactor bears the exchange risk. The general rule is that the transaction is denominated in the currency of the seller. The importer, who is usually extended credit, has an obligation to pay out foreign currency. A change in the exchange rate changes the amount of domestic currency he has to pay out. The importer can also speculate against currencies by changing the timing of his payments.

Exchange risk can be cover by buying or selling forward foreign exchange. The exchange risk can also be covered by borrowing and lending in different countries. An importer who has a future liability in foreign exchange can borrow domestic funds and lend them abroad. His position is covered against a possible devaluation of the domestic currency. The exchange risk is also a function of market conditions. An importer having future liabilities in foreign exchange does not risk any loss if he can raise the domestic price of his goods by the amount of the devaluation. (There are problems with the timing of the selling of inventories. Even if an importer has reduced his foriegn liabilities, he may want to hedge against changes in the value of his inventory.)

Two questions arise concerning exchange rate risk covering operations. Do these operations offer sufficient cover against exchange rate risk? Do these operations have any effect on the ability of traders to speculate against a currency through leads and lags? Both questions have some bearing on the government's attitude towards various currency regimes.

Traders can protect themselves against exchange rate risk by using the forward market or borrowing and lending abroad. Covering open positions in foreign exchange may be difficult because of capital and liquidity constraints. Exchange controls in a country like Sweden compound this difficulty.

Forward markets may not provide sufficient cover either. In a country such as Sweden, the forward market is quite small and thin. In Sweden in 1969, forward purchases were 6 percent of the value of imports of goods and services and sales were 6.8 percent of the value of exports of goods and services. (17, p. 89) While "...the volume of forward contracts on the Swedish foreign exchange market increased during the general gloat in 1971 (August 15 to December 15), this increase ...was well within the normal fluctuations of forward transactions during the period." (17, p. 93)[1/] Access to forward markets

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1/ After 1973 with the institution of the flexible rate system, the amount of forward cover in Swedish trade doubled, but was still only a small fraction of total trade is covered. Forward cover is used mainly by "large" firms on contracts with long credit periods denominated mostly in dollars, pounds, and Deutsche marks.

While an obvious correlation between forward cover and instability for certain currencies is distinguishable, the habit of covering on forward markets seems to be common in particular commodities and types of firms. Thus, forward activity is not exclusively a response to short-run changes in general exchange risk or specific may be further restricted by exchange controls.2/

1/ continued.

expectations as to exchange-rate alterations or field conditions for certain currencies. (Grassman, 19, pp. 219-220.)

2/ The argument might be made that the forward markets will arise should the demand increase sufficiently. McKinnon points out that this has not occured even for the large trading countries since 1973 when general floating began where demand for such services must be large.

Bid-ask spreads in forward markets have risen relatively more sharply (than in the spot market) -- particularly in longer term contracts where trade has tended to diminish. Interbank forward trading -although not necessarily bank-customer forward trading -- may have declined. Floating rates have not induced any noticeable expansion in the facilities for forward trading across pairs of currencies, or in longer-term contracts. (34, p. 3)

McKinnon ascribes this lack of growth in the forward exchange market to reduced supply of capital available for currency speculations due to increased banking risk of insolvency. (34, p. 10.)

The following discussion on the merits and disadvantages of the forward exchange market is from McKinnon (34).

The increased fluctuation in exchange rate increases the margin required for forward transactions, and, as the margin rises, so does its opportunity cost. This cost induces firms to cover their foreign exchange risk through the spot market--borrowing on the spot market and holding the currency. The firm earns interest on its spot deposits. Banking risk will also push firms to cover their positions through spot operations. Banks may not be able to come up with the foreign currency in the future because of defaults. Deposits can be moved relatively quickly between banks. The asymmetry between forward operations and holding spot pruchases is, as McKinnon points out, that the latter requires a 100 percent margin compared to far smaller margin of the former. This imposes a liquidity constraint on the firm. The tendency to move towards holding spot purchases also increases the pressure on banks as their deposits shift towards more liquid forms.

In short, the heightened uncertainty has increased the capital requirements of both banks and their customers, and restricted the scope of their operations. The social costs of shifting from forward to spot are of some consequence contrary to what past literature on forward markets in foreign exchange might have suggested. (34, p. 13)[1/]

1/ The usual interest parity formulas can be adjusted to reflect the opportunity costs of having margins in forward contracts. The usual interest parity formula which assumes zero margins is:

$$-1 + \frac{Rf}{Rs} = \frac{Rf-Rs}{Rs} = \frac{rA-rD}{(1-rA)} \quad \text{where}$$

Rf = forward exchange rate $\left[\frac{\text{domestic units}}{\text{foreign unit}}\right]$

Rs = spot rate
rA = interest rate abroad
rD = domestic interest rate

If a margin in q proportion of the domestic value of the forward contract is required, and the opportunity cost is r [r = rA or rD], the cost of a forward contract is:

$$\frac{q}{Rs}(1+rA)Rf - r$$

This is the margin cost of lending one unit of domestic currency abroad and covering it in the forward market. The interest rate parity formula is

$$-1 + \frac{Rf}{Rs} = \left[\frac{rA - rD}{(1+rA)} + q(1+rA)r\right]\left(\frac{1}{1-q(rA)}\right)$$

If the forward rate confirms to this formula, the existence of margins (and hence the size of these margins) will make traders indifferent between covering through forward or spot transactions. The probability of default on forward contracts can be similarly handled through risk premium modified interest rate parity formulas. There will be a forward rate that will make traders

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indifferent between forward and spot market covering transactions. These modifications make it more probable that interest rate parity will be violated and that forward and spot market covering operations will no longer be equivalent. McKinnon is contending that this is indeed the case and that spot operations are favored. These spot operations, however, impose liquidity and capital use constraints on firms.

Traders can speculate against a currency by changing the timing of their payments. They can also speculate against a currency by changing the exchange rate covering arrangements of their payments. Expectations of a devaluation can lead to increased use of forward transactions (purchases, for those with an open position in foreign exchange). Pressure on the forward exchange rate can be transmitted to the spot rate. (An increase in forward purchases may induce dealers to enter the market and buy spot to cover their forward positions. These attempts to cover through spot transactions will affect the spot rate.)

Leads and Lags and Currency Arrangements

Leads and lags can affect two economic targets of interest to the government. The first is the stability and movement of the exchange rate. The second is the welfare of traders and the exchange risk that they face. Much of international trade is conducted in terms of credit. Outstanding trade credits are quite large can affect the spot rate and the level of foreign exchange reserves.

We have seen that it may be quite difficult to cover exchange risk through either forward or spot transactions. The trader who faces the foreign exchange risk is the trader who has uncovered liabilities or assets in foreign exchange.

The data indicate that most credit is denominated in the currency of the seller, implying that the buyer faces foreign exchange risk. If the contract is denominated in a thrid currency, both traders face exchange risk.[1/]

1/ Professor Kindleberger takes a broader view of exchange risk. Even if a trader has no open positions in foreign currency, he may be affected by the decisions of other traders who maintain an open position. These competing traders might be able to increase their profits because of this speculation in commercial credit and force down the price of the commodity.

> ".....Hedging does not eliminate exchange risk. Under a system of flexible exchange rates, a trader faces two risks--one on the price he pays or receives for foreign exchange, the other the possibility that his competitors may get a more favorable rate. It is possible to hedge against the first risk, not against the second. Accordingly, forward markets or hedging through spot transactions by borrowing/lending does not remove all risk." (Kindleberger, 28, p. 103)

From Tables 2 and 3, we see that most of Sweden's imports are invoiced in foreign currency while its exports are usually invoiced in domestic currency. The exception on the import side is Scandinavia. Over 50 percent of Sweden's imports from Scandinavia, which accounted for close to 20 percent of Sweden's total imports in 1974, are denominated in Swedish kronor. This implies that the sellers face exchange risk. On the export side, the United States and the United Kingdom are the exceptions. Less than 50 percent of Swedish exports to these countries are denominated in Swedish kronor implying that the exporters bear the exchange risk. Swedish exports to the United Kingdom account for 13 percent of Swedish exports and those to the United States account for 6.8 percent. (These are 1974 figures.)

The pattern that emerges from Tables 2 and 3 is that more of Sweden's exports are denominated in the currency of the buyer than are its imports. This is consistent with the small country assumption. Sweden is a "small country" that can exert little influence on the prices of internationally traded goods. The Swedish trader, be he importer or exporter, has to assume the exchange risk in trade with a "large country."

Given that the prices of Sweden's exports are determined by the prices of goods in the larger countries--Sweden is a small country--then other small countries to which Sweden exports would bear exchange risk regardless of whether the contracts are made in terms of third currencies, those of the larger countries, or in terms of kronor. Swedish exporters, however, benefit from having a kronor invoice. Swedish exports to the larger countries are denominated in terms of the buying country's currency since Swedish goods are competing with goods denominated in these currencies and the foreign importer can avoid the exchange risk by switching to non-Swedish goods.

The evidence is also consistent with the hypothesis of a "Keynesian" small country that exercises some monopoly power on the export side. This is reflected in Table 3 in terms of the large proportions of exports denominated in kronor. The Swedish exporter uses his monopoly power to shift the foreign exchange risk onto the foreign buyer. If Swedish exporters did not have some measure of monopoly power, all the trade with larger countries such as the United Kingdom and the United States would be denominated in foreign currency.

While less than 50 percent of Swedish exports to the United States and to the United Kingdom are denominated in terms of Swedish kronor, 58 percent of Swedish exports to Germany are denominated in Swedish kronor. This is still far less than the kronor denomination for other countries. This phenomenon could possibly be due to geographic proximity of

TABLE 2

IMPORTS OF SWEDEN COUNTRY OR REGION	1 % of Import 1/ Revenue Open to Speculation (3)/100x(5)	2 % of Trade Denominated in Third Country Currency	3 % of Trade 2/, 3/ Denominated in Selling Country Currency	4	5 % of Trade 2/ Denominated in Kronor	6 % of 4/ Trade Total
Denmark						7.29
Finland						5.50
Norway						6.95
Scandinavia	7.58 (9.6)	10.4	38.4	9.6	51.2	19.74
West Germany	15.23 (16.1)	4.9	80.9	16.1	14.2	18.82
United Kingdom	8.71 (2.9)	10.6	78.3	10.0	11.1	11.12
France	2.28 (2.9)	14.9	57.4	2.9	27.7	3.48
United States & Canada	6.84 (7.1)	8.1	94.3	7.1	2.6	7.25
Switzerland		27.2	60.1	1.9	12.7	2.16
Netherlands	1.30 (1.9)					4.89
Belgium						4.35
Austria						1.82
Italy	(9.3)					2.98
Rest of Europe	5.50	27.2	39.2	9.3	33.6	14.04
in the "snake"; Scandinavia & West Germany & Rest of Europe	28.31			3.5		52.6
TOTAL	(56.8)			56.9		77.5

1/ figures in ( ) are % non-kronor trade, $\frac{(2)+(3)}{100}$ x (5)

2/ 1968 figures

(continued)

3/ The second column is the percent open to risk of exchange rate changes =

$$\frac{[(2)+(3)X(5)]}{100}$$

4/ 1974 figures

Source: Sveriges Riksbank (4, 1974) and Grassman (1, p. 32).

TABLE 3

SWEDISH EXPORTS COUNTRY OR REGION	(1) = $\frac{(4) \times (5)}{100}$ [1] % of Export Revenue Open to Speculation	(2) % of Exports in Third Country Currency	(3) [2] % of trade Exports in Buying Country Currency	(4) [3] % of Exports in Kronor	(5) [4] % of Total Exports
Scandinavia	22.10 (3.8)	4.2	10.6	85.2 (23.2)	25.94
Denmark					8.46
Finland					7.08
Norway					10.40
West Germany	5.69 (4.1)	7.6	34.4	58.0 (6.4)	9.8
United Kingdom	5.51 (8.8)	2.3	64.4	33.3 (4.7)	13.23
France	4.13 (1.1)	6.1	14.9	79.0 (4.4)	5.23
United States & Canada	2.38 (4.4)	0.2	64.5	35.3 (2.4)	6.75
Switzerland	1.75 (0.5)	4.4	18.0	77.6 (1.9)	2.26
Rest of Europe	9.49 (2.6)	8.1	13.3	78.6 (10.5)	12.07
Netherlands					4.41
Belgium					3.23
Austria					1.39
Italy					3.04
"snake" Scandinavia & West Germany & Rest of Europe	37.28 (10.5)			(40.1)	47.82
TOTAL	25.3			(53.5)	75.29

1/ The second column is the percent open to exchange risk; $\frac{[(2)+(3)]}{100} \times (5)$

2/ 1968

(continued)

3/ The second column is the percent open to speculation by foreign importers

$$\frac{(2) + (4)}{100.} \times (5)$$

4/ 1974

Source: Sveriges Riksbank (4, 1974) and Grassman (17, p. 32)

TABLE 4

	Total % Exports	S.I.T.C. 0	1	2	3	4	5	6	7	8	9
Germany	10.6	27.5	-	18.8	.8	15.9	8.3	13.4	4.7	9.4	1.3
United Kingdom	11.6	5.3	-	18.6	6.6	6.1	10.0	13.4	8.3	10.0	32.0
United States & Canada	6.5	1.6	1.4	.5	-	-	4.1	5.1	12.7	7.9	-
as % of total Swedish imports		6.8	.8	4.6	17.5	.5	8.7	22.0	28.9	10.1	.1
% of total exports		2.9	.1	17.2	1.3	.4	4.6	27.7	40.0	5.5	.3

S.I.T.C.

0. Food and Live Animals
1. Beverages and Tobacco
2. Crude Materials, Inedible, Except Fuels
3. Mineral Fuels, Lubricants and Related Materials
4. Animal and Vegetable Oils and Fats
5. Chemicals
6. Manufactured Goods Classified Chiefly by Material
7. Machinery and Transport Equipment
8. Miscellaneous Manufactured Articles
9. Commodities and Transactions not Classified According to Kind

SOURCE: O.E.C.D., Statistics of Foreign Trade. Series B.

Sweden and Germany. The geographic proximity allows German buyers to pruchase products more indigenous to the Swedish market and for which German consumers have developed a taste. Swedish exporters are more likely to have monopoly power in these markets and to use this to obtain kronor contracts. Furthermore, the indigenous quality of these goods would tend to make their prices constant in kronor as opposed to Deutsche mark. Table 4 indicated that during the first quarter of 1975, Swedish commodity exports to the United Kingdom and Germany were of approximately the same magnitude. Exports to Germany in S.I.T.C. categories 0 and 4, food and live animals and animal and vegetable oils and fats, were far larger. These are the types of goods which would tend to be indigenous to Sweden and for which regional preferences exist.

Using the 1968 customs survey and 1974 trade shares, we see from Tables 2 and 3 that 56.9 percent of Sweden's import revenue and 25.3 percent of its export revenue are not denominated in kronor and hence open to exchange risk. (The actual figures are larger as the tables only include countries which together account for approximately 75 percent of total Swedish exports and imports.) We have seen how difficult it is for traders to cover this risk. Tables 2 and 3 show that 35 percent of the exchange risk on the import side and 25 percent on the export side occurs within trade with snake countries.[1/] (These countries account for 52.6 percent of imports and 47.8 percent of exports in Sweden.) By tying its currency to that of these countries, the Swedish government reduces the exchange risk faced by traders. The tighter the currency arrangements, the more exchange risk is eliminated. (There remains the possibility that one or more countries will leave the snake or that internal rates will be realigned so some risk remains even for intra-bloc trade.)

Longer run adjustments to the exchange risk can be made. The currency of invoice can change. It would be interesting to see if trade credits with countries against whose currencies the kronor fluctuates have become shorter in duration as a way of reducing the risk.[2/] Trade patterns may themselves change.

1/ The figures referring to the "snake" are overestimates since they include countries such as Italy which are not members of the "snake." Trade between Sweden and these countries is not very extensive.

2/ Looking at data from 1973, after the beginning of those flexible rates in international trade, Grassman (19) shows that while Sweden's overall pattern of currency invoices in trade has not changed except for the decline in pound Sterling invoices - from 11 to 5 percent in exports and 17 to 10 percent in imports there has been a minor increase in the use of Deutsche mark invoices. The parallel decrease of pound denominations in both exports and imports might perhaps...be interpreted as a case where the recurrent variability of the pound has been an overriding consideration, forcing both sellers and buyers...to switch to other currencies. (Grassman, (19), p. 218).

Table 4 presents some very tentative results in this direction. During the first quarter of 1975, the percentage of Swedish exports going to Germany grew while that going to the United Kingdom fell.[1/]

1/ The usual small country assumption is taken to mean that the terms of trade are independent of the exchange rate for the home country. A devaluation against all countries changes the prices of importables and exportables by the same amount. If all goods are traded and an importer has liabilities in foreign exchange, he may not face any exchange risk. The small country assumption together with the assumption of all goods traded means that a devaluation raises the domestic currency price of all goods. The importer does not face an exchange risk. He does face an exchange risk if the prices of his products cannot be increased by the amount of the devaluation - either because of substitution between traded and non-traded goods or because of a non-accomodating (actually continuously and increasingly deflationary) aggregate demand policy that does not allow domestic prices overall to rise.

An exporter with future claims in foreign exchange is in a similar situation. He does not gain from a devaluation (or lose from a revaluation) if <u>all</u> domestic prices increase by the amount of the exchange-rate change. If the prices of inputs do not change immediately with the change in the exchange rate and the production process is still proceeding or there are stocks of completed products, the producer will benefit from a change in the exchange rate.

It is seemingly paradoxical that in the case where domestic prices reflect fully the change in the exchange rate, the exchange rate risk is for contracts denominated in domestic currency. This paradox is resolved by the observation that the stable monetary unit in this case is foreign exchange and not domestic currency. Foreign exchange is the stable store of value. In this case, even the contracts for inputs ought to be denominated in foreign exchange.

TABLE 5

Country or Region	Contract	Acceptances & Documentary Credits & Cash Against Documents & Advance	Open Account & Consignment & Gifts
EXPORTS			
Scandinavia	12.9	10.1	77.1
West Germany	8.3	34.4	57.4
United Kingdom	15.5	41.3	43.2
France	7.4	44.6	48.0
Switzerland	5.2	20.9	74.0
Rest of West Europe	8.4	40.2	51.2
United States, Canada	5.9	14.5	79.6
All Countries	11.8	81.6	57.1
IMPORTS			
Scandinavia	13.8	13.5	82.8
West Germany	9.0	19.6	71.4
United Kingdom	4.7	10.7	84.6
France	5.9	17.8	76.2
Switzerland	7.2	14.3	78.5
Rest of West Europe	3.8	19.5	76.7
United States, Canada	9.8	30.6	59.7
All Countries	6.1	32.3	71.7

SOURCE: Grassman (17, p. 35)

In the extreme short run, we have seen that it is usually the buyer who has the freedom of action to indulge in leads and lags. In the case of leads and lags because of exchange expectations, the buyer will alter his payment plans if the contract is not denominated in local currency. Tables 2 and 3 indicate that 57 percent of Sweden's import revenue and 54 percent of its export revenue are not denominated in the currency of the buyer. These funds are liable to move quicker or slower in response to changed exchange rate expectations. Table 5 shows the form of payment by country. The prevalence of open accounts, the form most susceptible to leads and lags, can be noted. These figures include third currency contracts, mostly pounds sterling and U. S. dollars in 1968, since a trader can speculate against changes in the rate between his domestic currency and these of her currencies.

The "snake" arrangements reduce the room for leads and lags in trade payments as a response to expectations about exchange rates. Intra-snake currencies account for 28 percent of import revenue and 37 percent of export revenue. The tighter the currency arrangements and the stronger the expectations that these arrangements will hold in the future, the smaller the shifts in trade payments in response to expectations concerning exchange rates. For Sweden, a country with severe exchange controls, leads and lags are a major short-run influence on the spot rate.

The snake arrangements imply that each member currency is now subject to the external shocks affecting any other member currency. An expectation of a revaluation of the mark with respect to the dollar will lead to expectations of a revaluation of the kronor with respect to the dollar if the mark and the kronor are tied with no margin of fluctuation. The 2.5 percent margin of fluctuation allowed in the snake eases this requirement. Of course, the fluctuations of any one currency within the snake against outside currencies may be so great as to offset the intra-snake currency stability. Given that 48 percent of Sweden's exports go to snake countries and 53 percent of its imports are from them, this amount of fluctuation is unlikely. The fact that Sweden has remained within the currency arrangement suggests that the fluctuations caused by events outside the bloc do not overwhelm the intra-bloc fluctuations.

Leads and lags may also occur in response to interest rate differentials. In Sweden where short-term capital mobility is severely restricted, leads and lags are the main form of short-term capital movement. Since most Swedish trade is conducted within the snake bloc, the maintenance of fixed exchange parities within the bloc prevents leads and lags resulting from short-run interest differentials from disturbing the exchange rate.

CHAPTER 5

THE EFFECTS OF FOREIGN PRICE DEVELOPMENTS ON SWEDISH PRICES AND THE DOMESTIC INFLATION-UNEMPLOYMENT TRADEOFF UNDER FIXED EXCHANGE RATES

INTRODUCTION

The international transmission of inflation has direct consequences for national policies concerning exchange rates and monetary unions. The evidence shows that the period of fixed exchange rates in international finance coincided with similar rates of inflation for developed countries. As Branson observes (2). "One implication of the monetarist model is the convergence of national rates of inflation toward the world rate (given fixed exchange rates). One can obtain the same result from a Keynesian foreign trade multiplier model plus a price-Phillips curve, as well." (His version of the monetarist model is based on the quantity equation and the endogeneity of the money supply.) The crucial issues are how long the transmission process takes, what the process is, and how government policy can affect it. A "small country", like Sweden, joining a currency bloc has to have, in the long run, the same rate of inflation as the rest of the bloc. (What determines the rate of inflation for the currency bloc is an interesting issue. While a small country cannot affect the world rate of inflation, several small countries with similar policy preferences may have a significant weight in a smaller currency bloc. This answer also depends on whether bloc arrangements force adjustment upon deficit or surplus countries.) The mechanism governing the short-run transmission of inflation determines the short-run policy flexibility open to domestic authorities concerning the inflation-unemployment tradeoff. How different can the domestic rate be from the bloc rate? What government policies can be used to maintain the different rate of inflation? What are the longer term implications of these policies? Finally, what is the mechanism that forces the long term convergence of bloc inflation rates?

To focus on the unemployment-inflation tradeoff, we should look at the wage equation for the economy. Wages are the main component of costs. Prices usually reflect primary costs plus a markup which may depend on aggregate demand. Changes in productivity also affect prices. In the long run, prices reflect wages adjusted for productivity increases.

Two issues are crucial in looking at the wage equation and inflation. Do expectations concerning inflation affect the rate of increase of wages? Does the unemployment rate affect the rate of increase of wages? There are two distinct channels of transmission here. Foreign inflation can affect the domestic rate of inflation through aggregate demand. On the other hand, foreign inflation can also increase expectations of inflation and imply a higher rate of wage inflation at the same level of aggregate demand. We will refer to these as the demand mechanism and the supply mechanism for the transmission of inflation. They have different policy implications and it is important to distinguish between them.

A distinction must also be drawn between one good and two good models. In one good models, the home country produces only one commodity, the traded commodity, and consumes two commodities, the export good and the import good. In two good models, the home country produces a traded good and a non-traded good. It consumes three commodities, the export good, the import good, and the non-traded good.

For a small country, the terms of trade are given. If the terms of trade are constant, we can speak of a "tradable" commodity which is a composite basket of exports and imports. The crucial distinction is between the tradable commodity and the non-tradable commodity. The price of the former is determined abroad and the price of the latter is determined domestically. The domestic price level is a function of both tradable and non-tradable prices. Domestic government policy can affect the price of non-tradables. In the longrun, the relative price of tradables and non-tradables is determined by the balance of payment trade equilibrium conditions. The Scandinavian model of inflation is a two good model in which the government has no flexibility in changing the relative price of tradables to non-tradables as price increases in tradables are passed on through the supply side to non-tradables.

The main difference between monetarist and Keynesian approaches to the balance of payments and the transmission of inflation is that the monetarist approach takes into account the asset market and the observation that balance of payments disequilibria affect the asset market. Monetarist models do not lose their flavor if we allow short-run sterilization of the effects of reserve changes on the money supply. In these models, sterilization cannot continue indefinitely and at some point changes in the foreign exchange reserves will affect the domestic money supply. This endogeneity of the money supply implies that domestic authorities cannot use monetary policy for short-run manipulation of the inflation unemployment tradeoff inherent in the wage equation.

The significant issue is the endogeneity of the money supply. It is well known that increased capital mobility under fixed exchange rates reduces the efficacy of monetary policy. In the absence of such mobility, the amount of sterilization of foreign exchange earnings determines the effect of the trade balance on the money supply. As long as sterilization continues, the domestic money supply is insulated from the effects of the trade balance.

In the case of a trade deficit, it is clear that the level of foreign exchange reserves determine the government's ability to maintain a certain level of money supply. The payments deficit will reduce the money stock as foreign exchange reserves are depleted. (An outflow of foreign exchange reduces the monetary base. This government can maintain the stock of money through open market operations.) As reserves are depleted, the government will have to undertake contractionary policies or devalue.

The real test of sterilization is for a surplus country. Can a government prevent the inflow of foreign exchange from increasing the stock of money? In theory, the government can still manage the stock of money through open market operations. As Professor Kindleberger points out, the government can issue debt and set the proceeds aside as with the Exchange Equalization Account in Britain in the 1930's. As long as sterilization is feasible, monetary policy is potent. The viability of sterilization does not affect monetarist models which emphasize assets markets, but does affect the results of the "monetarist approach to the balance of payments" which emphasize the endogeneity of the money supply under fixed exchange rates.

Evidence on the Convergence of Inflation Rates Under Fixed Exchange Rates

Fixed exchange rates imply similar rates of inflation. Hansen Genberg has done several studies of the relations between national price levels under fixed rates (Genberg, (11), (12)). These studies cover OECD countries including Sweden. He concludes that in the post World Ware II period of fixed rates national rates of inflation do move together. (He covers the period until 1970 in most of his work.)

He conducts two different sets of tests. In the first set of tests, he does an analysis of variance test on the mean inflation rate. Dividing the sample into low, 0 - 2 percent; medium, 2 -4 percent; and high, 4 - 6 percent, rates of inflation, he cannot reject the hypothesis that the mean rate for each country does not differ from the overall mean rate for all countries for the low and high categories. In the medium rate of inflation category, he is able to reject this hypothesis.[1/] He attributes this to exchange rate changes that occured during this period which includes 1967. Using the same type of test and similar declination of periods, he

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1/ One problem with these tests is the treatment of exchange rate changes. He treats them as a one period break in the inflation series with full adjustment to the exchange rate change occuring in one period. When inflation rates differ, there is pressure on the balance of payments which affects either exchange reserves or the exchange rate. It is interesting that Genberg can reject the hypothesis that all countries have similar mean rates of inflation only for the period of intermediate values of inflation. It is also during this period that many exchange rates changed. These observations suggest that inflation rates do not converge immediately. The adjustment occurs over time but can be affected by changes in the exchange rate. The adjustment may take more than one quarter finds that the mean rate of inflation for each of 15 large U. S. cities does not differ from the overall mean. He concludes,

> It appears...that the differences between the OECD countries are no greater on average than those between cities within the U. S. Thus if we believe that the whole of the U. S. can be treated as a single market in a macroeconomic context, then the area composed of the above countries could be treated likewise. (Genberg, 1975, p. 28)

Using the same set of countries, he also does a principal component analysis of the consumer price indices. An index of the world price level, the first principal component of the CPI base, explains over 90 percent of the variation in the data.

Genberg's evidence indicates that, over time, inflation rates converge under fixed rates. During this period, exchange rates were controlled by governments. The results say that given the development of either exchange rates or prices, the other adjusts over time so exchange rate corrected prices converge.

To look at the relationship between the rate of inflation in Sweden and the external rate of inflation, we have constructed a "world price index" for Sweden. (All price indices are CPIs. This may ldea to some bias in the results as the Swedish CPI also includes the prices of imported goods.

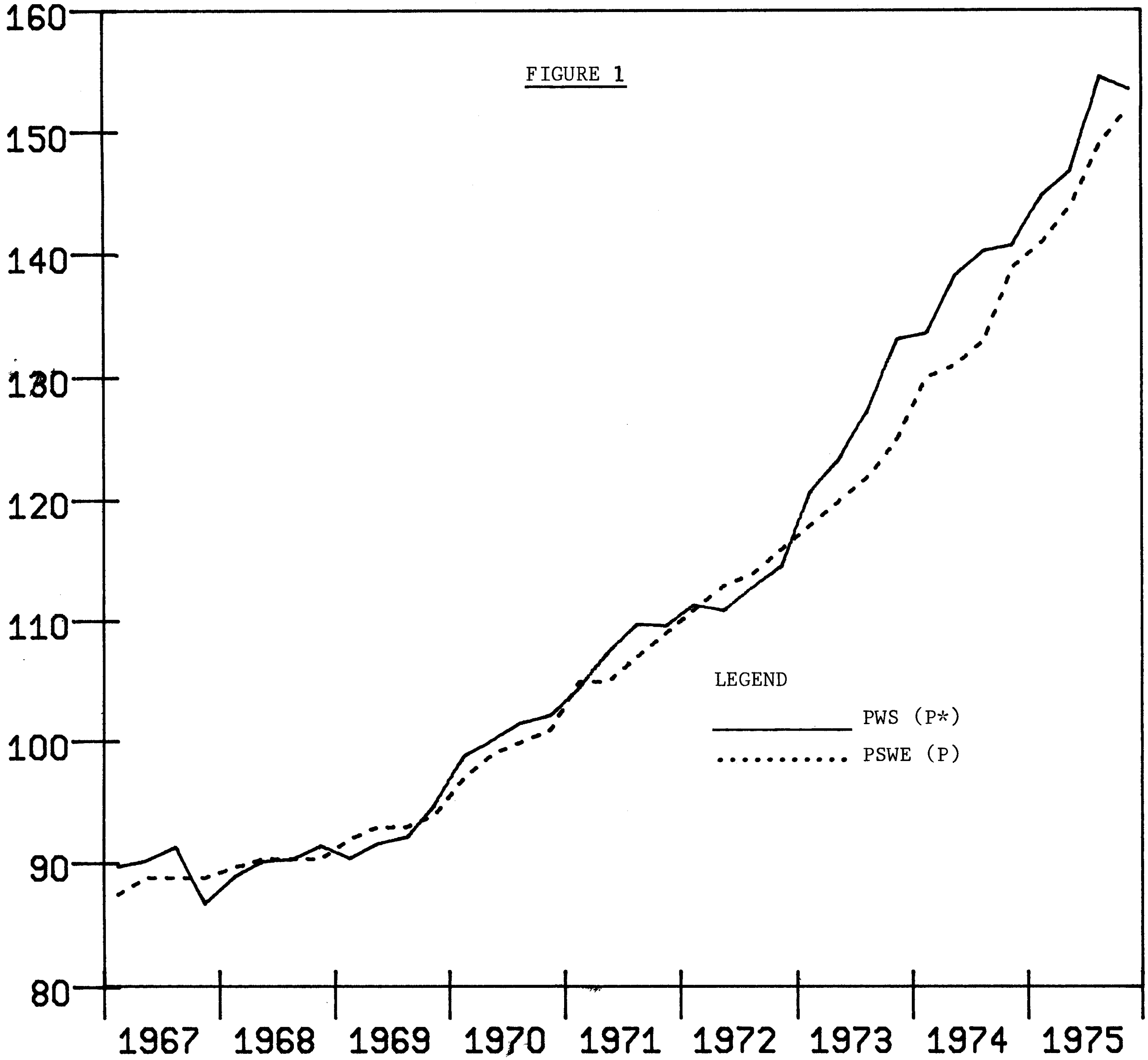
It is very difficult to find wholesale price indices that extend over the entire period continuously.) The weights for the index are the average of each foreign country's share in Sweden's trade with the group of countries considered. The group of countries (not in any particular order) that constitute the "world" are the United States, Germany, the United Kingdom, Belgium, the Netherlands, Norway, Denmark, and Finland. These are all major trading partners of Sweden. France with a trade share around 4.5 percent has the largest trade share of any country excluded from the list. The two smallest trade shares are those of the Netherlands and Belgium with trade shares of approximately 4.4 and 3.3 percent respectively. Both these countries are included because they are members of the European joint float and their price levels are important in determining the bloc rate of inflation since its formation in 1973. The average trade shares of the entire group in Sweden's trade are 64 percent of Sweden's total exports and 66 percent of its imports.

These are two reasons for using trade shares to construct the "foreign" price index for Sweden. Foreign prices constrain domestic prices. Under fixed exchange rates, foreign and domestic rates of inflation cannot diverge without balance of trade disequilibria. Trade shares change slowly and are a good indicator of the importance of short-run balance of trade problems that can result from shifts in prices between countries before trading patterns adjust. For our purposes it is not very important to see what is causing the inflation in these countries and what the common rate between them ought to be as long as the Swedish rate of inflation does not affect it. In the short run, it is the divergence between Sweden's prices and this trade weighted price that is important.

Another reason for using trade weights is to make the index applicable to the post-1973 period when Sweden joined the European joint float. Since much of Sweden's trade is done with other countries in the joint float, this index is continuous over time and does not shift dramatically because of exchange rate changes. The period that we will consider is from 1967 to 1975 with quarterly data.

If the foreign price level is P* (asterisks will denote foreign countries), the domestic price level has to move with eP* where e is the exchange rate, the units of domestic currency per unit of foreign currency. A change in P* that is exactly offset by a change in e will not affect relative prices. If we let E denote an index of the exchange rate (all indices have 1970=100), then $P^*=\Sigma P^*_i E_i t_i$ where t_i is trade share and $\Sigma t_i = 1$. Figure 1 is a graph of P_{swe} against P* while Figure 2 is a graph of the ratio of these variables. These figures indicate that the price level in Sweden moves with the world price index corrected for changes in the exchange rate.

FIGURE 1


160
150
140
130
120
110
100
90
80
1967
1968
1969
1970
1971
1972
1973
1974
1975
LEGEND
PWS (P*)
PSWE (P)

At 5 percent significance we cannot reject the hypothesis that the P*/P equals one. We can also test to see if the convergence of rates of inflation or of the price levels corrected for exchange rate changes is immediate or occurs over time.[1/] To test this hypothesis, we regress P_{swe} on a constant and a distributed lag of 8 periods of P*. The coefficients of the lag distribution are constrained to lie on a parabola (second degree polynomial) and go to zero at the end of the period. The same regression is run using rates of change of the price indices (changes in the logarithms). A look at the ratio graph Figure 2 indicates that departures from unity persist, indicating adjustment over time. The regression results are presented in Table 1.

1/ The stability of P*/P around 1 can mean that either prices converge given exchange rates or exchange rates change so P*/P = 1 given prices. The exogenous variable is the exchange rate in this case, and we can speak of the convergence of rates of inflation (See Footnote (1) P. 11).

FIGURE 2

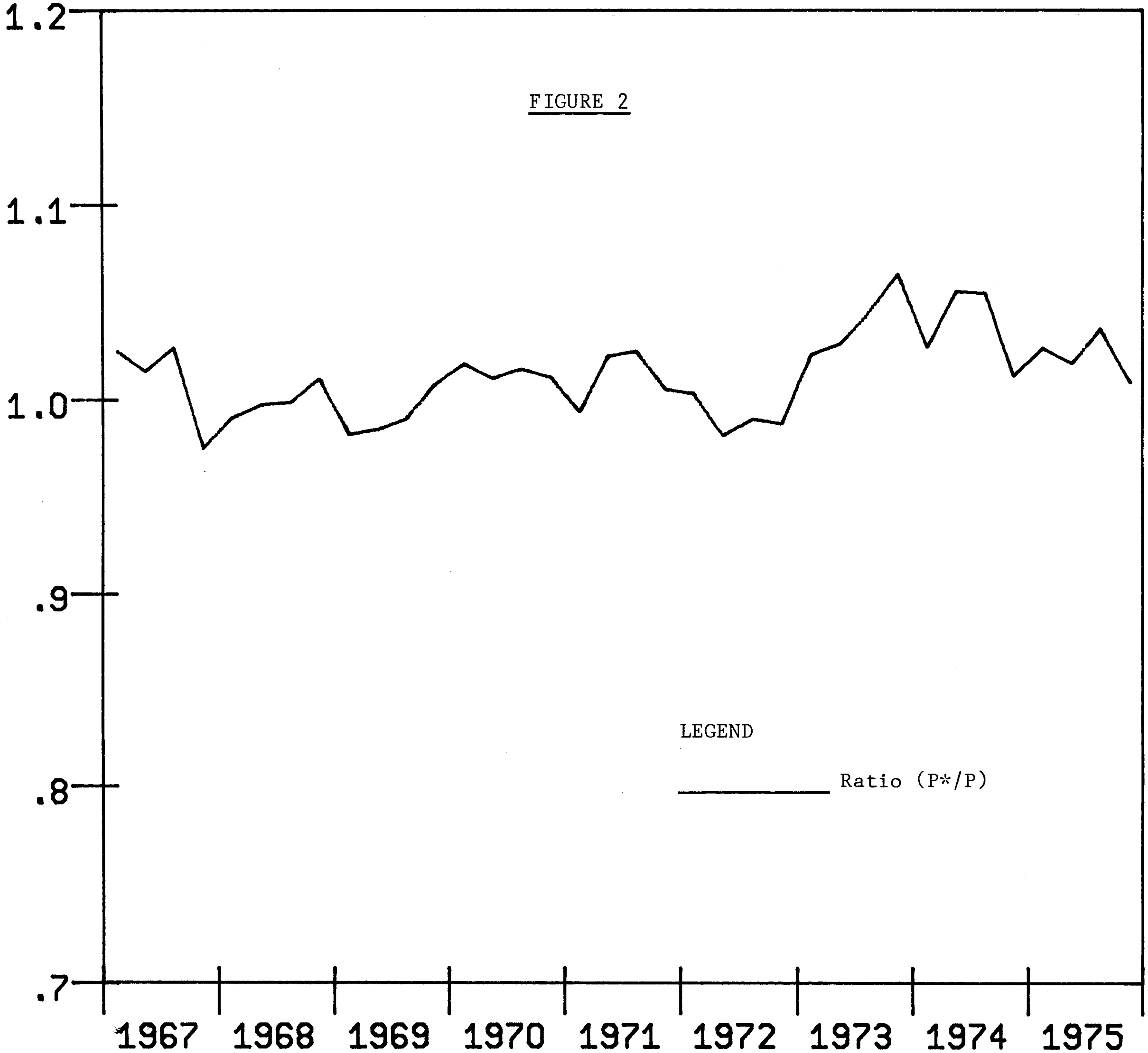

1.2
1.1
1.0
.9
.8
.7
LEGEND
Ratio (P*/P)
1967
1968
1969
1970
1971
1972
1973
1974
1975

TABLE 1

RELATIONS BETWEEN EXCHANGE RATE DEFLATED DOMESTIC AND FOREIGN PRICES LEVELS FOR SWEDEN

	$Pswe = C + \Sigma B_i P^*_{-i} + U$	$\Delta \ln Pswe = C + \Sigma B_i \Delta \ln P_{-i} + U$
Constant	.872 (1.668)	.01 (.006)
B0	.154 (.043)	.068 (.103
B1	.163 (.020)	.080 (.067
B2	.163 (.003)	.086 (.048)
B3	.156 (.011)	.086 (.047)
B4	.141 (.018)	.080 (.051)
B5	.118 (.021)	.069 (.051)
B6	.086 (.019)	.052 (.043)
B7	.047 (.012)	.029 (.026)
ΣB_i	1.03 (.02)	.55 (.30)
Mean Lag	2.88 (.36)	3.07 (1.35)
R^2	.997	.12
D.W.	1.38	2.63
Period	1969:1 1975:4	1969:1 1975:4

() signify standard errors

While the price level equation shows positive correlation of the residuals, the rate of change equation, which is equivalent to a serial correlation correction of -1, shows negative correlation. The level equation fits well. The interesting fact about the level equation is that the sum of the lags equals one. An increase of 1 in foreign prices will translate into an increase of one point in the domestic index. The mean lag is three quarters between changes in foreign prices and domestic prices. This mean lag is the same from both regressions. The sum of the lag coefficients in the rate of change equation is .55 with a 95 percent confidence interval of (-.03, 1.2). This is a very large interval but combined with the information from the level equation tells us that foreign price increases, corrected for exchange-rate changes, translate into domestic price increases with a lag of three quarters and are completely transmitted in 7 quarters.[1/]

1/ As mentioned earlier, the test that exchange rate corrected prices converge implies that either prices are adjusting to exchange rates determined exogenously, or exchange rates are adjusting to exogenous prices. These tests cannot distinguish between these results.

In the case of Sweden, however, we can interpret these results as indicating that Swedish prices adjust to the foreign price index corrected for exchange rate changes. The Swedish authorities allow the exchange rate to be determined exogenously. Sweden cannot affect the development of prices or exchange rates abroad. It is the Swedish rate of inflation that converges to the foreign rate.

One problem with these results is that we are using the CPI which already includes the prices of imports. This would give us a seemingly faster rate of transmission. To find the magnitude of this effect, we use the wholesale price index of manufactured goods. While this excludes food and services, it is a domestic price index. This index is plotted against the foreign price index in Figure 3 and P*/P is plotted in Figure 4. There do not seem to be important differences between the two price indices. If the CPI were unduly influenced by the prices of imported products, we would expect the P*/P index to be smaller for the CPI since P is higher. This does not appear to be the case.[1/, 2/]

1/ Using the same lag distribution regression as earlier, the mean lag in the level equation is 1 quarter and that in the rate of change equation 1.6 quarters using the wholesale price of manufactured products. The sum of the lag coefficients is slightly larger than 1 in both regressions. On the other hand, the serial correlation is quite sever in both these regressions.

2/ These regressions may give biased results if we have left out variables. If government policy can be used to affect the transmission process, a variable representing this should be included in the equation. Leaving out this variable biases the coefficient. Specification analysis reveals that this bias is negative if the leftout variable of government policy is negatively correlated with the included explanatory variables and positively correlated with the endogenous variable. We expect a negative correlation since government policy is supposed to be countercyclical. The coefficient on the foreign price level does not appear to be too low. This suggests that either government policy has not been directed towards countercyclical stabilization or, if it has been, it

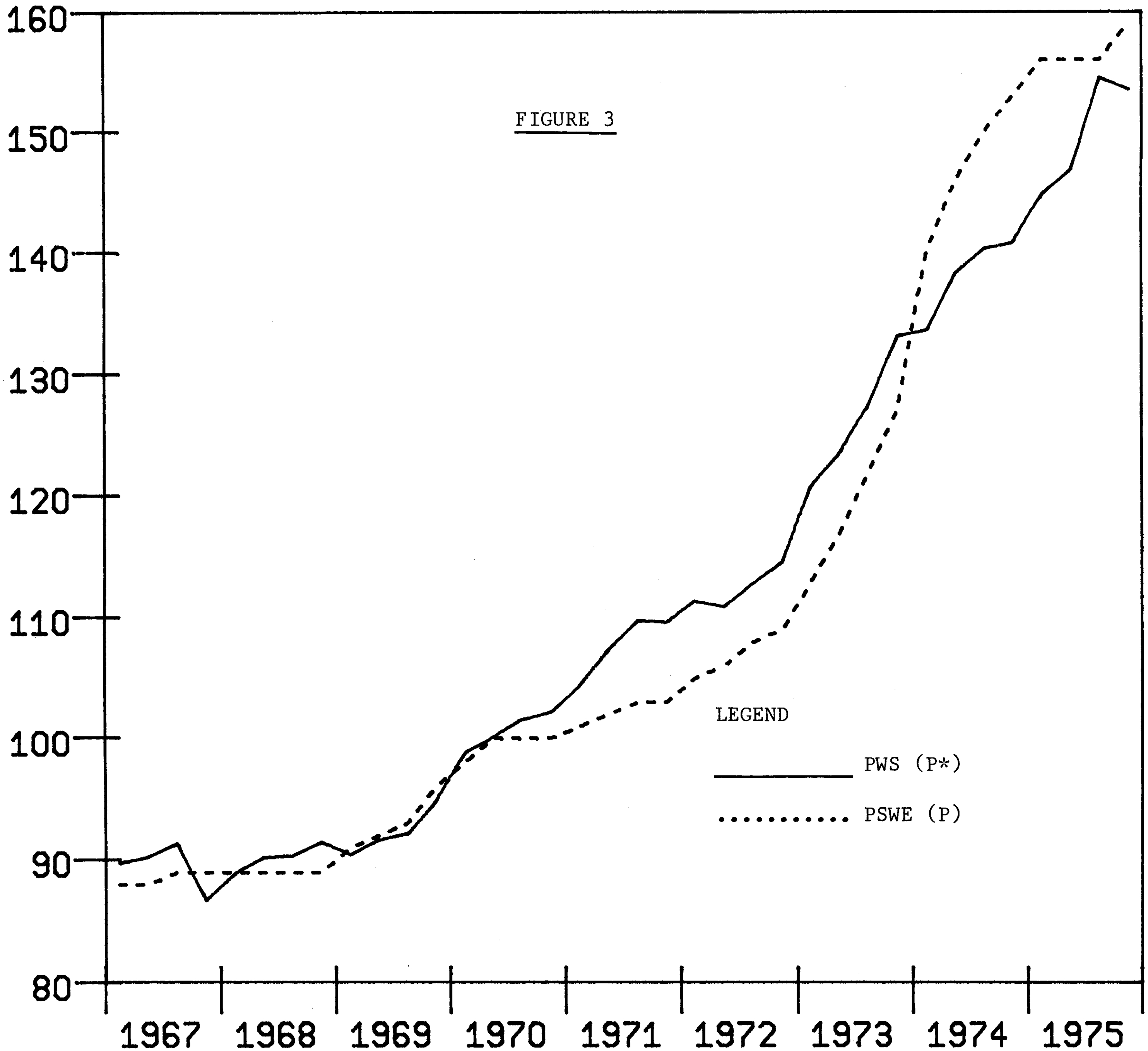
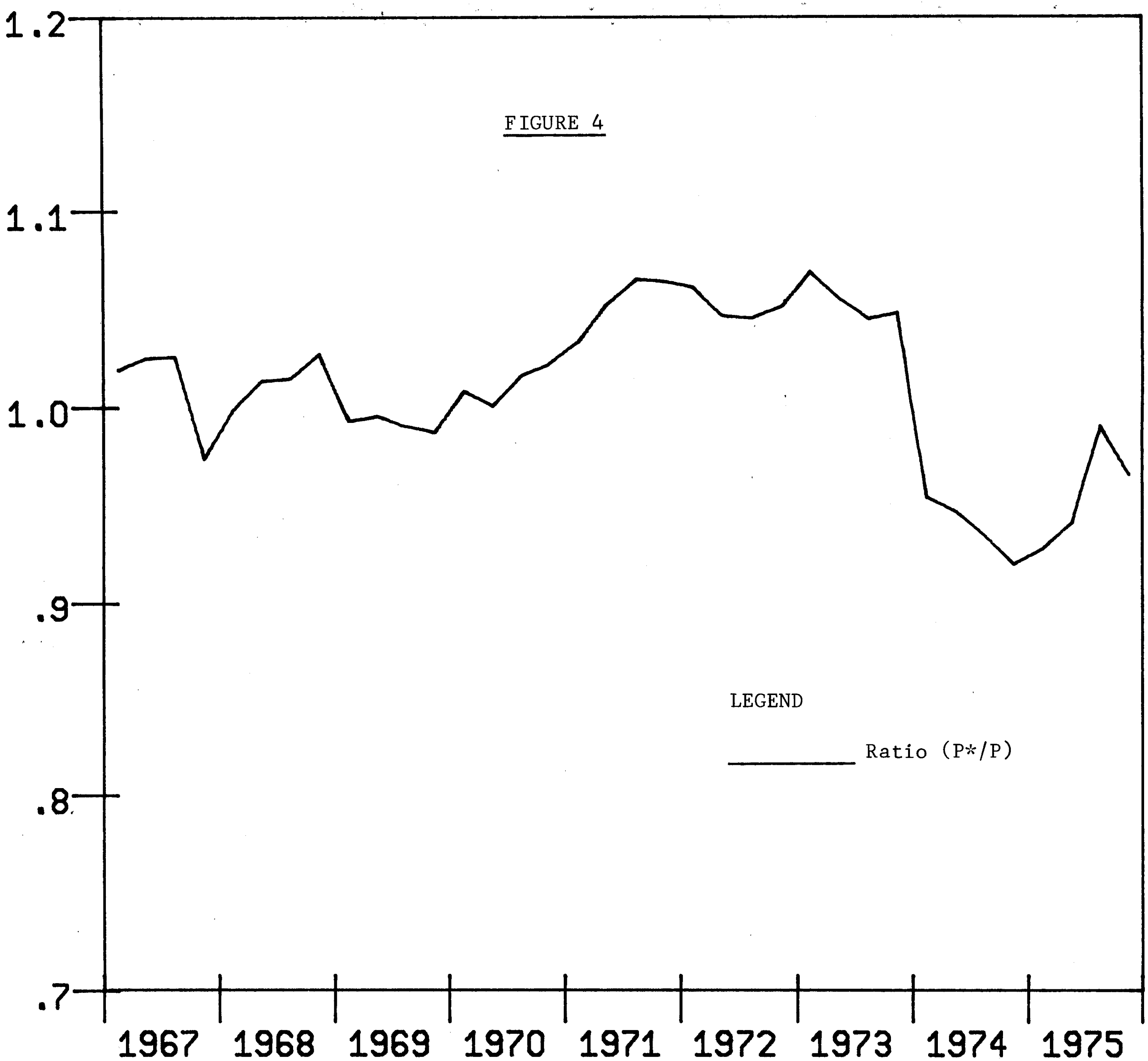


FIGURE 3
160
150
140
130
120
110
100
90
80
1967
1968
1969
1970
1971
1972
1973
1974
1975
LEGEND
PWS (P*)
PSWE (P)

FIGURE 4

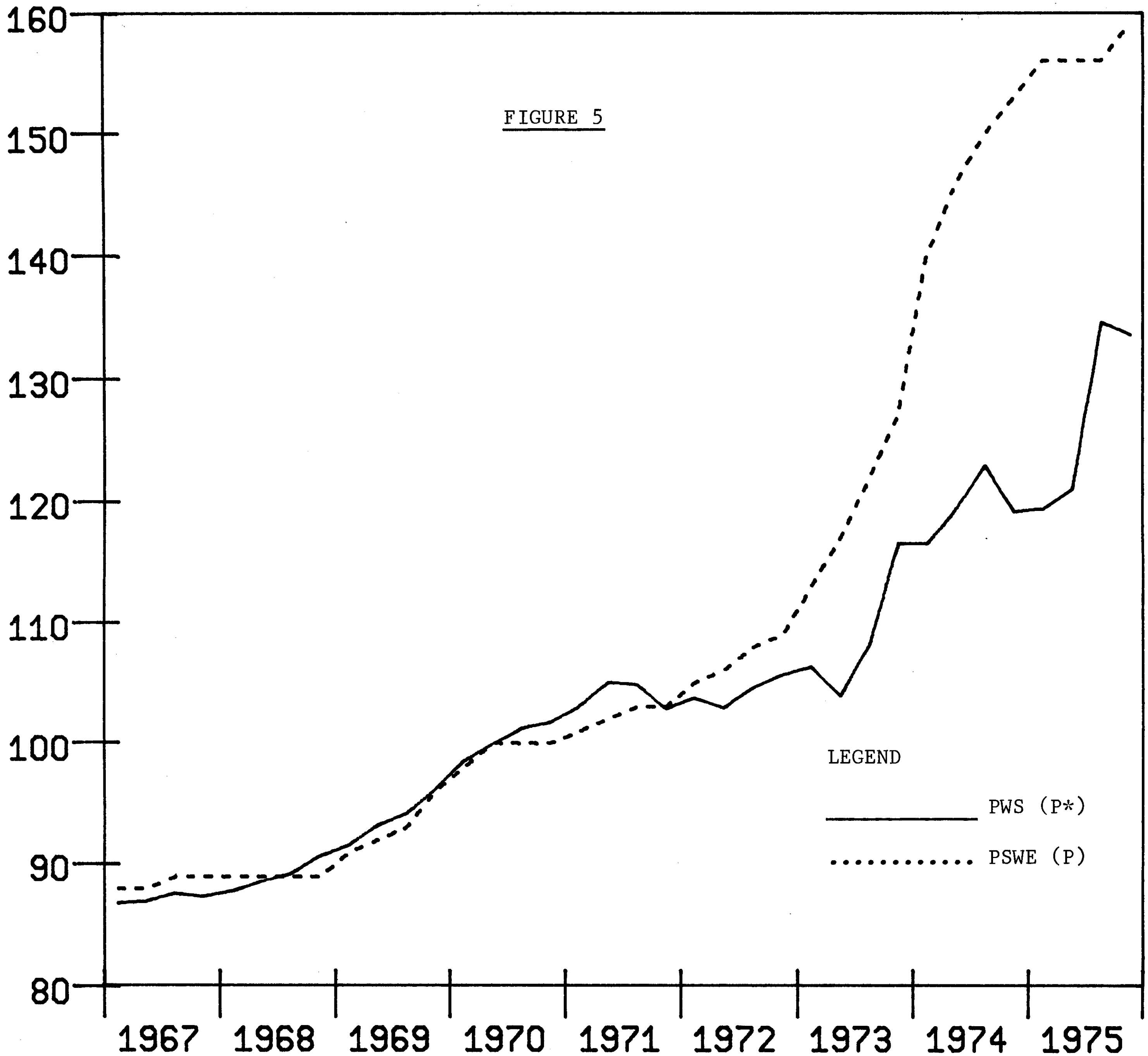

1.2
1.1
1.0
.9
.8
.7
1967
1968
1969
1970
1971
1972
1973
1974
1975
LEGEND
Ratio (P*/P)

Finally, we can look at a GNP weighted price index that is more representative of the world as a whole. Using the same set of countries as in the trade-weighted index, we constructed a new P*. This index is plotted against the Swedish CPI in Figure 5 and the ratio of P* to the CPI is plotted in Figure 6. From 1967 to 1971, P* and P behave in similar ways. After 1971, they begin to diverge dramatically. This is due to the fact that the United States price index constitutes over 60 percent of the weights in P* and the depreciation of the dollar with respect to the joint float countries forces down the foreign price level for Sweden. This is not quite the appropriate index as most of Sweden's trade is conducted with countries relative to whose currencies the Swedish kronor is far more stable.[1/]

1/ It is very interesting, though, that the regression results using this P* are quite similar to the previous ones. While there is a difference in the levels of the two indices - the constant term is not zero - a one point increase in P* leads to a 1.8 point rise in P in 8 quarters with a mean lag of approximately 2.7 quarters. The results from the rate of change equation are quite similar to those obtained earlier as well.

2/ continued

has been ineffective in this role. (By countercyclical policy we mean a policy designed to counter the effect of imported inflation.)


160
150
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1967
1968
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1975
LEGEND
PWS (P*)
PSWE (P)

FIGURE 5

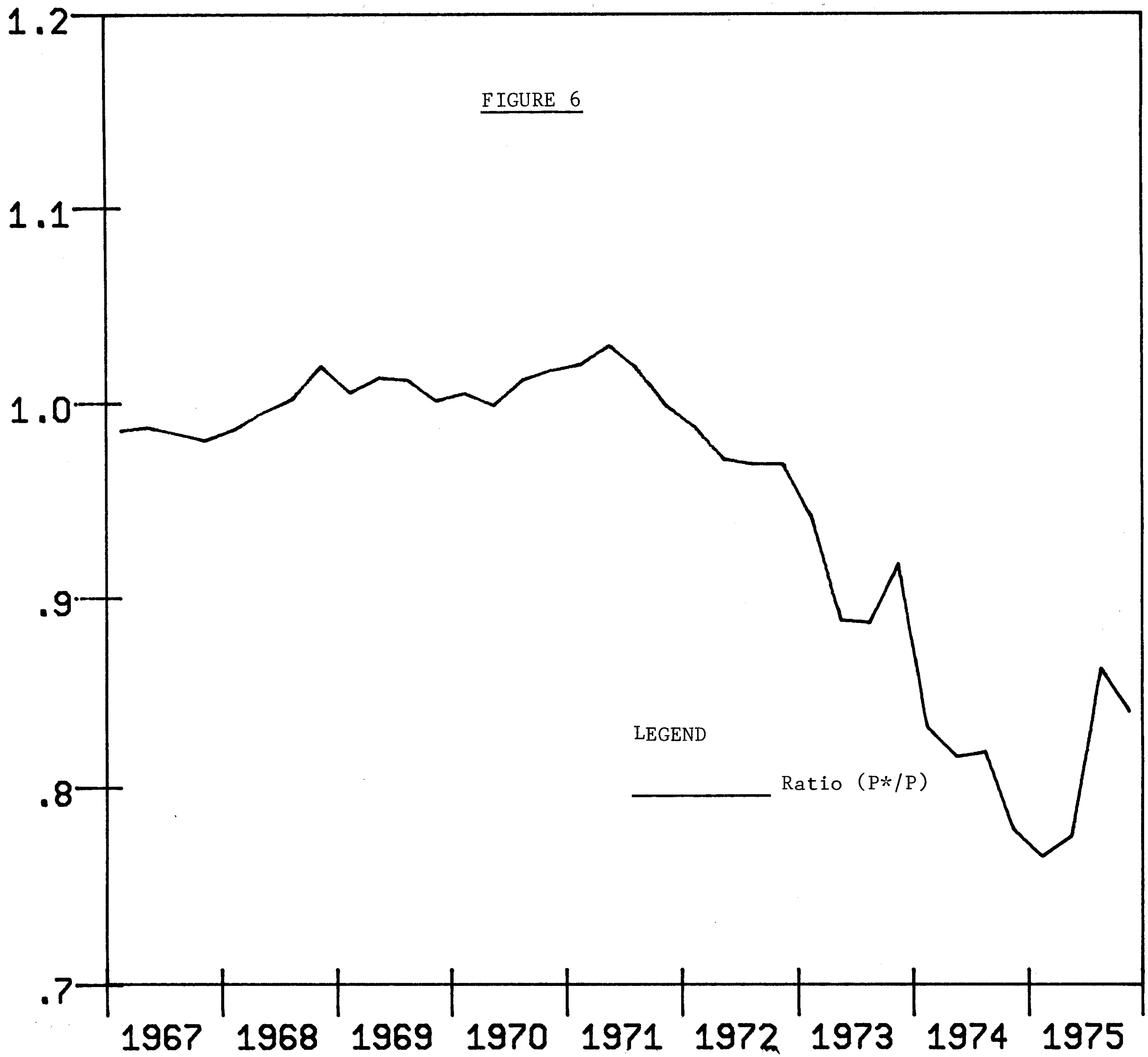
1.2
1.1
1.0
.9
.8
.7
1967
1968
1969
1970
1971
1972
1973
1974
1975
LEGEND
Ratio (P*/P)

FIGURE 6

One-Good Models and the Transmission of Inflation

To distinguish the transmission of inflation through aggregate demand channels from the effect of inflation on expectations and hence on wages, we can look at a one-good model. The crucial assumption is that the home country has some monopoly power in pricing its exports because of product differentiation.

The basic model contains four equations to explain the movement of wages, prices, expectations of inflation, and the unemployment rate. The following symbols will be used and hatted variables denote rates of change (i.e. $dx/dt/x=\hat{x}$).

1/ continued

The figures indicate that exchange rate changes are not offsetting only price changes. Including a dummy for the period after 1973 in the level equation gives a coefficient for this variable that is significantly different from zero indicating that exchange rates are not determined only by price changes. The mean lag is 3.0 quarters in this equation and the long run effect of a one point increase in foreign prices is a 1.6 point increase in domestic prices.

These results indicate that the Swedish kronor and the U. S. dollar have departed from pruchasing power parity since 1973 and that the U. S. dollar may very well be undervalued vis-a-vis the kronor.

The price level in Sweden moves quite closely with that of Sweden's trading partners. Increases in foreign prices translate into increases in domestic prices fully with a lag of 3.0 quarters. Government policy does not appear to have affected this process.

Starred variables denote foreign variables.

W = nominal wages.

π = rate of inflation

P = price level, so $\hat{P}=\pi$

u = unemployment rate.

π^e= expected rate of inflation.

m = markup on prices

d = rate of increase of productivity.

x = government policy variables.

Equation 1 is the wage equation representing a Phillips Curve with price expectations. This implies some rigidity of nominal wages.

$$(1) \quad \hat{W} = \hat{W}(1/u,\ \pi^e). \qquad \partial W/_{\partial(1/u)} > 0,\ 0 \leq \frac{\partial W}{\partial \pi^e} \leq 1$$

Equation 2 is the price equation which states that prices are a markup over labor costs adjusted for increases in productivity. Although we could make the price markup a function of aggregate demand, this will not change the basic properties of the model. We will also assume that productivity growth is zero.

$$(2) \quad P = (1+m)We^{-dt}$$

Equation 3 is the expectations formation equation. It states that the expectations of inflation are formed on the basis of domestic and foreign rates of inflation. We will have some lagged adjustment of expectations. Both the nature of the lagged adjustment and the relative weight of the domestic rate of inflation will affect the short term behavior of the model.

$$(3) \quad \pi^e = \pi^e(\pi, \pi^*);\ 0 \leq \frac{\partial \pi^e}{\partial \pi} \leq 1,\ 0 < \frac{\partial \pi^e}{\partial \pi^*} < 1$$

Equation 4 is the equation for the determination of the unemployment rate. It states that the domestic unemployment rate is a function of domestic and foreign policy variables, in the home country and abroad and the ratio of domestic prices to foreign prices.

$$(4) \quad 1/u = 1/u(x, x^*, P/P^*) \qquad \frac{\partial(1/u)}{\partial(P/P^*)} < 0$$

Equation (4) is derived from the Keynesian equilibrium condition that real output equals real domestic absorption plus the real balance of trade. If we let y denote real domestic output, and b the balance of trade

$$(5) \quad y = c(y, x) + b(y^*(x^*, p^*), y, p/p^*).$$

We can solve this equation for y as a function of x, x^*, and P^*/P. In the shortrun, output can increase only if employment increases so we can associate the level of real output with the unemployment rate as in equation (4).

This model is very Keynesian in that output adjusts to clear markets. It does not, however, preclude any of the monetarist concerns. The monetarist propositions can be discussed with respect to x, and the other variables in the output equation. One monetarist point is that we cannot ignore asset markets. If we are going to ignore the x variables, we have to assume that real wealth is being held constant and/or the interest rate is not changing. The other monetarist insight is that in the long run, the money supply has to be affected by changes in the balance of payments.

We can compare this model to Branson's 1975 Keynesian model. To do this, allow the effect of expectations to be zero and let real government spending and real wealth be constant. If productivity growth is zero, we can let $\hat{P}=\hat{W}$ and operate in terms of a price Phillips Curve. We now have two equations:[1/]

1') $\hat{P} = \hat{W}(1/u; \bar{\pi}^e)$ with $\frac{\partial \hat{P}}{\partial(1/u)} >$: Phillips Curve.

2') $1/u = 1/u(P/P^*; \bar{x}, \bar{x}^*)$

(Bars denote variables that are fixed in the period under consideration.) In the equilibrium state, $P=P^*$ and $\frac{d(\frac{1}{u})}{dt} = 0$.

In the equilibrium state, domestic and foreign rates of inflation are equal, output and employment are not changing,

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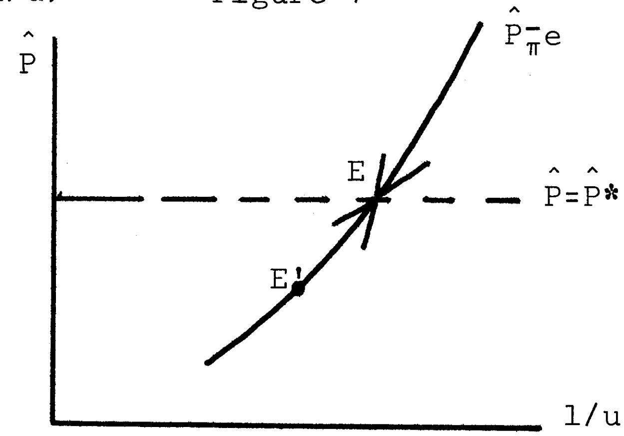
1/ We now interpret x to also contain information about asset market variables that are held constant.

and the balance of trade is not changing. We can represent this in the phase diagram below, Figure 7. A domestic rate of inflation higher than foreign rates of inflation leads to a balance of trade deficit and a decrease in output. The decreased demand for output decreases the demand for labor and decreases nominal wages and prices. Domestic rates of inflation lower than foreign rates lead to increased domestic output and prices. This is precisely the model described by Branson (2). Output and unemployment adjust so rates of inflation converge. (The P curve in the equation is positively sloped since $\frac{\partial P}{\partial(1/u)} > 0$.)

Figure 7



Dornbusch (6, p. 16) points out a crucial characteristic of this model.

> In Branson's model we can focus on the foreign trade multiplier to the exclusion of all other considerations only if in fact real income and <u>relative</u> prices are the only variables. This in turn requires that the real interest rate be held constant... . Such constancy of the rate of interest and real wealth requires in turn that the authorities pursue an asset market policy that involves an expansion in

> the nominal quantity of money. It is important to recognize this point since it eliminates most of the possible disagreement between monetarist and alternative approaches in this context.

Another monetarist contention is that the required increase in the nominal money supply occurs automatically as the domestic money stock increases to reflect increased stocks of foreign exchange reserves generated by trade surpluses.

Within the context of this model, the government can maintain a domestic rate of inflation lower than the foreign rate only if it engages in accelerating deflationary policies. A once and for all contractionary policy will move the equilibrium away from E. To stay away from E where foreign and domestic rates are equal, this deflationary action has to be repeated over and over again.1/

1/ Suppose that real wealth is held constant. To keep the domestic rate of inflation from converging to the world rate, real government spending g has to decrease continuously to keep output at the nonequilibrium level.

$$1/u = 1/u(g, P/P^*)$$

$$\frac{d(1/u)}{dt} = \overset{+}{\frac{\partial(1/u)}{\partial g}} \frac{dg}{dt} + \overset{-}{\frac{\partial(1/u)}{\partial(p/P^*)}} \left(\frac{DP/dt}{P^*} - \frac{pdP^*/dt}{P^*}\right)$$

For $\frac{d(1/u)}{dt} = 0$ and $\frac{dP/dt}{P} < \frac{dP^*/dt}{P^*}$

$dg/dt < 0$.

A once and for all decrease in real government spending shifts the economy to a point E' with lower output and employment. The economy will then move back to E with a higher balance of trade surplus at E to compensate for lower

The monetarist-Keynesian differences do not affect equation (1'), the Phillips Curve. The argument is over what policy variables x are being manipulated by the government and how these variables affect aggregate output and employment. The second monetarist contention that the supply of money is endogenous with fixed rates and free movement of capital implies that the government cannot use monetary policy to move the economy temporarily away from the long run equilibrium.

Before going on to examine the role of real wealth, let us look at the role of expectations assuming that real government spending and real wealth remain constant. An increase in the foreign rate of inflation will eventually lead to an increase in the domestic rate of inflation, and over time, to an increase in inflationary expectations given lagged adjustment. From the policy perspective there are two important questions here. The first issue is what effect inflationary expectations have on the behavior of nominal wages. If an increase in inflationary expectations is fully offset by an increase in the rate of change of wages, the long-run Phillips

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1/ continued

government spending.

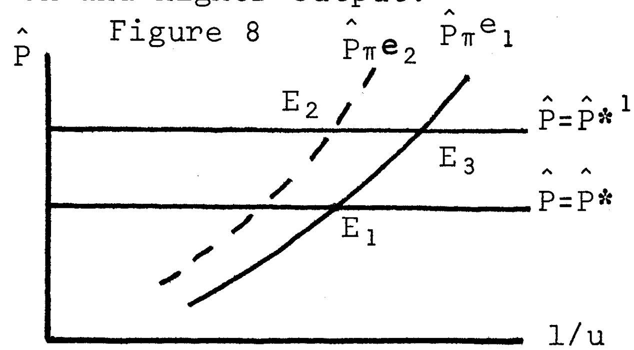
$$\hat{P} = \hat{W}(1/u(g), \bar{\pi}^e)$$

$$\frac{d\hat{P}}{dg} = \frac{dw}{d(1/u)} \quad \frac{d(1/u)}{dg} > 0$$

Curve is vertical. In this case higher rates of inflation have no output effect once the new equilibrium is reached. The other issue is how long it takes domestic expectations to adjust to higher rates of inflation at home and abroad. Are these expectations functions of the domestic or the foreign rate of inflation?

Let the foreign rate of inflation increase from $\hat{P}*$ to $\hat{P}*'$. In terms of Figure 8, the new equilibrium point at the old level of expectations is E_3 where the previous equilibrium was E_1. The $\hat{P}$ line has not shifted since expectations have not changed. Long-run equilibrium now occurs at a higher rate of domestic inflation and higher output.

Figure 8



The increase in output and employment is a consequence of the fall in real wages associated with the increase in the rate of inflation. An increase in expectations of inflation that is compensated for by an increase in the rate of increase of nominal wages reduces the increased employment effect of higher rates of inflation.

Suppose that expectations rise by the full amount of the increase in foreign inflation. The increase in expectations shifts the P curve by the amount that nominal wages increase in relation to expectations. In the limit, nominal wages increase exacrly enough to offset higher expectations. The new equilibrium point E_2 is directly above the old equilibrium and there is no change in output or employment. The $\hat{P}$ curve shifts up the same amount that the $\hat{P} = \hat{P}*$ line has shifted. If the rate of increase of nominal wages does not increase by the full amount that expectations have increased, employment will increase as the P line shifts up by less than the $\hat{P}=\hat{P}*$ line. (Employment increases because real wages fall.) The point E_2 will be to the right of E_1 but to the left of E_3. In this case, the trade surplus will be higher in the new equilibrium. The trade surplus will be the same in both the old and the new equilibrium only if the rate of increase of nominal wages increases by the full amount of the increase in the rate of inflation. It is debatable whether or not a new equilibrium in which the trade balance has changed is a true equilibrium that can be sustained.

The formation of inflationary expectations determines the speed of adjustment. If π^e adjusts slowly to changes in $\hat{P}*$, the $\hat{P}$ curve shifts up slowly and adjustment takes longer. If π^e is an average of $\hat{P}$ and $\hat{P}*$, the adjustment of the domestic rate of inflation to the foreign rate occurs even more slowly.

Government policy can affect the speed of adjustment in this case. A once and for all decline in government spending will force down the domestic rate of inflation and the level of output. This implies that it will take inflationary expectations even longer to adjust. In terms of short-term inflation-employment choices, the government is interested in how long the adjustment of expectations takes.

The monetarist approach to the balance of payments stresses the role of asset demand in the economy. So far we have assumed that real wealth is held constant. Let us incorporate the wealth effect into the model. Let V be nominal wealth and $p^{\alpha} p^{*1-\alpha}$ the CPI which is a weighted average of domestic and foreign prices. Thus real wealth is $v = V/p^{\alpha} p^{*(1-\alpha)}$ and we can write the output equation as

$$2'')\quad \frac{1}{u} = \frac{1}{u}\left(\bar{x}, \bar{x}^{*}, \frac{V}{p_{\alpha} p^{*(1-\alpha)}}, P/P^{*}\right)$$

An increase in prices with nominal wealth constant decreases real wealth leading to a fall in domestic real expenditures and therefore employment.

The model now has different properties. It is no longer true that $\hat{b}=\hat{u}=0$ can occur simultaneously with other factors held constant. (We will assume that expectations are constant.)

Differentiating (2'') with respect to time and letting

$$\frac{d(1/u)}{dt} = 0,$$

we have,

$$0=\frac{d(1/u)}{dt} = \frac{\partial(1/u)}{\partial(P/P^*)}(\hat{P}-\hat{P}^*)\ \frac{P}{P^*} - P^{\alpha}P^{*1-\alpha}\left(\frac{\partial(1/u)}{\partial v}\right)(\alpha\hat{P}+(1-\alpha)\hat{P}^*)$$

Thus $\widehat{\left(\frac{1}{u}\right)} = 0$ if

$$6)\quad \hat{P} = \hat{P}^* \quad \frac{\frac{\partial(1/u)}{\partial(P/P^*)}\frac{P}{P^*} + (1-\alpha)\frac{\partial(1/u)}{\partial v}P^A}{\frac{\partial(1/u)}{\partial(P/P^*)}\frac{P}{P^*} - \alpha\frac{\partial(1/u)}{\partial v}P^A}$$

$$P^A = P^{\alpha}P^{*1-\alpha}$$

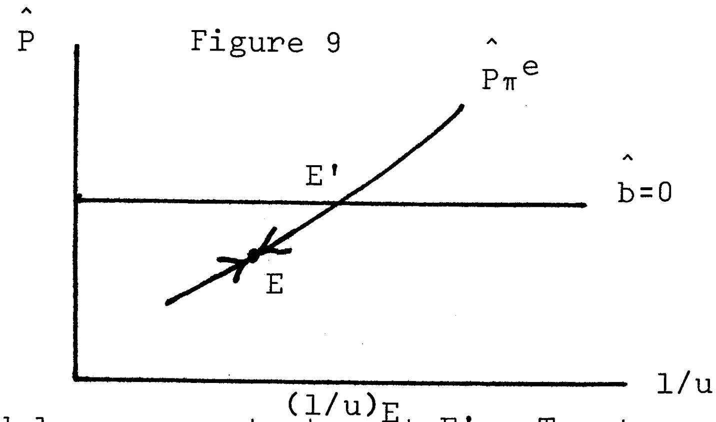
The denominator of the expression in parenthesis in equation (6) is negative. The numerator is negative if we make the reasonable assumption that the increase in foreign prices with constant domestic prices increases the trade surplus by more than it decreases real expenditure through the wealth effect. That is

$$\frac{\partial(1/u)}{\partial(P/P^*)}\ \frac{P}{P^*} + (1-\alpha)\ \frac{\partial(1/u)}{\partial v}\ P^A < 0$$

A sufficient condition for this to hold is that the weight on foreign prices be small.

Equation 6 implies that with $\hat{u}=0, \hat{P}<\hat{P}^*$ since the numerator is a larger negative number (smaller in absolute value). For $\hat{b}=0$ or a trade balance, $\hat{P}=\hat{P}^*$. This implies, however, that

$\hat{(1/u)}<0$ since the fall in real wealth decreases expenditures and income.



In this model, we cannot stay at E'. To stay at E', real wealth has to increase. If nominal wealth is constant, domestic output moves towards $(1/u)_E$. Inflation rates do not converge. There is a trade surplus that is increasing to account for falling domestic consumption.

The second monetarist contention is important here. Point E, on the other hand, cannot be a real equilibrium as foreign exchange reserves accumulate. The increasing trade surplus induces the government to increase the nominal money supply and hence real wealth. Point E' is the real equilibrium point where both output and the trade balance are constant. This point implies that nominal wealth is increasing at the rate of increase of prices and real wealth is constant. It is an entirely different issue whether or not the adjustment of the moninal money supply is automatic in the shortrun.1/

1/ Instead of looking at the effect of inflation on real wealth, we can incorporate a money demand function directly into the analysis.

$M^D = M^D\ (i, 1/u,\ P^A)$	Money demand, i is the interest rate.
$M^O = \bar{M}$	Money supply (sterilization is possible.)
$M^S = M^D$	Money market equilibrium.

Furthermore, we can write

$$1/u = 1/u(\bar{X}, \bar{X}^*,\ P/P^*,\ i) \quad \frac{\partial(1/u)}{\partial i} < 0$$

An increase in the interest leads to a fall in real income and employment.

Solving for the equilibrium rate of interest in the money market, we obtain

$$i = i(1/u,\ P^A, \bar{M});\ \partial i/\partial(1/u) > 0\ ;\ \frac{\partial i}{\partial P^A} > 0;\ \frac{\partial i}{\partial \bar{M}} < 0$$

This implies the reduced form for output equation with i solved out

$$1/u = 1/u(\bar{X}, \bar{X}^*; P/P^*,\ i(1/u,\ P^A, \bar{M}))$$

Differentiating with respect to time yields

$$\frac{d(1/u)}{dt} = \frac{\partial(1/u)}{\partial(P/P^*)}\ (\hat{P} - \hat{P}^*)\ P/P^* + \frac{\partial(1/u)}{\partial i}\ \left(\frac{d(1/u)}{dt} + \alpha\ \hat{P} + (1-\alpha\ )\hat{P}^*\right)P^A$$

The condition $\frac{d(1/u)}{dt} = 0$ implies

$$\hat{P} = \hat{P}^*\ \left(\frac{(\partial(1/u)/\partial(P/P^*)(P/P^*) - (1-\alpha\ )\ \frac{\partial(1/u)}{\partial i}\ P^A}{(\partial(1/u)/\partial(P/P^*)(P/P^*) + \frac{\partial(1/u)}{di}\ P^A}\right)$$

The denominator of the expression in parenthesis is negative. If numerator were positive, the effect of an increase of i on 1/u were sufficiently large and the weight on P* were also sufficiently large, a positive rate ofinflation abroad would imply deflation at home at constant levels of output and a constant nominal supply of money with growing foreign exchange reserve. In this case, increases in foreign prices increase the demand for domestic money. Since the money supply is constant, domestic interest rates rise and domestic expenditure falls. Output does not fall because the increase in the trade surplus compensates for the fall in domestic expenditure.

This is an unlikely case. It is sufficient that $1-\alpha$ be sufficiently close to zero - the weight on domestic goods be sufficiently high - for the numerator to be negative. If the numerator is negative, then $\hat{u}=0$ implies $\hat{P}<\hat{P}^*$ since the numerator is smaller than the denominator in absolute value.

We have the same situation described earlier. At the point where output is constant, the trade balance is in surplus and reserves accumulate. As the authorities increase the nominal money supply, the point where output is constant moves towards the point where the trade account is in balance. Since

$$\hat{P}|_{\hat{u}=0} = \frac{P^*\left(\frac{\partial(1/u)}{\partial(P/P^*)}\frac{P}{P^*} - (1-\alpha)\frac{\partial(1/u)}{\partial i}PA\right) + \frac{\partial(1/u)}{\partial i}\hat{M}M}{\frac{\partial(1/u)}{\partial(P/P^*)}P/P^* + \alpha\frac{\partial(1/u)}{\partial i}PA}$$

we can find the increase in the supply of money that gives us trade balance and constant output.

If we have free capital movements and $i=i^*$, the money supply is endogenous and we return to the original diagram. $\hat{P}=\hat{P}^*$ implies $\hat{b}=0$ and $\hat{u}=0$.

But $M^D = M^D(i^*, 1/u, P^*)$

and $M^S = \bar{M} = M^D \qquad M^S = \frac{1}{M}\frac{\partial M^D}{\partial P^A}\hat{P}^*$

If $\frac{1}{M}\frac{\partial M^D}{\partial P^*} = 1$ then $\hat{M}=\hat{P}$. This is also the required increase in the money supply if the authroities want to maintain a constant rate of interest.

Returning to equation (1) we are interested in the transmission of inflation through the wage equation. We want to distinguish between the effects of inflation abroad on wages directly through expectations and through aggregate demand effects. We are interested in the slope of the short-run Phillips Curve because it tells us how much government policy has to decrease expenditure to obtain a domestic rate of inflation that is temporarily lower than the foreign rate. We are also interested in the formation of expectations. The slower expectations adjust, the less government has to decrease real expenditures to maintain a lower domestic rate of inflation for a given time. Finally we are interested in the slope of the long run Phillips Curve or how much the rate of increase of nominal wages adjusts in response to a change in expectations. This tells us whether a higher rate of inflation has real output effects and whether changes in the foreign rate of inflation involve changes in the domestic unemployment rate.

In estimating the Phillips Curve, we have to take into account the endogeneity of the unemployment rate of a small open economy. Failure to take this into account will result in a coefficient for $1/u$ that is biased downwards. This gives the impression that the shortrun Phillips Curve is flatter than the true short-run curve. This in turn implies that a far greater change in government expenditures is needed to obtain a short-run change in wage inflation. The true short-run curve can be estimated correctly if we take into account the endogeneity of the unemployment rate. This estimate will be consistent regardless of whether or not the domestic money is endogenous if we do not use any domestic monetary variables as instruments in the estimation.

Two-Good Models

The argument that national rates of inflation cannot diverge under fixed rates and long-run equilibrium is similar to the purchasing power parity argument in its relative form. While B. Balassa (1, p. 205) is not willing to accept the absolute version of pruchasing power parity doctrine because of the existence of nontraded goods, he is more amenable to the relative version of purchasing power parity.

> The purchasing-power parity doctrine could still find application if productivity increases and wage adjustments were identical in every country, and if we also assumed neutral production and consumption effects. Under these, admittedly restrictive, assumptions, parallel changes in the price level will take place and the doctrine will give the correct answer: there is no need for adjusting the rates of inflation. (Balassa, 1969, p. 205.)

Hans Genberg (11) examines the behavior of relative rates of inflation for a small country and the rest of the world under fixed exchange rates. He explicitly includes the distinction between traded and nontraded goods. He concludes that while the existence of nontraded goods allows the small country to diverge in the short run from the world rate of inflation, it cannot do so in the long run if long-run shifts in the production possibility frontier are neutral between the two sectors.

A small country faces exogenous traded goods prices. The relative price between traded and nontraded goods determines expenditures on traded goods. The equilibrium relative price is the price that at which the trade account balances. Given the production possibility frontier and consumption patterns, this relative price is constant and inflation of the traded goods price has to result in inflation of the price of non-traded goods if trade equilibrium is to be maintained. The domestic country has the choice of supporting or not supporting an internal rate of inflation different from the foreign rate in the short run. By deflating the economy, the domestic government can reduce the relative price of nontraded goods. To maintain a lower rate of inflation, a continuous deflation is necessary. In the long run, to maintain a domestic rate of inflation different from the foreign rate under a regime of fixed exchange rates, the domestic government has to have biased shifts in production or consumption patterns. This is the conclusion that Balassa came to as well. The evidence points to the convergence of rates of inflation under fixed exchange rates. This suggests that for countries at the same stage of development purchasing power parity is a good assumption and that the special conditions that invalidate it are unlikely to hold.[1/]

1/ In a two-good model with fixed exchange rates, the restriction imposed by international trade is that the price of the traded good is equalized. Assume that wages are rising faster than the rate of increase of productivity in the traded goods sector. This implies that the prices of traded goods are increasing by the amount that wage increases exceed productivity gains. Since traded goods prices are equalized, wages must be increasing at the same rate across countries given the reasonable assumption that productivity increases are similar across countries in the traded goods sector. There is still the possibility that inflation rates across countries will not be similar with no balance-of-payments difficulties emerging.

The rate of inflation is a weighted average of the rate of price increases in the traded goods and the non-traded goods sectors. The rate of increase of traded goods prices is the same across countries. The rate of increase of non-traded goods prices is a function of the increase in wages and on productivity in the non-traded goods sector. Since wages are increasing at a uniform rate, if productivity increases in non-traded goods are not uniform across countries, prices increases in this sector will not be uniform across countries. This in turn means that rates of inflation need not converge.

1/ continued

Even if productivity increases are similar in the non-traded goods sector, the rates of inflation may differ because of different sectoral shares of this commodity across countries. Productivity increases in the non-traded goods sector are generally assumed to be lower than those in the traded goods sector since the former consists mostly of services. The lower rate of growth of service productivity results in a rate of growth of service prices higher than that of traded goods when wage increases are uniform across the economy. Differing developments of non-traded goods prices with similar developments of traded goods prices imply that demand patterns are dissimilar across countries. (Balance-of-payments equilibrium is assured for the small home country as long as expenditure equals income and non-traded goods prices can adjust--traded goods prices are determined abroad. Demand patterns must also be dissimilar if sectoral output shares differ while price developments are similar.

Countries at the same stage of development probably have similar patterns of demand. This implies that countries at the same stage of development will have similar rates of inflation even though the price developments of traded and non-traded goods are dissimilar. The tests on the similarity of rates of inflation across countries suggest that these rates are indeed similar. This supports the conjecture that demand patterns are similar.

Scandinavian economists have worked extensively with two sector models of the economy. The main two sector model is known as the EFO model which analyzes long-run price developments in Sweden. The main conclusion drawn by the authors of this model is that under fixed exchange rates, price increases in the traded goods sector translate into wage increases that spread throughout the economy. Given the rates of growth of productivity in the traded and nontraded goods sectors, the overall price level is determined by international developments. The crucial assumption in the analysis is that demand policy is accomodating.

The EFO Model

The model is named after its authors Gosta Edgren, Karl-Olof Faxen, and Clas-Erik Odhner (9, 7). This is developed along the same lines as Aukrust's similar model for Norway in the mid 1960s. The economy[1/] is separated into two aggregate sectors, the competitive and sheltered sectors. The competitive sector produces goods traded internationally and whose prices are exogenous to the Swedish economy given the exchange

1/ An excellent analytic summary of this model is in Branson and Myhrman, (2).

rate. The sheltered sector produces domestically consumed goods not subject to international price competition and includes nontraded commodities such as services and government as well as protected sectors such as agriculture.

The model assumes that labor productivity is exogenous to the economy and is rising faster in the competitive sector than in the sheltered sector. Prices are set on a cost plus basis and factor shares are constant. This implies that wages can rise in the competitive sector by the full amount of the increase in productivity and the rise in world prices of traded commodities. Wages are assumed uniform throughout the economy. A rise in competitive sector wages raises wages by the same amount in the sheltered sector. Since the productivity increase in the latter is smaller, prices have to rise more in the sheltered sector than in the competitive sector. The price level for the economy as a whole will increase faster than international prices. As Branson and Myhrman (2, p. 20) point out, the overall rate of inflation is determinate only when we know the shares of sectoral output in GNP.

Edgren, Faxen, and Odhner do not explicitly discuss the development of sectoral shares. They indicate that the share of the competitive sector which is presently at 1/3 of gross output should not decline precipitously if Sweden is to continue growing as an open economy competitive on world markets. Competition, as they see it, is a dynamic consequence of investment and innovation. If the competitive sector were to shrink in size as a result of lower profitability, it could not compete effectively on international markets. Economies of scale in the manufacture of traded goods or research and development would produce such a result. They emphasize the role of retained profits in financing new investment. Low profitability and a lack of internal finance would curtail investment.

If sectoral output shares are to remain constant in the face of different price developments in the two sectors, demand must not shift between the two sectors. If income is static, a zero price elasticity of demand for sheltered sector goods is necessary to maintain demand patterns. If income is increasing, another necessary condition to maintain constant sectoral output shares in the face of differing sectoral price developments is that the income elasticity of demand for the sector whose prices are increasing faster (the sheltered sector) be larger than the income elasticity of demand for goods whose prices are growing less rapidly (the competitive sector). The smaller the price elasticity demand for the sheltered sector products, the smaller the required differential between the income elasticities of demand.[1/]

1/ Branson and Myhrman (2, pp. 28-30) derive these conditions analytically and state the exact

Edgren, Faxen, and Odhner recognize this and state that the price elasticity of demand for goods in the sheltered sector is very low while the income elasticity of demand is large enough to permit constant output shares with growing income and different price developments.[2/]

1/ continued

necessary conditions.

2/ "A fact of fundamental importance for the formation of prices is that the goods and services of the sheltered sector would be demanded by the public, even though on a slightly smaller scale, even if prices rose considerably." (8, p. 177)

"It is true that one can expect the wage increases which are carried out fairly uniformly over virtually the whole labour market to provide an income base sufficient for the sheltered sector to make compensating price increases without encountering any general resistance." (8, p. 180)

The initial adjustment to increased wages in the sheltered sector may be a temporary decline in profits as producers maintain prices to prevent a shift in demand in the short run.[1/]

In the EFO model, inflation is transmitted through the labor market and the demand for labor. No explicit analysis is made of the aggregate demand policies to be followed by the government. Edgren, Faxen, and Odhner recognize that wage increases can be used to attract labor and that these wage increases depend on the tightness of the labor market. Wage increases, however, act not prices but on profitability in the competitive sector.[2/]

1/ It is clear that wage increase impulses from the competing sector affect the price level in the sheltered sector in the long run, in many cases for several years. The length of the contract periods and other institutional conditions mean that wages in most of the sheltered industries lag behind those of the competing sector by one or two years. Even after the wage increases in the sheltered sector have been implemented it may be some time before prices are adjusted to the new cost situation. The demand situation or structural conditions in the industry may persuade producers to accept, for a shorter or longer period, a reduced operating surplus while awaiting a suitable occasion to raise their prices. (8, pp. 185-186)

2/ From the account of wage formation...it emerges that the distribution of the available margin in the competing sector between wages and profits depends on the demand for labour which is created by the general cyclical situation. Wages do not automatically follow the main course; but the balance between supply and demand for labour

Although a deflationary aggregate demand policy cannot lower the prices of goods in the traded goods sector, it can prevent wages and prices from rising in the sheltered sector and thus lower the rate of inflation. The inelastic demand for nontraded goods prevents a shift in demand to this sector's products. In the long run, the higher profitability in the competitive sector would attract increased capital, and labor used in this sector would increase unless the nominal wage rose faster than the prices of competitive products and the increase in productivity. Thus the EFO model implicitly assumes that the government pursues an aggregate demand policy that does not put pressure on sectoral or factoral shares to change. This implicit assumption emerges forcefully from Branson and Myhrman's (2) analysis of the EFO model.

Branson and Myhrman combine the Phillips Curve (or any

2/ continued

influences wages in a way that sometimes leads to an increase in the share of wages and a fall in profits, and sometimes to the reverse. In the Swedish economy, the international price level affects the development of prices in the whole competing sector so much that to dampen wage developments by economic policy measures which limit the demand for labour does not affect prices in the sector. Instead, the result is a fall in the share of wages and an increase in profits. (8, p. 155.)

other demand oriented model) with the EFO model. Given constant factor shares, the EFO model can be summarized with an equation for the GNP deflator as

(1) $\hat{P} = \hat{P}_c + Q_s/Q(\hat{q}_c - \hat{q}_s)$

where q_i is the rate of growth of productivity in the ith sector, Q is output, and $\hat{P}$ is the rate of growth of the deflator with $\hat{P}_i$ is the rate of growth of prices in the ith sector.[1/] This can be combined with a relationship of the form

(2) $\hat{P}$=f (demand relative to potential output) with $f'>0$.

Equations (1) and (2) now determine the system. If sectoral shares are constant, (1) gives the overall rate of inflation and (2) gives the appropriate level of demand. Branson and Myhrman reject this explanation on the grounds

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1/ With factor shares constant and a common rate of change of wages in both sectors, the equations for the rate of change of prices are given as:

(i) $\hat{P}_c = \hat{W} - \hat{q}_c$;

(ii) $\hat{P}_s = \hat{W} - \hat{q}_s$;

(iii) $\hat{P} = (Q_s/Q)\hat{P}_s + (1 - Q_s/Q)\hat{P}_c$.

The rate of change of prices in the competitive sector is given exogenously as are the productivity changes in both sectors. Combining these relationships yields equation (1) above.

that at least part of aggregate demand is determined exogenously by policy authorities. Edgren, Faxwn, and Odhner do allow this interpretation as they feel that a falling share for the competitive sector would reduce Sweden's competitiveness on world markets. The accomodating demand policy which is implicit in their analysis is one that allows sectoral shares to remain constant.

Branson and Myhrman see the policy authorities determining the level of aggregate demand and hence the rate of inflation through the Phillips Curve. The EFO price equation (1) then determines the sectoral shares that are compatible with this rate of inflation. As long as each share is positive, the authorities can have a domestic rate of inflation that differs from the rate of change of traded goods prices. The adjustment of the shares of output depends on the relative price and income elasticities for the two goods.

The EFO model does not make any statements about the convergence of international rate of inflation. The domestic rate of inflation will be similar to that of other countries if, as Balassa indicates, the rate of increase of productivity in traded and nontraded goods sectors separately is similar for the home country and foreign countries and if foreign sectoral and factoral shares are constant or change similarly to the domestic one. For developed countries as a bloc, these homogeneity assumptions are not a bad assumption and one expects purchasing power parity to hold in the long run.

Empirical Work and the EFO Model

The EFO model assumes that increases in traded goods prices translate into wage increases which spread throughout the economy. The crucial assumption is that demand policy is accomodating. Simple monetarist and Keynesian models, on the other hand, stress the demand aspect in determining the rate of domestic inflation. The EFO price equation (equation (1) in the previous section) then determines the sectoral shares of output. Branson and Myhrman (2) and Nordhaus (48) compare the performance of the EFO model, a simple Phillips Curve, and a Quantity theory equation in explaining the Swedish rate of inflation.

Branson and Myhrman test price equations while Nordhaus tests wage equations. In terms of predictive ability, the rankings are (1) Naive Phillips Curve; (2) EFO; and (3) Quantity theory in the Branson and Myhrman analysis. In Nordhaus' analysis, the EFO and Phillips Curve exchange rankings. His ranking in terms of predicitive ability are (1) EFO, (2) Phillips Curve, and (3) Monetarist equation. Branson and Myhrman explain the reversal in position of the EFO and Phillips Curve models in terms of the greater rigidity of wages as compared to prices.[1/]

> ...The explanation may be that commodity prices respond more rapidly and with more regularity to excess demand for goods and services than wage rates do to excess demand for labor. In that case a price-Phillips Curve [the Branson-Myhrman formulation] would behave better than a wage-Phillips Curve [the Nordhaus formulation]. (2, p. 26.)

1/ The Branson-Myhrman equations are:

(1) $\hat{P}=\hat{P}_c+Q_s/Q(\hat{q}_c-\hat{q}_s)$; EFO model: or,

(1') $\hat{P}_s=\hat{P}_c+(\hat{q}_c-\hat{q}_s)$; (the equation actually used).

(2) $\hat{P}=\hat{M}-\hat{Y}$; Quantity theory

(3) $\hat{P}_{t+1}=a_0+a_1\left(\frac{y-y^*}{y^*}\right)$; Naive Phillips Curve.

Hatted variables denote the rate of change. P is the implicit GNP deflator, M is the stock of money, y is real output, and y* is a measure of potential output (trend output). The share of the sheltered sector in output is assumed to remain constant. The Phillips Curve equation (3) is estimated using ordinary least squares. Velocity is assumed constant in the Quantity equation. The predictive ability of each model is presented below.

Model	Measure of prediction error			
	1954-1968		1964-1970	
	RMSE	SEE	RMSE	SEE
ERO	2.1		2.6	
Quantity Theory	3.6		4.2	
Naive Phillips Curve		1.0		0.5

Source: (2) p. 25. (The second set of estimates refers to estimates from revised data.)

The Nordhaus equations are:

(4) $\ln w_t = a_o + a_1 t + a_2 \ln M_t + a_3 \ln X_t$; Monetarist.

This equation is derived from an equation for trend real wages assuming constant real growth of productivity combined with the equation of exchange. In the constrained version, $a_2 = -a_3 = -1$.

(5) $\Delta \ln w_t = b_0 + b_1 (1/u_t)$; Naive Phillips Curve.

(5') $\Delta \ln w_t = b_0 + b_1 (1/u_t) + b_2 \hat{P}^e_t$; Expectational Phillips Curve.

Expectations are estimated as distributed lag of past rates of inflation.

(6) $\Delta \ln W^*_t = m_o + m_1 \ \ln P_{I_t}$ ' m_0 0<and $m_1 > 0$; EFO model.

This equation is derived from a cost-plus pricing equation for exports with trend productivity growth and the observation that the "equilibrium" price level keeps the terms of trade constant. The wage rate moves with import prices and the constant rate of growth of productivity in the export industries. The equation actually used is

(6') $\Delta \ln w^*_t = m_0 + m_1 (.5 \Delta \ln P_{I_t} + 0.33 \Delta \ln P_{I_{t-1}} + 0.17 \Delta \ln P_{I_{t-2}})$.

In these equations, w is hourly money wages, t is time, M is the money supply lagged six months, X is real output, u is the unemployment rate, P is the expected rate of inflation, and P_I is the price of imports. The table below shows the prediction errors for these equations for the period 1968-1971 in Sweden.

Prediction Errors for 1968-1971

Monetarist		Phillips Curve		Export constraint
Con-strained	Uncon-strained	Naive	Expec-tations	
-1.0	a	1.4	1.4	0.1

These are mean prediction errors in percent per year. (continued)

It is crucial to note that Nordhaus' version of the EFO model which performs better than the Phillips Curve does not make the distinction between traded and nontraded goods central to this hypothesis. The equation is no more than a variant on purchasing power parity. These results indicate that the implicit assumption of the EFO model that demand policy is accomodating is wrong. In these circumstances, we should look at models that do allow for government policy and external developments to have an effect on the development of wages and prices.

Empirical Work on the Effect of Prices on Wages

A crucial issue is whether prices have a direct effect on wages as in an expectational Phillips Curve model. This effect is not precluded theoretically by the EFO model. There is, however, not much discussion of a direct effect of prices on wages through a shift in the supply of labor schedule. Such effects are discounted by the authors in the case of agricultural prices.[2/]

1/ continued
The equations were not estimated over this period.
a. At least one incorrect sign for a crucial coefficient. Source. (48, p. 455.)

2/ "in earlier periods, the price increase [in agriculture] probably had some significance for wage negotiations, in the sense that attempts were made to obtain compensation for price increases when the development of wages was calculated. On occasions when price increases have been a bone of contention in wage negotiations, prices of agricultural products have to some extent given rise to an inflationary circle. They would then lead to heightened wage demands which in turn led to demands in the agricultural negotiations for higher prices so that incomes in agriculture would follow those of industry. This then influenced wage negotiations. In the last few years it has been appreciated that this leads to a circular process in wages and prices, and it seems that prices have become much less important as issues in the negotiations.

The conclusion is that agriculture and agricultural policy nowadays play a relatively passive part in the process that we have described here. It is true that agricultural policy nowadays plays a relatively passive part in the process that we have described here. It is true that agricultural prices still go up more quickly than wholesale prices in other sectors of the economy, but this is rather as a consequence of an incomes policy based on solidarity where agriculture is now rather lossly tied to the development of incomes in industry. Outside its own sector, agriculture hardly exerts any influence on prices or incomes." (7, p. 176.)

George Perry (49, pp. 408-409) rejects the role of consumer prices in increasing wages directly.

> Although lagged consumer prices have commonly been used in wage equations, the models underlying their use can be questioned. No evidence that I know relates labor supply positively to real wages. And while protection of real wages is an understandable aim of unions in bargaining situations, a model based on this fact ignores the employer on the other side of the bargaining table.

Perry is more willing to use value added producer prices since a rise in these prices raises the demand for labor and the firm's willingness to meet demands for higher wages. Robert E. Hall (22) is willing to regard value added producer prices as an indication of excess demand, but maintains that if that is the reason for the dependence of wages on prices, it should be the difference between prices and marginal cost that is important and not producer prices alone. Indeed, Hall formulates his particular version of the Phillips Curve with wage inertia as present wages feed on past wages. He regards the inclusion of past prices as a substitute for the inclusion of lagged wages since wages constitute about 75 percent of costs.1/

1/

He sees the Phillips Curve arising not from the pressure of unemployed workers on the wage rate, but from the difference between the scale and marginal effective wage rates and the hiring strategy of the firm which seeks to find the most qualified person to fill a particular job category. As unemployment increases, the firm can fill each

Robert J. Gordon (comment on Hall's paper, Hall(22)) is unwilling to accept the hypothesis that producer prices have an effect only in that they are another indicator of excess supply. (If labor demand depends on product price and an upwards sloping labor supply curve depends on the expected level of prices, an increase in product prices will temporarily shift out the demand curve and disturb the equilibrium until expectations adjust.) With a vertical supply curve (inelastic supply), the shift in product prices permanently shifts the wage rate while the unemployment rate remains the same. He maintains:

> This example is not an empirical oddity, but may be potentially important to the extent that the prime-age segment of the adult-male labor force is characterized by a vertical labor supply curve. An external event occuring in a prosperous period - say, a devaluation - might raise the wage rate of adult males without any appreciable effect on their unemployment rate if initially their unemployment rate were near its irreducible "fractional" minimum.
>
> Recent events have reminded us of another route by which prices may raise wage rates without a simultaneous reduction in unemployment. An increase in the relative price of farm products or foreign oil can raise the consumer price index without directly affecting the price of nonfarm products. In graphic terms, in the nonfarm sector, the labor supply curve

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1/ job category with a more qualified applicant at the old scale wage thus lowering the marginal effective wage.

> shifts up along the fixed labor demand curve as expectations adjust to the higher consumer prices, and employment falls while the wage rate increases. (Gordon, in comments on Hall, 22, pp. 395-396.)

Two remarks are in order on Gordon's comments. First, it is expectations concerning movements in the consumer price index that are important for the position of the demand curve. Hall does not consider this effect. Second, the demand for labor is a derived demand and depends on the demand for output which is a function of expenditure. A rise in prices will have a deflationary effect and shift the demand curve in unless nominal expenditures increase.[1/]

1/

Recently, Robert J. Gordon (14) examines the response of policy to supply shocks in the context of a two sector model. He examines cases where prices or wages are nominally fixed and cases in which they adjust immediately or partially to excess supply. Where prices and wages adjust partially and there is a direct dependence of wages on prices, a permanent curtailment of supply can cause a permanently higher rate of inflation with a policy of accomodating nominal income. (In Phillips curve terminology, the short-run unemployment-inflation tradeoff shifts out for every expected level of inflation.) Indexation of wage contracts causes problems in that it inhibits the decline in real wages needed to compensate for an external supply shock.

George L. Perry (49) conducts a comparative study of wage inflation in several countries. He points out that he is interested in the direct transmission mechanism for inflation. This includes the influence of prices of traded goods on domestic output and wages as opposed to the indirect effects operating through aggregate demand being influenced by changes in the volume of exports or imports or through capital flows. He uses four price variables; import, export, private nonfarm GNP deflators, and consumer prices; and three measures of labor market tightness; aggregate and male unemployment rates, output gaps, and lagged wages.[1/] He distinguishes between import and export prices since import prices contain raw material and fuel costs. A rise in these prices will not increase production in import competing industries but could have a cost-of-living effect on wages.

The main result that emerges from Perry's work on Sweden is that export prices and lagged wages dominate the formation of wages. A labor market effect on wages appears when he includes a wage explosion dummy in the wage equation as a

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1/ The dependent variable is $\Delta \ln W_t$. All prices are entered as the distributed lag $0.2\Delta \ln P_{t-1}+0.6\Delta \ln P_{t-1}+0.2\Delta \ln P_{t-2}$. He first allows all variables to enter and drops only the ones whose coefficients have the wrong sign.

proxy for the attempt by labor to increase its share of output. Wages exploded in 1970 in Sweden. A similar phenomenon occured in most other European countries towards the end of the 60s. Perry presents evidence that the share of labor was falling prior to the wage explosion but rising after it. This type of behavior is also suggested by Edgren, Faxen, and Odhner.

Perry also estimates an equation that includes a cost-of-living effect on wages constrained to be 20 percent of the rise in the CPI. He notes that while this constrained equation may account for cost-of-living escalators, escalators could reduce the size of negotiated wage increases. The labor market effect drops out of the equation when the CPI is included as an explanatory variable. The predictive ability of the CPI escalated equation does not differ greatly from that of the equation including a measure of labor market tightness for 1974 and 1975. He concludes that cost-of-living effects on wages cannot be discounted. The labor market effect is very weak. A 25 percent increase in the unemployment rate will reduce the rate of increase of wage by 0.3 percent in the first year and by 1.6 percent in the longrun. (The effect of a rise in unemployment is underestimated as he does not include the feedback from wages on export prices which occurs even in an open economy.)[1/]

The significant result of Perry's paper is that the aggregate unemployment rate has such a weak effect on the rate of increase of wages in Sweden while export prices and past wages have a rather strong effect. Value-added prices may be acting as a measure of excess demand. This may account for the low value of the labor market variable. Furthermore, the unemployment rate is not exogenous insofar as changes in foreign

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1/ The equations estimated by Perry (1975) are:

(1) $\underset{}{\Delta \ln w_t} = \underset{(1.9)}{0.052} + \underset{(2.5)}{0.783}\Delta \ln P_{export} + \underset{(1.3)}{0.402}\Delta \ln w_{t-2} \underset{(-2.7)}{-0.069} D_1$;

$\bar{R}^2 = 0.506$, DW=1.9, s.e.e.=0.0179, D_1=+1 in 1971 with an incomes policy, the numbers in parenthesis are t-statistics, and the period is 1963-1972. Wages are lagged two years since centralized wage negotiations occur every other year in Sweden.

(2) $\Delta \ln w_t = \underset{(0.2)}{0.004} + \underset{(1.0)}{0.059}(1/u)_t + \underset{(3.0)}{0.373}\Delta \ln P_{export} +$

$\underset{(7.0)}{0.813}\Delta \ln w_{t-2} + \underset{(7.7)}{0.042} D_2$

$\bar{R}^2 = 0.967$, s.e.e.=0.0079, P=0.43 (correction for serial correlation),
D_2=+1 in 1970 when wages exploded.

(3) $\Delta \ln w_t = \underset{(1.2)}{0.014} + \underset{(1.9)}{0.228}\Delta \ln P_{export} + 0.2\Delta \ln CPI_t + \underset{(7.0)}{0.854}\Delta \ln w_{t-2}$

$+ \underset{(9.1)}{0.043} D_2$

$\bar{R}^2 = 0.959$, s.e.e.=0.0081, ρ=0.40.

demand will affect the tightness of the labor market. Treating the unemployment rate as exogenous, as in Perry's paper, biases its coefficient downwards. Another source of bias in Perry's estimates is that domestic export prices are treated as exogenous whereas they are a function of domestic wages. In the next section, we will analyze estimates of an expectational Phillips Curve for Sweden which incorporates modifications to reduce these biases. Perry's work does, however, offer support for the hypothesis that expectations affect wages.

An Expectational Phillips Curve

The following estimates of an expectational Phillips Curve for Sweden are based on the model discussed earlier.

(1) $\hat{W}=\hat{W}(1/u,\hat{P}^{e})$

1/ continued

Equation	Prediction Effors Prediction Error 1973	 1974	s.e.e.	Actual wage acceleration (1974 growth in wages less average 1970-1972 growth)
(2) conventional	1.7	-3.4	0.8	4.3
(3) CPI escalated	2.0	-3.3	0.8	

SOURCE: (22) p. 431

The prediction error is the actual increase in wage minus the predicted increase in percentage points.

(2) $\hat{P}^e = \hat{P}^e(\hat{P}, \hat{P}^*)$

(3) $P = (1+m)We^{-dt}$

(4) $1/u = 1/u(X, X^*, P/P^*)$

We will focus on estimates of the Phillips Curve by two-stage least squares to correct for the simultaneity problem between wages, prices, and the unemployment rate. We will use real government spending, a policy instrument, as an instrument together with foreign prices and an index of production in Germany. Foreign prices are represented by the trade weighted index of prices used earlier. The three issues of interest are (1) the sensitivity of the rate of increase of wages to changes in unemployment; (2) the slope of the long-run Phillips Curve; and (3) the nature of the formation of expectations.[1/]

1/ Lars Jacobsson and Assar Lindbeck (26) did a more detailed analysis of the wage mechanism in Sweden between 1955 and 1967. During this period consumer prices and the GNP deflator rose 4 percent per annum. They also differentiated between negotiated wages and wage drift. Generally they found that only the state of the labor market was important in explaining wages. Lagged productivity, profits, or consumer prices did not have a significant effect. (Using their estimates in a Chow test, however, we cannot reject the null hypothesis that productivity changes, profits, and consumer prices have no effect.) The equations that they present are (Jacobsson and Lindbeck, 1969, pp. 80-81):

(i) $\Delta W_{negotiated} = \underset{(1.32)}{6.45}(1/u) - 0.76$, DW=1.56, R=0.909

(ii) $\Delta W_{drift} = \underset{(.73)}{4.61}(1/u) + 0.59$, DW=1.67, R=.904.

An important feature of the model is the formation of expectations. The previous section gave some evidence that nominal wage increases do depend on the expected rate of inflation. We will use an adaptive expectations framework. Are expectations formed on the basis of domestic or foreign rates of inflation? Both are important. Fixed exchange rates imply that the domestic and foreign rates of inflation have to converge in the longrun. There is, however, a lag in the adjustment process. Furthermore, the rates of inflation need not converge if the exchange rate changes. This is what happened recently in the joint float when divergences between the national rates of inflation of member countries persisted. It is interesting to note that the relative changes in parity between the Deutsche mark and the other currencies bore a close relationship to differences between the German rate of inflation and the domestic inflation rate for the other

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1/ continued

(The numbers in parenthesis are standard errors. Alternative lag structures are also tried but do not change the results that (i) and (ii) are the best estimates of wage behavior.)

A simple Phillips Curve for Sweden for the period 1969-1975 is presented in regression (22). There is large serial correlation which indicates that the equation might be misspecified. The fit is not very good either.

currencies. Expectations of inflation must take into consideration both the domestic and foreign rates of inflation where the foreign rates are adjusted for the expected trend change in the exchange rate. (The trend change in the exchange rates ought to be zero for joint float member countries unless periodic parity adjustments become frequent.)

The attempt to estimate the expectational Phillips Curve using a weighted average of domestic and foreign rate of inflation - with the weights to be estimated - does not succeed. Expectations are assumed to be adaptive with a five period lag. The sum of the lag coefficient is constrained to equal one and the lag coefficients are assumed to lie on a straight line (first degree polynomial distributed lag). The equation[1/] estimated by nonlinear instrumental variables is

$$\Delta \ln W_t = \beta o + \beta_1 (1/u)_t + \beta_2 \sum_{i=0}^{5} \alpha_i \Delta \ln \bar{P}_t + t$$

with i) $\bar{P}_t = wP_t + (1-w) \quad P^*_t$

ii) $\sum_{o}^{5} \alpha_i = 1$

iii) $\alpha_i = d_o + d_1 i.$

1/ The sum of the lag coefficients is constrained to equal one to allow us to estimate the coefficient of the expected rate of inflation. Since the two coefficients, the sum of the lag coefficients and the coefficient of the expected rate of inflation, always enter as a multiplicative pair, we can only identify one of them if we make specific assumptions about the other.

The equation is estimated using indices of either consumer prices or wholesale manufacturing prices. (We look at the period from 1968 to 1975 using quarterly data.) Neither series represents the true variable. The problem with the consumer price indices is that they already include the prices of imported goods. This biases w upwards. (In other words, since the domestic CPI already includes the price of imports, it already reflects foreign price developments and the weight on foreign rates of inflation is underestimated.) On the other hand, indices of the wholesale prices of manufactures do not include the prices of food and services which are important in determining the real purchasing power of the nominal wage.

Estimating the expecational Phillips Curve using a weighted average of domestic and foreign prices does not yield any acceptable results. With the CPIs, the estimation procedure does not converge. With the wholesale price indices, the coefficients have the wrong sign. This is true whether or not the coefficient of $1/u$ is constrained to equal zero. In regressions (6), (7), and (8) we present the results of using the CPI and w=0.3, 0.5, and 0.7 respectively. While B_2 is less than zero, the minimum SSR is achieved at w=0.7. Correcting for serial correlation does not change the sign of B_2. (See regressions (16) and (17). These are estimated for w=0.5. Regressions using other values of w and a correction for autocorrelation blew up.) In regressions (11), (12), and (13) we present the results of using wholesale prices and w=0.3, 0.5, and 0.7. The SSR is minimized at w=0.3. This is an expected result. Using wholesale prices leads to an increased weight on foreign rates of inflation. Although the regressions using wholesale prices fit better in the sense of having a smaller s.e.e., B_1 is still negative. Regression (12) shows that B_2 is not significantly different from 1. That is, that the longrun curve is vertical. The weights in the adaptive scheme decline to zero rapidly. The mean lag is 5.7 quarters. Since using a weighted average of foreign and domestic rates of inflation leads to coefficients with a wrong sign, we look regressions where inflationary expectations are functions of either domestic or foreign rates of inflation. Once again, expectations are formed on an adaptive basis.

Regressions (1), (2), (3), and (5) present the results obtained by using foreign rates of inflation. Prices are measured by the CPI. Two comments are in order. Since Swedish prices have a negligible effect on foreign consumer prices, we do not have to worry about the problem of simultaneity between foreign prices and domestic wages. The endogeneity of the unemployment rate still calls for simultaneous equations estimation techniques. Second, the movement of foreign consumer prices is a good guide to the movement of domestic consumer prices if pruchasing power parity holds, as we have indicated it does.

In regression (2), we assume that expectations of domestic inflation are exactly equal to the current foreign rate of inflation. Although the standard errors of the coefficients have the correct signs. (As anticipated, the short-run curve is far steeper than Perry's results indicate. This results from the bias of his estimation technique.) An increase in the unemployment rate by 1 percent to 3 percent from its average level of 2 percent will reduce the rate of increase of wages by 2.5 percent. Note that this is a 33 percent increase in the rate of unemployment and at the upper end of rates actually experienced in Sweden. The short-run curve is fairly flat. The coefficient of the expected rate of inflation suggests that the long-run curve may not be vertical. Again, the coefficients are not significantly different from zero and these results are only suggestive.

Using an adaptive structure for expectations (with a five period lag structure and lag coefficients constrained to lie on a straight line) gives us highly autocorrelated results and a negative coefficient for 1/u which is not, however, significantly different from zero. When the coefficient of 1/u is constrained to equal zero, we obtain regression

(2). A 5 percent confidence interval for the coefficient of the expected rate of inflation goes from 0.53 to 0.92. The mean lag of the adaptive structure is 4.6 quarters and the lags decline to zero by the fourth quarter. (When a GNP weighted index of foreign prices - CPIs - is used, we obtain slightly different results as in regression (4). The mean lag is longer but the coefficient B_2 is smaller. The results show more serial correlation. A GNP weighted index of foreign prices is a broader index and a long-run concept. The prices that have an immediate effect are those of traded goods and the index of foreign prices used in the other regressions is weighted by trade shares.)

Adjusting for autocorrelation, we obtain regression (3) with both the expected rate of inflation and the unemployment rate included. The curvature of the short-run curve is similar to that of regression (1) where the inflationary expectations are assumed to equal the current foreign rate of inflation. The coefficient of the expected rate of inflation is much larger. A 95 percent confidence interval for B_2 gives (1.12 to 1.86). What is interesting about the lag structure in this[1/]

1/ An estimated B_2 larger than 1 gives an unstable system. A 1 percent increase in foreign inflation raises wages by more than 1 percent. If domestic prices rise as much as domestic wages, the domestic rate of inflation will exceed the foreign rate and regression is that the coefficients are fairly similar over the entire period. The mean lag is 2.7 quarters. This expectational curve implies that the government does not have much leeway for short-run discretionary policy changes to control the rate of inflation. The short-run curve is flat and expectations adjust rapidly to the foreign rate of inflation. The domestic rate of inflation will converge to the foreign rate within the same approximate time.

We also test the hypothesis that inflationary expectations exerted a stronger effect after 1974 than before it. These results are shown in regression (5). While the equation exhibits considerable autocorrelation, we can reject the hypothesis that the coefficient of expectations is the same for both periods. In the post 1974 period, this coefficient is not significantly different from 1 implying a vertical long-run curve. In the preceeding period, it is far smaller. (The lag structure is assumed to be the same for both periods.) Although the coefficient of 1/u is negative, it is so small as to be insignificant in value as well as in statistical terms.

1/ continued
the balance of payments will deteriorate necessitating a devaluation. A devaluation, however, raises foreign prices which leads to an increase in domestic wages and a spiralling system.

This result indicates that from 1974 on when inflation rates rose dramatically, the nature of wages formation changed and workers began to obtain full compensation for increased inflation.

Making expectations a function of domestic prices gives us a broadly similar picture of a very flat short-run curve and a vertical long-run curve. Within this general framework, the results are different. The short-run curve is somewhat flatter than in the case of expectations based on foreign prices. More significantly, the structure of the adaptive expectation formation is quite different. The lags are longer and there appears to be some element of "averaging" information over time. The results using domestic prices in expectations are given in regressions (9)-(10), (14)-(15), (19), and (21)-(22).

Regressions (9) and (10) use expectations based on the domestic CPI which includes import prices. Expectations are assumed to be formed on a five period lag structure with the coefficients lying on a straight line. In regressions (9) we see that the expectational coefficient is quite small and the coefficient of (1/u) is relatively large. The standard errors are quite large and the lag distribution is peculiar in that the lag coefficients increase over time and are negative to start. When the coefficient of 1/u is constrained to equal zero as in regression (10), the fit improves considerably and the serial correlation of regression (9) is reduced. Regression (10) indicates that a 1 percent increase in expected inflation leads to a 1 percent rise in the rate of increase of wages. Although the lag coefficients increase over time to give more weight to periods further back, the increase is quite small and the mean lag is 2 quarters.

In regressions (14) and (15) we use wholesale prices. When the labor market variable is included, its coefficient has the wrong sign. The lag structure is reasonable but with a very fast decline. The standard errors are quite large and a 95 percent confidence interval for the coefficient of expected inflation is

$$-0.11 \leq B_2 \leq 1.44$$

which has too large a range to be meaningful. In regression (15), $B_1=0$. The fit improves - judged by the s.e.e. - and the serial correlation is reduced. A 95 percent confidence interval for the effect of expectations is

$$0.36 \leq B_2 \leq 0.69.$$

This is rather perplexing as wages do not rise as much as prices and there is no labor market effect. The apparent paradox is resolved by recalling that we are using wholesale prices of manufactured goods and food and services are not covered. Regression (10) which uses the CPI shows that wages rise by the full increase in the cost of living. Furthermore, the s.e.e. is smaller for regression (10) than regression (15).

In regressions (19), (21), and (22) we look at a slightly different lag structure for expectations. We use an eight period lag and the coefficients are assumed to lie on a parabola - a second degree polynomial distributed lag. In all these regressions, when we constrain the lag coefficients to go to zero towards the end of the lag period, the estimated coefficients have the wrong sign. Although the lag coefficients are occassionally negative, there is a strong suggestion that what happens at the beginning and at the end of the lag period is quite important in determining expectations.

In regression (19), we use the CPI. While B_1 and B_2 have the correct signs, B_2 is far too large and implies an unstable system. (A 95 percent confidence interval for B_2 is

$$1.34 \leq B_2 \leq 3.63.$$

$B_1 = 0.124$ which is the same order of magnitude as in earlier results.) The lag coefficients are initially positive, turn negative, and become strongly positive at the end of the period. The mean lag is rather large at 12 quarters.

In regression (21), we use wholesale prices. This regression exhibits considerable serial correlation and B_1 is negative. Correcting for the serial correlation by a two stage procedure gives regression (22) where not only are the coefficients of the right sign but the estimates are fairly tight. The labor market effect is exceedingly weak. The estimate of the labor market effect is not statistically different from zero. A 95 percent confidence interval for B_1 is

$$-.067 \leq B_1 \leq 0.113.$$

At the upper end of this interval, B_1 is of the same size as in regressions with expectations based on foreign prices. The estimated $B_1 = 0.023$ implies that an increase in unemployment by 33 percent from 2 percent to 3 percent of the labor force will reduce wage inflation by only 0.4 percent.

The short-run Phillips Curve is virtually horizontal. The long-run curve, as the other results in this section indicate, is undoubtedly vertical. A 95 percent confidence interval for B_2 is

$$0.23 \leq B_2 \leq 2.1.$$

The mean lag is 6.3 quarters. Again, the lag coefficients are initially positive, turn negative, and become strongly positive again. This indicates that expectations, if they are adaptive as assumed, allow for short-run fluctuations in the experienced rate of inflation. As expected, using domestic prices in expectations leads to a higher mean lag than using foreign prices. As domestic prices take about 3 quarters to adjust to a foreign shock, domestic expectations will adjust fully to the foreign shock in about 9 quarters.

Conclusion

An examination of price movements in Sweden and those abroad reveals that the Swedish price level moves quite closely with a trade share weighted index of prices abroad when foreign prices are adjusted for changes in the exchange rate. An increase in foreign prices translates into domestic price increases in three quarters and is completely transmitted in seven quarters.

What is the mechanism behind the transmission of inflation? Foreign inflation need not translate into domestic inflation if foreign price movements are completely offset by movements in the exchange rate. While movements in the exchange rate have been correlated with price developments, the correspondence is not on a one-to-one basis. Furthermore, in the case of Sweden, the exchange rate is fixed by the government's decision to joint the European joint currency float. Given this exogenously determined exchange rate how are foreign price impulses transmitted to the domestic economy?

This chapter looks at the "Keynesian" Phillips-Curve mechanism for the transmission of inflation under exogenously determined exchange rate. The implicit assumption of this approach in a one commodity model is that the home country, even though it is a small country, can affect the price of its exports. Otherwise, the small country assumption combined with exogenous exchange rates means that domestic prices are completely - and tautologically determined abroad.

In an expectational Phillips Curve model, wages are determined by the level of aggregate demand and inflationary expectations. Prices are determined on a market basis. There are two distinct channels for the international transmission of inflation here. First, foreign inflation can affect the domestic economy through the level of aggregate demand. An increase in the foreign rate of inflation will shift foreign demand towards the products of the domestic economy increasing aggregate demand, wages and prices. Foreign inflation can also affect wages directly by entering directly into the formation of expectations.

The slope of the short-run curve determines how strong government policy has to be to cause changes in the short-run rate of inflation. The estimated short-run curve is very flat which implies that extremely strong government action is required to change the shortrun rate of inflation. The long-run curve, on the other hand, if virtually vertical as the coefficient of expectations is close to one. (Expectations are formed on an adaptive hypothesis in this model.) Foreign prices are important in the formation of inflationary expectations. Finally, the lag in the formation of expectations is short.

The implications of these results are: First, by fixing the exchange rate, the Swedish government has fixed the domestic price level, this constraint applies even in the short-run given the extremely flat Phillips Curve. Second, since the long-run curve appears to be vertical, the price level constraint imposed by the exchange rate policy is not also a constraint on the domestic unemployment rate. There does not appear to be a long-run inflation-unemployment tradeoff in Sweden.

	C	(1/u)	CPI $\Delta \ln P^*_t$	NO. OBS.	S.E.E.	D.W.	I.V.	$\frac{\text{S.E.E.}}{\Delta \ln W_t}$
1) $\Delta \ln W_t$	-0.051	0.146	0.452	36	0.034	1.62	C	121%
67:1-75:4	(0.196)	(0.395)	(0.300)				$\Delta \ln P^*$	
linear I.V.	[-0.26]	[0.37]	[1.50]				RGOV	
CPI								

	C	$\beta_2 \Sigma \alpha_i P^*_{t-i}$	α_0	α_1	α_2	α_3
2) $\Delta \ln W_t$	0.014	0.725	0.349	0.276	0.203	0.130
NonL. I.V.	(0.002)	(0.099)	(0.043)	(0.026)	(0.009)	(0.009)
68:3-75:4	[7.69]	[7.31]	[8.19]	[10.79]	[23.8]	[15.29]
30 Obs.						
P*=CPI						

	α_4	α_5	S.E.E.	$\frac{\text{S.E.E.}}{\Delta \ln W_t}$	D. W.
2) $\Delta \ln W_t$	0.057	-0.015	0.28	108%	2.17
NonL. I.V.	(0.026)	(0.043			
68:3-75:4	[2.24]	[-0.36]			
30 Obs.					
P*=CPI					

MEAN LAG = 4.56
(0.48)
[9.45]

1/ P: domestic price, * foreign prices [I.V. - instrumental variables used]

W: domestic wages (s.e.) [t-stat]

RGOV: real government spending

All distributed lags are linear and $\Sigma\alpha_i = 1$ is a constraint

	C	(1/u)	$\beta_2\Sigma\alpha_i P^*_{t-i}$	α_0	α_1	α_2	α_3
3) $\Delta \ln W_t$	0.058	0.162	1.49	0.184	0.177	0.170	0.163
NonL. 2SLS	(0.040)	(0.019)	(0.19)	(0.20)	(0.012)	(0.004)	(0.004)
w/AC	[1.43]	[8.41]	[7.67]	[9.16]	[14.69]	[42.3]	[40.6]
68:4-75:4							
P*=CPI							

	α_4	α_5	
3) $\Delta \ln W_t$	0.156	0.149	0.84
NonL. 2SLS	(0.012)	(0.020)	(0.03)
w/AC	[12.96]	[7.43]	[24.6]
68:4-75:4			
P*=CAP			

S.E.E. 0.0288	MEAN LAG = 2.70	I.V.:C	
S.E.E./$\bar{y}$ = 103%	(0.23)	RGOV	$\Sigma\Delta \ln P^*_i$
D.W. = 1.66	[11.85]	$\Delta \ln P^*$	$\Sigma\Delta \ln P^*_{-1-i}$
No. Obs = 29		$\Delta \ln P^*_{-1}$	$\Delta \ln W_{-1}$
			$(1/u)_{-1}$

	C	$\beta_2[\Sigma\alpha_i P^*_{t-1}]$	α_0	α_1	α_2	α_3	α_4	α_5	Mean Lag
4) $\Delta \ln W_t$	0.022	0.455	0.421	0.319	0.217	0.116	0.014	-0.087	5.38
NonLIN I.V.	(0.002)	(0.109)	(0.083)	(0.050)	(0.017)	(0.017)	(0.050)	(0.083)	(0.94)
68:4-75:4	[14.5]	[4.17]	[5.08]	[6.42]	[13.12]	[6.99]	[0.29]	[-1.05]	[5.73]
P*=CPI									
-GNP weighted									

S.E.E. = 0.028
S.E.E. = 101%

No. Obs. = 29
D. W. = 2.28

	C	$\beta_1(1/u)$	Pre '74 $\beta_{21}(\Sigma\alpha_i P^*_{t-i})_1$	Post '74 $\beta_{22}(\Sigma\alpha_i P^*_{t-i})_2$	α_0	α_1	α_2
5) $\Delta \ln W_t$	0.022	-0.0095	0.269	1.32	0.716	0.496	0.276
68:3-75:4	(0.012)	(0.026)	(0.061)	(0.15)	(0.058)	(0.035)	(0.012)
P*=CPI	[1.77]	[-0.37]	[4.44]	[8.77]	[12.31]	[14.22]	[23.78]
No. Obs. = 30							

	α_3	α_4	α_5
5) $\Delta \ln W_t$	0.057	-0.16	-0.38
68:3-75:4	(0.012)	(0.035)	(0.58)
P*=CPI	[4.89]	[-4.66]	[-6.58]
No. Obs. = 30			

S.E.E. = 0.028

S.E.E./$\bar{y}$ = 104%

D. W. = 2.52

Mean Lag = 8.72
(0.66)
[13.24]

$\beta_{21}-\beta_{22}$ = -1.04
(0.132)
[-7.87]

IV: RGOV, $\Delta \ln P^*_1$, $\Delta \ln P^*_2$, $\Sigma\Delta \ln P^*_{i1}$, $\Sigma\Delta \ln P^*_{i2}$ C

	C	β_1	$\beta_2 \Sigma\Delta \ln\overline{P}$	α_0	α_1	α_2	α_3
6) $\Delta \ln W_t$	-0.509	1.10	-0.968	0.615	0.436	0.256	0.077
68:3-75:4	(1.926)	(4.05)	(7.61)	(1.77)	(1.06)	(0.355)	(0.36)
CPI	[-0.27]	[0.27]	[-0.12]	[0.35]	[0.41]	[0.72]	[0.22]

	α_4	α_5	Mean Lag
6) $\Delta \ln W_t$	-0.102	-0.28	7.58
68:3-75:4	(1.06)	(1.77)	(20.10)
CPI	[-0.10]	[-0.16]	[0.38]

$\overline{P} = WP+(1-W)P^*$
w = .5

SSR = 0.498

S.E.E. = 0.138

S.E.E./$\overline{y}$ = 515%

D. W. = 0.57

No. Obs. = 30

IV: C, RGOV, $\Sigma\Delta \ln P^*_{t-i}$, $\Sigma i\Delta \ln P^*_{t-i}$

	C	β_1	$\beta_2 \Sigma \Delta \ln \overline{P}$	α_0	α_1	α_2	α_3	α_4
7) $\Delta \ln W_t$	-0.520	1.12	-0.960	0.501	0.37	0.23	0.10	-0.034
68:3-75:4	(2.01)	(4.24)	(7.38)	(1.29)	(0.78)	(0.26)	(0.26)	(0.775)
CPI	[-0.26]	[0.26]	[-0.13]	[0.39]	[0.47]	[0.90]	[0.39]	[-0.04]

	α_5	Mean Lag
7) $\Delta \ln W_t$	-0.17	6.29
68:3-75:4	(1.29)	(14.65)
CPI	[-0.04]	[0.43]

w=.3
CPI

SSR = 0.519

S.E.E. = 0.142

S.E.E./$\overline{y}$ = 530%

IV: C, RGOV, $\Sigma \Delta \ln P^*_{t-i}$, $\Sigma i \Delta \ln P^*_{t-i}$

D. W. = 0.56

No. Obs = 30

	C	β_1	β_2	α_0	α_1	α_2	α_3	α_4
8) $\Delta \ln W_t$	-0.452	0.98	-0.75	0.91	0.61	0.32	0.018	-0.28
CPI	(1.133)	(2.79)	(5.59)	(3.27)	(1.96)	(0.65)	(0.65)	(1.96)
w=.7	[-0.34]	[0.35]	[-0.13]	[0.28]	[0.31]	[0.48]	[0.03]	[-0.14]

	α_5	Mean Lag
8) $\Delta \ln W_t$	-0.58	10.9
CPI	(3.27)	(37.1)
w=.7	[-0.18]	[0.29]

CPI

SSR = 0.395

S.E.E. = 0.123

S.E.E./$\overline{y}$ = 460%

D. W. = 0.60

No. Obs. = 30

(min. SSR)

IV: c, RGOV, $\Sigma \Delta \ln P^*_{t-i}$, $\Sigma i \Delta \ln P^*_{t-i}$

	C	$\beta_1(1/u)$	$\beta_2(\Sigma\Delta \ln P_{t-i})$	α_0	α_1	α_2	α_3	α_4
9) $\Delta \ln W_t$ 1/	-0.274	0.596	0.166	-3.17	-1.83	-0.50	-0.83	2.17
68:3-75:4	(0.265)	(0.556)	(1.34)	(29.16)	(17.50)	(5.83)	(5.83)	(17.50)
CPI	[-1.03]	[1.07]	[0.12]	[-0.11]	[-0.10]	[-0.09]	[0.14]	[0.12]

	α_5	Mean Lag
9) $\Delta \ln W_t$	3.51	-35.3
68:3-75:4	(29.16	(330.5)
CPI	[0.12]	[-0.11]

NONLINIV

S.E.E. = 0.0764

S.E.E./$\overline{y}$ = 285%

D.W. = 0.72

No. Obs = 30

IV: C, RGOV,

$\Sigma\Delta \ln P^*_{-i}$

$\Sigma i \Delta \ln P^*_{-i}$

1/ Note that equation 9 is estimated - unintentionally - using ordinary least squares so the estimated coefficients are inconsistent. The direction of the inconsistency is positive.

	C	$\beta_2(\Sigma \Delta \ln P_{-i})$	α_0	α_1	α_2	α_3	α_4	α_5	Mean Lag
10) $\Delta \ln W_t$	0.0103	1.06	0.182	0.146	0.160	0.174	0.188	0.201	2.11
68:3-75:4	(0.0025)	(0.15)	(0.143)	(0.086)	(0.029)	(0.029)	(0.086)	(0.143)	(1.62)
CPI	[4.11]	[7.11]	[0.92]	[1.70]	[5.59]	[6.07]	[2.19]	[1.41]	[1.30]

NONLINIV

S.E.E. = 0.028

S.E.E./$\overline{y}$ = 106%

D. W. = 2.27

No. Obs. = 30

	C	$\beta_1(1/u)$	$\beta_2(\Sigma\Delta \ln P_{-i})$	α_0	α_1	α_2	α_3	α_4
11) $\Delta \ln W_t$	0.113	-0.202	0.824	0.546	0.394	0.243	0.091	-0.061
	(0.038)	(0.077)	(0.201)	(0.132)	(0.079)	(0.026)	(0.026)	(0.079)
	[3.01]	[-2.62]	[4.09]	[4.12]	[4.96]	[9.16]	[3.43]	[-0.77]

	α_5	Mean Lag
	-0.21	6.80
	(0.13)	(1.50)
	[-1.61]	[4.53]

Pwholesale

$\overline{P} = WP+(1-w)P^*$
w=0.5

NONLINIV

SSR = 0.0484

D. W. = 1.47

S.E.E. =0.043

S.E.E./$\overline{y}$ = 160%

No. Obs = 30

IV: RGOV, C

$\Sigma\Delta \ln P^*_{-i}$

$\Sigma i \Delta \ln P^*_{-i}$

	C	α_1	α_2	α_0	α_1	α_2	α_3	α_4	α_5
12) $\Delta \ln W_t$	0.110	-0.197	0.89	0.452	0.338	0.224	0.110	-0.004	-0.118
68:3-75:4	(0.034)	(0.069)	(0.20)	(0.092)	(0.055)	(0.018)	(0.018	(0.055)	(0.092)
Pwholesale	[3.26]	[-2.84]	[4.46]	[4.90]	[6.11]	[12.14]	[5.96]	[-0.08]	[-1.28]
$\overline{P}$, w=0.3									

Mean Lag
5.73
(1.04)
[5.49]

SSR = 0.0445

S.E.E. = 0.041

S.E.E./$\overline{y}$ = 154%

D. W. = 1.55

No. Obs. = 30

Minimum SSR

I.V. = C, ROG

$\Sigma \Delta \ln P^*_{-i}$

$\Sigma\, i\ \Delta \ln P^*_{-i}$

	C	β_1	β_2	α_0	α_1	α_2	α_3	α_4
13) $\Delta \ln W_t$	0.123	-0.220	0.760	0.694	0.483	0.272	0.061	-0.150
68:3-75:4	(0.048)	(0.098)	(0.225)	(0.222)	(0.133)	(0.044)	(0.044)	(0.133)
Pwholesale	[2.55]	[-2.24]	[3.37]	[3.13]	[3.62]	[6.14]	[1.38]	[-1.13]

	α_5	Mean Lag
13) $\Delta \ln W_t$	-0.360	8.47
68:3-75:4	(0.222)	(2.51)
Pwholesale	[-1.63]	[3.37]

w=0.7

SSR = 0.0583

S.E.E. = 0.0474

S.E.E./$\overline{y}$ = 177%

D. W. = 1.32

No. Obs. = 30

I.V. = C, RGOV

$\Sigma \Delta \ln P^*_{-i}$

$\Sigma i \Delta \ln P^*_{-i}$

	C	$\beta_1(1/u)$	$\beta_2(\Sigma\alpha_i \Delta \ln P_{-i})$	α_0	α_1	α_2	α_3	α_4
14) $\Delta \ln W_t$	0.168	-0.307	0.665	1.18	0.776	0.370	-0.037	-0.443
Pwholesale	(0.120)	(0.243)	(0.393)	(0.85)	(0.510)	(0.170)	(0.170)	(0.850)
8/16/76	[1.40]	[-1.26]	[1.70]	[1.39]	[1.52]	[2.17]	[-0.22]	[-0.87]
(18:48:2)								
68:3-75:4								

	α_5	Mean Lag
14) $\Delta \ln W_t$	-0.850	14.01
Pwholesale	(0.850)	(9.64)
8/16/76	[-0.999]	[1.45]
(18:48:2)		
68:3-75:4		

S.E.E. = 0.0661

S.E.E./$\overline{y}$ = 247%

D. W. = 0.95

No. Obs. = 30

I.V.: C, RGOV

$\Sigma \Delta \ln P^*_{-i}$

$\Sigma i \Delta \ln P^*_{-i}$

	C	β_2	α_0	α_1	α_2	α_3	α_4
15) $\Delta \ln W_t$	0.017	0.525	0.476	0.352	0.229	0.105	-0.019
Pwholesale	(0.018)	(0.082)	(0.145)	(0.087)	(0.029)	(0.029)	(0.088)
68:3-75:4	[9.38]	[6.37]	[3.29]	[4.06]	[7.89]	[3.62]	[-0.22]

	α_5	Mean Lag
15) $\Delta \ln W_t$	-0.142	6.01
Pwholesale	(0.145)	(1.64)
68:3-75:4	[-0.99]	[3.66]

S.E.E. = 0.0306

S.E.E./$\overline{y}$ = 114%

D. W. = 2.01

No. Obs = 30

I.V. C, RGOV

$\Sigma \Delta \ln P^*_{-i}$

$\Sigma\ i \Delta \ln P^*_{-i}$

	c	α_1	α_2	α_0	α_1	α_2	α_3	α_4
16) $\Delta \ln W_t$	0.029	-0.026	0.661	0.1635	0.328	0.221	0.113	0.005
69:1-75:4	(0.029)	(0.514)	(0.886)	(0.3578)	(0.215)	(0.072)	(0.072)	(0.215)
	[0.99]	[-0.50]	[0.75]	[0.46]	[1.53]	[3.09]	[1.57]	[0.02]

	α_5	Mean Lag
16) $\Delta \ln W_t$	-0.103	5.56
69:1-75:4	(0.358)	(4.05)
	[-0.29]	[1.37]

ρ = -0.15
(0.19)
-0.78

linear I.V.
w/A.C. correction

w=0.5

$\overline{P} = WP+(1-w)P*$

P=CPI

SSR = 0.0210

S.E.E. = 0.0296

S.E.E./$\overline{y}$ = 110%

D. W. = 1.97

No. Obs = 28

I.V. C, RGOV, $\Sigma\Delta \ln P^*_{-i}$, $\Sigma\, i\, \Delta \ln P^*_{-i}$

$\Delta \ln W_{-1}$, $(1/u)_{-1}$, $\Sigma\Delta \ln \overline{P}_{-1}$ $[\Sigma\, i\, \Delta \ln \overline{P}_{-1} - \frac{15}{6}\Sigma\Delta \ln \overline{P}_{-i}]$

	C	$\beta_1(1/u)$	$\beta_2 \Sigma \Delta \ln \overline{P}_{-i}$	α_0	α_1	α_2	α_3	α_4
17) $\Delta \ln W_t$	0.028	-0.027	0.707	-9.47	-5.61	-1.76	2.09	5.94
PCPI	(0.004)	(0.008)	(0.125)	(3.17)	(1.90)	(0.63)	(0.63)	(1.90)
8/16/76; 21:26	[6.42]	[-3.29]	[5.67]	[-2.98]	[-2.95]	[-2.77]	[3.30]	[3.12]

	α_5	Mean Lag
17) $\Delta \ln W_t$	9.80	-106.7
PCPI	3.17	35.9
8/16/76; 21:26	[3.08]	[-2.97]

NONLIN I.V.
w/A.C. correction

$\rho = -0.09$
0.03
-2.91

$\overline{P} = WP+(1-W)P^*$

w=0.5
68:4-75:4

SSR = 0.0213

S.E.E. = 0.0298

S.E.E./$\overline{y}$ = 106%

D. W. = 2.10

No. Obs = 29

I.V. = C, RGOV, $\Sigma \Delta \ln P^*_{-i}$, $\Sigma i \Delta \ln P^*_{-i}$, $\Delta \ln \overline{P}_{-i}$,

$\Sigma i \Delta \ln \overline{P}_{-i} - \frac{15}{6} \Sigma \Delta \ln \overline{P}_{-i}$

	C	$\beta_1(1/u)$	$\beta_2 \Sigma \Delta \ln P_{-i} \alpha_i$	α_0	α_1	α_2	α_3	α_4
18) $\Delta \ln W_t$	-0.061	0.123	2.49	.646	-.029	-0.472	-.683	-.662
69:1-75:4	(0.188)	(0.332)	(2.91)					
	[-0.33]	[0.37]	[0.85]					

	α_5	α_6	α_7	α_8	Mean Lag
18) $\Delta \ln W_t$	-.409	.076	.793	1.742	12.22
69:1-75:4					(19.03)
					[0.64]

CPI
Linear I.V.

D. W. = 2.06

No. Obs. = 28

S.E.E. = .0419

S.E.E/$\overline{y}$ = 148%

I.V.: C, RGOV, $\sum_{0}^{8} \Delta \ln P^*_{-i}$

$\Sigma i \Delta \ln P^*_{-i}$, IN

	C	$\beta_1(1/u)$	$\beta_2 \Sigma \Delta \ln P_{-i}$	α_0	α_1	α_2	α_3	α_4
19) $\Delta \ln W_t$	-0.061	0.124	2.488	.646	-.029	-.0472	-.683	-.662
69:1-75:4	(0.038)	(0.067)	(0.585)	(.506)	(.416	(.323)	(.225	(.125)
CPI	[-1.62]	[1.86]	[4.26]	[1.28]	[.07]	[-.15]	[-3.04]	[-5.30]
NonL. I.V.								

	α_5	α_6	α_7	α_8	Mean Lag
19) $\Delta \ln W_t$	-.409	.076	.793	1.742	12.22
69:1-75:4	(.122)	(.268)	(.465)	(0.700)	(8.78)
CPI	[-3.35]	[0.28]	[1.71]	[2.49]	[1.39]
NonL. I.V.					

D. W. = 2.06

No. Obs. = 28

S.E.E. = 0.4194

S.E.E./$\overline{y}$ = 149%

I.V.: C, RGOV . $\Sigma \Delta \ln P^*_{-i}$, $\Sigma\, i\, \Delta \ln P^*_{-i}$, IN

	C	$\beta_1(1/u)$
20) $\Delta \ln W_t$	-0.138	0.329
69:1-75:4	(0.378)	(0.745)
CPI	[-0.37]	[0.44]
Linear I.V.		

D. W. = 0.94 I.V., C RGOV, $\Delta \ln P^*$

S.E.E. = 0.0478

S.E.E./$\overline{y}$ = 170%

No. Obs. = 28

	C	$\beta_1(1/u)$	$\beta_2(\Sigma \nabla i \Delta \ln P_{-i})$	α_0	α_1	α_2	α_3
21) $\Delta \ln W_t$	0.116	-0.185	0.092	-0.861	0.930	2.07	2.53
8/19/76 10:19	(0.034)	(0.057)	(0.533)	(59.2)	(49.85)	(39.89)	(28.44)
Pwholesale	[3.47]	[-3.25]	[0.172]	[-.01]	[0.02]	[0.05]	[0.09]

	α_4	α_5	α_6	α_7	α_8	Mean Lag
21) $\Delta \ln W_t$	2.33	1.46	-0.069	-2.27	-5.13	-28.04
8/19/76 10:19	(16.00)	(13.89)	(31.9)	(57.1)	(87.3)	(106.1)
Pwholesale	[0.15]	[0.11]	[-.002]	[-.04]	[-.06]	[0.03]

D. W. = 1.47

No. Obs. = 28

S.E.E. = 0.0439

S.E.E./$\overline{y}$ = 155%

I.V.: C, RGOV, $\Sigma \Delta \ln P^*_{-i}$, $\Sigma i \Delta \ln P^*_{-i}$, IN

	C	$\beta_1(1/u)$	$\beta_2(\Sigma\alpha\Delta \ln P_{-i})$	α_0	α_1	α_2	α_3
22) $\Delta \ln W_t$	-0.0002	0.023	1.17	0.398	0.107	-0.090	-0.193
P=Pwholesale	(0.0251)	(0.046)	(0.48)	(1.293)	(0.089)	(0.075)	(0.150)
A.C. I.V.	[-0.006]	[0.49]	[2.45]	[0.31]	[1.20]	[-1.20]	[-1.29]
69:3-75:4							

	α_4	α_5	α_6	α_7	α_8	Mean Lag	
22) $\Delta \ln W_t$	-0.202	-0.117	0.062	0.335	0.702	6.28	ρ = -0.40
							(0.18)
P=Pwholesale	(1.006)	(0.128)	(0.052)	(0.289)	(0.206)	(3.54)	-2.21
A.C. I.V.	[-0.20]	[-0.91]	[1.19]	[1.16]	[3.41]	[1.73]	
69:3-75:4							

D. W. = 1.87

S.E.E. = .0287

S.E.E./$\bar{y}$ = 101%

No. Obs. = 26

I. V.: C, $\Delta \ln W_{-1}$, $(1/u)_{-1}$, RGOV, $\Sigma\Delta \ln P^*_{-i}$, $\Sigma_i \Delta \ln P^*_{-i}$, IN

$\Sigma\Delta \ln P_{-i_{-1}}$, $[(\Sigma i \Delta \ln P_{-i}) - 4*(\Sigma\Delta \ln P_{-i})]_{-1}$,

$[(\Sigma i^2 \Delta \ln P_{-i}) - \frac{68}{3} (\Sigma\Delta \ln P_{-i})]_{-1}$.

CHAPTER 6

CONCLUSION

We have looked at the implication of Sweden's decision to participate in the European joint float from two separate angles--the effect on fluctuations in the terms of trade, and the effect on the domestic price level.

The theoretical model developed in Chapter 2 indicates that a small, open economy may choose to join a larger currency bloc to stabilize movements in its terms of trade that emanate from changes in exchange rates abroad. The movements that cause fluctuations in the terms of trade are random movements caused, perhaps, by short-run capital flows. The cost of the decreased fluctuations in the terms of trade is an increased fluctuation of domestic income as the exchange rate changes affect the trade balance and, hence, income.

In Chapter 3, we examined empirically the effects of foreign exchange rate movements and price movements on the Swedish terms of trade. We found that these effects do exist and that the level of prices in Sweden also affects the Swedish terms of trade. The latter implies that Sweden has some monopoly power in trade through product differentiation and behaves as a "Keynesian" small country.

The interesting result that emerged is that for the period from 1973 to 1975, Sweden could have reduced fluctuations in its terms of trade even more by tying its currency to the pound Sterling than by its decision to tie effectively to the Deutsche mark. Tying to the pound, however, would have implied a larger deterioration in the terms of trade over time.

The source of fluctuations in the terms of trade is the diverging behavior of exchange rates and prices. Short-term capital flows affect the exchange rate and move it away from purchasing power parity. Although capital flows are strictly controlled in Sweden, there is still a significant channel for these movements through leads and lags in commercial payments. The decision to maintain parity prevents these short-term movements from affecting the exchange rate. Fixed parities may also prevent short-term capital flows arising from expectations of changes in exchange rates-- so long as speculators believe that parities will be maintained. Chapter 4 examined the issue of leads and lags in the Swedish context.

In Chapter 5 we returned to the question of the effect of the currency regime on domestic price developments in Sweden. The data show that price movements in Sweden follow, with a short lag, the movements of prices abroad given the exchange rate. The exchange rate is set independently of Sweden by the joint float countries' overall rate of inflation which is dominated by Germany. In short, Swedish prices are constrained to increase at the bloc's rate of inflation since the exchange rate between the bloc and the rest of the world compensates for differences in inflation rates with the rest of the world.

What is the constraint faced by the foreign determination of prices? The constraint is, effectively, that Sweden has its unemployment rate determined by this price behavior dictated by the exchange rate. An analysis of the unemployment-inflation tradeoff in Sweden suggests that this constraint is not very costly. The constraint on the unemployment rate is not very important because the long-run Phillips Curve is virtually vertical in Sweden. Furthermore, the "long-run" is around a year and a half long. In the short-run, it would take very large changes in the unemployment rate to have any effect on the rate of inflation.

Given that the long-run unemployment rate is exogenous, the decision to join the joint float is a decision to accept the snake rate of inflation. This could very well be the crucial element in the decision. Foreign considerations do not permit the government to allow the rate of inflation to increase. The interesting questions which now arises, but is not pursued here, is what determines the bloc rate of inflation.

What happens when a group of countries in the snake inflate faster than other member countries? Three options are open: either the countries inflating at a slower rate inflate faster; those inflating faster deflate; or internal parities change. Faced with this situation, the member countries of the joint float have twice decided to change internal parities. Germany, which had the lowest rate of inflation, had its currency appreciate. The fact that they did not dismantle the joint float indicates that member countries derive some benefit from more stable internal exchange rates; and, for the smaller countries, the price discipline imposed by fixed parities are of some value.

The issues to be pursued further are: 1) What are the consequences for member countries of disparate price developments; 2) What are the causes of those disparate price developments; and 3) Which method of attaining internal balance, inflation for surplus countries, deflation for deficit countries, or exchange rate changes should be used and what are the consequences of each?

POSTSCRIPT

Since the original draft of this thesis was written, there have been two episodes of parity adjustments between members of the joint currency float. In the fall of 1976 and the spring of 1977, the Deutsche mark appreciated with respect to the other members of the joint float. During this period the rate of inflation in Germany was lower than that of the other joint float members. These internal parity adjustments show and re-enforce the view that the adjustment of prices under fixed rates is fairly rapid. The adjustment pressure is on the countries that have a higher rate of inflation and are running a balance-of-payments deficit. If these countries cannot reduce their domestic rate of inflation, they have to devalue their currencies. In the case of Sweden, these devaluations against the Deutsche mark reveal that even though the long-run Phillips Curve is vertical, the short-run costs of reducing the long-run rate of inflation through temporary increases in the unemployment rate are not politically acceptable. The analysis of the short-run inflation-unemployment tradeoff revealed that it is likely to take fairly severe increases in the unemployment rate to reduce the domestic rate of inflation.

The decision to remain in the joint float while adjusting internal parities reveals that the joint float does have some beneficial effects through its stabilizing effects on the exchange rate. The main body of the thesis revealed that a currency tie to a larger bloc could reduce fluctuations in the terms of trade. For the period of empirical analysis in the thesis from 1973 to the end of 1975, however, a kronor tie to the pound Sterling would have reduced fluctuations in the Swedish terms of trade more than a Deutsche mark tie. Disregarding the implications of a currency tie on the trend rate of inflation in the home country, it is doubtful that the same result would hold for the period after 1975. After 1975, theGerman mark was not the only "refuge" currency for use in short-run speculation against other currencies. Many other currencies had settled into parity with the Deutsche mark since exchange rate changes more or less offset diverging domestic rates of inflation. This meant that these currencies, and in particular the U. S. dollar, could all be used as "refuge" currencies for short-run speculation. The Deutsche mark exchange rate against most other currencies did not fluctuate widely when one currency such as the pound Sterling came under attack.

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Biographical Note

The author was born in Tehran, Iran on April 21, 1950 and is an Iranian citizen. He graduated from Community High School in Tehran in 1968 and matriculated at Swarthmore College, Swarthmore, Pennsylvania in the same year. He received his B.A. (Phi Beta Kappa) from Swarthmore College in 1971 with a major in economics and a minor in mathematics. In the same year, he started graduate work in economics at the Massachusetts Institute for Technology. During the academic year 1973-1974, he was at Nuffield College, Oxford University. The author is currently an economist with the World Bank in Washington, D. C.