THE REAL EFFECTS OF FREQUENT DEVALUATIONS IN DEVELOPING COUNTRIES

By

AKIN SAKIR TALUY

Diploma
The Faculty of Political Sciences
Ankara University
Ankara, Turkey
1970

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1975

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Thesis Approved

Gerald M. Lage
Thesis Adviser

Frank J. Steindl

Richard H. Leftwich

Daryll E. Ray

Norman N. Durham
Dean of the Graduate College

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CHAPTER I

INTRODUCTION

Balance of payments adjustment problems have attracted many economists' attention since the end of the Mercantilist period; but not until the depression decade of the 1930's did the balance of payments and the foreign exchange rate become a national and international policy issue. According to Viner (1937, pp. 1-118), the Mercantilist writers were obsessed with a balance of payments surplus. But, they did not have a coherent theory on how a balance of payments surplus would affect an economy. However, Viner's study shows that some mercantilist writers were aware of the effects of balance of payments disequilibrium on the price level, but "they failed to incorporate it as an integral part of their foreign trade doctrine."[1]

Classical economists viewed the adjustment process to a disequilibrium in the balance of payments as an automatic mechanism. In the classical adjustment process the prominent role was played by changes in the quantity of money. Classical economists overlooked the effects of the balance of payments adjustment mechanism on the levels of output and employment. The emergence of the Keynesian approach to the balance of payments was a reaction to the automatic adjustment mechanism advocated by the classical economists.

Starting with the models which incorporated less than full employment conditions and downwardly rigid prices, Keynesians showed that the adjustment to the balance of payments would involve an adjustment in income and employment. They claimed that the automatic adjustment process may be too costly to follow in the short run; therefore, a balance of payments policy was necessary. Viner explains the postwar Keynesian position as follows:

> In the modern models expounding the theory of exchanges, it is assumed that governments determine the exchange rates, and the problem as posited is as to the manner and degree in which a disequilibrium in the balance of payments resulting, for example, from a relative difference in degree of inflation can be corrected by changes in exchange rates. In these models, national money incomes and price levels in terms of each country's own currency are held constant, and the sole factor recognized as playing an equilibrating role is changes in exchange rates.[2]

Keynesians put emphasis on a national domestic goal of a high and stable rate of employment. In the long run models of the classical economists unemployment was not a problem. Viner (1952) points out that the classical economists,

> ...neglected the short run phases of economic process and economic policy, and especially cyclical instabilities of employment and income, at times even to the extent of completely ignoring them or denying to them any valid claims to recognition or any genuine existence...During the great depression of the 1930s, some economists continued blindly and stubbornly to apply long run equilibrium analysis to a prevailing situation of which mass unemployment of major and growing proportions was the most

conspicuous feature.[3]

Achievement of the international equilibrium was reduced to a level of secondary importance relative to the achievement of the employment level in the post depression period. The trade-off between international equilibrium and employment was emphasized by Metzler as follows:

> In the modern view, a country with a deficit in its balance of payments is likely to eliminate this deficit, in part at least, through a low level of income and employment. The conflict between domestic stability and international disequilibrium, which has long been a familiar part of classical monetary theory, is thus shown to be much more important than had formerly supposed. In an unstable world, the choice confronting an individual country is not merely between price stability and international equilibrium, as envisaged by the classical theory, but between stability of employment and international equilibrium.[4]

The automatic adjustment mechanism was replaced by an adjustable peg system in 1944. The adjustable peg system was perceived as a tool to bring order to international trade. At the same time, it would be instrumental in achieving the national domestic goal of full employment. By pegging their currencies, countries would insulate themselves from the "Begger-Thy-Neighbour" policies of the other countries. Actual, but infrequent devaluations would be used to achieve the elimination of fundamental disequilibrium in the balance of payments, which otherwise would require deflationary policies. Between 1944 and 1971, deficit countries, especially the LDC's, tried to avoid devaluations by resorting to second best measures such as tariffs, export subsidies and multiple exchange rates to alleviate their balance of payments problems.

During the Bretton Woods era, LDC's along with other countries pegged their currencies indirectly to gold. At the same time exchange rate policies in LDC's were assigned other objectives, such as fostering industrialization and improving the terms of trade, besides their proper function which should be the clearance of the foreign exchange market. The reluctance of LDCs' governments to devalue their currencies in the Bretton Woods era, even under the conditions of fundamental disequilibrium in their balance of payments, forced them to adopt second best policies which, in turn, disturbed the resource allocation in these countries and proved to be ineffective in solving their balance of payments problems in the long run.

Due to the exchange controls, tariffs, overvalued currencies, and so on, domestic relative prices were distorted. Price distortions affected the supply side of the economies by causing misallocation of resources in favor of excessive production of high-cost import substitutes, insufficient production of low-cost exports, distorted consumption patterns, and excessive production of nontraded goods relative to tradeable goods production (Krueger, 1969).

Overvalued currencies, coupled with persistent inflationary policies pursued by the governments, insulated the LDC markets from outside competition by "weakening and even destroying the incentives necessary for improving quality of output and lowering cost under the private enterprise system".[5] Price distortions created by the policies of LDC governments resulted in high imported capital intensity in production and made the relatively abundant factor of production, which is labor, relatively more expensive. As a result, achievement of high employment levels in LDC's were obstructed by the very policies of their governments.

Implementation of economically inappropriate policies and their repercussions during the Bretton Woods period left LDC's with fundamental disequilibrium in their balances of payments at the time leading currencies started floating in 1973.

Large payments deficits inherited during the Bretton Woods period, floating exchange rates among the key currencies, and shifting policy emphasis from import substitution to export promotion required LDC governments to adopt more flexible exchange rate policies in the second half of the 1970's in order to alleviate their chronic balance of payments problems (Diaz-Alejandro, 1975; Bautista, 1981).

Chronic inflations and balances of payments problems in LDC's require their governments to adopt some kind of managed exchange rate policy. Managed flexibility in the foreign exchange rate, if it is used to minimize real exchange rate variations, can be instrumental in countering the adverse real effects of inflation. In fact, a managed flexibility is the most suitable policy alternative for LDC's. The other options are either to adopt a flexible exchange rate policy or to continue with a fixed exchange rate policy. The adverse resource allocation effects of a fixed exchange rate policy are discussed in some detail in Chapter IV. A flexible exchange rate policy, on the other hand, is not a viable alternative for LDC's where foreign exchange markets do not exist. Managed flexibility of foreign exchange rates is expected to improve their balances of payments and hopefully result in dismantlement of the distortionary measures adopted in the past.

Besides these static benefits, frequent devaluations may allow the investors to reap dynamic benefits if investors in these countries are made to believe that devaluations will not be carried out on a "once-for-all" basis and governments will not resort to distortionary measures in the future. Managed flexibility in foreign exchange rates may also affect investments in LDC's by reducing their reliance on imported capital and by giving investors incentives to adopt technologies that are suitable to their economies and also by increasing the availability of foreign capital.

In this study, the microeconomic implications of more flexible exchange rate policies adopted by less developed countries since 1973 for their adjustment problems are analyzed in a general equilibrium framework. The real effects of frequent devaluations in the Turkish economy are simulated in a recursive linear programming model.

Turkey pursued fixed exchange rate policies during the 1946-1977 period. Until the 1980's the Turkish lira had been overvalued. The government tried to counter the detorioration of the balance of payments by adopting the second best policies during the 1946-1958 period. De facto devaluation of the lira by almost 300% in 1958 set the official rate in 1960. After a short respite following the devaluation, the balance of payments difficulties continued until 1970 when the lira was devalued by 66 per-cent. The devaluation was followed by the improvement in the balance of payments. However, the rising oil prices and stagnation of the world economic activity after 1974 led Turkey into balance of payments difficulties once again. From 1978 on, adjustments in the foreign exchange rate became more frequent. The foreign exchange rate was adjusted in 1978 and in 1979. In the 1980's Turkey started to devalue its currency according to market conditions.

The balance of payment difficulties of Turkey reflect the rapid industrialization that has taken place in the country. In the 1960's and 1970's the growth of exports did not keep pace with the growth of imports. The growth rate of per capita gross national product averaged 4.1% during the 1960-1970 period. The growth rate of exports during the 1960-1970 period was 1.6% and dropped to 0.8% in the 1970's. During the 1974-1977 period the growth rate of imports was four times the growth rate of exports.

In 1972 Turkey had a population of 36.347 million.

Agriculture employed 65.7% of the total labor force of 13.349 million. With respect to the levels of employment, Services was the second largest sector and Manufacturing was the third with employment shares of 11.9% and 10.4%, respectively. However, the ranking of the industries differed with respect to the shares of the industries in total output. Manufacturing accounted for 33% of total output in 1972, while Agriculture's share was 23.5% in the same year. Despite the significant contribution of Manufacturing to total output, the value of exports from Manufacturing was a distant second to the value of agricultural exports. Imbalanced shares of Manufacturing in total output and in the value of total exports reflect the import competing character of the Turkish manufacturing sector. The import substituting nature of the manufacturing sector is also detected whenever the composition of imports is considered. In 1972, 56.6% of the value of total imports were noncompetitive imports. The second largest component of the value of total imports was manufacturing imports.

In fact, import substitution has been encouraged in Turkey since the 1950's. The ad hoc measures adopted by the government to alleviate the balance of payments difficulties led to import substitution in the economy by distorting relative prices in favor of importable goods. During the 1960's and 1970's import substitution was encouraged systematically by the Turkish government. Overvalued currency was one of the major contributors to this policy. At the same time, the export industries were affected adversely by infrequent devaluations and by other measures such as a multiple exchange rate system unfavorable to exports and tariffs.

In this study, the sectoral level impacts of frequent devaluations are studied in a general equilibrium framework. Most of the studies in the literature focus on the effects of devaluations in the isolated markets by utilizing partial equilibrium analyses. The main interest of these studies is to estimate the output response to devaluations in some of the tradeable goods markets. The macroeconomic studies, on the other hand, are not disaggregated enough to derive conclusions about the sectoral level impacts of devaluations. This study differs from the earlier ones. The effects of devaluations on the sectoral activity levels and resource allocation are studied under the assumption that the nominal devaluations do lead to real devaluations, and that an economy can be represented by a linear programming model.

The subsequent chapters of this study cover the following topics. Chapter II reviews the literature. The chapter also presents the theoretical analysis of the exchange rate reallignments. Chapter III presents the alternative approaches to the balance of payments geometrically. Chapter IV examines the real effects of devaluations in some detail by utilizing partial and general equilibrium analyses. Chapter V outlines the recursive linear programming model that is used to simulate the real effects of the frequent devaluations. The chapter then lists the findings of the study. Chapter VI provides a brief summary of and conclusions for the study.

ENDNOTES

[1]Jacob Viner, <u>Studies in the Theory of International Trade</u>, New York, Harper, 1937. p.41.

[2]Jacob Viner, <u>International Trade and Economic Development</u>, Glencoe, The Free Press, 1952. p.45.

[3]Ibid., pp.18-19

[4]Lloyd A. Metzler, "The Theory of International Trade", Howard S. Ellis Ed., <u>A Survey of Contemporary Economics</u>, Philedelphia, Blakiston, 1948. p.212.

[5]Harry G. Johnson, "Policy Obstacles to Trade and Development", <u>Economic Policies Toward the Less Developed Countries</u>, The Brookings Institution, Washigtom, D.C., 1967. p. 62.

CHAPTER II

REVIEW OF LITERATURE

During the gold standard period, classical economists contended that disequilibria in the balance of payments would be self-correcting. Hume's price-specie-flow mechanism would guarantee the achievement of the balance of payments equilibrium. Classical economists emphasized the monetary nature of the international adjustment mechanism. The only effect of an international adjustment mechanism would be on prices.

The price-specie-flow mechanism can be explained by a two-country, two-good model. For simplicity, assume that each country specializes in the production of one good. From the viewpoint of each country, goods are either exportables or importables. The relative price of the goods gives the terms of trade. Now assume an increase in the money supply in one of the countries. This increase in the money supply increases the price of the exported good in the country. Therefore, the terms of trade change. Demand for the country's exports falls while demand for imports in the country increases. The result is a balance of trade deficit. This deficit causes the money supply in the inflating country to fall and the money supply in the other country to increase. This increase in the money supply in the other country increases the price of its exports. The adjustment process continues until the relative price of the goods reaches its original level. In the process, prices of both goods (in the absence of transportation costs) increase by the same proportion as the initial increase in the world money supply.

In summary, in the classical model of the adjustment mechanism, money plays the central role. The classical theory contains an explicit acceptance of the quantity theory of money as well as an implied assumption that output and employment are unaffected by international disturbances.

A new theory of the balance of payments adjustment mechanism, which is usually referred to in the literature as the standard model, (Johnson, 1972, 1977; Isard, 1978) emerged in the postdepression era. These models are the product of the Keynesian macro models and reflect the characteristics of the time period in which they were built.

In contrast to the assumptions of the classical model, Keynesians build their models on the assumptions of wage and price rigidity and the existence of less than full employment equilibrium. Under these assumptions, the Keynesian models (Polak, 1953; Harberger, 1950; Laursen and Metzler, 1950) incorporate the neo-Marshallian elasticities approach to the balance of payments equilibrium and the Keynesian income determination model. The models put emphasis on the balance of trade. Consideration of the monetary repercussions of external disequilibrium on the international adjustment mechanism is avoided by assuming that these repercussions are sterilized by the monetary authorities. The effects of a successful devaluation are divided into the initial (or impact) effect and the income effect. The initial effect refers to the effect of devaluation on relative prices. The income effect is related to the changes in real income and employment.

The impact effect is analyzed with the help of the neo-Marshallian elasticities approach. In two-country, two-good models, perfectly elastic supplies and initially balanced trade are two of the conditions to be satisfied for a successful devaluation. Another condition requires the sum of the price elasticities of demand for the devaluing country's exports and imports to be greater than one. If these conditions are satisfied, the change in the relative price of traded and domestic goods triggers the substitution effects in consumption and production. The end result is an improvement in the trade account which, in turn, affects the levels of income and employment through the multiplier process. The increase in income dampens the initial improvement in the trade balance, but the overall effect of devaluation on the trade balance remains positive.

The effects of devaluation on the trade balance and on income can be explained in a two-country, two-good model. Assume that each country specializes in the production of one good, that the level of output in each country is demand determined, and that the composition of spending is affected by the relative price of two goods. The trade balance equation of a country can be written as follows (Dornbusch,1980):

$$T= M^*(p) - pM(p,Y) \tag{1}$$

M^* : Foreign demand for domestically produced goods.

M : Domestic demand for imports.

$p= eP^*/P$: The terms of trade.

e : Number of domestic currency units per unit of foreign currency.

Y : The level of income.

The impact effect of devaluation on the trade balance can be obtained by differentiating equation 1 with respect to the terms of trade.

$$\partial T/\partial p = \partial M^*/\partial p - M - p\,(\partial M/\partial p) \tag{2}$$

If the trade account is initially balanced, equation 2 becomes,

$$\partial T/\partial p = M(a^* + a -1) \tag{3}$$

where a^* and a are the price elasticities of demand for the devaluing country's exports and imports. Equation 3 requires the sum of these elasticities to be greater than one in order for a devaluation to have a favorable impact effect on the trade balance.

The income effect of a devaluation can be derived from the equilibrium condition in the goods market. This condition requires aggregate spending to be equal to income and can be expressed as follows:

$$Y = E(Y) + T(p, Y) \tag{4}$$

E : Domestic residents' demand for home goods.

Total differentiation of equation 4 gives the impact effect of devaluation.

$$dY = [\ M^*(a^* + a - 1)/s + m\ ]\ (de/e) \tag{5}$$

where m and s are the marginal propensities to import and save, respectively.

Equation 5 indicates that income increases by a multiple of the initial improvement in the balance of trade as a result of a devaluation. This increase in income, however, dampens the initial improvement in the balance of trade as the higher level of income induces a higher volume of imports:

$$dT = M^*(a^* + a - 1)\ (de/e) - mdY. \tag{6}$$

After substituting 5 in 6 and arranging the terms

$$dT = (s/s + m)\ [\ M^*(a^* + a - 1)\ de/e\ ]. \tag{7}$$

The final improvement in the trade balance is smaller than the improvement achieved as a result of the impact effect of devaluation.

Thus, according to the Keynesian model, a devaluation is an effective tool to improve the trade balance. It also affects the real aggregates in the devaluing country.

Under less than full employment condition, this conclusion was acceptable for the economists. But controversy evolved on the effectiveness of devaluation in correcting the balance of trade disequilibrium and on the way the adjustment mechanism was initiated under full employment conditions. A more traditional approach promoted by Machlup (1955) claims that a devaluation, by changing the relative domestic price in a devaluing country, improves the trade balance. This improvement results from substitution that takes place in consumption and production in response to the change in the relative price brought about by a devaluation. The absorptionists, led by Alexander (1959), on the other hand, claim that in a full employment economy improvement in the trade balance requires a reduction in absorption.

Alexander starts with the national income identity Y = C + I + (X-M) (Y:national income, C:consumption, I:domestic investment, X:exports, M:imports). After rearranging the terms, the identity is written as, X-M = Y - (C + I). He calls C + I absorption, A. Thus the identity can be written as B = Y - A, where B is the trade balance, or in differece terms, $\Delta B = \Delta Y - \Delta A$. Therefore, for an improvement in the balance of trade, a devaluation must either increase real income or decrease the level of absorption. Since under full employment conditions real income cannot be increased, a successful devaluation must decrease the absorption in the economy. A reduction in absorption can be achieved if the central bank does not expand the money supply to replenish the reduced real cash balances after a devaluation. On the other hand, a devaluation fails to improve the trade balance if the money supply increases to the extent that the general price level in the economy increases in proportion to the rate of the devaluation.

The monetary approach to the balance of payments (Kemp, 1970; Johnson, 1972, 1977; Isard, 1978; Kreinin and Officer, 1978) is a reaction to standard Keynesian models. Monetarist models are built on certain assumptions. In the models it is assumed that the elasticities of substitution among the industrial products are such that "the law of one price " rules in the world markets. The assumption implies that a devaluing country cannot alter the relative price of domestic goods and their foreign counterparts. Monetarists also assume price flexibility in their models. Therefore, countries tend toward full emloyment. According to monetarists the monetary repercussions of the balance of payments cannot be absorbed by the monetary authorities. Finally, the supply of national currencies and other assets must be equal to the demand for these assets in order to reach an equilibrium in an open economy.

Under these assumptions, a devaluation is effective in improving the balance of payments of an economy in the short-run by altering the level of the domestic currency prices of traded goods relative to the prices of the nontraded goods in proportion to the rate of the devaluation. However, price competitiveness of domestic producers of traded goods is not affected. An increase in the domestic currency prices of the tradeables lowers the level of real cash balances in the economy. Residents react to this situation by increasing their demand for nominal money balances. If this increase in the demand for nominal money balances is not met by an increase in domestic credit, the excess demand for nominal balances will be met by a reserve inflow through a balance of payments surplus. According to Dornbusch (1974), the balance of payments surplus results from substitution in consumption and production that takes place after a devaluation. In the short-run a decrease in the level of real balances pursuant to a devaluation affects the prices of the nontraded goods. Excess demand for money reduces the level of real expenditures relative to real income. This results in an excess supply in the nontraded goods market. As a result, the relative price of nontraded goods is further reduced until short-run equilibrium is achieved. This change in the relative price encourages consumers to substitute nontraded goods for traded goods while resources shift into now relatively higher priced tradeable goods production. The changes in the production and consumption patterns result in a surplus in the balance of trade. The surplus continues until real expenditures in the economy return to their initial level. The balance of payments surplus represents a stock adjustment in the money market and disappears at the time money market equilibrium is achieved. At the time when money market equilibrium is reached following the devaluation, domestic prices of nontradeables increase at the same rate as prices of tradeables.

The relative price effect of devaluation can be shown by utilizing the one-good, two-country monetary model built by Dornbusch (1980). The model assumes that the world money supply is fixed, and that relative prices cannot be changed. Equilibrium in goods market in such a world requires,

$$Y + Y^* = (1/P)(VH + V^*eH^*). \tag{8}$$

Y, Y^* :Output in home and foreign country.

V, V^* :Expenditure velocity in each country.

H, H^* :Nominal money balances in each country.

P :Price level in domestic currency of home country,

$P = eP^*$, P^* and e denote the price level in terms of foreign currency and the foreign exchange rate, respectively.

The equilibrium price level implied by equation 8 is

$$P = (VH + V^*eH^*)/\ Y + Y^*. \tag{9}$$

In such a one good world, a devaluation affects the relative price of two monies. The general price level in the devaluing country changes in proportion to the rate of the devaluation. The increase in the price level is determined as follows:

$$dP/P = [\ eV^*H^*/P(Y + Y^*)]\ de/e. \qquad (10)$$

The increase in the domestic price level is proportional to the rate of the devaluation if the devaluing country is small. Under the aforementioned assumptions Johnson (1972) builds a monetary equilibrium model for a single country in which the supply of money is assumed to be adjusted to the demand for money. The adjustment is achieved through the transactions between the domestic residents and the residents of rest of the world.

Johnson's model contains the money market equilibrium:

$$M^d = pf(\ y,\ i\ ) \qquad (11)$$

$$M^s = R + D \qquad (12)$$

$$M^s = M^d \qquad (13)$$

$$R = M^d - D. \qquad (14)$$

Equation 11 defines a stable demand for money which is a function of real income, y, and the interest rate, i. The symbol, p, denotes the price level. Equation 12 specifies the money supply in terms of its components; domestic credit, D, and the net holdings of foreign reserves, R. Equation 13 is the money market equilibrium. Equation 14 indicates that the money supply, through its foreign component, instantaneously adjusts to the demand for money. In other words, any discrepancy between the desired money balances and the domestic component of the money supply is made up by the foreign component of the money supply. Equation 14 implies that the foreign component of money can be predicted if the demand for money is a stable function of some variables, and the level of domestic credit is known. In terms of the growth rates of the aggregates, equation 14 is written as:

$$g_R = (1/R)\ B(t) = (M^d/R)g_{M^d} - (D/R)g_D \qquad (15)$$

or

$$g_R = (1/r)\ (g_p + n_y g_y + n_i g_i) - (1\text{-}r/r)g_D. \qquad (16)$$

r=R/M : The initial international reserve ratio.

g : The growth rates of the variables indicated by the subscripts.

B(t) : The current overall balance of payments.

n_y : The income elasticity of demand for money.

n_i : The interest elasticity of demand for money.

Under the assumption that the interest rate, the price level, and the level of income are constant, equation 16 implies a proportional inverse relation between the balance of payments and the rate of domestic credit expansion. He applies this model to devaluation by including the foreign exchange rate in the model. His equation becomes:

$$g_R = (1/r)(g_e + g_{pf} + n_y g_y + n_i g_i) - (1-r/r)g_D. \qquad (17)$$

He concludes that a devaluation is equivalent to a domestic credit contraction, that any transitory effect of a devaluation on the balance of payments may be offset by the changes in the growth rates of the other variables, and that an improvement in the balance of payments is not related to the level but to the rate of change, of the foreign exchange rate.

In summary, according to the monetarist approach to the balance of payments, a devaluation affects neither real aggregates nor the balance of payments in the long-run. Keynesian models, however, predict that devaluations, by changing the relative prices, cause an improvement in the balance of trade and change the levels of real aggregates of the devaluing country. The differences in the predictions of the alternative models result from the assumptions underlying each model. Monetarist models are claimed to be the long-run equilibrium models, while Keynesian models are associated with the short-run. Empirical work on the validity of the predictions and the assumptions of each model is limited in number. Most of the empirical work is devoted to examining the effects of devaluations in certain isolated markets. The rest of the chapter provides a brief review of empirical work on the topic.

Empirical Studies on the Relative Price Effects of Devaluations

In the Keynesian models, the success of the devaluations is tied to the realization of the impact effect. In order to have an impact effect, however, nominal devaluations must lead to real effective devaluations. Empirical studies show that nominal devaluations, in fact, result in real effective devaluations.

Halevi (1972) estimates the elasticity of exports with respect to devaluations in Israel. He defines the real exchange rate as the ratio of the index of foreign prices of Israel's exports in terms of domestic currency to an index of domestic prices. The ratio approximates the rate of real devaluation. In the study, value added in manufacturing is related to the computed index and to the fixed capital stock in manufacturing export industries. His regression results show that the elasticity of manufacturing exports with respect to the devaluation ranges from .87 to 1.6 for different specifications of the model.

Houthakker and Magee (1969) calculate the income and price elasticities of exports and imports in the industrial countries for the period 1951-1966. In the import equations the relative price is represented by the ratio of import and wholesale price indices. In the export equations the ratio of a country's export price index to an index of export prices of the rest of the world is used as a relative price. They estimate the sum of the price elasticities of exports and imports for most of the countries to be greater than unity.

Nelson, Schultz and Slighton (1971) relate the volume of Colombian exports to the real effective exchange rate, volume of total world exports, and to dummy variables that capture quarterly variations in the volume of exports. For the period 1960-1967, they estimate the price elasticities of agricultural exports other than coffee, non-agricultural exports other than petroleum, and all other exports as 1.06, .77, .72, respectively. Their study also shows no relation between the real exchange rate and the general price level in Colombia. The same result is obtained for the relation between the real exchange rate and the wage rate.

Michaely (1975) examines the effects of the devaluations that took place in Israel in the 1950's and 1960's. According to Michaely, the 1952-1954 devaluations in Israel were successful in altering the effective real exchange rate. His study shows that the increase in the domestic prices was far below the increase in tradeable goods prices. He observes that by 1954 the increase in the domestic price level over its predevaluation level was one-fourth of the increase in the rate of foreign exchange after the devaluations, and it was not until 1970 that the increase in domestic prices was equal to the increase in the foreign exchange rate. However, according to Michaely, adjustment of domestic prices to later devaluations was more rapid, but the adjustment lag was no less than three years. In order to trace the effects of the devaluations on the export and import volumes, he compares the computed volumes of exports and imports in the absence of the devaluations with the actual volumes observed after the devaluations. The computed values are obtained under the assumption that exports and imports are proportional to GNP. Deviations of the actual values from the computed values are attributed to the relative price effect of devaluations. His analysis shows that both exports and imports are affected in the right directions by the devaluations.

Leith (1974) looks at the short-term and medium-term effects of the 1967 devaluation that took place in Ghana. He observes that, following the devaluation, the weighted average price increase for all exported commodities amounted to 43% of the gross devaluation in 1967 compared to its value in the period prior to the devaluation. On the import side, 55% of the gross devaluation is transmitted to the domestic retail prices of imports within six months. In order to trace the medium-term effects of the devaluation, he estimates a log linear equation with three dummy variables. Dummy variables are supposed to capture the effects of the devaluation on noncocoa exports. However, estimated coefficients of dummy variables do not indicate any relation between the devaluation and noncocoa exports. He attributes this insensitivity of noncocoa exports partly to British devaluation that took place in 1967, and partly to the government's expansionary policies after the devaluation. His studies also fail to show a significant relation between the import volume and the devaluation.

Khan (1975) estimates import demand functions for nine groups of commodities in Venezuela. He regresses the quantity of imports of each commodity group on the income level and relative prices. The relative price for each group is represented by the ratio of import to domestic prices. Except for two groups of commodities, the price elasticities of demand for imports range between 5.98 and .765.

Askari, Bizien, and Hossein (1973) analyze the effects of the devaluations that took place in developing countries during the period 1957-1967 on exports, imports, and on the trade balances. They find that exports are more responsive to devaluations than imports. Exports in agricultural economies (they approximate the markets where price elasticity of exports are low) respond to the devaluations much faster than the exports of industrial countries. Their study shows no systematic relation between the effectiveness of a devaluation and the level of unemployment.

Donovan (1981) analyzes the effects of eleven devaluations that took place in developing countries between 1970-1976 on the volumes of exports and imports the rates of inflation and growth in these countries. He looks at the countries' performance in the year immediately following the devaluation (short-run) and in three years after the devaluation. The comparison of the export volumes in the year prior to the devaluation with the export volumes in the year following the devaluation indicates that devaluations were effective in increasing the volume of exports in six out of eleven cases. In the long-run, however, eight out of eleven countries experience export volume growth. The average real growth rate of exports originating from the countries increases by 11% and exceeds the average growth rate of world exports in the same period. The effects of the devaluations on the import volumes vary from country to country. For the entire group the growth rate of the volume of imports is slightly higher than the growth rate experienced prior to the devaluations. Inspite of this increase in imports, however, the real component of the trade balance for the group improves. Despite the fact that the average inflation rate for the group is higher after the devaluations, in six cases the real effective exchange rates do not return to their predevaluation levels. In five cases depreciations of the real exchange rates erode very rapidly. The countries experience higher growth rates in the short-run. The data indicates no negative effect on the growth rates in the medium-run.

Cooper (1971) studies twenty-four devaluations involving nineteen countries. The emphasis in the study is on the impact effect of the devaluations studied, i.e. the effects of the devaluations within a year. He observes that in fifteen cases balance of trade improves and in sixteen cases the monetary balances (the changes in net international reserves) are positive. The volume of exports increases in nineteen cases and the volume of imports decreases in fourteen cases. He concludes that the devaluations have a corrective influence on the trade balances. His study shows that the devaluations do lead to wage and price increases but these increases lag behind the rates of devaluations.

Bhagwati and Srinivasan (1975) estimate the impact of the 1966 devaluation on India's exports. They relate main exports to supply and demand conditions in the domestic markets. In order to capture the impact of the devaluation on exports, they include a dummy variable which takes the value of zero in the years prior to the devaluation and one in the years following the devaluation. They estimate regression equations for sub-groups of nontraditional exports and traditional exports. They find significant coefficients for dummy variables in the nontraditional export equations. For traditional exports the coefficients of dummy variables are not significant. They attribute the rather poor showing of devaluation variables to the economic conditions that prevailed at the time of the devaluation. According to the authors, droughts in 1966 and 1967 and the demand-reducing policies of the Indian government right after the devaluation were largely responsible for the limited supply response in the export markets. The authors use the Eckaus-Parikh intertemporal maximization model in order to see the effects of the changes in export performance on the overall economy. The Eckaus-Parikh model is a planning model in which international trade is tied to the other real variables of the system. Exports are treated exogeneously in the model.

The model is used to trace the effects of a higher level of exports. The simulation results of the model show that a higher export volume increases the level of economic activity. The model could have been used to trace the economy-wide effects of the 1966 devaluations had the volume of exports been affected significantly by the devaluation. Since the exports did not respond significantly to the devaluation, the general equilibrium analysis does not give information about the economy-wide effects of the devaluation.

Empirical Studies on the Economy-Wide Effects of Devaluations

The studies that are reviewed so far attempt to capture the impact effect of devaluations. Each study uses a partial equilibrium model and focuses on the effects of devaluations, ceteris paribus. The general equilibrium analysis is needed to estimate the total effects of devaluations in devaluing countries. In order to estimate the total effect of a devaluation, the impact effect that is calculated in a partial framework should be fed into a macroeconometric model or into a sectoral level planning model. In a sectoral level planning model, such as the Eckaus-Parikh model, the optimal adjustment mechanism defined by the objective function and the constraints determine the economy-wide effects of a devaluation. In macroeconometric models the total effects of devaluations are determined by feeding the impact effect of devaluations into the models in which the international sector is tied to the other sectors of an economy with behavioral equations and identities. Some of the general equilibrium models are reviewed here.

Bautista (1973) builds a macroeconomic model for the Philippine economy. The model combines the balance of trade equation with other structural equations of the economy. He estimates the structural equations for employment, output, capital stock, general price level, wage rate, and investment. Exports in the model are related to the price of exports and to the previous year's export volume. Import prices affect the general price level directly which, in turn, affects the economy. A devaluation exerts influence in the economy via the level of exports and import prices. Export volume is determined through its price elasticity. The ordinary least squares method is utilized to estimate the structural equations. Bautista then simulates the estimated model for the assumed values of the exchange rate and the export price elasticity. The results indicate that output and employment increase in the first three years following a devaluation. In the fourth year, however, they start to decrease as the wage rate becomes higher.

An econometric model for Colombia is built by Marwah (1969) to analyze the direct and indirect effects of a devaluation. He uses data for the 1951-1962 period to estimate the structural equations of the macroeconomic model.

The model includes structural equations for consumption, investment, imports, direct taxes, the demand for money, domestic price determination and a number of identities. Exports are treated as exogeneous variables. A devaluation affects the system through import prices. He estimates the model and makes forecasts for two years. He then simulates the model for the assumed values of foreign exchange and compares the values obtained from this run with the values obtained from the first run. His simulation results indicate a fairly rapid price increase as a result of a devaluation (25% devaluation results in 12.8% increase in the general price level in the first year and 11.4% increase in the second year after the devaluation). The model also predicts a slight reduction in real consumption right after a devalution and a slight decrease in fixed investment in the third year.

His later study (1970) is a similar general equilibrium model for India. The model includes foreign parameters and induced impact parameters. The model contains forty-seven equations, twelve of which describe imports, exports, and their prices. A devaluation affects the prices of imports which, in turn, affect the other variables of the system and the prices of exports which affect the competitiveness of Indian exports and, hence, the volume of exports. The method in his 1969 study is used to predict the effects of devaluations. Simulation results show an improvement in the trade balance as a result of the devaluation.

Dervis (1981) builds a general equilibrium model and examines the resource allocation effect of devaluations for the Turkish economy. In the sectoral level model, substitution between capital and labor is allowed, however, intermediate input use is given by an input-output matrix. In the model neither imports and importables nor exports and exportables are treated as perfect substitutes. The total level of imports adjusts, through rationing, to the level of exports and exogeneously set net foreign capital inflow. The model also includes equlibrium conditions in goods markets. The model's solution shows that the resource-pull effect of devaluation is substantial and the sectors which produce import substitutes are adversely affected by a devaluation. He attributes this unconventional finding to the existence of rationing before devaluation.

Empirical Studies on the Monetary Approach to the Balance of Payments

The partial equilibrium models that are reviewed so far in the chapter indicate that relative prices, hence the real aggregates, are affected by devaluations. The general equilibrium models are built upon this prediction. Monetarists, however, dispute these conclusions. According to monetarists, as it was mentioned earlier, relative prices are not affected by devaluations. Therefore, devaluations do not cause real changes in the devaluing countries, and the trade balances cannot be affected. According to monetarists the balance of payments surpluses and deficits represent adjustments to a disequilibrium in the money market. A devaluation by raising domestic prices reduce the real cash balances. The reduction in real cash balances results in a temporary balance of payments surplus, if excess demand for money is not met through domestic credit creation. However, the increase in the general price level in proportion to the rate of devaluation results in no long-lasting improvement in the balance of payments. Assumed high elasticity of substitution between domestic and foreign goods guarantees the long run equalization of domestic and world prices. A surplus continues until equilibrium in the money market is restored.

The validity of the predictions of the monetary approach to the balance of payments has been tested in developing economies. The results are not conclusive.

Khan (1976) builds an eleven-equation model to trace the short-run implications of the monetary approach to the balance of payments. Therefore, the model allows for real income and prices to fluctuate. The balance of payments in the model represents an excess of income over expenditures. The model explains the relations between the changes in reserves and the monetary variables, as well as the changes in the monetary variables and domestic demand for goods and financial assets. The latter changes, in turn, affect the balance of payments further. He estimates the structural equations of the model by using quarterly data for Venezuela for the period 1968-1973 and solves the model for the period. The model is then solved under the assumption that monetary policy becomes restrictive. The comparison of the two solutions indicates that a reduction in the domestic credit leads to a lower level of income and rate of inflation, but an improvement in the balance of payments.

Bhatia (1982) tests the monetary approach to the balance of payments in India during the period 1951-1973. He estimates two equations. The first relates the growth rate in nominal demand for money to the rates of growth in the price level, real income, and interest rate. The second equation relates the reserve flow to the same independent vaiables included in the first equation and also to the time rates of change of multiplier, and of domestic money creation. The results of the empirical study lead him to conclude that reserve flows closely made up the difference between the demand for money and the domestically supplied portion of money in India during the period. However, elsewhere, Magee (1976) argues that the good fit of such ordinary least squares estimates may reflect the simultaneous equation bias. Magee reasons that increases in the money supply may affect real income, prices, and the rate of interest.

Miller and Askin (1976) test the validity of the monetary approach to the balance of payments in Brazil, and in Chile for the period 1955-1971. Their model includes both the money market and the goods market. They estimate two reduced form equations for each country. The first equation specifies income (no distinction is made between nominal and real variables) as a function of government spending, exports and the foreign exchange rate. The second equation relates international reserves to time, income, the domestic component of the monetary base, and to the foreign exchange rate. The estimation method is 2SLS. The predicted values of income estimated in the first equation are used in the estimation of the second equation. Finally, the predicted values of the dependent variables of both equations are used to estimate one of the model's structural equations which defines the domestic component of money as a function of foreign reserves, the income level, and of time. Estimation of the equation shows that a one dollar increase in the domestic component of the money supply does not lead to a one dollar decrease in the foreign reserves in either country. They conclude that Chile and Brazil had complete control over their money supplies and successfully sterilized the effects of the balance of payments on their monetary base during the period.

Miles (1978, 1979) examines the effects of twenty-six devaluations on the trade balances and on the balances of payments in eighteen countries. He regresses the ratio of the changes in the balance of trade to real income in each country on the changes in each country's growth rate differentials of real income, the ratio of high-powered money to real income, the ratio of government consumption to real income with respect to the rest of the world, and on the changes in the foreign exchange rate. The independent variables other than the exchange rate isolate the effects of devaluations on the trade balance. In only two out of eighteen cases does he find significant coefficients for the foreign exchange rate. He concludes that the devaluations had no effect on the trade balances. However, his empirical study shows an improvement in the balances of payments following devaluations whenever the ratio of balance of payments to real income is substituted for the ratio of trade balance to real income in the equations. According to Miles, devaluations have no effect on the real variables, but they do cause a portfolio adjustment.

Connolly and Taylor (1976) test the validity of the monetary approach to the balance of payments in developing countries by utilizing data for eighteen devaluations that took place during the period 1959-1970. They estimate a reduced form equation which is derived from money market equilibrium (similar to one derived by Johnson). They regress the ratio of improvement in the balance of payments to the money stock on the changes in the exchange rate and on the increase in the rate of growth of domestic credit as a proportion of the money stock. Their results show that the relation between the rate of growth of domestic credit expansion and the changes in the balance of payments is very strong. However, the study also shows that the demand for money does not increase by the full proportion of the devaluation as predicted by the monetary approach to the balance of payments, and over the two-year period the prices of tradeables rise at a much faster rate than consumer or producer price indices.

In empirical studies the controversy on the effectiveness of a devaluation in changing the relative prices is not yet settled. The predictions of the monetarists do not clearly hold in developing countries. Most of the studies covered in the chapter indicate that devaluations do affect relative prices and, hence, the trade balances in devaluing countries. Some studies, (Michaely, 1975; Nelson, Schultz, and Slighton, 1971; Donovan, 1981; Cooper, 1971; Connolly and Taylor, 1976) focus directly on the relative price effect of devaluations. These studies find that relative prices in the devaluing countries are affected over a period of time that lasts for two years or more after the devaluations. Michaely notes that after the 1952-1954 devaluations relative prices in Israel were affected over a six year period. Other studies, (Halevi, 1972; Khan, 1975; Askari, Bizien, and Hossein, 1973; Donovan, 1981; Cooper, 1971; Bautista, 1973) focus on the effects of the foreign exchange reallignments on the volumes of exports and imports and, hence, the trade balances of the devaluing countries. These studies also indicate that the devaluations have been effective in changing relative prices and, as a result, the volumes of exports and imports in the devaluing countries.

The findings of these studies show that relative prices and, hence, the trade balances of LDCs may be affected by devaluations over a period of time. This conclusion contradicts one of the assumptions of the monetarist approach to the balance of payments; that is, the trade balances cannot be affected by devaluations in the long run.

Other studies, (Leith, 1974; Bhagwati and Srinivasan, 1975; Miles, 1978, 1979), however, do not a find long-lasting improvement on the trade balances following the devaluations. Miles uses his findings in support of the monetarist approach to the balance of payments. In the studies of Leith, Bhagwati and Srinivasan, the ineffectiveness of devaluations in changing the trade balances is attributed to the factors that occurred simultaneously at the time of the devaluations studied. In this study, instead of getting into the debate of whether or not the real effective exchange rate can be altered by devaluations, it is assumed that the real exchange rate can be altered as a result of a devaluation. The real effects of devaluations are then traced within a planning model.

Recursive Planning Models

The planning model that is built to study the real effects of devaluation is Keynesian in nature. The international sector is represented by a balance of trade constraint and deficits or surpluses result from flow adjustments. The equilibrium condition implicit in the model equates saving to investment. The model is similar to the model built by Cigno (1971).

The planning models and, in particular, the model in this study differ from macroeconometric models (Marwah, 1969, 1970; Bautista, 1973). The macroeconometric models examine the effects of the devaluations under the assumption that the economic agents in the economy follow their traditional behavioral patterns whenever the foreign exchange rate is altered. Therefore, a structural model that defines an economy is estimated by utilizing regression techniques. In these models the foreign exchange rate and/or import and export prices, which are exogeneous to the models, are linked to the endogeneous variables of the models. The effects of the devaluations on the endogeneous variables are traced by simulating the models for the changes in the exogeneous variables triggered by the devaluations.

The planning models, however, try to answer what could happen if a socially optimal adjustment mechanism takes place in response to a change in a policy variable. In the Eckaus-Parikh model, for instance, socially optimal adjustment requires the maximization of the discounted sum of consumption in each year during the implementation period of the model subject to some constraints. In this particular model the effects of devaluations can be traced, as is done by Srinivasan and Bhagwati, by first estimating the export vector after the devaluation and then by imposing the devaluation affected export vector into the model and letting the system adjust to the exogeneous change according to the socially optimal rules (the objective function and the constraints) of the system.

The model built in this study, as was mentioned earlier, is similar to the models in Cigno (1971) and Heidhues (1966). The models are constructed to examine the effects of the changes in the relative prices on the production decisions. Therefore, the focus is on relative prices faced by the agents of the systems. The changes in relative prices affect the very parameters of each model. In other words, optimal adjustment rules directly account for the changes in the relative prices that are caused by factors external to the models.

Cigno, in his model, examines the effects of an European Economic Community's (EEC) agricultural price policy on Italian farmers. The problem faced by the Italian producers of farm products was to accept lower prices for their products while they were forced to pay more for their inputs as a result of EEC policies. In the study the production response to such an exogeneous change is examined. A similar problem is examined by Heidhues (1966). He examines the effects of EEC's price policies on different sizes of farms in Northern Germany. Both studies use recursive linear programming models to examine the effects of the external shocks on production decisions. The problem studied here is similar to the problems tackled in both studies. Under the small country assumption a devaluation, if effective, affects the production decisions in an economy by changing the relative price of tradeables and nontradeables and increases the prices of imported inputs.

The optimal adjustment rules of each model are defined by their objective functions, and by each model's constraints. The objective function of the model of this study is similar to the objective function in Cigno. There, the objective of the system is to maximize the total value of products in each year during the implementation period subject to certain constraints. In the present model the total value of products net of foreign capital inflow is maximized subject to the model's constraints. Both models treat the end of year capital as part of the final products of each period. This way capital as input does not last for more than a year and the end of year capital that is transferred to the next period is treated as capital output of the period. In both models the capital outputs of each period are valued at the expected prices of capital in the next period. The discounted expected value of the capital outputs of each period, then, is added to the value of the final products of the period. The treatment of capital as a part of final products of a period is customary in the period analysis. In the planning models, the end of the period is also the end of the world. Therefore, the end of the period capital stock should be treated as output and its value should be added to the value of the final products. The final products, excluding capital output, are valued at current prices.

In the model of the present study a devaluation directly affects the price vector in the objective function. Production decisions are based, at the beginning of each period, on these "current" prices and are motivated by the objective to maximize the total value of products net of foreign capital inflow. In addition to the parameters of the objective function, some of the parameters of the foreign exchange constraint are also affected. Production decisions in the model are assumed to be made by utilizing the most recent information. The model is described in some detail in Chapter V. In the next chapter the alternative approaches to the balance of payments explained geometrically. A theory of devaluation is outlined in Chapter IV.

CHAPTER III

GEOMETRIC PRESENTATION OF THE ALTERNATIVE APPROACHES TO THE BALANCE OF PAYMENTS

In this chapter, implications of the alternative approaches to the balance of payments are shown geometrically. First, the adjustment process to the balance of payments disequilibrium is worked out under alternative assumptions that full employment and less than full employment conditions prevail in a country with external disequilibrium. Later, the implications of the monetarist approach to the balance of payments are shown.

The Keynesian approach to the balance of payments, in contrast to the monetarist approach, does not rule out the real effects of the balance of payments adjustment process. An adjustment process in a country where full employment cannot be achieved at the existing relative price ratio is studied in Figure 1. Figure 2 explains the balance of payments adjustment mechanism in a full employment economy.

In Figure 1 (and also in the following figures), the vertical axis measures nontraded goods. Traded goods are shown along the horizontal axis. The trade-off in production

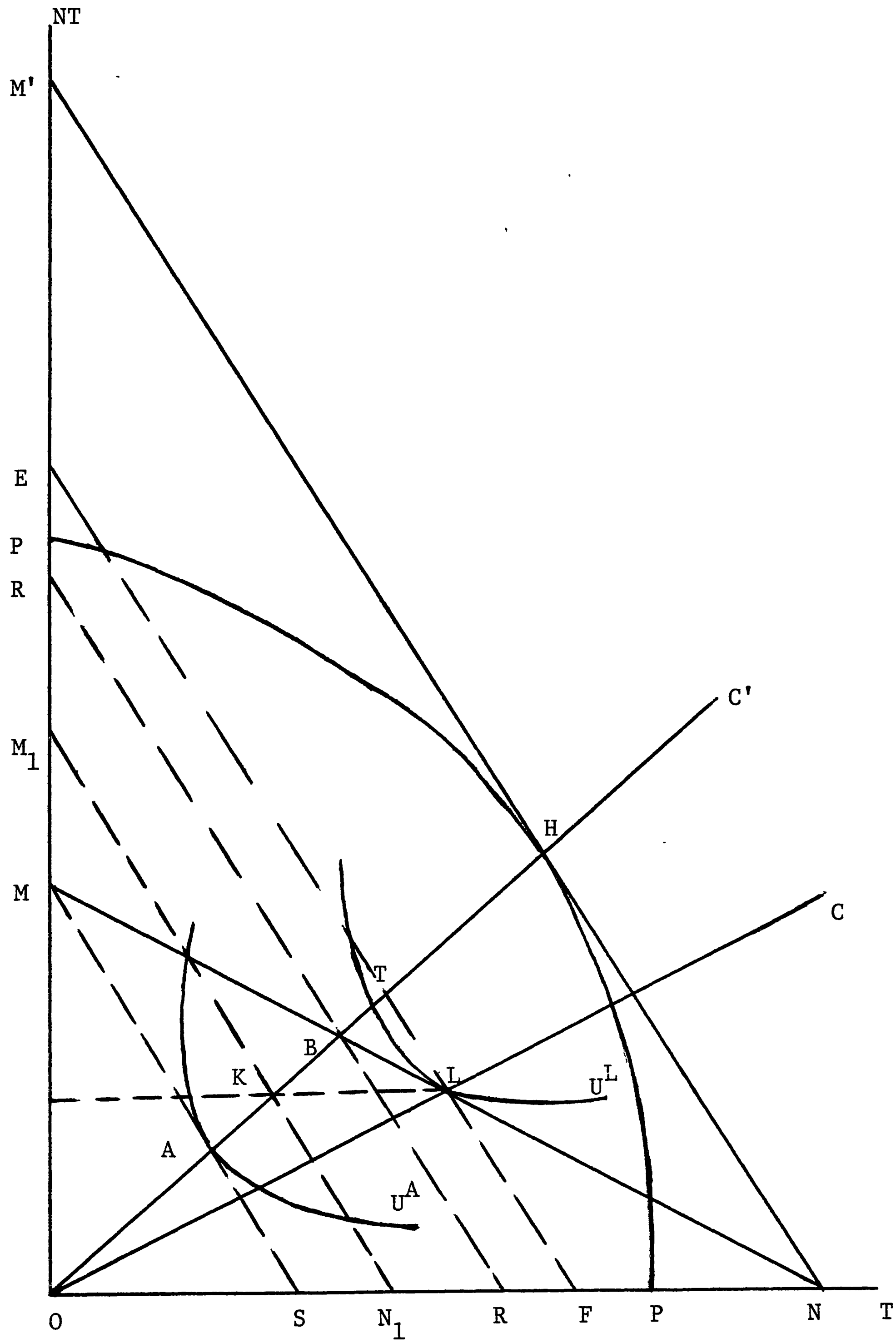

Figure 1. The Keynesian Approach to the Balance of Payments Under Less than Full Employment Conditions

between traded and nontraded goods is shown by the production possibilities frontier, PP. Under the assumption that the community indifference curves (identical incomes and homogeneous indifference curves are assumed to derive them) are linear homogeneous, OC and OC' describe the income consumption lines before and after the devaluation, respectively. Community indifference curves are depicted by the convex curves, U^A and U^L.

Assume that consumption and production in the country take place at point L where the market for nontraded goods is cleared, and the external equilibrium is achieved. At point L, real income and real expenditures in terms of nontraded goods are equal to the distance, OM, if the relative price ratio is equal to the slope of the line, MN. At the same price ratio, real income and real expenditures in terms of traded goods are shown by the distance, ON, along the horizontal axis. The welfare level of the country at point L is indicated by the community indifference curve, U^L. The points along the indifference curve indicate a constant level of real expenditures at alternative price ratios.

A real devaluation changes the relative domestic price of traded and nontraded goods, hence the position of the income consumption line. Following the devaluation, real expenditures in terms of traded goods fall to OS. Therefore, real expenditures in the economy are smaller after the devaluation.

The reduction in real expenditures is indicated by the movement from a higher indifference curve, U^L, to a lower indifference curve, U^A. Pursuant to the devaluation consumption and production points are represented by the points, A and L, respectively. The consumption point stays at point A unless government takes some action to bring equilibrium in the nontraded goods market. The necessary expenditure for equilibrium in the nontraded goods market is shown by the distance OM_1. Assuming that the government does not allow an excess supply in the nontraded market to appear, the consumption point moves to point K where the nontraded goods market is in equilibrium. At the consumption and production points, K and L, respectively, the balance of payments (trade) surplus is shown by the distance, KL. This surplus, coupled with now higher domestic prices of exports, represents an addition to aggregate money expenditure in the economy which is determined by the levels of domestic credit and foreign currency proceeds. Therefore, aggregate expenditure after the devaluation must be higher than OM_1, say, at the level of OE. The stimulating effect of the devaluation does not stop here. According to Keynesians, this increase in exports and export proceeds (shown by the difference between the distances OE and OM_1 in the figure) increases income and expenditure still further via the multiplier process. The extent of the increase in income and expenditures is determined by the marginal propensities to save and to import. In the Keynesian model, under less than full employment conditions, a devaluation results in an initial favorable effect in the balance of trade which, in turn, causes expenditure and income to increase. An increase in income reduces the favorable effect of a devaluation, but according to Keynesians, the net effect of a devaluation is favorable. Though Keynesians were in agreement on the effects of devaluations under less than full employment conditions, they were in disagreement on the effects of devaluations whenever a full employment economy was considered. Controversy was between the adherents of the relative price and absorptionist approaches to the balance of payments. Machlup was the leading proponent of the former and Alexander was the advocate of the later approach.

According to the relative price approach, a devaluation improves the balance of trade even in a full employment economy. The improvement in the balance of trade results from more efficient allocation of resources pursuant to a devaluation . The absorptionists, on the other hand, claim that a devaluation has a favorable effect on the balance of trade of a full employment economy only if it results in a reduction in real expenditures. It is shown in Figure 2 that in reality there is no difference between the two approaches.

The differences between Figure 2 and Figure 1 are the locations of the initial consumption and production points. In Figure 2, the axes and all other curves represent the same variables as they are in Figure 1. Assume that the country achieves full employment (internal balance), but experiences external disequilibrium, at the initial domestic

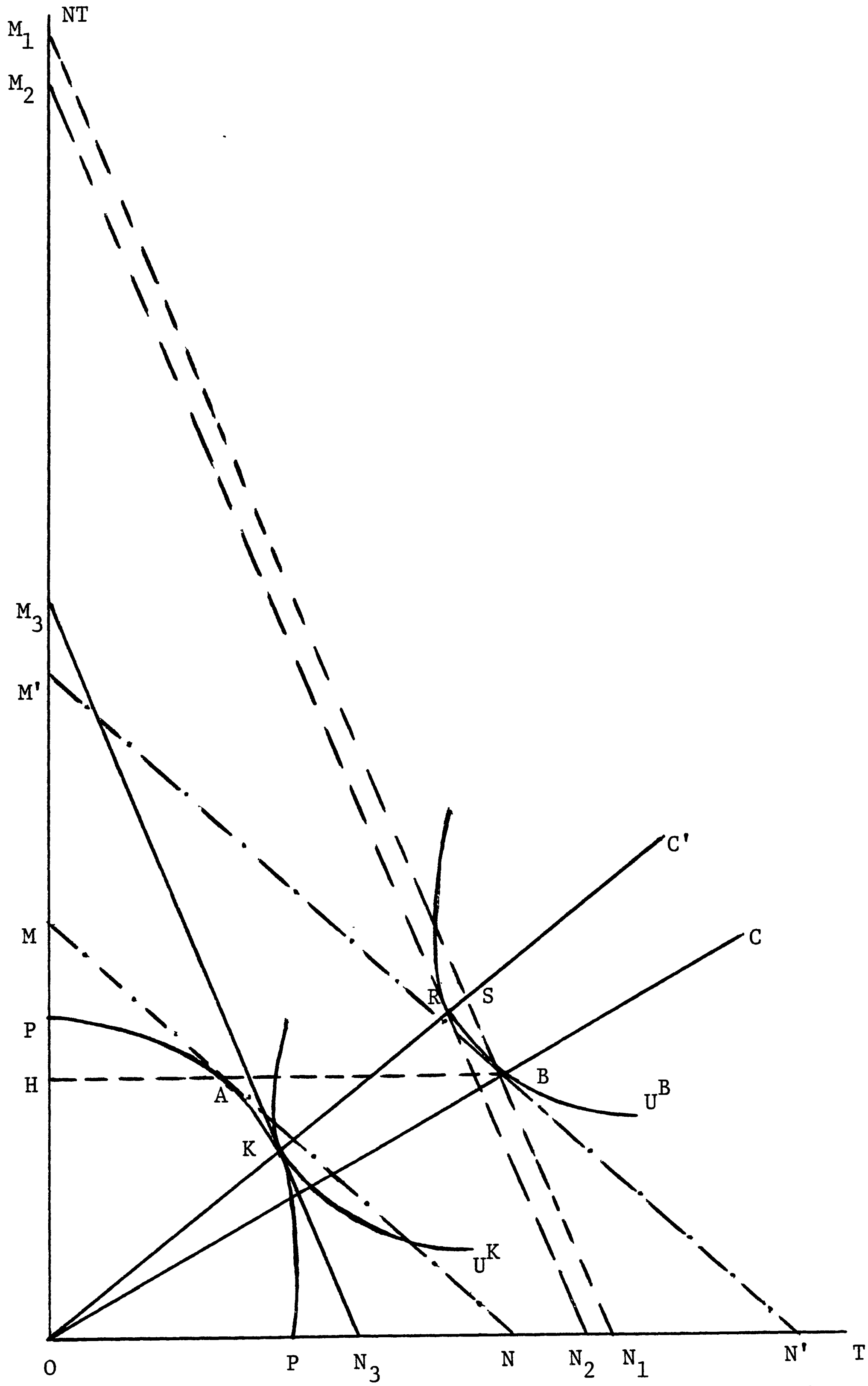

Figure 2. The Relative Price and the Absorptionist Approaches

price ratio which is indicated by the slopes of the lines, MN and M'N'. U^B and U^K are the community indifference curves. At the initial price ratio, the production point is A and the consumption point is B. The distance, AB, is the balance of payments deficit. In such a situation, according to the relative price approach, nontraded goods prices are too high. Therefore, a devaluation which makes both the consumption and the production points coincide at point K, where both external and internal balances are achieved, is needed.

According to the absorptionists, a devaluation is ineffective in obtaining balances in both markets unless real expenditure is reduced. In other words, in a full employment economy the trade deficit exists because real expenditure is too high relative to the level of real income of an economy. In order to show their point, assume that the initial consumption and production points are A and B, respectively. Also assume that the government devalues its currency, but keeps the real absorption in the economy from falling. The government may keep the real absorption level constant at the new domestic price ratio by either maintaining real expenditure at the level prevailing before the devaluation, OM_1, or by maintaining real expenditure at the level that keeps the welfare level of the country's residents constant, OM_2. In either case, a devaluation results in an initial favorable effect on the trade balance. The consumption point moves to S ,while the production point moves to K, from point A. The new production and consumption points imply excess demand for nontraded goods. As long as absorption is not reduced, excess demand puts upward pressure on nontraded goods prices. As a result, the production point shifts back to the initial point, A, and the consumption point returns to point B.

Thus, for the initial relative price effect of devaluation to improve the balance of trade the real absorption must be cut from OM_1 (or OM_2) to OM_3. This reduction may result from the real balance effect of a devaluation.

The argument between the proponents of the relative price and the absorptionist approaches revolves around whether the relative price effect of a devaluations is temporary or permanent (Michaely, 1960). The relative price approach implicitly assumes that the effect of a devaluations on relative prices is permanent. The absorptionists, on the other hand, set the condition to be satisfied for a permanent change in relative prices. According to the absorptionists, the achievement of a permanent relative price effect is conditional on the reduction of the real absorption in the economy.

Monetarists view the balance of payments as a purely monetary phenomenon. In a full employment economy, according to monetarists, a devaluation does not have any real effect in the long-run. A devaluation, they claim, affects only the money supply and the absolute price level in the devaluing country in the long-run. Following a devaluation, the nominal money supply and the absolute price level increase at the rate of the devaluation. The monetarist approach to the balance of payments is explained in Figure 3.

In Figure 3 , the axes and the curves represent the same variables as they do in the previous figures. Assume that in the country both external and internal balances are achieved at point A. Real income and real expenditure are both equal to OM_1 in terms of nontraded goods at the domestic price ratio indicated by the slope of the line, MN. A devaluation changes the domestic price ratio in the economy in the short-run. At the new price ratio after the devaluation, the production point moves from A to L and the consumption point moves from A to, say, K. At the new consumption and production points real expenditure and income are no longer the same.

In the short-run, a devaluation reduces the real money balances while the demand for real money balances increases. The result is a further reduction in aggregate spending if the monetary effects of devaluation are not neutralized. Aggregate spending falls to, say, OM_3 and the consumption point moves to Z at the new price ratio. In the short-run, then, the real effects of devaluation may be observed. In the long-run, however, these real effects disappear.

In the short-run, when the consumption and the production points are Z and L, respectively, desired real cash balances are higher than actual real cash balances. Therefore, the country's residents attempt to reach

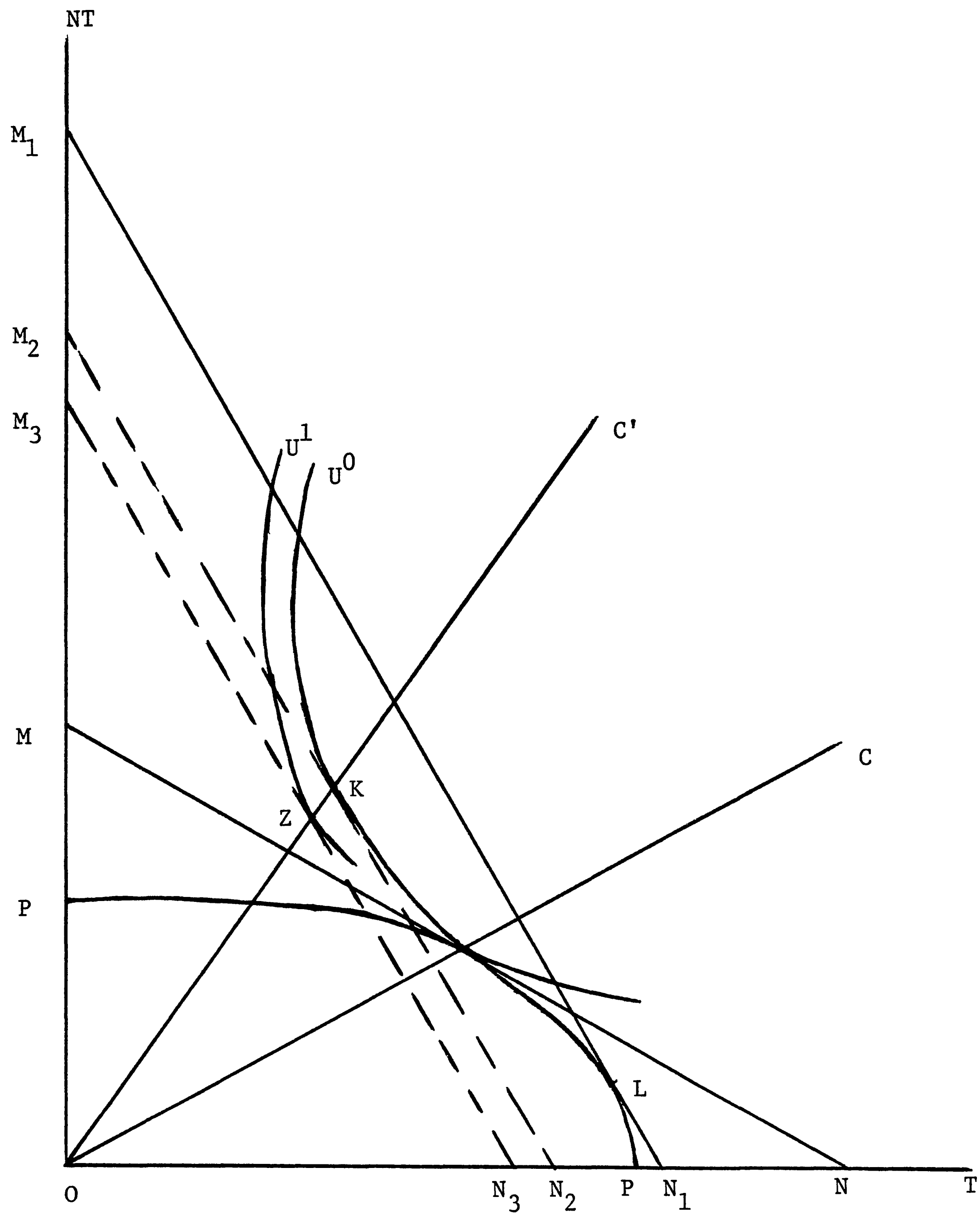

Figure 3. The Monetarist Approach to the Balance of Payments

equilibrium by running a trade surplus. A balance of payments surplus increases the money supply in the economy while an excess demand for nontraded goods increases the prices of nontraded goods. Because of the inflow of money in the form of international reserves, and of the higher prices of nontraded goods, the real expenditure line rotates and shifts to the right until the initial equilibrium point, A, is reached. At point A once again external and internal balances are achieved, and real expenditure is equal to real income.

CHAPTER IV

THEORY OF DEVALUATION

In this chapter the effects of fixed exchange rate policies on the real part of the system are examined. Exchange rates throughout the chapter refer to the relative price of tradeable and nontradeable goods. Tradeable goods are composed of exportables and importables and are viewed as alternative ways of earning foreign exchange.[1] Under a small country assumption, prices of traded goods are determined by the rest of the outside world. Domestic prices of traded goods are equal to $P_I * R$, where R is the nominal[2] foreign exchange rate, and P_I is the international price of a tradeable in terms of foreign currency.

The price of a nontradeable good is determined in the domestic market according to supply and demand conditions. It is the changes in the real exchange rate which have real repercussions in a small economy. The changes in the nominal exchange rate affect only the prices of exportable and importable goods in the same proportion in the absence of barriers to trade.

Fixed exchange rate policies result in distortions in both product and factor markets if domestic policies in the country are mismanaged. In this chapter, the distortions that may be created by a fixed exchange rate policy are examined first. Later, real repercussions of these distortions are shown by utilizing partial and general equilibrium analyses.

Figure 4 depicts the production possibilities frontier of a small country. It is assumed that the country is endowed with two primary factors of production, namely, capital and labor. Capital and labor are assumed to be transformed into tradeable and nontradeable goods through the linear homogeneous relations. Furthermore, it is assumed that the tradeable good is capital intensive and the nontradeable good is labor intensive.

In Figure 4, the vertical axis measures the tradeable good and the horizantal axis depicts the nontradeable good. The frontier PP represents the production possibilty curve of the small country. Community indifference curves are assumed to be represented by smooth curves convex towards the origin. The income consumption line in the economy is depicted by the curve, OAC.

The real exchange rate in a flexible exchange rate regime is indicated by the slope of the common tangency of the production possibilities curve and a community indifference curve (not shown in the figure) at A. In the absence of distortions, the observed price ratio is also the marginal social rate of transformation. At point A, the economy achieves both internal and external equilibrium.

Now assume that the government starts pursuing a fixed

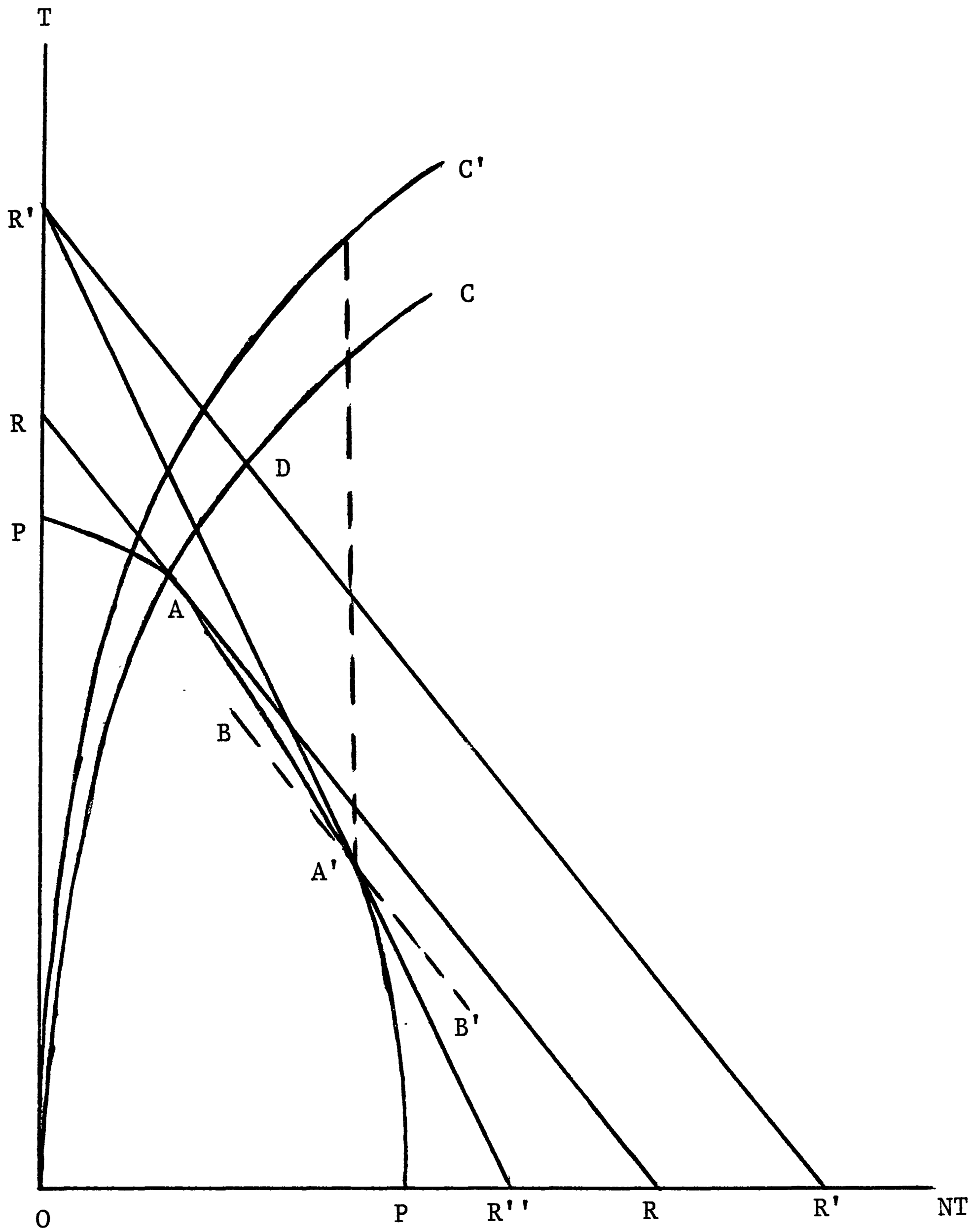

Figure 4. The Effects of Expansionary Domestic Policies When a Fixed Exchange Rate Policy is Implemented

exchange rate policy along with expansionary domestic policies. Under the small country assumption, the combination of these policies results in an increase in real income initially. Real income in terms of the nontraded good increases to, say, OR'. At the initial price ratio the production point stays at A, the consumption point moves to D. The new consumption point, D, implies excess demand for both goods at the initial price ratio. Excess demand for the traded goods can be satisfied if the country has foreign exchange reserves on hand or if there is an inflow of foreign exchange. Excess demand in the nontraded good market, on the other hand, requires the price of the nontraded good to go up, hence real income in terms of the nontraded goods to go down, until the new price ratio is equal to the slope of R'R''. At the new price ratio, real income in terms of nontraded good is OR''. The new income consumption line is OC'. The new production point is A'. The movement from A to A' is achieved by allocating resources from traded good production into nontraded good production. If the country pursues a full employment policy, the trade deficit persists at the level of A'K. Any effort to reduce the deficit results in unemployment under the fixed exchange rate system. The slope of the tangency at point A' depicts the marginal private rate of transformation, which is equal to the ratio of the observed prices. The marginal social rate of transformation at point A is depicted by the slope of the line BB" that cuts the production possibilities curve at point A'. The divergence between the marginal private and social ratios results from the government's fixed exchange rate policies. In fact, the government, by not allowing the foreign exchange rate to adjust to a disequilibrium in the balance of trade, distorts the product price ratio. Since the nominal foreign exchange rate no longer reflects the marginal social cost of producing the tradeable good, the observed product price ratio does not represent the marginal social rate of transformation. The distortion in the product market distorts the factor product market as is implied by the Stolper-Samuelson theorem. In other words, as the price of nontraded good increases the price of the factor which is used intensively in the production of nontraded good, labor, also increases.

Thus, the foreign exchange policy distorts prices not only in the product markets, but also in the factor markets. The distortion in the factor markets affects the labor capital ratios in production. Therefore, a fixed exchange rate policy may increase the price of labor and cause more intensive use of capital in a country where labor is relatively abundant and capital is relatively scarce.

Partial Equilibrium Analysis

Product market distortions that are caused by a fixed exchange rate policy can be analyzed in a partial equilibrium framework. In the beginning of this chapter, exportables and importables are lumped under a Hicksian composite good which is called tradeables. In partial equilibrium analysis exportable and importable goods are treated as separate goods, and the effects of an overvalued currency in each market are examined.

In Figure 5, the quantity of the importable is depicted by the horizontal axis and its price is shown along the vertical axis. At the disequilibrium foreign exchange rate, the initial domestic price of the importable is OP which indicates the marginal private, but not the marginal social cost of imports. Under the small country assumption, the foreign supply of the importable good is perfectly elastic and shown by PP'. The domestic supply curve, SS', shows the private cost of producing each additional unit. S_1S_1' describes the marginal social cost of production. The divergence reflects the distortionary effect of the fixed foreign exchange rate in the factor market. At the disequilibrium foreign exchange rate, as is implied by the Stolper-Samuelson theorem, the market wage rate and the scarcity value of labor may no longer be equal. The line, DD', on the other hand, shows the consumers' valuation of this good at the margin. The social valuation of the tradeable good is described by D_1D_1'. This divergence may have been caused by the consumers' perception that the government's fixed exchange rate policy will continue and, as a result, a drastic devaluation will be necessary in the near future.[3] At the diequilibrium foreign exchange rate, domestic

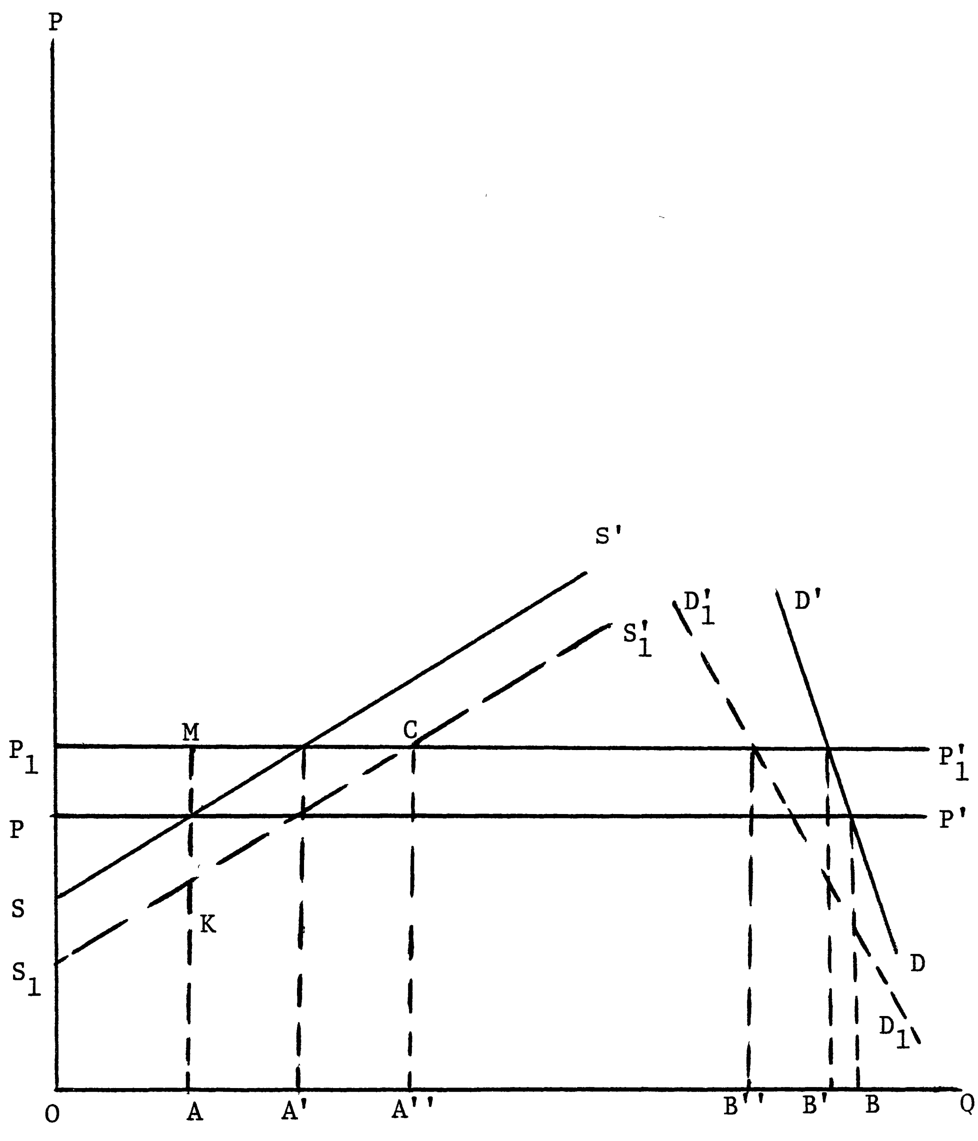

Figure 5. The Effects of Devaluations in the Importable Good Market

producers produce OA amount of tradeable good. Domestic consumption is OB. The difference between domestic consumption and production is imported.

At the disequilibrium rate, neither the level of consumption nor the level of production is socially desirable. The importable good is underproduced and overconsumed. What then, is the impact of an exchange rate reallignment? The devaluation may be carried out to the extent that the marginal private and social costs of imports are equal. Such a policy shifts the supply curve of imports upwards by affecting the domestic price of the importable good. In Figure 5, the price of imports after the devaluation is shown by the distance OP_1. The new supply curve of imports becomes P_1P_1'. The increase in the domestic price of the importable affects the production and consumption of the importable good in a predictable manner. Production increases to OA', while consumption decreases to OB'. As a result, imports fall to A'B'.

In addition to its initial price effect, the devaluation (by eliminating the divergences between the marginal private and social costs and between the marginal private and social valuations of the tradeable good) causes the supply and the demand curves to shift to S_1S_1' and D_1D_1', respectively. Therefore, at the equilibrium exchange rate after the devaluation, domestic production increases to OA'' and domestic consumption decreases to OB''. Hence, imports fall to A''B''.

Replacement of AA'' of imports with domestic production represents a social gain for the country. The social cost of AA'' amount of imports is shown by the area, MAA''C in Figure 5. After the devaluation, the same amount of the importable good can be produced at a social cost depicted by the area, AKCA''. Thus, the triangle, KMC, represents a social gain for the country. After the devaluation, consumption decreases from OB to OB''. The reduction in consumption from OB to OB'is attributable to the change in the domestic price of the importable good. The reduction in consumption from OB' to OB'' is due to the synchronization of the marginal social and private valuations of the importable good. At the equilibrium exchange rate, the domestic price of the importable good, OP_1, represents the marginal social costs of both importables and imports. Therefore, at the consumption level, OB'', the marginal benefit of consuming the importable good is equal to the marginal social cost of producing and/or importing it. This condition is required for social optimization.

Thus, flexibility in the foreign exchange rate is expected to contribute to the achievement of social optimization. A fixed exchange rate policy, on the other hand, hinders the attainment of social optimization.

The effects of a devaluation in the exportable good market can be shown geometrically as well. In Figure 6, the vertical axis measures the price of the exportable good. The quantity of the exportable good is shown along the horizontal axis. OP is the domestic price level at the disequilibrium

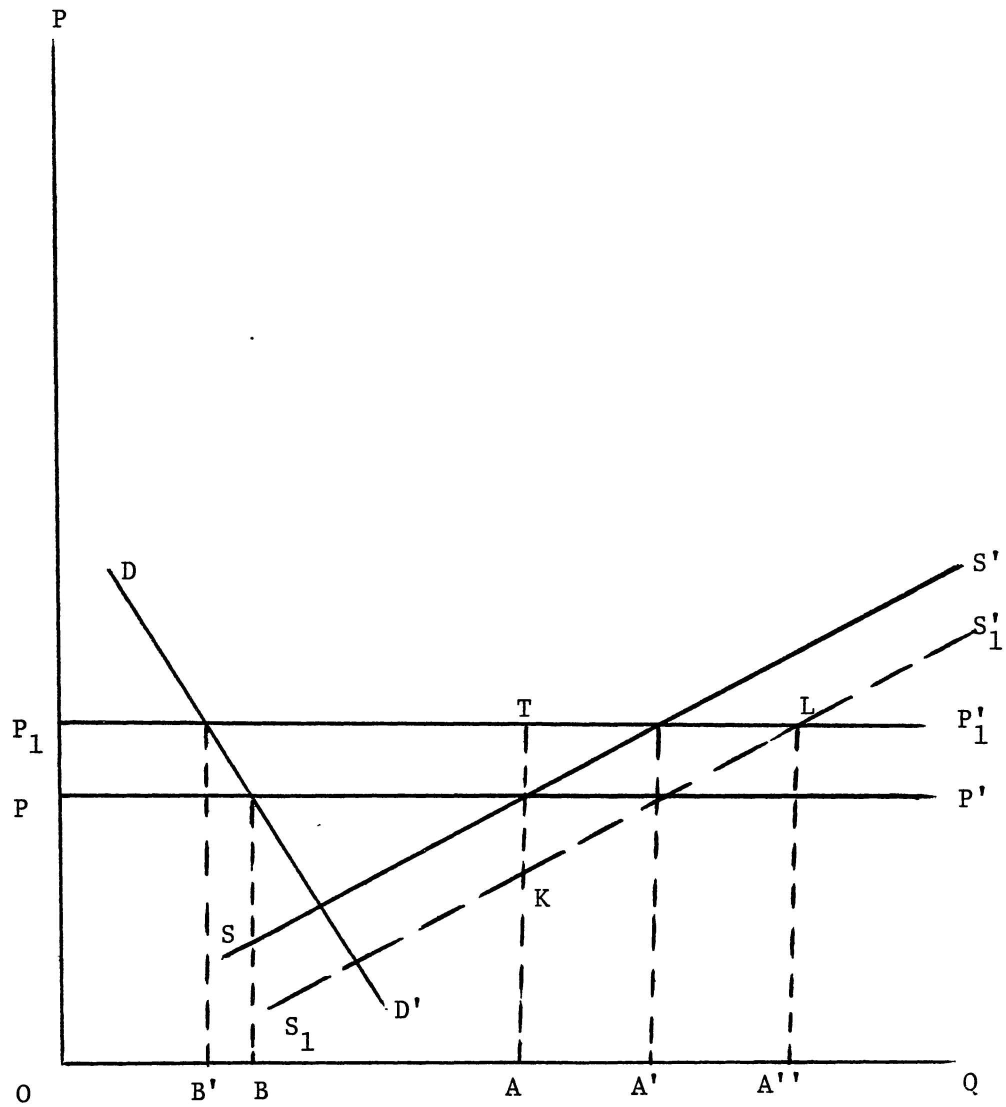

Figure 6. The Effects of Devaluations in the Exportable Good Market

foreign exchange rate. DD' is the domestic demand curve which traces the marginal benefit of the exportable good at different levels of its use.[4] SS' is the supply curve which traces the marginal private cost of producing exportable good at different production levels, while S_1'S_1' shows the marginal social cost of production at alternative production levels. The divergence between the marginal social and private costs again reflects the distortionary effect of a fixed exchange rate policy in the factor market.

In Figure 6, OP_1 represents the marginal social cost of exports. The observed price of exports at the disequilibrium exchange rate is OP. The foreign demand curves at the disequilibrium and at the equilibrium exchange rates are shown by PP' and P_1P_1', respectively. At the disequilibrium foreign exchange rate, the consumption level is OB and the production level is OA. The country exports BA amount of exportable good. Assume that the country devalues its currency to an extent that the equilibrium rate is achieved. At the equilibrium exchange rate, as the domestic price of the exportable increases, the distortion in the factor market disappears. Therefore, the supply curve after the devaluation is S_1S_1', which describes the marginal social and private costs of production. At the equilibrium exchange rate, production increases to OA'' and consumption decreases to OB'. Exports are equal to B'A''. The increase in production from OA to OA'' represents a social gain for the country. In Figure 6, this gain is represented by the difference between the social benefit of extra exports (foreign exchange earnings), ATLA'', and the social cost of producing additional amounts of exports, AKLA''. Thus, the triangle, KTL, represents a social gain obtained by allowing the foreign exchange rate to reach its equilibrium value. After the devaluation consumption and production of exportable good are at the levels required by social optimization.

General Equiulibrium Analysis Revisited

In this section the real effects of foreign exchange rate policies are shown within a general equilibrium framework.

In Figure 7a, the Edgeworth-Bowley box diagram shows the isoquants for tradeable and nontradeable goods. The production possibility curve is depicted in Figure 7b. It is assumed that both goods use two inputs, labor(L) and capital(K), and that the factor intensities in production are different. The tradeable good is assumed to be capital intensive while the nontradeable good is assumed to be labor intensive. The relative price is given by the slope of the line which is tangent to the production possibilities curve at A, through which the income consumption line passes. Production functions in Figure 7a are represented by linear homogeneous isoquants. The contract curve, $O_{NT}A'O_T$, on which the isoquants are tangent to each other, shows the efficient combinations of the goods that can be produced with a given

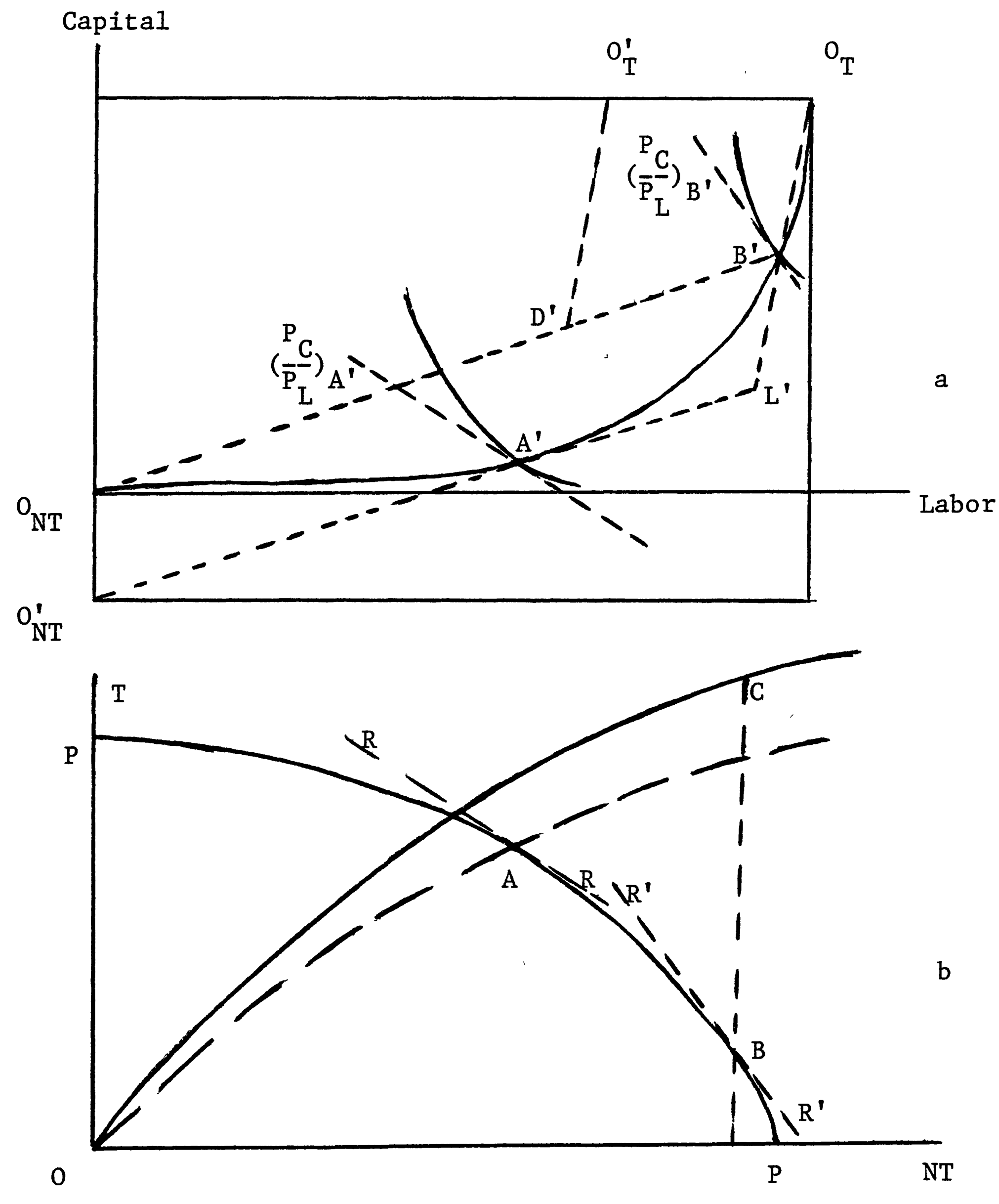

Figure 7. The General Equilibrium Implications of Fixed Exchange Rate Policies

factor endowment. The contract curve is nonlinear because of the factor intensity differential. The slopes of the common tangencies between isoquants along the contract curve give factor price ratios. The movement away from O_{NT} requires the slopes of successive tangencies to become steeper. Hence, the marginal product of capital, MP_K, decreases as the marginal product of labor, MP_L, increases. More production of the non-tradeable requires a reduction in tradeable production. But, due to factor intensity differences, contraction of tradeable good production frees more capital than can be absorbed by expanding nontraded good production at the going factor prices. As a result, the factor price ratio must change. Therefore, more production of the nontraded good requires the price of the factor which is used intensively in the production of the nontraded good, labor in this case, to increase relative to the price of the other factor, capital.

In Figure 7b, assume that the point A along the production possibility curve is the equilibrium point. The slope of the tangency at A represents both the marginal private and social rates of transformation. At point A, the country achieves external equilibrium and the factor price ratio equals the slope of line $(P_C/P_L)_A$, in Figure 7a. The production point becomes B and consumption point moves to C in Figure 7b, if the price of the nontraded good increases while the government keeps the foreign exchange rate at the same level. At point B the country achieves internal equilibrium, but runs a trade deficit. The movement from A to

B along the production possibility curve implies a movement from A' to B' in Figure 7a. Therefore, the new factor price ratio is represented by the slope of the line, $(P_C/P_L)_{B'}$ which is steeper than $(P_C/P_L)_{A'}$.

Point B' cannot be the equilibrium point because at B' both the price and the quantity of the tradeable good are lower than their levels at A'. The equilibrium can be restored at the observed product price ratio or at the observed factor price ratio, if the capital stock in the country is increased (for instance, by importing capital), or the level of employment is reduced. Assuming that the country is not able to import capital, the production of the nontraded good must contract. This frees more labor than can be absorbed by the expanding traded good production at the given factor ratio. In the box diagram, the northeast origin shifts to O'_T. $O_TO'_T$ represents the unemployment of labor caused by the overvalued currency. The new production point becomes D'. At D' capital-labor ratios are the same as they are at point B'. The new contract curve is the broken line, $O_{NT}D'O'_T$. In Figure 7b, unemployment results in a movement of the production point from B to D. At point D, income in terms of both tradeable and nontradeable goods decreases.

The impact of a fixed exchange rate policy when the country is able to import enough capital to restore full employment can also be explained in Figure 7. The country has to import $O_{NT}O'_{NT}$ of capital in order to achieve full employment. The new southeast origin is O'_{NT}. As long as the foreign exchange rate is not allowed to vary the capital-labor ratios in production do not change and the new production point is L'. $O'_{NT}L'$ is parallel to $O_{NT}B'$ extended. The new contract curve is the broken line, $O'_{NT}L'O_T$. The price ratio at the new equilibrium point is the same as it is at point B'. At point L' tradeable good production may be lower than the production level at the equilibrium exchange rate, described by the production point, A', in Figure 7a. In the case where it is lower, the country's balance of payments problems are expected to worsen in the next period.

In summary, the fixed exchange rate policy distorts the optimal resource allocation in the economy. The resource allocation effect implies income redistribution among the productive factors. The new income distribution favors the factor of production which is used intensively in the protected sector. In this model the protected sector is the nontraded good sector. Therefore, labor which is used intensively in the production of the nontraded good is made better off. However, it cannot be said that the labor force is made better off if the higher wages are obtained at the cost of unemployment. An empirical study is needed to judge this. In addition to its redistributive effect, the fixed exchange rate policy makes the country more dependent on imported capital.

Thus, bringing more flexibility to the foreign exchange rate not only improves the country's income and moves the country towards a socially optimal state, it also increases the employment level if the foreign exchange reserves are limited to financing imported capital needed to maintain full employment in the country.

The Effects of Devaluations Under Supply and Demand Rigidities

In this section, the real effects of a devaluation are examined in a country where production and consumption relations are described by linear functions.

In the model it is assumed that there are two factors of production and they are used to produce tradeable and nontradeable goods. Labor is assumed to be the primary factor of production. Capital is produced by each sector and is used in the production of both goods according to fixed capital coefficients. In the model, each production process requires the use of labor, capital, and intermediate inputs. The intermediate input coefficients are assumed to be known.

The production possibilities frontier is shown in Figure 8. The method to derive it is based on the method used by Evans (1972). The vertical axis in Figure 8 measures the output of nontradeable good net of intra-industry requirements and the horizontal axis measures the tradeable good output net of intra-industry requirements. The rays OA' and OB' describe the intermediate requirements of tradeable good in the production of nontradeable and nontradeable good in the production of tradeable good, respectively.

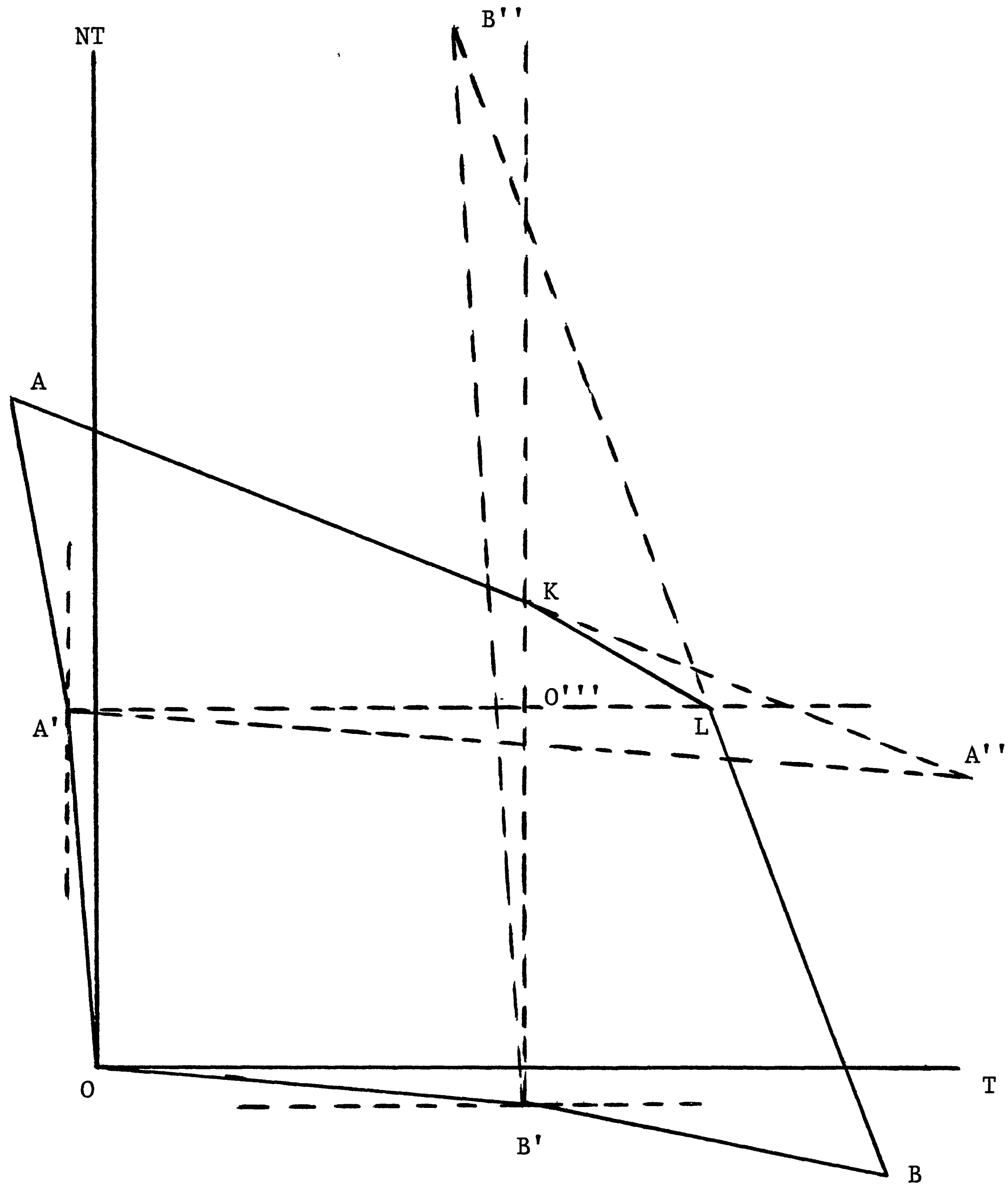

Figure 8. Production Possibilities Frontier When No Substitution in Production is Allowed

The lengths of rays OA' and OB' show the outputs obtainable from the base year capacities. It is assumed that once plant and equipment are installed, they cannot be reinstalled in the other sector within a period. However, in the case that a sector cannot utilize its capacity fully, excess capital may be shifted to the other sector in the next period. Capital accumulation is brought about by the investment activity. The base year capacity in each sector is binding if labor cannot be fully employed in either sector.

In Figure 8, the lengths of rays A'A and B'B measure the maximum investment activities in the nontradeable and tradeable goods sectors in the case that the available labor supply (assuming that labor is the only constraint along with the base year capacities) is allocated fully to one sector or to the other. Taking A' and B' as origins and ignoring the base year capacities in each sector, the production possibilities frontier between the investment activity and output is AA'' in the tradeable good sector and BB'' in the nontradeable sector. Since the portions, LB'' and KA'', along the frontiers are not feasible when capacity constraints are taken into account, the production possibilities frontier between tradeable and nontradeable goods is depicted by AKLB. Point O''' is the production point where both capacity constraints are binding. However, at O''' full employment cannot be achieved under the assumption that labor cannot be utilized fully in either activity. Therefore, full employment and full capacity utilization are achieved along the KL segment of the production possibilities frontier. The "small" country never produces the tradeable good at the level less than full capacity production. However, less than full capacity production is possible in the nontradeable good sector.

In Figure 9, the production possibility frontier shown is that derived from Figure 8. The income consumption line is depicted by OC . The slope of RR is equal to the observed price ratio under the assumption that the foreign exchange rate is flexible. Production and consumption take place at the vertex, L, where the economy achieves full employment, full capacity utilization, and also the external equilibrium.

A fixed exchange rate policy, coupled with expansionary domestic policies, changes the relative product price ratio. The new price ratio is shown by the slope of R'R' which is tangent to the production possibility frontier at the other vertex, K. Given the impossibility of substitution in consumption, the production point, K, does not represent the equilibrium point. Excess supply of nontradeables at point K forces tradeable good production to contract. The consumption point, D, determines the final production point. However, the point, D, represents a suboptimal point. Being on point D requires unemployment along with undercapacity utilization of capital in the nontradeable sector.

The reverse reasoning suggests that in an economy marked with supply and demand rigidities continuation of a fixed exchange rate policy may result in a contraction in the

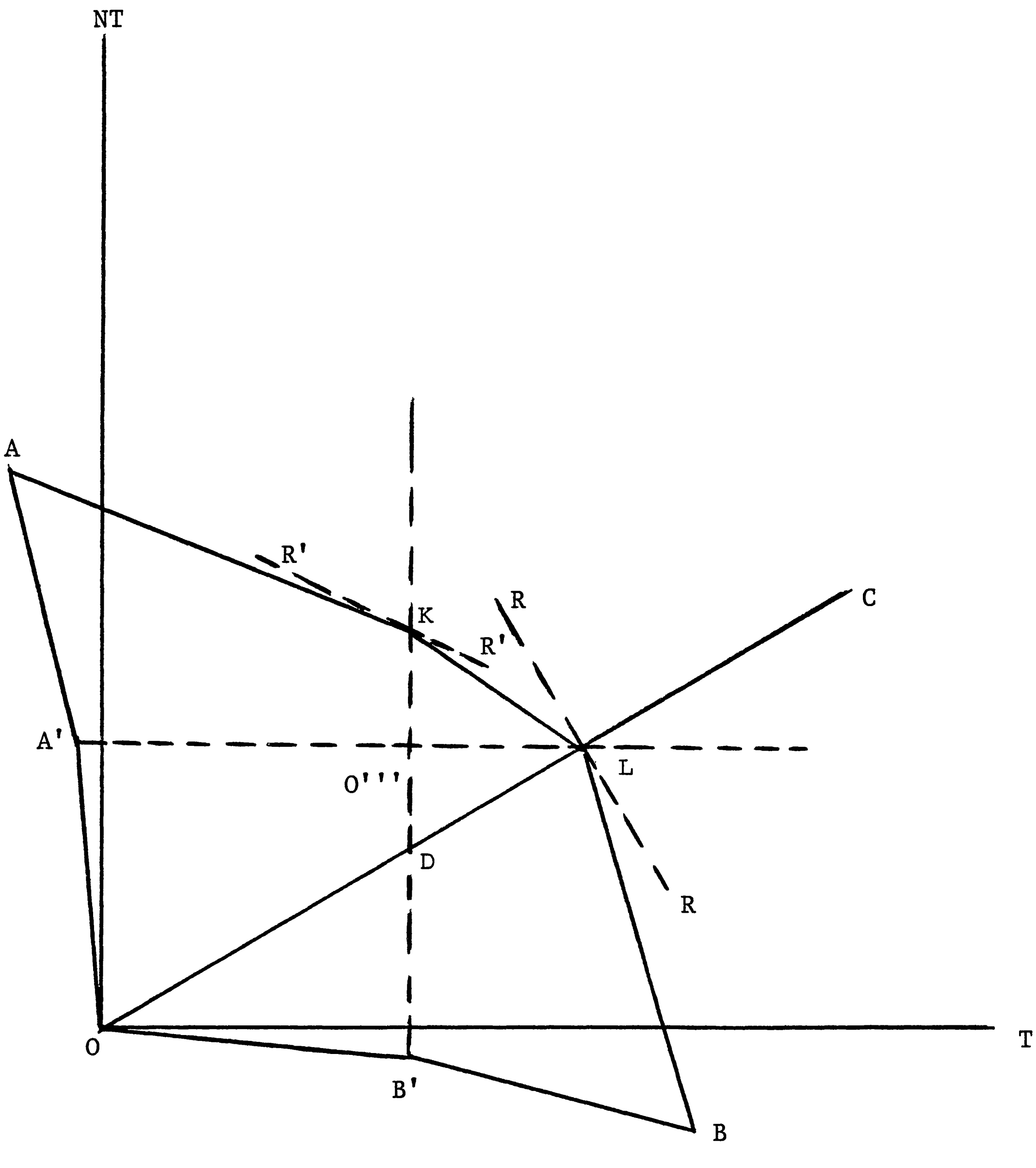

Figure 9. The Effects of a Fixed Exchange Rate Policy When No Substitution in Consumption and Production is allowed

economic activity. The easiest way to correct the adverse effect of fixed exchange policy is to bring flexibility to the exchange rate. Insistence on the fixed exchange policy requires the economy to go through some structural changes in order to attain both external and internal equilibrium. In terms of Figure 9, continuation of fixed exchange rate policies requires the production possibilities frontier to change its shape. This can only happen if the traded good sector expands. Given the unfavorable terms created by the fixed exchange rate policy, however, output expansion in the tradeable sector is difficult to achieve.

Thus, exchange rate policies bring about changes in production and distribution of income. In Figures 8, and 9 , it is assumed that the only limitation to expand production capacity comes from the availability of labor. In the event of other binding constraints, such as the foreign exchange constraint or a saving constraint , the shape of the production possibilities frontier is expected to be different. In order not to complicate the exposition, additional costraints are assumed away. However, such constraints are included into the mathematical formulation of the model.

ENDNOTES

[1]Traded goods are treated as a Hicksian composite good. Under the small country assumption, the prices of importable and exportable goods are determined in the rest of the world. Therefore, the changes in the foreign exchange rate do not affect the relative price of these goods. Thus, exportable and importable goods are viewed as units of a single commodity.

[2]Nominal exchange rate is defined as the number of units of local currency per unit of foreign currency.

[3]Consumers are willing to buy more of importables at each alternative price because they expect the price of importable to be higher in the near future.

[4]For simplicity the marginal private and social valuations of the good are assumed to be the same. A diversion between them, however, does not affect the analysis.

CHAPTER V

THE MODEL

In this chapter a recursive planning model is built to study the impacts of frequent devaluations. The model is used to simulate the Turkish economy, which is considered to be a semi-industrial economy. The effects of more flexible exchange rate policies on resource allocation, the sectoral activity levels, sectoral allocation of capital and distribution of income are estimated under the assumption that the foreign exchange rate is depreciated at the beginning of each time period that the model is run.

A recursive programming model is a sequence of optimization problems in which one or more parameters or coefficients of any problem in the sequence are functionally dependent on the optimal variables of preceeding members of the sequence.[1] Like dynamic programming, it deals with the dynamics of the decision making process; but unlike dynamic programming, it uses sequential optimizing to explain behavior and does not attempt to devise optimal decision rules which lead to optimal policies over the time period considered.[2]

The model built in this chapter is similar to the recursive programming models for agricultural development constructed by Day (1963), Heidhues (1966), and Cigno (1971). These models estimate production and investment at farm levels in a given period by employing a single linear programming model which includes "flexibility constraints" in order to keep activity levels within bounds. These upper and lower bounds allow only limited changes in the levels of production activities in any year.

Components of the Model

Components of the model are: an objective function which is maximized annually; commodity balance constraints; technical constraints for capital, labor and foreign exchange; and, flexibility constraints.

Variables of the Model

The variables explained by the model are: sectoral output levels; sectoral labor use; sectoral utilization of capital; exports; imports; consumption levels; foreign capiatal requirements; and, accounting prices imputed to scarce resources. The time unit is a year. Accounting prices imputed to scarce resources are obtained from the solutions of the dual problem for each year. The rest are given by the solutions of the primal problem.

The variables that are exogeneous to the model are current prices of goods, import and export prices, the rate of interest, capital-output coefficients, input-output coefficients, upper and lower bounds of flexibility constraints, and the saving coefficient which relates saving to the consumption level.

Algebraic Presentation of the Model

The constraints of the primal recursive linear programming problem are as follows:

Constraints	z^1	x^1	e^1	m^1	qF^1	z^2	x^2	e^2	m^2	qF^{2}*		
Balance	$-(I-A)$	I	I	$-I$							$\leq$	0
Capital	k										$\leq$	K^o
Labor	l										$\leq$	L
Foreign Ex.	$ancm$		$-p^e$	p^m	-1						$\leq$	0
Foreign Cap.		$-nsu$			1						$\leq$	0
Flexibility	I										$\leq$	$(I+d_u)z^{t-1}$
Flexibility	$-I$										$\leq$	$(I-d_l)z^{t-1}$

						$-(I-A)$	I	I	$-I$		$\leq$	0
	$-k$					k					$\leq$	0
						l					$\leq$	L
						$ancm$		$-p^e$	p^m	-1	$\leq$	0
							$-nsu$			1	$\leq$	0
	$-(I+d_u)$					I					$\leq$	0
	$(I-d_l)$					$-I$					$\leq$	0

* Superscripts define the time period.

z - (M*1) vector of output levels.

x - (M*1) vector of consumption levels.

e - (M*1) export vector, elements of which are positive for exportables.

m - (M*1) import vector, elements of which are positive for importables.

qF - Foreign capital inflow in terms of domestic currency.

q - The foreign exchange rate.

K^o- (N*1) vector of the base year capital stocks.

s - Saving coefficient.

k - (N*M) matrix of capital-output coefficients.

l - (K*M) matrix of labor coefficients.

p^e, p^m- (1*M) vectors of international prices of exports and imports in terms of domestic currency.

u - (1*M) unit vector.

n - Foreign capital inflow coefficient.

a^{ncm}- (1*M) vector of coefficients for noncompetitive inputs in terms of domestic currency.

A - (M*M) matrix of intermediate input coefficients.

I - (M*M) identity matrix.

d_u, d_l- (M*1) vectors of upper and lower bound coefficients.

M - The number of sectors.

N - The number of different types of capital.

K - The number of labor skill groups.

The commodity balance constraints insure that the commodity supply from production augmented by imports is at least as great as commodity use in consumption, production, and exports.

Capital constraints indicate that current capital utilization should not exceed the initial capacities.

The foreign exchange constraint states that foreign exchange use must not be greater than foreign exchange inflow. Foreign capital inflow is an endogeneous variable of the model. Since the model is constructed to trace the effects of frequent devaluations, the foreign exchange rate is externally determined and is not a variable of the model. The foreign capital inflow constraint is added into the model in order to eliminate the possibility of the model choosing excessive F values. According to this constraint, foreign capital inflow must not exceed a certain fraction of domestic saving, which is assumed to be proportional to consumption. This constraint reflects the Turkish government's self reliance goal.[3] It can also be argued that financial institutions are reluctant to extend credit without limit to any country.

Finally, the flexibility constraints keep the changes in output levels within bounds. In the model upper and lower bounds are the functions of the previous year's output levels.

The Objective Function

The objective function[4] to be maximized annually is:

$$\text{Max } (1/1+r)(k'g^{t-1})'z^t + p^t x^t - q^t F^t$$

r - The rate of interest.

g^{t-1} - (N*1) vector of shadow prices imputed to capital outputs (closing stocks) in the previous year. As it will be explained later, they approximate the expected prices of opening capital stocks in year t+1.

p^t - (1*M) vector of exogeneously determined prices of the goods in terms of domestic currency.

The objective function is similar to the one used in Cigno (1971). The function maximizes the value of the total final products net of foreign capital inflow in each period. Since recursive planning models are period analyses and use sequential optimizing to explain the behavior of economic agents, closing capital stocks of each period are treated as capital outputs, hence as part of the final produts of a period. This is because the end of a period represents the end of the world in the model. Therefore, the value of the capital outputs of each period is added to the value of the final products in the objective function. In this way capital as input does not last more than one period. Capital outputs of a period are valued at the expected prices in the next period, discounted to the present at the market rate of interest, r.

Capital outputs of year t or opening capital stocks in year t+1 (or closing stocks in year t) should be valued at accounting prices imputed to opening stocks in year t+1.

However, the accounting prices in t+1 are not known in year t. Therefore, capital outputs (closing stocks) in year t are valued at expected accounting prices imputed to opening stocks in year t+1. Furtheremore, it is assumed that expected accounting prices in year t+1 are dependent solely on the most recent experience as was done in Cigno (1971). Therefore the model implies that expected accounting prices of capital outputs in year t are equal to the accounting prices imputed to closing stocks (capital outputs) in year t-1. The final products other than capital outputs are valued at domestic current prices. Thus, according to the model, production decisions are based on the most recent information available.

The constraints of the primal problem imply the objective function of the dual problem must be written as follows:

$$\text{Min } L^{t\prime}w^t + (kz^{t-1})'g^t + [(I+d_u)z^{t-1}]'j^t - [(I-d_l)z^{t-1}]'y^t$$

where:

w^t - (K*1) vector of shadow prices of labor in year t.

g^t - (N*1) vector of shadow prices of capital.

j^t - (M*1) vector of entrepreneurial profits[5] in year t.

y^t - (M*1) vector of entrepreneurial losses in year t.

The dual problem minimizes the payments to the factors of production subject to the following constraints.

b^t	g^t	w^t	h^t	c^t	j^t	y^t		
$-(I-A)'$	k'	l'	$ancm'$		I	$-I$	$\geq$	$(1/1+r)(k'g^{t-1})$
I				$-nsu'$			$\geq$	p
I			$-pe'$				$\geq$	0
$-I$			pm'				$\geq$	0
			-1	1			$\geq$	-1

b^t - (1*M) vector of shadow prices of goods in year t.

h^t - The shadow price of the foreign exchange in year t.

c^t - The shadow price associated with the foreign capital inflow constraint in year t.

The first set of constraints are the excess profit constraints in production. They state that the value of final output, including the value of capital output transferred from one period to the next cannot exceed the payments made to inputs, including the payments made to the entrepreneurs. Therefore, the constraints require excess profits to be equal to zero. The third and the fourth sets of constraints are the excess profit constraints in foreign trade. These constraints state that domestic prices of tradeable goods cannot be greater than the world prices measured in domestic currency. The second set of constraints and the fifth constraint are rather difficult to interpret. They are the reflections of the behavioral foreign capital inflow constraint included in the primal problem. However, most of the maximization problems include such behavioral constraints in their primal problems in order to produce normal behavior of variables.[6] The second set of constraints define the relationship between cost of consumption of a unit of each good to the unit's value in consumption. Each constraint in the set states that the cost of consuming a unit of a particular good is at least as great as its value in consumption. In the model the cost of foreign capital inflow is added proportionally to the cost of consumption of each good. Therefore, the cost of consuming each unit of a good net of the proportional cost of capital inflow, which is also imputed to the cost of consumption, must be at least as great as its value in consumption. Alternatively, the cost of consuming each unit of a good must be at least as great as the value in consumption plus each unit's share of the cost of capital inflow. The fifth constraint states that the cost of a unit of foreign capital inflow is at least as great as the premium on the foreign exchange over the cost of obtaining a unit of domestic currency. This is because each unit of domestic currency equivalent of foreign capital inflow is tied to a sacrifice from consumption.

The model outlined above satisfies the equilibrium condition in the economy that saving should be equal to investment. At equilibrium the values of the objective functions of both the dual and the primal problems must be equal; thus,

$$(1/1+r)(k'g^{t-1})'z^t+p^tx^t-q^tF^t=L^{t}{}'w^t+(kz^{t-1})'g^t+[(1+d^u)z^{t-1}]'j^t -[(1-d_1)z^{t-1}]'y^t \quad (1)$$

or $$(k'g^{t-1})'z^t+(1+r)p^tx^t-(1+r)q^tF^t = (1+r)[L^{t}{}'w^t+(kz^{t-1})'g^t + ((1+d_u)z^{t-1})'j^t -((1-d_1)z^{t-1})'y^t] \quad (2)$$

or

$$(k'g^{t-1})'z^{t} - (k'g^{t})'z^{t-1} = (1+r)(L^{t}{}'w^{t}-p^{t}x^{t}) + r(k'g^{t})'z^{t-1} + +(1+r)[((1+d_{u})z^{t-1})'j^{t} -((1-d_{l})z^{t-1})'y^{t} +q^{t}F^{t}] \quad (3)$$

Since the first term on the left side of Equation 3 gives the value of the closing stocks in year t (opening stocks in year t+1) and the second term gives the value of opening stocks in year t, the left side represents the value of investment in year t. The right side, on the other hand, gives the level of total saving. The total saving includes not only domestic saving, but foreign saving (foreign capital inflow) as well.

Implementation of the Model

The model represents the dynamic nature of the economy. It allows for changes in production decisions as new information becomes available. Once the model is initiated, the optimal solution in each year determines some of the parameters of the model in the next year. In other words, each year's optimal solution is reached by taking into account the information that becomes available at the beginning of each year.

The model presented above is limited by the availability of data. It is used to predict the resource allocation effects of devaluations in Turkey taking 1972 as the base year and by implementing it for four years. The conclusions that are reached from the empirical implementation of the model should be viewed as an explanatory exercise rather than be accepted as forecasts of the real effects of exchange rate policy in Turkey during the period.

Eight sector data are obtained from a World Bank study (1975) on Turkey. Physical input requirements per unit of output are measured in 1972 prices. Labor stocks for different skill groups are measured in thousands of man-years. Labor coefficients are measured in thousand man-years per billion Turkish Liras output in 1972 prices. Capital-output ratios are measured in 1972 purchaser prices. They are the estimates of incremental capital-output coefficients which are also drawn from the World Bank study. Noncompetitive import coefficients are in terms of domestic prices. Capital stocks are measured in 1972 purchaser prices. Replacement investment is not introduced explicitly. Following Parikh (1980), replacement investments are assumed to be incorporated in the intermediate input coefficients.

In order to make comparisons between the situation prevalent in the base year and the model's solutions in the successive years possible, the base year is assumed to represent an equilibrium with factor and product distortions, as was done in DeMelo (1978, 1981), and distorted prices in the base year are set equal to one. Furthermore, it is assumed that the foreign exchange rate is fixed and altered annually by the government. Under the small country assumption the changes in the foreign exchange rate affect the domestic prices of tradeable goods and the domestic prices of the imported inputs in the same proportion. Domestic prices of nontraded goods are the numeraire. The implicit assumption is that the central bank aligns its monetary policy in such a way that the prices of nontraded goods are kept constant.

In order to allow for simultaneous import and export of the same commodity, transportation margins are added to the prices of imported goods and substracted from the prices of exports as explained in Evans (1972).

In the model four sectors - Mining, Agriculture, Manufacturing, and Commerce-are identified as export sectors. Mining and Manufacturing are identified as competing imports. The model includes noncompetitive imports separately. Throughout the period under study the state of technology is assumed to stay the same. Therefore, in each period the same input-output and capital-output coefficients are used. The rate of interest is kept at 10% during the period. Flexibility constraints allow for 5% variation around the beginning of the period output levels. Devaluation of 6% on annual basis is assumed during the period in which the model is run.

Findings

The model is solved for the effects of devaluations during the implementation period. The successive solutions of the model are compared to the computed base year results of the model first. Later the solutions of the model are compared with the solutions of the model obtained under the assumption that no devaluation takes place during the period. The computed values of the objective function and the shadow prices of the foreign exchange during the implementation period of the model are reported in Table I.

TABLE I

THE VALUES OF THE OBJECTIVE FUNCTION AND THE SHADOW PRICES OF THE FOREIGN EXCHANGE

	Base Yr.	First Yr.	Second Yr.	Third Yr.	Fourth Yr.
Obj. Funct.	103.428	113.219	118.147	130.248	152.741
Shadow P. F.E.	1.12857	1.11542	1.11548	1.11598	1.05051

The value of the objective function increases from 103.42821 billions of Turkish liras in the base year to 152.74144 billions of Turkish liras in the fifth year. Since the objective function represents the total value of the final products net of foreign capital inflow, the model predicts an increase in the value of the final products.

Foreign exchange is a binding constraint during the period. Its shadow price decreases from its base year value in the first two years. In the third year it increases slightly, but then decreases in the fourth year. Since the domestic prices are the numeraire, this reduction in the shadow price of the exchange rate is attributable to an improvement in the terms of trade of traded goods vs. non-traded goods as a result of devaluation.

In addition to the foreign exchange constraint, two types of capital which are produced by Manufacturing and Construction become binding. The shadow price of capital produced by Manufacturing increases from .27844 in the base year to .48031 in the fourth year. Capital produced by Construction is not binding in the base year. However, its shadow price increases from .0049 in the first year to .02079 in the fourth year.

According to the model's results entrepreneurial ability is a scarce resource in Agriculture and in Commerce. During the period entrepreneurs in Agriculture and Commerce are awarded dynamic profits which are interpreted as rewards to the entrepreneurs for predicting the future correctly as was done in Cigno (1971). Dynamic profits in Agriculture increase in the first, third, and the fourth years. In the second year entrepreneurs in Commerce are awarded dynamic profits. In Mining, Utilities, Construction, and Transportation the model predicts dynamic losses. Dynamic profits and dynamic losses incurred during the period are reported in Table II.

In Mining these losses increase in the period except in the fourth year. In Utilities, Construction, and Transportation, however, dynamic losses are increasing throughout the period.

TABLE II

DYNAMIC PROFITS AND LOSSES

	Base Yr.	First Yr.	Second Yr.	Third Yr.	Fourth Yr.
Agriculture	.248(P)		.236(P)	.265(P)	.257(P)
Mining	1.030(L)	1.090(L)	1.622(L)	.809(L)	.917(L)
Utilities	2.967(L)	2.486(L)	2.956(L)	2.987(L)	3.058(L)
Construction	.785(L)	.830(L)	.955(L)	.959(L)	.975(L)
Commerce		.013(P)			
Transport	.806(L)	.872(L)	.935(L)	.964(L)	1.149(L)

In the model labor is separated into five skill groups. The groups represent the scientists, the high school graduates, the technically skilled group, the middle school graduates, and labor with no schooling or primary school graduates. Only the technically skilled labor is a binding constraint in the model throughout the period. The shadow price of tecnically skilled labor increases from .13783 in the base year to .15959 in the fourth year.

The solution of the primal problem gives the sectoral composition of output during the period. The sectoral activity levels are tabulated in Table III. During the period Agriculture and Commerce gain at the expense of the other sectors. In accordance with the change in the composition of the activity levels capital is reallocated among the sectors. Allocation of capital during the period is shown in Table IV.

TABLE III

SECTORAL ACTIVITY LEVELS

	Base Yr.	First Yr.	Second Yr.	Third Yr.	Fourth Yr.
Agriculture	110.00	116.00	121.38	127.45	132.28
Mining	4.20	3.99	3.79	3.00	2.85
Manufacturing	102.72	96.82	91.96	87.46	82.90
Utilities	5.00	4.75	4.51	4.28	4.07
Construction	20.00	19.00	18.05	17.14	16.29
Commerce	31.62	33.11	34.49	35.99	37.18
Transport	15.00	14.25	13.53	12.86	12.21
Services	52.07	51.47	50.87	50.2	46.66

TABLE IV

SECTORAL CAPITAL USE IN DEVALUATION ALTERNATIVE

	Base Yr.	First Yr.	Second Yr.	Third Yr.	Fourth Yr.
Agriculture	160.95	169.50	176.10	184.80	191.81
Mining	6.25	5.94	5.64	4.47	4.24
Manufacturing	73.96	69.71	66.21	62.97	59.90
Utilities	26.22	20.75	19.75	18.70	17.78
Construction	4.40	4.18	3.97	3.77	3.58
Commerce	7.58	7.95	8.27	8.63	8.92
Transportation	40.50	38.47	36.55	34.72	32.98
Services	117.53	175.53	173.48	170.93	159.37

No Devaluation Alternative

The model is also run under the assumption that no devaluation takes place during the same period. The results of the devaluation case are compared with the results of the model obtained under the assumption that no devaluation takes place during the implementation period. Such a comparison is necessary in order to determine the extent of the yearly variations in the activity levels directly attributable to the changes in the foreign exchange rate.

The sectoral output levels obtained from the solutions of the model when no devaluation takes place are shown in Table V.

TABLE V

THE YEARLY SECTORAL OUTPUT LEVELS IN NO DEVALUATION ALTERNATIVE

	Base Yr.	First Yr.	Second Yr.	Third Yr.	Fourth Yr.
Agriculture	110.00	116.09	115.92	122.98	131.59
Mining	4.20	3.99	3.79	3.00	2.85
Manufacturing	102.72	88.52	91.98	86.01	75.89
Utilities	5.00	4.75	4.51	4.28	4.07
Construction	20.00	19.00	18.05	17.14	16.29
Commerce	31.62	32.20	34.77	36.47	38.29
Transport	15.00	14.25	13.53	12.86	12.21
Services	52.07	52.22	50.04	49.16	48.21

The comparison of the model's results obtained under alternative assumptions shows that the sectoral output levels are not very sensitive to the changes in the foreign exchange rate during the period. The comparison of Table V with Table III reveals that the output levels in Mining, Utilities, Construction, and Transportation reach lower limits in both devaluation and no devaluation alternatives. The fourth year sectoral output levels of the remaining sectors are compared in the following table.

TABLE VI

COMPARISON OF THE SECTORAL OUTPUT LEVELS
IN THE FOURTH YEAR

	Devaluation Alt.	No Devaluation Alt.
Agriculture	132.28263	131.59280
Manufacturing	82.90393	75.89990
Commerce	37.18524	38.29753
Services	46.66980	48.21647

The variations in the sectoral output levels attributable to devaluations are very small. The sectoral otput levels in Agriculture and Manufacturing are higher in the devaluation case. The output levels in Commerce and

Services are slightly higher in no devaluation alternative. Therefore, only some of the traded sectors are affected favorably from devaluations. The only significant change in the output level occurs in Manufacturing.

Along with these changes in the levels of output, however small, capital allocation among the sectors is also affected by devaluations. Sectoral allocation of capital in the fourth year under alternative solutions is compared in Table VII.

TABLE VII

COMPARISON OF SECTORAL DISTRIBUTION OF
CAPITAL IN THE FOURTH YEAR

	Devaluation Alt.	No Devaluation Alt.
Agriculture	191.81016	190.57892
Manufacturing	59.90830	47.05793
Commerce	8.92445	9.19140
Services	159.37402	171.43410

In the devaluation case capital is reallocated among the sectors in favor of Agriculture and Manufacturing. Again the effect of devaluation on the allocation of capital is not very strong. The services sector loses capital in the devaluation alternative.

The comparison of the results of both alternative solutions shows that the total resource use is also affected by the devaluations. The total use of resources in the devaluation and no devaluation alternatives in the fourth year are compared in Table VIII.

TABLE VIII

COMPARISON OF TOTAL RESOURCE USE IN THE FOURTH YEAR

	Devaluation	No Devaluation
Total Labor Use[a]	3760.3845	3696.3187
Capital[b]	110.5620	107.9623
Capital[c]	329.5574	328.3056
Capital[d]	28.2199	27.6014
Capital[e]	8.3512	8.1939

[a] In thousand man-years. [b],[c],[d],[e] capital produced by Manufacturing, Construction, Commerce, and Transportation, respectively.

The total resource use is lower in the no devaluation alternative. Higher labor utilization that is achieved in the devaluation alternative is desirable in an economy with chronic unemployment. The capital use is also higher in the devaluation alternative.

The values of the objective function obtained from the model's alternative solutions are compared in Table IX.

TABLE IX

THE VALUES OF THE OBJECTIVE FUNCTION IN EACH YEAR IN ALTERNATIVE SOLUTIONS

	Base Yr.	First Yr.	Second Yr.	Third Yr.	Fourth Yr.
Devaluation	103.428	113.219	119.147	130.248	152.741
No Devaluation	103.428	105.901	108.030	113.730	118.332

The values of the objective function in the devaluation alternative are higher throughout the period compared to the values obtained under the no devaluation assumption. However, the higher values for the total final products net of capital inflow in the devaluation alternative reflect not only the changes in the real variables but also the price variations caused by devaluations. In order to deal with this problem, and to provide a basis to judge the welfare gain attributable to devaluations, the total consumption levels in alternative solutions in each year are compared, as was done in Evans (1972). The total consumption levels in alternative solutions are reported in Table X.

TABLE X

ANNUAL CONSUMPTION LEVELS IN DEVALUATION AND NO DEVALUATION ALTERNATIVES

	Base Yr.	First Yr.	Second Yr.	Third Yr.	Fourth Yr.
Devaluation	100.640	104.810	107.911	111.939	118.204
No Devaluation	100.640	102.881	104.791	109.008	112.733

In the devaluation alternative, total consumption increases at a faster rate than it does in the no devaluation alternative. The favorable effect of devaluations on the levels of total consumption in each year under the devaluation assumption is interpreted as a welfare gain obtained due to devaluations.

The shadow prices of factor inputs obtained from the alternative solutions of the dual problem in the fourth year are compared to see if one of the alternatives provides more protection to factor inputs than the other alternative. The comparison indicates that two types of capital, Manufacturing capital and Construction capital, are binding in both solutions in the fourth year. However, the shadow prices of both capital are higher in the no devaluation alternative than in the devaluation alternative. The difference between the shadow prices of Manufacturing capital in alternative solutions is not very big (.48031 in the devaluation alternative versus .51641 in the no devaluation alternative).

However, the shadow prices of Construction capital in alternative solutions differ markedly (.02079 in the devaluation alternative versus .20075 in the no devaluation alternative). On the other hand, none of the skill groups of labor is a binding constraint in the no devaluation alternative. In the devaluation alternative, however, only technically skilled labor is a binding constraint with a shadow price of .15959.

In summary, the computed results of the model indicate that the devaluations affect some of the variables of the model in the direction as expected in a Keynesian model. However, the effects of devaluations on the real variables of the model are not strong. The results also show that each traded good sector is not affected by devaluations uniformly. Only two sectors, Manufacturing and Agriculture, out of four traded goods sectors appear to gain from the devaluations. The relatively significant effect of devaluations takes place only in Manufacturing. Among the nontraded goods sectors only Services is affected adversely by the devaluations. Again the adverse effect of devaluations in Services is not strong. The model also predicts a weak resource allocation effect of devaluations. Labor use is affected favorably by the devaluations. The effects of devaluations on capital use are even weaker.

ENDNOTES

[1] Richard H. Day, "Recursive Programming", Workshop on the Firm and Market, Social Systems Research Institute, University of Wisconsin, Workshop Paper 6519, 1965. p.1.

[2] Ibid., pp.23-24.

[3] It has been a Turkish government's goal to reduce the country's dependence on foreign capital since the implementation of the First Five Year Plan. In the plans this goal explicitly stated. The self-reliance goal has been one of the policy objectives in developing countries. Michaely (1973) notes that one of the forces behind the decision to devalue the Israeli pound in mid 1950s was "to reduce the dependence of the economy on capital imports".

[4] As is explained in the chapter the linear programming model in this study minimizes saving and maximizes investment. Saving minimization implies current consumption maximization.

[5] As is explained in Cigno (1971), if in a certain year one of the upper limit constraints is binding then the activity has a value greater than the value imputed to its inputs. This positive residual is attributed to entrepreneurs' ability to predict market conditions correctly and imputed to the scarce resource, entrepreneur. In Day (1963) the positive residuals are defined as uncertainity premium. In the case a lower limit constraint is binding the value of activity is lower than the value imputed to its imputs. The negative residual is imputed to entrepreneurs for not anticipating the contraction in the activity level.

[6] Gynsburgh and Waelbroeck (1973) reports that Sandee in his 1960 study introduces a constant saving function and relates it to investment in the model. Evans (1972) introduces minumum export and minumum growth constraints. All these behavioral constraints in turn pick shadow prices.

CHAPTER VI

SUMMARY AND CONCLUSIONS

One of the overlooked problems of LDC's is the distortions that are created by their exchange rate policies. Reluctance of LDC governments to devalue their currencies in the face of balance of payments problems has contributed to misallocation of resources in these countries. LDC's became more and more dependent on relatively cheap imported capital while they were adopting labor-saving technologies to produce import competing goods. As a result, most of the LDC's were not able to create enough jobs to reduce their unemployment rates significantly in the past. Furthermore, their reluctance to devalue forced governments to adopt second best policies. These measures, in turn, have resulted in distortions in their markets.

The reluctance of the governments to devalue their currencies is deeply rooted in the static elasticities approach. The governments often cited inelasticities of demand for their exports and for their imports to justify their reluctance to devalue. However, the empirical studies that are covered in Chapter II show that exports and imports were responsive to the changes in the exchange rates in LDC's, and that the trade balances in the devaluing countries were affected favorably after the devaluations. These studies use the partial equilibrium analysis to estimate the responsiveness of exports and imports, hence the trade balances, to changes in the foreign exchange rates.

The present study differs from the studies that are covered in Chapter II by utilizing a general equilibrium optimization model. The model of the present study also indicates that resource allocation is affected by devaluations. However, the resource-pull effects of devaluations are calculated to be weak.

In Chapters II and III the alternative approaches to the balance of payments, their assumptions and predictions are covered. The empirical studies in the literature on the effects of devaluations are briefly summarized in Chapter II. Most of the studies use partial equilibrium analyses to estimate the impact effects of devaluations. These studies show that nominal devaluations do lead to real devaluations in the devaluing LDC's and the trade balances are affected favorably by the devaluations.

In Chapter IV it is shown that the fixed exchange rate policies of a country result in price distortions in both product and factor markets. In the chapter the real effects of price distortions are shown by utilizing partial and general equilibrium analyses. Within the general equilibrium analysis, it is shown that the fixed exchange rate policies result in either inefficiency (by causing underutilization of the factor which is used intensively in the production of the nontraded good) or chronic balance of payments deficits. Therefore, it is suggested that some flexibility in foreign exchange rates is necessary. In this study, frequent devaluations are suggested as a policy tool to alleviate chronic balance of payments deficits and to improve efficiency in LDC's.

In Chapter V a recursive linear programming model is built to trace the effects of devaluations within a sectoral level general equilibrium framework. As was mentioned in Chapter II the model differs from the models used in the devaluation literature. In the model devaluation affects the production decisions of the optimizing agents directly at the beginning of the period. The sectoral production levels, hence the sectoral resource use, are determined according to relative prices which are assumed to be affected by devaluations and the optimal adjustment rules that are determined by the objective function and the constraints of the model. The model is used to simulate the effects of devaluations by utilizing data for the Turkish economy.

The computed results of the model show that devaluations cause resource-pull in favor of some of the traded sectors. Comparison of the model's results obtained under the devaluation and no devaluation assumptions indicate that the devaluations have the resource-pull effect in four out of eight sectors. Agriculture and Manufacturing show resource gains while Commerce and Services show resource losses in the devaluation case. In Mining, Utilities, Construction, and in Transportation resource use is the same in both solutions.

The model also predicts higher utilization of economic resources in the devaluation alternative. A higher utilization rate of labor is a contributing factor to efficiency in an economy where chronic unemployment exists. Higher utilization of labor can also be interpreted as an improvement in the distribution of income in an underemployment economy. The model's results also indicate a higher level of total consumption in each year under the devaluation alternative compared to the corresponding levels of consumption in the no devaluation alternative.

The results of the model should be viewed as indicating the potential resource-pull effects of devaluations rather than predictions. The direction of changes in some of the real variables of the model conforms with the conclusions that are reached in Chapter IV. However, the real effects of devaluations predicted by the model are weaker than those estimated in the partial and general equilibrium models that are covered in Chapter II.

In a world of generalized floating exchange rates among the major currencies, LDC's must take advantages of the price mechanism to improve resource allocation at home and their competitiveness in the world markets by adopting more flexible exchange rate policies. More flexible exchange rate policies are expected to increase labor utilization and alleviate balance of payments problems in LDC's.

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VITA 2

Akin Sakir Taluy

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE REAL EFFECTS OF FREQUENT DEVALUATIONS IN DEVELOPING COUNTRIES

Major Field: Economics

Biographical:

Personal Data: Born in Ankara, Turkey, May 19, 1948, the son of Mr. and Mrs. Taluy.

Education: Graduated with a Diploma from the Faculty of Political Sciences, Ankara, Turkey in 1970; received Master of Science degree in Economics from Oklahoma State University in 1975; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in July, 1985.

Professional Experience: Graduate Assistant, Department of Economics, Oklahoma State University, 1974-1978; Instructor, Department of Economics, Southeast Missouri State University, 1979-1980; Assistant Professor, Department of Economics, The University of Tennesseee at Chattanooga, 1980-1984;