A MONETARY MODEL OF INDIA'S TRADE BALANCE AND INFLATION

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By

C. ASHA PRASUNA

Supervised

By

Dr. K.N. MURTY

DEPARTMENT OF ECONOMICS
SCHOOL OF SOCIAL SCIENCES
UNIVERSITY OF HYDERABAD
HYDERABAD- 500 046
INDIA

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DECLARATION

This is to state that the thesis entitled "A MONETARY MODEL OF INDIA'S TRADE BALANCE AND INFLATION" submitted to the Department of Economics, University Of Hyderabad for the award of degree of Doctor of Philosophy in Economics, is the original work done by me under the supervision of Dr. K.N. Murty, Reader, Department of Economics, University Of Hyderabad; and the same has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or any other similar title of recognition.

C Asha prasuna

HYDERABAD.
DATE4.5.1996

(C. ASHA PRASUNA)

CERTIFICATE

Dr. K.N. Murty
Reader in Economics

University Of Hyderabad
Hyderabad - 500 046

I certify that the thesis entitled "A MONETARY MODEL OF INDIA'S TRADE BALANCE AND INFLATION" submitted by Ms.C. Asha Prasuna to fulfil the requirement for the award of the degree of Doctor of Philosophy in Economics, has been carried out under my supervision.

HYDERABAD
DATE 4 May, 1996

(Dr. K.N. MURTY)

M. Akbar Reddy 7/5/96

H E A D
Department of Economics
University of Hyderabad.
HYDERABAD - 500 134.

T K Sharma 9/5/96

DEAN
School of Social Sciences

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CHAPTER 1

INTRODUCTION

1.0. The Setting

Understanding the nature and problems relating to India's external trade and payments position is a complex task and warrants an in depth inquiry into the inter-linkages between various sectors and the related issues. These have structural and institutional dimensions that have been existing ever since independence. Problems such as trade balance (TB) and balance of payments (BOP) deficits, foreign exchange shortages, deficit financing, rising inflation etc., though appear to have been solved during some specific short periods, have continued unabated and frustrating policy formulations.

The BOP crisis has intensified after the mid sixties primarily due to the widening of trade gap, successive droughts, oil shocks, mounting external debt, and the growing budget deficit. When the situation went out of control, the government resorted to devaluation as a last resort to overcome the crisis as a short-term measure.

During the process of planned development with inward oriented industrial policies, resulted in high cost structure and economy continued to depend on strategic imports to implement its plans. The share of India's exports in world trade fell from

1.91% in 1950 to about 0.53% in 1992. The trade deficit continued to widen except for one year during 1970's. The second oil shock of 1979 was more severe as compared to the first one of 1973-74. There was a substantial increase in petroleum, oil, and lubricants (POL) imports and the world recession of 1980-83 depressed the export performance. However, an increase in domestic production of crude oil during 1984-85 has eased the balance of payments position to some extent.

During the second half of 1980s, the current account deficit continued in spite of a robust growth in exports. The non-oil imports, export related imports rose significantly. The deterioration in fiscal imbalances- ratio of gross fiscal deficit to GDP; rose from 6.3% in the first-half of the 1980's to 8.2% during 1985-90. The debt service ratio rose to 30.9% in 1989-90. The Gulf Crisis of 1990 resulted in a decline of Non-Resident workers' remittances and an increase in oil import bill. This has lead to the recent devaluation in July, 1991. The present study tries to analyse the whole gamut of issues underlying the above policy measure viz, devaluation in its entirity.

1.1. INDIA'S FOREIGN TRADE POLICIES - A REVIEW

A brief review of India's foreign trade policies is presented here. International trade is an activity of strategic importance in the development process mainly of a developing economy. Scarce foreign exchange resources provide crucial inputs

and capital goods that are needed in the early stages of economic development. In view of the several limitations to the inflow of foreign aid, foreign trade assumes greater significance in the earnings and conserves foreign exchange resources. The choice of suitable economic policies- import substitution, or export promotion and related trade and industrial policies constitute significant part in the overall framework of the economic policy.

India has inherited a system of quantitative restrictions since the Second World War. During the first five-year plan, with good harvest and little pressure on the foreign exchange, the system continued without any major modifications. However, with the second plan onwards, there was a massive rise in the developmental expenditure and expansion of investments. As the developmental projects depended heavily on import of capital goods and machinery, soon it resulted in a shortage of foreign exchange which got compounded in later years with large imports of food grains and petroleum products. It was at this time that two basic policies viz (a) Industrial targeting and licensing and (b) Exchange control were introduced which were aimed at improving the economic efficiency of the regime.

During the second and third five-year plans (1955-66), import licensing and the exchange control policies were aimed at a comprehensive and direct control over the foreign exchange utilization. The major criteria for the use of import license

relate to the essentiality of imports and the indigenous non-availability of the imported products. The restrictions in the form of high import tariffs resulted in high import costs and led to a stagnation of import intensive exports.

There was an attempt for partial liberalization from 1962 onwards with export subsidies given in the form of fiscal measures or import entitlement schemes. On 6th of June, 1966, the rupee was devalued by 57.5% and it stood at Rs. 7.50 per dollar compared to Rs 4.75 earlier. This devaluation was the culmination of liberalization trend that had begun in the third plan and there was a considerable attempt to rationalize the trade and payments regime. The details of this 1966 devaluation package and its after effects are well documented in Kruger and Bhagavati (1974).

The petroleum price hike (first oil shock of 1973) resulted in acute foreign exchange shortage initially but soon was resolved with the increase in remittances from expatriates working in the Gulf countries.

However, the country's increase in imports led to the worsening of trade balance. When the Bretton Woods international monetary system collapsed in 1973, Indian Rupee was delinked from the Pound Sterling and has been linked to a basket of currencies. The exchange rate system had changed from the fixed exchange rate system to that of managed/flexible system with the

Reserve Bank monitoring the exchange rates.

The proliferation of export incentives during the 1970-80 and the widening trade gap prompted the setting-up of committees to review the trade and industrial policy regimes. The need to reduce the trade gap and to bring about stability in the trade policies was recognized. Accordingly, a three-year trade policy called as Import-Export policy of 1985-88 was introduced to reflect the liberalization trend with a considerable relaxation of import controls and a reduction of import duties on capital goods. The tariff structure was simplified by reducing the previous eleven auxiliary customs duty rates to only three rates. They are fixed at nil, 25% and 40%. Further, computerization of the custom houses was a major move to reduce the administrative delays. The trade policy reinforced the policy of canalizing agencies.

The Import-Export Policy of 1988-91 also strengthened the process of trade liberalization. Seven hundred and forty three new items have been brought under Open General License (OGL). The benefit of import replenishment has also been enlarged based on the net value added in the export products. Twenty six items of exports have been decanalised and the procedure of licensing was abolished for them.

The year 1990-91 was marked by a severe balance of payment crisis due to unfavorable developments in the external sector. A

steep fall in the growth of exports may be attributed to a variety of reasons both internal and external. External factors included recession in the US and the UK, changing international economic environment, the Gulf crisis and decelerated rate of growth of exports to rupee payment countries. The internal factors included the erosion in the competitiveness of exports, rising inflation, high import elasticity of exports, and slow rate of depreciation in nominal exchange rate resulting in the contraction of exports.

The Gulf crisis had resulted in an adverse situation on the merchandise trade. It affected both ways, namely, in an increase in POL import bill and contraction in exports (due to a trade embargo on Iraq). The rise in crude oil price emanating from the Gulf crisis had resulted in a massive bulge in import bill. Consequently, the growth of exports achieved during 1985-86 to 89-90 could not be sustained in 1990-91 due to the above mentioned reasons. The payments crisis coupled with the pressure on internal price front necessitated the formulation and implementation of a package of reforms in fiscal, industrial and trade areas.

Government announced a new trade policy on 4th of July, 1991 to carry out major structural reforms in the area of external trade. This followed the downward adjustment in the value of the rupee affected on the 1st and 3rd of July, 1991. Various other measures with regard to foreign exchange remittances, repurchase from the IMF, structural adjustment loan from the World Bank,

aid from the Aid-India Consortium and an upper credit Tranche stand-by arrangement from IMF were also undertaken to improve India's balance of payments.[1]

However, the economic performance in 1991-92 looked to be a mixed one. Severe inflationary pressure was built-up in the economy and industrial production suffered a setback due to import compression measures.

Along with the exchange rate adjustment in July 1991, EXIM scrip scheme was introduced. This policy measure tried to establish a quantitative link between imports and exports, under which certain imports were permitted only against export entitlement. This was followed by a dual exchange rate arrangement, which is known as Liberalized Exchange Rate Management System (LERMS). According to this scheme, 40% of exchange earnings are to be surrendered at official exchange rate, and the rest can be exchanged at the market exchange rate. This system brought about stability in the exchange rate and the spread between official and market rates moved in a relatively narrow range of around 17%. Since 1st of March 1993, almost all foreign exchange transactions began to be put through at the market determined exchange rate.

[1]See Rangarajan (1994)

The above review of India's trade policies can be summarized as follows: In the early years of planning process import substitution trade policies were adopted and these resulted in high cost structure and foreign exchange shortages. The need to give importance to exports was felt and consequently, incentives were given to promote exports. However, after the 1966 devaluation package, though the trade and payments regime was liberalized to some extent, the trade policies had continued to be of ad hoc in nature, and it was only from 1985 onwards, a three-year trade policy was introduced to induce stability for a period of time in the policies. The slow growth of exports, the continued liberalization of imports and other external factors caused a deep crisis in 1990-91 forcing the country to devalue its currency.

The above review highlighted the fact that though the trade policies changed according to the need of time, long-term measures to sustain the growth in exports and to minimize the imports were not given enough importance. Whenever the foreign exchange shortage occurred, import compression measures along with export promotion incentives were undertaken. When once the shortage was temporarily tackled, there was rise in imports again due to liberalization efforts. The exports could not be sustained because of the structural rigidities, high cost structure and lack of quality competitiveness of our exports. Therefore, there

is a need to frame policies which can be sustained for a longer time and able to address the fundamental causes of the trade deficit and BOP crisis.

1.2. FOCUS AND OBJECTIVES OF THIS STUDY

The present study focuses its attention on the long-standing problems of India's trade deficit, declining foreign exchange reserves and spiralling domestic prices. It tries to identify the determinants of India's trade balance and inflation within the framework of a Computable General Equilibrium (CGE) model. It examines the policy impact of exchange rate changes (devaluation) on important macro-economic aggregates of the economy. The need for a proper integration of monetary and trade sectors in analyzing the effects of devaluation is emphasized. The model takes into account some of the institutional features of the Indian economy such as foreign exchange rationing, export subsidies, import restrictions, etc.

The following are the specific objectives of the present study:

(i) To examine critically the devaluation concept, the major approaches using this concept and the linkages between trade and monetary sectors,

(ii) To review the existing models linking devaluation, trade balance and inflation using monetary approach with a view to identify a suitable methodology and model for analysing the current BOP crisis,

(iii) To identify the determinants of demand for real cash balances, export supply, import demand and India's trade balance,

(iv) To analyze the effect of devaluation on trade balance, BOP and inflation in a theoretically consistent CGE framework,

(v) To examine the usefulness of devaluation as a policy instrument

to improve trade balance and BOP, and

(vi) To undertake policy analysis involving hypothetical policy changes like devaluation, credit control, reduction in subsidies, import tariffs, and increase in export demand elasticity.

1.3. JUSTIFICATION OF THE STUDY

Earlier studies made use of models in which devaluation as an instrument to study problems relating to Trade Balance (TB) and Balance of Payments (BOP) and focussed on how devaluation affects output, prices, TB, money supply and other related macro-economic variables. They can be grouped into three broad categories viz. elasticities, absorption and monetary approaches. These approaches made certain theoretical and empirical propositions which were tested while analysing the effects of devaluation on TB and BOP using both multi-country as well as country-specific data. Improvement in the availability of reliable data and the econometric techniques prompted the growth of literature in this area. Both macro-econometric and

computable general equilibrium models were used in these studies.

The LDCs having similar BOP problems started adopting these models straightaway. Though it may sound too strong a proposition, yet, the fact remains that these approaches were developed in the advanced industrial countries to suit their economies. These models are unable to explain the behavior of LDCs' BOP crises mainly because these economies have an altogether different institutional background and also because the principles that guided the trade pattern of advanced countries cannot directly be applied to these LDC economies. The three approaches were also tested using Indian data and it was found that none of them in isolation was capable enough to explain the nature and behavior of our external sector. Due to the non-availability of an ideal model for the Indian economy, as a justification, one can adopt a closely related model and modify it to suit the economy. To analyse the BOP crisis in India, one needs to consider India's structural rigidities, development priorities and the conflicting objectives in our Five Year plans. Further, the non-synchronization of industrial and trade policies with built-in adhocism calls for a pragmatic and careful approach in analysing the BOP crisis situation.

With the above objective, we examine in some detail the devaluation concept and the related issues. Then, a critical review of the existing works is undertaken to identify the gaps

and choose a suitable methodology for the present study.

1.4. DATA SOURCES AND ORGANIZATION OF THE THESIS

The data required were collected from various issues of the following sources:

(i) Report on Currency and Finance

(ii) International Financial Statistics

(Hi) National Account Statistics

(iv) Reserve Bank of India Bulletins

The dissertation is organized in the following manner:Chapter 1 contains a review of the trade policies in the Indian context, Chapter 2 discusses the devaluation concept, theoretical approaches to devaluation and trade and monetary sector linkages. Chapter 3 reviews the empirical studies on devaluation, trade balance and inflation. Chapter 4 presents the methodology of this present study. Chapter 5 contains the empirical results and Chapter 6 consists of policy analysis and conclusions, chapter 7 gives summary, conclusions and limitations of the study.

CHAPTER 2

DEVALUATION, TRADE BALANCE AND INFLATION

Before analysing the concept and effects of devaluation, a briefreview of International monetary systems is given. This will enable us to know how the external payments were adjusted and the revolution of devaluation as an instrument to reduce the imbalances in the external sector of an economy.

2.0. INTERNATIONAL MONETARY SYSTEM

This part traces the evolution and growth of international monetary system. This helps to know how the external trade and payments adjustments occured. With the expansion of trade among nations, the issue of BOP adjustment problems have been acquiring prominence. The international monetary system had been changing from time to time to address the trade and payments problems.

The historical development of the international monetary system can be divided into the following periods, namely, Gold Standard, Gold Exchange Standard and Managed Exchange Rates with Centrally Created Reserves.

Gold Standard: The basic theoretical model depends on the assumptions that were made in classical economic theory and general equilibrium analysis: viz, the economy operates under

conditions of perfect competition, prices and wages are perfectly flexible, there is always full employment of resources, money is held only for transactions purpose, and money supply consists of entirely gold. The discussion proceeds in terms of two-country world, where there is neither technical change nor economic growth and no autonomous capital movements between the two countries.

Under these conditions, the quantity theory of money holds. This model is used to analyze more often the process of international adjustments under the gold standard. The most prominent sources of disturbances to international equilibrium were natural or man-made catastrophies which reduce the national output during a given period of time. This results in increase in domestic price level, which induces foreigners to reduce their purchases and domestic residents to increase their purchases abroad, leading to a payments deficit and an outflow of gold. As a result of reduced stock of money in the economy, the price level falls and the size of the deficit in the following period is reduced with the national output remaining at its catastrophy reduced level; the deficit, gold losses and the price reductions continue in the subsequent periods until the prices reach *a* level where the payments imbalance is zero.

This basic model is applicable in modified form to the explanation of adjustments to cause payments disequilibrium other

than natural catastrophies, such as changes in technology, shift of capital, domestic inflation due to excess spending and others. In all cases the resultant deficits are cured by domestic prices reductions, which the gold losses bring about automatically in the manner described.

The principal advantages of the system include: an expectation of long run price stability among all countries, implicit in the analysis of the gold standards financial mechanism is a beneficial flow of real resources, and it functions without any government intervention.

Gold Exchange Standard: It had evolved form the gold standard but differs from it most basically in that under its operation international reserves consist of both gold and convertible national currencies.

The features of this system include world; (a) consists of many countries, one of which is called 'banker' and the rest of which are known as 'others', (b) all countries are assumed to have fixed exchange rates and independent monetary and fiscal systems and thus they have the need to hold international reserves for settlement of payment imbalances. This has not been based on an explicit agreement among nations, but represents the outcome of historic evolution. However, the system was quite successful for a number of years from the point of enconomising

on gold, due to several shortcomings, and the 1960 Dollar Crisis led to a systematic proposal for the reform of the gold exchange standard.

Managed Exchange Rates with Centrally Created Reserves: With an international agreement at Bretton Woods in July 1944, the IMF was created. The problem of competitive devaluation was tackled by an agreement, that member countries should adhere to the maintenance of parity exchange rates. These rates were declared and registered legally with IMF and every country committed itself to maintain them and changes in parity greater than 10% could be undertaken only with concurrence from the IMF. After the first dollar crisis of 1960, the difficulties inherent in the gold exchange standard, Triffin (1968) developed the theoretical case for enabling the IMF to create centrally owned international reserves (SDR's).

The crucial weakness of the Bretton Woods system was the absence of an efficient BOP adjustment mechanism. Because of continuous changes in the underlying variables determining BOP relations- relative national income, price levels, tastes, technology, interest rates and so on, disequilibrium in the BOP continued to be a normal phenomenon. But for any country, BOP disequilibrium of the deficit variety cannot persist indefinitely. The ability to sustain a deficit is based on the amount of international reserves that the country possesses. The principal types of adjustment mechanisms include (a) changes in

relative national income or price levels, (b) movements in exchange rates and (c) imposition of direct controls over foreign exchange transactions.

The Bretton Woods system, generally, outlaws the employment of direct controls. This leaves only changes in income or prices or interest rate changes as possible methods of adjustment. However, a basic principle of the system was that exchange rates were to be held stable unless a 'fundamental disequilibrium' warranted exchange rate adjustment.

Although several exchange rate adjustments were in fact adopted by various members of the IMF prior to the break-down of the system in August 1971, the general tendency was for countries to resist adjusting exchange rates until forced by adverse BOP levels. The exchange rate adjustment problem was further seriously complicated by the inability of the US to change effectively the international value of the dollar. By 1971, following the collapse of the Bretton Woods system, the members of IMF are no longer compelled to state and maintain par values for their currencies. Instead of stable but adjustable exchange rates, a system of floating exchange rates has come into vogue among major trading countries.

Experience with managed floating during 1973-78 has shown that the advent of float rates in 1973 was an unplanned and adhoc

reaction to the collapse of Bretton Woods system. The result of this new system was wide and frequent fluctuations in exchange rates and excessive instability in the international trade and investment. The structural shock of oil price increase has led to world wide inflation with divergent rates of inflation among nations followed by deep recession in 1973-75, and large scale capital movements.

The work on reforming the above system began and an agreement on the proposed modifications to the exchange rate regime, the role of gold and SDRs was reached. Accordingly, the member countries of IMF collaborate with the Fund and other members to ensure orderly exchange agreements. Special programs like compensatory financing are devised to support member countries for the purpose of buffer stock financing to stabilize commodity prices through international agreements. Extended and supplementary financing facilities were operated by the Fund to members with BOP problems.

2.1. CONCEPT OF DEVALUATION

Devaluation means a reduction in the exchange rate or value of a country's currency in terms of foreign currency. It is viewed as a method of improving country's competitiveness. It renders domestically produced goods more attractive abroad, while making foreign goods less attractive at home. This shift in the attractiveness of traded goods causes the level of exports to

rise, and the level of imports to fall, there by leading to an improvement in trade balance.

The necessity of devaluation arises when the currency of a nation continues to be over valued. Thus, it is used as a corrective action. When the nominal exchange rate is held fixed or adjusted too little in response to over expansion of domestic money supply, or increases in import or domestic costs, or the domestic inflation out-paces the foreign inflation, devaluation is undertaken sooner or later[1].

The adoption of a new and lower parity of exchange rate occurs when a country has a consistent deficit on trade account, is building-up debits, increase in domestic inflation making exports internationally uncompetitive, industrial inefficiency and improper management of the economy.

A country's foreign exchange system can be used to pursue objectives like clearance of the foreign exchange markets, foster industrialization, improving terms-of-trade and raising revenue for re-distribution of income among broad classes.

International capital flows and foreign trade play a major

[1]See Fisher (1977)

role in all economies, more so, in developing countries; as the problems of industrialization have always been linked to problems of trade. The instruments of trade policy had been used both for purely trade related goals but also as tools of overall development policy.

In the context of flexible exchange rate model, foreign exchange is seen as a resource like any other good and the demand for it always equals to its supply. The exchange rate as a price of foreign exchange clears the demand and supply in foreign exchange market just as commodity prices are allowed to clear commodity markets.

However, in many developing countries the acute shortages of foreign exchange had been a recurring problem. This problem was discussed in development planning literature in the framework of 'two-gap' or 'multi-gap' models. These models assume fixed input-output coefficients and limited possibility of expansion of exports. This results in a foreign exchange shortage which becomes a constraint on growth.

The neo-classical response to the structuralist view is in terms of role of relative prices and in particular exchange rate adjustment as a means of overcoming any foreign exchange shortage. They argue that the foreign exchange gap reflects the over valued real exchange rate and if the exchange rates were

allowed to adjust the foreign exchange market, there would be no foreign exchange gap.

However, the experience of developing countries reveal that it is a difficult task to achieve or restore equilibrium in foreign exchange market by raising the effective exchange rate. As was argued by Kruger (1978), the typical pattern of adjustment policies often involves an unsuccessful devaluation followed by a return to various forms of foreign exchange rationing.

The reasons for a country to face a foreign exchange crisis may stem from fiscal and monetary policies resulting in an inflation above that of world inflation which leads to an appreciation of real exchange rate and excess demand for foreign exchange and ultimately leading to balance of payments problems. A shortage can also occur due to an exogenous change in the country's terms-of-trade. Depending on the intensity of the problem, a variety of measures are adopted like, letting the exchange rate float until the excess demand for foreign exchange disappears, or it may keep the exchange rate fixed and attempt to adjust by borrowing or it can devalue its currency or ration the foreign exchange expenditure.

Historically, the analysis of devaluation was centered around the potential income and employment effects[2] . It had been

[2]See Robinson (1947)

seen as a method of improving the country's export competitiveness. During 1930s, nations facing with domestic pressures decided to devalue their currencies in the hope of alleviating domestic pressures. Thus, the theoretical works reflect the pro-employment bias concerning the effects of devaluation (Joan Robinson, 1947) .

After the setting-up of IMF, devaluation is encouraged whenever a country's international payments position is in 'fundamental disequilibrium, whether that disequilibrium is brought about by factors outside the country or by indigenous developments. As the measure is politically disfavoured, governments kept it as a last resort after adopting several partial substitutes. There were over 200 devaluations occurred during 1947-70 and many took place in the years of postwar re-adjustment, especially in 1949.

Devaluation in the context of a developing nation is more complex than a simple adjustment of exchange rate. The exact nature of disequilibrium is important in analyzing devaluation and care should be taken to study other adjustments as well that accompany devaluation. Broadly, one can find four types of devaluation packages (see Kueger, 1974):

(a) straight devaluation (discrete change in principal exchange

rate),

(b) devaluation with a stabilization program of contractionary monetary and fiscal policies aimed at reducing the level of aggregate demand or the rate of increase in it,

(c) devaluation accompanied by liberalization whereby import controls are reduced and

(d) devaluation accompanied by partial or full unification of exchange rates whereby multiple exchange rates are combined into a single unified or at most two rates.

These categories however, are not mutually exclusive. Some elements of all are often present in devaluations that take place in developing countries.

The usual apprehensions expressed about the consequences of devaluation include:

(i) the presence of elasticity pessimism- it may not lead to an improvement in the balance of payments,

(ii) it may in fact lead to worsening the terms-of-trade,

(iii) by inducing an increase in domestic prices it may set in motion wage-price spiral and lead to an erosion of competitiveness that the devaluation is expected to achieve,

(iv) it may create income distribution problems and finally,

(v) it may be politically disastrous for the government which undertakes it.

The measure of devaluation requires both judgment and

delicacy in handling through the transitional phase. The problem of decline in aggregate demand and price rise should be tackled carefully.

Initially, during 1945-73, countries tried to use devaluation to maintain a stable exchange rate. Most countries had pegged their currencies against the US dollar. Governments were willing to buy and sell foreign exchange at the official exchange rate. The level of reserves was an indicator to maintain constant exchange rates. Outflow of reserves were a sign that the exchange rate might have to be devalued. Though the Bretton Woods system saw a remarkable expansion of world trade, countries started following policies that were incompatible with maintenance of constant exchange rates and consequently the system became crisis prone during 1960's and collapsed in 1973.

Some countries initiated fiscal and monetary policies to prevent devaluations (for example, US in early 1960s and UK during 1964-67). Governments regard devaluation as a sign of failure and were anxious to avoid it. Yet, when the policies needed for an external balance (restrictive monetary policy for instance) clashed with the needs of domestic policy (monetary expansion), devaluation became more attractive. Particularly after an election, devaluation was used to blame the economic misdeeds of the previous governments.

Once it became clear that countries were not willing to run

their macro-economic policies with the main goal of keeping exchange rate stable, the rapid capital movements led to the collapse of Bretton Woods system.

During the flexible exchange rate regime, exchange rate may vary from day to day or even minute to minute. Governments intervention in foreign exchange market takes place in this system too. Usually, governments have some exchange rate target and intervene to attain it. Since exchange rate movements affect trade and domestic inflation, countries are unwilling to initiate domestic policies independent of the exchange rate. They intervene from time-to-time with the hope of moving the exchange rate in appropriate direction.

There were 109 devaluations[3] that were effected during the period 1948-67. Twenty four countries devalued to the extent of 75%, while thirty eight countries devalued their currencies in the range of 40-75%. The distribution of these devaluations across continents reveals that thirty six countries were in Africa, twenty three in Latin America, fourteen in Asia (excluding Japan) and twenty in Europe.

Since Independence, the Indian rupee was devalued thrice.

3 World Development Report (1984)

The first devaluation took place on the 18th September, 1949 to the extent of 30.5%. This was inevitable because 75% of India's export trade was with the countries of Pound Sterling and the U.K. had devalued its currency in 1949 and so India had to follow suit to retain its export trade share. The second devaluation took place in 1966 due to the severe foreign exchange crisis and the need for stepping-up essential imports necessitated due to droughts. Again in 1991 for the third time, rupee was devalued as the country was faced with severe foreign exchange and BOP problems.

2.1.1. GENERAL EFFECTS OF DEVALUATION

(1) Expenditure switching effect: Devaluation pushes-up prices of traded goods. If there is full employment with current account deficit, then the demand would switch from foreign to domestic goods and the problem is solved. But it is a very rare event. So, devaluation causes a two-way effect- both reduces and increases domestic demand. Unless measures are taken to curtail the aggregate demand, it results in domestic excess demand which in turn increases wages and will off-set the initial positive effects of devaluation. Devaluation may be effective unless it translates into real devaluation.

The relative prices of imports also go-up as compared to the prices of non-traded goods. So far as the demand is concerned, there would presumably be a substitution of traded goods by

non-traded goods. Since import substituting industry becomes more profitable, diversion of resources takes place. Exports become more profitable and diversion of resources from non-traded goods sector to traded goods sector may occur.

(2) Expenditure reduction effect: In the context of supply constraint i.e., when output, Y cannot be increased, expenditure (E) must be reduced for the balance of trade to improve (TB = Y-E) . Devaluation should be accompanied by contractionary monetary and fiscal policies. Otherwise, goods for additional exports or goods for import substitution will not come.

(3) Terms of Trade effect (ToTr): Devaluation leads to an increase in price of imports in terms of the domestic currency. The increase in the price of exports may not be immediate and as a result, the terms of trade, measured as a relative price of exports and imports will tend to worsen. It is of course, expected that additional volume of exports and reduced volume of imports would neutralize this effect, so that the overall impact on TB is positive. But ToTr effect is significant in countries which have an import basket of capital and intermediate goods for which import demand is price inelastic.

(4) Real balance effect: Devaluation increases prices of traded goods and thus contributes to inflation. Accordingly, the value of real wealth falls. Consumption expenditure can therefore be reduced so that additional savings ensure that the value of real

wealth is unchanged. This would have a positive impact on balance of trade which however, may not be very significant.

(5) Investment effect: Due to rise in the prices of traded goods, profitability increases. This induces investment in these sectors leading to capacity creation and multiplier effects will operate in the long-run.

(6) Capital inflow effect: This effect will occur depending on the expectation of future devaluations. If there is no further devaluation, there should be an increase in capital flows into the home country. When devaluation is a part of an overall liberalization package, it may increase foreign direct investment which will have positive effect on balance of trade in the long-run.

(7) Redistributional effect: As there is an increase in prices of traded goods, resources move from the non-traded goods sector to the traded goods sector. Factors of production will be used more intensively in the traded goods sector to its benefit. There may be some redistribution from the private sector to the government sector. Also there will be redistribution from wages to profits. This takes place because money wages do not react immediately to a rise in prices. They either do not react, or react with a lag. The result is that real wages go down.

(8) Monetary effects: Depending on the way the budget deficit is financed, the supply of money will change. The demand for money in any case goes-up because of the higher price level. Higher prices, particularly of imported inputs, leads to greater credit requirements to finance inventory holdings. If money supply is restricted through curbs on bank credit, the additional credit requirement may push-up the interest rate. This reduces investment. To the extent that the real interest rate increases, inflow of capital should fall.

(9) Output and price effects: The fear that the devaluation is inflationary had been expressed several times. But, at least hypothetically, it could also be deflationary. If imports are constrained by exports, to the extent that a devaluation leads to increased export earnings, it permits increased imports. This could lead to a fall in the prices of imported goods. Even if the prices of exported goods go-up, the overall effect on the price level could therefore be deflationary. Output expansion or contraction depends crucially on whether new capacity is created or existing capacity is switched from the domestic sector to export sector[4].

Several empirical works tried to quantify the above effects of devaluation using different models.

[4] See Debroy (1991)

2.2. THEORETICAL APPROACHES TO DEVALUATION

The question of an imbalance in balance of payments and its restoration had been analyzed for the past six decades in various ways. The earlier approaches were of partial equilibrium type whereas recently, the focus has shifted to general equilibrium framework; with foreign exchange markets seen as one of the interrelated markets.

In one of the earliest works, Humes' (1752), described the price-specie flow mechanism i.e., the automatic adjustment of balance of payments deficit under the gold standard. The out-flow of gold from a deficit country would reduce its money supply and this leads to a decline in prices and, on the other hand, surplus country will have increased money supply and higher price level. This makes foreign goods more expensive in a deficit country and imports will be more in a surplus country. Because of changed relative prices and real balances, people in deficit country decrease their purchases from abroad and citizens of surplus country increase their imports. This process would continue until the payments balance is restored.

The analysis emphasizes the need for price adjustments (elasticities approach of Robinson (1947)) through exchange rate adjustment. The foreign trade multiplier model tries to analyze the effects of exchange rate changes on terms-of-trade and the

conditions under which devaluation improves the trade balance (Metzler, 1949).

The conditions under which exchange rate depreciation improves the payments balance is a partial equilibrium analysis, where all other exogenous variables except exchange rate are assumed constant i.e.,*'ceteris paribus'* clause, and consequently the impacts defined were 'partial' in nature. Infact, the change in the payments balance directly determined by the exchange-rate variation influences, among other things, national income and the stock of money. The rate of changes in money stock and domestic prices are ignored in the partial equilibrium analysis. The elasticities approach suffers from the assumption that the incomes and prices of all other goods remain constant.

There were some attempts to introduce the possibility of income or price changes into the elasticities approach (Clament, Pfister and Rothwell, 1967). This approach could not be used as a guide by policy makers because there are computational difficulties with it.

Haberger (1950) derived an expression for the change in trade balance following a devaluation in a Keynesian framework. However, this analysis also has difficulty in the empirical estimation of the parameters.

Alexander (1952) tried to look at the macro-economic aspects of the problem with the help of Keynesian model. His contribution, known as the 'absorption approach' was the major development to analyze the effects of devaluation. Starting with an accounting identity, that a payments deficit is nothing but the difference between country's income and expenditure, he highlighted the role of macro-economic factors on analysis of devaluation and analyzed the effect of devaluation on levels of absorption and income.

According to him, devaluation would lead to an increase in exports, and real income would increase via the foreign trade multiplier. Expenditure would rise with income. Thus, if devaluation leads to a smaller increase in real expenditure than in real income, there will be an improvement in trade balance. This line of argument raised the efficiency of exchange rate policy (i.e. Monetary and fiscal policies can be used to correct the trade deficits) .

Absorption approach was criticised by Machlup (1955, 1956). In Alexander's formulation, all quantities are in real terms while from a balance of payments point of view, they ought to be in money terms. Since it is clearly possible for the 'real' and 'money' balances to move in opposite directions, an analysis based on real values may well be misleading from a policy

makers' point of view. The neglect of relative price effect was also pointed out.

However, Alexander's contribution was his analysis of effects of devaluation under differing cases of full employment and unemployment, and varying supply and demand conditions. Alexander (1959) tried to synthesize the elasticities and absorption approaches. The initial effects or impact and secondary effects of devaluation were analysed.

There were some other attempts to reconcile the two approaches Brens (1957) and Michealy (1960). Brens using the Leontiff input-output framework tried to analyze the effects of devaluation. His conclusion was that the efficiency of devaluation depends on income and substitution effects under the stated assumptions.

Michealy (1960) felt that under conditions of unemployment in a developing country, the possibility of employment and output increases leads to an improvement in the trade balance. He highlighted the importance of cash balance effect. A change in relative prices leads to a decline in real cash balances and, therefore, decreases the absorption. The role of money and monetary policy in the analysis of devaluation was suggested. in particular, he argued that Keynesian neutral monetary policy (fixing interest rates) will nullify the effect, while the

orthodox neutral policy (fixing nominal money supply) will make it a success.

The debate on the synthesis of the two approaches led to the recognition of role of money. Meade (1951) in an eleven equation model tried to include monetary variables. Noting that Meade's analysis is some what restrictive, Tsiang (1961) tried to see the role of money supply in cases such as (a) Internal balance being assumed, (b) Keynesian neutral monetary policy and (c) Orthodox neutral monetary policy are assumed. Further, the fact that money income, real income and real output are different in an open economy was explicitly taken into account.

The attempts to introduce money into the analysis of the balance of payments using general equilibrium models was started with the significant contribution of Hahn (1959) . The standard two-country, two-goods model was used into which two fiat currencies were introduced. It was demonstrated that in the model without money, there were two alternative sufficient conditions for the BOP to improve when the terms-of-trade deteriorates. These are: (1) the sum of marginal propensity to spend on imports should exceed unity and (2) the two goods should be gross substitutes in the world market.

After the introduction of money into the analysis, the

result obtained was: "Assuming that the goods market to be in equilibrium both before and after a change in the exchange rate, the balance of payments of country-1 will change in the same direction as the price of currency-2 in terms of currency-1 changes provided all goods and currencies are gross substitutes" (Hahn 1959, p.117). As a special case, if a small country devalues its currency so that its bilateral terms-of-trade cannot change, then devaluation necessarily improves trade balance regardless of whether or not goods are gross substitutes.

Kemp (1962) obtained similar results as that of Hahn, with an addition of role of real balance effect in the actual adjustment and mechanics of the process. In small country case, the balance of trade always improves with devaluation. The direction of movement of terms-of-trade was found to be independent of the result on the balance of payments. This implies that gross substitutability is sufficient to have a successful devaluation regardless of terms-of-trade.

Pearce (1961) introduced the role of non-traded goods in the adjustment process of balance of payments theories. Devaluation will cause the price of home goods to fall relative to traded goods and this results in a shift in production away from home goods to traded goods. In full-employment, with no change in output, this requires a cut in real expenditure. For a devaluation to improve trade balance, the following conditions

are required:

1. "A cut in money spending equal to
   a. the trade balance improvement plus
   b. the money equivalent of the real gain or loss due to the change in the terms-of-trade
   c. the money equivalent of any change in tariff revenue due to the change in terms-of-trade.
2. A fall in the price of non-traded goods relative to that of traded goods.
3. Some change in the real terms-of-trade which may be positive or negative. This will be small relative to the effect in 2".

Kruger (1974) had shown that the change in relative prices implies a drop in real income at full-employment and therefore a decline in real consumption.

The introduction of non-traded goods makes the model complete and its working much clearer and did not alter the basic result obtained by Hahn (1959) viz, the balance of trade improves with a devaluation if all goods and money are gross substitutes.

The general consensus on the elasticities-absorption debate was that it led to a rediscovery of the role of monetary factors in balance of payments adjustment process. As a result of the works of Hahn (1959), Johnson (1958), Michealy (1960), Mundell (1968), Tsaing (1961), another major and new approach in the

analysis of payments issue called 'monetary approach' had emerged.

2.3. MONETARY APPROACH TO DEVALUATION

The succession of approaches (summarized in Johnson 1976b, 1977b) to the theory of balance of payments adjustment process led to the emergence of monetary approach during 1970s as an alternative to the elasticities, absorption and other Keynesian approaches.

The role of money in the adjustment process originated in the works of Polak (1957) and his associates at the IMF and also in the works of Mundell (1968, 71), and Johnson (1972). The analyses of Branson (1975a, 1975b), Frankel and Johnson (1975, 1976a, 1976b, 1977a, 1977b, 1977c), Romberg and Heller (1977), Whiteman (1975), Dornbusch (1973, 1974, 1975), Mussa (1976a), Rodrigeiz (1976) and Swobade (1973) refer to fixed or adjustably pegged exchange rate regime. For floating exchange rate regime, the studies include Myhorman (1976), Isard (1978), Dornbusch (1976), Frankel (1976b) Humphrey (1977) and Mussa (1976b).

The historical development of balance of payments theory (described in detail in Johnson 1977) compares the Humes price-specie flow mechanism and monetary approach. Describing the other approaches in sequential manner, it explains the monetary approach in detail. The basic proposition is that balance of payments disequilibrium involves an inflow or outflow

of international money and hence must be treated as a monetary phenomenon and requires application of tools and concepts of monetary theory (Frankel and Johnson eds 1976).

Monetary approach in the context of fixed exchange rates can be summarized as follows: According to monetary approach, the relationship between the demand for and supply of money is *a* crucial determinant of balance of payments. It is treated as a stock (and not flow) over a given time period. The approach rests on the basic principle that for any country over the long run, there exists a stable demand function for money as a stock, i.e., demand for money is a stable, linearly homogeneous function of real income.

Supply of nominal money is the product of money multiplier (m) and the monetary base (high-powered money). The multiplier, which represents the extent of multiple credit creation is sometimes assumed to be either constant or does not systematically change in response to changes in monetary base. The monetary base has two components- domestic credit (D) and international reserves (R). The latter is domestic currency value of international reserves of the government and central bank. This R can be increased or decreased by any inflow or outflow of reserves when the balance of payments is in a surplus or a deficit. It can also change with exchange rate variation.

In line with these concepts, M_1 is used as the money concept

(though some use broader definition of the money supply)• The money market equilibrium is described as $M^d = m (D+R)$.

The crucial thing in monetary approach is that it identifies balance of payments disequilibrium with adjustments in money market. The relationship between demand for and supply of money is important in this analysis. They postulate that there is always a tendency towards the stock equilibrium in the money market.

For simplicity, assuming constant multiplier (m), changes in money demand (M^d) and domestic credit (D) are the active variables that can pull the money market out of equilibrium. Therefore, changes in R, international component of monetary base, that restore or maintain money market equilibrium under fixed exchange rates. Such changes in R constitute balance of payments deficits or surpluses.

Depending on the role of money i.e., whether treated as asset or wealth, the monetary approach models can be grouped into two categories, viz., Monetarist literature and Portfolio balance literature.

In the monetarist literature, the analytical techniques include both macro-economic growth models (Dornbusch (1971), Frankel (1971), Frankel and Rodinguez (1975), Johnson (1972) and

Purvis (1972)) and Hahn type Walrasian comparative static models of which Dornbusch (1973a, 1973b) are the most representative.

The usefulness of Hahn type Walrasian model lies in the fact that it enables the investigation of the direction of changes in the terms-of-trade that accompany a devaluation and the role of non-traded goods in the adjustment process. Dornbusch (1973b) analyses the impact of a change in a control variable and the long-run effects of such changes focusing on balance of trade rather than on the overall balance of payments.

The major conclusions of these two types of models in the monetary approach seem to be identical. They include (i) in the long-run, devaluation has no lasting impact on the balance of payments, (ii) in the short-run, Kemp (1970), Kruger (1974) found that equi-proportional devaluations and decreases in the nominal money supply have equal impacts on the balance of payments, (iii) devaluation improves trade balance and overall balance of payments in the short-run, (iv) Frankel and Rodinguez (1975) showed that devaluation leads to a short-run surplus in the capital account and a deterioration in the debt service account, (v) introducing non-traded goods into the model, Dornbusch (1973b) confirmed the results of Kemp and Kruger that the relative price of the home goods declines in the developing country in the short-run, thus leading to a shift in production

away from home goods to traded goods.

John Kyle (1976), tried to reconcile the elasticity and absorption approaches to payments analysis using an open economy model. Traditional method of extending macro-economic model to deal with trade problems was considered inadequate. A more complete macro-economic model which included production and monetary sectors along with real variables was specified. This model was then used to analyze the short-run impact of exchange rate changes on output, employment and balance of payments. It was shown that under Keynesian unemployment, a devaluation might lower the level of employment and output even if it succeeds in improving trade balance, whereas under the Classical full-employment situation, a devaluation would always lower the level of output and employment.

Connolly and Taylor (1979) analyzed the application of monetary approach to developed and developing countries. They compared the results for 17 developing and 10 developed countries that had changed their exchange rate regimes during 1959-70. The relationship between foreign reserves and domestic credit was also examined. Relative and absolute changes before and after devaluation were analyzed.

Sunderajan and Bhole (1988,89) have tried to test the monetary approach to devaluation in the Indian context. The

relationship between BOP and foreign prices, exchange rates, real income and domestic assets was examined. The effects of domestic assets on the BOP and vice-versa were also analyzed. Following Connolly and Taylor (1976), the above relationships are estimated in three functional forms for the period 1960-61 to 1984-85 on annual data. The broadconclusion is that the performance of the monetary model is not satisfactory and the changes in BOP cannot be explained solely with a monetary model in India.

2.3.1. RELEVANCE OF MONETARY APPROACH TO DEVELOPING COUNTRIES

Role of demand for and supply of money has been an implicit feature in most attempts to analyze BOP over the past five decades with traditional tools of value theory. Demand and supply schedules and their elasticities occupied center stage during 1920s and 1930s.

In developing countries where inflation rates widely differ, to examine the causality between devaluation and inflation, given the domestic credit level, all other things being equal, requires fixed exchange rate adjustment through devaluation over time. The process has an impact on balance of payments [5].

[5] See Edwards (1987)

Balance of payments is viewed essentially as a monetary phenomenon and the monetary planners' responsibility lies in the orderly growth of money supply. Monetary approach provides simple empirical framework for policy evaluation. It aggregates current and capital account and focuses on demand and supply of money and their consequent influence on reserves position. It argues further that a developing country can maintain a negative current account balance, yet promote balance of payments stability by attracting capital inflows. This hypothesis has a special relevance in the sense that, through appropriate monetary management, it is possible to create a stable climate to attract foreign exchange and utilize it for development programmes. The reserves accrued to capital account may be utilized to off-set current account imports. The policy prescriptions of this approach are simple and credit control can be used as an instrument of monetary management. The measurement of equilibrium adjustment values of prices, output and foreign reserves to a policy change in credit will become much simpler.

2.4. LINKAGE OF TRADE AND MONETARY SECTORS

Various approaches to devaluation tried to examine the effects of devaluation on trade balance and balance of payments. The elasticities approach concentrates on trade elasticities and the absorption approach tries to explain the effectiveness of devaluation in terms of total expenditure and income, while the

monetary approach, on the other hand, analyses the role of monetary factors in the analysis of devaluation.

While the elasticities approach postulates the Marshall-Lerner condition for an improvement in the trade balance to occur, the absorption approach highlights the need for cutting down the aggregate demand. The monetary approach believes that devaluation will only have a transitory effect. Synthesis of the first two approaches has led to the monetary approach. However, the inter-linkages between the trade and monetary sectors had not been clearly established. The influence of monetary variables i.e., the supply of and demand for money on trade variables could be analyzed with the help of an integrated model. Such a model can incorporate an additional link between trade and monetary sectors through a new variable called the 'monetary disequilibrium variable' derived from the estimated money demand function. This variable is used in exports and imports functions to capture the effect of monetary variables on trade variables.

The policy of devaluation has a multi-faceted effect. It not only influences the trade flows but also affects the monetary sector. It affects imports, exports, price level, money supply, output etc. One can analyse its influence in detail.

2.4.1. DEVALUATION AND TRADE BALANCE

The question **as** to whether devaluation improves trade balance (TB) or not has been debated for the past four decades. The level of trade balance after devaluation could be traced with the help of a J-curve , i.e., the TB may deteriorate first and an improvement may come about later. This proposition is based on the empirical observation that trade flows require some time-lags to adjust to a change in the exchange rate.

In other words, at the time of devaluation, the economy (TB) is at the left most point on the J-curve. Soon after devaluation, current account may worsen as the economy travels to the bottom of the J-curve. This may occur because imports had been contracted and need to be paid in foreign currency. The value of imports rise in domestic currency as foreign currency becomes more expensive due to devaluation. The increase in the value of exports will be slow. As the value of imports decreases and that of exports increases, overtime, the current account will improve.

Empirical studies pertaining to both developed and developing countries have, however, thrown-up mixed evidence. On the occurance of J-curve phenomenon, in the short-run, the existence of J-curve implies that the foreign exchange market may be unstable in the absence of capital mobility. The nature of the capital account need to be considered for the analysis of effects of exchange rate changes.

2.4.2. DEVALUATION AND INFLATION

Devaluations are generally feared and postponed for long periods. It is undertaken usually as a last resort. The potential inflationary effects of a devaluation are widely debated and analyzed empirically. Monetarists argue that inflation is basically caused by excess demand from the monetary expansion while the structuralists contend that inflation is caused by the structural and supply rigidities in the economy.

The relation between devaluation and inflation is based on the relative price and trade effects of devaluation. Devaluation raises the relative prices and production shifts in favour of traded goods sector and, therefore, raises the relative domestic price of traded goods. To the extent that traded goods form the component of workers budget, devaluation reduces their consumption, forcing a reduction in real wages. If higher money wages are demanded by the workers, this creates a spiral of high prices, further wage demands and so on. Therefore, nominal devaluation may result in price rise and reducing the effective rate of devaluation.

The implications of monetary approach to balance of payments are viewed as self correcting and as such no policies are required, and may even be ineffective except in the short-run.

The only possible long-run remedy to a BOP deficit is reduction in the rate of credit creation.

It is viewed that devaluation can have an impact only through possible effects on the demand for and supply of money. This effect must come through the increase in domestic prices caused by the downward adjustment in the exchange rate. The change in the relative prices of traded and non-traded goods leads to an increase in the domestic general price level. This increases the demand for nominal money balances which is a stable function of money income. If that stock demand is not satisfied from domestic credit expansion, an inflow of money from abroad will take place, producing a balance of payments surplus and, therefore, a gain in international reserves. The real domestic balances will be reduced because of devaluation and residents will be forced to restore them through international credit or commodity markets. However, the resulting balance of payments surplus continues only until the stock money market equilibrium is restored. That means the effects of devaluation are strictly transitory.

In the long-run, devaluation has no effect on real economic variables and it merely raises the price level. The only condition postulated is that a reduction in real cash balances (caused by devaluation) would produce a reduction in real expenditures or absorption, out of a given real income.

This real balance effect is supplemented by an increase in the domestic currency prices of traded goods relative to those of non-traded goods. A resource shift from non-traded to traded goods industries may occur. Inflationary expectations are incorporated into the floating exchange rate determination where as it is omitted in the analysis of fixed exchange rate case (except to the extent that inflationary expectations affect the demand for money).

CHAPTER 3

REVIEW OF LITERATURE

A review of some of the important studies relating to devaluation and its effects is presented here. These are grouped into three categories viz, (i) studies relating to devaluation and trade balance (J-curve phenomenon) (ii) devaluation and inflation and (iii) devaluation studies in the Indian context.

The effects of devaluation on trade balance and balance of payments were analysed in the form of country-specific and multi-country studies. The pattern of adjustment of trade balance in response to a devaluation was termed as J-curve phenomenon.

The relationship between devaluation and inflation is based on the relative price and trade effects of devaluation. Devaluation changes the relative prices and production shifts in favour of traded goods sector and, therefore, raises the relative domestic price of traded goods. Therefore, nominal devaluation may result in price rise. Monetarists argue that inflation is basically caused by excess demand coming from the monetary expansion while the structuralists argue that inflation is caused by the structural and supply rigidities in the economy.

3.0. EFFECT OF DEVALUATION ON TRADE BALANCE

Richard Cooper (1971) analysed 24 devaluations undertaken during 1959-66 in 19 developing countries. He examined the

one-year change in the level of foreign exchange accounts from the year of devaluation to the following year and found that the impact was consistent with the theories that expect both current account and balance of payments to improve. The drawbacks of the study, however, include (a) the non-reporting of foreign accounts for later years, thus making it impossible to determine whether the improvement was a temporary or permanent one, (b) other important variables like government policy on credit were not included in the analysis.

In an attempt to overcome the short-comings of the Cooper's analysis, Connolly and Taylor (1972) estimated the relationship between balance of payments and rate of domestic credit creation. Percentage change in net foreign reserves in the year after devaluation was regressed on the rate of domestic credit creation in the year following devaluation. It was found that (i) higher the rate of devaluation, greater was the improvement in foreign exchange reserve position and (ii) higher the rate of domestic credit expansion following devaluation, smaller was the improvement in reserve position.

Some studies such as Lafer (1973), Talent (1975), Miles (1978) have tried to see whether devaluation improved trade balance (TB) over time. Lafer's (1973) analysis used the time path of TB that included apart from the devaluing year, three years preceding to it and three years succeeding to it. The TB

was defined as the level of free on board (f.o.b.) exports minus level of customs, insurance, freight (c.i.f.) imports both in foreign and domestic currency. He tried to determine whether TB, on an average, was negative in the years following devaluation as compared to the preceding years. Like in other studies, the association between TB and changes in exchange rate was examined without including any other domestic policy measures. The results provided little evidence of devaluation causing significant or sustained improvement in the TB.

The J-curve phenomenon explains possible rapid increase in domestic activity relative to activity abroad because of the favourable effect that devaluation is likely to generate. The contracts already in force in specified currencies dominate the determinants of current account at the time of devaluation. Over a period of time, new contracts made after devaluation begin to dominate and the pass-through of devaluation is effected (Magee, 1973).

Junz and Rhomberg (1973) felt that the expansion of exports and the decline in imports involve substantial lags. They had identified five types of such lags and the evidence supported lags of up to five years in the effects of exchange rate changes on market shares of countries in world trade.

Lafer's study was re-examined and expanded by Salent (1975)

for some developed countries. The data were expressed in foreign currency and this modification has slightly increased the frequency of TB improvement but the conclusions were similar to those of Lafer's findings. He extended the analysis to Balance of Payments (BOP) which was defined as the changes in international reserves minus allocations of SDR's. It was found that devaluation improves BOP in most cases, with improvement in the combined capital account and non-trade current account more than off-setting any deterioration in TB. Thus, it appears that devaluation clearly improved BOP but did not seem to affect the TB in any particular direction.

Miles (1978) examined the impact of devaluation on TB and BOP. The data related to 17 countries for the period 1955-73 incorporating variables such as government policy, high powered money, government consumption and exchange rate. In this analysis, the ratio of exports to imports (X/M) was used rather than the usual TB variable. It was tested whether there was any significant increase in the average value of X/M following devaluation. 'Difference of means test (t-test) was performed to determine whether the average value of X/M before devaluation was statistically different from the average value of X/M after devaluation. The results show that devaluation had not caused any faster increase in exports relative to imports compared to the pre-devaluation period. A similar analysis for BOP has shown improvement in the BOP but not in TB after devaluation.

Donovan (1981) examined twelve IMF sponsored devaluations between 1970-76 . He compared the experience of developing economies with that of non-oil exporting developing countries. It was found that devaluations tended to improve export growth in the long-run, though not initially, a result consistent with the J-curve view of export response. Imports have also grown following devaluation, but less rapidly than the exports.

Krueger (1983) had argued that the J-curve phenomenon occurs because of exchange rate changes. After devaluation, transactions relating to goods already in transit and under contract need completion and they dominate the short-run changes in the TB. So the TB first deteriorates and after some time, during which the elasticities have a chance to increase, the TB begins to improve.

A method to detect the existence of the J-curve was presented and applied to four developing countries by Bahmani (1985) . The empirical results show that despite the fact that the Marshall- Lerner conditions were met at least for the industrialized countries, trade balance did not improve after devaluation. For example, after the 1971 dollar devaluation, the TB of the US deteriorated in 1972. This unfavourable effect of devaluation on the TB was termed as J-curve phenomenon, since the adjustment would take some time. Using quarterly data for the period 1973-80 the J-curve phenomenon is validated. The

multiplier based analysis of the effects of exchange rate on TB was extended to include the variables such as world income and domestic high powered money. Almon lag structure imposed on exchange rate supported the pattern of movement described by the j-curve.

The empirical validity of Monetarist proposition of devaluation effects on TB were examined by Himarios (1985). He tried to improve Miles's (1978) work on devaluation by including both relative price and lagged exchange rate variables in the TB equation. He argued that devaluation may have real effects as well and examined two different specifications that support the traditional view concerning nominal and real devaluations.

Edwards (1987) applied a similar analysis to 18 Latin American devaluations. It was found that the current account balance as well as international reserves initially deteriorated following devaluations but improved over a three-year period.

Perviz (1987) analysed the impact of devaluation on BOP of eleven less developed countries using the monetary approach. The impact of devaluation and the growth of money supply on the BOP of LDCs were examined taking 21 independent devaluations that occured in the 11 LDCs. The analysis showed that devaluation was successful in improving the BOP of LDCs. The growth of domestic credit had also a significant effect on the BOP of LDCs.

Dornbusch (1987) tried to explain the adjustment of relative prices to exchange rate movements using the industrial organisation approach. Adopting a partial equilibrium approach, given the labour costs in the respective currencies, the extent of price adjustment is shown to depend on product substitutability, the relative number of domestic and foreign firms and market structure. Equilibrium pricing models like the Cournot model, the Dixit-Stiglitz (1977)model and the extended version of Dixit (1986) models were analysed. The analysis dealt with the exchange rate effects on prices and also short-term effects of trade liberalisation.

Cooper's work was updated by Kamin (1988). It focused on the behaviour of key indicators of macro-economic and external sector performance in developing countries. The data on fifty to ninety devaluations out of a sample of 107 devaluations effected between 1953-83 were analysed. It was found that TB typically improved significantly in the year following devaluation, but began to decline again subsequently. The improvement in TB was also associated with an increase in exports. The results confirmed both short-and long- term improvements in the BOP (indicated by changes in reserves) after a devaluation. But they contradict other arguments that improvements were associated with the improvements in current account rather than in capital inflows. Capital inflows were found to grow more slowly for the devaluing countries than for the total sample.

Meade (1988) analysed the decline in exchange value of the dollar since early 1985. The J-curve phenomenon initially was suggested as an explanation for continuation of nominal trade deficits. But it was found that the negative effects of devaluation had been small and were not a major cause of persistence of the US trade deficit. The US dollar registered a sizeable depreciation in terms of other industrialised countries' currencies between 1985 and the middle of 1988. The weighted average value of the dollar measured against a group of ten other countries was declined by over 40% in about two and half years. This decline, as expected did not stimulate exports and curtailed imports and thus resulted in nominal trade and current account deficits.

The trade balance started improving only during the first-half of 1988 through a decline in imports and a strong growth of exports. Thus, it was concluded that other developments in the international accounts like the Latin American debt problem, large difference between the levels of exports and imports and lags involved in the process of adjustment were largely responsible for the persistence of US trade deficits other than the J-curve phenomenon.

Rosenweig (1988) tried to explain the slow-down in the US TB following the dollar's 1985 peak level. The four variables that

influenced TB viz., prices and volumes of imports and exports were analysed to explain the operation of the J-curve theory. The nature and extent of the dynamic relationship between the dollar value and the four components of TB was analysed. The study concentrated on the precise timing and the direction of the relationships. The assumptions about the time path reactions to the dollar depreciation that underlie the standard J-curve were discussed. The analysis was carried out for the period between April 1973 and December 1986 using monthly data starting with the floating exchange rate period. Granger's causality tests were performed to investigate the direction of lead-lag relationships.

The evidence on the dynamic relationships between the dollar and the four components of the TB suggests a new view of the US trade balance response to dollar depreciation. It showed that import price pass through occurs most clearly only after a lag of at least one year and that import volume responds with even a longer lag. In this view the nominal balance of trade traces out a 'delayed J-curve' primarily because dollar change was not significantly reflected in import prices for some months but it was also weaker. It was concluded that the initial deterioration and the subsequent up-turn in a J-curve pattern were delayed, leading to the proposal of an alternative view- the 'delayed J-curve'.

Moffett (1989) attempted to test the occurrence of J-curve

effects in the US economy for the period 1967-87. This is done by decomposing the adjustment path into three sub-periods, viz., (a) the currency contract period, (b) the pass-through period, and (c) the quantity response period along with their respective components. Both the import and export sectors were modelled. The results for the import sector were not consistent with the J-curve theory i.e., import prices increased in response to the dollar depreciation with a subsequent decline in import quantities. Import own-price elasticities were found to be inelastic and hence import expenditures were found to rise as a result of dollar depreciation.

Similar analysis for the export sector showed that dollar depreciation had resulted in export price rise and consequent decline in export volume. Due to inelastic exports, export earnings also increased but not sufficiently enough as to off-set increased import expenditure. The net result of these changes was that the long-run merchandise trade balance path typically resembled with that of a sine wave rather than a J-curve.

Gerlach (1989) offered a new theoretical explanation for the J-curve phenomenon. He opined that the traditional view attributes the J-curve effects to the time- price elasticities varying overtime and the reasons were left unexplained. In his approach, quantities can adjust freely while the domestic currency prices were believed to adjust slowly to the excess

demand. It was shown that after a sudden devaluation, the TB is subject to two potentially off-setting effects, namely, *a* relative price effect and an inter-temporal price effect. Depending on the magnitudes of these two effects, the J-curve may arise. The model used is similar to that of Dornbusch, Connolly and Taylor (1976) and analysed the effects of devaluation under imperfect capital mobility. It was also shown that if there is an inter-temporal component in the demand for traded goods and if traded goods prices adjust only slowly to the exchange rate changes, J-curve may arise under both perfect and imperfect capital mobility.

The short-to-medium term effects of devaluation on macro-economic performance in the least developed countries was analysed by Gylfason and Radetzki (1991). A macro model for a small open economy of an LDC was specified and estimated. The effects of devaluation on the current account, GNP, wages, employment and profits was analysed. It was found that devaluation could be an effective tool for correcting current account deficits in the least developed countries provided it could be accompanied with domestic monetary restraint, a fall in real wages at least enough to prevent employment from declining and sufficient inflows of foreign capital to avert a reduction in GNP.

Relative prices affect balance of trade and employment. A reduction in domestic consumption of traded versus non-traded goods and a shift in production structure occur as a result of devaluation. The consumption effects have immediate impact, while the production effects take longer gestation. Thus, some improvement in the balance of payments may occur in the short-run but the overall impact may be a contraction of economic activity and employment as monetary contraction is accompanied with devaluation (Krugman and Taylor 1978).

A large and discrete devaluation provides an opportunity for raising output prices by the producers. Cooper (1971) observes that "devaluation can serve as an excuse to producers to raise the prices of certain products where it was difficult to do before the exchange rate change for reasons of law, custom, fear of public opprobrium or simple inertia" (Cooper,1971, pp.27). Expectations of further changes in exchange rate may contribute to potential inflationary pressures.

The transmission mechanism of devaluation and inflation was explained in Stanley Fisher (1977) for the cases of both fixed and flexible exchange rates. The effect of devaluation on terms-of-trade in high inflation situation was also analysed.

The effect of devaluation on inflation had been the major

concern in the development literature. Cooper (1971) gives the transmission mechanism in the context of LDCs. The rise in imported input prices will push-up the cost of production and this stimulates demand for an increase in wages which will, inturn, increase domestic (money) cost in a vicious circle there by reducing the gains of devaluation ultimately.

The results of empirical tests to see the impact of devaluation on inflation are mixed and uncertain. While Cooper (1971) and Kruger (1978) have felt that devaluation may reduce domestic prices, since devaluations are often associated with removal of exchange controls, pressure on price level may be dampened. Likewise, Krugman and Taylor (1978) analyzed the effect of devaluation on aggregate demand. A decline in aggregate demand due to contractionary monetary policy,ceteris Paribuz,reduces inflationary pressure over time.

Some studies suggest that the impact is usually less than one to one. Cooper (1971) in a multi-country cross-section devaluation study, estimated the trade-off to be 30-40%. Likewise, Lowinger (1978) in a time series study of four developing countries felt that the estimated effects are smaller but significant.

Himarios' (1987) study relating to discrete devaluations of 15 countries for the period 1953-73 showed that the estimated

effect on inflation ranged from zero to one in most cases.

Lowinger (1978) observed that large and infrequent devaluations would more likely to generate wage-price spiral than continuous adjustments. Rodriguez (1978) argued that the price level and exchange rate, both being led by developments in the monetary sector, are endogenous with no direct causality between them.

Pinto (1991) suggested another inflationary channel. He argued that the discrepancy between the free market and official exchange rate is a source of hidden fiscal deficit. As the discrepancy narrows, this hidden export tax shrinks which leads to a compensating increase in tax on domestic money viz., inflation, provided new sources of tax revenue are not available.

Causality tests have been employed (Kewai, 1980) to test the relationship between inflation and devaluation. Edwards (1986) with the help of a macro-economic model, examined the time-gap between devaluation, foreign interest payments and current account for a group of highly indebted industrial and developing countries. The results proved that high foreign debt and interest payments reduce the short- to medium-run effect of devaluation on national income, especially in the LDCs but make little difference to its generally positive effect on current account.

Edwards (1989) found a mixed evidence on the effectiveness of devaluation in a multi-country study. The findings included: (i) Exchange rate policies have limited effect on real exchange rate, success of devaluation depends on consistency between exchange rate policy and other policies, (ii) Devaluation in the short-run affects real exchange rates (iii) Countries can maintain stable real exchange rate, if they follow stable macro-economic policies and are not subjected to external shock. (iv) There is a trade-off between policies aimed at maintaining under-valued exchange rates and those aimed at keeping low inflation. Countries have a choice of either using exchange rate as a nominal anchor (hence exchange rate has active role) to decrease or maintain low inflation or adopt an exchange rate rule that accommodates inflation (exchange rate takes a passive role) (for a detailed discussion refer, Corden (1977,1990)),

India devalued the rupee on 6th June, 1966. Several investigators have examined the effects of this devaluation on the Indian economy and the opinions deferred. Some authors have categorically disapproved the measure while others felt that it was inevitable and strengthened the currency. The latter view is found in studies such as Vakil (1966), Ganguli (1966), and Shah (1970). Some studies have also used sophisticated modelling for this purpose (Marwah, Telele, and Negishi 1970, 1984, 1968)).

Shah (1970) used the absorption approach and analyzed the

1966 devaluation. He felt that in the short-run, the burden of improving BOP would mainly depends on exports rather than imports. On the contrary, the strategy focused at that time was on import restrictions and licensing system which tended to limit the effects of devaluation. Thus, the policy change designed to improve BOP was found to be inappropriate.

Marwah (1970) used an elaborate general equilibrium model to investigate the general problem of price formation and related issues. The impact of devaluation in terms of gains and losses was analyzed. It was concluded that the 1966 devaluation had produced some sizeable gains on India's BOP position. In the process, it resulted in higher domestic prices.

Bhagavati and Srinivasan (1975) have analyzed the 1966 devaluation using both elasticities and absorption approaches. They felt that the measure was of limited success because the effective devaluation was much smaller than the nominal devaluation. Effective devaluation would set the price of foreign exchange by market forces in the absence of quantitative and other direct restrictions by the government. In such a situation, the prices would be determined by free market forces that allocate resources optimally.

Telele (1984) used the monetary approach of balance of payments. The effects of domestic credit expansion on the current account and the overall balance of payments are analysed. The

relationship between external account and GDP, as well as domestic and foreign prices was also examined.

Following 1966 devaluation, there has been some improvement in export earnings in current rupee terms as well as volume. There was also a significant change in the composition and diversification of exports. The foreign exchange reserves increased from 1966 onwards. Export-import ratio, considered as an indicator of the pressure on the balance of trade, had slightly declined initially and started increasing from 1967-68 onwards. But, this in itself could not be termed as a positive effect of devaluation because there were other influencing factors for this ratio to rise. These include export incentives and external trade conditions. Domestic recession also played an important role for the increase in exports. The general conclusion was however, that the 1966 devaluation has been largely forced upon the government by the Aid India Consortium. The timing and magnitude were felt to be incorrect. The follow-up measures seem to have neutralised partly the benefits of 1966 devaluation.

Debroy (1991) reviewed the trends in India's foreign trade, the BOP crisis, solutions, liberalisation in the 1980s and the recent trade policy changes. The effects of 1966 devaluation and sectoral issues were analysed in terms of elasticities. Quoting a study of Virmani (1991) on trade elasticities, he felt that

exports are no longer price inelastic, although the elasticity is higher for manufactured exports compared to primary products. The elasticity of supply for manufactured exports is 14.29 which is much higher compared to primary products which face a supply constraint. On imports front also, devaluation makes imports more expensive and in terms of elasticities, it was felt that imports are not as inelastic as one have expected . General effects of devaluation on prices, output, investment and J-curve effects were also analysed.

Arvind Virmani (1991) estimated the aggregate export and import functions for India during 1970-71 to 1985-86. Specifically, the export function and the causative factors in export performance were analysed. The need for the correct specification of the function and the role of prices versus aggregate demand in the case of imports was addressed. The degree of commodity aggregation and the price indices to be used in the regressions were discussed. The empirical results show that the price effects are stronger and significant in export and import demand functions for manufactured goods. They are smaller for primary products. Since manufactured exports constitute 60% of the total exports, any exchange rate depreciation has a substantial positive effect on balance of trade. Domestic inflation has a particularly strong effect on both primary and manufactured products' imports.

Rangarajan (1994) presented an excellent review on the emerging dimensions of India's trade policies and some issues relating to the management of BOP. It was felt that the current account deficit should be maintained by normal capital flows. The stepping-up of exports is the key to maintenance of a viable BOP. The market determined exchange rate should take the Indian economy towards a near-equilibrium situation. Energy related imports in TB must be kept under control to protect the economy from external shocks. The annual growth rate of exports at 15% and with a change in the composition of the financial flows, the BOP situation can be maintained properly.

Paharia (1994) discussed the economics of devaluation, its effects on trade balance, inflation, terms-of-trade, and income distribution. A comparison of 1966 and 1991 devaluations and the follow-up reforms of 1991 devaluation were described. Suggestions for the improvement in TB and BOP, reducing the impact of debt burden, need for fiscal discipline were also discussed.

CHAPTER 4

CGE METHODOLOGY AND THE PRESENT MODEL

4.0. INTRODUCTION

A computable general equilibrium (CGE) model, which is also known as applied general equilibrium model, tries to relate the basic notions of economic theory with policy issues of current concern. Unlike the traditional macro-econometric models, most of the CGE models do not estimate but numerically calculate the parameters of the model (Gary Macmohan 1989) . In this framework, a researcher assumes that the structure of the model is correct at a given point in time, describes an equilibrium and then algebraically calculates the parameters of the model.

The fundamental notion of general equilibrium goes back to Walras and the empirical estimation starts with the Johansen's path breaking model of the Norwegian economy. Computable general equilibrium models which analyze a wide variety of policy issues have now became one of the standard tools in some policy areas.

Depending on their focus the existing CGE models fall into four broad categories, viz (1) models that focus on issues of international trade, growth, structure and income distribution, (2) models that focus on the theory of public finance, (3) multi-country international trade models that explore issues

concerning the volume, and direction of trade and its impact on particular regions and (4) country-specific and multi-country models focusing on energy.

The CGE models are also price endogenous. Issues relating to imperfect competitive behavior, quantity and price adjustment lags and wide-spread government intervention are compatible with the CGE framework. This essentially is an applied general equilibrium analysis adopted for mixed market economies.

Two sector models provide a good starting point for such an analysis. These CGE models capture the essential mechanism by which external shocks and economic policies ripple through the economy. They are used in the developing countries to analyze the effect of economic policy changes on the relative prices and so on. Consider for example, the appropriateness of a major devaluation in a country facing a foreign exchange shortage and deficits in external accounts. This can be studied with the help of a model that captures the shocks and policies relating to the external sector of the economy. Questions like the following could be analysed:

(a) Would devaluation be effective with low export demand elasticities and or low substitution elasticities between domestic and imported goods (terms of trade effect)?

(b) Are supply elasticities thought to be very low? If so, in which sectors and for what reasons?

(c) Is the problem more of macro-economic in nature i.e., does a nominal devaluation turn into a real devaluation ? and

(d) Does devaluation adversely affect the income distribution patterns?

Theory and intuition can provide only limited help in settling such questions. What is needed is an economy-wide framework that permits an explicit specification of an economy's working where each of these views can be evaluated. The first task in the CGE modeling is to compile a consistent data set. Once the data are collected, an appropriate model can be constructed. The structure of the model will usually depend on the availability of the data.

The application of CGE models in the field of international trade includes studies pertaining to country-specific issues (case studies), multi-country studies that focus on trade relations among nations, studies relating to BOP, devaluation and its effects, exchange rate models dealing with terms-of-trade effects, trade strategies and so on.

Another issue in trade policy modelling concerns the role of exchange rates and the related issue of international capital flows. In traditional pure theory of international trade, exchange rate changes produce no real effects. If a monetized extension of a classical general equilibrium model were to be used to analyze trade policy changes, money demand function

appeares along with specified levels of national money stocks, neutrality would prevail in the sense that once the real and financial behaviour of the economy were known, specifying national money stocks would simply serve to determine domestic price levels and exchange rates. Alternatively, should a fixed exchange rate regime be analyzed, one can calculate the national money stocks that are necessary to support the equilibrium and achieve the desired exchange rates. In either case there are no real effects emanating from the monetary sector.

4.1. PAST STUDIES ON CGE MODELS OF TRADE

Numerical general equilibrium trade policy analysis started with the works of Scarf (1973) and subsequently these models were used to study the policy issues in the areas of public finance, trade and development. The major objective in the general equilibrium models is to make an attempt to blend theory and policy so as to improve both analytical foundations of policy evaluation work and to bring the theoretical work that already exists in the literature more fully into the policy debate.

Global trade policy issues are analyzed in multi-country models, while single country models investigate as to how developments abroad affect individual economies. Some are oriented exclusively to trade policy questions. The major features of the models are summarized in the work of Srinivasan

and Whalley (1989) and cover a wide range of applications.

A multi- sector CGE model for the Yugoslav economy is used (Robinson et al 1985) to analyse some of the internal and external causes of the foreign exchange crises of the 1976-80 period. Empirical results suggest that internal policy errors were the main factors behind Yugoslavia's growing foreign exchange crisis.

Gupta and Togan (1984) employed separate multi-sectoral general equilibrium models for Turkey, Kenya and India to study the adjustment problems confronting these countries. The effects of liberal and interventionist policies on GDP and on class-specific incomes were analysed. Their results have shown that liberal policies minimised the GDP losses and both capitalists and farmers are relatively better-off under these policies, while industrial workers experienced reduced welfare.

In Chile, a comprehensive package of reforms, liberalised international trade were introduced in 1977. The restrictive labour legislation was abolished. These reforms resulted in significant changes in relative prices and structure of production and demand. The economy witnessed an unprecedented growth with declining inflation. But, by the year 1982, Chile was seen to develop large macro-economic imbalances and a sudden and severe recession. Timothy Condon *et al* (1985) have tried to

analyse the causes for this sudden change of events in the Chilean economy during 1977-81 using a CGE model. In their model, the authors used real exchange rate as an exogenous policy variable and compared the model generated growth path with that of the actual growth path of the economy. It was suggested that the macro-economic imbalances that led to the crisis in 1982 were exacerbated by large capital inflows and appreciation of real exchange rate that resulted from the use of the real exchange rate as a stabilisation device.

Canvary (1986) examined the persistent trade deficits phenomenon that occured in the developing countries in general and for the Turkish economy, in particular after the oil price hike of the 1970s. His results highlighted the primary role played by government tariff and exchange rate policies in the creation of trade deficits. The Turkish economy provided an example of contractionary devaluation. It also highlighted the importance of devaluation-cum-1iberalisation for deficit reduction and economic growth.

Sweder (1986) identified the channels through which devaluation affects the supply side of the economy. A comparison is made between contractionary effects of devaluation through supply and demand sides. He found that effects through supply side are more damaging than that of Krugman and Taylor (1978) effects via demand side to counter inflation.

The modelling efforts of Chakravarthy (1973) for India's fifth five year plan was the starting point and, since then, most of the Indian models are in that spirit. De Janvry and Subba Rao (1986) tried to quantify the links between government's agricultural pricing policies and income distribution. Taylor, Sarkar and Rettso (1984) have incorporated both price and quantity adjustments in their model of the Indian economy. Sarkar and Kadekodi (1988) have analysed the energy pricing policies in India. Two other CGE models for India, which are close to the neo-classical tradition, are those of Mohammed and Whalley (1983) and Blomoquist and Mohammed (1986).

The mainstream CGE modelling has been to develop frameworks based on neo-classical micro-economic theory, and for the most part, neglected structural factors. The main contribution of Indian models has been to bring these important structural aspects back into the spotlight. The major challenge of the future is to merge these two approaches into models which allow some flexibility while realistically addressing the economic structure of the country in question.

4.2. THE PRESENT MODEL

This study considers an aggregate model of the Indian economy. It focuses on identifying the determinants of India's

trade balance and inflation, it aims at examining the linkage between trade and monetary sectors. Traditional export and import functions do not include monetary sector variables in the analysis. Here, an attempt is made to incorporate a monetary disequilibrium variable into the trade equations and test its impact. The effectiveness of devaluation and credit policy on trade balance and balance of payments is analysed with the estimated model and policy simulations are undertaken.

A computable general equilibrium trade model was specified and estimated. Some of the institutional features like import restrictions, tariffs and export subsidies, etc. were taken into account. The model provides a proper synthesis of both elasticities and monetary approaches to BOP. The role of monetary factors (money demand and supply) on trade variables was examined by integrating monetary and trade sectors.

The effects of devaluation on macro variables like trade balance, domestic prices, money supply, imports, exports in the Indian economy are analysed. The monetary disequilibrium variable is derived from the estimated money demand equation and is used in the export supplies and import demand equations to capture the effect of monetary changes on trade. The trade block of the model explains the export demand, export supplies and imports. Two specifications namely, with and without the monetary disequilibrium variable are estimated and compared.

Thus, the trade equations, the money demand function, and various definitional identities together make-up the complete model, representing the markets for three goods namely exportables, importables and non-traded goods as well as one asset viz., money. The complete model, thus determines price level, balance of payments and money supply under the assumption that output is exogenously given. The model emphasises the endogeneity of money supply owing to the link between prices and balance of payments. Changes in these variables are regarded as primary channels through which equilibrium be brought about in the money market, keeping the level of output as exogenous.

Output is assumed to be exogenous in the model in order to analyse the complex and dynamic interactions between devaluation and inflation. The present study draws heavily from the model of Sunderarajan (1986) . The modifications in this theoretical model include (i) replacing R_{-1} with $(R/PM^{s})_{-1}$ in imports equation i.e., imports depend on lagged purchasing power (foreign exchange) rather than simply lagged foreign exchange assets, (ii) incorporating another important variable in the equation viz essential imports mainly consisting of Petroleum, Oil and Lubricants (POL), (iii) including a dummy variable representing change in exchange rate regime from fixed to flexible type since 1973 in three equations- unit value of exports, demand for exports and import demand and (iv) more importantly, the EM variable (excess flow demand for real cash balances) is made

independent of *v* parameter obtainable from money demand function i.e., it is assumed that adjustment of real cash balances to desired level is instantaneous (v=l) for purpose of measuring EM. This modification is important particularly because of volatality (excessive sensitivity) of *v* to changes in sample period which is transmitted to EM if it depends on *v* through partial adjustment. However, in policy simulations, EM is computed by using estimated value of *v*. As we shall notice, this modification made EM variable more significant. The exchange rate regime dummy also turned out to be significant thereby improving the goodness of fit as well. The modified theoretical model may be summarised as below:

4.3. MODEL SPECIFICATION

Money demand and price determination:

In the empirical specification of money demand function, three broad issues are discussed and debated. The first one relates to the appropriate definition of money which is identifiable, controllable and linked stably with the national income or price level. The second issue relates to the conditions under which the demand for money is consistent with aggregation theory. Third one concerns whether demand for money is a stable function or not, so that the effects of monetary policy action on the economic system can be reasonably and accurately predicted and explained. A survey of the main stream money demand models

can be found in Subramanyam (1990). The inflation rate has a direct and significant effect on demand for money. The issue of money substitutes, adjustment costs and opportunity cost of holding real money balances necessitates the inclusion of inflation rate into the empirical models.

Goldfeld (1971) has analysed the issues concerning specification and estimation of money demand function incorporating the expected rate of inflation in the money demand function. He used a distributed lag of current and past rates of inflation in a stock adjustment version and polynomial distributed lags on income and interest rates. Inflation rate was found to have a significantly negative effect.

The traditional models of money demand function assumed that nominal interest rate on short term bonds is sufficient to explain the opportunity cost of holding money. However, the inclusion of inflation rates as a direct determinant of money demand function was employed by Baba, Hendry and Sterr (1988), Hetzel and Mehra (1989). The theoretical justification was provided in the work of Emery (1991) . There were also some attempts to include rate of inflation in the money demand function for India ((Kamaiah (1985), Sunderarajan (1986), Thomas Paul(1994)).

The demand for money is specified as a function of a scale

variable (income or wealth) and an opportunity cost variable (interest rate or expected rate of inflation). In situations of excessive price rise, the opportunity cost of money is better proxied by the rate of return on real assets. In literature, the expected rate of inflation is used to capture this.

Following Sunderarajan (1986), the demand for real cash balances is specified[1] in a log-linear (infact semi-log) form[2] as:

$$\text{In } (M/P)^d = a_0 + a_1 \text{ In } (YM) - a_2 \pi^e \qquad (4.1)$$

where M= stock of nominal money balances, P = price level, YM = marketed output or real income, r^e = expected rate of inflation. The expected rate of inflation is assumed as a distributed lag function of current and past rates of inflation upto n periods. The value of n is determined empirically .

$$\pi^e = \sigma_0 \pi + \sum_{i=1} \sigma_i \pi_{-i} \qquad (4.2)$$

The actual stock of real money balances is assumed to adjust partially to the gap between the demand for real money balances and the actual stock in the previous period:

$$\text{In } (M/P) - \text{In } (M/P)_{-1} = \nu \quad (\text{In } (M/P)^d - \text{In } (M/P)_{-1}) \qquad (4.3)$$

1 In each of the equations specified below, the expected sign of the coefficient is incorporated into the specification itself in order to facilitate interpretation/understanding of the likely effect. For example, in money demand function, output and expected rate of inflation are expected to have positive and negative coefficients respectively.

[2]In empirical analysis, both linear and semi-log forms are estimated.

3 we use the value of n as 5, obtained by Sunderarajan (1986).

Substituting equations (4.1) and (4.2) into equation (4.3) and solving for real money balances we get:

$$\ln (M/P) = \nu a_0 + \nu a_1 \ln(YM) - \nu a_2 \sigma_0 \pi - \nu a_2 \sum_1^p \sigma_1 \pi_{-1} + (1-\nu)\ln (M/P)_{-1} \quad (4.4)$$

A model of price determination can be stated by re-writing equation (4.4) to bring price level to the left hand side and by spelling out the definition of the rate of inflation.

$$\ln(P)_t = \ln(M) - \nu a_0 - \nu a_1 \ln(YM) + \nu a_{20} \pi + \nu a_{21} \sum_i^p \sigma_i \pi_{-i} - (1-\nu)\ln(M/P) \quad (4.5)$$

$$\pi \equiv \ln(P) - \ln(P-1) \quad (4.6)$$

Equations (4.5) and (4.6) together determine the price level and the rate of inflation corresponding to any given level of nominal money stock, real output and past history of output and inflation.

From the parameter estimates of the money demand function, we can compute the unobservable variable viz., desired level of real balances as:

$$\ln(M/P)^d = a_0 + a_1 \ln(YM) - a_{20} \sigma \pi - a_{21} \sum_{1-1}^p \sigma \pi \quad (4.7)$$

Using (4.7) in conjunction with the adjustment mechanism given in (4.3), a new unobservable variable called "flow excess demand for real balances" (EM) can now be defined as,

$$EM = (M/P)^d - (M/P)_{-1} - \Delta (D.k/P) \quad (4.8)$$

where A is the first difference operator. In the R.H.S of (4.8), $(M/P)^d$ - $(M/P)_{-1}$ measures the gap between desired real balances and the existing opening stock of real balances, which can be interpreted as the flow demand for real balances. Some part of this flow demand is met from domestic credit creation. The expression (D.k/P) measures the stock of real balances supplied domestically, either through fiscal deficits or through RBI lending to the commercial banks. The second part of (4.8) can thus be viewed as flow supply of real balances and EM therefore is excess flow demand for real cash balances. This way of measuring excess flow demand which is a measure of extent of disequilibrium in the market for real cash balances is one of the several ways (see White (1978) and Lumsden (1979) for other alternative measures) .

Money Supply:

The supply of money is related to the stock of high power money through money multiplier which is assumed to be exogenous,

$$M = k(R+D) \qquad (4.9)$$

where k = money multiplier, R - net foreign assets of RBI, D = net domestic assets of RBI.

Supply of and Demand For Exports:

The empirical literature on trade modelling has been appearing in the trade surveys at least once in every five years

since 1959. The early estimates of income and price elasticities during 1936-57 were surveyed by Cheng (1959) and Prais (1962). World trade models are discussed in Taplin (1973), Deardorff and Stern (1977) and Fair (1979). Another comprehensive trade survey of Learner and Stern (1970) gives the discussion of the time series estimation of import and export demand relationships. Magee's (1975) trade survey is the broadest one available, and deals with the methodological questions, empirical evidence, pure trade and monetary theory. The specification and the theoretical justification of export and import equations was given in the survey of income and price effects in foreign trade in Goldstein and Khan (1985). Export and import eqution for developing countries was estimated (Khan, 1974)

The export supply is specified as a function of subsidy inclusive relative price, real national income and lagged exports. The monetary disequilibrium variable is also used to estimate the export supply function in one variant.

$$\ln(X^s) = b_0 + b_1(\text{In } PX^s(E+s)/P) + b_2 \ln(Y) + b_3 EM + b_4 \text{ In } (X_{-1}) \qquad (4.10)$$

where X^s = export supply at constant prices, PX^s = unit export value, E = exchange rate of Indian Rupee, s = unit export subsidies, Y = real national income.

Since EM takes both positive and negative values, it enters the export supply equation (4.10) only linearly. The export

supply equation is otherwise log-linear. The lagged volume of exports on the R.H.S. of (4.10) represents a partial adjustment mechanism of exports to desired level of exports. This adjustment may arise both from domestic demand and supply of exportables given the exogenous output. The subsidy inclusive relative price of exports can be viewed as relative profitability or attractiveness of supplying to export market rather than domestic market. Higher the profitability, more the exports. In computing this relative price, unit subsidy is added to exchange rate because it reflects the unit rate received by the exporters. Export subsidy used to be an important element of export promotion measures until recently (prior to liberalisation). The inclusion of excess flow demand for real balances (EM) in export supply function is meant to measure the domestic demand component of tradable and non-tradables. An increase in EM is expected to reduce real expenditures on both tradables and non-tradables and therefore will have a positive effect on export supply since domestic demand component will be reduced. This may be called the expenditure effect of changes in EM. Further, EM will have a relative price effect through the prices of non-tradables and export substitute goods.

The demand for exports is specified as a function of real GNP of major trading partners and unit value of Indian exports relative to prices in India's trading partners and competitor countries.

$$\ln(X^d) - c_0 - c_1 \ln(PX^s/PW) + c_2 \ln(YW) + c_3 \ln(X_{-1}) \quad (4.11)$$

where X^d = demand for exports, PW = price level in trading partner and competitor countries in US Dollars, YW = real GNP of trading partner countries.

Assuming equilibrium in export market i.e., equating exports supply with exports demand and solving for PX^S, in other words, the reduced form equation for the unit value of exports can be obtained as:

$$\ln(PX^s) = 1/(b^1+c_1)\ ((c_0-b_0) + b_1(\text{In}\ (P/(E+s))) - c_1 \ln(PW) - b_2 \ln(Y) + c_2 \ln(YW) - b_3 EM + (b_4-c_3)\ \ln(X_{-1}) \quad (4.12)$$

Equation (4.12) should be used in combination with either (4.10) or (4.11), but not both, since only one data series on exports volume are available to describe exports market. Equation (4.12) reflects the price taking nature of India in export market. The numerical values of coefficients for the relative price variables in demand and supply equations would tell us whether India is a price taker or price setter in the export market.

Import Demand and Foreign Exchange Rationing:

The import demand is specified as a function of tariff inclusive relative price, real national income, the excess flow demand for real balances and essential imports. While specifying the function, the importance of essential imports and the nature

of foreign exchange rationing was taken into account. The import restrictions that were prevailing in the country during early 1960's played an important role in the allocation of foreign exchange receipts. The need for incorporating such behaviour into the import functions was well documented in the work of Heller (1976). Considering the importance of all the above institutional factors, the import demand function for India was specified as:

$$I^d - d_0 - d_1 (PM^s(E+t)/P) + d_2Y + d_3I_F - d_4EM \qquad (4.13)$$

where I^d = import demand in volume terms, PM^s = unit value of imports, t = unit import duties, I_F = proxy for essential imports.

The actual volume of imports is governed by the import licensing system. The authorities are expected to permit the optimal level of imports in order to minimise the cost of deviations from the desired import level, as well as the cost of deviations of actual reserves from the desired reserve level. Since these two objectives conflict with each other, a compromise linear allocation procedure is adopted as given below:

$$I^p = (1-\beta)I^d + \beta(F-(R^*-R_{-1})) \qquad (4.14)$$

where I^p = permitted level of imports, F = foreign exchange receipts, R* = desired reserve level, R_{-1} = reserve level at the beginning of the period.

In equation (4.14), the foreign exchange receipts are the sum total of current value of exports and capital inflows. This variable as well as the desired level of reserves are expressed in real terms by deflating with import price index. The deflated foreign exchange receipts represents the importing capacity of the country which is linearly allocated between current imports and desired reserve changes as in (4.14). The unobservable desired reserves variable (R^*) is specified as a linear function of long-run exchange receipts as perceived by the licensing authorities:

$$R^* = \alpha_0 + \alpha_1 F^* \qquad (4.15)$$

where F^*= long-run exchange receipts.

Further, it is assumed that

$$I - I_{-1} = \lambda(I^P - I_{-1}) \qquad 0 < \lambda < 1 \qquad (4.16)$$

i.e., the change in import flow is some positive fraction (A) of the discrepancy between the permitted level of imports and the previous period's imports. Rewriting (4.16) suitably we get

$$I = \lambda I^P + (1-\lambda)I_{-1} \quad , \qquad (4.16')$$

Equation (4.16') implies that the actual level of imports is assumed to be a distributed lag function of the permitted level of imports with geometrically declining lag coefficients

Assuming that the long-run exchange receipts can be approximated by current exchange receipts ($F^*=\dot{F}$), and substituting equations (4.13), (4.14) and (4.15) into equation (4.16'), we get the estimable import demand function :

$$I = D_0 + D_1 (PM^S(E+t)/P) + D_2Y + D_3I_F + D_4EM + D_5 ((X.PX^S + KI^S)/PM^S) + D_6 (R/PM)^S_{-1} + D_7 I_{-1} \quad (4.17)$$

The BOP identity can be written as:

$$R = R + X.PX^S - I.PM^S + KI^S \quad \textbf{(4.18)}$$

where R= reserves.

The four equations (4.4) or (4.5), (4.10) or (4.11), (4.12), and (4.17), together with four identities viz., (4.6), (4.7), (4.9) and (4.18) constitute the complete CGE trade model of balance of payments and inflation. Thus, the complete model may be written as:

1. Money demand function and price equation:

$$\ln (M/P) = va_0 + na_1 \ln(YM) - va_2\sigma_0\pi - va_2\sum_{i=1}^{n}\sigma_i\pi_{0-i} + (1-v)\ln (M/P)_{-1}$$

4 A log-linear version of (4.17) can be obtained by suitably modifying equations (4.13) to (4.16') into log-linear form. Care should be taken to specify variables like EM in linear form only.

$$\ln(P) = \ln(M) - \nu a_0 - \nu a_1 \ln(YM) + \nu a_2 \sigma_0 r + + \nu a_* \sum_1 \sigma \pi_{-i} - (1-\nu) \ln(M/P)_{-1}$$

2. Rate of inflation definition:

$$\pi \equiv \ln(P) - \ln(P)_{-1}$$

3. Desired real balances identity:

$$\ln(M/P)^d \equiv a + a_0 \ln(YM) - a_2 \sigma_0 \pi - a_2 \sum \sigma_1 \pi_{-i}$$

4.Money supply identity:

$$M \equiv k(R+D)$$

5. Export supply and unit value of exports equations:

$$\ln(X^{8s} = b_0 + b_1 (\ln PX^s (E+s)/P) + b_2 \ln(Y) + b_3 EM + b_4 \ln(X_{-1})$$

$$\ln(PX^8) = 1/(b_1+c_1) ((c_o-b_o) + b_1 \ln P/(E+s))) - c_1 \ln(PW) - b_2 \ln(Y) + c_2 \ln(YW) - b_3 EM + (b_4-c_3) \ln(X_{-1})$$

where

$$EM = (M/P) - (M^d/P)_{-1} - A (D.k/P)$$

6. Export demand equation:

$$\ln(X^d) = C_0 - c_1 \ln(PX^s/PW) + c_2 \ln(YW) + c_3 \ln(X_{-1})$$

7. Import demand equation:

$$I = D_0 + D_1 (PM^s (E+t)/P) + D_2 Y + D_3 I_F + D_4 EM + D_5 ((X.PX^{s+} + KI^S)/PM^S) + D_6 (R/PM^8)_{-1} + D^7 I_{-1}$$

8. Balance of payments identity:

$$R = R + X.PX^S - I.PM^S + KI^S$$

where

Endogenous variables; P = Price level, r = Rate of inflation, M - Nominal money supply, $(M/P)^d$= Desired real balances, PX^s= Unit value of exports, X = Export volume, I = Import volume, R = Net foreign assets in rupees.

Exogenous variables; YM = Marketed output, Y = Real national income, YW = Real GNP of trading partners, E = Exchange rate (Rs per US $ 1) , s = Unit export subsidies, t = Unit import duties, PW = World price level, PM^S = Import unit value, KI^S= net capital inflows, I = Essential imports, D = Net domestic assets of the RBI and k = Money multiplier.

CHAPTER 5

EMPIRICAL RESULTS AND DISCUSSION

5.0. TRENDS IN DATA:

Before we estimate the proposed model, as a preliminary exercise, we analyse the trends in all the important variables used in the study over the period 1960-61 to 1991-92. This can help in understanding the historical development in these variables over time. The trend analysis uses growth rates, means, standard deviations and graphs. The variables included in this trend analysis are real national income, money supply, price level, volume and unit values of exports and imports, credit and world price level. Tables 5.1-5.2 contain respectively the decade-wise growth rates, means and standard deviations of these variables. In Appendix, we give the actual data used in this study.

Real National income:

During the period under study, 1961-92, the real national income (GNP at 1980-81 prices) rose at the compound rate of 3.8% per year. GNP had increased (more than trebled) from Rs 58,602 crores in 1960-61 to Rs 1,86,135 crores in 1991-92 (see Graph 5.1). The growth in real GNP was slower in 60s, barely equal to Population growth, but picked-up during 70s and 80s. During this period, wholesale prices have also risen steadily at around 7-8% P.a., the overall rate of inflation being 8%.

Money supply:

The growth in money supply (Ml) was slower during the 60s, but accelerated subsequently. During 1961-80, rate of increase in money supply was almost equal to the sum total of increases in real income and prices, thus balancing the rate of money supply with money value of output. But, in the 80s, money supply has grown faster, triggering an imbalance between the two. One of the sources of this imbalance seems to be creation of disproportionate amount of domestic credit which has registered an alarming 16.3% p.a. during 80s. The money supply has increased slowly during 60s at 9.5%, while it has grown much faster in 70s (13%) and in 80s (15.1%) and the overall growth rate being 12.5% per annum for the entire period 1960-61 to 1991-92. In absolute terms, money supply had increased manifold from Rs 2,869 crores in 1961 to Rs 1,41,111 crores in 1991-92 (see Graph 5.2). There had been a rapid increase from 1989 onwards.

Table 5.1: Annual Compound Growth Rates (per cent)

VARIABLE	TIME PERIOD			
	1961-70	1971-80	1981-90	1961-92
Real Income	2.9	3.4	4.9	3.8
Money Supply	9.5	13.0	15.1	12.5
Wholesale Price Index	7.4	8.8	6.6	8.1
Exports Volume	0.9	7.6	6.0	5.2
Imports Volume	-0.2	5.6	7.1	5.2
Unit Value of Exports	9.1	10.8	8.4	8.4

Unit value of Imports	10.2	15.2	3.8	8.3
World Prices	3.7	12.0	9.9	9.5

Inflation:

Rate of inflation is measured by the rate of change in wholesale price index (WPI) for all commodities. It has registered 8.1% per annum during 1960-61 to 1991-92. There were, however, erratic year-to-year fluctuations in WPI. From 1960-61 to 1970-71, WPI rose by 7.4%. During 70s inflation was at 8.88% which fall to 6.6% during 80s (see Graph 5.3), Thus, the rate of inflation was consistently higher than the growth of real national income and lower than the rate of increase in money supply throughout the sample period.

Imports and Exports:

During 1961-80, imports, in volume terms, have grown slower than exports. But 80s have witnessed a reversal of this trend with widening trade gap, thus heralding a balance of trade and payments crisis which assumed unmanageable proportions soon after. Infact, the malice seem to have set-in during late 70s itself as trade balance figures indicate. The decade-wise rate of growth of exports shows that during 60s it was very low and had picked-up (7.6%) in 70s and decelerated to 6% in 80s. The overall growth rate of exports in volume terms was 5.3%. Similarly, imports were growing at 5.6% in 70s and 7.1% in 80s, the overall growth rate being 5.21% per annum, (see Graph 5.4 and 5.5).

Unit value of Imports and Exports:

The sizeable deceleration in import prices, from 15.2% in 70s to 3.8% in 80s, must have provided some breathing time for differing the imminent BOP crisis. It may be noted that import prices were volatile after 1973 oil crisis, more so during 80s. Export prices were rising at a rate of 9.1% during 60's, 10.8% during 70s and 8.4% during 80s and the overall growth rate being 8.4% per annum for the entire period (see Graph 5.6),

Table **5.2:** Period-vise Mean and Standard Deviations

	Time Period			
	1961-70	1971-80	1981-90	1961-90
Real Income (Rs cr)	66790	92776	138390	99319
	(6232)	(10151)	(20867)	(32943)
Money Supply (Rs cr)	4405	13713	138390	21012
	(1120)	(5036)	(20867)	(20817)
Wholesale Prices	25.95	55.98	124.88	68.9
	(5.73)	(14.12)	(24.4)	(45.1)
Exports (Rs cr)	946.8	3770	13177	5965
	(293.6)	(1829)	(6460)	(6504)
Imports (Rs cr)	1472.5	4512	19906	8630
	(355.7)	(2468)	(7188)	(9237)
Unit value of Exports	33.8	70.0	154.7	86.2
	(12.9)	(20.8)	(37.5)	(57.2)
Unit value of Imports	25.4	63.4	117.8	68.8
	(7.2)	(26.2)	(17.3)	(42.5)
World Prices	17.5	36.8	107.5	53.9
	(1.7)	(12.5)	(32.6)	(43.9)

* Figures in parantheses are the standard deviations.

Table 5.2 gives the period-wise mean and standard deviations for all the important variables. It can be seen from the table that for few variables like exports and imports standard deviations are higher than that of their respective mean values for the period 1961-1990. This shows that there are wide fluctuations in the data series. The mean value of real national

income is Rs 99,319 crores for the entire period 1961-90. Similarly money supply and inflation had an average values of Rs 21,012 crores and 68.94 respectively during the same period. Exports registered an increase in 1981-90 period with a mean value of Rs 13,177 and for the entire period it stood at Rs 5,965 crores. Imports too were on increasing side with an average value of Rs 8,630 crores. The world price index had an average value of 53.95 and the unit value of exports and imports averaged at 86.17 and 68.85 respectively.

5.1. Direction of Foreign Trade:

The direction of India's foreign trade indicates that there has been an increase in the importance of developing countries both as export destinations and as sources of imports. A major shift of trade between India and the OECD countries can also be noticed (Table 5.2).

Table **5.3:** Direction of Trade (per cent)

COUNTRIES	1960-61		1980-81		1989-90	
	Exports	Imports	Exports	Imports	Exports	Imports
l.OECD	66.2	78.0	46.6	45.7	53.3	57.1
a)USA	16.0	29.2	11.1	12.9	16.2	12.0
b)Japan	5.5	5.4	8.9	6.0	9.9	8.0
c)UK	26.8	19.3	5.9	5.8	5.8	8.4
d)France	1.4	1.9	2.2	2.2	2.3	4.6
e)FRG	3.1	10.9	5.7	5.5	6.4	7.8
2.OPEC	4.1	4.6	11.1	27.8	6.7	14.3

3.E.Europe	7.0	3.4	22.1	10.3	19.3	8.4
a) USSR	4.5	1.4	18.3	8.1	16.1	5.8
4. Developing count.	14.8	11.8	19.2	15.7	15.4	17.0

Source: Debroy (1992)

There have been changes in the commodity composition of exports and imports over time. Raw materials, intermediate manufactures and capital goods have continued to dominate our import basket. The share of food imports had declined compared to the 60s and 70s. Imports of petroleum products had increased sharply during eighties. Most of the imports being essential in nature, they tend to be price inelastic. On the exports front, the share of manufactures and engineering goods had increased sharply during eighties.

5.2. ESTIMATION OF CGE TRADE MODEL:

Data Transformations:

In the earlier section, we discussed the trends in some important variables that we use in empirical analysis. Annual time series data are collected on all the required variables- money supply (narrow money, M) , wholesale price index of all commodities (price level, P*),* value of exports, value of imports, unit value of exports, net foreign assets (R) which are all endogeneous; and real national income (GNP at factor cost, Y) , weighted average of real national incomes of all trading partners

(YW), nominal exchange rate (E), amount of import tariff collected, amount of export subsidy incurred, unit value of imports (PM^S), price level in trading partner countries (world price level, PW), reserve money (D+R, D being domestic credit) and essential imports (foodgrains plus petroleum products, I_F), which are all exogeneous in nature. Two additional dummy variables were generated to reflect change in exchange rate regime (from fixed to floating exchange, DUMEXR) and inflation rate (high /low, DUMINF).

From this basic data set, variables which are needed for the analysis are generated in a consistent fashion (both in levels and units of measurement). For example, unit values of exports (PX^S) and imports (indices) are treated as price indices of exports and imports respectively. They are used as deflators to compute volume of exports (X) and imports (I) from value of exports and imports. Likewise, the unit rates of tariffs (t) and subsidies (s) are obtained by dividing aggregate amounts of tariffs and subsidies with volume of exports and imports respectively. The domestic credit (D) variable is worked out as reserve money minus net foreign assets (R). Trade balance (TB) is computed as the difference between values of exports and imports. Net foreign assets (R) is treated as balance of payments variable.

For the estimation of the four structural equations

representing demand for real cash balances (M/P), export demand (X), unit value of exports (PX^S) and import demand (I), the appropriate price variables are generated. These include rate of inflation ($r - (P-P_{-1})/P_{-1}$), relative price of exports (PX^S/PW), subsidy adjusted domestic price level ($P/(E+s)$) which measures the relative profitability of exports, import tariff adjusted price of imports ($PM^S(E+t)/P$) to measure the real cost of imports and export linked foreign exchange resource available for imports ($KI^S+PX^SX)/PM^S$).

The important variable, viz., excess flow demand for real cash balances (EM) is computed from historical data itself by assuming instantaneous adjustment of actual real balances to desired level (i.e., *v=1).* As a matter of fact, EM should be computed using the estimated money demand function. This requires a sequential, rather than simultaneous, procedure of estimation which would make EM susceptible to errors/ inaccuracies in the estimation of money demand function. These errors can also percolate to other equations through EM. This problem is avoided by computing EM directly and independent of money demand function. In OLS estimation, EM thus is purely exogeneous variable. However, in 2SLS, an instrumental variable is computed for EM as well along with other current endogeneous explanatory variables.

Annual time series data are used for estimating each equation in the system both by OLS and 2SLS methods. The model

is estimated using both linear and semi-log forms due to the presence of r or EM (which take negative values) and for three overlapping time periods. Data on import tariffs and export subsidies are available only from 1971 onwards. Two equations involving these variables viz., unit value of exports and import demand could be estimated for the period 1971-91 only. The two other equations, demand for real cash balances and export demand were estimated using longer time series viz., 1961-91. Although data are available for 1992, we could not use it for model estimation because of its outlier nature (some variables are quite away from previous series).

Choice of the "best" model:

In regression analysis, choice of appropriate functional form, method of estimation and the length of time series, which together determine the numerical values of parameters, are the three most important tasks for the researcher. Even if we know the list of endogenous and exogenous variables from the theory, the "true" functional form is rarely known and to be decided by the data and the analyst. Linear or log-linear functional forms are the popular choices, because linear regression techniques can be used and the parameters can be interpreted easily. Between these two functional forms, log-linear functional form is more often preferred because the regression coefficients can be directly interpreted as elasticities with which the economists are generally familiar.

For over-identified system of equations like the present model, 2SLS is recommended because OLS estimates suffer from "simultaneous equation bias". Thus, a prior*ily* the choice of estimates is narrowed to log-linear model using 2SLS method. But, it must be added that the data may not conform to this a priori choice in the sense that there can be conflict between theoretical desirability and statistical goodness of fit. There is often need for trade-off between the two- theoretically consistent model may not be able to describe the given data well. Therefore, one needs to try and experiment with alternative naive methods as well. Keeping this in mind, OLS estimates are obtained for linear as well as log-linear (semi-log) model and 2SLS estimates for linear model only and are given in Appendix. Since both OLS and 2SLS methods use single equation approach, within each equation, the decision to retain a particular explanatory variable is based on appropriate sign for the regression coefficient and significant t-ratio. A few variables may be retained in the model even if either of the above criteria is not fulfilled, as departures from expected behaviour. OLS estimates are discussed for log-linear model. The estimated OLS equations are reproduced here from Appendix:

(a) Log-linear OLS Model
Sample period: 1962-91

$$\text{In } (M/P) = -2.4931^{*} + 0.3903^{*} \text{ In } Y - 0.8919^{*} \pi - 0.1539\pi$$

(-2.95) (2.84) (-4.59) (-0.88) $^{-1}$

$-0.2790^{***}\ \pi_{-2} + 0.6623\ *\ \text{in}\ (M/P)_{-1}$

(-1.74) (4.75)

. . . . . (A)

R^{-2} 0.98, DW = 1.99, F= 215.6, Dh Statistic = 0.0424

$\text{In}\ X^{d} = 1.4531^{*} - 0.5495^{*}\ \text{In}\ (PX^{s}/PW) + 0\text{-}5230^{*}\ \text{ln}\ YW +$
(3.93) (-4.46) (3.58)

$0\ 2965^{*}\ \text{In}\ X_{-1} + 0.2885^{*}\ DUMEXR + 0.0024^{*}\ EM$ (B)
(2.07) (3-43) (3.87)

R^{-2} = 0.95, DW = 1.40, F = 138, Dh statistic = 0.0424

Sample period: 1971-91

$\text{In}\ PX^{s} = 1.4281^{*} + 0.0330\ \text{In}\ (P/(E+s)) + 0.7378^{*}\ \text{In}\ PW$
(6.94) (0.36) (27.50)

$+ 0.0024^{*}\ EM + 0.1334\ DUMEXR$
(3.87) (3.11)

. . . . . (C)

R^{-2} = 0.99, DW = 1.80, F = 346.5

$\text{In}\ I = -3.4873^{***} - 0.1796^{*}\ \text{In}\ (PM^{s}(E+t)/P) + 0.3492\ \text{In}\ Y$
(-1.61) (-4.27) (1.50)

$+ 0.8067^{*}\ \text{In}\ ((XPX^{8}+KI^{8})/PM^{8}) - 0.0203\ \text{In}\ (R/PM^{8})_{-1}$
(10.0) (-1-19)

$+ 0.0636^{*}\ \text{In}\ I + 0.1753^{**}\ \text{In}\ I_{-1} - 0.0036^{*}\ EM$
(2.24) F (2.46) (-6.14)

R^{-2} = 0.99, DW = 2.25, F = 198, Dh statistic = -.61

. . . . . (D)

$\text{In}\ X^{s} = -4.6819\%\ 0.5557^{**}\ \text{In}\ Y + 0.5783^{*}\ \text{in}\ X_{-1}$
(-2.10) (2.18) (3.00)

R^{-2}= 0.93, DW - 2.11, F - 120, Dh statistic = -.54

. . . . . (E)

Without EM

$$\ln PX^{s} = \underset{(-1.66)}{-7.8173^{***}} + \underset{(0.48)}{0.0667} \ln (P/(E+s)) + \underset{(2.06)}{0.3543^{**}} \ln PW + \underset{(2.05)}{0.9199^{**}} \ln Y + \underset{(4.13)}{0.2154^{*}} DUMEXR$$

$$R^{-2} = 0.99, \quad DW = 1.21, \quad F = 346.5$$

$$\ln I = \underset{(-0.36)}{-1.4814} - \underset{(-4.01)}{0.2903^{*}} \ln (PM^{s}(E+t)/P) + \underset{(0.27)}{0.1195} \ln Y + \underset{(4.54)}{0.6695^{*}} \ln ((XPX^{s}-KI^{s})/PM)^{s} + \underset{(1.72)}{0.0442^{***}} \ln (R/PM)^{s}_{-1} + \underset{(3.88)}{0.4291^{*}} \ln I_{-1} + \underset{(3.57)}{0.1609} \ln IF$$

$$R^{-2} = 0.99, \quad DW = 1.80, \quad F = 98, \quad Dh \text{ statistic} = .5314$$

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

Money Demand Function:

A perusal at the estimated equations shows that the overall goodness of fit measured by R^{-2} is satisfactory for all the four equations. The demand for real cash balances (Eq. A) is well explained by real income, current rate of inflation and rate of inflation lagged upto two years . Lagged dependent variable has

[1]This is in contrast to the four-years lag observed in Sunderarajan (1986) . We also tried the four-year lags, but lags of 3 and 4 years are not consistent in sign and statistically insignificant. This implies that inflationary expectations are of shorter *memory now in* determining *the demand for* real cash balances in India.

the expected sign, with largest t-ratio in that equation and statistically significant coefficient. The explanatory variables have significant coefficients with expected signs. The coefficients of the lagged rate of inflation decline in magnitude (at least initially), and become statistically insignificant as we go back into the past. The distributed-lag structure for rate of inflation implies a fairly large and negative coefficient for expected rate of inflation.

The coefficients of real income (0.39) and lagged dependent variable (0.66) are statistically significant and quite close to the values obtained by Sunderarajan (0.32, 0.72) for the period 1952-77. This shows that the money demand function has been quite

stable over time in the Indian context . Numerically, a 10% increase in output/real income leads to a 3.9% increase in demand for real cash balances indicating a strong link between level of economic activity and monetary base.

The speed of adjustment of actual real cash balances to the desired level is moderate-to-slow as seen from the coefficient

shorter memory now in determining the demand for real cash balances in India.

[2]However, there is no consensus about the stability of money demand function in the literature.

for the lagged dependent variable *(v*= 1-.6623 = .3377). The speed of adjustment seems to have picked-up since Sunderarajan's study. The coefficient of current inflation rate is (-.8919). The large value for the coefficient of current inflation would mean a large value for $\delta\pi/\delta\Delta \ln M$ viz. 1/(1-.8919) = 9.25. It implies that following an increase in rate of monetary expansion, the rate of inflation will tend to over-shoot initially and will adjust downward subsequently. This will have implication for the policy analysis to be undertaken in the next chapter.

Unit value of Exports:

The monetary disequilibrium variable is expected to influence trade flows both directly and indirectly through its effects on relative prices. The market for exportables is assumed to be in equilibrium and is described by a reduced form equation for unit value of exports and the structural equation for export demand.

The crucial relative price variable in the unit value of exports function (Eq. (C)) has correct but low (0.033) and statistically insignificant coefficient (with a t-ratio, .36). It may be recalled that relative price here is the ratio of domestic wholesale price deflated with exchange rate plus unit export subsidy. It measures the relative attractiveness or profitability of supplying the export markets compared to the domestic market. A positive sign for this relative price is essential for policy instruments like devaluation or increase in export subsidy to

have a favourable effect on export price and thereby India's exports.

From the results, a 10% increase in relative price pushes-up unit value of exports by 0.3%. Increase in world price level seems to exert an up-ward pressure on export prices rather than reducing them. A 10% increase in world price level pushes-up the unit value of exports by 7%, indicating a high degree of integration of Indian export market with world market. It may also indicate the potential danger of wholesale transmission of inflationary pressure from abroad. The income coefficients, domestic as well as trading partners' are insignificant and hence are omitted from the regression. An increase in monetary disequilibrium variable, i.e. flow excess demand for real balances, seems to push-up prices of exports rather than reducing them. The coefficient is statistically significant. However, the effect is numerically small (0.0024).

Export Demand:

All the explanatory variables in export demand function are statistically significant. In the order of their t-values, these include, relative export price (defined as the ratio of unit value of exports to world price), income of trading partners, dummy variable representing change in exchange rate regime and lagged dependent variable. There is a significant habit persistence in demand for Indian exports. This equation also satisfies stability condition.

The results indicate that a 10% increase in relative export price would cut demand for Indian exports by 5.5%, while a 10% increase in trading partners' income would have an almost equal but opposite effect. These are short-run responses. The long-run or equilibrium responses are about one and half times larger. The change in exchange rate regime from fixed to flexible seem to have a significant positive effect on Indian exports.

Import Demand:

The import demand function has been well explained by the set of chosen explanatory variables. Most of them are significant, some with very high t-ratios. India's aggregate imports (Eq. (D)) are mainly determined by the current foreign exchange receipts, the monetary disequilibrium variable, relative import price, the lagged dependent variable (stock-adjustment mechanism) and essential imports. The monetary disequilibrium variable has a significant negative effect. The other variables like the domestic real income and lagged foreign assets are also important to a lesser extent. A 10% increase in currrent foreign exchange receipts would push-up imports by 8%. But, net foreign assets (lagged by one year) have a small negative effect on current imports. A 10% cut in relative import price would increase Indian imports by 1.8%.

Export Supply;

The export supply is specified as a function of real income and lagged exports. The estimated Export supply function shows that the goodness of fit is satisfactory (.93). The coefficients are of correct sign and significant at 5 and 10% level of significance. A 10% increase in the real income would push up the export supply by 5.5%. The cofficient of lagged exports variable is statistically significant with a t-ratio of 3.0[3],

Equations without monetary disequilibrium variable;

Omitting EM variable from the model seem to cause substantial changes in the parameter estimates, particularly their t-ratios though not overall goodness of fit. Absence of EM from unit value of exports equation has resulted in doubling the coefficient of relative export price, decreasing (reducing by half) the coefficient of world price and making domestic income variable statistically significant with almost unitary elasticity. Likewise, the import demand equation also has changed substantially. In particular, the role of lagged dependent variable and essential imports has increased due to the deletion of EM variable as a determinant of imports into India.

[3]The Dh statistic was computed and reported for all the equations which have a lagged dependent variable. As the Dh test is a large sample test, and the sample being small we could not test the presence of serial correlation using the Dh statistic. We realise that some equations might test positive for serial correlation based on DW statistic. This could not be incorporated either.

Thus, the log-linear OLS model is quite satisfactory both in terms of *ex-post* descriptive power, and signs as well as magnitudes of crucial coefficients. There are some exceptions, of course.

(b) Linear 2SLS Model:

We noted earlier that the CGE model which we are estimating is simultaneous in nature- all current endogenous variables also appear as explanatory variables in some equation or identity. This violates one of the crucial assumption of Ordinary Least Squares (OLS) method of estimation viz., that the explanatory variables be uncorrelated with stochastic disturbance term in each equation. The consequence is that the OLS estimates are no longer unbiased and they suffer from what is commonly known as "simultaneous equation bias". Further, such models are usually over-identified.

For estimating over-identified simultaneous equation models, a modified OLS method known as Two-Stage Least Squares (2SLS) is used. Although this method is called a simultaneous equation method, it is based on single equation approach only. It involves in "purging-out" the endogenous explanatory variables from the correlation with stochastic disturbance term by estimating an instrumental variable for each of such endogenous variable. These instrumental variables are nothing but (OLS) estimated values of respective endogenous variable by regressing each of them on all

the predetermined (explanatory and lagged endogenous) variables in the system. These regressions are called first-stage regressions.

In the second-stage, OLS regressions are run for structural equations by replacing the current endogenous variables on the right-hand side with their instruments. The resultant parameter estimates are known as 2SLS estimates. Strictly speaking, we need to consider the identities as well in the second-stage estimation procedure. Unfortunately, in our case, the identities are non-linear and hence their incorporation into 2SLS estimation seems difficult and therefore not implemented. Further, due to nonavailability of data on import tariffs and export subsidies prior to 1971, 2SLS method could be applied only for a shorter time series viz., 1971-91. We need to remember this while comparing OLS and 2SLS estimates. The linear 2SLS model estimates are reproduced from Appendix:

Sample period: 1971-91

$$(M/P) = \underset{(0.49)}{10.0981} + \underset{(2.70)}{0.0012^{**}}\, Y - \underset{(-3.17)}{253.6045^{*}}\, \pi - \underset{(-1.57)}{103.7435}\pi_{-2} + \underset{(3.62)}{0.6163^{*}}\, (M/P)^{-1}$$

$$R^{-2} = 0.96,\ DW = 2.38,\ F = 96,\ Dh \text{ statistic} = -1.3887 \qquad \text{(A)}$$

$$X^{d} = \underset{(-.84)}{-9.0555} + \underset{(1.38)}{1.2733}\ YW + \underset{(5.14)}{0.8277^{*}}\ X_{-1} \quad \ldots \qquad \text{(B)}$$

$$R^{-2} = 0.86,\ DW = 2.20,\ F = 66,\ Dh = -.6449$$

$$PX^{s} = \underset{(-13.1)}{-101.2979^{*}} + \underset{(9.63)}{0.0016^{*}}\ Y + \underset{(2.56)}{0.5653^{**}}\ X_{-1} \qquad \text{(C)}$$

$$R^{-2} = 0.98,\ DW = 1.68,\ F = 441$$

$$I = \underset{(0.73)}{2.7063} + \underset{(40.40)}{1.0045^{*}}\ (XPX^{s} + KI^{s})/PM^{s}) - \underset{(-2.1)}{0.2040^{**}}(R/PM^{s})_{-1} - \underset{(-5.37)}{0.4372^{*}}\ EM \qquad \text{(D)}$$

$$R^{-2} = 0.99,\ DW = 2.04,\ F = 561$$

$$X^{s} = \underset{(-1.8)}{-13.9709} + \underset{(3.03)}{0.0005^{*}}\ Y + \underset{(1.73)}{0.3841^{***}}\ X_{-1}$$

$$R^{-2} = 0.99,\ DW = 2.10,\ F = 53.32$$

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

Broadly, in an absolute sense, the 2SLS estimates are satisfactory in terms of goodness of fit, expected signs, magnitudes and t-ratios of coefficients. All the equations satisfy stability condition as well. However, when compared to OLS results, the 2SLS estimates seem less robust- goodness of fit and t-ratios are lower overall. This implies that the precision of 2SLS estimates is lower compared to OLS estimates. This could

be due to several reasons- difference in length of time series, "true" structural model may not be simultaneous but we are imposing this property on the model, and ignoring identities in the model.

The linear model using OLS and 2SLS methods also seem to be strong contenders in providing a good description of the historical data. On the basis of pure statistical criteria, it would be difficult to ignore these estimates. Infact, we propose to use these estimates for undertaking policy analysis in the next chapter.

Fig 5.1: REAL GNP AT FACTOR COST

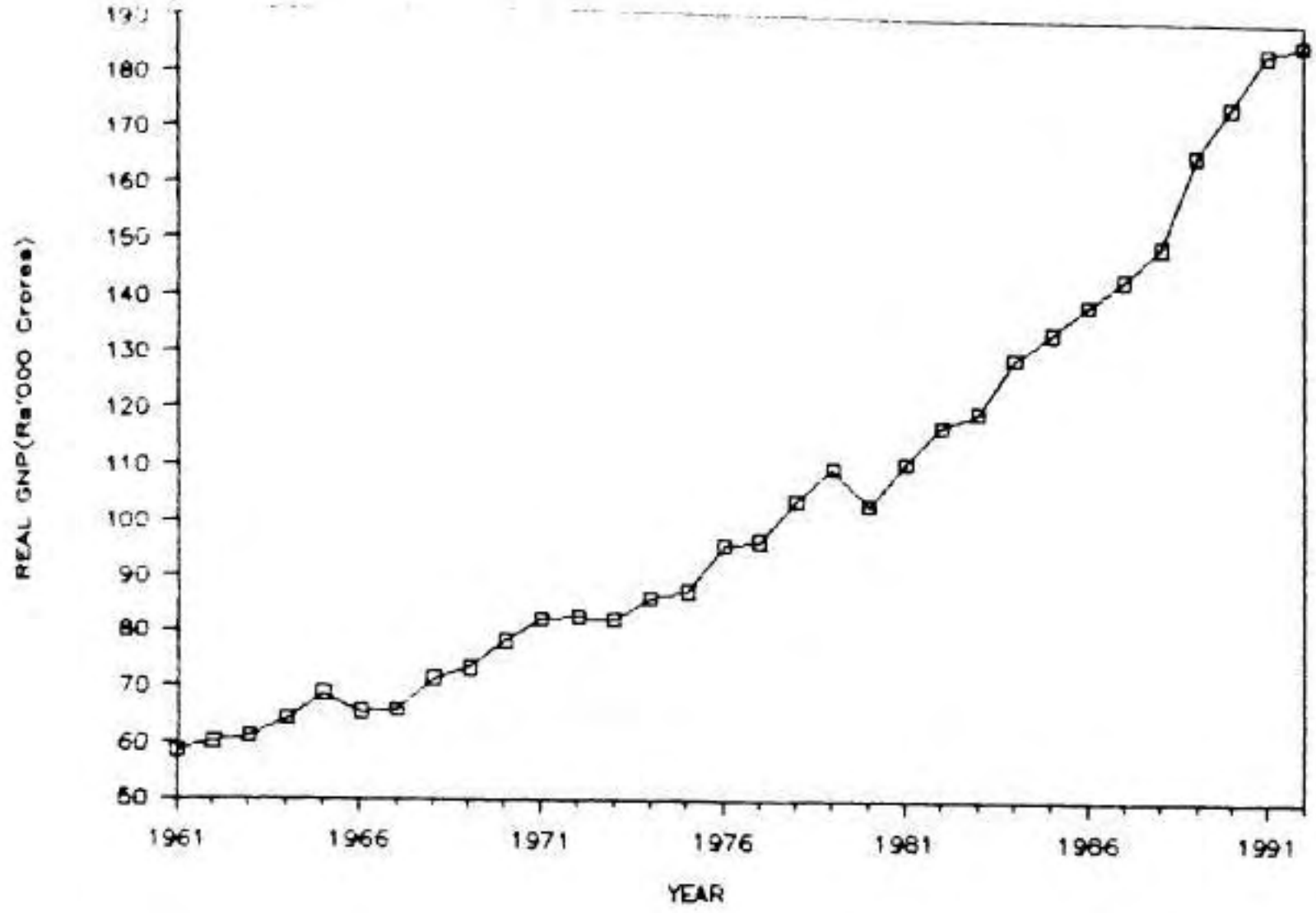


Fig 5.2: MONEY SUPPLY (M1)

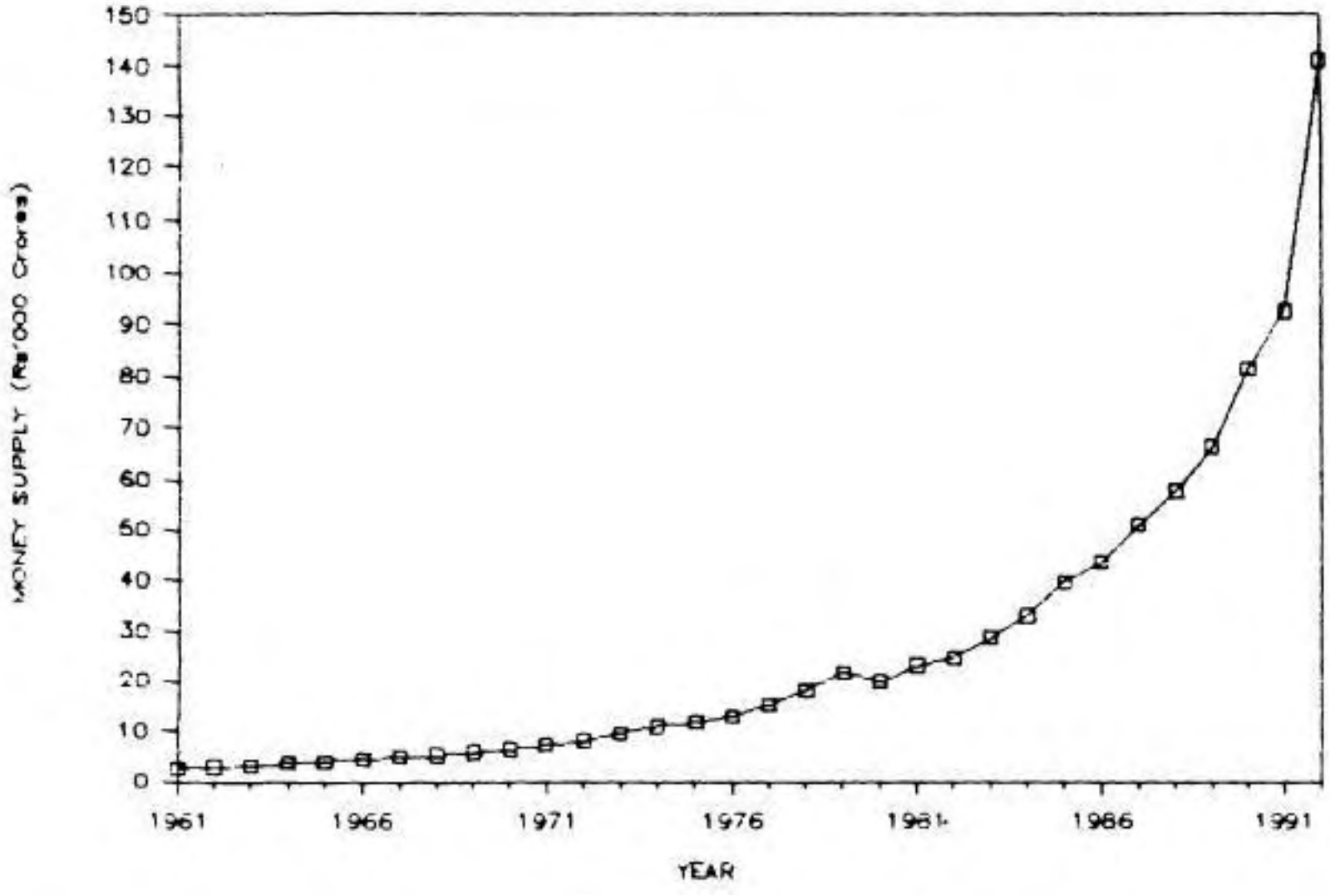


Fig 5.3 WHOLESALE PRICE INDEX

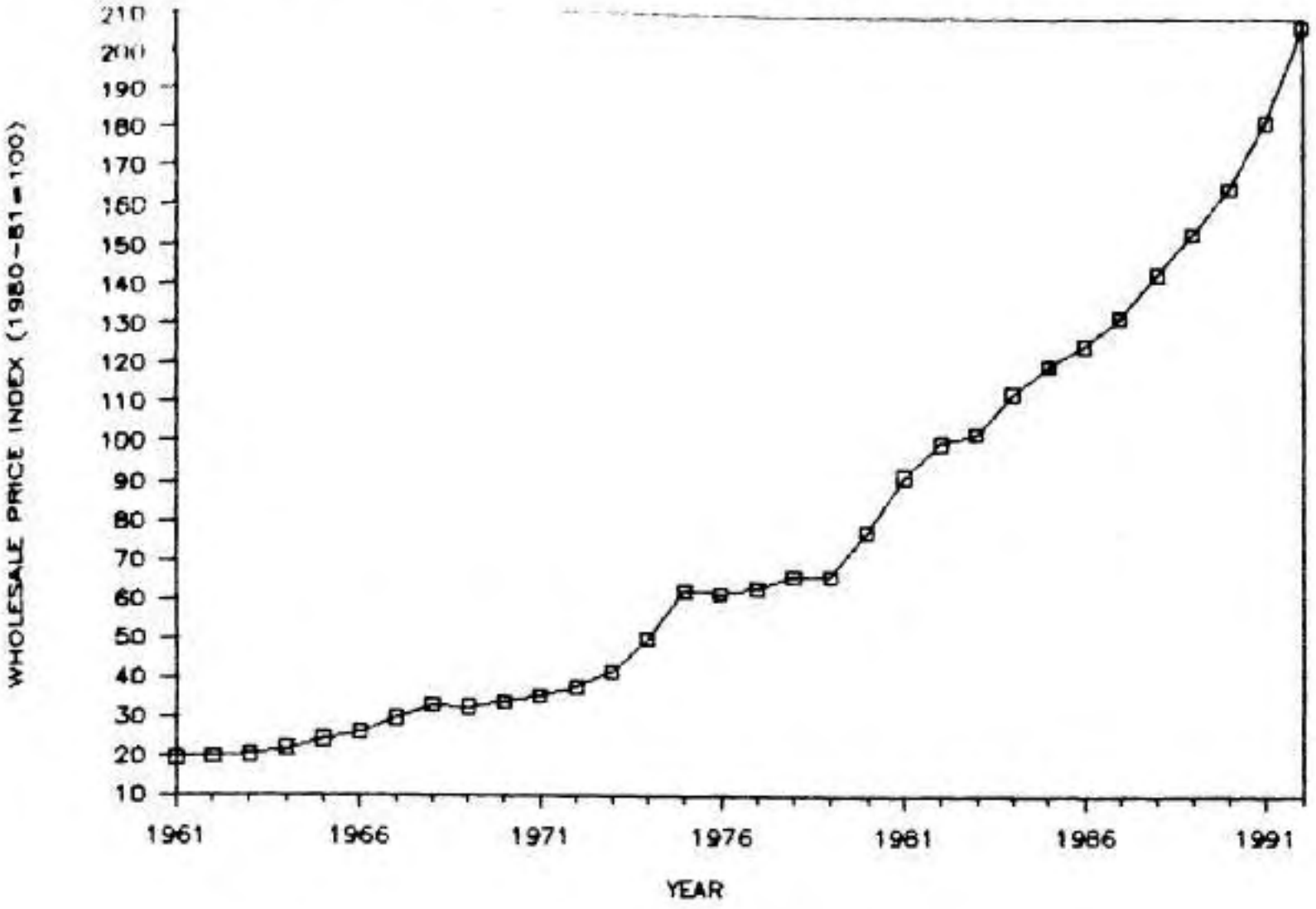


Fig 5.4: IMPORTS VOLUME

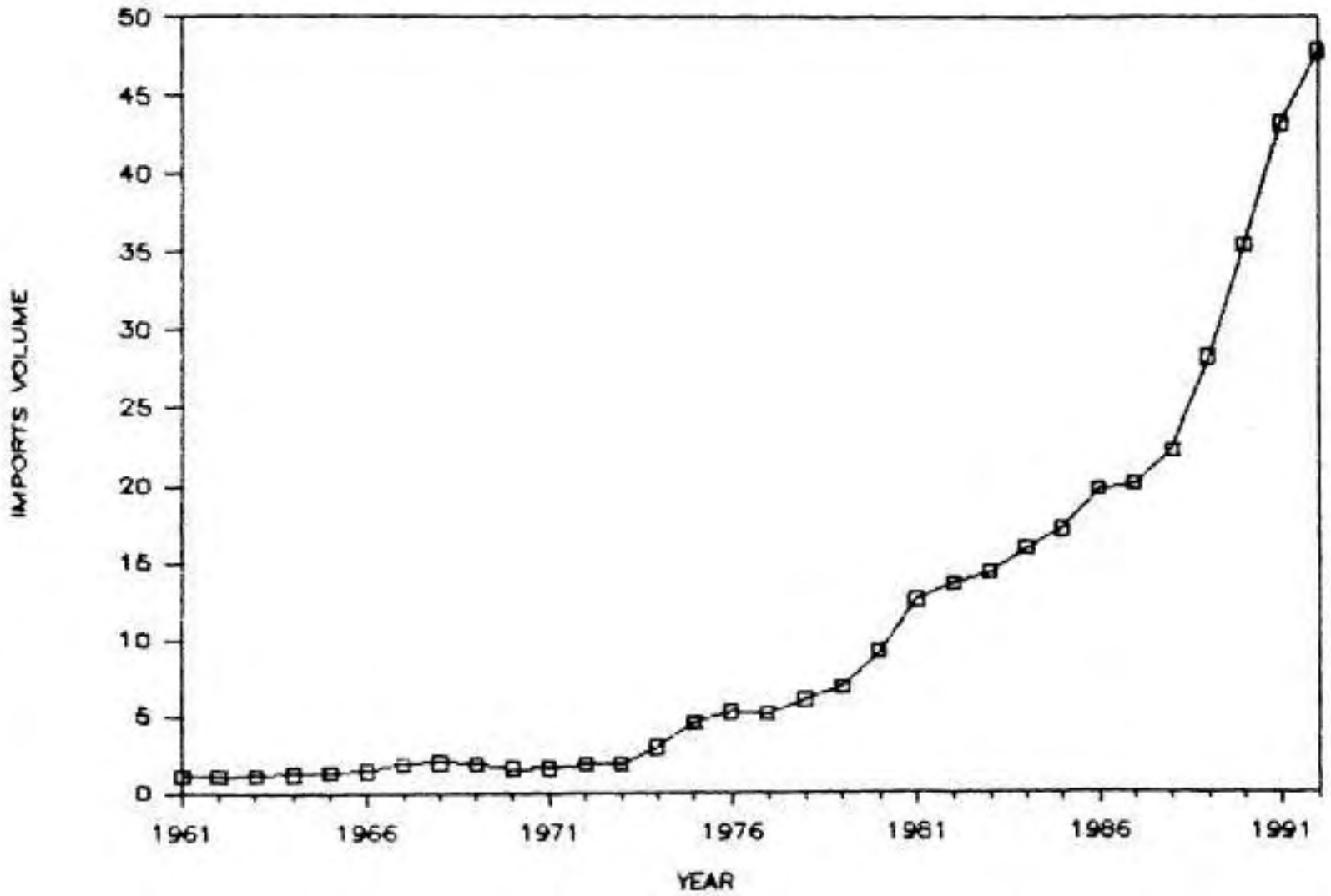


Fig 5.5: EXPORTS VOLUME

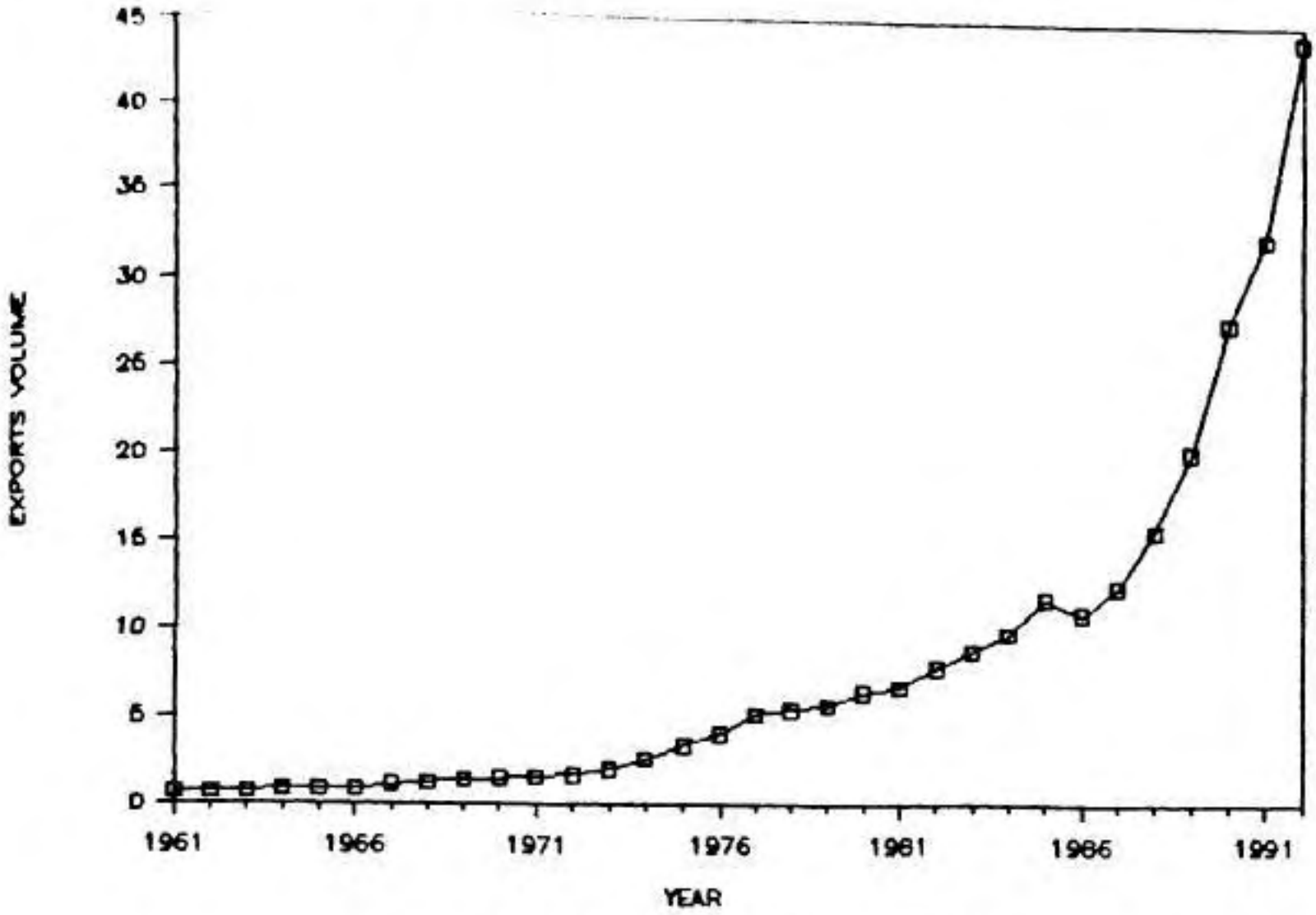


Fig 5.6: UNIT VALUE OF EXPORTS

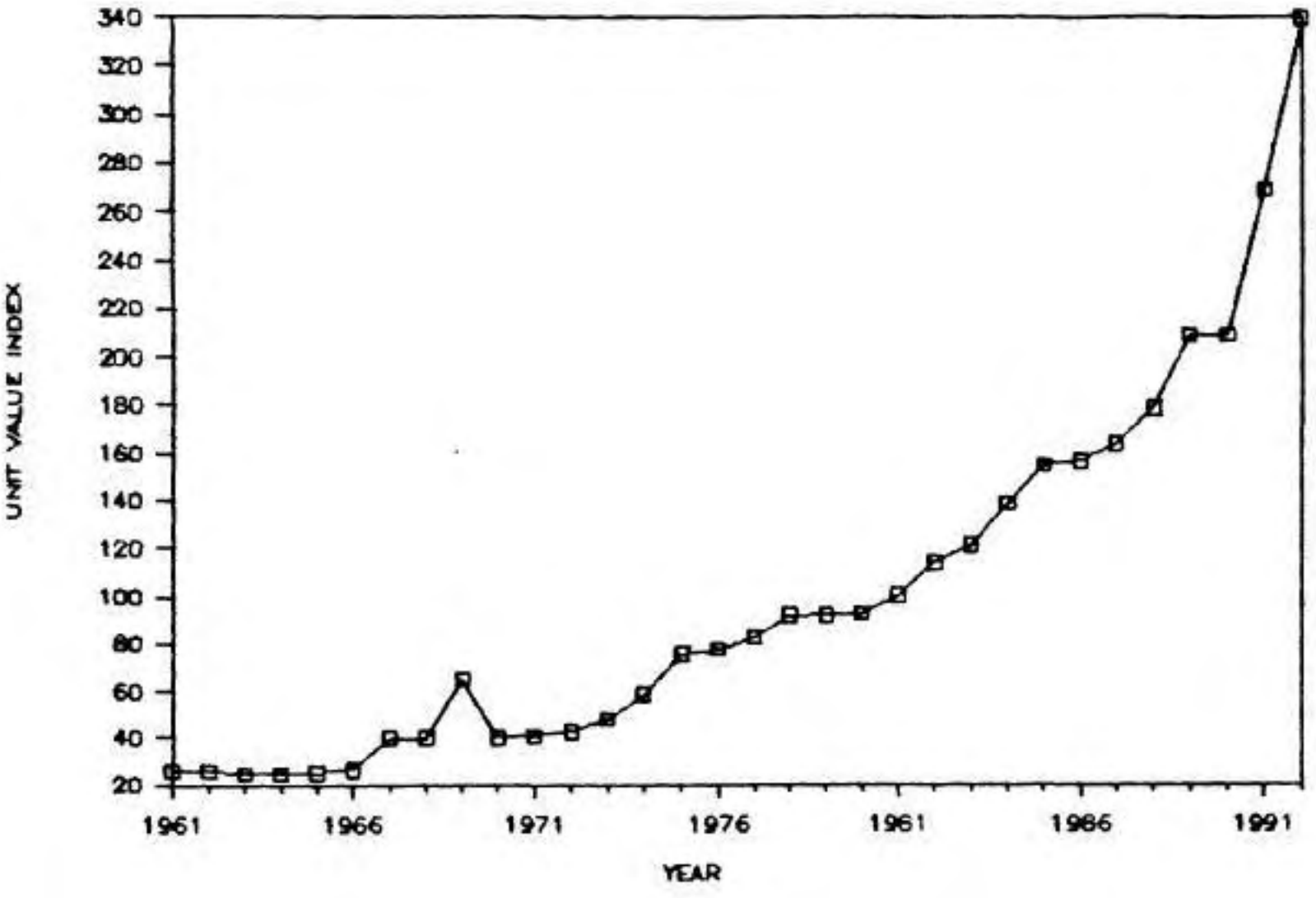


Fig 5.7: UNIT VALUE OF IMPORTS

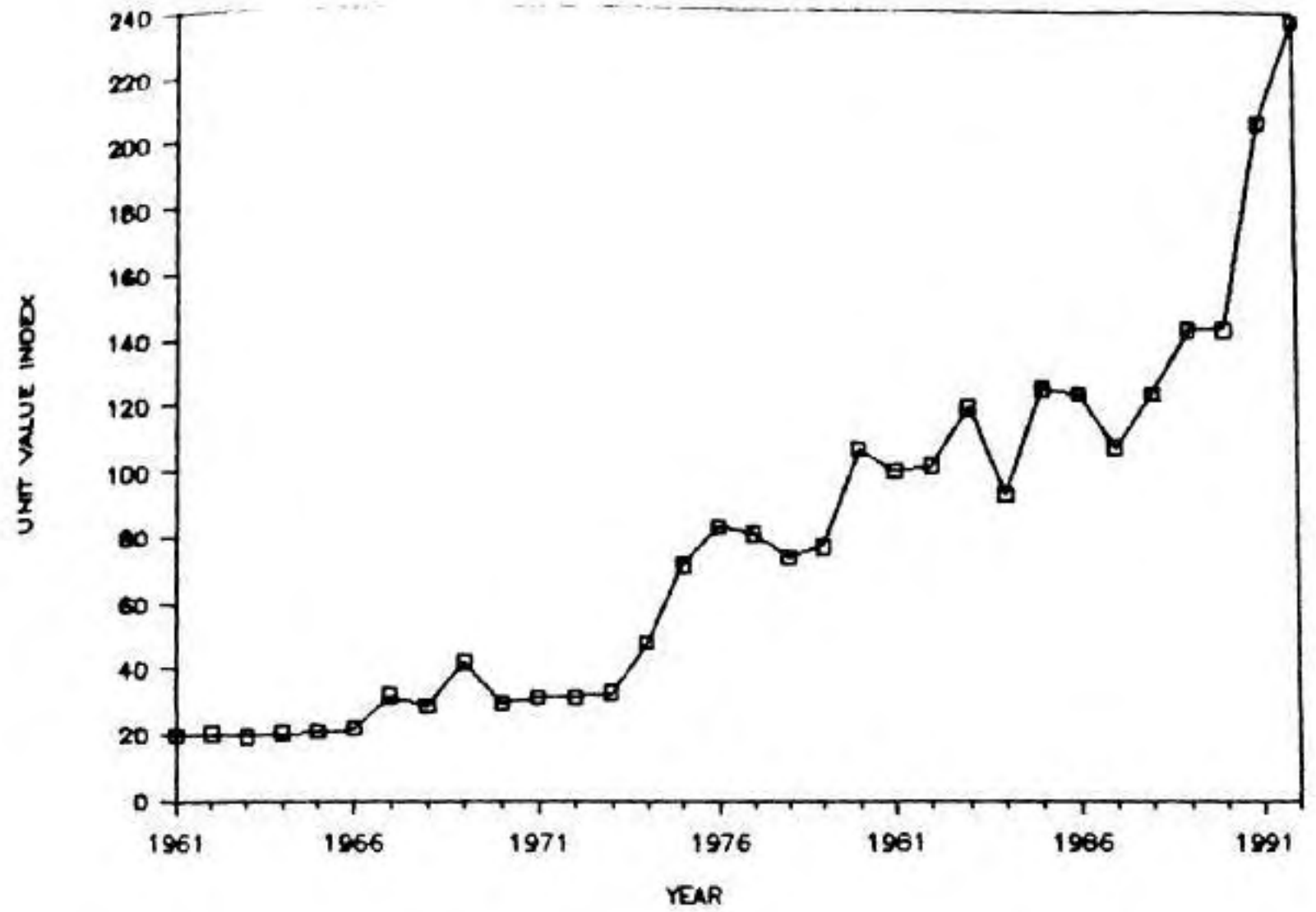
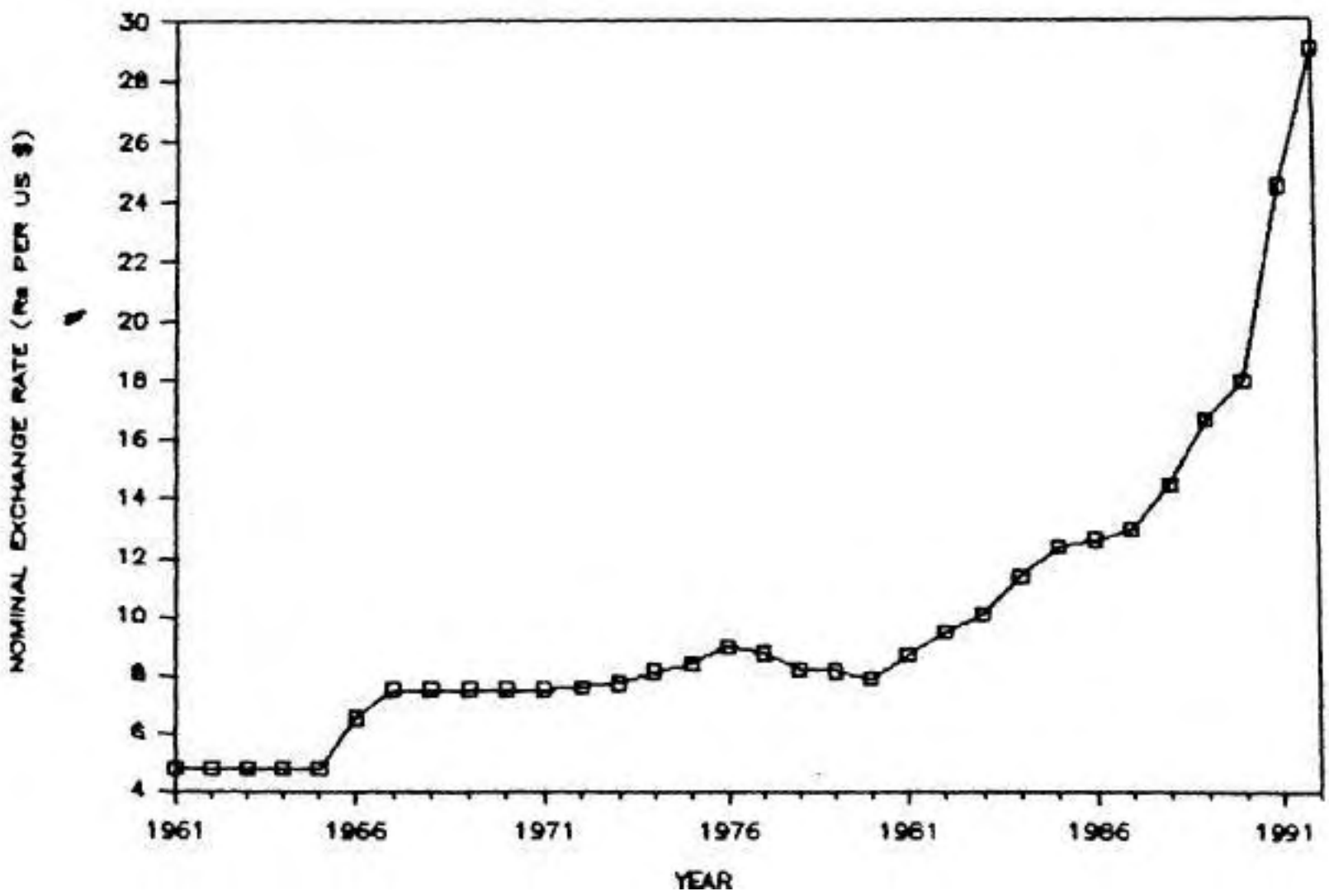


Fig 5.8: NOMINAL EXCHANGE RATE



APPENDIX V-I

DATA LISTING

YEAR	SUB	TAR	MON SUP	PRI IND	Y	YW
1961			2869	19.59	58602	8.238
1962			3046	19.63	60168	8.974
1963			3310	20.38	61165	9.022
1964			3752	21.63	64216	10.22
1965			4080	24.01	68942	11.20
1966			4529	25.83	65734	12.31
1967			4950	29.42	66089	12.69
1968			5350	32.84	71519	12.91
1969			5779	32.47	**73285**	14.51
1970			6387	33.68	78177	15.43
1971	391	18	7321	35.35	82211	15.00
1972	**572**	24	8138	37.54	82675	16.34
1973	729	27	9684	41.31	81991	16.73
1974	895	43	11172	49.66	86010	15.09
1975	1194	65	11907	62.17	87116	14.36
1976	1290	182	13143	61.50	95433	15.08
1977	1330	310	15609	62.78	96253	14.55
1978	1541	310	18383	66.05	103670	16.17
1979	2104	470	21819	66.05	109466	16.98
1980	2660	431	19953	77.36	102937	16.86
1981	3229	505	23117	91.47	110685	17.49
1982	4104	695	24729	100.0	117140	17.53
1983	4883	650	28535	102.6	119704	18.50
1984	5428	668	33066	112.9	129392	21.21
1985	6937	698	39649	120.1	133844	22.03
1986	9090	749	43599	125.4	139059	23.46
1987	9819	949	50996	132.7	143682	23.87
1988	13405	1280	57656	143.6	149408	24.28
1989	15610	1825	66259	154.3	166200	24.70
1990	17658	2707	81580	165.7	174798	25.13
1991	19974	4015	92892	182.7	184460	25.57
1992	22594	5955	141111	207.8	186135	26.01

YEAR	RBR	EXR	PW	RM	MPS
1961	185	4.762	15.30	2232	1122
1962	118	4.762	15.60	2344	1092
1963	157	4.762	16.00	2534	1131
1964	122	4.762	16.60	2777	1222
1965	95	4.762	17.20	2959	1349
1966	59	6.539	17.90	3231	1408
1967	130	7.500	18.20	3463	1902
1968	150	7.500	18.60	3662	2008
1969	302	7.500	19.40	4069	1908
1970	565	7.500	20.40	4390	1582
1971	525	7.501	21.30	4814	1634
1972	596	7.594	22.40	5380	1825
1973	551	7.742	25.50	6015	1867
1974	659	8.102	31.30	7260	2955
1975	531	8.376	34.10	7387	4519
1976	**1078**	8.960	37.50	7732	5265
1977	**2542**	8.739	41.20	9544	5074
1978	4532	8.193	44.40	10938	6025
1979	**5431**	8.126	50.90	14083	6814

YEAR	XPS	UVE	UVI	EXRR	EXRN
1961	642	25.74	20.13	171	201
1962	660	25.74	20.56	173	203
1963	685	25.04	19.72	173	203
1964	793	24.80	20.35	183	204
1965	816	25.27	20.77	190	205
1966	806	26.68	21.82	155	156
1967	1094	39.98	31.48	143	130
1968	1198	39.92	28.53	144	133
1969	1358	65.08	41.72	136	133
1970	1413	40.15	29.38	137	133
1971	1535	40.86	30.85	125	122
1972	1608	42.51	31.27	121	115
1973	1971	47.71	32.52	119	106
1974	2523	58.33	47.42	127	102
1975	3329	75.34	71.13	114	99
1976	4042	77.24	82.83	99	97
1977	5146	82.33	80.48	98	98
1978	5404	91.52	73.67	92	98
1979	5726	91.70	76.92	94	98
1980	6418	92.52	106.5	105	102
1981	6711	100.0	100.0	107	102
1982	7806	113.7	101.5	103	104
1983	8803	121.1	119.2	104	104
1984	9771	138.5	92.92	102	101
1985	11744	155.0	124.6	100	100
1986	10895	156.8	123.0	92	88
1987	12452	164.2	106.9	85	81
1988	15674	178.9	123.0	**82**	77
1989	20232	209.1	143.0	**78**	72
1990	27681	209.1	143.0	85	81
1991	32553	268.8	206.1	82	77
1992	**44042**	339.4	237.6	78	72
1980	5388	7.863	59.70	16573	9143
1981	4775	8.659	67.60	19441	12549
1982	2706	9.455	75.20	20998	13608
1983	1729	10.09	84.00	23110	14293
1984	1624	11.36	92.60	28823	15831
1985	3044	12.36	100.0	31484	17134
1986	3343	12.61	102.0	37793	19658
1987	4594	12.96	109.7	44762	20096
1988	5267	14.48	124.0	53296	22244
1989	5904	16.65	147.2	62342	28235
1990	5989	17.94	172.6	73147	35412
1991	7983	24.47	201.7	87779	43193
1992	L8838	28.99	218.0	99509	47851

Abreviations used

SUB = Export subsidies in rupees crores
TAR = Import tariffs in rupees crores
MON SUP = Money supply (Ml) in rupees crores
PRI IND = Wholesale price index (1980-81=100)
Y=Realnationalincomeinrupees000'crores(1980-81prices)
YW = Real GNP of trading partners in US dollars
RBR = Foreign exchange assets of RBI in rupees

EXR = Nominal exchange rate
PW = World price index
RM = Reserve money in rupees crores
MPS = Import value in crores of rupees
XPS = Export value in crores of rupees
UVE = Unit value index of exports
UVI = Unit value index of imports
EXRR = Real effective exchange rate
EXRN = Nominal effective exchange rate.

APPENDIX V-ILINEAR OLS ESTIMATES:

Sample period: 1962-91

$$(M/P) = \underset{(0.64)}{6.5208} + \underset{(3.26)}{0.0012^{*}}\, Y - \underset{(-3.70)}{210.7588^{*}}\,\pi - \underset{(-0.60)}{31.9641}\,\pi_{-1}$$

$$-\underset{(-1.68)^{-2}}{82.9325}\,\pi + \underset{(4.28)}{0.6304}\,^{*}\,(M/P)_{-1}$$

$R^{-2} = 0.98,\ DW = 1.96,\ F = 235.2,\ Dh\ \textbf{statistics} = 0.185$

$$X^{d} = \underset{(1.09)}{11.4003} - \underset{(-2.13)}{8.7544^{**}}\,(PX/PW)^{s} + \underset{(2.08)}{1.3069^{**}}\,YW + \underset{(4.55)}{0.6651}\,X_{-1}$$

$$+ \underset{(1.13)}{5.2544}\ DUMEXR$$

$R^{-2} = 0.92,\ DW = 1.86,\ F = 97.92,\ Dh\ statistic = 0.64$

Sample period: 1971-91

$$PX^{S} = \underset{(-1.03)}{-27.3792} + \underset{(0.62)}{2.1793}\,(P/(E+s)) + \underset{(4.90)}{0.8945^{*}}\,PW$$

$$+ \underset{(1.54)}{1.9639}\,YW + \underset{(1.01)^{-1}}{0.2867}\,X + \underset{(2.33)}{0.2061}\,^{**}\,EM + \underset{(2.08)}{12.3209}\,^{***}\,DUMEXR$$

$R^{-2} = 0.99,\ DW = 2.63\ \ F = 231,\ Dh\ statistic = -1.50$

$$I = \underset{(-4.86)}{-62.8179} - \underset{(-5.84)}{0.5574^{*}}\,(PM^{S}(E+t)/P) + \underset{(4.87)}{0.0011^{*}}\,Y - \underset{(-11.2)}{0.4244^{*}}\,EM$$

$$+ \underset{(6.95)}{0.5992^{*}}\,((XPX^{S} + KI^{S})/PM^{S}) - \underset{(-3.90)}{0.1650^{*}}\,(R/PM^{6}) + \underset{(3.09)}{0.1657^{*}}\,I$$

$R^{-2} = 0.99,\ DW = 2.02$

$$X^{S} = \underset{(-1.80)}{-13.9709} + \underset{(3.03)}{0.0005^{*}}\,Y + \underset{(1\text{-}73)}{0.3841^{***}}\,X_{-1}$$

$R^{-2} = 0.90,\ DW = 2.10,\ F = 91,\ Dh\ statistic = -.2345$

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

Without EM

PX^S = -27.0992 4 0.7374 PW + 0.0007 Y + 11.4319 DUMEXR
(-.9 6) (3.01) (1.64) (2.17)

R^{-2} = 0.98, DW - 2.04, F = 277.67

I - -7.5205 - 0.5442*(PM*(E+t)/P) + 0.8708*(XPX^S+KI^S)/PM^S
(-1.68) (-3.34) (11.3)

+ 0.1579 $(R/PM^S)_{-1}$ + 0.2451$_{-1}$*** I - 7.6385 DUMEXR
(1.58)* (2.05) (-1.34)
+ 0.5040 I_F
(3.58)

R^{-2} = 0.99, DW = 1.78, F = 231, Dh statistic = 0.603

X^S= -13.9709 + 0.0005* Y + 0.3841***X_{-1}
(-1.80) (3.02) (1.73)

R^{-2}= 0.90, DW = 2.10, F = 91, Dh statistic = -.2345

Sample period 1962-89

$(M/P) = 16.2598 + 0.0013^{*} Y - 196.4479^{*} \pi - 40.5878 \pi_{-1}$
(1.54) (3.56) (-3.70) (-0.82)

$-89.3873^{***}\pi_{-2} + 0.5556^{*} (M/P)_{-1}$
(-1.96) (3.68)

R^{-2} = 0.97, DW = 1.90, F = 142.27, Dh statistic = .439

X^d =16.7782 - 8.1092* (PX^S /PW) + 1.3465* YW + 0.4348** X_{-1}
(2.55) (-3.17) (2.99) (2.61)

+ 11.5103* DUMEXR
(2.89)

R^{-2}= 0.96, DW = 1.68, F = 138, Dh statistic = 1.793

Sample period: 1971-89

PX^S = -44.8580 + 4.5389** (P/(E4-s)) + 0.8566* PW
(-1.48) (2.42) (3.60)

+ 0.0007***Y - 0.3241***X_{-1} + 0.1712* EM + 10. 3524*DUMEXR
(1.99) (-1.94) (3.56) (3.38)

R^{-2} = 0.99, DW = 2.23 F = 198, Dh statistic = -.7331

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

$$I = -61.1818 - 0.5259^{*}\ (PM^{s}(E4t)/p) + 0.0011^{*}\ Y - 0.4201^{*}EM$$
$$(-4.49)\quad (-4,83)\qquad\qquad (4.51)\qquad\quad (-10.33)$$

$$+ 0.5969^{*}((XPX^{s}KI^{s})/PM)^{s} - 0.1665^{*}(R/PM^{s})_{-1} + 0.1722^{**}I_{F}$$
$$(6.62)\qquad\qquad\qquad (-3.76)\qquad\qquad (2.90)$$

$$R^{-2} = 0.99,\ \ DW = 1.82,\ \ F = 198$$

$$X^{s} * 16.1566 + 0.8086^{*}\ (PX^{s}\ (E+S)/P)\ ) + 0.4189^{**}\ X_{-1} - 0.0565\ EM$$
$$(2.94)\quad (3.49)\qquad\qquad (2.28)\qquad\quad (-1.14)$$

$$+ 5.8680\ \ DUMEXR$$
$$(1.67)$$

$$R^{-2} = 0.94,\ \ DW\ = 2.54,\ \ F = 84,\ \ Dh\ statistic = -1.9685$$

Without EM

$$PX^{s}\ =\ -91.8728\ + 4.5947\ ^{**}(P/(E+s))\ + 0.3793\ PW$$
$$(-2.45)\quad (1.78)\qquad\qquad (1.40)$$

$$+ 0.0015^{*}\ Y\ -\ 0.4794^{***}\ \ X_{-1}\ +\ \ 11.5416^{**}\ DUMEXR$$
$$(3.68)\qquad (-2.15)\qquad\qquad (2.75)$$

$$R^{-2} = 0.99,\ \ DW = 1.55,\ \ F = 257.4,\ \ Dh\ \textbf{statistic} = 3.996$$

$$I\ \ = -9.6548 - 0.2223\ \ (PM^{s}(E+t)/P)\ + 0.8690^{*}\ (XPX^{s}+KI^{S}\ )/PM^{s})$$
$$(-2.48)\quad (-1.31)\qquad\qquad (12.24)$$

$$+\ 0.1338\ \ (R/PM^{S})\ \ + 0.1505\ \ I_{-1}\ -\ 17.6405^{**}\ \ DUMEXR$$
$$(1.63)\qquad\qquad (1.43)\qquad\quad (-2.96)$$

$$+ 0.7009^{*}\ \ I_{F}$$
$$(5.18)$$

$$R^{-2} = 0.99,\ \ DW = 2.24,\ \ F = 198,\ \ Dh\ statistic = -.5886$$

$$X^{S} = 13.7525 + 0.7051^{*}\ PX^{s}(E+s)/P)\ + 0.5102^{*}\ X_{-1} + 4.7354\ \ DUMEXR$$
$$(2.69)\quad (3.27)\qquad\qquad (3.05)\qquad\quad (1\text{-}39)$$

$$R^{-2} = 0.94,\ \ DW\ = 2.43,\ \ F = 95,\ \ Dh\ statistic = -1.3687$$

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

Sample period: 1962-87

$$(M/P) = \underset{(1.53)}{19.1426} + \underset{(3.44)}{0.0013}\ Y - \underset{(-3.36)}{190.2529}\ \pi - \underset{(-0.85)}{44.3993}\ \pi_{-1}$$

$$\underset{(-1.85)}{-88.1564}^{**}\pi_{-2} + \underset{(3.14)}{0.5259}^{*}\ (M/P)_{-1}$$

$R^{-2} = 0.95,\ DW = 1.88,\ F - 96,\ Dh\ statistic = 0.59$

$$X^{d} = \underset{(3.95)}{22.6939} - \underset{(-3.80)}{8.1583}^{*}\ (PX^{s}/PW) + \underset{(3.10)}{1.2039}^{*}\ YW + \underset{(2.08)}{0.3072}^{**}\ X_{-1}$$

$$+ \underset{(4.31)}{15.2390}^{*}\ DUMEXR$$

$R^{-2} = 0.96,\ DW = 2.30,\ F = 126,\ Dh\ statistic = -1.1606$

Sample period: 1971-87

$$PX^{s} = \underset{(-2.48)}{-78.2959} + \underset{(3.45)}{7.1084}^{*}\ (P/(E+s)) + \underset{(2.36)}{0.5915}^{**}\ PW$$

$$+ \underset{(2.90)}{0.0010}^{**}\ Y - \underset{(-1.92)}{0.2952}^{***}X_{-1} - I - \underset{(3.51)}{0.1537}^{*}\ EM + \underset{(3.66)}{10.0874}^{*}DUMEXR$$

$R^{-2} = 0.99,\ DW = 2.86,\ F = 165,\ Dh\ statistic = -1.8026$

$$I = \underset{(-4.51)}{-64.9708} - \underset{(-5.71)}{0.5859}^{*}\ (PM^{s}(E+t)/P) + \underset{(4.64)}{0.0012}^{*}\ Y + \underset{(3.43)}{0.2054}^{*}\ I_{F}$$

$$+ \underset{(6.08)}{0.5623}^{*}\ (XPX^{S}+KI^{S})/PM^{S} - \underset{(-4.32)}{0.1716}^{*}\ (R/PM^{s})_{-1} - \underset{(-11.21)}{0.4118}^{*}\ EM$$

$R^{-2} = 0.99,\ DW = 1.73,\ F = 165$

$$X^{S} = \underset{(2.88)}{52.2244} + \underset{(2.78)}{2.6906}^{**}(PX^{s}\ (E+s)/P) - \underset{(-2.32)}{0.0008}^{**}Y - \underset{(-1.74)}{0.0972}\ EM$$

$$+ \underset{(4.20)}{0.7318}^{*}\ X_{-1}$$

$R^{-2} = 0.93,\ DW = 2.95,\ F = 165,\ Dh\ statistic = -2.8113$

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

Without EM

$$PX^{s} = \underset{(-13.64)}{-141.4899} + \underset{(4.61)}{8.6234^{*}}\,(P/(E+s)) + \underset{(16.78)}{0.0019}\,Y$$

$$\underset{(-1.98)}{-\,0.3900^{***}}\,X^{-1} + \underset{(3.12)}{10.3923^{*}}DUMEXR$$

$R^{-2} = 0.99$, DW = 1.97, F = 297, Dh statistic = 0.106

$$I = \underset{(-1.87)}{-8.7167} - \underset{(-1.21)}{0.2843}\,(PM^{s}(E+t)/P)$$

$$+ \underset{(10.21)}{0.8580^{*}}\,(XPXs+Kl^{s})/PM^{s} + \underset{(1.42)}{0.1273}\,(R/PM^{s})_{-1} + \underset{(1.26)}{0.1640}\,I_{-1}$$

$$\underset{(-2.14)}{-\,16.0969}\,DUMEXR + \underset{(4.58)}{0.7062}\,I_{F}$$

$R^{-2} = 0.98$, DW = 2.14, F = 81.67, Dh statistic = -.3415

$$X^{S} = \underset{(2.68)}{13.5680} + \underset{(1.41)}{0.4550}\,PX^{s}(E+s)/P) + \underset{(3.27)}{0.5792^{*}}\,X_{-1} + \underset{(1.59)}{5.6165}\,DUMEXR$$

$R^{-2} = 0.92$, DW = 2.78, F = 57.57, Dh statistic = -2.3475

(a) Log-linear OLS Model

Sample period: 1962-91

$$\ln (M/P) = \underset{(-2.95)}{-2.4931^{*}} + \underset{(2.84)}{0.3903}\,\ln Y - \underset{(-4.59)}{0.8919^{*}}\,\pi - \underset{(-0.88)}{0.1539}\pi_{-1}$$

$$\underset{(-1.74)}{-0.2790^{***}}\,\pi_{-2} + \underset{(4.75)}{0.6623^{*}}\,\ln (M/P)^{-1}$$

$R^{-2} = 0.98$, DW = 1.99, F = 215.6, Dh statistic = 0.0424

$$\ln X^{d} = \underset{(3.93)}{1.4531} - \underset{(-4.46)}{0.5495^{*}}\,\ln (PX^{S}/PW) + \underset{(3.58)}{0.5230^{*}}\,\ln YW$$

$$+ \underset{(2.07)}{0.2965}\,\ln X_{-1} + \underset{(3.43)}{0.2885}\,DUMEXR + \underset{(3.87)}{0.0024}\,EM$$

$R^{-2} = 0.95$, DW = 1.40, F = 138, Dh statistic = 0.0424

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

Sample period: 1971-91

$$\ln PX^{s} = \underset{(6.94)}{1.4281^{*}} + \underset{(0.36)}{0.0330}\ \ln (P/(E+s)) + \underset{(27.50)}{0.7378^{*}}\ \ln PW$$

$$+ \underset{(3.87)}{0.0024^{*}}\ EM + \underset{(3.11)}{0.1334^{*}}\ DUMEXR$$

$$R^{-2} = 0.99,\ DW = 1.80,\ F = 346.5$$

$$\ln I = \underset{(-1.61)}{-3.4873^{***}} - \underset{(-4.27)}{0-1796^{*}}\ \ln (PM^{s}(E+t)/P) + \underset{(1.50)}{0.3492}\ \ln Y$$

$$+ \underset{(10.0)}{0.8067^{*}}\ \ln (XPX^{s}+KI^{s})/PM^{s} - \underset{(-1.19)}{0.0203}\ \ln (R/PM^{s})_{-1}$$

$$+ \underset{(2.24)}{0.0636^{**}}\ \ln I_{F} + \underset{(2.46)}{0.1753^{*}}\ \ln I_{-1} - \underset{(-6.14)}{0.0036^{*}}\ EM$$

$$R^{-2} = 0.99,\ DW = 2.25,\ F = 198,\ Dh \text{ statistic} = -.61$$

$$\ln X^{S} = \underset{(-.46)}{-2.5386} + \underset{(0.72)}{0.1243}\ \ln PX^{s}(E+s)/P) + \underset{(1.32)}{0.3637^{***}}\ \ln Y$$

$$+ \underset{(-.59)}{0.5089}\ \ln X^{-1}$$

$$R^{-2} = 0.93,\ DW = 2.26,\ F = 113.7$$

Without EM

$$\ln PX^{S} = \underset{(-1.66)}{-7.8173^{***}} + \underset{(0.48)}{0.0667}\ \ln (P/(E+s)) + \underset{(2.06)}{0.3543^{**}}\ \ln PW$$

$$+ \underset{(2.05)}{0.9199^{**}}\ \ln Y + \underset{(4.13)}{0.2154^{*}}\ DUMEXR$$

$$R^{-2} = 0.99,\ DW = 1.21,\ F = 346.5$$

$$\ln I = \underset{(-0.36)}{-1.4814} - \underset{(-4.01)}{0.2903^{*}}\ \ln (PM^{s}(E+t)/P) + \underset{(0.27)}{0.1195}\ \ln Y$$

$$+ \underset{(4.54)}{0.6695^{*}}\ln ((XPX^{S}+KI^{s})/PM^{S} + \underset{(1.72)}{0.0442^{***}}\ln (R/PM)^{s}-1$$

$$+ \underset{(3.88)}{0.4291^{*}}\ \ln I_{-1} + \underset{(3.57)}{0.1609^{*}}\ \ln I_{F}$$

$$R^{-2} = 0.99,\ DW = 1.80,\ F = 98,\ Dh \text{ statistic} = .5314$$

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

$$\text{In } X^S = \underset{(-2.10)}{-4.6819^*} + \underset{(2.18)}{0.5557} \text{ In } Y + \underset{(3.00)}{0.5783^*} \text{ In } X_{-1}$$

$R^{-2}=0.93, DW=2.11, F=120, Dh statistic=-.54$

Sample period: 1962-89

$$\text{In } (M/P) = \underset{(-3.02)}{-2.5420} + \underset{(3.00)}{0.4191^*} \text{ In } Y - \underset{(-4.35)}{0.8476^*}\ \pi - \underset{(-1.02)}{0.1783}\ \pi_{-1}$$

$$\underset{(-1.86)}{-0.2957^{**}}\ \pi_{-2} + \underset{(4.17)}{0.6099^*} \text{ In } (M/P)_{-1}$$

$R^{-2}= 0.98,\ DW = 1.97,\ F = 235.2,\ Dh \text{ statistic} = .1255$

$$\text{In } X^d = 1.8565 - \underset{(-4.52)}{0.5168^*} \text{ In } (PX^s/PW) + \underset{(3.94)}{0.5391^*} \text{ In } YW$$

$$+ \underset{(4.21)}{0.3696^*}\ DUMEXR + \underset{(1\text{-}04)}{0.1604} \text{ In } X_{-1}$$

$R^{-2}= 0.95,\ DW = 1.59,\ F = 150,\ Dh \text{ statistic} = 1.876$

Sample period 1971-89

$$\text{In } PX^s = \underset{(5.78)}{1.2286} + \underset{(1.38)}{0.1592} \text{ In } (P/(E+s)) + \underset{(27.91)}{0.7381^*} \text{ In } PW$$

$$+ \underset{(4.56)}{0.0026^*}\ EM + \underset{(3.18)}{0.1248}\ DUMEXR$$

$R^{-2} = 0.99,\ DW = 1.41,\ F = 396$

$$\text{In } I = \underset{(-2.02)}{-5.7506} - \underset{(-4.98)}{0.2144^*} \text{ In } (PM^S(E+t)/P) + \underset{(1.94)}{0.5833^{***}} \ln Y$$

$$+ \underset{(6.77)}{0.6881^*} \text{ In } ((XPX^S+KI^S)/PM^S) + \underset{(2.70)}{0.1899^{**}} \ln I_{-1}$$

$$- \underset{(-6.31)}{0.0030^*}EM + \underset{(3.25)}{0.0902^*} \ln I_F$$

$R^{-2} = 0.99,\ DW = 2.06,\ F = 183.86,\ Dh \text{ statistic} = -.14$

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

$$\ln X^s = \underset{(2.92)}{10.2616} + \underset{(3.95)}{0.6991^*} \ln PX^s (E+s)/P) - \underset{(-2.56)}{0.8731^{**}} \ln Y$$

$$+ \underset{(3.30)}{0.4737^*} \ln X_{-1} - \underset{(-2.13)}{0.0016} EM$$

$R^{-2} = 0.96$, DW = 2.83, F = 76.09, Dh statistic = -1.41

Without EM

$$\ln PX^s = \underset{(-3.14)}{-14.4157} + \underset{(2.22)}{0.3940} \ln (P/(E+s)) + \underset{(0.70)}{0.1185} \ln PW$$

$$+ \underset{(3.51)}{1.5237^*} \ln Y + \underset{(5.11)}{0.2296} DUMEXR$$

$R^{-2} = 0.99$, DW = **1.01,** F = 196

$$\ln I = \underset{(-1.12)}{-5.8902} - \underset{(-4.14)}{0.3115^*} \ln (PM^s(E+t)/P) + \underset{(1.05)}{0.5843} \ln Y$$

$$+ \underset{(2.77)}{0.5017^{**}} \ln (XPX^s+KI^s)/PM^s + \underset{(1.78)}{0.0442^{**}} \ln (R/P^sM)_{-1}$$

$$+ \underset{(3.91)}{0.1770^*} \ln I_F + \underset{(3.37)}{0.3882^*} \ln I_{-1}$$

$R^{-2} = 0.98$, DW = 1.86, F = 231, Dh **statistic** = 1.776

$$\ln X^S = \underset{(1.94)}{6.6632} + \underset{(2.99)}{0.4813^*} \ln (PX^s(E+s)/P) - \underset{(-1.62)}{0.5502} \ln Y$$

$$+ \underset{(4.05)}{0.5948^*} \ln X_{-1}$$

$R^{-2} = 0.96$, DW = 2.38, F = **141,** Dh **statistic** = -1.075

Sample period: 1962-87

$$\ln (M/P) = \underset{(-2.88)}{-2.5486} + \underset{(2.85)}{0.4242^*} \ln Y - \underset{(-4.01)}{0.8384^*} \pi - \underset{(-0.99)}{0.1832\pi_{-1}}$$

$$\underset{(-1.76)}{-0.2937^{***}} \pi^{-2} + \underset{(3.74)}{0.6003} \ln (M/P)_{-1}$$

$R^{-2} = 0.96$, DW = **1.96,** F = 129.33, Dh **statistic** = .1498

$$\text{In } X^d = \underset{(4.67)}{1\text{-}9663} - \underset{(-4.20)}{0.5010^*} \text{ In } (PX^s/PW) + \underset{(3.54)}{0.5136^*} \text{ In YW}$$

$$+ \underset{(4.21)}{0.3833^*} \text{ DUMEXR} + \underset{(0.90)}{0.1445} \text{ In } X_{-1}$$

R^{-2}- 0.94, DW - 1.63, F - 82.25, Dh statistic = 1.623

Sample period 1971-87

$$\text{In } PX^s = \underset{(1.40)}{-5.3240} + \underset{(3.38)}{0.4271^*} \text{ In } (P/(E+s)) + \underset{(3.16)}{0.4555^*} \text{ In PW}$$

$$+ \underset{(1.70)}{0.6212} \text{ In Y} + \underset{(3.90)}{0.0021^*} \text{ EM} + \underset{(4.86)}{0.1750^*} \text{ DUMEXR}$$

R^{-2}=0.99, DW = 2.33,F = 217.8

$$\text{In I} = \underset{(-1.25)}{-5.9831} - \underset{(-4.37)}{0.2163^*} \text{ In } (PM^S(E+t)/P) + \underset{(1.20)}{0.6081} \text{ In Y}$$

$$+ \underset{(4.52)}{0.6816^*} \text{ In } (XPX^s+KI^S)/PM^S + \underset{(1.90)}{0.1849^{***}} \ln I_{-1}$$

$$- \underset{(-5.68)}{0.0030^*}\text{EM} + \underset{(2.87)}{0.0913^{**}} \ln I_F$$

R^{-2} = 0.99, DW = 2.01, F = 165, Dh statistic = -0.0225

$$\text{In } X^S = \underset{(2.92)}{10.5924} + \underset{(3.54)}{0.6844^*} \text{ In } PX^S (E+s)/P) + \underset{(3.09)}{0.5143^*} \text{ In } X_{-1}$$

$$- \underset{(-1.93)}{0.0015} \text{ EM} - \underset{(-2.59)}{0.9124} \text{ Y}$$

R-^{2}=0.95, DW =2.94, F = 72, Dh statistic = -2.6608

WITHOUT EM

$$\text{In } PX^s = \underset{(-2.91)}{-13.6302} + \underset{(2.46)}{0.4590^{**}} \text{ In } (P/(E+s)) + \underset{(0.70)}{0.1199} \text{ In PW}$$

$$+ \underset{(3.26)}{1.4450^*} \text{ In Y} + \underset{(5.21)}{0.2428^*} \text{ DUMEXR}$$

R^{-2}= 0.99, DW = 1.20, F = 147

$$\ln I = \underset{(-0.42)}{-3.6934} - \underset{(-3.44)}{0.3025^{*}} \ln (PM^{S}(E+t)/P) + \underset{(0.38)}{0.3544} \ln Y$$

$$+ \underset{(2.04)}{0.5664^{***}} \ln (XPX^{S} + KI^{S})/PM^{S} + \underset{(2.63)}{0.4194^{**}} \ln I_{-1}$$

$$+ \underset{(3.41)}{0.1768^{*}} \ln I_{F} + \underset{(1.58)}{0.0430} \ln (R/PM^{S})_{-1}$$

$R^{-2} = 0.98$, DW = 1.86, F = 81.67, Dh statistic = .3833

$$\ln X^{S} = \underset{(2.06)}{7.2731} + \underset{(2.71)}{0.4573^{**}} \ln PX^{S}(E+s)/P) - \underset{(-1.77)}{0.6196^{***}} \ln Y$$

$$+ \underset{(4.03)}{0.6589^{*}} \ln X_{-1}$$

$R^{-2} = 0.94$, DW = 2.57, F = 82.33, Dh statistic = -1.5901

LIKEAR 2SLS

Sample period 1971-87

$$(M/P) = \underset{(1.37)}{41.2290} + \underset{(8.53)}{0.0023} Y - \underset{(-2.81)}{205.6650}\pi_{1}$$

$R^{-2} = 0.84$, DW = 1.77, F = 43

$$X^{d} = \underset{(13.5)}{98.9121} - \underset{(-8.32)}{31.2144} (PX^{S}/PW) + \underset{(9.26)}{19.7543} DUMEXR$$

$R^{-2} = 0.93$, DW = 1.83, F - 109.67

$$PX^{S} = \underset{(-1.33)}{-57.2433} + \underset{(1.92)}{5.9047} (P/(E+s)) + \underset{(1.76)}{0.0008} Y + \underset{(2.29)}{0.7504} PW$$

$$- \underset{(-1.71)}{0.3238} X^{-1} + \underset{(2.90)}{0.1616} EM + \underset{(3.20)}{11.0766} DUMEXR$$

$R^{-2} = 0.99$, DW = 2.14, F = 165, Dh statistic = -0.4675

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

$$I = -5.8397 + 0.9522\ (XPX^{S}+KI^{S})/PM^{S} + 0.5818\ I_{F} - 0.1580\ EM$$
$$(-1.71) \qquad (26.48) \qquad (4.15) \qquad (-2.15)$$

$$- 16.4398\ DUMEXR$$
$$(-3.38)$$

$$R^{-2} = 0.99,\ DW = 2.11,\ F = 297$$

$$X^{S} = 13.4111 + 0.4405\ PX^{S}(E+s)/P) + 0.5870\ X_{-1}$$
$$(2.65) \quad (1.37) \qquad (3.34)$$

$$+\ 5.5919\ DUMEXR$$
$$(1.57)$$

$$R^{-2} = 0.92,\ DW = 2.82,\ F = 57.57,\ Dh\ statistic = -2.4523$$

Sample period 1971-89

$$(M/P) = 31.5337 + 0.0010\ Y - 265.1536\ \pi - 110.3469\ \pi^{-2}$$
$$(1.58) \quad (2.68) \quad (-4.28) \quad (-1.97)$$

$$+ 0.6086\ (M/P)^{-1}$$
$$(3.88)$$

$$R^{-2} = 0.94,\ DW = 1.99,\ F = 84,\ Dh\ statistic = .0298$$

$$X^{d} = 2.1562 + 1.0182\ X_{-1}$$
$$(0.47) \quad (13.56)$$

$$R^{-2} = 0.91,\ DW = 2.05,\ F = 171.89,\ Dh\ statistic = -0.0922$$

$$PX^{S} = 16.6992 + 1.2287\ PW$$
$$(9.07) \quad (45.3)$$

$$+\ 0.2166\ EM + 10.3786\ DUMEXR$$
$$(5.46) \qquad (4.3)$$

$$R^{-2} = 0.99,\ DW = 1.33,\ F = 495$$

$$I = 2.4286 + 1.0027\ (XPX^{S}+KI^{S})/PM^{s} - 0.1914\ (R/PM)^{s}_{-1}$$
$$(0.47) \quad (26.3) \qquad (-1.58)$$

$$- 0.4062\ EM$$
$$(-4.00)$$

$$R^{2} = 0.98,\ DW = 1.95,\ F=245$$

$$X^s \quad \underset{(2.32)}{27.2783} + \underset{(2.76)}{1.2761}\ PX^s(E+s)/P) - \underset{(-1.47)}{0.0003}\ Y + \underset{(4.58)}{0.7842}\ X_{-1}$$

R^{-2}=0.94, DW = 2.64, F - 95, Dh statistic = -2.0985

Sample period 1971-91

$$(M/P) = \underset{(0.49)}{10.0981} + \underset{(2.70)}{0.0012}\ Y - \underset{(-3.17)}{253.6045}\ \pi - \underset{(-1.57)}{103.7435}\ \pi_{-2}$$

$$+ \underset{(3.62)}{0.6163}\ (M/P)_{-1}$$

R^{-2}= 0.96, DW = 2.38, F = *96,* Dh statistic = -1.3887

$$X^d = \underset{(-.84)}{-9.0555} + \underset{(1.38)}{1.2733}\ YW + \underset{(5.14)}{0.8277}\ X$$

R^{-2}= 0.86, DW = 2.20, F = 66, Dh statistic = -0.6449

$$PX^S = \underset{(-13.1)}{-101.2979} + \underset{(9.63)}{0.0016}\ Y + \underset{(2.56)}{0.5653}\ X$$

R^{-2} = 0.98, DW = 1.68, F = 441

$$I = \underset{(0.73)}{2.7063} + \underset{(40.4)}{1.0045}\ (XP^S+KI^S)/PM^S - \underset{(-2.1)}{0.2040}\ (R/PM^s)_{-1} - \underset{(-5.37)}{0.4372}\ EM$$

R^{-2} = 0.99, DW = 2.04, F = 561

$$X^S = \underset{(-1.8)}{-13.9709} + \underset{(3.03)}{0.0005}\ Y + \underset{(1\text{-}73)}{0.3841}\ X_{-1}$$

R^{-2}= 0.90, DW = 2.10, F = 53.32

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

CHAPTER 6

POLICY ANALYSIS

6.0. Simulation Methodology:

The empirical results, including those of 2SLS, discussed so far are partial in nature and do not take into account the inter-dependencies between endogenous variables and their dynamics. This additional task is done by either obtaining the reduced form system underlying the structural model or undertaking simulations using the estimated model. The first option is tedious if the structural model is non-linear, and also the reduced form model is less appealing because each endogenous variable depends on all explanatory variables whether relevent or not. The simulation approach is more attractive and has several other advantages. These include scenario simulations involving hypothetical policy changes, both individually and in combinations, like devaluation, credit control, reduction in subsidies, tariffs etc. We now turn our attention to this analysis.

The model performance can be evaluated by simulating the model historically and examining how faithfully the model tracks the original data. The common measures to compare the closeness of the original and simulated values are the Root Mean Square Percentage Error (RMPE), the Mean Absolute Percentage Error (MAPE) and Theil's measure of Inaccuracy in forecasts (THIF).

MAPE and RMPE indicate the first and second (infact, square root of the second moment) of the error distributions.

"Model simulation ...is simply the mathematical solution of a simultaneous set of (difference) equations. Simulation refers to a set of such equations" (Pindyck and Rubinfeld (1976)). For simulating a model, the estimated values of the parameters have to be provided along with the initial values of the endogenous variables and a time series of exogenous variables. When such a model is simulated and solved over time, solutions for each endogenous variable can be obtained. Such a simulation exercise can be carried out for model testing and evaluation, historical policy analysis and forecasting. Both static and dynamic simulations are possible. In a static or one period simulation, historical values are assigned to lagged endogenous variables; whereas in a dynamic simulation, model estimated values will be used for these variables. Hence, there is a possibility of error build-up in a dynamic simulation but not so in one period simulation. Further, there are two sub-categories of simulations viz shock and sustained types in both one period and dynamic simulations.

Comparison of historical series of endogenous variables with the model simulated values can provide valuable guide for model validation. Such ex-post simulations play an important role in policy analysis. By changing parameter estimates or values of exogenous variables, very interesting and useful policy

simulations, though hypothetical, cab be carried out (provided there are no changes in the policy regime). This could help examine the impact of alternative policy options.

To evaluate historical simulations is a difficult task. Each individual equation in the model may fit the data well but the simulated values may not be close to observed values. Pindyck and Rubinfeld point out that models having a good statistical fit may simulate badly because "behaviour of the model as a dynamic structure may bear little relation to the way individual equations fit historical data". Besides, some equations in the model may have a good fit whereas others may not. This is because it is easier to construct some parts of the model while others may pose greater problems. Sometimes, the model may have a bad fit but may simulate well. A compromise may have to be made by the model builder wherein a few equations which may not have a good fit are accepted as long as good simulation results are obtained.

The performance of the model can also be guaged by seing how well the simulated values trace the actual values. When turning points in the endogenous variables are traced by the simulated series of respective variables, then the model performance may be pronounced as good. But, various problems may arise in the model simulation. The equation may have low RMPE values but may not trace the turning points well. The opposite may also hold true. But as pointed out by Pindyck and Rubinfeld, "model building is

very much an art, and part of the art is learning to trade off alternative criteria in different ways".

6.1. Historical (Base) Simulation:

For the purpose of model validation, we start with the linear model because our interest is in predicting the levels of endogenous variables and the fluctuations therein. Since 2SLS estimates are not very encouraging we use the former for simulation purpose. The linear 2SLS estimates and the log-linear model using OLS method will however be used to analyse the sensitivity of policy impacts to method of estimation and functional form respectively.

The model was simulated historically to check for its *ex-post* (sample peroid) performance. Both static and dynamic simulations were performed using the model estimated by OLS method for the time period 1962-87. The basic data for such a simulation are parameter estimates, values of the endogenous variables in the initial year(s) depending on the number of lagged years and values of the exogenous variables for the entire simulation period. The RMPE and MAPE were computed for six crucial endogenous variables and presented in Table 6.1. A third goodness of fit measure called Theil's inaccuracy in forecasts (THIF) is also computed and presented in Table 6.1. The rate of inflation variable has been omitted from this table because the rate of change in price level also gives same information. Likewise, desired real balances variable is also excluded because

it has no historical series. In addition, plots of endogenous variables containing historical and simulated values also confirm this. The above measures are computed for sample sub-periods 1972-81, 1982-87 and the entire sample period, 1972-87. The above sub periodisation is to see whether the model performance differs between these sub-periods.

From Table 6.1, the *ex-post* performance of the static simulation in tracing the historical values given the observed lagged values is fairly satisfactory, except perhaps for net foreign assets variable (R). All the three summary measures have low values indicating close fit of simulated values with historical series. The model (Linear OLS parameters) seem to forecast better for the second half of the sample viz., 1982-87 than the first half for four endogenous variables. The model did not do well for price level and net foreign assets variables.

Table 6.1. Goodness of Fit Measures for Ex-Post Static Simulations

Endogenous Variable	1972-81			1982-87			1972-87		
	MAPE	RMPE	THIF	MAPE	RMPE	THIF	MAPE	RMPE	THIF
Price Level (P)	4.14	5.10	2.76	5.69	6.47	3.30	4.92	5.82	3.16
Money Supply (Ml)	4.64	5.75	2.92	1.87	2.39	1.03	3.26	4.40	1.60
Unit Export Value (PX^S)	5.48	6.62	3.34	4.14	4.79	2.34	4.81	5.78	2.66
Export Volume (X)	3.69	5.49	2.89	4.36	5.22	2.55	4.02	5.36	2.70
Import Volume (I)	7.98	10.37	5.11	3.17	3.68	1.78	5.58	7.78	2.97
Net Foreign Assets (R)	15.79	18.82	9.26	19.18	22.70	10.45	17.49	20.85	9.69

MAPE- Mean Absolute Percentage Error
RMPE- Root Mean Percentage Error
THIF- Theil's Inaccuracy in Forecasts

Table 6.2. Goodness of Fit Measures for Ex-Post Dynamic Simulations

Endogenous Variable	1972-81			1982-87			1972-87		
	MAPE	RMPE	THIF	MAPE	RMPE	THIF	MAPE	RMPE	THIF
Price Level (P)	3.86	5.19	2.76	10.77	12.25	3.60	7.32	9.41	5.55
Money Supply (Ml)	4.60	6.04	3.22	2.18	3.00	0.83	3.39	4.77	1.93
Unit Export Value (PX^S)	5.56	6.24	3.07	4.56	5.41	1.50	5.06	5.84	2.74
Export Vol (X)	5.21	6.32	3.35	4.12	5.03	1.42	4.66	5.71	2.87
Import Vol (I)	7.67	10.48	5.26	6.37	7.15	1.92	7.02	8.97	3.89
Net Foreign Assets (R)	14.54	17.97	9.46	21.79	29.48	8.77	18.16	24.41	11.72

MAPE- Mean Absolute Percentage Error
RMPE- Root Mean Percentage Error
THIF- Theil's Inaccuracy in Forecasts

The unsatisfactory performance for these two variables is perhaps due to the fact that there are no estimated equations for these two variables. Their values are dependent on other variables. Errors in those variables may cumulate to produce large errors for these two variables.

Summary measures relating to dynamic simulations are presented in Table 6.2. As expected, broadly, the MAPE, RMPE and THIF values for static simulation are less than the corresponding values for dynamic simulation with a few exceptions, indicating some error build-up in the latter. The dynamic simulations exhibit similar pattern as that of static ones in predicting the variables between the two sub-periods. Within each simulation, the degree of success varied across variables. Money supply variable stands-out well traced uniformly in all simulations, particularly for the second sub-sample period 1982-87, possibly because its historical series is quite smooth. The magnitude of MAPE, RMPE and THIF values for all other variables with the exception of price level (some times) and net foreign assets (R) variables, seem reasonable. In every simulation, the RMPE is always exceeding MAPE reflecting the volatile nature of the trade variables.

6.2 Post-Sample Forecasts:

An honest way to judge how well a model performs is to subject it to post-sample forecasts. In this study, post sample predictions were made for the five year period 1988-92. Since the

actual values of the endogenous variables were available for this period, a comparison could be made to ascertain how close the forecasts are to the actual values. Table 6.3 contains the actual and predicted values along with error in prediction for the six selected endogenous variables for each year of the post-sample period. Further, in order to compare post-sample performance with *ex-post* period, the same summary measures (MAPE, RMPE and THIF) are computed for two sub-periods viz., 1988-90, 1991-92 and the entire period. This periodisation for the post-sample period is based on the actual and predicted values given in Table 6.3. These summary measures are presented in Table 6.4.

Table 6.3: Post-Sample Forecasts for 1988-92 using Dynamic Simulation

Endogenous Variable	1988 Actual	1988 Predicted	1988 Error	1989 Actual	1989 Predicted	1989 Error
Price level	143.6	148.6	4.9 (3.4)	154.3	148.5	-5.8 (-3.8)
Money supply	57656	57385	-270.9 (-.4)	66259	63556	-2703.0 (-4.1)
Unit value of Exports	178.9	182.9	4.0 (2.2)	208.2	206.3	-2.8 (-1.4)
Export volume	87.6	78.4	-9.2 (-10.4)	96.7	80.3	-16.4 (-16.9)
Import volume	180.7	172.0	-8.7 **(-4.8)**	197.3	187.8	-9.5 (-7.6)
Net foreign Assets	5267.0	5016.4	-250.6 (-4.8)	5904	3360.8	-2543.2 (-43.1)

Figures in parentheses are percentage errors.

Table 6.3: (contd)

Endogenous Variable	1990 Actual	Predicted	Error	1991 Actual	Predicted	Error
Price level	209.2	225.2	16.1 (7.6)	182.7	147.3	-35.4 (-19.4)
Money supply	81580	71526	-10054 (-12.3)	92892	74433	-18459 (-19.8)
Unit value of exports	209.2	225.2	16.1 (7.7)	268.8	240.7	-28.1 (-10.4)
Exports volume	132.3	82.2	-50.1 (-37.9)	121.1	84.2	-36.8 (-30.4)
Imports volume	247.5	228.7	-18.8 (-7.6)	209.5	190.9	-18.6 (-8.9)
Net foreign Assets	5989	-3026	-9015	7983	-9460	-17443 (-218.5)

Figures in parantheses are percentage errors. (contd)

Table 6.3: (contd)

Endogenous Variable	1992 Actual	Predicted	Error
Price level	207.8	152.5	-55.3 (-26.6)
Money supply	141111	78790	-62321 (-44.2)
Unit value of exports	339.4	229.6	-109.8 (-32.34)
Export volume	129.8	86.5	-43.2 (-33.3)
Import volume	201.3	211.1	9.8 (4.8)
Net foriegn Assets	18838	-25110	-43948 (-233.3)

Figures in parentheses are percentage errors.

Table 6.4: Goodness of Fit Measures for Post-Sample Dynamic Simulations

Endogenous Variable	1988-90			1991-92			1988-92		
	MAPE	RMPE	THIF	MAPE	RMPE	THIF	MAPE	RMPE	THIF
Price Level (P)	3.43	3.44	1.72	23.00	23.28	13.32	11.26	14.96	9.1
Money Supply (Ml)	5.62	7.50	4.50	32.02	34.24	22.90	16.18	22.42	18.1
Unit Export value (PX^S)	3.77	4.69	2.40	21.40	24.03	14.68	10.82	15.63	11.0
Export Volume (X)	21.77	24.70	16.47	31.87	31.90	18.71	25.81	27.81	17.6
Import Volume (I)	5.75	5.90	3.23	6.90	7.18	3.67	6.21	6.44	3.4
Net foreign Assets (R)	66.12	90.44	56.19	225.90	226.02	99.08	130.0	159.18	95.6

MAPE- Mean Absolute Percentage Error
RMPE- Root Mean Percentage Error
THIF- Theil's Inaccuracy in Forecasts

Table 6.5: Goodness of Fit Measures for Combined Simulation for 1972

Endogenous Variable	Static Simulation			Dynamic Simulation		
	MAPE	RMPE	THIF	MAPE	RMPE	THIF
Price Level (P)	4.60	5.42	2.68	6.92	8.82	4.75
Money Supply (Ml)	3.37	4.49	2.36	4.08	5.74	4.03
Unit Export Value (PX^S)	4.63	5.53	2.50	4.79	5.59	2.55
Export Volume (X)	7.11	10.96	8.67	8.06	12.14	9.72
Import Volume (I)	5.55	7.40	3.01	6.64	8.44	3.66
Net Foreign Assets (R)	22.86	31.80	20.82	30.49	50.87	37.46

MAPE- Mean Absolute Percentage Error
RMPE- Root Mean Percentage Error
THIF- Theil's Inaccuracy in Forecasts

In general, based on the summary measures, there does not seem to be any uniform pattern between *ex-post* and post-sample simulations in terms of relative superiority. One may expect *ex-post* simulation to be better than post-sample (inclusive of sample period here) simulation, but this does not seem to hold good. However, the net foreign assets variable seem to support the expected behaviour.

The low magnitudes of forecast errors for the immediate three year post-sample period underscore the usefulness of the model for short-run forecasting purpose. As noted earlier, the historical data for the years 1991-92, more specifically for 1992, do not follow the past trends and exhibit serious outlier nature. For this reason, the model failed to forecast the variables satisfactorily. The imports volume seems to be an exception. This variable could be forecasted well throughout the five year period where as price level, unit export value and money supply could be predicted well during the three year immediate post-sample period. Net foreign assets variable seem to reflect the cumulative errors, especially of exports volume variable. To assess the base/historical simulations for the *ex-post* and post-sample periods put together, combined simulations, static and dynamic, are run for the 1972-90 period. The summary measures are presented in Table 6.5. The summary measures indicate a more balanced picture and underscore the above conclusions.

6.3. Impact, Dynamic and Equilibrium Multipliers:

In a dynamic simultaneous equation system like the presentmodel, it is possible to quantify the effects of changes in exogenous variables on the endogenous variables through the computation of responses known as impact and dynamic multipliers. The impact multiplier measures the effect of a shock or once-for-all unit change (relative change if the variables are in a logarithmic form) in an exogenous variable on the endogenous variable. The exogenous change and the impact corresponds to the immediate one period only. In other words, the impact multipliers represent reduced form coefficients of pure exogenous variables. The residual effect of a once-for-all shock can be carried over to subsequent periods in a truly dynamic model involving lagged dependent explanatory variables like the present model. In such cases, the effect of an exogenous change on an endogenous variable can be measured after each time interval and can be cumulated as short, medium and long-term effects. These are called dynamic multipliers and measure the cumulative effect after one, two, three... periods. In addition, it is also possible to quantify the total effect after an infinite time gap through long-run or equilibrium multipliers. The dynamic multipliers coincide with the impacts of a sustained exogenous change. For a linear model, linear in both variables and parameters, multipliers can be computed analytically from the estimated parameters without under-taking any simulation exercise. For a non-linear model, multipliers can be computed

numerically using dynamic simulations. We use this latter procedure in our case.

6.4. Sensitivity Analysis:

Before we undertake any specific policy change and quantify its effects, it is necessary to analyse (a) the dynamic stability of the model and the sensitivity of the impacts to choice of (b) timing of the exogenous change, (c) level of exogenous change, (d) functional form and the parameters used (e) method of estimation used to quantify the regression coefficients. The example of devaluation is used to analyse each of these in some detail.

(a) Dynamic Stability:

We take the case of a 30% once-for-all devaluation in Indian rupee. To implement this, the nominal exchange rate (E) is increased by 30% in a specific year and its allocative and dynamic effects are quantified.

Since the exogenous change is of a shock type, it is expected that it produces an initial impact on the endogenous variable(s) with which it is directly associated. Due to dynamic nature of the model, the effects will continue into future but with declining magnitudes and eventually the impact should die down and the simulated path returns to the reference path (base simulation). For some variables, it is possible that the effects may not die down, but tend to stabilise (becomes constant) overtime i.e., the simulated path may not merge with base

simulation but stays more or less parallel. If either of this happens, the model is said to be dynamically stable. These two situations are sometimes referred to as stability of first and second kind respectively. Yet, a third possibility is that the simulated path fluctuates or diverges away from base simulation, in which case the model is said to be dynamically unstable. A dynamically unstable model may not be suitable for any policy analysis. Further, due to simultaneity of the model, there will be allocative effects on other endogenous variables in the event of an exogenous change. The timing of these effects depends on the lags and leads in the model i.e., they need not occur in the same year.

A perusal at the dynamic impacts of a one-shot 30%devaluation in 1978 (Table 6.6) shows that the model is dynamically stable (of the first kind).with respect to unit value of exports and export and import volumes, the endogenous variables directly affected by devaluation. Price level and money supply (at least in relative terms) variables seem to indicate stability of second kind whereas the net foreign assets variable indicate some what cyclical behaviour and perhaps dynamic instability.

Table **6.6.** Dynamic Impacts of a 30% One-shot Devaluation in 1978
Linear Model for 1962-87

Year or	Price level	Unit value of Exports	Money supply	Exports volume	Imports volume	Net foreign Assets
1978	.18 (.27)	-5.47 (-5.7)	11.5 (.06)	1.0 (1.7)	-3.23 (-3.7)	6.9 (.15)
1979	.23 (.33)	-.16 (-.17)	30.4 (.15)	.33 (.54)	.12 (.12)	19.6 (.44)
1980	.16 (.22)	-.03 (-.03)	22.5 (.11)	.11 (.17)	.09 (.13)	18.7 (.30)
1981	.13 (.14)	.06 (.05)	35.0 (.15)	.02 (.04)	-.04 (-.03)	29.4 (.55)
1982	.07 (.08)	.04 (.03)	48.8 (.18)	.0 (.01)	-.09 (-.07)	41.4 (.92)
1983	.10 (.09)	.03 (.02)	56.3 (.19)	-.00 (-.0)	-.02 (-.02)	45.6 (1.9)
1984	.14 (.13)	.05 (.03)	59.9 (.17)	-.00 (-.01)	-.04 (-.02)	52.2 (1.94)
				*..		
1988	.12 (.08)	.04 (.02)	70.1 (.12)	-.0 -.01)	-.08 (-.05)	64.8 (1.0)
1989	.18 (.12)	.04 (.02)	77.2 (.12)	-.0 (-.0)	-.04 (-.02)	72.6 (1.8)
1990	.18 (.11)	.04 (.02)	95.1 (.13)	-.0 (-.0)	-.07 (-.03)	85.2 (4.9)

...Indicates that in-between values are omitted.
The entries are actual change in the variable over its base simul tion value with percentage change given in parantheses.

(b) Effect of timing of the exogenous change:

The 30% once-for-all devaluation is repeated for several years. The idea is to see if the effects are independent of the timing of the exogenous change. Probably it need not. Infact, this is one of the main criticisms of devaluation as a possible measure to improve trade balance and balance of payments. However, if we can notice some pattern in the way the endogenous variables are affected due to devaluation undertaken at different points of time, it would be a useful guide for the policy maker. Towards this end, we simulate a 30% devaluation in Indian rupee in 1978, 1979,___,1984,..., 1988 and 1991. Since the effects can occur only into future starting from the year of exogenous change, we get a triangular matrix of impacts for each endogenous variable. These are tabulated seperately for each of six important endogenous variables viz., price level, money supply, unit value of exports, export volume, import volume and net foreign assets (BOP). Both the level and percentage change are tabulated (Table 6.7.1-6.7.6),

Table 6.7.1. Dynamic Impacts of a 30% One-shot Devaluation In different years on Price Level

(1980-81=100)

Year of Impact	Year of Devaluation								
	1978	1979	1980	1981	1982	1983	1984	1988	1991
1978	.18 (.27)								
1979	.23 (.33)	.45 (.66)							
1980	.16 (.22)	.29 (.40)	.82 (1.2)						
1981	.13 (.14)	.56 (.61)	.95 (1.0)	.67 (.73)					
1982	.07 (.08)	.17 (.19)	.96 (1.0)	.34 (.37)	.96 (1.0)				
1983	.10 (.09)	.53 (.44)	.21 (.18)	1.4 (1.1)	1.1 (.91)	2.1 (1.7)			
1984	.14 (.13)	.08 (-07)	.48 (.45)	-.13 (-.12)	.77 (.73)	.32 (.30)	.30 (.28)		
1988	.12 (.08)	.17 (.11)	.95 (.62)	-.10 (-.07)	.44 (.29)	-.5 (-.33)	.10 (.06)	.65 (.42)	
1991	.16 (.11)	.20 (.13)	.94 (.63)	-.08 (-.06)	.68 (.46)	-.08 (-.05)	.19 (.13)	.34 (.23)	5.3 (3.5)
1992	.29 (.18)	.37 (.23)	2.0 (1.3)	-.30 (-.18)	1.3 (.81)	-.43 (-.27)	.38 (.23)	.71 (.44)	6.8 (4.2)

. . . Indicates that in-between values are omitted.
The entries are actual change in the variable over its base Simulation value with percentage change given in parantheses.

Table 6.7.2. Dynamic Impacts of a 30% One-shot Devaluation in different Years on Unit Value of Exports

Year of Impact	Year of Devaluation								
	1978	1979	1980	1981	1982	1983	1984	1988	1991
1978	-5.47 (-5.7)								
1979	-.16 (-.17)	-4.0 (-4.2)							
1980	-.02 (-.03)	-0 (.00)	-4.8 (-4.8)						
1981	.06 (.05)	.13 (.12)	.32 (.29)	-5.42 (-4.9)					
1982	.04 (.03)	.16 (.14)	.32 (.27)	.02 (.01)	-3.88 (-3.30)				
1983	.03 (.02)	.15 (.12)	.24 (.18)	.35 (.26)	.34 (.26)	-5.65 (-4.22)			
1984	.05 (.03)	.08 (.06)	.22 (.15)	.02 (.02)	.26 (.18)	.03 (.02)	-4.92 (-3.38)		
1988	.04 (.02)	.08 (.05)	.24 (.13)	.01 (.01)	.10 (.05)	-.05 (-.03)	.03 (.02)	-4.65 (-2.51)	
1991	.01 (.00)	.01 (.01)	.16 (.07)	-.02 (-.01)	.09 (.04)	-.04 (-.02)	.01 (.01)	.04 (.01)	.44 (.18)
1992	.08 (.04)	.13 (.06)	.78 (.33)	-.10 (-.04)	.46 (.20)	-.17 (-.07)	.12 (.05)	.26 (.11)	2.13 (.91)

... Indicates that in-between values are omitted.

The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.

Table 6.7.3. Dynamic Impacts of a 30% One-shot Devaluation in different Years on Net Foreign Assets (Rs Crores)

Year of Impact	Year of Devaluation								
	1978	1979	1980	1981	1982	1983	1984	1988	1991
1978	6.8 (.15)								
1979	19.6 (.44)	29.8 (.67)							
1980	18.7 (.30)	43.8 (.71)	65.1 (1.1)						
1981	29.4 (.55)	27.5 (.51)	95.2 (1.8)	5.3 (.10)					
1982	41.4 (.92)	64.8 (1.4)	101.0 (2.24)	32.7 (.73)	82.1 (1.8)				
1983	45.6 (1.9)	51.8 (2.2)	173.0 (7.31)	-22.2 (-.94)	99.7 (4.2)	-22.7 (-.96)			
1984	52.2 (1.9)	72.4 (2.7)	205.3 (7.6)	-1.9 (-.07)	113.6 (4.2)	0.96 (.04)	44.0 (1.6)		
1988	64.8 (1.0)	82.6 (1.3)	317.0 (5.1)	-13.2 (-.21)	228.7 (3.6)	-19.0 (-.3)	74.6 (1.2)	125.5 (2.0)	
1991	83.8 (1.1)	102.8 (1.3)	457 (5.9)	-51.5 (-.66)	304.5 (3.9)	-76.9 (-.99)	100.4 (1.3)	174.3 (2.2)	1601 (20.5)
1992	96.6 (.45)	130.4 (.60)	589 (2.7)	-55.4 (-.26)	370.3 (1.7)	-102 (-.47)	115.1 (.53)	222.4 (1.03)	1762 (8.13)

... Indicates that in-between values are omitted.

The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.

Table 6.7.4. Dynamic Impacts of a 30% One-shot Devaluation in different Years on Export Volume

Year of Impact	Year of Devaluation								
	1978	1979	1980	1981	1982	1983	1984	1988	1991
1978	1.00 (1.7)								
1979	.33 (.54)	.64 (1.05)							
1980	.11 (.17)	.20 (.31)	.66 (1.04)						
1981	.03 (-04)	.04 (.07)	.16 (0.25)	.65 (1.0)					
1982	.00 (.01)	.00 (-.01)	.02 (.02)	.20 (.30)	.42 (.64)				
1983	-.02 (.00)	-.02 (-.02)	-.02 (-.03)	.03 (.04)	.10 (.14)	.54 (.81)			
1984	-.01 (-.01)	-.01 (-.02)	-.02 (-.03)	.01 (.01)	.01 (.01)	.16 (.23)	.43 (.61)		
...	..	...	...	..	...				
1988	-.00 (-.01)	-.01 (-.01)	-.02 (-.03)	.00 (.00)	-.01 (-.01)	.00 (.00)	0 (0)	.30 (.39)	
...	...	...	...	...	...	..	...	...	..
1991	-.00 (.00)	.00 (.00)	-.01 (-.02)	.00 (.00)	-.01 (-.01)	.00 (.00)	.00 (.00)	.01 (.01)	-.02 (-.02)
1992	.00 (.00)	-.01 (-.01)	-.03 (-.04)	.00 (.00)	-.02 (-.02)	.01 (.01)	0 (-.0l)	-.01 (-.01)	-.08 (-.1)

. . . Indicates that in-between values are omitted.
The entries are actual change in the variable over its base simulated value with percentage change given in parantheses.

Table 6.7.5. Dynamic Impacts of a 30% One-shot Devaluation In different Years on Imports Volume

Year of Impact	Year of Devaluation								
	1978	1979	1980	1981	1982	1983	1984	1988	1991
1978	-3.23 (-3.7)								
1979	.12 (.12)	-2.8 (-2.8)							
1980	.09 (.13)	.05 (.07)	-2.9 (-4.3)						
1981	-.04 (-.03)	.30 (.23)	.08 (.07)	-2.9 (-2.2)					
1982	-.08 (-.07)	-.26 (-.21)	.16 (.14)	-.03 (-.02)	-2.9 (-2.4)				
1983	-.02 (-.02)	.18 (.14)	-.48 (-.37)	.69 (.52)	.15 (.12)	-2.4 (-1.8)			
1984	-.40 (-.02)	-.17 (-.1)	-.22 (-.13)	-.18 (-.11)	.06 (.03)	.03 (.02)	-3.6 (-2.08)		
...	...	...	...	...	...	...	...	...	...
1988	-.08 (-.05)	-.13 (-.08)	-.16 (-.10)	-.08 (-.05)	-.16 (-.1)	-.26 (-.15)	-.1 (-.06)	-3.5 (-2.1)	
...	...	...	...	...	...	...	...	...	...
1991	.01 (.01)	.01 (.00)	-.03 (-.02)	.02 (.01)	.05 (.03)	.08 (.04)	.01 (.01)	.01 (.00)	-7.6 (-4.0)
1992	-.01 (-.01)	-.07 (-.04)	-.30 (-.15)	-.01 (-.01)	-.12 (-.06)	.05 (.02)	-.02 (-.01)	-.11 (-.06)	.01 (.01)

... indicates that the inbetween values are omitted
The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.

Table 6.7.6. Dynamic Impacts of a One-shot 30% Devaluation in different Years on Money Supply (Rs Crores)

Year of Impact	Year of Devaluation								
	1978	1979	1980	1981	1982	1983	1984	1988	1991
1978	11.5 (.06)								
1979	30.4 (.15)	46.2 (.23)							
1980	22.5 (.11)	52.7 (.25)	78.4 (.38)						
1981	35.0 (-15)	32.7 (.14)	113.3 (.48)	6.3 (.03)					
1982	48.8 (.18)	76.4 (.28)	118.9 (.44)	38.5 (.14)	96.6 (.36)				
1983	56.3 (.19)	63.9 (.22)	213.6 (.73)	-27.4 (-.09)	123.2 (.42)	-28.0 (-.1)			
1984	59.9 (.17)	83.0 (.24)	235.5 (.69)	-2.2 (-.01)	130.3 (.38)	1.1 (0)	50.5 (.15)		
1988	70.1 (.12)	89.3 (.15)	342.9 (.58)	-14.2 (-.02)	247.4 (.42)	-20.6 (-04)	80.7 (.14)	135.8 (.23)	
1991	88.8 (.12)	108.8 (.14)	484.2 (.64)	-54.5 (-.07)	322.2 (.42)	-81.4 (-.11)	106.3 (-14)	184.5 (-24)	1694 (2.2)
1992	137.0 (.16)	185.0 (.22)	835.8 (1.0)	-78.5 (-.09)	525.2 (.63)	-144 (-.17)	163.3 (.2)	315.4 (.38)	2499 (2.9)

...indicates that the in between values are omitted.
The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.

To answer the question whether the impacts are independent of timing of exogenous change, we need to look along the leading diagonals of the triangular matrices. If the values either in absolute level or percentage are roughly equal then we can say that the impacts are independent of the timing of exogenous change. As per this criteria, the answer seem to be 'yes' for some variables (e.g. import volume, unit value of exports and export volume), while it is uncertain for others. The direction of these impacts are broadly consistent with prior expectations- devaluation leads to rise in exports supply (demand), fall in imports, decline in unit value of exports, rise in domestic prices (inflation), increase in money supply and improve net foreign assets (balance of payments), with a few exceptions.

The magnitudes of these effects are varying overtime, substantially for some variables, probably because not all variables are in real terms and the model being in linear form. Infact, the exchange rate used here is nominal exchange rate[0] which has gone-up considerably overtime, from Rs 7.59 in 1972 to Rs 29 in 1992, implying a steep fall in real value of rupee, in other words, implicit depreciation. Consequently, the absolute increase in exchange rate due to a fixed 30% devaluation has increased considerably overtime.

°Use of effective exchange rate series, both nominal and real, did not give significant coefficients for crucial price variables and hence were not included here.

(c) Effect of level of exogenous change:

In order to analyse the effect of level of devaluation on the endogenous variables, four different levels of nominal devaluations, viz., 30%, 40%, 60%, and 100% were undertaken separately in the same year 1978. The dynamic impacts are tabulated separately for these six endogenous variables in Tables 6.8.1-6.8.6. For the purpose of comparison, all the effects have been reduced to a uniform 10% level by simple division. These are also tabulated along with gross impacts. As can be expected, the gross magnitudes of impacts will increase with higher levels of devaluation. But, the interest would be to see if there is any pattern in these impacts. As before, since the exogenous change is of a shock type, the simulated path returns to base path eventually for some variables in all simulations indicating dynamic stability.

It is also noticed that, larger the exogenous change (devaluation), longer is the time taken for the simulated path to merge with the base path i.e., larger the exogenous shock, it takes longer to get absorbed into the system which is quite justified. For example, when a 100% devaluation is effected in 1978, the impacts persisted beyond 1992, a lapse of 15 years.

From Table 6.8.1-6.8.6, it is clear that the dynamic impacts, both in absolute magnitude and percentage terms, are dependent on the level of exogenous change- the higher the rate of devaluation the larger are the impacts for price level, money supply and net foreign assets. The opposite is true for other variables. These impacts vary, somewhat in a narrow range, with

an increase in the rate of devaluation even after normalising them to a uniform 10% level.

Table 6.8.1. Dynamic Impacts of Different Levels of a one-shot Devaluation in 1978 on Price level (1980-81=100)

Year of Impact	Gross Impact				Impact due to 10% change			
	A	B	C	D	A	B	C	D
1978	.18 (.27)	.32 (.47)	.67 (.99)	1.62 (2.4)	.06 (.09)	.08 (.12)	.11 (.17)	.16 (.24)
1979	.23 (.33)	.36 (.53)	.68 (1.00)	1.49 (2.18)	.08 (.11)	.09 (.13)	.11 (.17)	.15 (.22)
1980	.16 (.22)	.24 (.35)	.46 (.66)	1.02 (1.43)	.05 (.07)	.06 (.09)	.08 (.11)	.1 (.14)
1981	.13 (.14)	.18 (.20)	.28 (.31)	0.40 (.44)	.04 (.05)	.04 (.05)	.05 (.05)	.04 (.04)
1982	.07 (.08)	.11 (.12)	.22 (.24)	0.47 (.51)	.02 (.03)	.03 (.03)	.04 (.04)	.05 (.05)
1983	.10 (.09)	.14 (.12)	.19 (.16)	0.28 (.23)	.03 (.03)	.04 (.03)	.03 (.03)	.03 (.02)
1984	.14 (.13)	.25 (.24)	.55 (.52)	1.36 (1.3)	.05 (.04)	.06 (.06)	.09 (.09)	.14 (.13)
	.	...	...	..	.**	...	...	...
1988	.12 (.08)	.20 (.13)	.43 (.28)	1.03 (.67)	.04 (.03)	.05 (.03)	.07 (.05)	.1 (.07)
1991	.16 (.11)	.30 (.20)	.66 (.44)	1.61 (1.1)	.05 (.04)	.08 (.05)	.11 (.07)	.16 (.10)
1992	.29 (.18)	.58 (.36)	1.38 (.86)	3.39 (2.1)	.1 (.06)	.15 (.09)	.23 (.14)	.34 (.21)

l.The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.

2. ...Indicates that the in-between values are omitted.
3. A: 30% one-shot Devaluation in 1978
   B: 40% one-shot Devaluation in 1978
   C: 60% one-shot Devaluation in 1978
   D: 100% one-shot Devaluation in 1978

Table 6.8.2. Dynamic Impacts of Different Levels of a one-shot Devaluation in 1978 on Unit value of Exports

Year of Impact	Gross Impact				Impact due to 10% change			
	A	B	C	D	A	B	C	D
1978	-5.47 (-5.6)	-6.9 (-7.1)	-9.4 (-9.7)	-13.2 (-13.7)	-1.8 (-1.9)	-1.7 (-1.8)	-1.6 (-1.6)	-1.3 (1.4)
1979	-.16 (-.17)	-.14 (-.16)	-.06 (-.07)	.27 (.29)	-.05 (-.06)	-.04 (-.04)	-.01 (-.01)	.03 (.03)
1980	-.02 (-.03)	-.02 (-.02)	04 (.04)	.20 (.21)	-.01 (-.01)	-.00 (-.00)	.01 (.01)	.02 (.02)
1981	.06 (.05)	.10 (.09)	.21 (.19)	.47 (.43)	.02 (.02)	.03 (.02)	.03 (.03)	.05 (.04)
1982	.04 (.03)	.06 (.05)	.13 (.11)	.27 (.23)	.01 (.01)	.02 (.01)	.02 (.02)	.03 (.02)
1983	.03 (.02)	.04 (.03)	.07 (.06)	.14 (.11)	.01 (.01)	.01 (.01)	.01 (.01)	.01 (.01)
1984	.05 (.03)	.09 (.06)	.21 (.14)	.51 (.35)	.02 (.01)	.02 (.01)	.03 (.02)	.05 (.04)
...	...	...	...	...	...	...	...	...
1988	.04 (.02)	.06 (.04)	.14 (.08)	.34 (.18)	.01 (.01)	.02 (.01)	.02 (.01)	.03 (.02)
...	...	...	...	...	...	...	...	...
1991	.01 (.00)	.04 (.01)	.10 (.04)	.28 (.12)	.00 (.00)	.01 (.00)	.02 (.01)	.03 (.01)
1992	.08 (.04)	.20 (.09)	.52 (.22)	1.26 (.54)	.03 (.01)	.05 (.02)	.09 (.04)	.13 (.05)

l.The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.
2. ...Indicates that the in-between values are omitted.
3. A: 30% one-shot Devaluation in 1978
B: 40% one-shot Devaluation in 1978
C: 60% one-shot Devaluation in 1978
D: 100% one-shot Devaluation in 1978

Table 6.8.3. Dynamic Impacts of Different Levels of a one-shot Devaluation in 1978 on Money Supply

Year of Impact	Gross Impact				Impact due to 10% change			
	A	B	C	D	A	B	C	D
1978	11.5 (.06)	20.13 (.11)	42.1 (.23)	96.8 (.53)	3.8 (.02)	5.03 (.03)	7.02 (.04)	9.7 (.05)
1979	30.4 (.15)	48.9 (.24)	94.7 (.47)	208.6 (1.0)	10.1 (.05)	12.23 (.06)	15.79 (.08)	20.9 (.10)
1980	22.5 (.11)	33.8 (.16)	59.9 (.29)	121.1 (.58)	7.5 (.04)	8.47 (.04)	9.99 (.05)	12.1 (.06)
1981	35.0 (.15)	56.8 (.24)	111.1 (.47)	254.0 (1.1)	11.7 (.05)	14.2 (.06)	18.5 (.08)	25.4 (.11)
1982	48.7 (.18)	77.3 (.29)	146.7 (.55)	321.1 (1.2)	16.2 (.06)	19.33 (0.7)	24.5 (.09)	32.1 .12)
1983	56.3 (.19)	91.1 (.31)	179.8 (.61)	407.4 (1.4)	18.8 (.06)	22.79 (.08)	30.0 (.10)	40.7 (.14)
1984	59.9 (.17)	96.9 (.28)	190.5 (.56)	426.1 (1.24)	20.0 (.06)	24.2 (.07)	31.8 (.09)	42.6 (.12)
	.*	..*	*..	...	...	...	...	...
1988	70.1 (.12)	116.9 (.20)	240.2 (.41)	555.3 (.95)	23.4 (.04)	29.2 (.05)	40.0 (.07)	55.5 (.10)
	...	...	...	...				
1991	88.7 (.12)	155.6 (.20)	334.1 (.44)	793.4 (1.05)	29.6 (.04)	38.9 (.05)	55.7 (.07)	79.3 (.10)
1992	136.1 (.16)	252.4 (.30)	556.0 (.68)	1347.5 (1.65)	45.4 (.05)	63.1 (.08)	92.7 (.11)	134.8 (.17)

l.The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.
2. ... Indicates that the in-between values are omitted.
3. A: 30% one-shot Devaluation in 1978
B: 40% one-shot Devaluation in 1978
C: 60% one-shot Devaluation in 1978
D: 100% one-shot Devaluation in 1978

Table 6.8.4. Dynamic Impacts of Different Levels of a one-shot Devaluation in 1978 on Net Foreign Assets

Year of Impact	Gross Impact				Impact due to 10% change			
	A	B	C	D	A	B	C	D
1978	6.8 (.15)	12.0 (.27)	25.1 (.56)	57.6 (1.3)	2.3 (.05)	3.0 (.07)	4.18 (.09)	5.8 (.13)
1979	19.6 (.44)	31.6 (.71)	61.1 (1.4)	134.6 (3.04)	6.5 (.15)	7.9 (.18)	10.2 (.23)	13.5 (.3)
1980	18.7 (.30)	28.1 (.46)	49.8 (.8)	100.6 (1.63)	6.2 (.10)	7.02 (.12)	8.30 (.13)	10.06 (.16)
1981	29.4 (.55)	47.8 (.89)	93.4 (1.74)	213.5 (4.0)	9.8 (.18)	11.9 (.22)	15.6 (.29)	21.3 (.40)
1982	41.4 (.92)	65.6 (1.5)	124.6 (2.8)	272.7 (6.05)	13.8 (.31)	16.4 (.37)	20.8 (.47)	27.3 (.60)
1983	45.6 (1.9)	73.8 (3.1)	145.6 (6.2)	329.9 (14.0)	15.2 (.63)	18.4 (.78)	24.3 (1.03)	33.0 (1.4)
1984	52.2 1.94)	84.4 (3.1)	166.1 (6.2)	371.4 (13.8)	17.4 (.65)	21.1 (.78)	27.7 (1.03)	37.1 (1.4)
...	...	...	...	...	...	...	...	...
1988	64.8 (1.0)	108.1 (1.72)	222.0 (3.5)	513.3 (8.17)	21.6 (.33)	27.02 (.43)	37.0 (.60)	51.3 (.82)
...	...	...	...	...	...	...	...	...
1991	83.8 (1.1)	147.0 (1.9)	315.8 (4.1)	749.7 (9.6)	27.9 (.37)	36.76 (.47)	52.6 (.68)	75.0 (.96)
1992	96.6 (.45)	178.0 (.8)	399.2 (1.84)	950.2 (4.38)	32.2 (.15)	44.5 (.2)	66.5 (.31)	95.0 (.44)

l.The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.
2. ...Indicates that the in-between values are omitted.
3. A: 30% one-shot Devaluation in 1978
   B: 40% one-shot Devaluation in 1978
   C: 60% one-shot Devaluation in 1978
   D: 100% one-shot Devaluation in 1978

Table 6.8.5. Dynamic Impacts **of** Different Levels of a one-shot Devaluation in 1978 on Exports volume

Year of Impact	Gross Impact A	B	C	D	Impact due to 10% change A	B	C	D
1978	1.0 (1.7)	1.27 (2.16)	1.73 (2.9)	2.4 (4.1)	.33 (.60)	.32 (.54)	.29 (.49)	.24 (.41)
1979	.33 (.54)	.41 (.68)	.54 (.88)	.70 (1.1)	.11 (.18)	.10 (.17)	.09 (.15)	.07 (.10)
1980	.11 (.17)	.13 (.20)	1.16 (.25)	.19 (.30)	.04 (.06)	.03 (.05)	.19 (.04)	.02 (.03)
1981	.03 (.04)	.02 (.04)	.02 (.04)	0 (0)	.01 (.01)	.00 (.01)	.00 (.01)	.00 (.00)
1982	.0 (.01)	.0 (0)	-.01 (-.01)	-.03 (-.04)	.00 (.00)	-.00 (-.00)	.00 (.00)	-.00 (-.00)
1983	-.02 (.0)	.0 (.01)	-.01 (-.01)	-.02 (-.03)	-.01 (-.00)	.00 (.00)	-.00 (-.01)	-.00 (-.00)
1984	-.01 (-.01)	-.01 (-.01)	-.02 (-.03)	-.05 (-.07)	-.00 (-.00)	-.00 (-.00)	.00 (.00)	-.01 (-.01)
...	...	...	...	...	...	...	...	...
1988	-.0 (-.01)	-.01 (-.01)	-.01 (-.02)	-.03 (-.04)	-.00 (-.00)	-.00 (-.00)	-.00 (-.00)	-.00 (-.00)
...	...	...	...	...	...	...	...	...
1991	-.0 (-.0)	0 (0)	-.01 (-.01)	-.02 (-.03)	-.00 (-.00)	.00 (0)	- 0 (-0)	-.00 (-0)
1992	.0 (.0)	-.01 (-.01)	-.02 (-.03)	-.05 (-.06)	.00 (.00)	-.00 (-.00)	.00 (.01)	-.01 (-.01)

l.The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.
2. ...Indicates that the in-between values are omitted.
3. A: 30% one-shot Devaluation in 1978
   B: 40% one-shot Devaluation in 1978
   C: 60% one-shot Devaluation in 1978
   D: 100% one-shot Devaluation in 1978

Table 6.8.6. Dynamic Impacts of Different Levels of a one-shot Devaluation in 1978 on Import volume

Year of Impact	Gross Impact				Impact due to 10% change			
	A	B	C	D	A	B	C	D
1978	-3.23 (-3.7)	-4.15 (-4.8)	-5.82 (-6.7)	-8.61 (-9.9)	-1.08 (-1.2)	-1.04 (-1.2)	-.97 (-1.1)	-.86 (-.99)
1979	.12 (.12)	.13 (.13)	.14 (.14)	.08 (.08)	.04 (.04)	.03 (.03)	.02 (.02)	.01 (.01)
1980	.09 (.13)	.14 (.21)	.28 (.41)	.61 (.91)	.03 (.04)	.03 (.05)	.06 (.07)	.06 (.09)
1981	-.04 (-.03)	-.10 (-.08)	-.27 (-.21)	-.82 (-.62)	-.01 (-.01)	-.03 (-.02)	-.04 (-.03)	-.08 (-.06)
1982	-.08 (-.07)	-.13 (-.11)	-.23 (-.19)	-.44 (-.36)	-.03 (-.02)	-.03 (-.03)	-.04 (-.03)	-.04 (-.04)
1983	-.02 (-.02)	-.04 (-.04)	-.14 (-.11)	-.42 (-.32)	-.01 (-.01)	-.01 (-.01)	-.02 (-.02)	-.04 (-.03)
1984	-.40 (-.02)	-.06 (-.03)	-.09 (-.05)	-.14 (-.08)	-.13 (-.01)	-.02 (-.01)	-.02 (-.01)	-.01 (-.01)
...	...	...	...	...	...	...	...	...
1988	-.08 (-.05)	-.13 (-.08)	-.24 (-.14)	-.54 (-.32)	-.03 (-.02)	-.03 (-.02)	-.04 (-.02)	-.05 (-.03)
...	...	...	...	...	...	...	...	...
1991	.01 (.01)	.01 (0)	0 (0)	-.02 (-.01)	.00 (.00)	.00 (0)	0 (0)	-.00 (-.00)
1992	-.01 (-.01)	-.06 (-.03)	-.18 (-.09)	-.44 (-.21)	-.00 (-.00)	-.02 (-.01)	-.03 (-.02)	-.04 (-.02)

1. The entries are actual change in the variable over its base simulation value with percentage change given in parantheses.
2. ... Indicates that the in-between values are omitted.
3. A: 30% one-shot Devaluation in 1978
   B: 40% one-shot Devaluation in 1978
   C: 60% one-shot Devaluation in 1978
   D: 100% one-shot Devaluation in 1978

(d) Effect of Functional Form and Parameters:

In order to analyse the sensitivity of impacts to choice of functional form and parameters, the log-linear model estimated for the same sample period are used. Since the policy effects are being compared between two different models, a separate base simulation is constructed using log-linear parameters. As in the linear model, a 30% one-shot devaluation in 1978 is dynamically simulated using this log-linear model as well. The allocate and dynamic effects for both the functional forms are tabulated in Table 6.9.

Table 6.9. Dynamic Impacts of a 30% One-shot Devaluation in 1978-Log-llnear Model for 1962-87

Year of Impact	Price level	Unit value of Exports	Money supply	Exports volume	Imports volume	Net foreign Assets
1978	.30	-6.20	15.3	1.9	-2.44	9.1
	(.48)	(-6.8)	(.09)	(3.6)	(-3.2)	(.24)
1979	.95	.49	61.9	.14	.15	39.9
	(1.4)	(.57)	(.31)	(.22)	(.16)	(.97)
1980	.36	.40	63.3	-.12	.02	52.6
	(.61)	(.43)	(.31)	(-.19)	(.03)	(.94)
1981	.28	.15	55.4	-.07	.09	46.6
	(.30)	(.15)	(.24)	(-.1)	(.07)	(1.0)
1982	-.32	10	118.0	-.04	-.50	100.2
	(-.4)	(.09)	(.45)	(-06)	(-.43)	(2.7)
1983	-.36	-.39	94.7	.10	.08	76.7
	(-.3)	(-.30)	(.34)	(.14)	(.06)	(6.5)
1984	-.03	.08	111.5	-.01	-.16	97.2
	(-.04)	(.06)	(.33)	(-.01)	(-.10)	(4.5)
...		...	...			
1988	-.14	-.02	11.3	.00	-.11	10.4
	(-.1)	(-.01)	(.02)	(.01)	(-.07)	(.17)
1989	-.07	-.06	8.0	.02	.0	7.5
	(-.04)	(-.04)	(.01)	(.02)	(.0)	(.43)
1990	-.02	.03	22.1	-.0	-.07	19.9
	(-.02)	(.02)	(.03)	(-.01)	(-.04)	(3.03)

... Indicates that the in-between values are omitted.
The entries are actual change in the variable over its simulation value with percentage change given in parantheses.

The log-linear model exhibits dynamic stability for all variables except net foreign assets. This is in contrast to linear model in which two more variables viz., price level and money supply exhibited dynamic stability of second kind. The impacts from both the functional forms are consistent with *a* priori thinking but vary marginally in their magnitudes. The log-linear model seems to produce marginally higher impacts, both in level and percentage terms compared to the linear model (Table 6.9). The exception however is imports volume.

For example, a 30% once-for-all increase in nominal exchange rate in 1978 results in a Rs 11.5 crores (.06%) increase in money supply in the same year using a linear model, whereas the impact would be RS 15.3 crores (.09%) with a log-linear model. Exports volume would increase by Rs 1 crore (1.7%) and Rs 1.9 crores (3.6%) in the two alternative models. Imports are expected to fall by Rs 3.23 crores (3.7%) if we use a linear model while the log-linear model simulates only a decline of Rs 2.44 crores (3.2%). The percentage change given in parantheses are with respect to the respective base simulation levels in all the above cases. The impacts over subsequent years also differ marginally between the two functional forms. The differences may widen if the exogenous change is undertaken in a later year,

(e) Effect of Method of Estimation;

In chapter 5, we reported parameter estimates using two different methods of estimation viz., OLS and 2SLS for each of three sample periods 1962-87, 1962-89, and 1962-91. Here, we

would like to analyse the effect of method of estimation on the impacts. Therefore, we construct another dynamic base simulation using 2SLS estimates of linear model for the same sample period, 1962-87. Keeping this as reference path, a 30% once-for-all increase in nominal exchange rate is hypothesised and its dynamic and allocative effects are tabulated in Table 6.10.

The results are somewhat puzzling. Due to a 30% devaluation in Indian rupee, it is surprising to find money supply, domestic price level and net foreign assets variables to decline rather than increasing. This is clearly a perverse effect probably due to absence of important linkages between endogenous variables. As already mentioned, crucial price variables in trade equations; current rate of inflation and lagged dependent variable in money demand function are statistically insignificant and omitted from these equations. Thus, the 2SLS results are perverse and not useful for policy analysis.

Table 6.10. Dynamic Impacts of a 30% One-shot Devaluation in 1978 *2SLS* Linear Model for 1962-87

Year of Impact	Price level	Unit value of Exports	Money supply	Exports volume	Imports volume	Net foreign Assets
1978	-.01 (-.01)	-4.01 (-4.8)	-1.6 (-.01)	2.8 (4.7)	-.20 (-.24)	-.10 (-.03)
1979	- 01 (-.02)	-.92 (-1.1)	-2.4 (-.01)	.56 (.85)	-.16 (-.16)	-1.5 (-.03)
1980	-.02 (-.02)	-.19 (-.21)	-2.1 (-.01)	.10 (.13)	-.05 (-.05)	-1.7 (-.04)
1981	-.01 (-.01)	-.04 (-.04)	-2.2 (-.01)	.02 (.02)	-.01 (-.01)	-1.8 (-.05)
1982	-.00 (-.00)	-.01 (-.01)	-2.2 (-.01)	.0 (.00)	-.00 (.00)	-1.9 (-.07)
1983	-.00 (-.0)	-.01 (-.0)	-2.3 (-.01)	.00 (.0)	-.00 (.00)	-1.8 (-.11)
1984	-.01 (-.01)	.00 (.00)	-1.7 (-.01)	-.00 (-.00)	-.00 (.00)	-1.5 (-.10)
	...	...	...	...	...	...
1988	-.01 (-.0)	.00 (.00)	-.72 (.00)	-.0 (.00)	-.00 (.00)	-.65 (-.01)
1989	-.00 (-.0)	.00 (.00)	-.47 (.00)	-.0 (.0)	-.00 (.00)	-.44 (-.01)
1990	-.00 (-.0)	.00 (.00)	-.04 (.00)	-.0 (.0)	-.00 (.00)	-.07 (.00)

... Indicates that the in-between values are omitted.
The entries are actual change in the variable over its base simulation

6.5. Base Simulation for Policy Analysis:

It is important to have an appropriate base simulation for undertaking policy analysis. We have noticed that linear OLS model is giving good *ex-post* performance but the sensitivity analysis showed that the log-linear model may have an edge over linear model due to better stability property of the former. Therefore, we look at the *ex-post* performance of the log-linear model before using it for policy analysis. Further, as mentioned in the beginning, log-linear model has its advantage in interpretation the coefficients as elasticities.

The OLS log-linear model was simulated historically to check for its performance. Both static and dynamic simulations were performed. Goodness of fit indicators viz. MAPE, RMPE and THIF show varying degree of success for different equations (Table 6.11). In addition, plots of endogenous variables containing historical and simulated values are also analysed (See also Figures 6.1-6.7).

Table 6.11. Goodness Of Fit Measures for Static Base Simulation using Log-Linear Model

Endogenous Variable	1972-87			1972-90		
	MAPE	RMPE	THIF	MAPE	RMPE	THIF
Price Level (P)	8.06	10.27	5.17	7.61	9.68	4.67
Money Supply (Ml)	3.18	4.15	1.62	3.36	4.49	2.75
Unit Export Value (PX^S)	3.99	4.91	2.24	5.65	7.27	4.75
Export Volume (X)	5.42	6.86	3.39	5.93	8.18	5.44
Import Volume (I)	4.93	7.06	2.81	5.10	6.88	2.97
Net Foreign Assets (R)	18.68	23.04	10.08	24.56	36.94	24.07

MAPE: Mean Absolute Percentage Error
RMPE: Root Mean Percentage Error
THIF: Theil's Inaccuracy in Forecasts

Table 6.11. Goodness Of Fit Measures for Dynamic Base Simulation using Log-Linear Model

Endogenous Variable	1972-87			1972-90		
	MAPE	RMPE	THIF	MAPE	RMPE	THIF
Price Level (P)	13.95	18.13	10.41	15.57	19.49	11.53
Money Supply (Ml)	4.22	5.05	2.43	4.44	5.22	2.89
Unit Export Value (PX^S)	3.22	4.22	1.99	5.36	7.69	5.38
Export Volume (X)	6.35	7.71	3.81	6.47	8.45	5.22
Import Volume (I)	10.49	12.35	6.84	11.27	13.21	7.93
Net Foreign Assets (R)	28.86	36.01	15.62	35.03	43.84	26.18

MAPE: Mean Absolute Percentage Error
RMPE: Root Mean Percentage Error
THIF: Theil's Inaccuracy in Forecasts

A broad within comparison of static and dynamic simulations shows that there is not much accumulation of (relative) errors over time. As expected, dynamic simulations indicate larger error build-up compared to their static counter-parts. The relative errors seem large for all variables during 1982-87, second half of the sample period as well as post-sample period (1988-90). This was the post-second oil crisis period during which the net trade balance deteriorated very rapidly, signalling a BOP crisis.

Within each simulation, the degree of success varies across variables. Money supply variable and to some extent, unit export value, stand-out well traced uniformly in all simulations. The magnitudes of both MAPE and RMPE values for all other variables, possibly with the exception of net foreign assets variable (R), seem reasonable. The RMPE is always exceeding MAPE which indicates volatile nature of the trade variables. Thus, the OLS log-linear model gave a satisfactory *ex-post* performance though it cannot outdo the linear model uniformly for all endogenous variables. Therefore, based on easy interpretability of parameters and better dynamic stability, we decide to use it for policy analysis.

6.6. Policy Simulations:

Some hypothetical policy simulations were carried out with the estimated model. In the context of economic liberalisation, important policy variables present in the model are exchange rate (E), unit export subsidy (s), unit import tariff (t), and net

domestic credit (D). To measure the effect of any policy simulation, the base simulation values of the endogenous variables are taken as reference levels. In this way, the effect of the policy alone can be isolated from the inaccuracies of model estimation. Otherwise, if the policy simulation is compared with the actual series, any imperfections in the model estimation get included in the policy effect and the resultant change cannot be attributed to policy alone. The period 1978-90 is used for policy simulations.

A shock type increase in the exogenous variable was postulated in 1978 and its allocative and dynamic effects measured in each year in the thirteen year period of 1978-90. The absolute deviation of the policy path from the base simulation is measured as impact for each year. The allocative (i.e across variables or equations within each period) and dynamic (i.e. over time) impacts of each of the postulated policy change are analysed below. The dynamic effects are reported at five points of time viz. 1978, 1979, 1980, 1981 and 1982, signifying respectively the immediate and dynamic impacts after 1, 2, 3, and 4 periods. These may be termed as short-term effects. The algebraic sum of these five impacts will be called as medium-term effect and the sum of the effects over the entire 13 year period is called long-term effect. Although trade balance (TB) was not an explicit endogenous variable in the model, it is included in simulation runs because of its policy importance. The net foreign assets (R) may be regarded as the BOP variable. The impacts of

any change in exogenous variable can be grouped into two categories- relative price and liquidity effects. The latter arises through monetary disequilibrium variable which represents excess demand for real cash balances.

In what follows, we consider five scenarios of hypothetical changes in exogenous variables directly related to the external trade sector. The extent of exogenous changes considered here are arbitrary, although scenarios like 30% devaluation are closer to actual policy. The four other scenarios are made comparable to devaluation scenario interms of their initial impact on trade balance exactly equal to that of 30% devaluation. Since the model is log-linear in most of the variables, we expect proportional changes in impacts, if different effects are postulated.

A) 30% Devaluation in Indian rupee:

Theoretically, soon after devaluation, the small but negative liquidity effect partly offsets the positive relative price effect with a net effect of an improvement in the trade

°The negative liquidity effect of devaluation in the initial period is in contradiction to monetary approach to devaluation. In the latter, due to devaluation, supply of real balances declines and no reference is made about demand for real balances. As a consequence, excess demand for money increases thereby reducing absorption and improving trade balance. In the present model, there is an additional link in the form of devaluation effect on demand for real balances. In the event of devaluation, if rate of decline in demand for real balances exceeds that of supply; then excess demand for real balances will be negative. However, since the positive relative price effect exceeds the negative liquidity effect, TB can still improve in the short-run. The opposite possibility also exists even if the Marshall-Lemer condition holds.

balance. In subsequent years, the relative price effect becomes negative due to rising prices and re-inforces the large negative liquidity effect thus leading to a deterioration in the trade balance. But in the medium to long-term, the relative price effect may become positive once again which in association with small but positive liquidity effect will improve the trade balance once again[1]. Such an improvement will tapper-off in a few years as the economy reaches a new long-run equilibrium. This process generates the well known J-curve for changes in trade balance variable. In our case, the J-curve will be somewhat modified because of wrong sign for monetary disequilibrium variable in unit value of exports equation, leading to perverse liquidity effect.

The allocative and dynamic effects of a 30% devaluation in Indian rupee are reported in columns 2-8 of Table 6.12. The signs of these impacts are quite in accordance with our prior expectation. The magnitudes of these effects also exhibit a systematic pattern over time, some variables occasionally showing erraticness.

[1]The oscillations in TB and BOP are attributable to oscillations in excess demand for real cash balances.

Table 6.12. Dynamic Impacts of a One-shot 30% Devaluation in 1978

Endogenous Variable	Short term					Medium term	Long term
	1978	1979	1980	1981	1982		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price level	.30 (.48)	0.95 (1.44)	0.36 (.61)	.28 (.30)	-.32 (-.39)	1.57 (2.44)	1.30 (2.22)
Unit Export Value	-6.20 (-6.8)	0.49 (0.57)	0.40 (0.43)	.15 (.15)	0.10 (0.09)	-5.06 (-5.6)	-5.65 (-5.96)
Relative Price of Exports	1.92 (9.7)	-.17 (-.86)	-.04 (-.18)	-.03 (-.15)	0.12 (0.49)	1.80 (9.0)	1.78 (8.82)
Export Volume in Rs Crores	1.94 (3.58)	0.14 (0.22)	-.12 (-.19)	-.07 (-.10)	-.04 (-.06)	1.85 (3.45)	2.02 (3.69)
Import Volume in Rs Crores	-2.44 (-3.2)	0.15 (0.16)	0.02 (0.03)	.09 (.07)	-.50 (-.43)	-2.68 (-3.37)	-2.19 (-3.05)
Money Supply in Rs Crores	15.32 (.09)	61.86 (.31)	63.3 (.31)	55.4 (.24)	118 (.45)	313.9 (1.4)	625.72 (2.3)
Desired Real cash Balances in Rs Crores	-1.08 (-.39)	-3.34 (-1.1)	-1.04 (-.30)	-0.15 (-.06)	2.73 (.85)	-2.88 (-1.0)	0.64 (0.14)
Excess Demand for Real cash Balances in Rs Crores	-.28 (-.54)	-.20 (-2.7)	0.82 (4.18)	.08 (.13)	1.24 (33.5)	1.66 (34.6)	0.11 (33.9)
Trade Balance in Rs Crores	9.14 (1.38)	30.76 (1.79)	12.7 (1.04)	-5.96 (-.09)	53.5 (1.2)	100.14 (5.32)	19.85 (4.36)
Net Foreign Assets (BOP) in Rs Crores	9.14 (.24)	39.91 (0.97)	52.6 (0.94)	46.64 (1.05)	100.2 (2.68)	248.49 (5.88)	512.12 (26.6)

* The entries are actual change from base simulation with percentage change given in parantheses.

A 30% devaluation, *ceteris paribus,* makes Indian exports relatively more attractive abroad (9.7%). This should result in a 4.1% decline in unit value of exports, as per the estimated

partial regression coefficients in the unit value of exports equation in the model. However, due to simultaneity in the model, these changes would trigger further allocative effects on all other current endogenous variables.

When Indian exports become relatively cheaper, importers abroad will be tempted to increase their imports (2%), improving our trade balance as well as net foreign assets. This increases money supply in the economy and thereby causes inflation. This mild inflation causes liquidity effects in addition to relative price effects. There is a negligible excess supply of real cash balances (Rs 2.8 millions) which would affect both exports supply and import demand. This would result in net fall in imports into India. These are first round effects which will inturn start a sequence of second and later round effects. This iterative process would continue until convergence is attained for all the variables. Here, 0.01% is taken as convergence criterion between two successive iterations. The net effects are thus different from the pure partial effects implied by the regression coefficients. This can be seen from the values reported in column 2 of Table 6.12.

Thus, a 30% devaluation is likely to increase India's exports by Rs 1.9 crores, an increase of 3.6% over its base simulation value. This is accompanied by a Rs 2.44 crore decrease in imports into India, an almost equal rate of decrease (3.2%) over base simulation level. Due to increase in export supply, unit value of exports declines by 6.8%. There will be an overall

improvement in India's trade balance by about Rs 9.1 crores (1.4% compared to base simulation level) within the first year. The BOP also increases by an identical amount, since the two other components present in BOP identity- lagged foreign assets and capital inflows do not change concurrently for this year, 1978. For subsequent years, the lagged variable will vary from base path due to dynamic nature of the simulation. The improvement in BOP is only 0.2%. Money supply will increase by about Rs 15.3 crores (0.1%), pushing up over all price index faster by 0.5%, due to over shooting effect mentioned earlier[2].

In the second and subsequent years, the magnitudes and signs of the impacts will be different because of the feed-back effects due to lagged specification of the endogenous variables. Infact, the two crucial price variables viz., relative price of exports and unit value of exports will reverse their direction although with a very dampended magnitude. Relative export price declined by 0.9% and unit value of exports went-up by 0.6%. Even imports have increased by 0.2%. However, due to lagged effects, export volume continued to increase negligibly (0.2%). Due to stronger liquidity effect, the price level rose faster. Money supply, trade balance and BOP rose by 0.3%, 1.8% and 1% respectively in the second year after devaluation.

[2]In Sunderarajan (1986), a mere 10% devaluation has caused larger and immediate impacts on money supply (0.2%) and price level (0.6%) probably due to a smaller value of a , the semi-elasticity of real balances w.r.t. expected rate of inflation compared to the present model.

The medium and long-term effects (columns 7 and 8) are some what stronger than expected. There is not much erosion in the relative price of exports due to rising prices - the former registering almost the same rates of increase (9% and 8.8%) even by medium and long-runs as in the immediate period (9.7%). This is attributable to smaller increases in price level. The continuance of large impacts on trade balance for longer period may also be due to wrong sign of monetary disequilibrium variable in unit value of exports function. This leads to a sustained rise in exports volume (3.4%, 3.7%), trade balance (5.3%, 4.4%) and balance of payments (5.9%, 26.6%). Money supply and price level rose by almost equal proportion (2.3%, 2.2%) implying thereby zero real effect due to devaluation.

Thus, the short and long-run elasticities of price level w.r.t. devaluation are 0.02 and 0.08 respectively. These are much smaller compared to 0.06 and 0.3, for the period 1952-77 obtained by Sunderarajan (1986). The smaller long-run response is perhaps due to shorter (2 year) time lag in rate of inflation variable in money demand function. This implies that the time required for the initial devaluation shock to get absorbed is quite long and extends much beyond the 13-year period. Thus, the full long-run equilibrium is too distant thereby, the theoretical property of neutrality of devaluation becoming less of practical significance.

B) .18% Reduction in Domestic Credit:

Another important policy variable in the model closely associated with both BOP and inflation is domestic credit. Level

of domestic credit directly influences money supply and thereby prices in the economy. In this scenario simulation, we would examine the impact of a one-shot .18425% reduction in domestic credit in 1978 (Table 6.13). This figure is obtained by keeping Rs 9.1379 crore improvement in trade balance in 1978 as the reference value and adjusting the rate of credit reduction by trial and error. The low rate of decrease in domestic credit (.18%) to achieve a Rs 9.14 crore improvement in TB shows the extreme sensitivity of the latter variable to changes in domestic credit.

As expected, there are significant beneficial effects in the first year of such a policy change. A .18% credit sqeeze would reduce money supply and prices by 0.03% and 0.16%; while it also improves foreign assets and trade balance by .24% and 1.4% respectively. In absolute terms, the gain in BOP is about Rs 9.14 crores. Clearly, such a policy can only be a short-run measure because lack of adequate credit facilities may adversely affect output, exports and hence BOP. As in the earlier scenarios the liquidity effect is quite erratic for reasons already mentioned. Since relative price effect is very small, liquidity effect dominates (whenever it is large). This leads to erraticness in TB and BOP. This can be seen from the impacts in rest of the short-run as well as medium and long-runs. The latter are negative. The long-run effects are much detrimental to the economy. Thus, credit control can play a beneficial role in taking BOP problems temporarily. This result is in continuity with that of Sundararajan (1986), who concluded that the trade

balance effects of devaluation are more stronger and enduring than those of tight credit control policy.

Table 6.13. Dynamic Impacts of a One-shot .18425% Reduction in Domestic Credit in 1978

Endogenous Variable	Short term					Medium term	Long term
	1978	1979	1980	1981	1982		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price level	-.10 (-.16)	0.04 (0.07)	-.02 (-.04)	.05 (.06)	-.06 (-.08)	.09 (-.15)	-.16 (-.34)
Unit Export Value	0.02 (.02)	-.07 (-.08)	0.02 (0.02)	-.02 (-.02)	-0.09 (0.00)	-.05 (-.06)	-0.18 (-.15)
Relative Price of Exports	.04 (.18)	-.03 (-.15)	.01 (0.06)	-.01 (-.08)	0.02 (0.08)	0.03 (0.09)	0.06 (0.18)
Export Volume in Rs Crores	-.00 (-.01)	0.02 (0.04)	-.00 (-.00)	.01 (0.01)	.00 (.00)	0.03 (0.04)	0.08 (.10)
Import Volume in Rs Crores	-.12 (-.15)	.11 (0.12)	-0.02 (-.03)	.09 (.07)	-.06 (-.05)	0.00 (-.04)	-0.04 (-.10)
Money Supply in Rs Crores	-4.52 (-.03)	-2.27 (-.01)	1.97 (.01)	-9.33 (-.04)	-2.40 (-.01)	-16.55 (-.08)	-57.7 (-.16)
Desired Real cash Balances in Rs Crores	.37 (.13)	-0.24 (-.08)	.16 (.05)	-0.25 (-.10)	0.22 (.07)	0.26 (.07)	1.48 (0.16)
Excess Demand for Real cash Balances in Rs Crores	.41 (.81)	-.52 (-7.1)	0.17 (0.88)	-.21 (-.37)	0.15 (3.97)	0.00 (-1.81)	-.04 (-. 20)
Trade Balance in Rs Crores	9.14 (1.38)	-10.6 (-.62)	3.15 (0.26)	-9.50 (-.15)	5.82 (0.13)	-1.99 (1.0)	-2.89 (1.26)
Net Foreign Assets (BOP) in Rs Crores	9.14 (0.24)	-1.49 (-.04)	1.65 (0.03)	-7.84 (-.18)	-2.02 (-.05)	-.56 (0.0)	-36.45 (-2.7)

» The entries are actual change from base simulation with percentage change given in parantheses.

C) Reduction in Unit Export Subsidy:

Often it is argued that fiscal deficits cause inflation in the economy. Large deficits are caused partly due to huge subsidy, both direct and indirect. This may also inhibit efforts for improving cost efficiency by domestic producers. As part of new liberalisation policy, it is proposed to reduce export subsidies substantially.

As mentioned earlier, in order to make different scenarios comparable, we have simulated the required reduction in export subsidy which causes a Rs 9.1379 crore improvement in trade balance in 1978 as in 30% devaluation scenario. The exactly required reduction is obtained as 8.5555% by trial and error method. It goes without saying that this value is applicable only for 1978, given the model parameters and values of exogenous variables. If any of these change, then the required rate in subsidy reduction could be different. Here, we simulate the impacts of a 8.5555 = 8.6% reduction in unit export subsidy (Table 6.14). As expected, reduction in export subsidy would make exports less attractive (relative price of exports falls), thereby pushing-up unit value of exports and reducing exports volume (demand). Reduction in exports volume would off-set partly the increase in exports earnings arising out of rise in export price. However, due to inelastic export demand ((-.50, equation(B)), current foreign exchange reserves (R) may go-up, thereby increasing our import capacity.

Table 6.14. Dynamic Impacts of One-shot 8.56% Reduction in Unit Export Subsidy in 1978*

Endogenous Variable	Short term					Medium term	Long term
	1978	1979	1980	1981	1982		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price level	.30 (0.48)	0.03 (0.05)	.05 (0.08)	-.13 (-.14)	.03 (0.03)	.28 (0.50)	0.25 (0.5)
Unit Export Value	1.47 (1.6)	.11 (0.12)	-.02 (-.02)	.03 (0.03)	-.03 (-.03)	1.56 (1.7)	1.46 (1.64)
Relative Price of Exports	-.45 (-2.26)	.01 (0.07)	-.02 (-.10)	.03 (0.18)	-.02 (-.06)	-.45 (-2.17)	-.46 (-2.2)
Export Volume in Rs Crores	-.43 (-.80)	-.11 (-.18)	-.01 (-.02)	-.01 (-.02)	.01 (.01)	-.55 (-.99)	-.53 (-.96)
Import Volume in Rs Crores	.41 (.54)	-.05 (-.05)	.04 (0.06)	-.18 (-.14)	.02 (0.02)	.24 (.43)	.38 (.53)
Money Supply in Rs Crores	15.32 (.09)	15.40 (.08)	4.20 (.02)	27.3 (.12)	23.1 (.09)	85.32 (.40)	133.6 (.54)
Desired Real cash Balances in Rs Crores	-1.09 (-.39)	.08 (.03)	-0.21 (-.06)	0.66 (0.26)	.18 (.06)	-.38 (-.1)	0.01 (.05)
Excess Demand for Real cash Balances in Rs Crores	-.28 (-.54)	.46 (6.33)	-.24 (-1.2)	.43 (.73)	-.16 (-4.3)	.21 (1.02)	-.08 (-1.1)
Trade Balance in Rs Crores	9.14 (1.38)	.77 (0.04)	-6.4 (-.53)	19.46 (0.31)	-3.35 (-.08)	19.62 (1.12)	0.3 (.74)
Net Foreign Assets (BOP) in Rs Crores	9.14 (.24)	9.92 (0.24)	3.50 (0.06)	22.96 (0.52)	19.61 (0.52)	65.13 (1.58)	106.07 (4.58)

» The entries are actual change from base simulation with percentage change given in parantheses.

We notice these impacts occur ing in 1978. Following a 8.6% reduction in unit export subsidy in 1978, trade balance has risen by Rs 9.14 crores (1.4% over the base simulation level) in the same year. Balance of payments (R) however, increased only by 0.2%. Money supply and prices are negligibly affected as before. Even, liquidity effects are small. In the second and subsequent years, the effects are different. Relative price of exports improves, inflation comes down, but money supply continues to rise. The liquidity effects are erratic. As a consequence, changes in TB and BOP are also fluctuating. The long-term effect of a reduction in unit export subsidy on TB is nil, but BOP improves by Rs 106 crores. Money supply increases a bit more i.e., Rs 133.6 crores (0.5%), accompanied by an equal rate of mild inflation (0.5%). Exports will fall (1.0%) and imports rise over the base simulation levels.

D) 2.11% Increase in Unit Import Tariffs:

An important policy instrument in the kit of new liberalisation package is import tariffs. It is a common practice of govts to impose tariff barrier as a measure of protection to domestic producers from outside competition. Imposition of high tariff rates on final product makes domestic products artificially competitive, while the measure increases costs if levied on imported inputs.

Table 6.15. Dynamic Impacts of a One-shot 2.11% Increase in Unit Import Tariff In 1978*

Endogenous Variable	Short tern					Medium term	Long term
	1978	1979	1980	1981	1982		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price level	.30 (0.48)	0.18 (0.28)	.10 (0.17)	-.06 (-.07)	-.02 (-.03)	.50 (0.83)	0.43 (0.81)
Unit Export Value	.13 (.14)	.17 (0.20)	.05 (0.06)	.05 (0.05)	-.00 (-.00)	.40 (0.45)	.24 (0.35)
Relative Price of Exports	-.07 (-.34)	-.02 (-.08)	-.03 (-.12)	.02 (0.12)	.01 (0.02)	-.09 (-.40)	-.14 (-.49)
Export Volume in Rs Crores	-.04 (-.07)	-.07 (-.11)	-.03 (-.04)	-.02 (-.03)	-.00 (.00)	-.16 (-.25)	-.07 (-.19)
Import Volume in Rs Crores	-0.08 (-.10)	-.02 (-.02)	0.04 (0.06)	-.14 (-.11)	-.06 (-.05)	-.26 (-.22)	-.05 (-.08)
Money Supply in Rs Crores	15.32 (.09)	23.58 (.12)	14.0 (.07)	32.3 (.14)	38.46 (.15)	123.66 (.57)	218.4 (.84)
Desired Real cash Balances in Rs Crores	-1.09 (-.39)	-0.47 (-.16)	-.36 (-.10)	.53 (0.21)	.56 (.17)	-.83 (-.27)	-.05 (.04)
Excess Demand for Real cash Balances in Rs Crores	-.28 (-.54)	.36 (4.88)	-.07 (-.36)	.38 (.65)	.06 (1.76)	.45 (6.39)	-.07 (4.26)
Trade Balance in Rs Crores	9.14 (1.38)	6.05 (0.35)	-3.52 (-.29)	15.48 (.24)	5.52 (.12)	32.67 (1.8)	2.64 (1.28)
Net Foreign Assets (BOP) in Rs Crores	9.14 (.24)	15.2 (0.37)	11.66 (0.21)	27.15 (0.61)	32.67 (0.87)	95.82 (2.3)	175.8 (8.34)

* The entries are actual change from base simulation with percentage change given in parantheses.

However, in our case, for the purpose of comparability, unit import tariff is increased rather than reducing. The rate of increase is adjusted so that there will be a Rs 9.14 crore increase in trade balance in the first year (1978). The required

rate worked out to be 2.11% increase in unit import tariff in 1978. As a result of this policy change, both imports and exports volumes fell marginally. But, money supply increased by Rs 15.3 crores (0.1%) over the base simulation level causing a mild inflation (0.5%). In the second and subsequent years, relative price effect remains negligible but liquidity effect kept changing its sign and magnitude, leading to fluctuating effects, on TB and BOP. The medium to long-term impacts also seem to be positive on TB and BOP. Once again, in the long-run, money supply and prices increase by 0.8%; export and import volumes fall by 0.2-0.1%. But net foreign assets increase by Rs 176 crores (8.3%) over its base simulation level. Thus, if the interest is in improving balance of payments or trade deficits, the government should increase unit import tariffs rather than lowering them. This has an adverse impact on exports as well as imports. Therefore, such a policy perhaps can only be a short-term measure and cannot be sustained.

E) Reduction in Export Demand Elasticity:

In this scenario, a change in the numerical value of export demand elasticity, from .5 to .49 is undertaken to quantify its impacts on all the endogenous variables (Table 6.16). As in earlier scenarios, for the purpose of comparison, the magnitude of this change is arrived at by trial and error method so that the improvement on TB in 1978 is once again Rs 9.14 crores. This will enable us to examine the sensitivity of impacts to changes, including errors in estimation of this crucial parameter which

influences the external sector. It can be noticed that the impacts are extremely sensitive to this parameter. It is therefore, absolutely necessary to estimate this parameter with a high precision. For example, a .01 reduction in the export demand elasticity would increase the export volume by Rs 3.5 millions (.65%), and reduces the relative price of exports by .07%. Imports into India will also rise by 0.5%. Trade balance improved by Rs 9.12 crores (1.37%) in 1978. Both the relative price and liquidity effects, though small, re-inforced each other in this year. As before, money supply and price level went-up by 0.1% and 0.5% respectively.

Table **6.16.** Dynamic Impacts of a Sustained Decrease **in** Export Demand Elasticity

Endogenous Variable	Short term					Medium term	Long term
	1978	1979	1980	1981	1982		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price level	.30 (0.48)	.09 (.14)	0.06 (.10)	-.12 (-.13)	-.01 (-.01)	.32 (.90)	.29 (.91)
Unit Export Value	.13 (.14)	.13 (.15))	0 (0)	.03 (.03)	-.03 (-.03)	.26 (.29)	.16 (0.22)
Relative Price of Exports	-.07 (-.34)	0 (.01)	-.02 (-.09)	.03 (.16)	0 (-.01)	-.05 (-.27)	-.07 (-.34)
Export Volume in Rs Crores	.35 (0.65)	.01 (.02)	0 (0)	-.01 (-.02)	.01 (.01)	.36 (.66)	.40 (.71)
Import Volume in Rs Crores	.41 (.54)	.08 (.09))	.06 (.09)	-.16 (-.12)	-.02 (-.01)	.37 (.59)	.53 (.72)
Money Supply in Rs Crores	15.29 (.09)	18.2 (.09)	6.98 (.03)	27.5 (.12)	27.8 (.11)	95.8 (.44)	149.1 (.60)
Desired Real cash Balances in Rs Crores	-1.08 (-.39)	-.14 (-.05)	-.22 (-.06)	.64 (.25)	.38 (.12)	-.43 (-.13)	-.03 (.04)
Excess Demand for Real cash Balances in Rs Crores	-.28 (-.54)	.42 (5.75)	-.16 (-.81)	.40 (.68)	-.07 (-2.01)	.32 (3.07)	-.02 (1.2)
Trade Balance in Rs Crores	9.12 (1.37)	2.6 (.15)	-5.9 (-.49)	17.3 (.27)	.50 (.01)	23.64 (1.31)	1.55 (.89)
Net Foreign Assets (BOP) in Rs Crores	9.13 (.24)	11.7 (.29)	5.8 (.1)	23.1 (.52)	23.6 (.63)	73.3 (1.78)	118.4 (5.28)

» The entries are actual change from base simulation with percentage change given in parantheses.

In conclusion, we examined the likely impacts of some liberalisation measures on the Indian economy. These include devaluation; subsidy, tariff reduction, reduction in export

demand elasticity and credit control. A four commodity computable general equilibrium model for aggregate goods viz. imports, exports, non-traded goods and money is estimated and used for simulating hypothetical scenarios. The allocative and dynamic impacts of changes in each policy variable are analysed with reference to a base simulation.

The results are broadly in agreement with a priori thinking. In each policy simulation, due to feed-back effects from other variables in a simultaneous equations frame-work, the net impacts are different from pure partial effects implied by regression coefficients. The impacts vary across time due to lagged behaviour. Among the policy simulations, devaluation and reduction in export subsidies, the latter to a lesser extent, imply both short- and long-run benefits; credit squeeze will have only short-run benefit; and reduction in import tariffs would result in net losses interms of changes in trade balance, balance of payments and inflation in the Indian economy. Clearly, if two or more policy measures are used together, negative benefits from one policy may offset positive gains from another, resulting in no net benefit to the economy. Thus, the policy maker has to make a judicious choice of these policies keeping the objective in mind. Indiscriminate use of the measures package can jeopardise the very purpose.

FIG 6.1: ACTUAL AND BASE SIMULATED

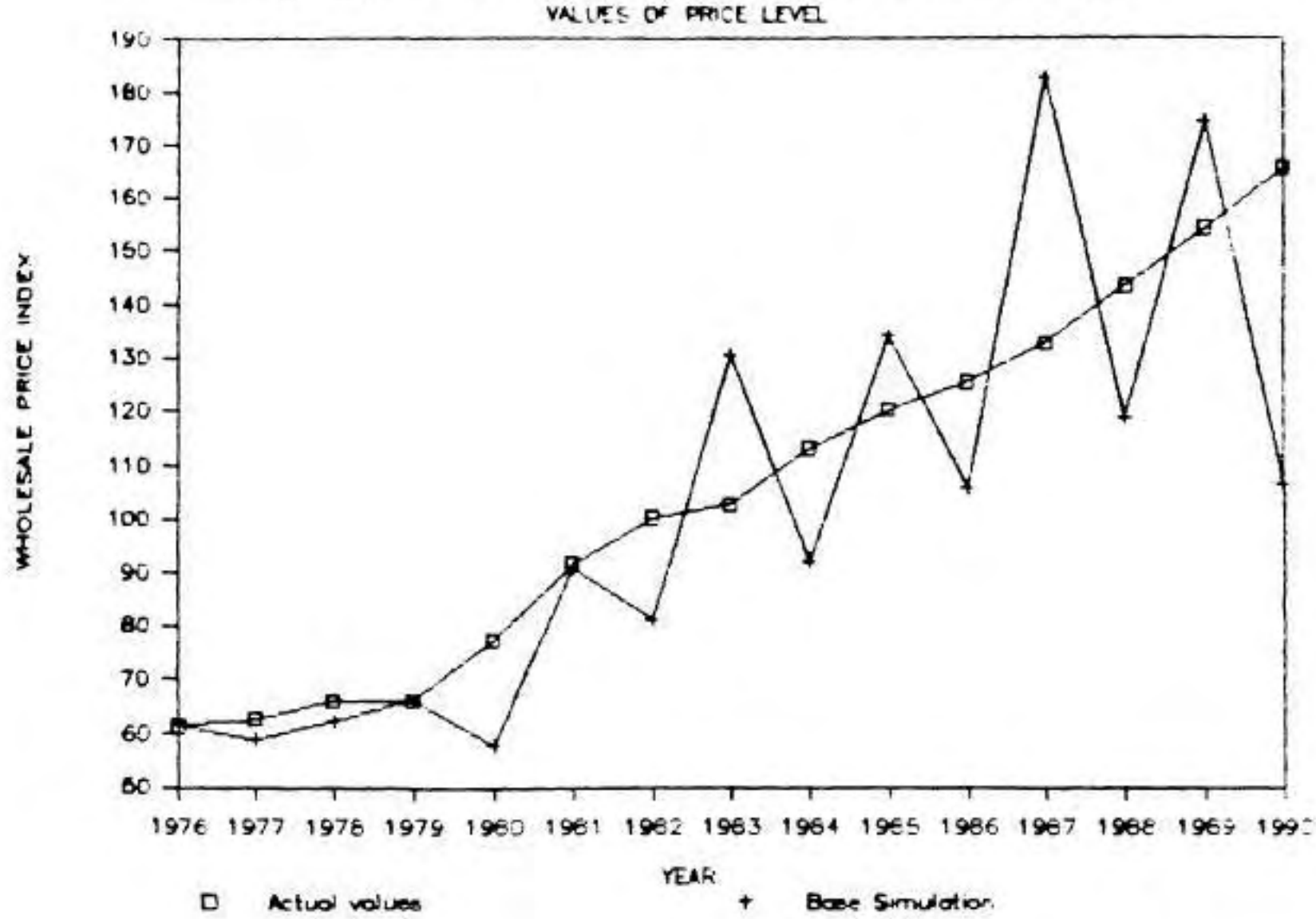


FIG 6.2: ACTUAL AND BASE SIMULATED

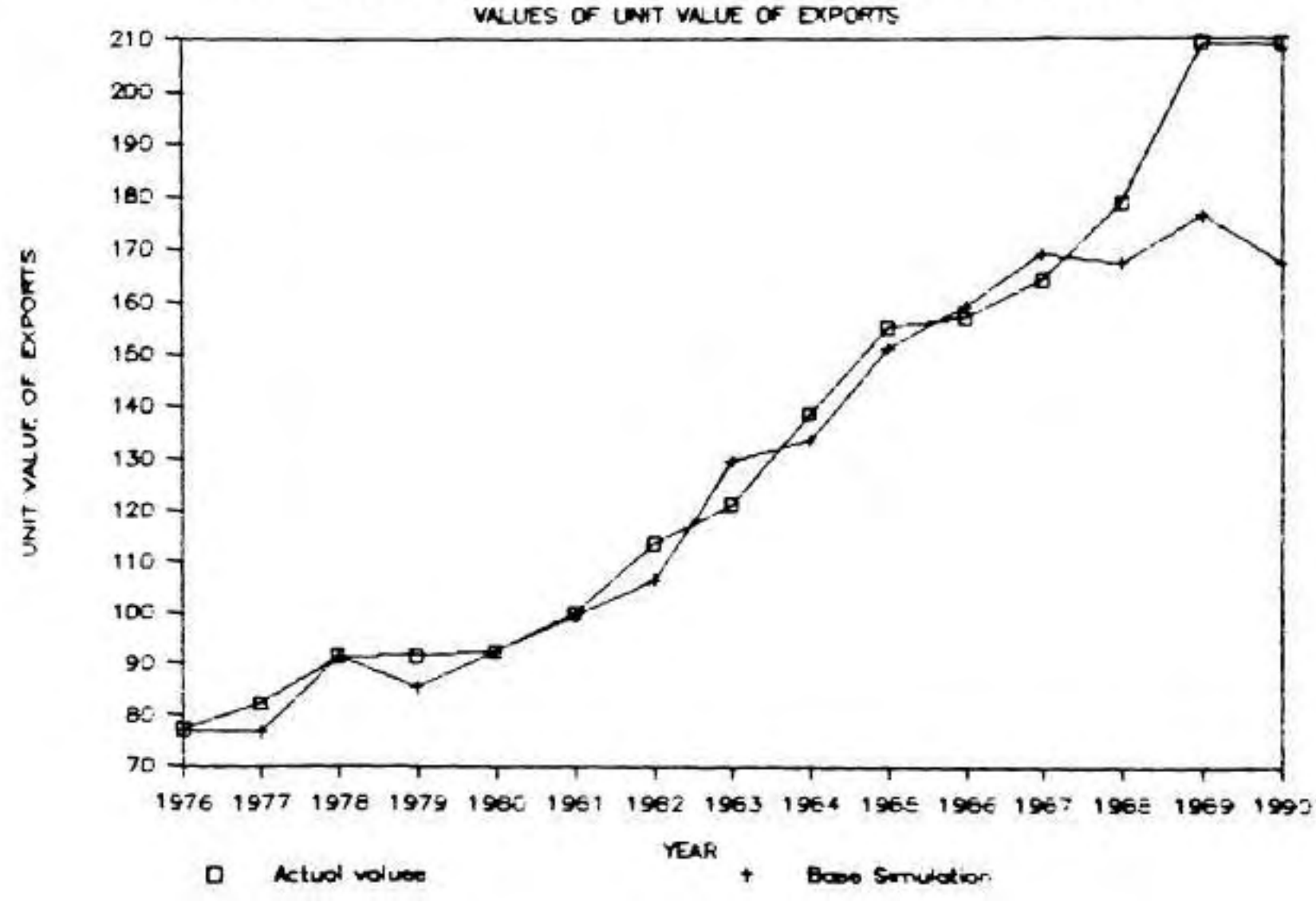


FIG 6.3: ACTUAL AND BASE SIMULATED

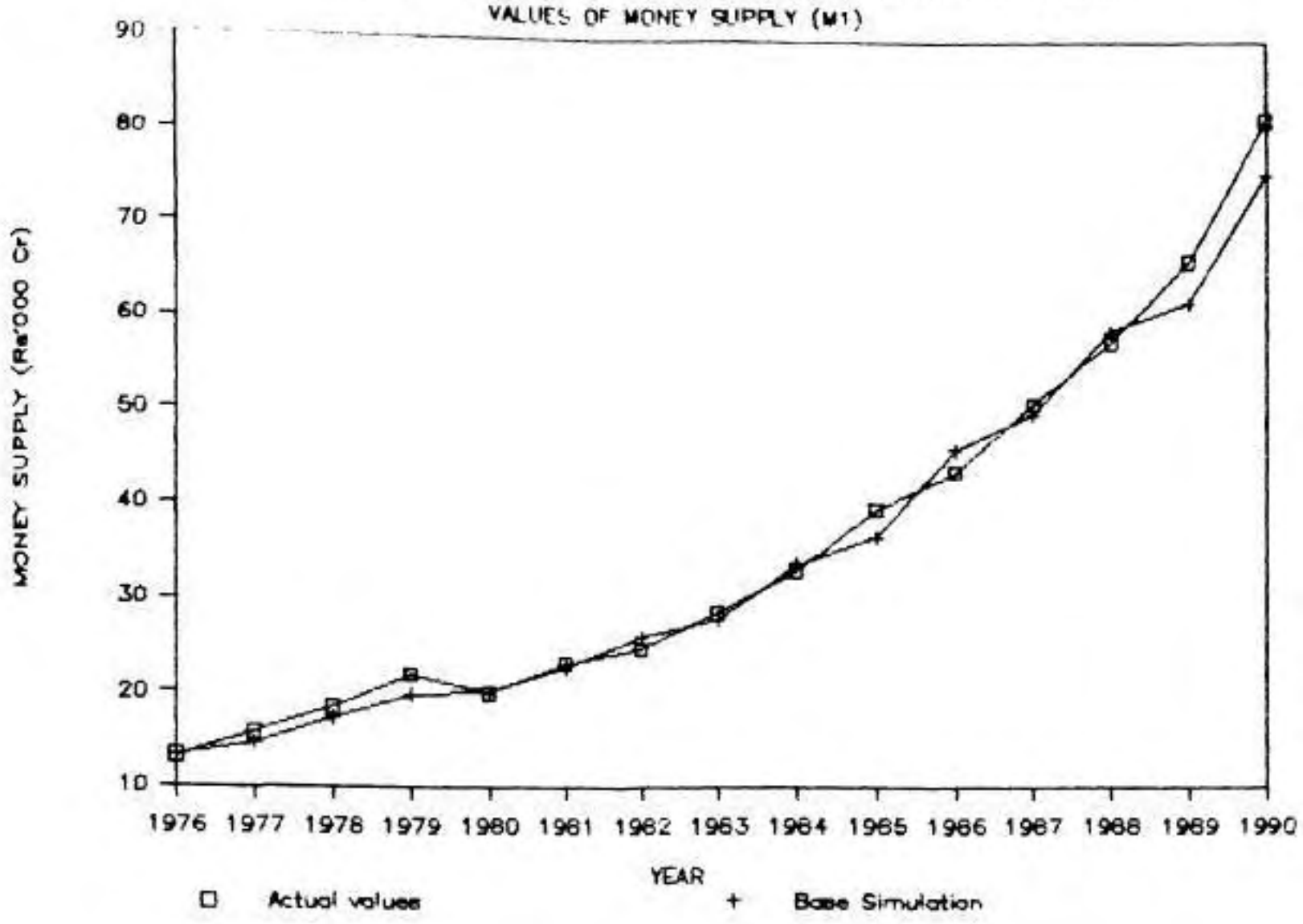


FIG 6.4: ACTUAL AND BASE SIMULATED

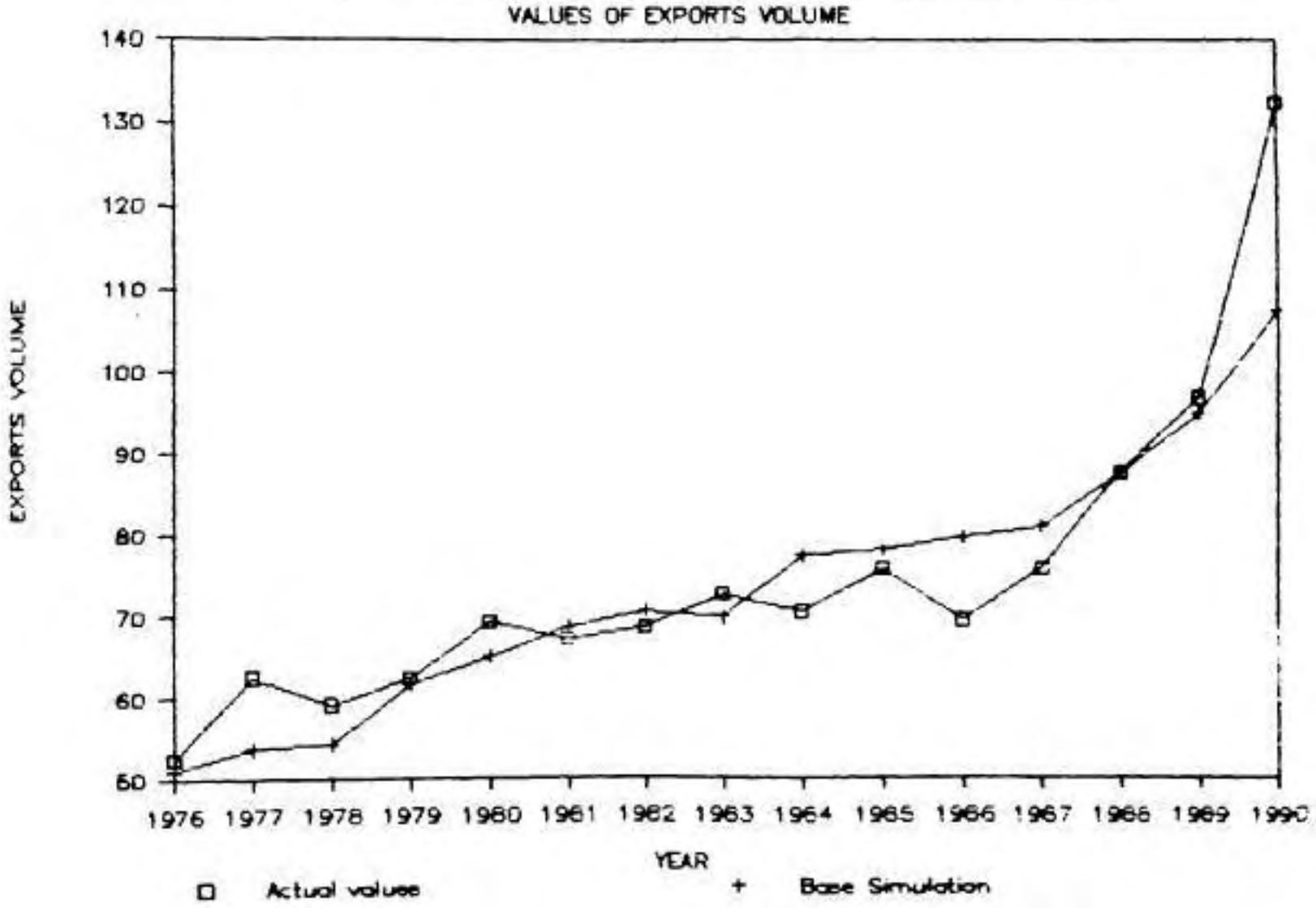


FIG. 6.5: ACTUAL AND BASE SIMULATED

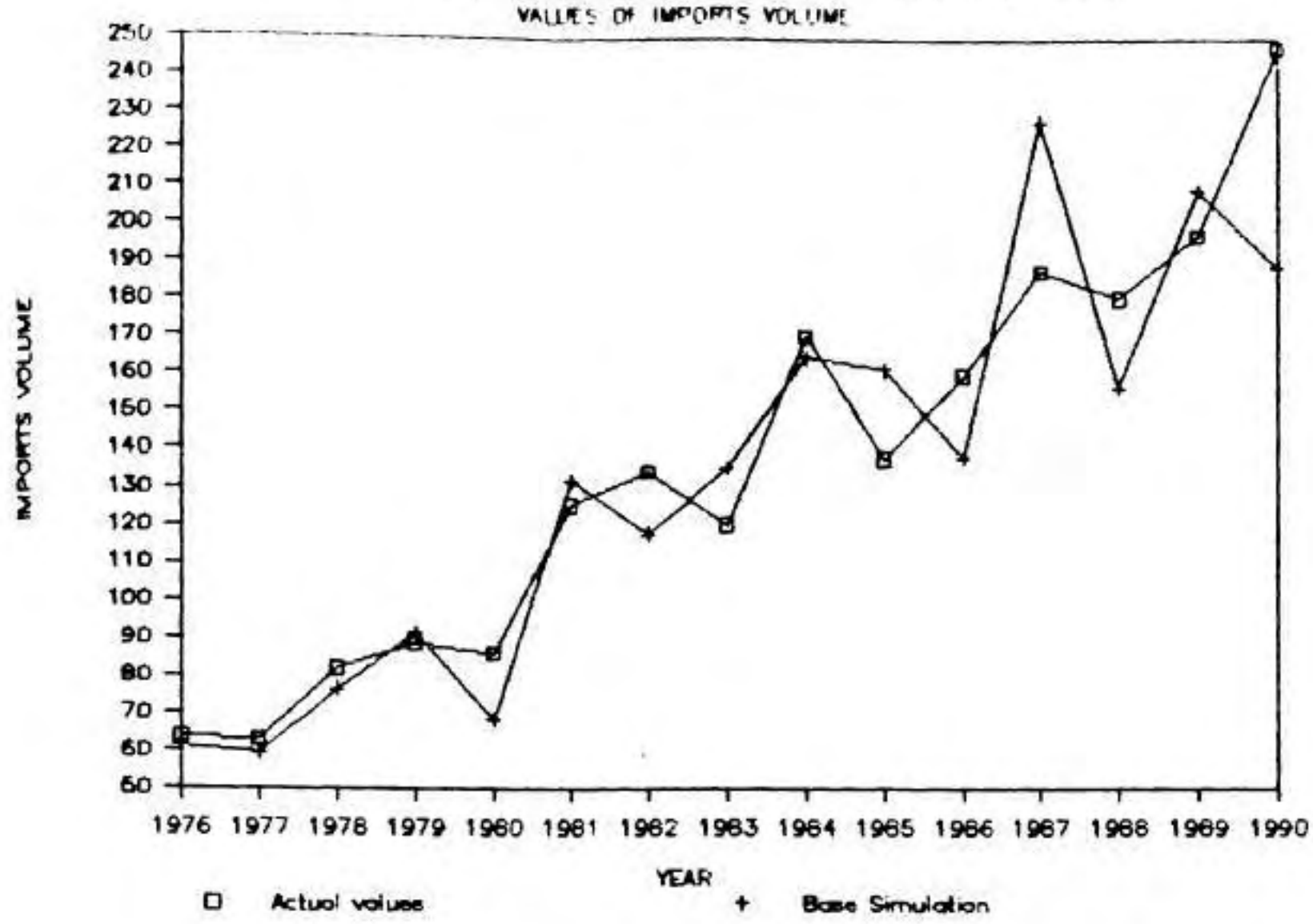


FIG 6.6: ACTUAL AND BASE SIMULATED

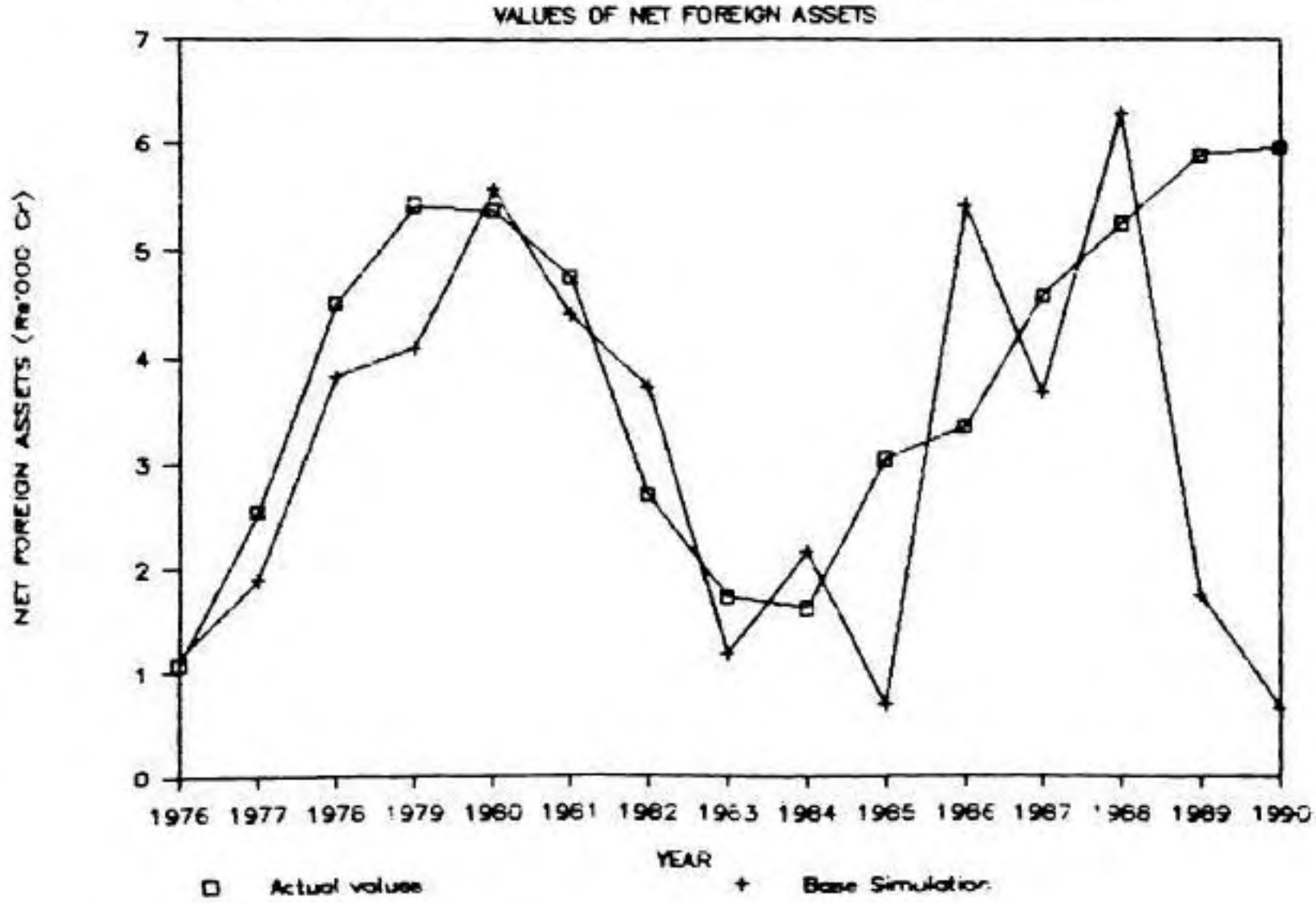


FIG 6.7: ACTUAL AND BASE SIMULATED VALUES OF TRADE BALANCE

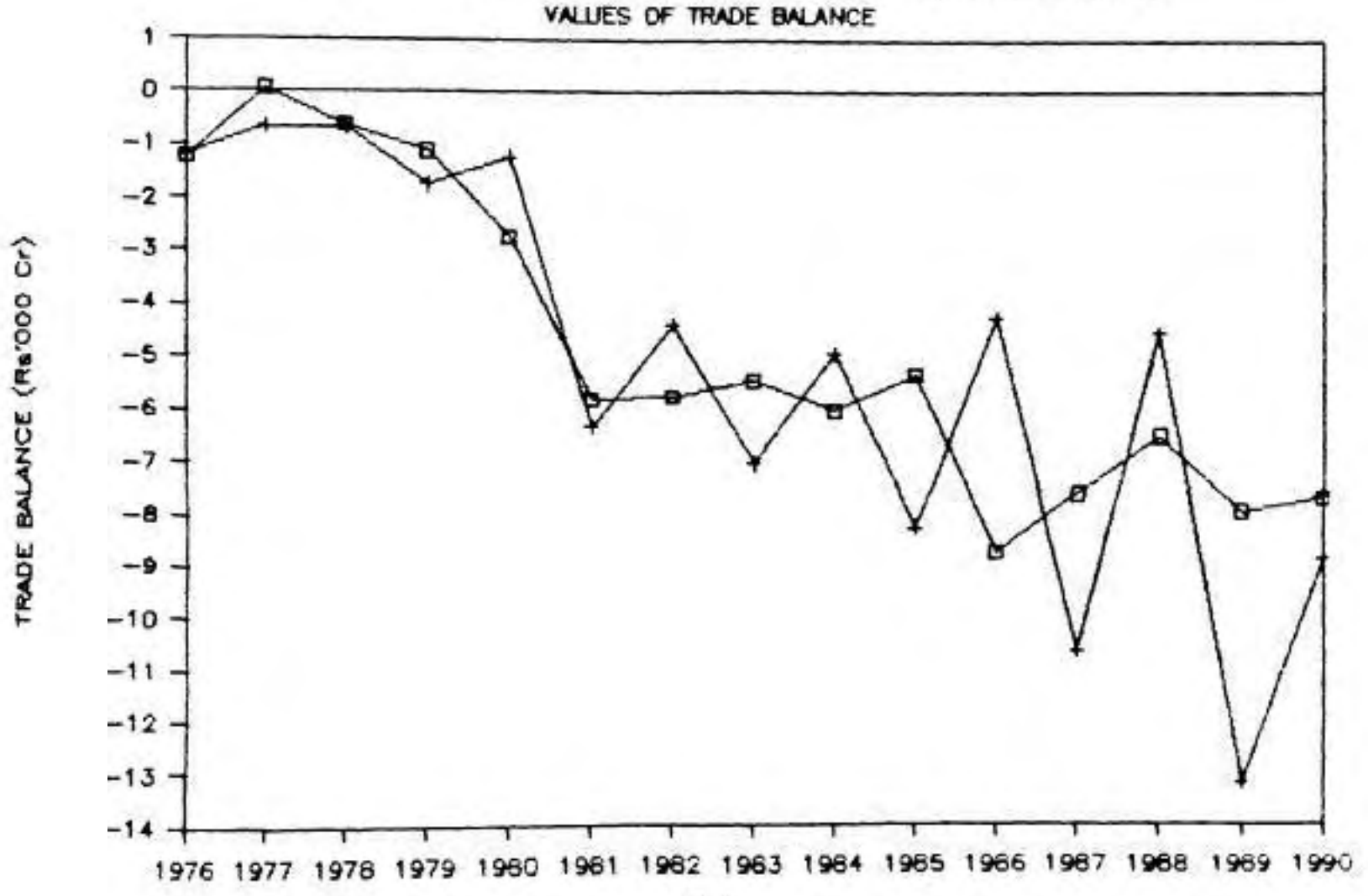


FIG 6.8: POLICY SIMULATED VALUES OF

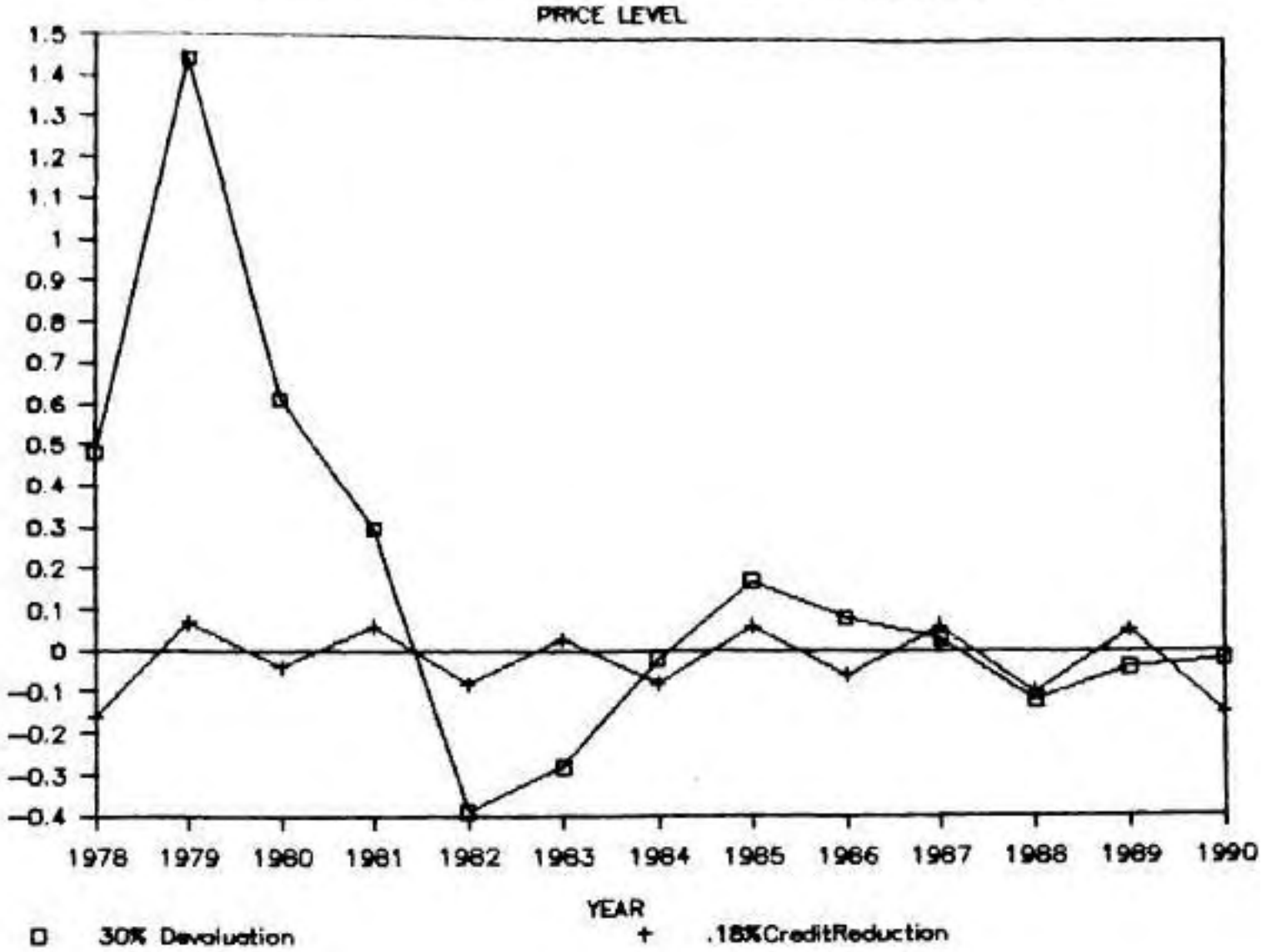


FIG 6.9: POLICY SIMULATED VALUES OF

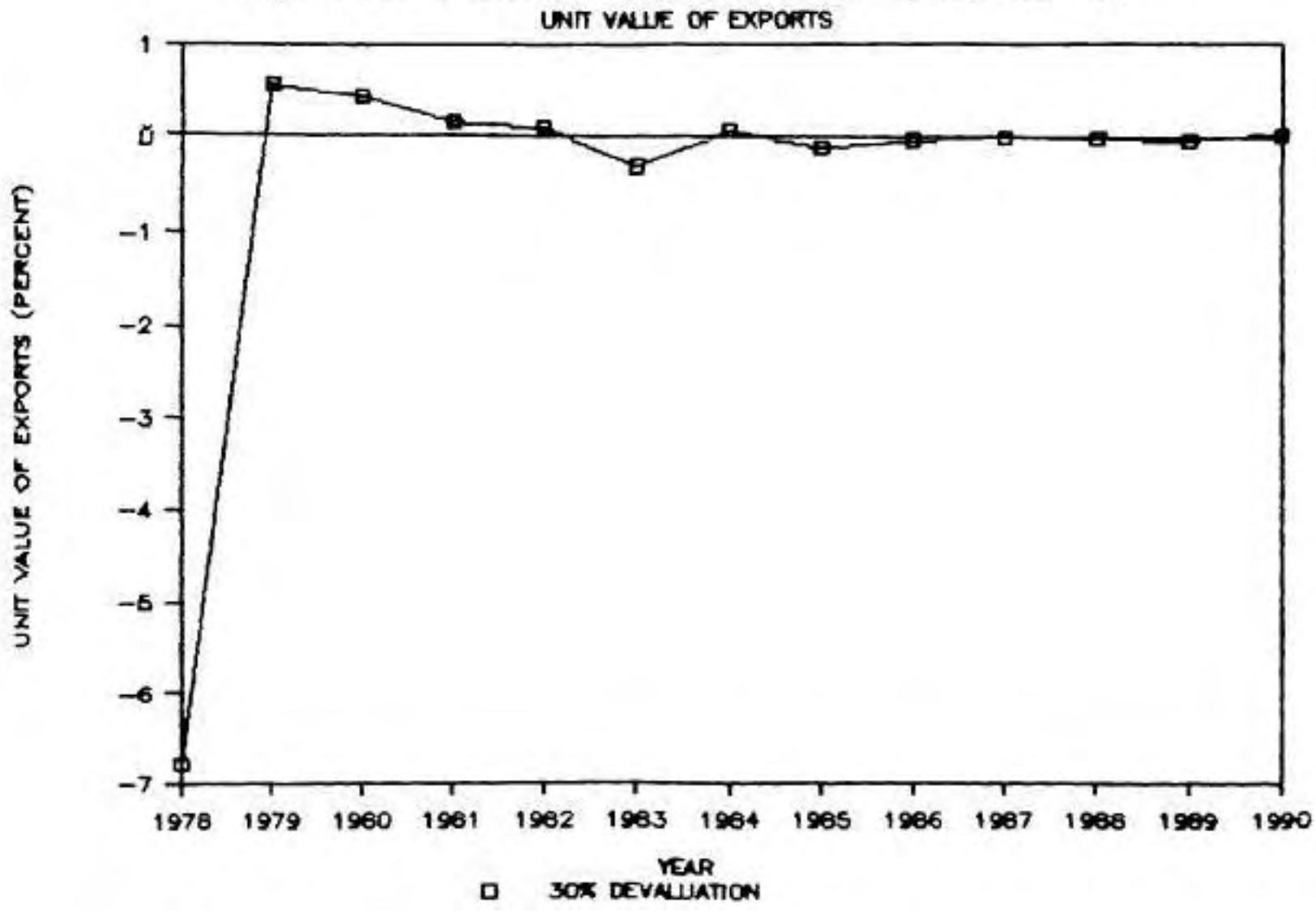


FIG 6.10: POLICY SIMULATED VALUES OF

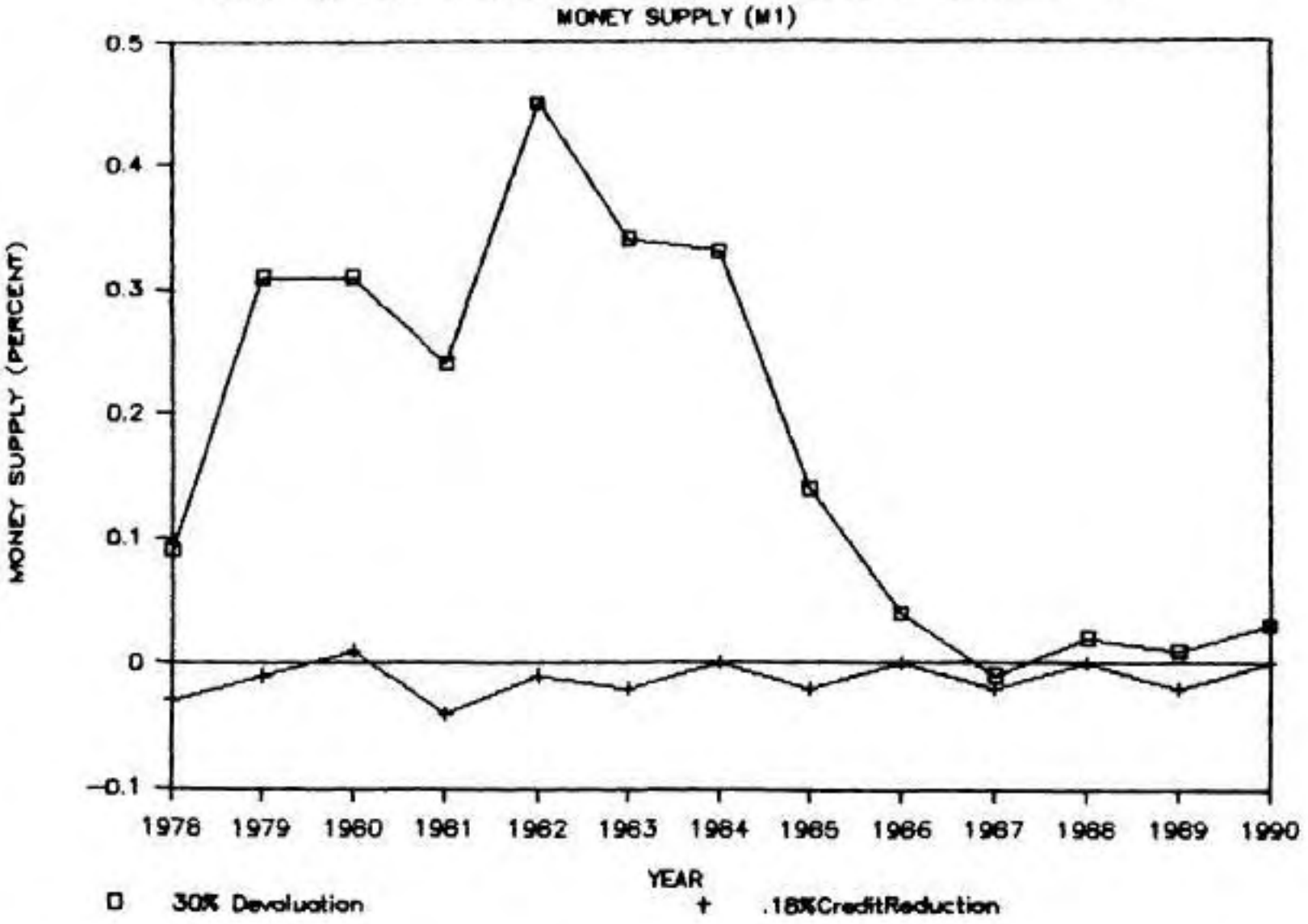


FIG 6.11: POLICY SIMULATED VALUES OF

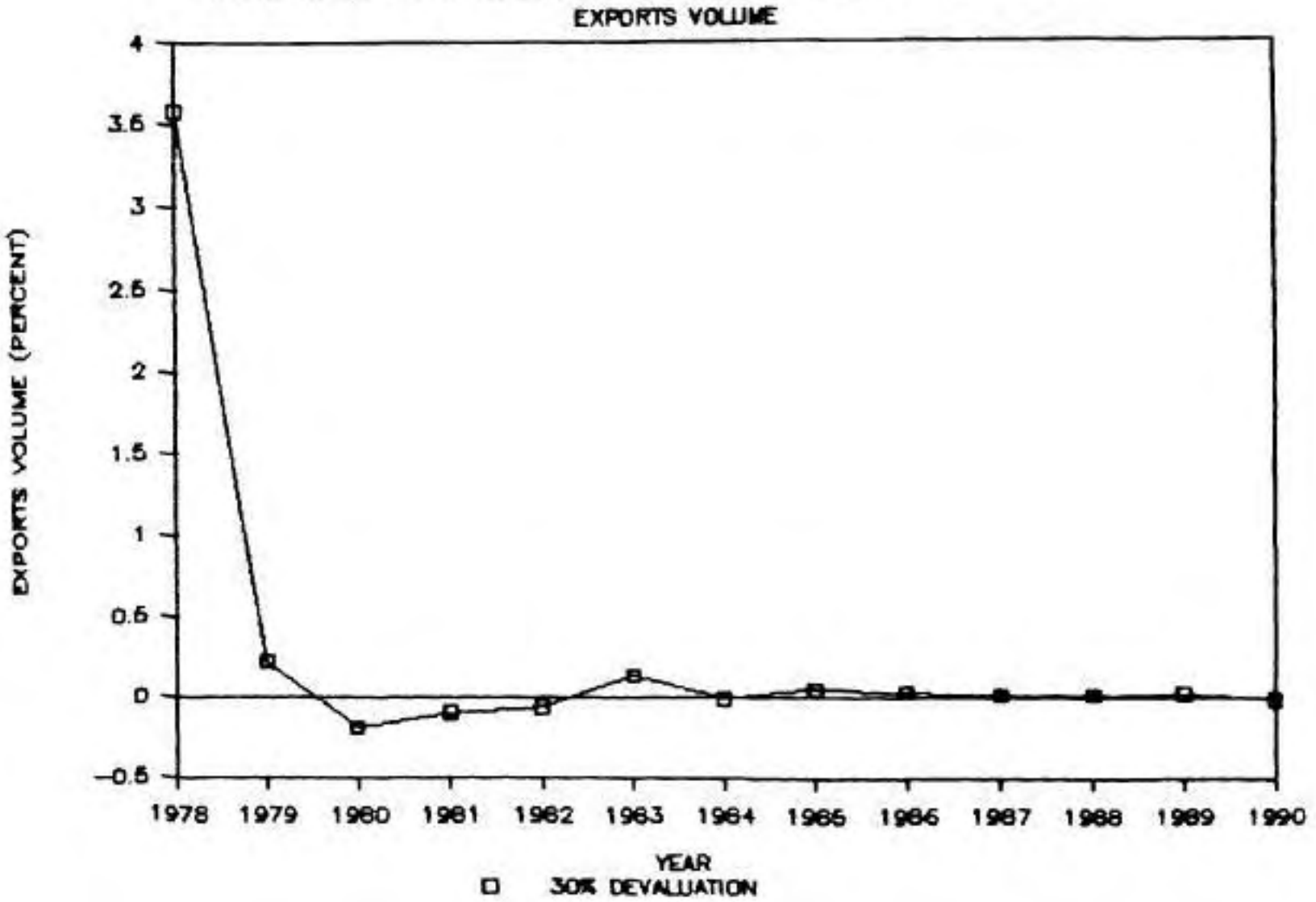


FIG 6.12: POLICY SIMULATED VALUES OF

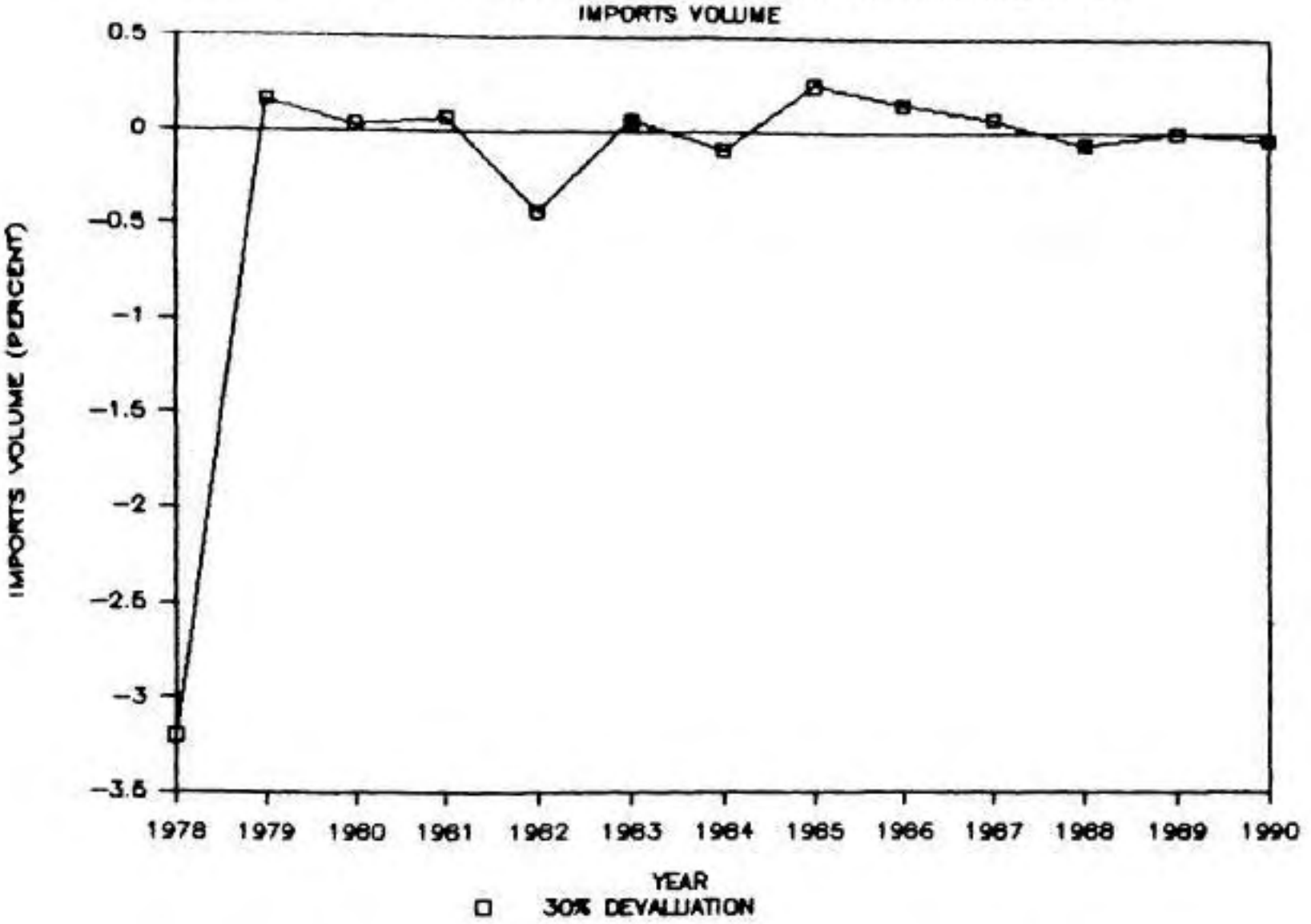


FIG 6.13: POLICY SIMULATED VALUES OF

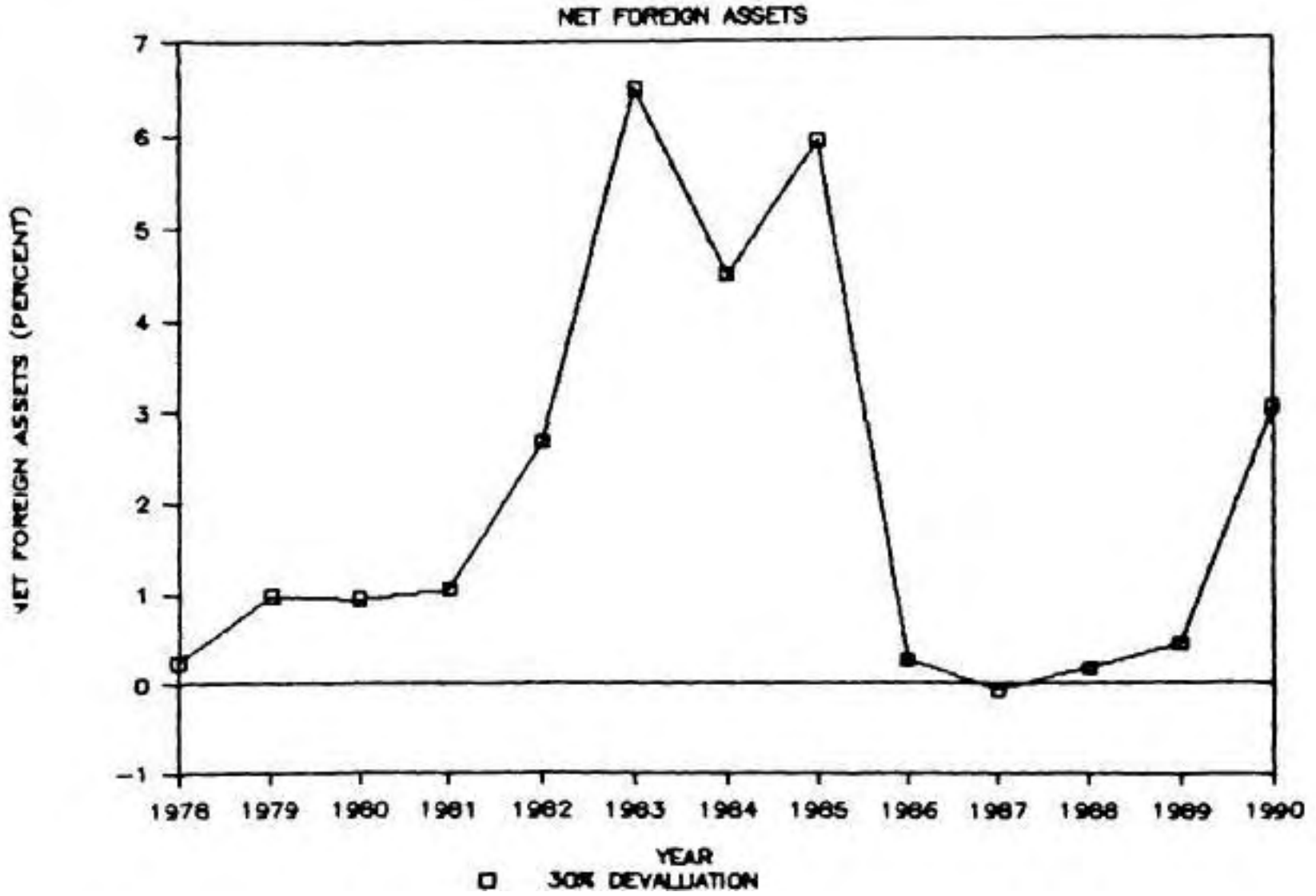


FIG 6.14: POLICY SIMULATED VALUES OF

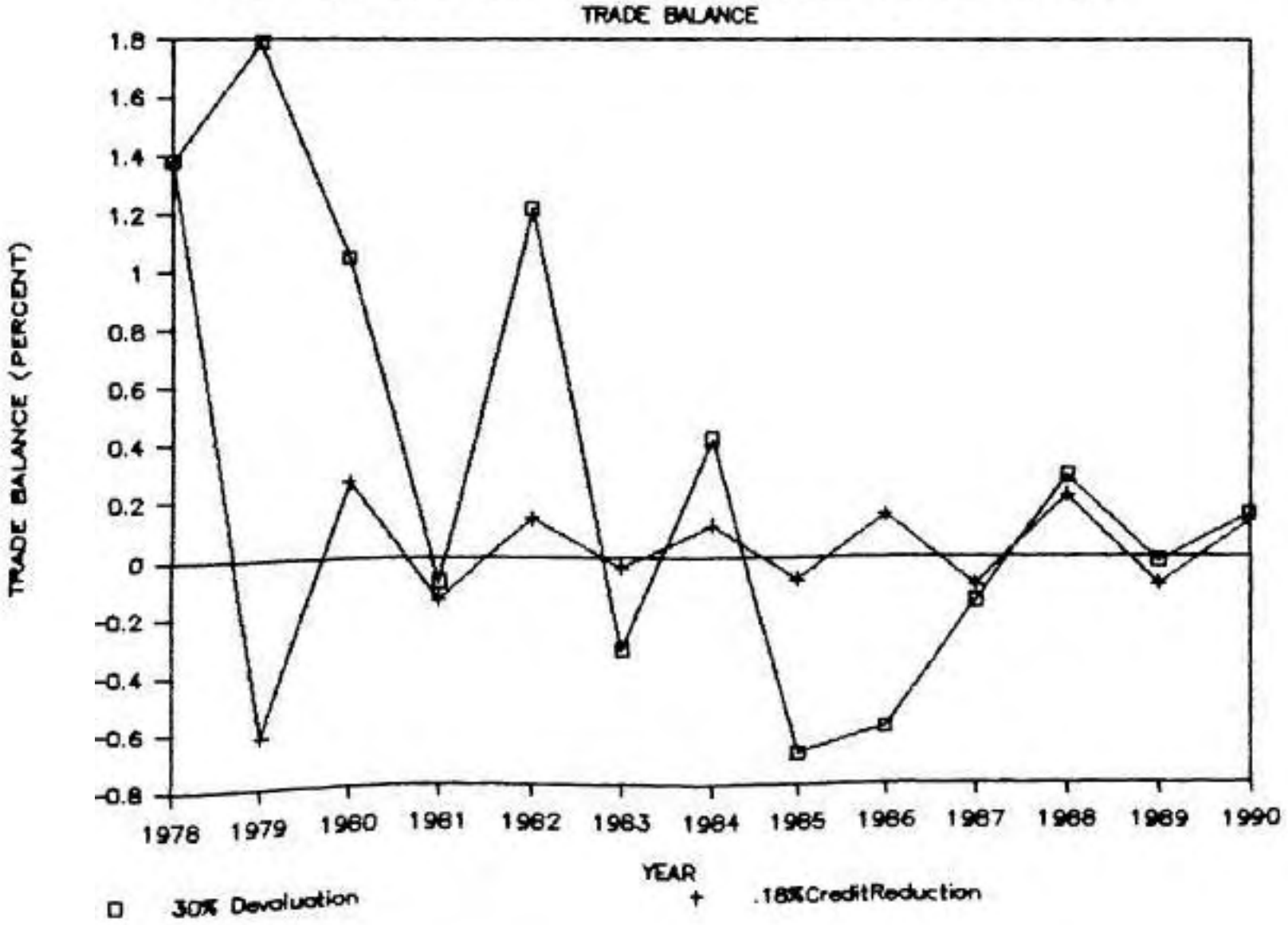


FIG 6.15: POLICY SIMULATED VALUES OF

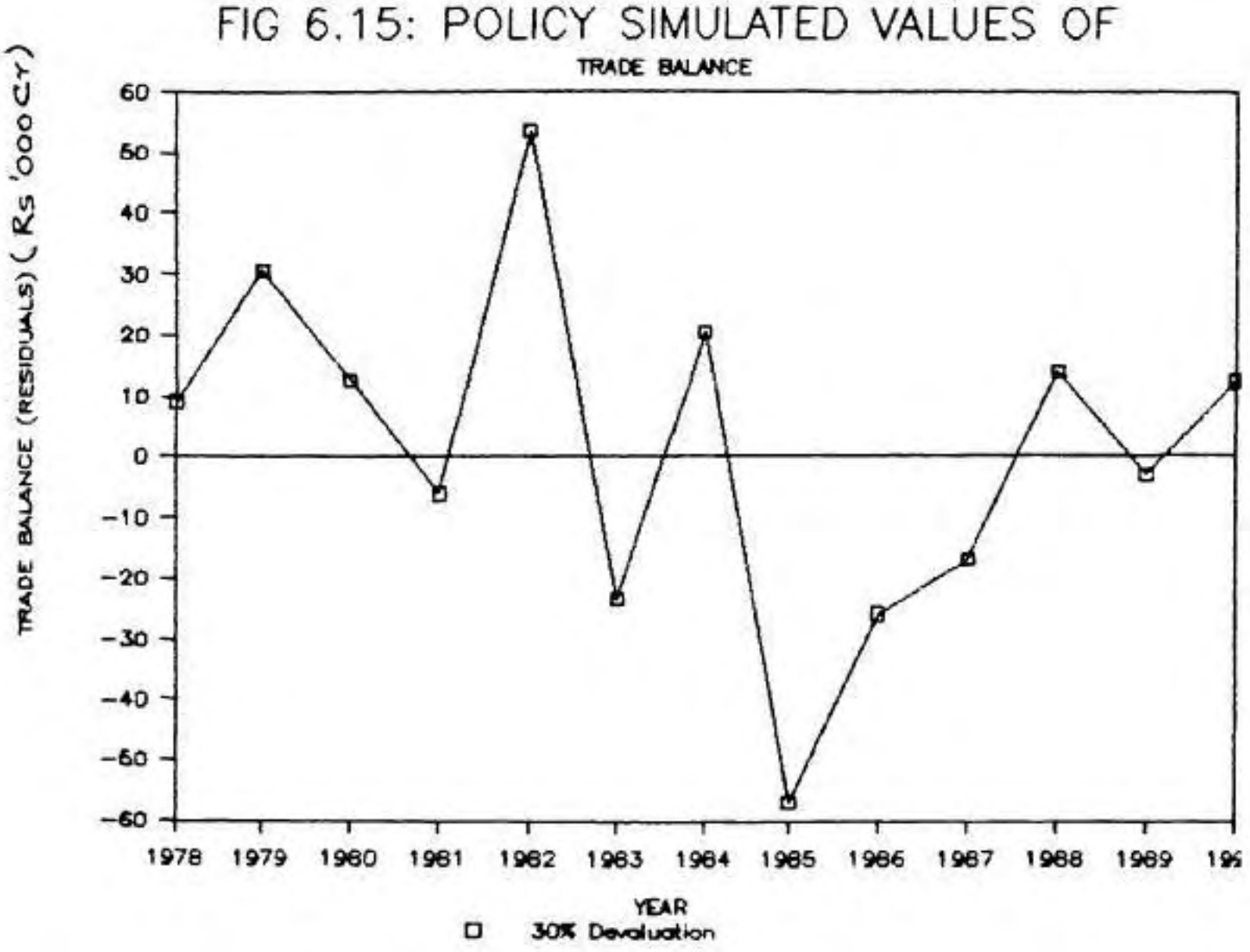
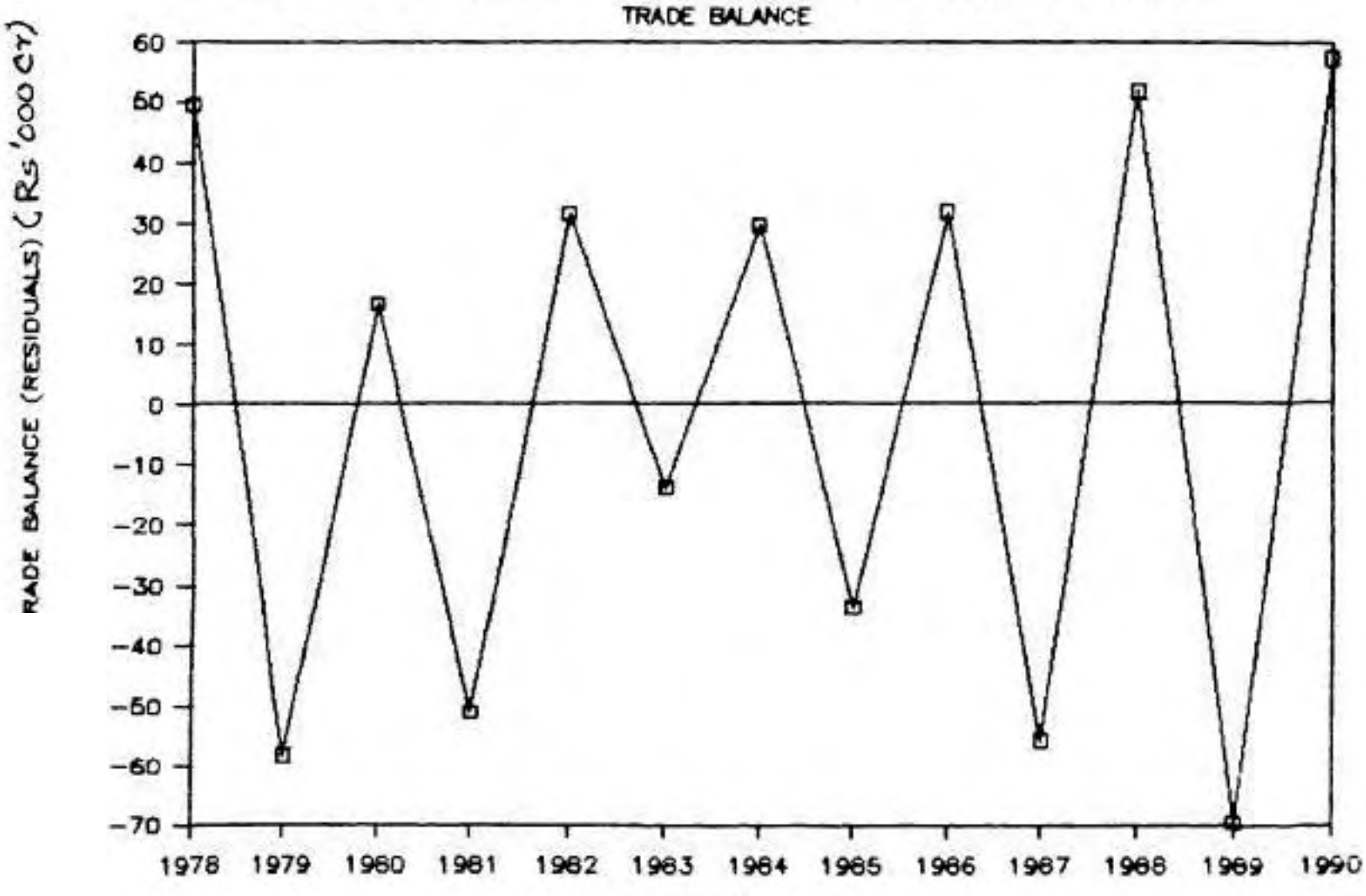


FIG 6.16: POLICY SIMULATED VALUES OF



CHAPTER 7

SUMMARY AND CONCLUSIONS

7.0. SUMMARY:

This study focussed its attention on the long standing problems of India's trade deficit, declining foreign exchange reserves and spiralling domestic prices. It tried to identify the determinants of trade balance and inflation within the framework of a Computable General Equilibrium (CGE) model. It examined the policy impact of exchange rate changes (devaluation) and other trade related policy instruments on important macro-economic aggregates of the economy. The need for integration of monetary and trade sectors in analysing the trade balance and balance of payments scenarios has been emphasised. The model took into account some of the institutional features of the Indian economy such as foreign exchange rationing, export subsidies, import restrictions etc.

Chapter 2 provided a brief review of International monetary systems, its evolution and growth. This enabled us to know how the external payments were adjusted historically and also the evolution of devaluation as a policy instrument to reduce the imbalance in the external sector of an economy. Among the three theoretical approaches to devaluation viz., the Elasticity, Absorption and Monetary Approaches, the Monetary Approach was considered more suitable to countries like India. Using this approach, the relationship between devaluation and trade balance

and inflation were examined.

A review of some relevant works was made in Chapter 3. The studies relating to devaluation were grouped into three categories viz., (i) studies relating to devaluation and trade balance, (ii) devaluation and inflation and (iii) devaluation studies in Indian context. This review of literature has lead us to identity the CGE model of Sunderarajan (1986) as the appropriate tool for our purpose.

The CGE methodology and the present model are given in Chapter 4. A computable general equilibrium trade model was specified. The postulated model comprises of eight equations of which four are identities. These include three trade equations, the money demand function and four definitional identities. These together make-up the complete model, representing the markets for three goods namely, exportables, importables and non-traded goods as well as one asset viz., money. This model provides a synthesis of both elasticities and monetary approaches to devaluation. The role of monetary factors (money demand and supply) on trade variables was examined by integrating monetary and trade sectors.

The model is suitable to analyse the effects of devaluation on macro variables like trade balance, domestic prices, money supply, imports and exports in the Indian economy. The model has incorporated an unobservable new variable called the monetary disequilibrium variable which is derived from the estimated money

demand function and is used in the export supplies and import demand equations to capture the effect of monetary changes on trade variables. Two variants of the model viz., with and without monetary disequilibrium variable are considered.

The model estimation results are discussed in chapter 5. A preliminary trend analysis was made using growth rates, mean and standard deviations. The analysis is supported by graphs for all the important variables used in the study. The CGE model is estimated using annual time series data by OLS and 2SLS methods and in both linear and log-linear functional forms. The model is estimated for three sample periods viz., 1961-87, 1961-89 and 1971-91. The OLS results looked better than 2SLS in terms of significant coefficients for crucial price variables. The estimated coefficients have appropriate signs, statistically significant and plausible magnitudes for most of the relevant variables like relative prices, domestic and trading partners' incomes, current foreign exchange receipts and more importantly the newly introduced flow excess demand for money variable in respective equations. The statistical goodness of fit is also satisfactory.

Chapter 6 dealt with the policy analysis. Historical or Base simulations were done to check the ex-post descriptive power of the model as a simultaneous system of equations. The ex-post and post-sample predictions were found to be satisfactory, with some

exceptions. Using base simulation as a reference scenario, policy simulations were undertaken and their impact, dynamic and equilibrium multipliers are computed. Before undertaking policy change scenarios, sensitivity tests were performed to analyse (a) the dynamic stability of the model and the sensitivity of the impacts to choice of (b) timing of the exogenous change, (c) level of exogenous change, (d) functional form and the parameters used and (e) the method of estimation used to quantify the regression coefficients. The example of devaluation was used to analyse each of these in some detail. The estimated model was found to be dynamically stable, but sensitive to level and timing of exogenous change. It is also sensitive to choice of functional form, sample period and method of estimation.

7.1. CONCLUSIONS:

Some of the broad conclusions of this study which emerge from the analysis of trade balance and inflation in India are as follows:

i) A trend analysis of the data showed that the rate of increase in prices is much faster than the rise in real national income, at the compound rates of 8.1% and 3.8% per annum respectively. The growth in money supply was faster from 1970s onwards at the rate of 13% in 70s, 15.1% in 80s and the overall growth rate being 12.5% for the entire period.

11) There has been acceleration (deceleration) in the import volume (export volume) into India during 1970-90. Imports into India have increased at 5.6% in 70s and 7.1% during 80s, while exports volume has increased at 7.6% and 6% during the respective decades. The overall growth rates in export and import volumes were equal at 5.2%, for the entire period, but imports always exceeded exports with widening trade gap thereby causing chronic imbalances in the trade sector. There needs to be a reversal in the growth rate of exports so that external payments situation could be brought under control.

iii) The world prices exhibited violent fluctuations during the sample period. They increased at 3.7% during 60s, 12% during 70s and 9.9% during 80s. This could have a destabilising effect on national economies and their trade sectors.

iv) Export and import price movements were not favourable to help improve India's trade balance and balance of payments. Though there was a deceleration in import prices during 80s, the growth rates of export and import prices for the entire period were almost equal at 8.4% and 8.3%. Therefore, the terms-of-trade was not favourable for improving India's trade balance.

v) Among the determinants of trade balance, the relative prices have a significant effect on exports and imports as indicated by statistically significant coefficients in the respective

equations.

vi) The coefficients for the lagged dependent variable in export and import functions were significant and satisfied stability condition. This implies that the adjustment process between actual and desired volumes involves lags and needs to be considered.

vii) The linkage between trade and monetary sector, through the incorporation of monetary disquilibrium variable, was found to be crucial in analysing the impacts of policy instruments like devaluation and credit control. This was revealed by the significant negative coefficient in import function.

viii) Summary measures like KAPE, RMPE AND THIF were used to validate the model. Based on these measures, there does not seem to be any uniform pattern between *ex-post* and post-sample simulations in terms of relative superiority. One may expect *ex-post* simulation to be better than post-sample (inclusive of sample period here) simulation, but this does not seem to hold good. However, the net foreign assets variable seem to support the expected behaviour.

ix) Since the model is simultaneous and dynamic, we could estimate impact, dynamic and equilibrium multipliers using shock type of exogenous change.

x) Sensitivity analysis has shown that the model is dynamically stable but the impacts are somewhat sensitive to level and timing of exogenous change, choice of functional form and method of estimation.

xi) Comparison between linear/log-linear functional forms and OLS/2SLS methods of estimation has shown that the OLS log-linear model has an edge over others due to better stability property. Moreover, log-linear model has its advantage in interpretating the coefficients as elasticities. Therefore, OLS log-linear model estimated for 1962-87 period was used for further policy analysis.

xii) A broad within comparison of static and dynamic simulations shows that there is not much accumulation of (relative) errors over time. As expected, dynamic simulations indicate larger error build-up compared to their static counter-parts.

xiii) Within each simulation, the degree of success varied across variables. Money supply variable and to some extent, unit export value, stand-out well traced uniformly in all simulations. The magnitudes of both MAPE and RMPE values for all other variables, possibly with the exception of net foreign assets variable (R), seem reasonable. The RMPE is always exceeding MAPE which indicates volatile nature of the trade variables. The relative

errors seem large for all variables during 1982-87, second half of the sample period as well as post-sample period (1988-90). This was the post-second oil crisis period during which the net trade balance deteriorated very rapidly, signalling a BOP crisis. It would be difficult to model such volatile behaviour of any phenomenon. Despite this limitation, the model was used for policy analysis.

xiv) Some hypothetical policy simulations were carried out with the estimated model. Important policy variables present in the model are exchange rate (E) , unit export subsidy (s) , unit import tariff (t), and net domestic credit (D), To measure the effect of any policy simulation, the base simulation values of the endogenous variables are taken as reference levels. In this way, the effect of the policy alone can be isolated from the inaccuracies of model estimation. Otherwise, if the policy simulation is compared with the actual series, any imperfections in the model estimation get included in the policy effect and the resultant change cannot be attributed to policy alone. The period 1978-90 is used for policy simulations.

xv) We examined the likely impacts of some structural adjustment measures on the Indian economy. These include devaluation, reduction in unit export subsidy, increase in import tariff, export: demand elasticity and credit control.

xvi) The results of these policy simulations are broadly in agreement with a priori thinking. In each policy simulation, due to feed-back effects from other variables in a simultaneous equations frame-work, the net impacts are different from pure partial effects implied by regression coefficients. The impacts vary across time due to lagged behaviour.

xvii) A 30% devaluation is likely to improve India's trade balance by Rs 9.14 crores within the first year. Money supply will increase by Rs 15.3 crores, pushing-up overall price index by 0.5%. There will be a larger fall in imports volume will than the rise in exports volume. The unit value of exports will fall by 6.8% making India's exports cheaper. In subsequent years in short-run, due to weaker relative price effect and strong liquidity effect, the overall trade balance will deteriorate. Exports may decline and imports will rise rather marginally. Money supply and price also may indicate a rising trend.

xviii) The direction of medium and long-term effects are as per expectation although somewhat large in magnitudes. Money supply and prices will rise by about 2.2% each. Trade balance and BOP continue to show an improvement. These effects together with the short-run effects describe the well known J-curve for trade balance variable in a slightly modified way. The full long-run equilibrium seems to extend much beyond the thirteen year sample period for verifying the long-run neutrality of devaluation. The

delay and ambiguity of some of these effects is perhaps due to the wrong sign of monetary disequilibrium variable in unit value of exports function. This needs some further probing. Devaluation thus is inflationary, both in short as well as long-runs.

xix) Other comparable scenarios of reduction in credit, unit export subsidy and export demand elasticity have similar but much smaller impacts. However, a policy like 10% reduction in unit import tariffs would spell substantial decline in trade balance and balance of payments which may throw the external sector off the rails, plunging the precarious BOP situation (as in 1991) into unretrivable depths.

xx) Thus to sum-up, among the policy simulations, devaluation and reduction in export subsidies, the latter to a lesser extent, imply both short- and long-run benefits; credit control has only immediate gain and reduction in import tariffs would result in net losses interms of changes in trade balance, balance of payments and inflation in the Indian economy. Clearly, if two or more policy measures are used together, negative benefits from one policy may offset positive gains from another, resulting in no net benefit to the economy. Thus, the policy maker has to make a judicious choice of these policies keeping the objective in mind. Indiscriminate use of the measures package can jeopardise the very purpose.

7.2. LIMITATIONS:

(a) The major limitation of this study is its aggregative nature. The external sector has been aggregated into four commodity groups. This surely conceals more than it reveals. Data are available for few disaggregated groups of imports and exports. Perhaps, two submodules- one for imports and another for exports, can be built and integrated with the above aggregate model.

(b) The annual time series data used here is another limitation. It would be better if atleast quarterly data is made available on all trade related variables so that seasonality could be modelled and the adjustment process in TB and BOP can be better explained.

(c) The present study also could not attend to problems relatingto time series models viz., testing for stationarity of variables, correcting for serial correlation and using more reliable estimation methods of simultaneous equation systems.

(d) Lastly, it would have been better if more recent data, particularly after 1991 devaluation, are made available for better quantification of impacts. Also, the data on tariffs and subsidies are not upto date. This also might have affected the quality of results. It must be admitted that the dynamics of international trade, external sector and balance of payments of countries like India are too complex to be captured in a set of few equations. At the most, we might have been able to touch upon only the periphery of the issues involved.

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