MONEY AND IMPORTED INFLATION:

AN EMPIRICAL STUDY

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CHAPTER I

INTRODUCTION

The new monetarist approach which emphasizes the influence of changes in the quantity of money has its antecedents in the classical quantity theory of money in a closed economy and in the international area to Hume's price-specie-flow mechanism (see for example, Frenkel and Johnson, 1976, pp. 37-40). Beginning in the mid-30s, the influence of Keynes's (1936) General Theory had been so great that much of the theory and research on money was classified as an extension of Keynesian ideas. It was not until the mid-1960s that Keynesianism was ready for criticism because it could not explain successfully a major social problem--inflation. Friedman's (1956) revival of the quantity theory a decade earlier led to the reemphasis of that theory and the rise of monetarism.

Following the Keynesian revolution, major contributions to the development of monetary theory had been numerous. However, they were mainly concerned with short-run equilibrium analysis in a closed economy. It was not until the integration of monetary theory with growth that the first break from the structure of short-run equilibrium analysis occurred. Besides the objective of achieving an adequate rate of economic growth, the maintenance of high employment without inflation, and the preservation of a balance-of-payments equilibrium were also of much interest. The greatest current concern probably is the rise of

monetarism and its integration into the theory of balance of payments.

Purpose of Study

Since the famous 1965 University of Chicago Conference (Johnson, 1972a, p. 13), pioneering work on the subject on the monetary approach to the balance-of-payments theory has been developed by Mundell (1971) and Johnson (1972b). It offered an anlternative to Keynesian approach to balance-of-payments theory. In order to mount a counter-revolution against the established orthodoxy, an important social problem which seemed intractable for the orthodox approach had to be chosen, and that was the issue of inflation. Consequently, an alternative theory which could provide a satisfactory analysis of the problem could be developed. It was important to convince the public that inflation was an important problem and that monetarism could provide an explanation and a policy solution while the Keynesian model could not.

To examine the issue of inflation in an open economy, the balance-of-payments approach provides a fundamental ground on which the subject, especially the issue of imported inflation, is to be analyzed. The main purpose of this thesis is to examine the relevancy of the theory and its application to the issue of inflation for a small open economy. Since the argument that inflation can be imported is critical to the analysis, it is of much interest to test the issue and to explore its behavior under a system of fixed and flexible rates.

Plan of Study

Chapter II of the thesis reviews the influence of the money supply in affecting an economy's activities. It discusses different approaches

to inflation in an open economy. The three main theories to be discussed are the traditional Keynesian approach, the Scandinavian approach, and the monetary approach to inflation. The chapter also points out the inadequacies of both the Keynesian and the Scandinavian models and the superiority of the monetary approach.

In Chapter III, the monetary approach to the issue of imported inflation under fixed and flexible exchange rates are of crucial interest. The basic premises of the approach are discussed so that further examination of the behavior of money supply can be made. The monetary approach to the balance of payments and to exchange rates are introduced because they provide the crucial determinants to imported inflation. In addition to the discussion of the money supply, it is also shown that inflationary expectations occupy an important role in the process. Finally, the mechanisms of transmission of inflation, the short-run process, and the long-run equilibrium are derived.

Chapter IV presents a monetary model to the problem for both fixed and flexible rates periods. Methodology and limitations of the test are discussed. The five statistical methods discussed are ordinary least squares regression model, instrumental variable method, covariance model, error component model, and cross-sectionally correlated and time-wise autoregressive model.

In Chapter V, empirical results from the model are presented and analyzed. The period of study is 1961-77, with 1961 through 1972 for fixed exchange rates and 1972 through 1977 for the flexible exchange rate period.

Chapter VI provides the summary and implications for the analysis of world inflation. Inflation can be imported and exported across

countries regardless of the exchange rate regime. Inflation is imported into a country through a balance-of-payments surplus when the exchange rates are fixed and through changes in exchange rates and expectations on exchange rates when the rates are flexible. Neither of the exchange rate systems is more or less inflationary than the other.

The implications derived from this study are that, first, neither of the exchange rate systems is more or less inflationary than the other. The choice of the exchange rate depends upon the economic characteristics of each country. Second, with a fixed exchange rate regime, the cause of imported inflation is the expansion of the world monetary stock. When the exchange rates are flexible, the responsibility of inflation mainly lies on the degrees of national monetary discipline and governmental interventions in the exchange rates market. Third, policies should aim at monetary stability and correction of inflationary expectations and these require international policy coordination and cooperation.

CHAPTER II

THEORIES OF INFLATION IN AN OPEN ECONOMY

After 1968, inflation began to accelerate for many countries and also for the world in general. Even countries which had previously controlled inflation started to face serious inflationary problems. As a result, the issue of inflation has drawn much attention during recent years and is one of the most controversial.

Money plays an important role in determining and coordinating economic activities. It serves as a unit of account, a medium of exchange, and a store of value. A continuously falling value of money impedes its storage function and its efficiency as a mechanism of exchange. Further, this impairs its function as a measure of value for both present and future transactions. As the opportunity costs of holding money increase, economization of holdings of cash diverts real resources from socially productive uses. The falling value of money can also be considered as a tax imposed on holding of real money balances. If people expect the inflation rate to increase, they have to hold more nominal cash balances in order to compensate for the loss in purchasing power. The base of the tax is the real value of money holdings and the tax rate is the rate of inflation. When inflation is unanticipated, redistribution effects of inflation become important. Redistribution of income and of wealth from creditors to debtors is inevitable. In this case, creditors lose and debtors gain at the expense of creditors.

Inflation therefore undermines the role of money, creates misallocation of resources, generates an arbitrary redistribution of income and imposes a welfare cost on the society.

Inflation has been considered essentially a monetary phenomenon. To the monetarists, inflation is the difference between the rate of increase of money supply and the rate of growth of real output (Johnson, 1972a, pp. 325-326). The role of money is so much emphasized that one would not completely omit any reference to monetary expansion in discussing inflation. As Johnson (1972a, p. 36) suggests, "Inflation is the consequence of, or at least associated with, the excessive issue of money." To Friedman (1970a, p. 24), "Inflation is always and everywhere a monetary phenomenon . . . and can be produced only by a more rapid increase in the quantity of money than in output." However, fiscalists would deny that the origin of the inflation is monetary and propose that perverse fiscal policy can be a necessary and sufficient condition for inflation (Monti, 1976, p. 83). Further, to the institutionalists, inflationary impulses are independent of market conditions and are explained by price movements as a response to particular sociological or institutional forces.

Different approaches to inflation have been classified by Bronfenbrenner and Holzman (1963), Johnson (1967), Brunner (1974), Laidler (1975b), Gordon (1976), and Frisch (1977). Among the approaches are the quantity theory approach, the Keynesian approach, the cost-push versus demand-pull approach, the Phillips curve model, the rational expectations approach, the new microeconomic approach, and the monetary approach to inflation. However, most of the literature has been concerned mainly with a closed economy under a autarkic regime.

Inflation is regarded as a national event. Various analyses are too preoccupied with its internal causes without giving sufficient attention to causes on a world-wide basis.

For the analysis of inflation in an open economy, three main theories of inflation have been developed in the past decade--the monetary approach to balance of payments (Mundell, 1971; Johnson, 1972b; Laidler, 1975a; Frenkel, 1976a; Swoboda, 1976), the Scandinavian or Aukrust-EFO approach (Aukrust, 1970; Edgren, Faxen, and Odhner, 1973), and the traditional Keynesian approach (Branson, 1974, 1975a, 1975b). When one examines inflation in an open economy, three main considerations immediately arise; first, the determinants of world rate of inflation; second, the transmission mechanism of inflationary impulses from one country to another; and third, the relevency of domestic inflation toward the open economy and how it can be related to the view that the domestic price level is pegged to that of the world. While the Scandinavian approach deals with the last two, the monetary approach provides a solution for all three considerations (Gordon, 1976, p. 213). For the traditional Keynesian approach, the first question is still left unanswered.

The Traditional Keynesian Approach

Elasticity Approach

The ideas of the elasticity approach have their roots in the Marshallian partial-equilibrium analysis. It emphasizes the substitution among commodities generated by a change in relative price as a result of a change in the exchange rate. In the analysis of the balance of payments, it focuses on the supply of and demand for exports

and imports of the trade account and that of foreign and domestic money. The approach works under the Keynesian assumptions of wage rigidity and involuntary unemployment. Hence, with wage rigidity, a devaluation lowers prices of domestic goods relative to foreign goods and thus encourages substitution both in consumption and production. Unemployment of resources enables the substitution of domestic goods for foreign goods and thus improves the balance of payments. However, this approach proves demonstrably unsatisfactory when wages are flexible or when there is full employment such as in the immediate postwar period.

Absorption Approach

The absorption approach is an improvement over the elasticity approach in the sense that it focuses on aggregate income and expenditures and recognizes the importance of the level of national income on the balance of payments. It proposes that an improvement in the trade balance requires an increase in the gap between total output and total expenditures. The total "absorption" (expenditures) of the goods and services available to the country is derived from the aggregate income and imports. Therefore, a devaluation will bring a favorable effect on the trade balance only if excess capacity and unemployment exist. In a full-employment economy, regardless of the elasticities, devaluation alone will not result in a favorable balance of payments unless aggregate expenditure is reduced. The analysis therefore implies that devaluation in case of full employment should be accompanied by deflationary monetary and fiscal policies in order to achieve an improvement in the trade balance. However, the monetary effects of a balance-of-payments surplus or deficit and internationally tradable securities are both

neglected in this analysis.

Keynesian Approach to World-wide Inflation

Both the elasticity and absorption approaches provide an explanation of how foreign disturbances affect the trade account and the price level of an economy. However, they both fail to discuss how the domestic price level is related to the world price level and how the inflationary mechanism is generated. More sophisticated versions of the Keynesian model such as that developed by Branson (1974, 1975a, 1975b) provide a solution to the relationship between the domestic and world price levels.

The Keynesian approach emphasizes the importance of expenditures on foreign goods and on trade multipliers in the transmission of economic disturbances. The interest rate is an important adjustment mechanism to bring the economy back to equilibrium. Branson (1974, 1975a, 1975b) uses a standard IS-LM model of income determination to determine the equilibrium sets of income and interest rate. The model is modified by substituting the price level for output as one of the variables to be determined. The two endogenous variables are the interest rate and the price level. The rate of inflation can then be determined.

According to Branson (1974, 1975a, 1975b), the effects of exogenous shocks on the balance of payments is indeterminate. Starting with a standard Keynesian IS-LM model, a balance-of-payments line which represents the equilibrium levels of interest rate and prices for the balance of payments to remain in equilibrium is added to the model. Any exogenous disturbance that moves the equilibrium position of the IS and LM curves below the balance-of-payments line indicates a deficit. This is

because given the interest rate, the price level is too high to maintain external balance. On the other hand, if the equilibrium point is moved to position above the balance-of-payments line, a surplus is generated.

An increase in the money supply in the key currency country shifts the LM curve to the right and thus moves the equilibrium point away from the balance-of-payments line, assuming the balance of payments line is unaffected by money . Then, the result is a rise in the price level and an increase in the balance-of-payments deficit. To other countries of the world, the effects are an increase in exportables and an accumulation of balance-of-payments surplus. Consequently, the domestic price levels in these countries are increased. This phenomenon is considered as normal imported inflation on the part of the rest of the world.

Although the effect of an exogenous disturbance through a monetary expansion has determinate effects on prices and balance of payments, the effects of exogenous disturbance of fiscal policy are ambiguous. An increase in government expenditures or tax cut shifts the IS curve to the right and thus moves the equilibrium point away from the balance-of-payments curve if the balance-of-payments line is steeper than the LM curve or toward the balance-of-payments line if it is flatter than the LM curve. As a result, a deficit or surplus may result; that is, the effect depends on the slope of the balance-of-payments line. If the line is steeper than the LM curve, an expansionary fiscal policy increases the deficit (or decreases the surplus); if the line is flatter, the result is a decrease in deficit (or an increase in surplus). According to Branson, empirical results on the slope of the balance-of-payments line suggest that it is steeper than the LM curve indicating that capital is immobile (Branson, 1975b, p. 117). Even though the

effect on the balance of payments is indeterminate, the effect on price level is determinate--the price level is increased. In this case, inflation imported as a result of an expansionary fiscal policy in the originating country would be accompanied by a balance-of-payments deficit or surplus in the inflation importing countries. Although the exogenous change has deterministic effect on the price level, there exists no predictable relationship between the price level and the balance of payments. The relationship depends on the source of the exogenous change (Branson, 1977, pp. 82-84).

The transmission mechanism in this Keynesian model thus depends not on the balance of payments but rather on the trade balance and the capital market (Dornbusch, 1977, pp. 95-96). An increase in demand abroad for domestic output would increase the exports of a country and thus the effects are transmitted through production, prices, and employment. The change in demand for domestic output at the initial prices of output would create excess demand in the commodity and labour markets and therefore raise the domestic price level and wage rate. A reduction in the foreign rates of interest will create excess demand in the capital market due to the substitution of domestic for foreign debt and thus increases the rate of inflation. Thus, the transmission mechanism of inflation in the Keynesian approach acts through the demand effects in form of a demand-pull on the economy.

The relationship between domestic and foreign price level is examined by incorporating the Phillips curve approach with the static Keynesian model to link inflation with the foreign-trade multiplier in order to explain whether national rates of inflation would converge toward the world rate (Branson, 1977, pp. 85-88). A low terms-of-trade

would induce a trade surplus which would exert a demand pressure on the economy. Hence, the domestic rate of inflation would be higher than the world rate. Consequently, the terms-of-trade would improve till the domestic rate of inflation converges to that of the world rate. Therefore, the domestic price can temporarily diverge from the world price level; yet, prices among countries could converge through the trade-multiplier alone (Branson, 1977, p. 88). Nevertheless, the generation of the mechanism is still left undefined in many Keynesian writings. Furthermore, the importance of monetary implication on the balance of payments and the role of money are deemphasized.

The Scandinavian Approach

An alternative to the Keynesian approach to world-wide inflation is the Scandinavian approach first started by Aukrust (1970) and later developed in greater detail by Edgren, Faxen, and Odhner (1973) and Kravis and Lipsey (1977). The Aukrust-EFO model of inflation describes that in a small or medium open economy, prices and incomes are strongly influenced by the outside world. The economy is composed of two sectors--the exposed sector which faces strong foreign competition and the sheltered sector which is well protected from competitive foreign pressure. Given the world price and the existing exchange rate, the exposed sector that has to compete in the world market is a price-taker so that the world market price determines its output prices which would determine the wage rate and the output prices of the sheltered sector. The weighted average of the output prices in both sectors determines the domestic price level.

Inflationary impulses can be transmitted from one country to

another through three channels (Aukrust, 1970)--first, through direct effects of import prices such as an increase in the prices of imported consumer goods, of raw materials and capital goods, and/or competitive imports; second, through direct export prices due to an increase of prices of export goods in the world market which would increase the prices in the national market. The price level of consumer goods would also be affected; third, through indirect wage effects from the exposed industries. The rising import and export prices would increase the profitability which increases the wage rate and then the price level. Therefore, the transmission mechanism in this model is solely foreign trade prices which enable inflation to be transmitted from one country to another. Prices are determined by either the world market or costs while demand has little influence except in the labor market in which wages affect prices indirectly.

The rate of inflation in the exposed sector will peg to the world level. The difference between the rate of inflation in the two sectors depends on the different rates of growth of productivity, on the labor share, and on the wage-setting behavior. However, in the long run, deviation between the two sectors is reduced through wage negotiations, labor market forces, and macroeconomic policies. The domestic price level pegs to the world's rate through the elimination of the deviations.

Although the Scandinavian model provides an explanation for the transmission mechanism and the pegging of national price level to that of the world, yet it suffers from two main effects. First, the rate of inflation is solely supply-side determined and demand is being neglected. Second, the generation mechanism of the world rate of

inflation is left out (Genberg and Swoboda, 1977, p. 77).

The Monetary Approach to World-wide Inflation

The monetary approach to world-wide inflation is developed from the monetary approach to balance-of-payments theory first started by Mundell (1971) and Johnson (1972b) and further developed by many others (such as Laidler, 1975a; Frenkel, 1976a; Swoboda, 1976; and Parkin, 1977). The approach is easily extended to the case of a flexible exchange rate through the monetary approach to exchange rates. The approach is superior to the Keynesian and the Scandinavian models in the sense that besides providing an explanation of the generation mechanism of world inflation, it also emphasizes the role of money and its relationship with inflation especially in an international context. Considering the role of the money supply and its determinants in an open economy involves the analysis of the balance of payments. Rather than analyzing the problem essentially within a closed-economy framework as in the orthodox post Keynesian analysis, the rest of the world plays a crucial role in this theory.

The Determinants of World Inflation

Inflation is basically a monetary phenomenon. It is a reflection of the adjustment of the price level to the excess supply of money. Therefore, monetary expansion is the fundamental determinant of inflation. Hence, transferring this explanation to the world-wide level under a fixed exchange rate, it is the world money stock that determines the world rate of inflation. The growth of money stock is determined by the sum of individual countries' monetary expansion and the growth of

the world reserves and their distributions. In a flexible exchange rate world, the world price is to be determined by the weighted average of each national price level with the size of the country as the weight.[1]

In the short run, there is a close relationship between money supply and money income and an excess money supply can be removed through an adjustment in money income. However, in the long run, the link is between the money supply and the price level and output is treated as exogenous or at the full-employment level. Hence, any expansion of the world supply of money over the demand for it would result in an adjustment of the world price level alone.

The Transmission Mechanism

A change in the rate of domestic credit expansion affects the rate of inflation of a country to the extent that it affects the world money supply and the world inflation rate. This is because a change in domestic credit alters the country's balance of payments--the route by which the influence is transmitted to the outside world. Therefore, the analysis stresses the importance of the relationship between the balance of payments and the price level and of the endogeneity of the national money supply. The world money supply, on the other hand, is exogenous to a country and determines the price level. The model therefore treats the world economy as a closed economy where the transmission process is important to the distribution of the world money stock. This proposition hence provides a route through which the issue of imported

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[1]Jain (1980) attempts to construct the world price index from the consumer price indices for 36 countries weighted by each country's GDP. The world price index derived is considered as a measurement of the world price level.

inflation which is of crucial interest to this paper can be analyzed.

Convergence of National Price Level

Whatever the transmission mechanism involved, the long-run national inflation rates will converge to the world rate as long as exchange rates are fixed and perfect goods arbitrage exists. Johnson (1972a, p. 88) emphasizes that "As long as countries maintain a fixed exchange rate, they cannot in the long run avoid the common rate of inflation." This is made possible through the equilization of the prices of traded goods and of their rates of change. The inflationary impulses are transmitted to the nontraded goods sectors by virtue of substitution effects between the two kinds of goods. Hence, the national price will peg to the world level. Nevertheless, the theory does allow national inflation rates to diverge in the short run through nonfixity of exchange rates, sluggish arbitrage and/or delay in inflationary impulse transmission from the tradable to the nontradable goods, and impediments to trade (Swoboda, 1977, pp. 27-32) and in the long run through different productivity growth rates of the two sectors (Laidler, 1975a, p. 176).

In the extension to the case where exchange rates are flexible, national prices will not converge but are determined somewhere between their own desired rates of inflation and the world's rate.

CHAPTER III

A MONETARIST APPROACH TO IMPORTED INFLATION

The monetary approach to balance-of-payments theory under fixed or flexible exchange rates is an extension of the monetary approach in a closed economy. The theory thus provides a potential role to the analysis of the monetary approach to international inflation theory--imported inflation. Although quite a number of theoretical analyses has been developed on the subject of imported inflation, little empirical testing has been done (Courchene and Singh, 1976; Parkins, 1977; Brunner and Meltzer, 1977; Jain, 1980). It can be shown that the monetary approach can be extended successfully to cover the floating-rates case. The interest of this chapter is to develop the theoretical basis behind the issue of imported inflation under both fixed and flexible exchange rates. An empirical study on the issue is performed to test the relevancy of the theory.

Characteristics of the Monetary Approach

Before discussing the issue, it is important to examine the basic assumptions on which the theory is based. The monetary approach is based on the ideas of the quantity theory of money. It therefore incorporates most of the main characteristics of the quantity theory. Three of the most important are, first, money demand is a stable function of a small number of variables. Second, the removal of the assumption of

money illusion is important. The theory implies a unitary price elasticity of the demand of money. Given a stable money demand function (that is, factors that affect the money supply will not affect the variables in the money demand function), the nominal money supply determines the time path of prices so that relative commodity prices play no role. Third, prices are necessarily assumed to be flexible to provide for relative price adjustment in the long run. Given wage and price flexibility, although real income could change in the short run, it is assumed to be exogenous in the long run and at the full employment level.

Furthermore, two additional features should be discussed in the analysis of inflation in an open economy. First, capital is assumed to be highly mobile. One implication of this assumption is that any international interest rate differentials would be removed to ensure equality between domestic and foreign interest rates through interest rate arbitrage. Second, the issue of sterilization is also important. Disequilibrium is temporary as long as the monetary authorities do not sterilize completely the inflow of foreign funds. If a policy of complete sterilization is pursued, continuous balance-of-payments disequilibrium is possible and the surplus or deficit in the balance of payments can be treated as a flow equilibrium (Johnson, 1973, pp. 234-235). The impact of a change in monetary policy on the balance of payments depends upon the degree of sterilization. If sterilization is complete, the impact is largest. Empirical evidence suggests that in most of the cases, various degrees of sterilization exist (Kreinin and Officer, 1978, p. 60).

Imported Inflation Under Fixed Exchange Rates

Monetary Approach to Balance of Payments

In order to examine the issue of inflation in an open economy, the analysis can begin with the balance of payments. The balance-of-payments theory has two main classifications--the traditional or 'income-absorption' theory and the new monetary approach. The monetary approach to balance of payments is the most recently developed concept. It can be considered as an extension of the domestic monetarism because of its emphasis on the monetary aspects as the essential mechanism in the adjustment process.

Since the development of the approach by Mundell (1971) and Johnson (1972b), the approach outlined under a fixed exchange rate system is discussed further by Branson (1975a, 1975b), Swoboda (1973), Frenkel and Johnson (1976), Grubel (1976), Harberler (1976), Johnson (1975, 1976, 1977a), Rhomberg and Heller (1977), Whitman (1975), Dornbusch (1973, 1974, 1975), Mussa (1976), and Rodriguez (1976). The volume and diversity of the literature on this approach are discussed in a detailed survey and analysis by Johnson (1967, 1973, 1976, 1977a) and Kreinin and Officer (1978).

The balance of payments is basically a monetary phenomenon with the demand for and the supply of money as the critical determinants. Any excess in supply of or demand for money is reflected in a country's balance of payments. A surplus or deficit in the balance of payments works toward equilibrium through the equilibrium in money demand and supply. The emphasis therefore is not on the relative prices but on the excess supply and demand of money. Consequently, the balance of payments

provides a channel for the consideration of the role and the long-run effects of money in an open economy. Since the analysis on the behavior of money on the overall balance of payments, individual components of the balance of payments are not discussed.

The analysis postulates that there exists a close relationship between the balance of payments, the supply of money, and the price level of the economy. Consider a small open economy with an inflow of international reserves or a trade surplus.[1] The monetary base of the country consists of domestic high-powered money and international reserves. The surplus in the payments balance changes international reserves which then affects the monetary base. Suppose there is an increase in the demand for money, as long as the monetary authorities do not attempt to sterilize or absorb the inflow of international reserves by a contraction of the domestic credit, the surplus is necessarily temporary. However, in the presence of continuous policy interventions that government reduces domestic credit in step with the increase in international reserves; continuous surplus is possible so that the impact is on the domestic money supply. This is because such a policy of sterilization of international monetary inflows induces continuous reserve inflows (which leads to excess money supply) when the money demand is not met by domestic sources. The existence of a continual surplus in the rest of the world implies that the key currency country is generating a deficit. With respect to the key currency country, an easy and simple way to finance the continual deficit is by issuing

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[1]Following the definition proposed by International Monetary Fund, international reserves is defined as the sum of foreign exchange, gold, SDRs, and the reserve position in the Fund.

money. The continuous increase in the money supply creates further excess supply of money and excess demand for goods and services. The result is a higher trade deficit in the key currency country or a trade surplus in the rest of the world. Monetary expansion in key currency countries is thus considered as the main determinant of inflation. In the long run, the growth of real income is exogenous and the effect of a monetary expansion is on the price level. Therefore, whenever the supply of money exceeds the demand for it, the surplus in the money market would lead to a rising price level.

Exchange Rates and Money Supply in an Open Economy

The Case of a Fixed Exchange Rate. The purpose of the Bretton Woods Agreement was to seek stability and confidence in the monetary system. Member countries were obligated to defend fixed exchange rate parities which could be altered only with the permission of the International Monetary Fund if the country's balance of payments was in fundamental disequilibrium.

Apart from the traditional approaches, the monetary approach views the exchange rate not as the relative prices of different national output but rather as the relative prices of different national monies (Mussa, 1976, p. 232). Since the exchange rate is the price of one money in terms of another, the monetary approach thus brings out the importance of the role of money in determining the exchange rate and the shortcoming of the traditional approaches where the rate is determined by changes in the relative prices of domestic and foreign goods. Following the monetary interpretation, the case of fixed international

exchange rates can be considered similar to the case for a common national currency (Johnson, 1973, p. 201).

In an open economy, any balance-of-payments disequilibrium is identified with adjustment in the money market between the supply and demand of money. The imbalance is necessarily temporary and self-correcting provided that the system is operating under a fixed exchange rate and the authorities have no intention of sterilization. Equilibrium is restored when the excess demand (supply) of money is removed by the inflow (outflow) of foreign (domestic) money. Countries with a balance-of-payments surplus (deficit) as a result of excess demand (supply) of money, in order to keep its exchange rate from appreciating (depreciating), would have to buy (sell) international reserves. The purchase of more foreign reserves when the balance of payments is in surplus increases the foreign component of the monetary base and then the overall money supply of the economy.

To remove the balance-of-payments deficit, changing the exchange rate is another alternative. Devaluation in this case is analytically parallel to a reduction in money supply (Cooper, 1971, p. 7). This is because a balance-of-payments deficit due to an excess demand for goods and services reflects the existence of excess supply of money. A devaluation represents a decrease in the real value of domestic money and of other financial assets measured in foreign currency. This implies that the price of foreign money in terms of home currency is increased. This increase raises the prices of tradable goods and services and then the prices of domestic goods through direct or indirect product substitution or through costs of production. On the other hand, the increase in the price level induces the public to reduce its aggregate spending which

produces the required improvement in the balance of payments. In addition, the general price increase also increases the demand for nominal balances. If the increased demand is not satisfied by domestic credit expansion, a surplus in the balance of payments is generated by virtue of an inflow of foreign money. Although devaluation has an inflationary impact, it can remove or improve a balance-of-payments deficit. Nevertheless, exchange rate alteration cannot bring a lasting change in the balance of payments position; the effect lasts only until the money-market equilibrium is restored or when the deficit is removed. Therefore, devaluation merely raises the price level and has no effect on the real variables in the long run. The policy of devaluation could be deflationary only if it is used to replace controls that previously resulted in an "equilibrium" (Yeager, 1976, pp. 223-230).

Any effect of devaluation if followed by expansion of domestic credit would be offset. Devaluation is likely to succeed only if the monetary authorities refrain from domestic credit expansion (Johnson, 1972a, p. 90; Mussa, 1976, p. 412). Repeated devaluation without domestic credit expansion can improve the balance of payments or lead to a continual balance-of-payments surplus by working through the adjustment in the excess demand for money. Conversely, excessive domestic credit expansion, that is, excess supply of money worsens the balance of payments and leads to a balance-of-payments deficit. The expansion of a country's money supply affects the world or other countries to the extent that it affects the world's money supply.

Endogeneity of Money Supply. In an open economy, there exists a close relationship between the exchange rates and the money supply. As long as the country keeps a fixed exchange rate, its money supply is

endogeous. Under a fixed exchange rate system, undervaluation of a currency and surplus with a continuation of the purchase of international reserves have been a characteristic of the pegged rates (Yeager, 1976, p. 228). When a reserve currency country expands its money supply continuously and develops a growing deficit, the loss of international reserves in the key currency country is accumulated in the rest of the world in the form of surpluses which would put upward pressure on the exchange rate. In order to keep the exchange rate from appreciating, surplus countries must buy international reserves, thereby increasing the foreign component of the monetary base. Consequently, the foreign source of the money supply is endogenous. If the monetary authorities attempt to sterilized the inflow of international reserves (sterilization of international reserves flow is the process of reducing domestic credit in step with the increase in international reserves inflow), the result is a continuous inflow of a foreign money and an increase in the money supply. This is because if sterilization occurs, money demand is in excess so that the excess demand not satisfied by domestic money is satisfied by an inflow of foreign money which will increase the international component of the monetary base and hence the money supply. Furthermore, if there is a persistent increase in the demand for money and the need is not satisfied by an increase in domestic money, inflow of foreign money occurs and the consequence is an increase in the money supply. Therefore, money supply is endogenous.

The endogeneity of money supply implies that doemstically, the country has no control over its money supply.[2] The pursuit of any

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[2]This does not apply to the key currency country.

domestic objective by means of using domestic money supply may be offset by the international reserves flows unless there is a change in the money multiplier or in money demand. However, given the stable money demand function which is independent from the money supply, a change in domestic credit does not change the money demand or the money multiplier. Hence, all the government can do is to control the composition of the money but not its level. Consequently, any exogenous change which results in a balance-of-payments imbalance leaves the country in a position to adjust the domestic prices and wages. Continuous imbalance is possible if the monetary authorities follow a sterilization policy or if the conditions causing an excess demand for money persist.

Another important implication of the endogeneity of the money supply is on the effect of domestic credit expansion on the country's money supply. A country's domestic credit expansion or its money multiplier has no long-run effect on its own money supply. The reasons are, first, an increase in domestic credit will result in an opposite change in international reserves and/or depreciation in the exchange rates (Mussa, 1976, p. 410). Second, it is regard that each individual country is too small to increase the growth of the world money supply.[3] Even though the effect of domestic credit expansion leaks through either the balance of payments or exchange rate depreciation, it still possesses an indirect effect in the sense that it affects the rest of the world to the extent that it affects the world's money supply and the

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[3]Laidler and Nobay (1974, p. 13) argue that, "the rate of domestic credit expansion changes the inflation rate only to the extent that it influences the rate of expansion of the world money supply and hence the world inflation rate. Its principal effect on the individual country is to change the balance of payments." For further details, see Laidler and Nobay, 1974, p. 13.

rate of inflation. The rise in the world inflation rate thus affects the country that initially increases the money supply.

The Operation of Inflationary Expectations

From the inflationary experiences of various countries over the past few years, the importance of inflationary expectations has been much emphasized. The idea of inflationary expectations can be dated back to Irving Fisher (1896) and is explicitly discussed in monetary economics by Cagan (1956), Friedman (1956), Bailey (1956), and Phelps (1965). Empirical evidence performed also indicates that expectations are one of the most important determinants in the process of inflation. Some of the studies are those by Solow (1969), Turnovsky and Wachter (1972), Vanderkamp (1972), Gordon (1972), and Lucas and Rapping (1969).

The evidence suggests that the coexistence of high unemployment and accelerating inflation results because expectations can lead to price increases. Expectations of inflation can be considered as an error learning process depending on the past history of inflation. Empirical evidence on the relevance of past errors in the adjustment of future expectations confirms that people revise their future expectations according to the past history of forecast errors in inflationary expectations (Resler, 1980, pp. 8-12). When people consistently expect prices to rise in the future, they would accelerate their spending at the existing lower price levels. This implies an increase in aggregate demand over supply and consequently increases the price level further than that has been expected. The price spiral thus continues and leads to increasing prices. In the absense of money illusion, the 'expectation hypothesis' predicts that in the long run, there is no tradeoff

between inflation and the level of economic activity (and the rate of unemployment). Therefore, in the long run, inflation persists due to the inflationary expectations and any action taken by the monetary authorities to reduce inflation would fail.

Besides depending on the past experiences on inflation, the rate of monetary expansion can also affect expectations and the velocity of money. During rapid monetary expansion, people would revise their expectations about further price inflation. As a result of economizing on the holding of real cash balances, the velocity of circulation increases. Therefore, inflation anticipations would not continue to accelerate if money supply is stable and policies are known to aim at monetary stability (Yeager, 1976, p. 225).

Although inflationary expectations in the home country are important in determining the inflationary process, there is no simple way of independently measuring expectations. One of the means is to generate expectations in terms of observable variables which are used as proxies for the unobservable expected rate of inflation. Since the inflationary expectations have been argued as depending upon the past inflationary experiences and the monetary stability, price expectations can be assumed to be based on the past rates of inflation and past rates of change in the money stock (Rutledge, 1976). This is to emphasize the effects of monetary policy on market price expectations and the mechanism through which monetary impulses are transmitted to the output and the labor markets.

Inflationary expectations in the reserve currency country are also said to generate a balance-of-payments surplus in other countries. Inflation in the reserve currency country imposes a tax on the rest of

the world (Mundell, 1971, pp. 143-144). The rate of depreciation of the dollar balances is approximately equal to the rate of inflation and the value of the real dollar balance is the base of the tax. In the absence of inflationary expectations, a zero balance of payments surplus is desired by the rest of the world. However, with inflationary expectations, the rest of the world would have to maintain a permanent balance-of-payments surplus with the reserve currency country in order to preserve the purchasing power of their reserves. The magnitude of the surplus is equal to the additonal quantity of dollars that is required to compensate for the amount of depreciation of the reserve balances. Moreover, inflationary expectations in the reserve currency country would cause an excess demand for foreign goods and services so that a balance-of-payments deficit is generated. Conversely, to the rest of the world, a balance-of-payments surplus is accumulated in the form of the reserve currency due to the trade surplus generated by the excess demand for domestic goods and services from abroad. Then, an inflationary pressure is exerted on the rest of the world. As a result, inflation in a country can be transmitted to the rest of the world.

Channels of Imported Inflation

The fixed exchange rate regime established under the Bretton Woods System worked well until the late 1950s. From the early 60s, sizable payments imbalances among major countries started to appear. The acceleration of inflation since 1965 had been argued by the monetarists as the consequence of an increase in the rate of world money due to the expansionary policy adopted by the United States and diffused to the rest of the world through the U.S. payments deficit (Johnson, 1972a, p.

335). Moreover, Bretton Woods did not provide strong enough incentives for sizable changes in exchange rates in order to remove the payment imbalances. The issue of imported inflation has become more important.

Mundell (1971, Chapter 15) first analyzes the international transmission of the inflationary process by arguing that countries would have to pay "seigniorage" in the form of keeping a balance-of-payments surplus and thus imported inflation from abroad. With inflationary expectations in the key currency country, the rest of the world would have to keep a balance of payments surplus in order to compensate for the loss of their purchasing power of their international reserves. Thus, an inflationary process in the key currency country imposes a tax on other countries which are abliged to pay "seigniorage" through a transfer of real resources. While he is mainly concerned with the long-run equilibrium analysis, Shinkai (1973) develops a model for imported inflation but mainly concentrates on a short-run analysis. His model emphasizes the adjustment process initiated by a rise in the exogenous prices of imports which generates a surplus of trade balance. In addition to Mundell's conclusion, Shinkai argues that the country will also suffer from a deterioration in the terms of trade. Turnovsky and Kaspura (1974) adopt a simple Keynesian macroeconomic model to analyze the effects of foreign inflation on the domestic economy in the short run. From the analysis, international inflation will be transmitted to the domestic economy through the effects of an increase in the rate of inflation of foreign goods, a balance-of-payments surplus, a direct price increase, and an increase in the price of imported goods. Scarfe (1973) also provides a similar analysis. Brunner (1974) argues that foreign inflation can affect a country through the imports, exports, and

the balance of payments by emphasizing the shift in demand induced by a unit change of each of the three factors. However, to Weintraub (1977), imported inflation is something that everybody complains to import and nobody exports. He argues that "Imported inflation appears mainly to be a comforting apologetic supporting inaction by political leaders . . . . Imported inflation is but one price of economic and political backwardness" (Weintraub, 1977, p. 35).

The importance of the interaction of a fixed exchange rate and the money supply and the operation of inflationary expectations at home and abroad are the fundamental ground on which imported inflation can be analyzed. Imported inflation can be defined as inflation as a result of the demand-pull impact of increases in money supply resulting from a continual surplus in the balance of payments. In the determination of price changes, the monetarist's view of inflation emphasizes the role of excess demand generated from an excess money supply and inflationary expectations both at home and abroad. Therefore, two main channels through which inflation can be transmitted into a country can be identified:

(1) Direct balance-of-payments effect

Monetary factors play a crucial role in the determination of prices and in the acceleration of monetary inflation. To study the effect of the money supply on inflation is to examine the effect of changes in the quantity of money on the aggregate demand on the economy. An increase in the money supply and a continual balance-of-payments deficits in the key currency country implies a balance-of-payments surplus in the form of accumulated international reserves in other countries from the rest of the world. When the exchange rate is fixed, the

accumulated surplus increases the money supply and creates a demand pull on the economy if the rate of inflation is expected to accelerate. As long as the country is able and willing to sterilize the inflow of international reserves, a continual balance-of-payments surplus exists. Consequently, the rest of the world would import inflation from abroad. Hence, the balance of payments serves as a channel for the importation of inflationary impulses from abroad.

(2) Inflationary expectations effect

Inflationary expectation is the second channel for inflation to be imported into a country. Besides the expectations at home, inflationary expectations in the reserve currency country also impose a tax on other countries in the form of a balance-of-payments surplus. Other than serving as a channel to import inflation as discussed, inflationary expectations can also lead to a situation of competitive inflation if countries try to resist the payments of "seigniorage."

With inflationary expectations in the key currency country, the rest of the world is obliged to pay "seigniorage" to the reserve currency country in the form of a transfer of real resources. This is because the increase in the rate of inflation in the foreign country raises the prices of imports relative to that of exports and causes a deterioration in the terms of trade in the short run. The increase in demand for exportables and domestically consumed goods or a reduction in demand for foreign goods will generate a trade surplus and a domestic price inflation.

However, countries may resist the undesirable reserve accumulation by expanding their domestic credit in order to compete for the "seigniorage" that would accrue to the reserve currency country. Although the

domestic credit expansion does not affect the country's own inflation directly, it would affect the world money supply to the amount that it creates. As Swoboda (1978) argues,

> Under fixed money stocks--the 'world money stock'--should play an important role in determining the behavior of the 'world price level' . . . under the assumption that all goods are traded . . . the world price level adjusts to equate the world demand for money with the supply (p. 625).

The world price level would rise at a more rapid rate and consequently, lead to a situation of competitive inflation.

Short-run Adjustment Process and the Long-run Equilibrium

Both monetary and direct demand effects are emphasized in the transmission of international inflation. The international characteristics of inflation in a world of fixed exchange rates involve the study of money supply in an open economy and the balance-of-payments problem. A change in a country's rate of monetary expansion alters the balance of payments and the level of prices. At this level, the monetary approach provides an international transmission mechanism for inflation among countries. Direct demand changes induced by an exogenous world price increase or inflationary expectations would work through the adjustment mechanisms of the arbitrage of tradable goods, repercussions of real balance effects generated by the surplus in trade balances, and the mobility of capital. Whatever the mechanisms, the pegging of exchange rates insures that the balance-of-payments mechanism will spread inflation to other countries through an equilibrium distribution of the world money stock.

A Short-run Adjustment Process. Whatever the transmission mechanism, inflation is to converge through perfect goods, arbitrage under exchange-rate fixity. However, in the short run, inflation rates are allowed to differ among countries. Monetary disturbances can affect the domestic rate of inflation and output. An unexpected increase in domestic money supply forces the domestic inflation rate to be different from the world's rate and temporarily increases real income and creates a deficit. However, the increase in output reverses the initial effect on the balance of payments. Therefore, there may exist a tradeoff between inflation, output, and the balance of payments when expectations have not been fully adjusted. After expectations are fully corrected, the inflation rate will return to the world level and monetary equilibrium is adjusted through the balance-of-payments channel.

The balance of payments will provide whatever change in the amount of reserves that are required for that rate of inflation. Therefore, in the long run, the central bank has no control over its money supply. At a particular point in time, the rate of inflation of the country is determined solely by its own rate of monetary expansion. In determining the rate of inflation in a short run, it is a good approximation to consider it to be equal to the rate in the long run. As Laidler (1975a) argues,

> . . . the long-run equilibrium . . . is one from which the world does not deviate very far even in the short run, and one that is quickly reached after any disturbance . . . . Then, it may actually be a better approximation to reality to treat the world as if it was always in the long-run equilibrium (p. 175).

The Long-run Equilibrium. In the long run, as long as the countries maintain a fixed exchange rate, domestic price levels will peg to the world rate; they cannot avoid a common rate of inflation. Thus,

inflation is regarded as part of the external environment rather than controlled by individual countries. In the short run, one would expect a close relationship to exist between the rate of change in nominal income and the aggregate monetary growth. However, in the long run the relationship is between money and the price level. Output is determined at the full employment level and is independent of the behavior of the endogenous money supply. An important implication derived is that no tradeoff exists between inflation and output in the long run. Real interest rates are given and are determined by forces of "productivity and thrift" on a world-wide basis. Every country is a price taker in the world market. Inflation in the world is thus determined by the expansion of world money stock which is the sum of domestic money supplies of individual countries, gold, and SDRs.[4] Hence, a change in a country's domestic money will affect directly the world inflation rate to the extent that it affects the world money supply. The national rate of inflation can differ from the world's only to the extent that the productivity growth rates of tradable and nontradable sectors are different. The world is considered to consist of a single integrated market for the tradable goods and capital; that is, the 'law of one price' as proposed by Global Monetarism (see e.g. Whitman, 1975; Swoboda, 1977).

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[4]There are various definitions for the world money supply. Parkin (1975) considers world money by converting an aggregate of national money supplies into a common U.S. dollar unit. Claassen (1977) also provides similar consideration that the world money is the sum of national quantities of money. Keran (1975) treats the sum of international reserves as the world money supply. Besides, Genberg and Swoboda (1977) raise the question that whether M_1 or M_2 (or M_n) should be used as the definition of world money stock. They suggest that on an analytical level M_2 is used. But on a practical level, it is difficult because there is no good estimate for the net money stock held by the public.

Imported Inflation and Flexible Exchange Rates

By the early 1960s, the rapid accumulation of the key currency reserves was undermining the stability of the monetary stystem. The fixed exchange rates did not provide enough adjustment to relieve the distortions that had gathered over the long period of time. As a result, the Bretton Woods System collapsed in late 1971, leaving each country free to choose the exchange rate best suited to its needs. It is interesting to examine whether a flexible exchange rate system would prevent the inflationary impulses from transmitting from one country to another.

Monetary Approach to Exchange Rates

The monetary approach to balance of payments under a fixed exchange rate regime can be extended to a world of flexible exchange rates. Mundell (1968, 1971) first incorporates the monetary consideration in the determination of exchange rates and the view is later much emphasized by Dornbusch (1975, 1976a, 1976b) and also by Mussa (1974, 1976), Johnson (1975), Frenkel and Rodriguez (1975), Kouri (1976), and Frenkel (1976b). The monetary approach to exchange rates can be considered as the dual relationship to the monetary approach to the balance of payments since the former emphasizes on the role of money and assets in determining the exchange rate when it is flexible and the later emphasizes on the role of money and assets in determining the balance of payments when the exchange rates are fixed.

In exchange rate determination, there are three main perspectives--the purchasing-power-parity theory, the asset view, and expectations. Exchange rates can be regarded as the relative prices of two assets or

two national monies. The equilibrium is determined by the supply of and the demand for different national monies. Therefore, the determination of exchange rates is primarily a monetary phenomenon. For this argument to be true, the theory thus recognizes the validity of the purchasing-power-parity theory which states that a unit of domestic currency when converted to foreign currency can exchange for the same quantity of goods and services abroad or at home. The implication of the theory is that the equilibrium exchange rate is the ratio of domestic to foreign prices. Therefore, the relationship thus suggests the acceptance of the law of one price in the commodity market. Expectations are also important in exchange rate determination. Exchange rates reflect the demand and supply of domestic and foreign monies. An expectation of a monetary expansion would be reflected in the exchange rates since asset holders in evaluating the value of their assets may incorporate the effect of anticipated inflation in their rate of return. The anticipated inflation thus lowers the demand for real balances and the asset equilibrium is achieved only at a higher price level. Since the domestic price level is related to the foreign price level through the purchasing power parity, a rise in the domestic price level with fixed foreign prices is a depreciation of the domestic currency.

In choosing the proper indices in computing the parity, different views are controversial (Frenkel, 1976b, pp. 201-203). One of the views in choosing the price indices pertains to traded goods only and thus emphasizes the role of commodity arbitrage. Another view argues that the broadest range of commodity should be included.

Exchange Rates and Money Supply Under Floating Rates

The Case of Floating Exchange Rates. Under the system of flexible or floating exchange rates, two main types of floating can be identified--the "clean" floats and the managed floats. On a scale of exchange rates flexibility, the fixed exchange rate case is on one extreme and the clean floats or perfect flexible exchange rates case is on the other. The managed floating, on the other hand, lies somewhere in between the two extremes depending on the extent of government intervention in the exchange rate market.

The issue of whether a fixed or flexible exchange rate is more inflationary is a controversial subject. Since inflation is said to be transmitted across countries as long as exchange rates are fixed, some of the economists have suggested that floating the exchange rates will prevent the transmission of foreign inflation. Friedman (1956), Meade (1955), Caves (1963), Johnson (1973), and Williamson (1976) support that flexible exchange rates should insulate an economy from external shocks.

Different countries may desire different rates of inflation and monetary expansion. One of the main advantages of flexible exchange rates is that it provides an extra degree of freedom to a country to adjust its exchange rate and enough flexibility to compensate for changes in the price level and the country's competitive position in the world market. Contrary to the fixed exchange rates regime, the impact of any exogenous change in this case is on the exchange rates rather

than on the balance of payments which is always zero.[5] Any balance-of-payments surplus (or deficit) of the country would be removed by appreciation (or depreciation) of the exchange rates. Thus, the level of international reserves is constant. An immediate conclusion from this argument of zero balance of payments is that inflation is not transmitted through this channel.

The use of international reserves by monetary authorities under a flexible exchange rate system should be minimal because there is no international liquidity problem or the problem is insignificant (Harberler, 1977, p. 119). Yet, it is possible that international reserves still play an important role because it is unlikely that government will give up entirely the control of the exchange rate and may intervene the market from time to time. Williamson (1976) examines reserves use under floating rates and concludes that there is no evidence of a decline in reserves use during the period of generalized floating. He then suggests that reserves use has not ceased with the adoption of floating rates. The study is updated and reworked by Ishiyama (1976) and Suss (1976) but yields opposite results. Although empirical evidence on reserves use under floating rate is both limited and ambiguous, reserves use under floating rates should be much less than under a fixed rate regime since governments have no obligation to keep the rate fixed.

Exogeneity of Money Supply. Since any disturbance is to be

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[5]To the monetarists, freely floating rates are not necessary for the maintenance of balance-of-payments in the long run because the imbalance is self-correction even when exchange rate is fixed unless conditions causing the imbalance persist.

absorbed by changing the exchange rates, the balance of payments is continuously in equilibrium. Thus, the foreign source component of the monetary base is fixed; that is, the demand for money can be satisfied by domestic credit expansion alone and thus surplus countries regain control over their money supplies. The nominal money supply which is endogenous under a fixed rate regime becomes a policy variable when exchange rates are flexible. Consequently, monetary authorities can choose their own rates of monetary expansion and inflation and regain the control over its monetary policy.[6]

Monetary consideration can play an important role in the determination of exchange rates. Since exchange rate is determined in the money market, monetary authorities can manage the exchange rates by changing the money supply in line with the changes in exchange rates. In the short run, exchanges rates and the effect of money expansion are completely dominated by the asset markets and expectations (Dornbusch, 1976a, pp. 1168-1171). Thus, exchange rates provide a critical channel through which the impact of monetary policy is transmitted to aggregate demand. A monetary expansion would cause a disequilibrium at the existing exchange rate and price level. The excess supply of money thus causes an increase in the price level and/or depreciation of exchange rates so that the asset market can restore to equilibrium. In the long run, this result must happen because there is no money illusion or no long-run price rigidity.

During the adjustment process, an expansion of money reduces the rate of interest and causes an immediate overshoot in exchange rate

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[6]This is possible in the short run.

depreciation. The extent of depreciation will depend on the interest response of demand and the level of expectations. This is because the lower interest rates will lead to an anticipation of depreciation and a capital outflow. The capital outflow causes the spot rate to depreciate to the extent that the public would anticipate an exchange rate appreciation that is just sufficient to offset the initial reduction in interest rate. Consequently, the final equilibrium rate of exchange will end up somewhere in between the initial and the short-run equilibrium rate. The effects of monetary expansion therefore are dominated by the asset market and depend on the extent of capital mobility and expectations. However, if money supply is controlled, the exchange rate would not have dominated the price level (Yeager, 1976, p. 225).

The Operation of Inflationary Expectations

Under a floating rate system, inflationary expectations play an important role because inflationary expectations create expectations in the exchange rates and thus induce movement in the price level. If a currency is expected to depreciate, the decrease in demand for it would force it to depreciate because of the excess supply and thus pushes up prices. Since the equilibrium exchange rate is to be determined in the money market, the state of expectations is to be revised by examining the behavior of the past and future growth of the money stock. Recent literature emphasizing on the subject are presented by Dornbusch (1976a, b), Frenkel (1976b), and Mussa (1976).

In the determination of exchange rates, expectations enter the analysis through interest rates. If domestic and foreign securities are perfect substitutes, the domestic interest rate will be equal to the

foreign rate. However, when expectations are introduced, the two rates will differ by the amount of expected rate of depreciation of the domestic currency (Dornbusch, 1976a, p. 1163). In the short run, when expectations are not fully adjusted, an anticipation of a change in the exchange rate changes the domestic interest rates. In the long run, when expectations are adjusted, the interest rates are not affected and will return to the world level.

An inflationary expectations at home would raise the domestic interest rates due to the reduction in aggregate demand. The higher domestic interest rates induce foreign capital inflow and a trade surplus results. Hence, the spot rate is lowered as a result of an increase in demand for domestic currency (that is, an appreciation of the exchange rate). However, when expectations completely dominate the income and liquidity effect which last only in a short period, the increase in interest rates will lead to an increase in spot rates. The initial trade balance is reversed (or depreciation of the exchange rates) due to the increase in aggregate demand. This analysis brings out the traditional possible confusion in using interest rate as an indicator of easy or tight monetary policy. Therefore, it is more suitable to interpret the high interest rate as the result of a monetary expansion and its ultimate effect is to increase the price level through a devaluation of exchange rates.

An inflationary expectations abroad under a flexible exchange rate can also affect the domestic country. An increase in foreign inflation raises the prices of imports and thus causes a deterioration in the terms of trade. The balance-of-payments surplus is increased (or deficit is decreased) due to the direct increase in demand for domestic

goods at home and abroad. Since exchange rates are allowed to change freely, a surplus in the trade induces an appreciation which causes a net capital outflow (or decrease in inflow). Consequently, the new equilibrium is achieved at a worsened terms of trade. The deterioration in the terms of trade causes an increase in foreign and domestic demand of the domestic goods and thus puts pressure on the price level of tradable goods and then nontradables. The result is an increase in the inflation rate.

Channels of Imported Inflation

One of the solutions to imported inflation under a fixed rate regime is that flexible exchange rate can insulate an economy from inflation from abroad and authorities can choose their own rates of inflation. Turnovsky and Kaspura (1974) in discussing the case of imported inflation argue that,

> . . . a floating exchange rate tends to insulate the domestic economy from foreign price movements . . . . Inflation is a consequence of many influences, and a floating exchange rate merely eliminates one of these, namely, foreign effects (p. 375).

However, Cassas (1977) with his analysis hinging on the importance of exchange rates as a function of capital inflow, maintains that even with a flexible rate, the foreign rate of inflation will increase the domestic rate. Dornbusch (1976c) also argues that flexible exchange rates fail to insulate an economy from foreign inflation. Swoboda (1977), Parkin and Swoboda (1977), Classen (1976), Machlup (1975), and Corden (1976) also give emphasis on the subject. However, little empirical evidence had been done on the issue.

Leakages Through Exchange Rates. Since the balance of payments

under a flexible exchange rate has been observed to be zero, any foreign inflation impulses to be transmitted through this channel is prohibited because disturbances will be absorbed by exchanges rate changes. When a balance of payments surplus is accumulated, the flexible rates system allows the exchange rates to change so that an exchange rate appreciation removes the surplus and the resulting balance of payments is zero. According to Laursen and Metzler (1950) and Mundell (1968, 1971), expansionary monetary policy taken by one country will have deflationary effect on other countries. Any balance-of-payments surplus (deficit) accumulated at home due to a monetary expansion (contraction) from abroad will be removed by an appreciation (depreciation) of the exchange rate so that the ultimate effect is deflationary (inflationary). This is because when exchange rates are flexible, countries are free to change the rate in order to remove the surplus which increases the domestic money supply and inflation. Consequently, inflation is not imported. However, monetary authorities in practice may not allow the exchange rate to appreciate when the balance-of-payments is in surplus. Instead, they would expand their own money supplies which lead to devaluation of the exchange rates. On the other hand, the ratchet effect is in effect so that prices of the countries fail to fall. Contrary to the argument that flexible exchange rates could insulate the economy from foreign stocks, two careful considerations should be given.

First, the reactions of monetary authorities in other countries are important especially when they take the exchange rates or the interest rates as the targets of their monetary policy. On a practical level, instead of letting the exchange rate appreciate, authorities may expand their money supply in order to prevent an appreciation of the exchange

rate or a rise of the interest rate so as to maintain their exchange rates or interest rates targets. An expansion of the domestic money supply will cause a devaluation of the exchange rates and a rise in the price level. The process is encouraged because governments usually find inflation a convenient way of taxation and a means to reduce unemployment. Although the transmission mechansim under the balance of payments is blocked, yet, the leakage is through the devaluation of the exchange rates. Therefore, inflation is imported not directly from the balance of payments but through exchange rate changes. In this case, as Parkin and Swoboda (1977, p. 14) argue that "the behavior of the flexible rate system will in fact simulate that of a fixed-rate one."

Second, the implication of the Mundell-Laffer ratchet effect (see e.g. Laffer, 1973, 1974; Wanniski, 1974, 1975) is important. The effect states that the impact of exchange rate changes on prices is asymmetrical. A depreciation of exchange rates causes a lower price of domestic goods and a higher price for imported goods and thus the effect is inflationary. On the other hand, an appreciating country or whose currency appreciates spontaneously to the depreciation of other currencies, the price of its goods rises internationally; a decline of the domestic price level should be expected. However, this process tends to be frustrated due to the price rigidity in modern industrial countries so that the prices of imported goods fail to decline. Therefore, an appreciation does not exert an opposite effect to that of depreciation. In this case, even if the countries are willing to appreciate, domestic price levels would not decrease. Consequently, whenever exchange rate changes (in either direction), the world-price increases. The root cause of the change in exchange rates is the differences in the growth of money

supply from which divergent inflation rates are transmitted across countries. The problem of inflation, therefore, is still global.

Inflationary Expecations. Inflationary expectations provide a second channel for impulse of inflation to be transmitted across countries. It has been discussed that inflationary expectations at home are important in determining exchange rates in the short run. The higher interest rate as a result of the inflationary expectations induces cap-capital inflow and hence a trade surplus. Expectations from abroad raises the prices of imports and generates a deterioration in the terms of trade and thus increases the excess demand in domestic goods. Therefore, regardless of the origins of expectations, the consequence is a rise in the domestic price level. Whether inflationary expectations are created by an expansionary monetary policy, an exogenous increase in foreign inflation, or a direct increase in the price of tradable goods, it would affect aggregate demand and capital mobility and ultimately be adjusted through the balance-of-payments and exchange rate changes. The ultimate effect of a change in exchange rate is a rise in the general price level. Floating the rates therefore will not prevent the transmission of international inflation.

A Short-run Adjustment Process and the Long-run Equilibrium

When exchange rates are fixed, inflation is a world phenomenon; however, it is still a global problem when exchange rates are flexible. In fact, exchange rates provide a critical channel for the transmission of disturbances and inflation across countries. Since monetary authorities regain their control on monetary policy under a flexible exchange

rate, in the short run, they can choose their own desired rates of inflation. A tradeoff between inflation, output, and employment is then possible.

In the long run, the world inflation rate will be different from the national rates of inflation. With a flexible rate system, there is no single world money but a number of national monies, gold, and SDRs. Inflation, instead of determined by the world money stock as in the case of a fixed rate, is determined by the weighted average of the national inflation rates. The relevant "closed" economy now is the national economy and not the world economy. A larger country will have a bigger impact on the world inflation rate than the smaller countries. Imported inflation under a flexible-rate system is therefore still possible. As proposed by Corden (1976),

> . . . since every country will end up with an inflation rate that is somewhere between this world rate and its own desired rate--and may in the long run be quite close to the former--it is true that the large country to some extent 'exports' its rate of inflation to the others (p. 377).

The law of one price can still be applied to a good in the world economy with its different national price levels connected by the changing exchange rates.

CHAPTER IV

A MONETARIST MODEL OF IMPORTED INFLATION

Hypotheses

Under a fixed exchange rate regime, a country has to increase (decrease) the international reserves component of its total monetary base in order to finance a balance-of-payments surplus (deficit) so as to ease the upward (downward) pressure on its exchange rate. Therefore, the base as well as the money supply are endogenous, assuming incomplete sterilization. Inflation is imported as a result of a continual balance-of-payments surplus. The hypothesis to be tested is that inflation is imported through two channels; first, a direct balance-of-payments surplus, and second, inflationary expectations.

Under the flexible exchange rate regime, the country can regain its control over its monetary policy through the adjustment of exchange rates. International transmission of inflation through the balance of payments does not occur. Rather, the effects would show up as a change in exchange rates. Inflation can still be imported through exchange rate fluctuations. The hypothesis to be tested is that inflation is imported not through a direct balance-of-payments surplus but rather through the channels of changes in exchanges rates and expectations on exchange rate changes.

The Basic Model

In order to examine the effects of the domestic monetary base and the balance of payments induced monetary base on inflation, a model is constructed starting with the money market where the money supply (M) is the product of the money multiplier (m) and the monetary base. The monetary base has two components--the domestic component (D) and the international component (R). D is the sources and uses of the base and R is in terms of international currency units which are converted to domestic currency units through the exchange rate (e). The exchange rate is expressed in domestic currency units in terms of a unit of foreign currency.

$$M = m\,(D + eR) \tag{1}$$

The level of international reserves (R) is determined by the following identity:

$$R = R_{-1} + B \tag{2}$$

where R_{-1} is the level of international reserves of last period and B is the balance-of-payments surplus; that is B is defined as a change in R.

The demand for money (L) is assumed to be a stable function of the general price level (P), real income (y), and the nominal interest rate (r); that is,

$$\underset{\quad + \; + \; -}{L = L\,(P,\ y,\ r)} \tag{3}$$

The sign underneath each variable represents the sign for the partial derivative. Assuming no money illusion, the demand function is homogenous of degree one in prices,

$$L = P\ L(y,\ r) \tag{4}$$

Equilibrium of the money market is indicated by the equality of

money supply and money demand.

$$P\ L(y, r) - m(D + eR) = 0 \tag{5}$$

Therefore, excess supply of money (ES^m) is expressed as

$$ES^m = m(D + eR) - P\ L(y, r) \tag{6}$$

In determining the rate of inflation, the monetarist extreme view considers that there are only two determinants affecting the rate of price changes; namely, the rate of change of excess supply of money $(\frac{\dot{ES}^m}{ES})$ and inflationary expectations of the public $(\frac{\dot{P}^e}{P})$. Therefore, the price adjustment equation is

$$\frac{\dot{P}}{P} = P\left(\underset{+}{\frac{\dot{ES}^m}{ES}}, \underset{+}{\frac{\dot{P}^e}{P}}\right) \tag{7}$$

where the dot (.) indicates the time rate of change.

From this basic model, two sub-models can be developed with each corresponding to different exchange rate period--fixed and flexible.

Model A--Fixed Exchange Rate System

Under a fixed exchange rate system, e can be considered as exogenous. The interest rate is assumed to be the sum of the permanent real rate (i*) and anticipated rate of inflation. Besides, following Friedman (1970b), the nominal rate is also determined by the rate that is expected to prevail in the long run (r*).

$$r = i^* + \frac{\dot{P}^e}{P} = r^* \tag{8}$$

From equation (6), the excess supply of money is derived from the money market equation and is determined by the rate of change of real income and the rates of change of monetary base. Therefore,

$$\frac{\dot{ES}^m}{ES} = ES\left(\underset{+}{\frac{\dot{y}}{y}}, \underset{0}{\frac{\dot{D}}{D}}, \underset{+}{\frac{\dot{R}}{R}}\right) \tag{9}$$

The money multiplier (m) is assumed to be constant for simplicity.

Following the monetarist approach (Rutledge, 1976), the rate of price expectations is assumed to be based on the past rates of inflation and the past rates of change of money supply.

$$\frac{\dot{P}^e}{P} = P^e\left(\underset{+}{\frac{\dot{P}}{P_{-t}}}, \underset{+}{\frac{\dot{M}}{M_{-t}}}\right) \tag{10}$$

where t = 1, 2, . . . , n.

Substituting equations (9) and (10) into (6), equation (11) is

$$\frac{\dot{P}}{P} = P\left(\underset{+}{\frac{\dot{y}}{y}}, \underset{0}{\frac{\dot{D}}{D}}, \underset{+}{\frac{\dot{R}}{R}}, \underset{+}{\frac{\dot{P}}{P_{-t}}}, \underset{+}{\frac{\dot{M}}{M_{-t}}}\right) \tag{11}$$

A linear version of equation (11) is

$$\frac{\dot{P}}{P} = \dot{a}_0 + a_1 \underset{-}{\frac{\dot{y}}{y}} + a_2 \underset{0}{\frac{\dot{D}}{D}} + a_3 \underset{+}{\frac{\dot{R}}{R}} + a_4 \underset{+}{\frac{\dot{P}}{P_{-t}}} + a_5 \underset{+}{\frac{\dot{M}}{M_{-t}}} \tag{12}$$

Coefficients a_1, a_2, a_3 are the real income growth effect, domestic monetary base effect, and balance-of-payments effect respectively. a_4 and a_5 are the expectations effects. The expected signs of the estimated parameters are positive except a_1 which is to be negative and a_2 to be zero. The length of t is determined empirically.

The growth of real income causes an increase in the demand for real, and therefore, nominal money balances. The increase in the demand for money implies that there is a reduction in the excess supply of money which in turn decreases the price level. As a result, the growth of real income decreases the price level through a decrease in the

excess supply of money. The result therefore is deflationary; that is, $a_1 < 0$.

The sign for the domestic monetary base effect (a_2) is zero because an expansion of the domestic base affects the world inflation rate to the extent that it affects the world money supply. By the small country assumption, D does not affect world money supply; increase in D will be offset by a decrease in R. Therefore, the effect leaks through international reserves changes. Nevertheless, the sign will be positive if the domestic monetary credit expansion can affect the world money supply significantly. Since each country is assumed to be small, the sign is likely zero.

When the equilibrium in the money market is disturbed by changes such as in the monetary base, the equilibrating factor is a change in international reserves (R). The disequilibrium is reflected by a surplus or deficit in the balance of payments. A change in R is from the balance of payments. An increase in R implies a surplus which raises the domestic price level due to the excess supply of money. Therefore, a_3 is expected to be positive.

Coefficients a_4 and a_5 are the expectations effects. People adjust their anticipations of the current price level according to the past rates of price changes and the money supply. The higher the past rates of changes, the higher is the expected current inflation rate. Therefore, the coefficients are expected to carry positive signs.

Effects of Devaluation. To examine the effects of devaluation on the price level under a fixed exchange rate regime, the exchange rate can be included as a variable to be tested. Equation (12) can be reestimated in the form of

$$\frac{\dot{P}}{P} = a_0 + a_1 \frac{\dot{y}}{y} + a_2 \frac{\dot{D}}{D} + a_3 \frac{\dot{R}}{R} + a_4 \frac{\dot{P}}{P_{-t}} + a_5 \frac{\dot{M}}{M_{-t}} + a_6 \frac{\dot{e}}{e} \qquad (13)$$

All coefficients are expected to carry the same expected sign as previously discussed. a_6' represents the effect of devaluation and is expected to be positive.

An increase in the rate of change in exchange rate, that is, an acceleration in the rise of the price of foreign currency raises the prices of tradable and nontradable goods. This general price increase also increases the demand for nominal money balances. If the increase in demand for money is not satisfied by domestic credit expansion, inflow of international reserves results and the consequence is a balance of payment surplus. Therefore, excessive devaluation brings in foreign money which increases the money supply. The ultimate effect is an increase in the price level. Devaluation is said to be inflationary; that is, a_6' is positive.

Model B--Flexible Exchange Rate System

When the exchange rate is flexible, the price level of a country will be determined by the purchasing-power-parity condition such that

$$P = eP^W \qquad (14)$$

where P^W is the price level and the flexible exchange rate (e) is a variable in this case.

Inflationary expectations in terms of exchange rate expectations can enter through the interest rate. The domestic interest rate (r) is assumed to be the sum of the world interest rate (i*) and the expected rate of depreciation (e^e) and is expected to prevail in the long run (r*). Therefore,

$$r = i^w + e^e = r^* \tag{15}$$

From equation (6), the excess supply of money is derived from the money market equation and is determined by the rates of change of real income, of monetary base, and of the exchange rates.

$$\frac{\dot{ES}^m}{ES} = ES\underset{-}{(}\underset{y}{\frac{\dot{y}}{y}}, \underset{D}{\frac{\dot{D}}{D}}, \underset{R}{\frac{\dot{R}}{R}}, \underset{e}{\frac{\dot{e}}{e}}\underset{+}{)} \tag{16}$$

The money multiplier is assumed to be constant.

Expectations are assumed to be based on the expectations of exchange rate depreciation. For simplicity, the expected rate of exchange rate depreciation is assumed to depend upon the past information on the rates of exchange rate changes. Nevertheless, this may not be the only specification. Carrying the idea from the fixed rate model and to obtain a parallel treatment for the comparison of the results between the two different exchange rates periods, infaltionary expectations can be assumed to base on past rates of inflation and money supply; that is, equation (13) is used for empirical testing for the flexible exchange rate period. If the expected rate of depreciation depends on past rates of exchange rate changes, then

$$\frac{\dot{P}^e}{P} = e^e = e^e\left(\frac{\dot{e}}{e_{-t}}\right) \tag{17}$$

where t = 1, 2, . . ., n.

Substituting equations (16) and (17) into (7) yields

$$\frac{\dot{P}}{P} = P\underset{+}{(}\underset{y}{\frac{\dot{y}}{y}}, \underset{D}{\frac{\dot{D}}{D}}, \underset{R}{\frac{\dot{R}}{R}}, \underset{e}{\frac{\dot{e}}{e}}, \underset{+}{\frac{\dot{e}}{e_{-t}}}\underset{+}{)} \tag{18}$$

A linearized version of this equation can be presented as

$$\frac{\dot{P}}{P} = a_0 + a_1 \frac{\dot{y}}{y} + a_2 \frac{\dot{D}}{D} + a_3 \frac{\dot{R}}{R} + a_4 \frac{\dot{e}}{e} + a_5 \frac{\dot{e}}{e_{-t}} \tag{19}$$

Coefficients a_1, a_2, a_3, a_4, and a_5 represent the real income growth effect, domestic monetary base effect, balance-of-payments effect, exchange rate depreciation effect, and expectational effect respectively.

a_1 is negative, the argument being the same as in the fixed rate model.

The argument for a_2 to be zero is similar to the case for fixed exchange rates. The domestic monetary base would not affect the economy directly but only indirectly. In the case of flexible rates, it will exert its effect through the exchange rates rather than through the balance of payments. Exchange rates are assumed to be predetermined by the money supply. Therefore, any effect of the base on the price level is to be expressed by exchange rate changes so that the sign is zero.

Since any balance-of-payments surplus or deficit is to be removed by exchange rate changes and the use of international reserves is constant or significant, a_3 is expected to carry a zero coefficient in this case. An important implication of this coefficient is that inflation is not to be imported through the balance-of-payments channel.

Both a_4 and a_5 are expected to carry positive signs. Any disturbance regardless of the origin is reflected through exchange rates depreciation or appreciation and expectations. The more the exchange rates actually depreciate and the more people expect them to depreciate, the higher the price will rise. The significance of these two coefficients would indicate that international inflation can still be transmitted to other countries even if exchange rates are flexible.

Methodology

Period for Testing

Due to the crises of the monetary system and the involuntary floating of countries in the world at the end of 1971, a period of eleven years from 1961 to 1971 is chosen to study countries which maintained a fixed exchange rate with the U.S. dollars. The flexible exchange rate period includes a period of six years from 1972 through 1977 during which selected countries adopted a generalized floating policy.

Sources of Data

Annual data for different countries were obtained from the International Monetary Fund, International Financial Statistics and United Nations, Statistical Yearbook. Selection of countries depended in part upon the availability of data. A total of 39 countries satisfying the small country assumption were selected for the study (Appendix A). Because the United States is the main supplier of international reserves, it is excluded from the study.

The rate of inflation was taken as measured by the consumer price index and real income (y) was obtained by nominal GDP deflated by the consumer price index. The domestic monetary base (D) is the reserve money in the Central Bank. It represents the liabilities of the monetary authorities in the form of currency and demand deposits. The foreign monetary base (R) is the international reserves in each country and is defined as the sum of foreign exchange, gold, SDRs, and reserves position in the Fund. The level of money supply (M) is measured according to the M_1 definition of money which is the sum of currency and

demand deposits held by the public. Exchange rates (e) are expressed as the price of the dollar; that is, the amount of domestic currency for one unit of foreign currency. All variables are expressed in rates of change form.

Statistical Methods

From the model developed, equations (12), (13), and (19) are the three equations to be estimated. Due to the limited number of years relevant to each sub-period for the fixed and flexible exchange rates, the method of pooling of time-series and cross-section is to be performed. Appendix B discusses the mathematical derivations of different methods of pooling.

Ordinary Least Squares Regression. The simplest method of pooling is to perform an ordinary least squares regression on the entire data set for a single equation by using both country cross-section and time-series data. The assumptions are that there is no correlation among the country units, no autocorrelation, and no heteroskedasticity. However, the difficulty from pooling of data is the lack of information of the disturbance term. The disturbance term may include information on the effects of serial correlation, cross-section disturbances, and a combination of both.

Further, problems also arise when ordinary least squares regression is performed on equations (12) and (13).

(1) The model is interdependent in the sense that it is based on simultaneous equations. Since international reserves (R) is endogenous, a regression using an endogenous variable as independent variable yields biased and inconsistent estimates--the classical Haavelmo problem

(Maddala, 1977, p. 249).

(2) Each equation contains lagged dependent variables $(\frac{\dot{P}}{P}_{-t})$ as explanatory variables. Lagged dependent variables are stochastic variables and are most likely correlated with the disturbance term.[1] According to the assumptions of classical linear regression model, explanatory variables should be nonstochastic. Therefore, using lagged dependent variables as explanatory variables in ordinary least squares regression yields biased and inconsistent estimates.

In dealing with the problem of estimating a simultaneous equation models with endogenous and lagged dependent variables, a simple and convenient method to get consistent estimates is by using instrumental variables technique. Fair (1970, 1972) suggests that a general technique that can be followed is of treating all endogenous and lagged endogenous variables as endogenous variables and to estimate the equation by instrumental variables. As long as only exogenous and lagged exogenous variables are chosen as instruments, the regression yields consistent estimation. The choice of the instrumental variables is arbitrary and is only limited by the requirement that the instruments are exogenous and are not correlated with the disturbance but are highly correlated with the variable to be replaced. However, it has to be recognized that estimation by using the method of instrumental variables loses the property of efficiency since the asympototic variance may not be the smallest because it depends upon the instruments chosen. The method of

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[1]Lagged dependent variable poses a serious problem especially in the use of the variance component model. For detail analysis, see Maddala (1971).

truncanted two stage least squares can be used for consistent estimation.[2]

(3) In estimation with cross-section data, heteroskedasticity is often encountered. The presence of heteroskedasticity yields unbiased but inefficient parameter estimates and biased variances.

Two remedies are suggested to reduce the heteroskedasticity: (a) express the variables in logs and (b) deflate all variables by some measure of "size" (Maddala, 1977, p. 265). Since the variables are expressed in rates of change form, the problem may be taken account of. However, the problem may not be removed. In that case, ordinary least squares regression also yields undesirable results.

Covariance Model. The use of ordinary least squares regression has the shortcomings that it assumes a constant intercept and hence does not consider the changing effects due to the change in cross-section and time-series units. An obvious solution to this problem is to introduce dummy variables which would allow the intercept to vary over time and over cross-sections. Then, each time period and cross-section would be characterized by its own intercept. In general, the covariance model for the three equations to be estimated can be expressed as follows:

$$\frac{\dot{P}}{P_{it}} = a_0 + \sum_{k=1}^{K}\alpha_k Z_{kit} + \sum_{i=1}^{N}\beta_i C_{it} + \sum_{t=1}^{T}\gamma_t T_{it} + \varepsilon_{it} \qquad (15)$$

where $C = 1$ for i^{th} country $\qquad i = 2, 3, \ldots, N$

$= 0$ otherwise

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[2]The method is to choose a subset of the exogenous variables included in the regression equation and other predetermined variables excluded from the equation as instruments. The predicted values on the endogenous and lagged dependent variables are obtained and used as explanatory variables in the second stage of the regression.

and $T = 1$ for t^{th} time period $\quad t = 2, 3, \ldots, T$

$= 0$ otherwise

Z_{kit} is the set of explanatory variables in each equation and ε_{it} is the disturbance term where $i = 1, 2, \ldots, N$; $t = 1, 2, \ldots, T$. α_k, β_i, and γ_t are the parameters and K represents the number of independent variables in that particular equation.

However, there are several problems in using the covariance model. The use of dummy variables is to adjust for important information by eliminating a major portion of the unexplained variation. But in fact, it does not provide any more information because coefficients of dummy variables are difficult to interpret economically. Besides, the method of dummy variables for each time and cross-section units consumes considerable degrees of freedom and thus may decrease the statistical power of the model (Maddala, 1971; Balestra and Nerlove, 1966).

Error Component Model. An alternative method of pooling is the error (random) component model which is an improvement over the covariance model in the sense that it extracts the information which is not provided by the dummy variables through the disturbance term. Instead of estimating β_i parameters for the cross-section units and γ_t parameters for the time units, the error components model estimates only two parameters--the variances of the random variables for cross-section (U_i) and for time (V_t). Therefore, a substantial number of degrees of freedom is conserved.

Consider the model

$$\frac{\dot{P}}{P_{it}} = a_0 + \sum_{k=1}^{K} \alpha_k Z_{kit} + \varepsilon_{it} \qquad (21)$$

$$\varepsilon_{it} = U_i + V_t + W_{it}$$

where α_k, Z_{kit}, and ε_{it} are defined in (20)

and U_i is the cross-section error component

V_t is the time-series error component

W_{it} is the combined error component

This model assumes that the error components are neither correlated with each other nor autocorrelated. In fact, this may not be the only specification. Balestra and Nerlove (1966) note that the assumption that the cross-section random components are independent among themselves may not be true. Besides, Nerlove (1971) also argues that it will be more realistic to allow for serial correlation for the same individual because the assumption that the random time effect persists for all time periods is too rigid. One would expect that disturbance from the time-series data may be autoregressive.

Cross-sectionally Correlated and Time-wise Autoregressive Model. An alternative model suggested by Parks (1967) and Kmenta (1971) incorporates both contemporaneous correlation among individual units for the cross-section observations and serial correlation or the time-series observations. In cross-sectional data, the regression disturbance is usually mutually dependent among each cross-section units as well as heteroskedastic. By adopting the idea of Zellner (1962) of seemingly unrelated model, information on the residuals for one cross-section unit can be obtained from (or correlated with) another unit. Therefore, mutual correlation between individual units is allowed. The problem of heteroskedasticity is also built into the model. Further, the disturbance resulted from time is assumed to be generated by a stationary first order autoregressive process. In general, the model to be estimated is

$$\frac{\dot{P}}{P_{it}} = a_0 + \sum_{k=1}^{K} \alpha_k Z_{kit} + \varepsilon_{it} \qquad (22)$$

where $E(\varepsilon^2) = \sigma_{ii}$ (heteroskedasticity)

$E(\varepsilon_i \varepsilon_j) = \sigma_{ij}$ (contemporaneous correlation)

$\varepsilon_{ij} = \rho_i \varepsilon_{i,t-1} + u_{it}$ (autoregression)

The variables in (22) are as defined and σ_{ii} and σ_{ij} are the variances. ρ_i is the first order autocorrelation coefficient and u_{it} is the white noise.

Each of the five different techniques of pooling is applied to the two equations (12) and (13) and the results are reported and compared. Besides, four different regression methods except the instrumental variables method are applied to equation (19). The method of instrumental variables estimation is excluded because the equation does not contain endogenous or lagged dependent variables so that within the framework of the classical linear regression model, ordinary least squares regression is sufficient.

CHAPTER V

THE EMPIRICAL RESULTS

Fixed Exchange Rates Period (1961-1971)

Ordinary least squares regression is performed on equation (12) and the pooled result for the 39 countries is reported in Table I. It is found that lagged inflation rate and money supply can affect significantly the present rate of inflation up to two periods and one period respectively. The regression result shows that the R^2 (goodness-of-fit) is high and all estimated parameters carry the expected signs and are highly significant except the coefficient for the domestic credit which is not significantly different from zero. However, the equation contains endogenous and lagged dependent variables which are correlated with the disturbance term and thus gives inconsistent estimations. Therefore, exogenous variables are chosen and the predicted values generated are used as instruments.[1] Hence, consistent estimation is

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[1] For the endogenous variable $\frac{\dot{R}}{R}$, exogenous variables included in the equations chosen are the rates of change of real income, domestic credit, past level of money supply and exogenous variables excluded from the model chosen are the rates of change of exchange rates (and exchange rate lag one period), foreign exchange (and foreign exchange lag one period), foreign asset (and foreign asset lag one period), and time.

For the lagged dependent variable of rate of inflation, exogenous variables included in the equation chosen are the rates of change of real income and domestic credit. Exogenous variables excluded from the model chosen are rates of change of exchange rates, government expenditures, domestic capital stock, and export.

TABLE I

EFFECTS ON INFLATION - FIXED EXCHANGE RATES (1961-1971)

Dependent Variables: $\frac{\dot{P}}{P}$	OLS	Instrumental Variable Regression	Covariance Model
Intercept	0.0428***	0.0141**	0.0663***
	(7.8456)	(2.3602)	(3.3662)
$\frac{\dot{y}}{y}$	-0.8373***	-0.7619***	-0.8782***
	(-13.8980)	(-11.8913)	(-13.9377)
$\frac{\dot{D}}{D}$	-0.0003	0.0007	0.0001
	(-0.2712)	(0.6063)	(0.1186)
$\frac{\dot{R}}{R}$	0.0247***	0.0719***	0.0499***
	(4.4556)	(7.2069)	(5.1233)
$\frac{\dot{P}}{P_{-1}}$	0.4001***	0.3481***	0.3263***
	(9.8840)	(8.0726)	(7.9613)
$\frac{\dot{P}}{P_{-2}}$	0.1280***	0.2103***	0.1309***
	(3.5401)	(5.3077)	(3.3776)
$\frac{\dot{M}}{M_{-1}}$	0.2719***	0.3663***	0.1852***
	(8.1171)	(11.0486)	(4.7069)
d.f.[a]	305	305	260
$\bar{R}^2$	0.7642	0.7299	0.7883
D.W.	0.8187	1.5588	1.6310
F	169.0230	141.0800	23.7100
S^2_{yx}	0.0027	0.0031	0.0024

***indicates significance at 1% level
**indicates significance at 5% level

[a]The first 117 observations are lost due to the rate of change of the price level is lagged up to two periods.

NOTE: Figures in parentheses are t-statistics.

obtained with the use of ordinary least squares regression.

Each of the four methods of pooling described in Chapter III is applied to equations (12) and (13) of the model and the results are reported in Tables I, II and Tables III, IV respectively. The statistical results indicate that the results are highly significant and tend to support the theoretical propositions and hypotheses. With different methods of pooling, the results obtained by various methods show that about 76% (with adjusted R_s^2 range from 0.7403 to 0.7783) of the inflation rate is explained by the model. The percentage is obtained by taking an average of all the R^2 from the pooled regression results.

To test for serial correlation for residual of each equation, the Durbin-Watson statistics are used. However, the Durbin-Watson statistics obtained from equations (12) and (13) are irrelevant for the test because both equations contain lagged dependent variables. When instrumental variables are used instead of the lagged dependent variables, the test can be applied. The Durbin-Watson is calculated by ordering the observations by countries and by years within each country. It tests the differences in residuals among countries and serial correlation of residuals within each country. Since the statistics obtained from the instrumental variables regressions from Tables I and III are significantly from two, serial correlation of the residuals within countries exists.[2] The use of dummy variables in the covariance model removes the residuals among countries which could bias the Durbin-Watson to differ from two. However, the Durbin-Watson statistics are also different from

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[2]Because the significance levels of the Durbin-Watson statistics have not been developed for pooled regressions, the criterion is based on the significance levels for time-series regressions.

TABLE II

EFFECTS ON INFLATION - FIXED EXCHANGE RATE (1961-1971)

Dependent Variable: $\frac{\dot{P}}{P}$	Error Component Model	Cross-sectionally Correlated and Time-wise Autoregressive Model
Intercept	0.0319***	0.0198***
	(3.7743)	(3.9507)
$\frac{\dot{y}}{y}$	-0.8165***	-0.8059***
	(-13.2000)	(-16.8530)
$\frac{\dot{D}}{D}$	0.0003	-0.0018
	(0.2945)	(-0.5505)
$\frac{\dot{R}}{R}$	0.0617***	0.0605***
	(6.4460)	(6.8437)
$\frac{\dot{P}}{P_{-1}}$	0.3415***	0.3441***
	(8.3707)	(8.5901)
$\frac{\dot{P}}{P_{-2}}$	0.1766***	0.2643***
	(4.6499)	(8.2091)
$\frac{\dot{M}}{M_{-1}}$	0.2926***	0.3240***
	(8.3427)	(8.3507)
d.f.[a]	305	305
$\hat{\sigma}^2_u$	0.0006	----
$\hat{\sigma}^2_v$	0.0001	----
$\hat{\sigma}^2_w$	0.0024	----
S^2_{yx}	0.0025	0.1942

***indicates significance at 1% level

[a]The first 117 observations are lost due to the rate of change of the price level is lagged up to two periods.

NOTE: Figures in parentheses are t-statistics.

TABLE III

EFFECTS ON INFLATION - FIXED EXCHANGE RATES AND DEVALUATION
(1961-1971)

Dependent Variable: $\frac{\dot{P}}{P}$	OLS	Instrumental Variables Regression	Covariance Model
Intercept	0.0431***	0.01768***	0.0660***
	(8.0833)	(2.9696)	(3.3784)
$\frac{\dot{y}}{y}$	-0.8267***	-0.7550***	-0.8764***
	(-14.0224)	(-12.0207)	(-14.0137)
$\frac{\dot{D}}{D}$	-0.0002	0.0004	-0.0001
	(-0.2426)	(0.3879)	(-0.1146)
$\frac{\dot{R}}{R}$	0.0164***	0.0442***	0.0313**
	(2.8164)	(3.5558)	(2.4482)
$\frac{\dot{P}}{P_{-1}}$	0.3831***	0.3458***	0.3344***
	(9.6228)	(8.1775)	(8.1890)
$\frac{\dot{P}}{P_{-2}}$	0.1057***	0.1997***	0.1374***
	(2.9522)	(5.1249)	(3.5614)
$\frac{\dot{M}}{M_{-1}}$	0.2741***	0.3603***	0.1877***
	(8.3707)	(11.0654)	(4.8401)
$\frac{\dot{e}}{e}$	0.0705***	0.0802***	0.0512**
	(3.8989)	(3.6256)	(2.2359)
d.f.[a]	304	304	259
$\bar{R}^2$	0.7747	0.7403	0.7915
D.W.	0.6417	1.6426	1.6981
F	153.7950	127.6200	23.7100
S^2_{yx}	0.0114	0.0030	0.0024

***indicates significance at 1% level
**indicates significance at 5% level

[a]The first 117 observations are lost due to the rate of change of the price level is lagged up to two periods.

NOTE: Figures in parentheses are t-statistics.

TABLE IV

EFFECTS ON INFLATION - FIXED EXCHANGE RATES AND DEVALUATION
(1961-1971)

Dependent Variable: $\frac{\dot{P}}{P}$	Error Component Model	Cross-sectionally Correlated and Time-wise Autoregressive Model
Intercept	0.0330***	0.0216***
	(3.9905)	(4.5150)
$\frac{\dot{y}}{y}$	-0.8120***	-0.8136***
	(-13.2810)	(-17.9370)
$\frac{\dot{D}}{D}$	0.0000	-0.0014
	(0.0259)	(-0.4149)
$\frac{\dot{R}}{R}$	0.0368***	0.0190*
	(2.9865)	(1.8008)
$\frac{\dot{P}}{P_{-1}}$	0.3473***	0.3871***
	(8.6098)	(11.3140)
$\frac{\dot{P}}{P_{-2}}$	0.1787***	0.2519***
	(4.7647)	(7.3092)
$\frac{\dot{M}}{M_{-1}}$	0.2946***	0.3111***
	(8.5489)	(9.2214)
$\frac{\dot{e}}{e}$	0.0706***	0.1285***
	(3.2230)	(6.6601)
d.f.[a]	304	304
$\hat{\sigma}^2_u$	0.0006	----
$\hat{\sigma}^2_v$	0.0001	----

TABLE IV (Continued)

Dependent Variable: $\frac{\dot{P}}{P}$	Error Component Model	Cross-sectionally Correlated and Time-wise Autoregressive Model
$\hat{\sigma}^2_w$	0.0024	----
S^2_{yx}	0.0025	0.1886

***indicates significance at 1% level
**indicates significance at 5% level
*indicates significance at 10% level

[a]The first 117 observations are lost due to the rate of change of the price level is lagged up to two periods.

NOTE: Figures in parentheses are t-statistics.

two indicating that serial correlation is present. Therefore, in choosing a more appropriate model, the cross-sectionally correlated and timewise autoregressive model is more desirable. Following this model, the effects of different variables on inflation are discussed as follows.[3]

Out of the explained portion of the inflation rate, real income is important in decreasing the rate of inflation. According to the result, a 1% increase in the rate of growth of real income decreases the inflation rate by about 0.81%

The coefficients of the domestic credit expansion is not significantly different from zero. This shows that the rate of domestic credit expansion does not affect directly the rate of inflation in the country which generates the domestic monetary expansion.

To the issue of imported inflation, the significance of the estimated parameters for the rate of growth of international reserves shows that inflation can be imported through the channel of balance of payments. The statistical result indicates that for every percent increase in the rate of international reserves accumulation, the consequence is an increase in the rate of inflation by about 0.04%.

In all the pooled regression results, inflationary expectations in terms of rates of change of past levels of inflation and of money supply are important. The coefficients of the past rates of inflation and of the money supply indicate that expectations based on the past rates of inflation explain about 62% of the present rate of inflation with a majority of the adjustment taken up by the first year while the lagged money supply contributes another 32%. Therefore, an increase in the

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[3]The estimates are calculated by taking an average of the coefficient of the two regression equations.

rate of expectations causes an almost proportionate increase (94%) in the present rate of inflation. An implication of the proportionate increase as a result of inflationary expectations is that there may exist no tradeoff between inflation and unemployment in the long run. Another implication that follows is that any monetary or fiscal policy aiming at reducing inflation would fail because of the expectational effects.

Devaluation in the fixed rate era affects the rate of inflation. The expected positive sign is obtained and is consistent for all the pooled regression results. The significant result supports the proposition that devaluation is inflationary. From the estimates recorded in Tables III and IV, it shows that a 1% increase in the rate of devaluation on average increases the rate of inflation by 0.1285%.

Flexible Exchange Rates Period (1972-1977)

Tables V and VI present the results of the four different pooled regressions on equation (19) for the 39 countries when generalized floating is in effect. All the estimated coefficients carry the expected signs and are highly significant except the coefficients for domestic credit and international reserves. Besides, the regression equations have high R_s^2 and the fits are good. By using ordinary least squares regression, 98.92% of the inflation is explained by the explanatory variables in the model. With the inclusion of dummy variables, 99.28% of the inflation is explained.

The Durbin-Watson is calculated by ordering the observations by countries and by years within each country. From ordinary least squares regression, the Durbin-Watson is significantly close to two suggesting

TABLE V

EFFECTS ON INFLATION - FLEXIBLE EXCHANGE RATES
(1972-1977)

Dependent Variable: $\frac{\dot{P}}{P}$	OLS	Covariance Model
Intercept	0.1418***	0.1149***
	(19.9888)	(3.2634)
$\frac{\dot{y}}{y}$	-0.4342***	-0.5145***
	(-10.2710)	(-12.4615)
$\frac{\dot{D}}{D}$	-0.0007	0.0002
	(-0.9948)	(0.3659)
$\frac{\dot{R}}{R}$	-0.0111	0.0085
	(-0.9192)	(0.7773)
$\frac{\dot{e}}{e}$	0.2432***	0.1910***
	(14.6403)	(11.5852)
$\frac{\dot{e}}{e_{-1}}$	0.1489***	0.1859***
	(5.0429)	(6.4329)
$\frac{\dot{e}}{e_{-2}}$	0.8009***	0.7668***
	(55.4971)	(57.2368)
$\frac{\dot{e}}{e_{-3}}$	0.1375***	0.2056***
	(3.0038)	(4.5480)
$\frac{\dot{e}}{e_{-4}}$	0.0964***	0.0582***
	(5.7024)	(3.6223)
d.f.	225	182
$\overline{R}^2$	0.9892	0.9928
D.W.	1.7061	2.2173
F	2678.6800	634.7100
S^2_{yx}	0.0094	0.0062

***indicates significance at 1% level

NOTE: Figures in parentheses are t-statistics.

TABLE VI

EFFECTS ON INFLATION - FLEXIBLE EXCHANGE RATES
(1972-1977)

Dependent Variable: $\frac{\dot{P}}{P}$	Error Component Model	Cross-sectionally Correlated and Time-wise Autoregressive Model
Intercept	0.1431***	0.1414***
	(6.1249)	(9.5421)
$\frac{\dot{y}}{y}$	-0.4850***	-0.5301***
	(-12.2570)	(-8.9406)
$\frac{\dot{D}}{D}$	0.0000	0.0028
	(0.0484)	(0.4594)
$\frac{\dot{R}}{R}$	0.0011	0.0090
	(0.1054)	(0.4747)
$\frac{\dot{e}}{e}$	0.2212***	0.2322***
	(15.2070)	(4.5496)
$\frac{\dot{e}}{e_{-1}}$	0.1794***	0.1894***
	(6.5896)	(3.2010)
$\frac{\dot{e}}{e_{-2}}$	0.7857***	0.7446***
	(60.9870)	(11.0300)
$\frac{\dot{e}}{e_{-3}}$	0.1886***	0.1866***
	(4.3968)	(5.9133)
$\frac{\dot{e}}{e_{-4}}$	0.0805***	0.0786
	(5.2027)	(1.6071)
d.f.	225	225
$\hat{\sigma}_u^2$	0.0010	----
$\hat{\sigma}_v^2$	0.0028	----
$\hat{\sigma}_w^2$	0.0062	----
S_{yx}^2	0.0064	0.1242

***indicates significance at 1% level

NOTE: Figures in parentheses are t-statistics.

that serial correlation is absent. By using the covariance model, the residuals among countries are removed and there exists no serial correlation. However, the use of dummy variables uses up a substantial number of degrees of freedom. The error component model is thus preferred by its property of conserving the degrees of freedom. According to the error component model, the effects of different variables on inflation are discussed below.

The growth of real income is also important in decreasing the rate of inflation although the effect is not as significant as during the fixed exchange rates period. However, the estimated parameters are highly significant and carry the expected negative sign. It is found that a 1% increase in the growth rate of real income decreases the rate of inflation by 0.485%.

The estimated coefficients from the pooled regressions for both domestic credit expansion and international reserves are not significantly different from zero. This indicates that during the period of flexible exchange rates, the two variables do not influence the rate of inflation. This is the result expected because changes in the rate of domestic credit do not affect the rate of inflation directly but will affect it through the changes in exchange rates. It is also argued that flexible exchange rates would block the balance-of-payments channel for imported inflation. The result tends to support the hypothesis that reserves use during the period of flexible rates is constant and thus inflation is not imported through this route.

Although inflation is not to be imported through the balance of payments, the effect is absorbed by the flexible exchange rate. Inflation is thus transmitted through exchange rate changes. The significant

coefficients with expected positive sign for the rates of change in exchange rates indicate that a 1% change leads to a 0.2212% increase in the rate of inflation.

Furthermore, inflation can also be transmitted through expectations on exchange rate changes. The statistical results show that expectations via exchange rates are crucial in affecting the rate of inflation. Lagged exchange rate changes can affect inflation up to four periods and the influence is greatest with a lag of two periods. A 1% increase in the rate of change in exchange rate lagged two periods alone increases the rate of inflation by 0.78%. The overall effect of exchange rate expectations is a more than proportionate increase in the inflation rate--1% change leads to a 1.23% increase in the rate of inflation. Therefore, flexible exchange rates have not stopped the international transmission of inflation.

Inflationary expectations in terms of exchange rate expectations may not be the only specification. In order to obtain a parallel consideration for the comparison with the fixed rate period, equation (13) is applied to the period of flexible rates. In this case, inflationary expectations are considered to depend upon past rates of inflation and of money supply. The statistical result obtained shows that variables representing expectations by using past rates of money supply are not significant. Besides, the R^2 is comparatively much lower than those obtained by using equation (19) which has a R^2 of 0.9892. This shows that equation (19) is a more appropriate model in explaining the rate of inflation under a period of floating rates; and the results obtained from this model are used and emphasized for further analysis.

Analysis of Results

The theme of this thesis is to investigate that under a micro-economic case of small open economy, whether inflation can be imported into the country and if so, through what channels the international inflationary impulses are transmitted into the economy. Under the case of a fixed exchange rate regime, the monetary approach to balance of payments postulates that in order to finance a balance-of-payments surplus which exerts an upward pressure on the exchange rates, the country has to buy international reserves and thus increases the money supply and then the price level. The significance of the estimated coefficient for international reserves (R) tends to support the above postulate that inflation can be transmitted into a small open economy through a balance-of-payments surplus. Thus, the fixity of exchange rates ensures that the balance of payments to serve as one of the main channels for inflation to be imported. Under the case of flexible rates, the monetary approach predicts that the balance of payments is in equilibrium because any disturbances are eliminated by exchange rate changes. Consequently, the rate of change in the use of international reserves is constant; that is the balance of payments is zero. Regardless of the methods of estimation, the estimated coefficient for international reserves (R) is not significantly different from zero. The result supports the hypothesis that when exchange rates are flexible, international transmission of inflation through the balance-of-payments channel is impossible. On the other hand, the significance of the estimated coefficient for exchange rate changes suggests that exchange rate changes absorb the external disturbances and serve as a channel for the transmission of international inflation. Consequently, the argument

that flexible exchange rates can insulate an economy from the transmission of inflationary impulses from abroad is not supported.

Inflationary expectations are suggested to be another channel for the transmission of foreign inflationary impulses. When exchange rates are fixed, inflationary expectations are revised through past rates of inflation and of money supply. The result of the empirical study shows that an increase in the rate of inflationary expectation would lead to an almost proportionate increase in the rate of inflation. When exchange rates are flexible, inflationary expectations are revised through expectations on the past rates of exchange rate changes. The result obtained is that an increase in the rate of inflationary expectations would lead to a more than proportionate increase in the present rate of inflation. An important implication that can be derived from these results is that in the long run, there exists no tradeoff between inflation and unemployment. Any governmental policy aiming at reducing inflation at the expense of employment would not succeed. International inflationary impulses are still transmitted across countries regardless of the exchange rates regimes.

Under both fixed and flexible exchange rates, a domestic credit expansion would affect the rate of inflation indirectly. If the exchange rates are fixed, an increase in the domestic monetary base (D) is offset by an opposite movement in the international reserves (R) so that the effect leaks through the changes in international reserves. If the exchange rates are flexible, the balance of payments is in equilibrium and the effect leaks through exchange rate changes. The insignificant estimated coefficient obtained for domestic monetary base from various methods of pooling suggests that the rate of inflation is not

affected directly by changing the domestic monetary base.

The conclusion that can be drawn from the above empirical test is that regardless of the exchange rate regime, imported inflation is possible except that the channels of transmission are different. However, whatever the channels of transmission, money plays a critical role in the process in affecting the rate of inflation.

Comparable empirical results obtained from other studies also support that inflation can be transmitted from one country to another. Courchene and Singh (1976) test the hypothesis that an increase in the balance-of-payments surplus (i.e. an increase in international reserves) has three main sources; namely, an increase in the excess demand for real money balances in the country itself, a decrease in the excess demand for real balances in the world, and/or an increase in the world reserves. Parkins (1977) utilizes the "monetarist" approach by testing that excess demand and inflationary expectations play important roles in affecting inflation. These positive results lead to the conclusion that inflation is transmitted across countries and in the long run, there exists no tradeoff between inflation and output. However, the results mainly apply to the fixed exchange rate period. Brunner and Meltzer (1977) provide the evidence that the operations of monetary and external impulses are important in affecting inflation. Jain (1980) mainly concerns with the problem of world money supply, also supports that inflation can be transmitted internationally and there exists no long run inflation and output tradeoff.

CHAPTER VI

SUMMARY AND IMPLICATIONS

Principal Purpose

The main purpose of the thesis is to investigate the relevancy of the issue of imported inflation for a small open economy under both a fixed and flexible exchange rate system. The interest is to test whether inflation can be imported into a country when exchange rates are fixed and subsequently, whether flexible rates can insulate a country from external shocks and ban importation of inflation. The literature on the issue of imported inflation is mixed and controversial. Under a fixed exchange rate regime, theoretical results indicate that inflation can be imported into an open economy through the balance of payments and inflationary expectations channels. Therefore, floating of the exchange rate is proposed as a solution to insulate the country from external disturbances. On the other hand, it is also argued that floating the rate does not ban the international transmission of inflation. Nevertheless, empirical evidence on the issue is very limited. Therefore, it is also of much interest to test the issue empirically in order to shed some light on the issue.

Main Results

The empirical results from this study maintain that in a world of fixed exchange rates, inflation is imported through the channels of a

balance-of-payments surplus and inflationary expectations from home and abroad. The money supply is endogenous and responds to changes in international reserves. Any effect of a monetary policy is offset by international reserves flows. Further, the presence of inflationary expectations in terms of past rates of inflation and of money supply indicates that there is no tradeoff between inflation and unemployment. Any monetary policy adopted by the government to reduce inflation at the expense of employment will not succeed.

Contrary to the argument that floating exchange rates can insulate a country from international inflation, empirical evidence provided by this study suggests that international transmission of inflation occurs under both fixed and flexible exchange rates regimes. Floating the rates has not prevented the international transmission of inflation. Instead of transmitting the inflationary impulses through the balance of payments, the mechanisms for transmission under flexible rates are the changes in exchange rates and the expectations on exchange rate changes. It is impossible to tell a priori which exchange rate system is more conducive to world inflation. Further, inflationary expectations play an important role when exchange rates are flexible. The more than proportionate increase in the rate of inflation as a result to a change in exchange rates expectations indicates that expectations are crucial in affecting inflation. The monetary authorities can regain their control over the money supply in the short run. In the long run, there exists no tradeoff between inflation and unemployment.

Implications

According to Corden (1976), the answer to the question of which

exchange rate system is more conducive to world inflation depends on whether the country is inflation-prone or inflation-shy (Corden, 1976, p. 381). An inflation-prone country, that is a country that chooses to have a higher inflation rate than the average world rate under a flexible exchange rate system, finds the flexible rate regime less inflationary. On the other hand, an inflation-shy country, one which chooses to have a lower rate than the world rate, would find the flexible exchange rate system more inflationary. This is because each country's actual inflation rate is somewhere between the world rate and its own desired rate. Consequently, inflation-prone countries have a lower than desired inflation rate under a flexible exchange rate system and the reverse is true for the inflation-shy countries. Therefore, the choice of an exchange rate system is important.

The Choice of an Exchange Rate System

The choice of an appropriate exchange rate regime is important to a country because it affects economic activities through the conduct of domestic and international economic policies. Nevertheless, the choice of an exchange rate system is not simple and it depends upon the economic characteristics of each country. Heller (1978) suggests that there are five main criteria for the choice of the exchange rate--the size of a country, degree of openness, degree of capital mobility, trade pattern, and divergence of inflation rates. Corden (1976) emphasizes that one's view towards government policy is important. If a maximum freedom for the government to exercise its economic policy is desired, a flexible exchange rate is best. If the government is believed to have an excessive deflationary bias (inflationary bias), then inflation-prone

countries should adopt a flexible exchange rates (fixed rates) and inflation-shy countries should adopt a fixed exchange rates (flexible rates). The fixed exchange rates would serve as a discipline on the inflation-prone countries and force some inflation on the inflation-shy countries. Therefore, if inflation-prone countries have an excessive inflationary bias while the inflation-shy countries have an excessive deflationary bias, a fixed exchange rates system is more suitable because that will move each country in the direction it wishes.

Generation of World Inflation

The answer to the question of whether flexible or fixed exchange rates are more conducive to world inflation is different for different countries. As Claassen (1976, p. 347) suggests, "Floating exchange rates can be more inflationary than fixed exchange rates in the same way as they can be less or equally inflationary." Nevertheless, evidence observed during the recent years especially after the floating indicates that unstable exchange rates are closely related with an acceleration of world inflation. This tends to support that a flexible rate system may provide a higher inflationary bias. Moreover, the empirical results from this study also support the view that inflation in a country is closely related with past and present exchanges rate changes. Hence, one may easily be tempted to draw a conclusion that flexible exchange rates are more inflationary. Yet, it is important to examine the generation and the cause of exchange rate changes and world inflation in order to shed some lights on the argument between fixed and flexible exchange rates.

Causes of Imported Inflation Under a Fixed Exchange Rate System

Fixed exchange rates are said to be inflationary on the ground that inflation is being exported and imported from one country to another. Countries which can influence the world inflation somewhat can export at least part of the inflation to the rest of the world. Thus the main symptoms of importation of inflation are a continual balance-of-payments surplus, a large capital inflow, and/or an increase in the prices of traded relative to nontraded goods. Consequently, in response to the inflationary biasedness in the key currency country, the rest of world has to inflate along with it and the national rates of inflation converge to the world rate. Therefore, it is important to examine the determinants of the world inflation rate. As discussed earlier in the paper, the world inflation rate is determined by the rate of expansion of the world money stock. Any monetary creation adds to the world money stock and thus to the world inflation rate. Fixed exchange rates ensure the balance of payments as a medium for the international transmission of inflation.

Causes of Imported Inflation Under a Flexible Exchange Rate System

Flexible exchange rates cannot be considered as a solution to ban international transmission of inflation among countries. In fact, flexible exchange rates ensure that the exchange rate itself is the channel through which international inflationary impulses are transmitted. Two main factors can be identified--the breakdown of monetary discipline and government intervention in the exchange rates market.

The Breakdown of Monetary Discipline. Under flexible exchange rates, a government has no obligation to keep a fixed exchange rate. Thus the government can regain control of its monetary policy. When exchange rates are flexible, government usually finds that monetary expansion is an easy way to achieve their goal of decreasing unemployment or to deflating part of the public debt, and/or to inflating away the effects of the recent oil price increase. Especially since 1973, the oil prices have increased at a rapid rate. Huge oil deficits are accumulated. With a flexible rate system, the government can expand the money supply more freely in order to finance the deficit. The consequence is an increase in the rate of inflation. Further, oil countries may attempt to increase the oil prices further and leads to more inflation. In the long run, the policy of monetary expansion is self-defeating because it would only lead to more price increase and inflation. Hence, money becomes both the cause and the consequence of inflation. Mundell (1976, p. 153) comments that "Monetary discipline is a sine qua non of monetary stability and monetary stability is essential to the survival of nontotalitarian political systems." The regime of flexible exchange rates provides the opportunity and becomes the channel through which monetary instability to be transmitted from one country to another.

Government Intervention in the Exchange Rates Market. Since the adoption of the flexible exchange rates, the rate of inflation has not been reduced as expected. On the contrary, there exists a high degree of fluctuations in the price level and unemployment among countries in the world. The exchange rates system in which countries are now operating is in fact not a pure flexible type but a highly managed float.

There are two kinds of managed floating. If the government intervention is only limited to smoothing exchange rates movements, then the floating will be close to free floating. However, government intervention may be vigorous in aiming at an "appropriate" exchange rate or at an exchange-rate target, then the floating will be close to a pegged rate except that a fixed rate is not maintained.

Whenever the monetary authorities want to achieve a certain exchange rate target or when exchange rates change in response to an external disturbance, government intervention in the exchange rate market is inevitable. In order to prevent an "undesirable" exchange rates appreciation, expansion of money supply would cause a depreciation and thus the result is inflationary. Hence, money is the tool used to arrive at the exchange rates targets. Whatever the money supply, the pressure is on the exchange rate. The authorities would decide the extent of the pressure to be relieved by allowing exchange rates to change.

A common factor which can be drawn from the determinants of exchange rates changes and the inflation is that money supply plays a crucial role. Because of the assymmetrical effect of exchange rates on prices, whenever there is a change in exchange rate (depreciation or appreciation), the result will be an increase in the world price level. Depreciation of exchange rates would cause an increase in the price level; however, appreciation of exchange rates does not provide a downward effect on the price level. When there is an exchange rate appreciation which put a downward pressure on prices, prices can be rigid downward in advanced countries and/or the monetary authorities may attempt to inflate away the pressure so as to reduce the pressure on

unemployment. Exchange rates becomes the critical channel for the transmission of monetary changes and money becomes both the cause and the result of inflation. Therefore, the responsbility of world inflation mainly lies on the national monetary policy--the degrees of monetary discipline and governmental intervention. Flexible exchange rates just happen to provide a leeway for these to occur. The regime of flexible exchange rates itself is neither more nor less inflationary than the fixed rates.

Policy Implication

The conclusion on the regime of flexible exchange rates is that it cannot insulate an economy from external disturbances and therefore, countries do not have purely independent national policies. International inflationary impulses can still be transmitted across countries and thus governmental policies generated from one country can influence the decisions of the others. The pressure will be on the exchange rates. The problem existing under a fixed exchange rates system is therefore modified rather than removed by the flexible rates. In order to avoid competitive depreciation and inconsistent interventions in the exchange rates market, altering the exchange rates system to a pure floating and abandoning government intervention in the exchange rate market are not sufficient. Traditional Keynesian stabilization policies that government as a stabilizer of fluctuations and equilibrium to be achieved by deliberate policy intervention are neither necessary nor effective. To restore stability and confidence in the international monetary system, policies should follow two main lines--monetary stability and correction of expectations.

Whatever the degree of inflation, it would continue to be world-wide. Since the acceleration of world-wide inflation from the late 1960s, the revival of the "monetarist" doctrine has shifted the attention from domestic to international money supply. Floating exchange rates may reduce the interdependence of national price levels; but it might not make inflation much less world-wide. The problem of international inflation requires international policy coordination and cooperation.

BIBLIOGRAPHY

Aliber, R. Z. (ed.). National Policies and the International Financial System. Chicago: University of Chicago Press, 1974.

Aukrust, O. "Inflation in the open economy: The Norwegian model." Central Bureau of Statistics of Norway, Working Paper 12 (March, 1975).

_____. "Prim I: A model of the price and income distribution." Review of Income Wealth, 16 (March, 1970), pp. 51-78.

Bailey, M. J. "The welfare cost of inflationary finance." Journal of Political Economy, 64 (1956), pp. 93-110.

Balestra, P. and Nerlove, M. "Pooling cross section and time series data in the estimation of a dynamic model: The demand for natural gas." Econometrica, 34 (1966), pp. 585-612.

Bilson, J. F. "Current experience with floating exchange rate: An appraisal of the monetary approach." American Economic Review, 68 (May, 1978), pp. 412-417.

Branson, W. H. "Comments and discussion." Brookings Papers on Economic Activity, 3 (1975), pp. 537-542. (a)

_____. "International transmission of inflation: A 'Keynesian' approach." Presented at Brookings Institutions Conference on Worldwide Inflation, November, 1974, pp. 21-23.

_____. "A Keynesian approach to worldwide inflation." In L. B. Krause and W. S. Salant (eds.), Worldwide Inflation: Theory and Recent Experience. Washington, D. C.: The Brookings Institution, 1977.

_____. "Monetarist and Keynesian models of transmission of inflation." American Economic Review, 65 (May, 1975), pp. 115-119. (b)

Bronfenbrenner, M. and Holzman, F. D. "Survey of inflation theory." American Economic Review, 53 (September, 1963), pp. 593-661.

Brunner, K. "Monetary management, domestic inflation, and imported inflation." In R. Z. Aliber (ed.), National Policies and the International Financial System. Chicago: University of Chicago Press, 1974.

_____ and Meltzer, A. H. "The explanation of inflation: Some international evidence." American Economic Review, 67 (February, 1977), pp. 148-154.

Cagan, P. "The monetary dynamics of hyperinflation." In M. Friedman (ed.), The Quantity Theory of Money. Chicago: Chicago University Press, 1956.

_____ et al. A New Look at Inflation and Economic Policy in the Early 1970s. Washington, D. C.: American Enterprise Institute for Public Policy Research, 1973.

Cassas, F. R. "Imported inflation: The case of floating exchange rates." Canadian Journal of Economics, 10 (1977), pp. 485-493.

Caves, R. E. "Flexible exchange rates." American Economic Review, 53 (May, 1963), pp. 120-129.

Claassen, E. M. "World inflation under flexible exchange rates." Scandinavian Journal of Economics, 78 (1976), pp. 346-365.

_____ and Salin, P. Recent Issues in International Monetary Economics. Amsterdam: North Holland, 1976.

Collery, A. "International adjustment, open economies, and the quantity theory of money." Princeton Studies in International Finance. Princeton: Princeton University, International Financial Section, 1971.

Connolly, M. B. and Swoboda, A. K. International Trade and Money. Geneva: George Allen and Unwin Ltd., 1973.

Cooper, R. N. "Currency devaluation in developing countries." Essays in International Finance No. 86. Princeton: Princeton University Press, 1971.

Corden, W. M. "Inflation and the exchange rate regime." Scandinavian Journal of Economics, 78 (1976), pp. 370-383.

Courchene, T. J. and Singh, K. "The monetary approach to the balance of payments." In M. Parkin and G. Zis (eds.), Inflation in the World Economy. Manchester: Manchester University Press, 1976.

Crockett, A. D. and Goldstein, M. "Inflation under fixed and flexible exchange rates." International Monetary Fund Staff Papers, 23 (November, 1976), pp. 509-544.

Dornbusch, R. "Devaluation, money, and non-traded goods." American Economic Review, 63 (December, 1973), pp. 871-883.

_____. "Expectations and exchange rate dynamics." Journal of Political Economy, 84 (December, 1976), pp. 1161-1176. (a)

_____. "Expectations and monetary policy." Journal of International Economics, 6 (August, 1976), pp. 231-244. (b)

_____. Personal Comment on "A Keynesian approach to worldwide inflation," by W. H. Branson. In L. B. Krause and W. S. Salant (eds.), Worldwide Inflation: Theory and Recent Experience. Washington, D. C.: The Brookings Institution, 1977.

_____. "A portfolio balance model of the open economy." Journal of Monetary Economics, 1 (January, 1975), pp. 3-20.

_____. "Real and monetary aspects of the effects of exchange rate changes." In R. Z. Aliber (ed.), National Monetary Policies and the International Financial System. Chicago: University of Chicago Press, 1974.

_____. "The theory of flexible exchange rate regime and macroeconomic policy." Scandinavian Journal of Economics, 78 (1976), pp. 255-275. (c)

Edgren, G., Faxen, K. and Ohdner, C. Wage Formation and the Economy. London: Allen and Unwin, 1973.

Enders, W. and Lapeen, H. E. "Stability, random disturbance and the exchange rate regime." Southern Economic Journal, 46 (July, 1979), pp. 49-70.

Fair, R. C. "Efficient estimation of simultaneous equation with autoregression errors by instrument variables." Review of Economics and Statistics, 54 (1972), pp. 444-449.

_____. "The estimation of simultaneous equation models with lagged endogenous variables and first order serially correlated errors." Econometrica, 38 (May, 1970), pp. 507-516.

Fisher, I. "Appreciation and interest." Publications of the American Economic Association, 2 (August, 1896), pp. 331-442.

_____. The Purchasing Power of Money. New York: Macmillan Publishing Co., Inc., 1911.

Frenkel, J. A. "Adjustment mechanism and the monetary approach to the balance of payments: A doctrinal perspective." In E. M. Claassen and P. Salin, Recent Issues in International Monetary Economics. Amsterdam: North Holland, (1976), pp. 29-48. (a)

_____. "A monetary approach to the exchange rate: Doctrinal aspects and empirical evidence." Scandinavian Journal of Economics, 78 (1976), pp. 200-222. (b)

_____ and Johnson, H. G. (eds.). The Monetary Approach to the Balance of Payments. Toronto: University of Toronto Press, 1976.

_____ and Rodriguez, C. A. "Portfolio equilibrium and the balance of payments: A monetary approach." American Economic Review, 65 (September, 1975), pp. 674-688.

Freidman, M. "The case for flexible exchange rates." In M. Friedman (ed.), Essays in Positive Economics. Chicago: University of Chicago Press, 1953, pp. 157-203.

_____. The Counter-Revolution in Monetary Theory. London: IEA (for Wincott Foundation) Occasional Paper, No. 33, 1970. (a)

_____. "The quantity theory of money: A restatement." In M. Freidman (ed.), Studies in the Quantity Theory of Money, Chicago: University of Chicago Press, 1956.

_____. "The role of monetary policy." American Economic Review, 58 (March, 1968), pp. 1-17.

_____. "A theoretical framework for monetary analysis." Journal of Political Economy, 78 (March, 1970), pp. 193-238. (b)

Frisch, H. "Inflation theory 1963-1975: 'A second generation' survey." Journal of Economic Literature, 15 (December, 1977), pp. 1290-1317.

Genberg, H. and Swoboda, A. K. "Causes and origins of the current worldwide inflation." In E. Lundberg (ed.), Inflation Theory and Anti-Inflation Policy. Colorado: Westview Press, 1977.

Goldstein, M. "Downward price inflexibility, ratcheting, and the inflationary impact of import price changes: Some empirical evidence." International Monetary Fund Staff Papers, 24 (November, 1977), pp. 569-612.

Gordon, R. J. "Recent developments in the theory of inflation and unemployment." Journal of Monetary Economics, 2 (1976), pp. 185-219.

_____. "Wage-price controls and shifting Phillips curve." Brookings Papers on Economic Activity, 3 (1972), pp. 385-421.

_____. "World inflation and monetary accomodation in eight countries." Brookings Papers on Economic Activity, 2 (1977), pp. 409-477.

Grubel, H. G. "Domestic origins of the monetary approach to the balance of payments." Essays in International Finance No. 117, Princeton: Princeton University, International Finance Section, 1976.

Guitian, M. "Effects of changes in exchange rate on output, prices, and the balance of payments." Journal of International Economics, 6 (February, 1976), pp. 65-74.

Harberler, G. "How important is control over international reserves?" In R. A. Mundell and J. J. Polak (eds.), The New International Monetary System. New York: University Press, 1977.

_____. Review of Journal of Economic Literature, 14 (December, 1976), pp. 1324-1328. In J. A. Frenkel and H. G. Johnson (eds.), The Monetary Approach to the Balance of Payments. Toronto: University of Toronto Press, 1976.

Heller, H. R. "Determinants of exchange rate practices." Journal of Money, Credit, and Banking, 10 (August, 1978), pp. 308-321.

_____. "International reserves and worldwide inflation." International Monetary Fund Staff Papers (1976), pp. 61-87.

Hinshaw, R. (ed.). Inflation as a Global Problem. Baltimore: The John Hopkins University Press, 1972.

Holden, P., et al. "Determinants of exchange rate flexibility: An empirical investigation." Review of Economics and Statistics, 61 (1979), pp. 327-333.

Holtrop, M. W. "Monetary policy in an open economy: Its objectives, instruments, limitations, and dilemmas." Princeton Studies in International Finance No. 43. Princeton: Princeton University, 1963.

International Monetary Fund. International Financial Statistics. Washington, D.C. Various issues used for data, 1961-1978.

Ishiyama, Y. "Exchange flexibility and reserve use: A note." International Monetary Fund Staff Papers, unpublished, 1976.

Jain, J. L. "World money supply, output, and inflation: An empirical study." (Unpub. Ph.D. dissertation, Oklahoma State University, 1980.)

Johnson, H. G. "Elasticity, absorption, Keynesian multiplier, Keynesian policy, and monetary approaches to devaluation theory: A simple geometric exposition." American Economic Review, 66 (June, 1976), pp. 448-452.

_____. Essays in Monetary Economics. London: George Allen and Unwin Ltd., 1967.

_____. Further Essays in Monetary Economics. Cambridge: Harvard University Press, 1973.

_____. Inflation and the Monetarist Controversy. Amsterdam: North-Holland Publishing Company, 1972. (a)

332.03 J76J

_____. "The monetary approach to balance-of-payments theory." Journal of Financial and Quantitative Analysis, 7 (March, 1972), pp. 1555-1572. (b)

_____. "The monetary approach to balance-of-payments theory: A diagramatic analysis." Manchester School of Economics and Social Studies (September, 1975), pp. 220-274.

_____. "The monetary approach to the balance of payments: A non-technical guide." Journal of International Economics, 7 (August, 1977), pp. 251-268. (a)

_____. "Money, balance-of-payments theory, and the international monetary problem." Essays in International Finance No. 124. Princeton: Princeton University, 1977. (b)

Keran, M. W. "Towards an explanation of simultaneous inflation-recession." Federal Reserve Bank of San Francisco, Business Review (Spring, 1975), pp. 18-30.

Keynes, J. M. The General Theory of Employment, Interest, and Money. London: Macmillan Publishing Co., Inc., 1936.

Kmenta, J. Elements of Econometrics. New York: Macmillan Publishing Co., Inc., 1971.

Kouri, J. K. "The exchange rate and the balance of payments in the short run and in the long run: A monetary approach." Scandinavian Journal of Economics, 78 (1976), pp. 280-304.

Krause, L. B. and Salant, W. S. (eds.). Worldwide Inflation: Theory and Recent Experience. Washington, D. C.: The Brookings Institution, 1977.

Kravis, I. B. and Lipsey, R. E. "Export prices and the transmission of inflation." American Economic Review, 67 (February, 1977), pp. 155-163.

Kreinin, M. E. and Officer, L. H. "The monetary approach to the balance of payments: A survey." Princeton Studies in International Finance No. 43. Princeton: Princeton University, International Finance Section, 1978.

Laffer, A. "The Bitter fruits of devaluation." Wall Street Journal (January 10, 1974), p. 14.

_____. "Does devaluation really help trade?" Wall Street Journal (February 5, 1973), p. 10.

Laidler, D. E. W. Essays on Money and Inflation. Chicago: The University of Chicago Press, 1975. (a)

_____. "Inflation: A survey." The Economic Journal, 85 (December, 1975), pp. 741-809. (b)

_____ and Nobay, A. R. "Some current issues concerning the international aspects of inflation." Paper presented at Third Dauphine Conference on International Monetary Economics. Paris, France (March 28, 1974).

Laursen, S. and Melzler, L. A. "Flexible exchange rates and the theory of employment." Review of Economics and Statistics, 32 (November, 1950), pp. 281-299.

Lucas, R. E., Jr. and Rapping, L. A. "Price expectations and the Phillips curve." American Economic Review, 59 (1969), pp. 342-350.

Lundberg, E. (ed.). Inflation Theory and Anti-Inflation Policy. Colorado: Westview Press, 1977.

Machlup, F. "How inflation is transmitted and imported." Euromoney (September, 1975), pp. 58-63.

Maddala, G. S. Econometrics. New York: McGraw-Hill Book Co., 1977.

_____. "The use of variance component models in pooling cross section and time series data." Econometrica, 39 (March, 1971), pp. 341-358.

Maynard, G. and Ryckegham, W. V. A World of Inflation. New York: Harper and Row Publishers, Inc., 1975.

Meade, J. E. "The case for flexible exchange rates." Three Banks Review, 27 (September, 1955), pp. 3-27.

Monti, M. (ed.). The 'New Inflation' and Monetary Policy. New York: Holmes and Meier Publishers, Inc., 1976.

Mortensen, D. T. "A theory of wage and employment dynamics." In E. S. Phelps (ed.), Microeconomic Foundations of Employment and Inflation Theory. New York: Norton, 1970.

Mundell, R. A. International Economics. New York: Macmillan Publishing Co., Inc., 1968.

_____. Monetary Theory: Inflation, Interest, and Growth in the World Economy. Pacific Palisades: Goodyear Publishing Co., 1971.

_____. "The new inflation and flexible exchange rates." In M. Monti (ed.), The 'New Inflation' and Monetary Policy. New York Holmes and Meier Publishers, Inc., 1976.

_____ and Polak, J. J. (eds.). The New International Monetary System. New York: University Press, 1977.

Mussa, M. "The exchange rate, the balance of payments, and monetary and fiscal policy under a regime of controlled floating." Scandanavian Journal of Economics, 78 (1976), pp. 230-248 and 410-412.

_____. "A monetary approach to balance-of-payments analysis." Journal of Money, Credit, and Banking, 6 (August, 1974), pp. 333-351.

Nerlove, M. "Further evidence on the estimation of dynamic economic relationships from a time series of cross sections." Econometrica, 39 (1971), pp. 359-382.

Parkin, M. "Inflation, the balance of payments, domestic credit expansion, and exchange rate adjustments." In R. Z. Aliber (ed.), National Policies and the International Financial System. Chicago: University of Chicago Press, 1974.

_____. "A 'monetarist' analysis of the generation and transmission of world inflation, 1958-71." American Economic Review, 67 (February, 1977), pp. 164-171.

_____, Richards, I. and Zis, G. "The determinants and control of world money supply under fixed exchange rates, 1961-1971." Manchester School of Economics and Social Studies (September, 1975), pp. 293-316.

_____ and Swoboda, A. K. "Inflation: A review of the issues." In E. Lundberg (ed.), Inflation Theory and Anti-Inflation Policy. Colorado: Westview Press, 1977.

_____ and Zis, G. (ed.). Inflation in the World Economy. Manchester: Manchester University Press, 1976.

Parks, R. W. "Efficient estimation of a system of regression equations when disturbances are both serially and contemporaneously correlated." Journal of American Statistical Association, 65 (1967), pp. 500-509.

Phelps, E. S. "Anticipated inflation and economic welfare." Journal of Political Economy, 73 (February, 1965), pp. 1-17.

_____. "Phillips curves, expectations of inflation and optimal unemployment over time." Economica, 34 (August, 1967), pp. 254-281.

Resler, D. H. "The formation of inflation expectations." Federal Reserve Bank of St. Louis, 62 (April, 1980), pp. 2-12.

Rhomberg, R. R. and Heller, R. "Introductory survey." International Monetary Fund Staff Papers (1977), pp. 1-14.

Rodriguez, C. A. "The terms of trade and the balance of payments in the short run." American Economic Review, 66 (September, 1976), pp. 710-716.

Rutledge, H. "A monetarist approach to price expectations." Quarterly Review of Economics and Business, 16 (Autumn, 1976), pp. 61-71.

Salant, W. S. "International transmission of inflation." In L. B. Krause and W. S. Salant (eds.) Worldwide Inflation: Theory and Recent Experience. Washington, D. C.: The Brookings Institution, 1977, pp. 167-226.

Sarlo, C. A. "Role of money in the Canadian economy: Fixed versus flexible exchange rates." Canadian Journal of Economics, 12 (February, 1979), pp. 89-93.

Scarfe, B. L. "A model of the inflation cycle in a small open economy." Oxford Economic Papers, 25 (1973), pp. 125-128.

Selden, R. T. "Monetary growth and the long-run rate of inflation." American Economic Review, 65 (May, 1975), pp. 125-128.

Shinkai, Y. "A model of imported inflation." Journal of Political Economy, 81 (1973), pp. 962-971.

Solow, R. M. Price Expectations and the Behavior of the Price Level. Manchester: Manchester University Press, 1969.

Suss, E. C. "A note on reserves use under alternative exchange regime." International Monetary Fund Staff Papers, 23 (July, 1976), pp. 387-394.

Swoboda, A. K. "Gold, dollars, euro-dollars, and the world money stock under fixed exchange rates." American Economic Review, 68 (September, 1978), pp. 625-642.

_____. "Monetary approach to balance of payments theory." In E. M. Classen and P. Salin, Recent Issues in International Monetary Economics. Amsterdam: North Holland, 1976.

_____. "Monetary approach to worldwide inflation." In L. B. Krause and W. S. Salant (eds.), Worldwide Inflation: Theory and Recent Experience. Washington, D. C.: The Brookings Institution, 1977.

_____. "Monetary policy under fixed exchange rates: Effectiveness, the speed of adjustment, and proper use." Economica, 41 (May, 1973), pp. 136-154.

Trevithick, J. A. and Mulvey, C. The Economics of Inflation. New York: John Wiley and Sons, 1975.

Turnovsky, S. J. "Empirical evidence on the formation of price expectations." Journal of the American Statistical Association, 65 (1970), pp. 1441-1454.

_____ and Kaspura, A. "An analysis of imported inflation in a short-run macroeconomic model." Canadian Journal of Economics, 7 (1974), pp. 355-380.

_____ and Wachter, M. L. "A test of the 'expectations hypothesis' using directly observed wage and price expectations." Review of Economics and Statistics, 54 (1972), pp. 47-54.

United Nations. Statistical Yearbook. New York. Various issues used for data, 1961-1978.

Vanderkamp, J. "Wage adjustment, productivity, and price change expectations." Review of Economic Studies, 39 (1972), pp. 61-72.

Wanniski, J. "The case for fixed exchange rates." Wall Street Journal (June 10, 1974), p. 10.

_____. "The Mundell-Laffer Hypothesis--A new view of the world economy." Public Interest, 39 (Spring, 1975), pp. 31-52.

Weintraub, S. "The price level in the open economy." Kyklos, 20 (1977), pp. 22-37.

Whitman, M. N. "Global monetarism and the monetary approach to the balance of payments." Brookings Papers on Economic Activity, 3 (1975), pp. 491-536.

Williamson, J. "Exchange-rate flexibility and reserve use." Scandanavian Journal of Economics, 78 (1976), pp. 327-345.

Yeager, L. B. International Monetary Relations: Theory, History, and Policy. 2nd ed. New York: Harper and Row Publishers, 1976.

Zellner, A. "An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias." Journal of American Statistical Association, 57 (1962), pp. 348-368.

APPENDIXES

APPENDIX A

A LIST OF SELECTED COUNTRIES

A LIST OF SELECTED COUNTRIES

Australia
Austria
Belgium
Bolivia
Brazil
Canada
Chile
Colombia
Costa Rica
Denmark
Domican Republic
Ecuador
El Salvador
Finland
France
Germany
Greece
Guatemala
Honduras
Iceland
India
Iran
Iraq
Israel
Italy
Japan
Korea
Mexico
Netherlands
New Zealand
Norway
Peru
Phillipines
Portugal
South Africa
Spain
Switzerland
Thailand
Venezuela

APPENDIX B

METHODS OF POOLING

METHODS OF POOLING

Consider the basic model of the cross-section and time-series model

$$\frac{\dot{P}}{P_{it}} = a_0 + \sum_{k=1}^{K} \alpha_k Z_{kit} + \varepsilon_{it} \qquad (2.0.1)$$

where Z_{kit} is the set of explanatary variables in each equation and ε_{it} is the disturbance term; i = 1, 2, ... N and t = 1, 2 ... T. α_k is the parameters to be estimated and K represents the number of independent variables in that equation.

In matrix notation, it can be expressed as

$$\underset{NTx1}{P} = \underset{NTx(k+1)}{Z} \quad \underset{(k+1)x1}{\alpha} + \underset{NTx1}{\xi} \qquad (2.0.2)$$

where

$$E(\xi) = 0$$

$$E(\xi\xi') = \Omega = \sigma^2 V$$

Different specifications on the model and disturbances will lead to different restrictions on Ω. The general framework for Ω can be expressed as

$$\Omega = \begin{bmatrix} E(\varepsilon_{11}^2) & E(\varepsilon_{11}\varepsilon_{12}) & \cdots & E(\varepsilon_{11}\varepsilon_{1T}) & E(\varepsilon_{11}\varepsilon_{21}) & \cdots & E(\varepsilon_{11}\varepsilon_{NT}) \\ E(\varepsilon_{12}\varepsilon_{11}) & E(\varepsilon_{12}^2) & \cdots & E(\varepsilon_{12}\varepsilon_{1T}) & E(\varepsilon_{12}\varepsilon_{21}) & \cdots & E(\varepsilon_{12}\varepsilon_{NT}) \\ \vdots & & & \vdots & \vdots & & \vdots \\ E(\varepsilon_{1T}\varepsilon_{11}) & E(\varepsilon_{1T}\varepsilon_{12}) & \cdots & E(\varepsilon_{1T}^2) & E(\varepsilon_{1T}\varepsilon_{21}) & \cdots & E(\varepsilon_{1T}\varepsilon_{NT}) \\ \vdots & & & \vdots & \vdots & & \vdots \\ E(\varepsilon_{N1}\varepsilon_{11}) & E(\varepsilon_{N1}\varepsilon_{12}) & \cdots & E(\varepsilon_{N1}\varepsilon_{1T}) & E(\varepsilon_{N1}\varepsilon_{21}) & \cdots & E(\varepsilon_{N1}\varepsilon_{NT}) \\ E(\varepsilon_{N2}\varepsilon_{11}) & E(\varepsilon_{N2}\varepsilon_{12}) & \cdots & E(\varepsilon_{N2}\varepsilon_{1T}) & \vdots & & \vdots \\ \vdots & & & \vdots & \vdots & & \vdots \\ E(\varepsilon_{NT}\varepsilon_{11}) & E(\varepsilon_{NT}\varepsilon_{12}) & \cdots & E(\varepsilon_{NT}\varepsilon_{1T}) & E(\varepsilon_{NT}\varepsilon_{21}) & \cdots & E(\varepsilon_{NT}^2) \end{bmatrix} \qquad (2.0.3)$$

Ordinary Least Squares Regression

For a classical linear normal regression model it is assumed that the disturbance term is normally distributed with a mean zero and variance σ^2; that is

$$\varepsilon \sim N(0, \sigma^2$$

then, $$E(\varepsilon_{it}) = 0$$

$$E(\varepsilon_{it}\varepsilon_{jt'}) = \sigma^2 \quad i = j,\ t = t'$$

$$= 0 \quad \text{otherwise}$$

and $i, j = 1, 2, \ldots N;\ t, t' = 1, 2, \ldots T$

Substituting the above conditions into (2.0.3), the Ω matrix becomes

$$\Omega = \begin{bmatrix} \sigma^2 & \cdots & 0 & \sigma^2 & \cdots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ 0 & \cdots & \sigma^2 & 0 & \cdots & \sigma^2 \\ \sigma^2 & \cdots & 0 & \sigma^2 & \cdots & 0 \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ 0 & \cdots & \sigma^2 & 0 & \cdots & \sigma^2 \end{bmatrix}$$

$$= \sigma^2 \begin{bmatrix} I_T & & I_T \\ & & \\ I_T & & I_T \end{bmatrix}$$

where $I_T = \begin{bmatrix} 1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 \end{bmatrix}$ is an identity matrix with order TxT

Therefore, $V = I_T$

Different effects of cross-section and time units are not recognized. The least squares estimator of α is

$$\hat{\alpha}_{OLS} = (Z' V^{-1} Z)^{-1} Z' V^{-1} P$$
$$= (Z' Z)^{-1} Z' P$$

The Use of Instrumental Variables

Since the regression models from Equations (12) and (13) contain endogenous and lagged dependent varibles, instrumental variables are chosen in order to yield consistent estimation. (2.0.2) is then partitioned in the following form

$$P = \begin{bmatrix} Z_1 & Z_2 \end{bmatrix} \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \xi \qquad (2.1.1)$$

where matrix Z_1 contains the set of exogenous variables and Z_2 the set of endogenous and lagged dependent variables.

The instruments chosen for Z_2 is the predicted values of Z_2 ($\hat{Z}_2$) which is generated by a different set of exogenous variables chosen. The ordinary least squares regression with instrumental variables on (2.1.1) becomes

$$P = \begin{bmatrix} Z_1 & Z_2 \end{bmatrix} \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \xi$$

The least squares estimators of α_1 and α_2 are

$$\hat{\alpha}_{\substack{OLS \\ IV}} = \begin{bmatrix} \hat{\alpha}_1 \\ \hat{\alpha}_2 \end{bmatrix} = \left(\begin{bmatrix} Z_1 \\ \hat{Z}_2 \end{bmatrix} \begin{bmatrix} Z_1 & \hat{Z}_2 \end{bmatrix} \right)^{-1} \begin{bmatrix} Z_1 \\ \hat{Z}_2 \end{bmatrix} P$$

Covariance Model

Cross-section and time units effects are expressed in this model by the use of dummy variables. (2.0.2) is expressed as

$$P = Z\,\alpha + D\,\beta + \xi \qquad (2.2.1)$$

where D is a NTx(N+T-2) matrix for dummy variables. If D is partitioned into a matrix for dummy variables for countries (C) and for time (T), then

$$P = Z\,\alpha + C\,\beta + T\,\gamma + \xi \qquad (2.2.2)$$

Then C is the matrix of order NTx(N-1) and T is of order NTx(T-1). The assumptions of the model are the same as in the ordinary least squares model; that is

$$\varepsilon \sim N(0,\ \sigma^2)$$

$$E(\varepsilon_{it}) = 0$$

$$E(\varepsilon_{it}\varepsilon_{jt'}) = \sigma^2 \quad i = j,\ t = t'$$

$$= 0 \quad \text{otherwise}$$

The country and time effects are captured through a change in the intercept term and therefore, the effects are fixed. The degrees of freedom will be reduced by the number of dummy variables used (N+T-2). However, this model in fact still works within the framework of the classical linear regression model.

The least squares with dummy variables estimator of α is

$$\hat{\alpha}_{DVLS} = (Z'\,M\,Z)^{-1}\,Z'\,M\,P$$

where $$M = I - D(D'D)^{-1}D'$$

and is idempotent. With the idea of analysis of variances and covariances, $\hat{\alpha}_{DVLS}$ becomes

$$\hat{\alpha}_{DVLS} = W_{ZZ}^{-1}\,W_{ZP}$$

where $$W_{ZZ} = \sum_i \sum_t (Z_{it} - \bar{Z}_i)^2$$

$$W_{ZP} = \sum_i \sum_t (Z_{it} - \bar{Z}_i)\ (P_{it} - \bar{P}_i)$$

and $\bar{Z}_i$ and $\bar{P}_i$ are the means of Z and P, respectively.

Since there are different intercepts representing different cross-section and time units, the least squares with dummy variables estimators for the intercepts (a_0) are

$$\hat{a}_{0i}{}_{DVLS} = \bar{P}_i - \hat{\alpha}\,\bar{Z}_i$$

For more detail discussion derivation, see Maddala (1977, pp. 320-26).

Error Component Model

In the error component model, the cross-section and time effects are random. The unexplained variation due to these two effects are captured by the disturbance term. With reference to (2.0.2),

$$\varepsilon_{it} = U_i + V_t + W_{it}$$

where U_i is the cross-section error component, V_t is the time-series error component, and W_{it} is the combined error component.

$$\varepsilon_{it} \sim N(0, \sigma^2 V)$$

$$U_i \sim N(0, \sigma_u^2)$$

$$V_t \sim N(0, \sigma_v^2)$$

$$W_{it} \sim N(0, \sigma_w^2)$$

Then, $$E(\varepsilon_{it}) = E(U_i) = E(V_t) = E(W_{it}) = 0$$

$$E(U_i V_t) = E(U_i W_{it}) = E(V_t W_{it}) = 0$$

$$E(U_i U_j) = \sigma_u^2 \qquad i = j$$
$$= 0 \qquad \text{otherwise}$$

$$E(V_t V_{t'}) = \sigma_v^2 \qquad t = t'$$
$$= 0 \qquad \text{otherwise}$$

$$E(W_{it} W_{it'}) = \sigma_w^2 \qquad i = j,\ t = t'$$
$$= 0 \qquad \text{otherwise}$$

$$E(\varepsilon_{it}\varepsilon_{jt'}) = \sigma_u^2 + \sigma_v^2 + \sigma_w^2 = \sigma^2 \qquad i = j,\ t = t'$$

Substituting these results into (2.0.3), the matrix Ω becomes

$$\Omega = \begin{bmatrix} \sigma^2 & \sigma_u^2 & \sigma_v^2 & 0 & & \sigma_v^2 & 0 \\ \cdot & \cdot & \cdot & \cdot & & \cdot & \cdot \\ \sigma_u^2 & \sigma^2 & 0 & \sigma_v^2 & & 0 & \sigma_v^2 \\ & & & & & & \\ \sigma_v^2 & 0 & & & & \sigma^2 & \sigma_u^2 \\ \cdot & \cdot & & & & \cdot & \cdot \\ 0 & \sigma_v^2 & & & & \sigma_u^2 & \sigma^2 \end{bmatrix}$$

$$= \sigma^2 \begin{bmatrix} A_T & B_T & \cdots & B_T \\ B_T & A_T & & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & & \cdot & \cdot \\ \cdot & & & \cdot \\ B_T & \cdots & & A_T \end{bmatrix}$$

$$A_T = \begin{bmatrix} 1 & \cdots & \frac{\sigma_u^2}{\sigma^2} \\ \vdots & \ddots & \vdots \\ \frac{\sigma_u^2}{\sigma^2} & \cdots & 1 \end{bmatrix}_{TxT} \quad \text{and} \quad B_T = \begin{bmatrix} \frac{\sigma_v^2}{\sigma^2} & & 0 \\ & \ddots & \\ 0 & & \frac{\sigma_v^2}{\sigma^2} \end{bmatrix}_{TxT}$$

Since the elements in matrices A_T and B_T are not constant, the model is to be estimated by generalized least squares method. The variance components in the V matrix is estimated by the following methods (Kmenta, 1971, pp. 515-516):

$$\hat{\sigma}_w^2 = \frac{1}{(N-1)(T-1)} \sum_{t=1}^{N} \sum_{t=1}^{T} [e_i - \frac{1}{T} \sum_{t=1}^{T} e_{it} - \frac{1}{N} \sum_{t=1}^{N} e_{it}]^2$$

$$\hat{\sigma}_u^2 = \frac{1}{T} \{ \frac{1}{(N-1)T} [\sum_{t=1}^{T} e_{it}]^2 - \hat{\sigma}_w^2 \}$$

$$\hat{\sigma}_v^2 = \frac{1}{N} \{ \frac{1}{(T-1)N} [\sum_{t=1}^{T} e_i]^2 - \hat{\sigma}_w^2 \}$$

and e_{it} is the residuals obtained by using ordinary least squares to the pooled data. Instead of estimating (N-1) + (T-1) parameters, only two parameters (σ_u^2 and σ_v^2) are estimated. Therefore, the method saves (N+T-2-2) degrees of freedom.

The generalized least square estimator of α is

$$\hat{\alpha}_{GLS} = (Z' \hat{\Omega}^{-1} Z)^{-1} Z' \hat{\Omega}^{-1} P$$

Cross-sectionally Correlated and Time-wise Autoregressive Model

The specifications of this model are that the disturbances are heteroskedastic with contemporaneous correlation and serial correlation; that is

$$E(\varepsilon_{it}) = \sigma_{ii} \qquad \text{(heteroskedasticity)}$$

$$E(\varepsilon_i \varepsilon_j) = \sigma_{ij} \qquad \text{(contemporaneous correlation)}$$

$$\varepsilon_{it} = \rho_i \varepsilon_{i,t-1} + u_t \qquad \text{(autoregression)}$$

where $u_{it} \sim N(0, \phi_{ii})$

$$E(u_{it}) = 0$$

$$E(u_{it}u_{jt'}) = \phi_{ij} \qquad t = t'$$

$$= 0 \qquad \text{otherwise}$$

It is further assumed that the initial values of ε are

$$\varepsilon_{i0} \sim N\left(0, \frac{\phi_{ii}}{1-\rho^2}\right)$$

$$E(\varepsilon_{i0}\, \varepsilon_{j0}) = \frac{\phi_{ij}}{1-\rho_i\rho_j}$$

Substituting the above properties into (2.0.3), the Ω matrix becomes

$$\Omega = \begin{bmatrix} \sigma_{11}H_{11} & \sigma_{12}H_{12} & \cdots & \sigma_{1N}H_{1N} \\ \sigma_{21}H_{21} & \sigma_{22}H_{22} & \cdots & \sigma_{2N}H_{2N} \\ \vdots & & & \vdots \\ \sigma_{N1}H_{N1} & \sigma_{N2}H_{82} & \cdots & \sigma_{NN}H_{NN} \end{bmatrix}$$

where

$$H = \begin{bmatrix} 1 & \rho_j & \rho_j^2 & \cdots & \rho_j^{T-1} \\ \rho_i & 1 & & & \rho_j^{T-2} \\ \rho_i^2 & & 1 & & \vdots \\ \vdots & & & \ddots & \vdots \\ \rho_i^{T-1} & & \cdots & & 1 \end{bmatrix}$$

Ordinary least squares method is first applied to the pooled data to obtain an estimate of $\varepsilon_{it}(e_{it})$ which is to be used to calculate ρ_i according to

$$\hat{\rho}_i = \frac{\sum_t e_{it} e_{i,t-1}}{\sum_t e_{i,t-1}^2} \qquad t = 2, 3, \ldots T$$

Then, (2.0.2) is transformed to

$$P_{it}^* = Z_i^* \alpha + u_{it}^*$$

where $P_{it}^* = P_{it} - \hat{\rho}_i P_{i,t-1}$

$$Z_{it}^* = Z_{it} - \hat{\rho}_i Z_{i,t-1}$$

$$u_{it}^* = \varepsilon_{it} - \hat{\rho}_i \varepsilon_{i,t-1}$$

$$t = 2, 3, \ldots, T$$

$$i = 1, 2, \ldots, N$$

and ordinary least squares regression is applied to the transformed equation and the residual $\hat{u}^*$ is obtained. Then the variance $(\hat{\sigma}_{ij})$ is estimated by

$$\hat{\sigma}_{ij} = \frac{\phi_{ij}}{1 - \rho_i \rho_j}$$

where $$\hat{\phi}_{ij} = \frac{1}{T - K - 1} \sum_{t=2}^{T} \hat{u}_{it}^* \hat{u}_{jt}^*$$

Consistent estimation is obtained for $\hat{\rho}_i$ and $\hat{\sigma}_{ij}$ which are used to estimate Ω.

The generalized least squares estimator of α is

$$\hat{\alpha}_{GLS} = (Z' \hat{\Omega}^{-1} Z)\, Z' \hat{\Omega}^{-1} P$$

For simplicity, $\hat{\alpha}_{GLS}$ can be obtained directly from

$$\hat{\alpha}_{GLS} = (Z'^* \hat{\Phi}^{-1} Z^*)^{-1} Z^* \hat{\Phi}^{-1} P^*$$

where

$$\hat{\Phi} = \begin{bmatrix} I_{T-1} & I_{T-1} & \cdots & I_{T-1} \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ \cdot & & & \cdot \\ I_{T-1} & & & I_{T-1} \end{bmatrix}$$

and I_{T-1} is an identity matrix with order T-1.

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Candidate for the Degree of

Doctor of Philosophy

Thesis: MONEY AND IMPORTED INFLATION: AN EMPIRICAL STUDY

Major Field: Economics

Biographical:

Personal Data: Born in Hong Kong, February 12, 1952, the daughter of Mr. and Mrs. S. C. Ng.

Education: Received Bachelor of Science degree in Economics and Business Administration from Northwestern Oklahoma State University in May, 1975; received Master of Science degree in Economics from Oklahoma State University in May, 1977; enrolled in doctoral program at Oklahoma State University, 1977-1980; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in December, 1980.

Professional Experience: Graduate teaching assistant, Department of Economics, Oklahoma State University, 1975-1979; research assistant, Department of Business and Economic Research, Oklahoma State University, 1979-1980.

Professional Memberships: Omicron Delta Epsilon, American Economic Association, Southern Economic Association.