A RATIONAL EXPECTATIONS MACROECONOMIC MODEL OF AN OIL-EXPORTING-DEVELOPING ECONOMY: CASE OF IRAN

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ABSTRACT

The object of this thesis is to analyze the impact of stabilization policy in an *oil-exporting-developing* economy under a *rational expectations* macroeconomic model, through a study of the Iranian economy.

The model is based on new-classical equilibrium theory and the *supply-side* economy and provides an explanation of the *natural rates* of output, real exchange rate, real wages and unemployment. Expectations are given a key role and modelled by rational expectations method. In this way the model uses an effective methodology for analysing the effects of alternative government policies under conditions of structural change, within the empirical limitations of building a fully structural model. Terminal conditions are used for selecting the unique stable path.

The nature of the Phillips curve is contract-based derivation under rational expectations, in which wages are set one period ahead by contract but prices adjust flexibly. The dual exchange rates system with the official and parallel market rates is considered as an exchange rate policy. Uncovered interest parity with the rational expectations solution determines the real interest differential as a fraction of the parallel market real exchange rate.

The model considers private wealth (financial and physical assets), the government budget constraint and external debt effects. It is assumed that financial assets are denominated in government bonds and domestic money. Currency substitution will show up in the demand for domestic monetary base.

According to oil prices determination and OPEC behaviour, it is assumed that the oil market is most competitive when the market is tight and OPEC plays an effective role when the market is weak by directing the oil prices towards a target level or zone.

The impact of monetary and fiscal policies, and policy response to the oil prices shock are examined. The high forecasts errors of the model, through historical tracking, in the case of unexpected government policy changes (by using information of exogenous and endogenous variables up to and including period t-1), indicate instability of the Iranian economy. This emphasises that the government policies should be as *predictable* and *credible* as possible.

Simulation results show that a once-for-all unanticipated rise in money supply, (with unchanged government spending), has no short or long-term effects on output, but there is a sharp rise in prices and a depreciation in real exchange rate in the short-run. The more short-run money financing of government deficit causes the more depreciated real exchange rate, the greater inflationary shock, and the lower output multipliers because of the high inflation tax.

The key policy implications of dual exchange rate system are explained. Accelerating rates of devaluation above prevailing inflation in the absence of credible fiscal and monetary policies could result in perverse black market premium response.

Money growth targeting as a monetary policy response to oil price shock (a temporary fall) can improve the economic performance.

Finally, macroeconomic effects of the oil sector boom as one of the main topics of recent natural resource economics, (*Dutch Disease*), are discussed.

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CHAPTER ONE

INTRODUCTION

1.1 Supply side of the economy: an overview

The supply side of the economy is an essential part of dynamics of prices (inflation) and output, that is, of the adjustment of prices and output over time when the economy is hit by a disturbance.

The representation of the supply side of the economy, however, produces fundamental differences between the various schools of macroeconomic analysis, regarding the self-equilibrating or full employment properties of the macrosystem and the role of demand changes. These divergent views underlie the debates on the role of stabilization policy, the channels and efficacy of monetary and fiscal measures, and the appropriate design of macroeconomic policy.

A highly simplified representation of the essence of these debates can be given in terms of the nature and slope of the aggregate supply schedule in (y,p) space. When aggregate supply is perfectly elastic at a given price level, output responds one for one to changes in aggregate demand. For any given price level, output is demand-determined. This is sometimes presented as the extreme *keynesian* view. The opposite view is where the aggregate supply curve is vertical. Any shift in aggregate demand does not alter the level of real output, but only the price level. This is the familiar representation of *classical* aggregate supply. The properties of a macromodel incorporating the classical aggregate supply schedule may be briefly summerised.

First, by the market-clearing condition, full employment in the labour market holds by assumption. Second, the level of aggregate demands plays no role in determining employment and output and merely to alter the price level. Consequently, the supply-side variables being independent of outcomes in the expenditure and monetary sectors. Finally, the classical view is essentially Walrasian in its equilibrium perspective and in the necessary role played by flexibility in prices and the money wage. If, however, the aggregate supply schedule is upward sloping, then both output and the price level vary with changes in aggregate demand.

The debate on stabilization policy between Keynes and the classical economists, and their respective successors, regarding the possibility of macroeconomic equilibrium at less than full employment, was resolved at a conceptual level some thirty years after the publication of the General Theory (Keynes,1936) in the *neoclassical synthesis* developed by Patinkin (1965), in which the Keynesian model augmented by a Phillips curve and then the classical properties were confirmed for the long-run equilibrium of the macrosystem.

Indeed, attempts by Keynesian to establish an analytical framework outside the neoclassical synthesis were essentially unsuccessful. The traditional approach, the so-called Keynesian ′fixed-wage′ model, postulates downward rigidity in the money wage, and hence the failure of the labour market to clear. While this generates involuntary unemployment, no rational justification for wage stickiness and the consequent market failure was offered.

Over the past two decades a new alternative to Keynesian macroeconomics has been developed, principally by Lucas and a number of other authors (see e.g. Friedman, 1968; Phelps, 1970; Lucas, 1972, 1975, 1976; Kydland and Prescott, 1977; Sargent and Wallace, 1975) particularly as a result of the Phillips-Lipsey version of Phillips curve. This approach is now commonly referred to as the *New Classical Macroeconomics*[1]. Friedman's work (1956a, 1959a, 1968) suggested that inflation is associated most closely with changes in the supply of money; that unemployment is a response to the real wage and there is no any long-run trade-off between rates of inflation and unemployment on basis of the *expectations augmented Phillips curve*. Thus, Friedman's views and the rational expectations hypothesis with different type of methodology (Walrasian)[2] rather than the Monetarism methodology (Marshalian), as arguments of Hoover (1984, 1988), has been formed the New-Classical conclusions.

The main points of the approach are, first, that observed outcomes in an economy are the result of the equilibration of the demand and supply and are consequently, market-clearing conditions. Second, the demand and supply functions in the economy are the result of intertemporal optimising decision of rational maximising firms and individuals, and their decisions are based on real not nominal factors. Third, that in many circumstances, agents will not have perfect information and accordingly will have to form expectations of current and future outcomes. These expectations are assumed to be formed rationally. Agents make no systematic errors in evaluating the economic environment which means that expectations are correct on average, and

[1] For a more detailed examination of the origins, methods and results of the New-Classical Macroeconomics, see Minford (1992).

[2] For the properties of the Walrasian methodology see Katzner (1989) and Benassy (1986).

forecast errors are uncorrelated with information available at time expectations were formed.

The dramatic result for the debate about stabilization policies in the New-Classical macroeconomics model that is on basis of the *Rational Expectations Hypothesis* (REH) and an expectations-augmented Phillips curve (e.g. assumed by Sargent and Wallace), without signal extraction from local prices, without intertemporal substitution in supply, and without asymmetric information, is that systematic policy can not effect real output or employment. In the other words, only unsystematic or unanticipated disturbances can have real effects in the economy[3].

Keynesian objections to this strong *policy invariance* or *policy neutrality* result may be divided into a number categories. Some objections are to the concept of rational expectations itself and the way in which economic agents learn about policy rules and economic structure. An important line of argument attacks not the REH itself but the model to which it has been applied. The New-Classical views involves the joint hypothesis of a market-clearing neo-classical model of the labour market and the REH, and thus, the strong invariance result proposed by this school depends essentially on the *natural rate* hypothesis.

In an attempt to justify stabilization policies, Keynesians have developed a number of non-market clearing models (e.g. non-contingent contracts model of Fischer, 1977) with short-run wage stickiness, and discussed that monetary policy has the ability to affect the short-run behaviour of output. As a final point it is important to consider

[3] For distinction between 'Monetarism' and the 'New-Classical' views also see Hoover (1984, pp.58-76) or Hoover (1988, part v)

however, stabilization policy is in general not ruled out by New-Classical models, but there are some points of weakness about theoretical basis of non-contingent approach, in which the nominal wage or price is fixed and quantity is set by demand (e.g. see Rotemberg, 1983; Parkin, 1986; and Minford, 1992).

1.2 The Phillips Curve and Stabilization Policy

Historical Issues

The debate of the simple Keynesaian model was how to explain inflation, given that changes in aggregate demand could only change output and employment on the assumption of fixed money wage. This was resolved by the discovery by Phillips (1958) of an inverse non-linear relation between the level of unemployment and the rate of growth of money wages for the period 1861-1957 in the United Kingdom[4]. This idea was seen as completing the Keynesian model by suggesting a trade-off between inflation and unemployment. However, it was initially as an empirical relationship without theoretical foundations. Lipsey (1960) attempted to explain this by formulating the Phillips curve as a labour market adjustment process as follows:

$$\dot{W} = f(n^s - n) \quad , \quad f'(.) < 0 \quad , \quad f(0) = 0 \qquad (1.1)$$

where $\dot{W}$ is the rate of growth of nominal wages, n is the actual employment level, and n^s is the labour supply. The Phillips curve is then interpreted as showing the way in which wage inflation reflects excess demand in the labour market. The Lipsey's

[4] About historical issues of the behaviour of prices and wages also see Laidler and Parkin (1975) and Friedman (1977).

theoretical concept of the ´Phillips curve´ is incompatible with the neo-classical theory of labour supply. This is another way of stating the point that to draw an upward sloping aggregate supply curve beyond the point of labour market equilibrium requires money illusion on the part of workers. We can show how a simple Keynesian macroeconomic model augmented by a Phillips curve, that so called the *Keynesian-neoclassical synthesis* model, may be used to describe inflation.

This inflationary equilibrium can be illustrated in figure 1.1. The monetary growth continually shifts aggregate demand (AD) rightwards, which the Phillips curve adjustment mechanism continuously shifts the aggregate supply (AS) curve leftwards according to the speed of adjustment. The dynamic path of the economy is mapped by the intersections of sequential AS and AD curves. Eventually, the system settles down to an inflationary steady state at output y_1. This implies that if the system is stable, wage inflation converge to an equilibrium where $\dot{W} = \dot{M}$, an inflationary equilibrium where $n > n^s$ even in the long-run. Therefore, it involves money illusion on the part of workers , and is incompatible with the neoclassical theory of labour supply.

The next development of Phillips curve was to relate prices to money wages as a major cost component. Samuelson and Solow (1960) took this process and estimated directly a relationship between the rate of unemployment and the rate of price inflation.

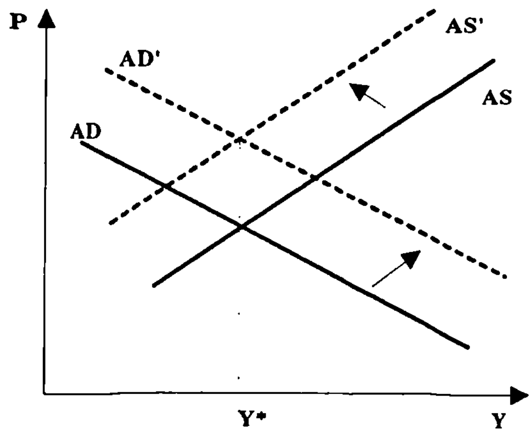

Figure 1.1: Keynesian - Neoclassical Synthesis Model

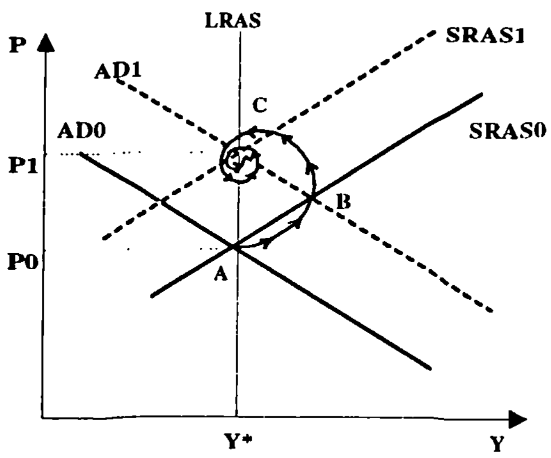

Figure 1.2: Expectations - Augmented Phillips curve

The Expectations - Augmented Phillips curve: Friedman's Model

The main Monetarist attack on the Phillips curve came with M. Friedman's (1968) argument that there is no long-run, stable trade-off between inflation and unemployment by arguing that optimizing workers will no exhibit money illusion and will base their labour decision on the level of the real wage, as neoclassical model of the labour market. However, in practice workers in the labour market will negotiate their wages in money terms on the basis of the *expected inflation* rate ($\dot{p}^e$). Thus, according to Friedman, the Phillips curve was fundamentally misspecified. The correct specification of the Phillips curve would be:

$$\dot{W} - \dot{p}^e = f(u) \quad , \quad u : \text{unemployment rate} \tag{1.2}$$

or $$\dot{W} - \dot{p}^e = f(n^s - n), \quad f'(.) < 0 \quad , \quad f(0) = 0 \tag{1.3}$$

In the previous subsection we saw that in the absence of inflationary expectations, the monetary authorities could permanently increase output and employment in the economy by rising monetary growth with a higher rate of wage and price inflation. However, the introduction of inflationary expectations suggests that such real output gains can be only temporary.

In order to see the effect of allowing for inflationary expectations in the Phillips curve, we consider a linear version of the *expectations-augmented* Phillips curve:

$$\dot{W} = -\phi (n^s - n) + \dot{p}^e \tag{1.4}$$

As figure 1.2 the initial rise in monetary growth leads to increasing output and employment (point B), as the initial price rise depresses real wage in the economy. However, as wage and price inflation approaches its equilibrium rate, expected inflation begins to rise and short-run aggregate supply shifts to left. As a result, in full equilibrium, wage and price inflation is equal to the rate of monetary growth, with output back to its *natural* level y* (point C). The route from A to B to C may be like the loop drawn in figure 1.2, depending on the process of adjustment of inflation expectations from P_1 to P_2. As Friedman's view, it is workers who react to money wage offers according to their expectations of inflation, however, as Phelps's (1967) it depends on firms rather than workers.

In these arguments, some main points must be noticed. First, the distinction between the long-run and the short-run is extremely important for Monetarist analysis. In the long-run, the real side of the economy is independent of the monetary side. In the short-run, however, Monetarists typically believe the money has effect. Second, expectations are formed on the basis of the *adaptive expectations*[5] or the

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[5] The adaptive expectations were modelled by Cagan (1956) before the Phillips curve literature, is that economic agents adapt their expectations on the basis of past experience and may be represented as follows:

$$\Delta P^e_t = \lambda\, (P_{t-1} - P^e_{t-1}) \qquad 0 < \lambda < 1 \tag{1.5}$$

that expectations of P changes by some positive fraction λ, of last period's error. This can be written as:

$$(1\text{-}L)\, P^e_t = \lambda\, L\, (P_t - P^e_t) \qquad \text{(L is Lag operator)}$$

$$(1 - L + \lambda L)\, P^e_t = \lambda L P_t$$

$$P^e_t = \lambda L P_t \,/\, [\, 1 - (\, 1 - \lambda\,)\, L\,]$$

or

$$P^e_t = \lambda \sum_{i=0}^{\infty} (1\text{-}\lambda)^i\, P_{t-i-1} \tag{1.6}$$

accelerationist hypothesis.

In the adaptive expectations hypothesis, agents in formulating their expectations, do not take into account any announcements of future policies made by government, but react only to what has already happened. Thus, government manipulation of aggregate demand leads to unanticipated changes in inflation and unemployment. The adaptive expectations hypothesis also implies that reduction of unemployment at any level below the natural rate would require accelerating inflation. The accelerationist hypothesis[6] may be shown by substituting of (1.6) into Phillips curve as follows:

$$P_t = P^e_t + \delta (y_t - y^*) \tag{1.7}$$

$$P_t = \lambda L P_t / [1 - (1 - \lambda) L] + \delta (y_t - y^*)$$

$$\text{or} \quad (y_t - y^*) = \{ (1 - L) / \delta [1 - (1 - \lambda) L] \} P_t = 1/\delta \sum_{i=0}^{\infty} (1-\lambda)^i \Delta P_{t-i} \tag{1.8}$$

As (1.8), this model has two policy lessons:

First, *gradualism*, that implies any reduction in order to decrease inflation should be carried out gradually, otherwise, the reduction will cause a large increase in unemployment, since it will not be predicted by the private sector, which takes time to adjust to new government policies. A large shock would set off a large cycle. To get inflation down it is preferable to initiate a series of small cycles by small regular decreases in the money supply. The model argues that the only to get rid of inflation is to create a recession. The choice is either a large recession with a rapid fall in

[6] For tests of the Phelps-Friedman 'accelerationist' view of the Phillips curve, see Sargent (1971) or in Lucas and Sargent, Rational expectations and Econometric Practice, 1981. Also see Laidler and Parkin (1975).

inflation or a more gradual approach. However, expectations will adjust much faster with a large shock, but gradualism takes no account of the speed of expectations adjustment.

Second policy lesson is *indexation*. Supporters of the model use indexation to argue that any fall in inflation there will be a rapid response of inflation expectations. Suppose prices increase each period by the general price index. For suppliers of good:

$$p_i = p + \delta\ (y_i - y^{*i})$$

Then aggregate inflation is given by:

$$p = p + \delta(y - y^*)$$

which implies on infinite response of prices to deviation of output from the natural level y*. We will always be on the long-run Phillips curve. In practice however, even with indexation this adjustment will not be instantaneous. Also, what is being argued here is that λ=1 which yields instability. If the speed of adjustment of expectations is not this great, then the model with indexation breaks down.

The New-Classical Model

A crude definition of the New-Classical model is Friedman's model with expectations-augmented Phillips curve, but on basis of the rational expectations. As arguments of the last section about the Neo-Keynesian synthesis, it was Friedman's assumption of adaptive expectations that permitted inflation to deviate from expected inflation and hence, allowed the labour supply curve to shift, producing cleared markets away from the natural rate.

The *Rational Expectations Hypothesis* (REH) with assumption of continuous market clearing in the labour market, based on real wage bargaining, leads to conclusions which differ from the adaptive expectations hypothesis. The REH implies that people do not make systematic mistakes in forming their expectations (Begg, 1982). As Minford's (1983) argument, individuals in the aggregate act, utilize efficiently the information available to them in forming expectations about future outcomes.

... By ´efficient utilization´, it is meant that the typical individual's perception of the probability distribution of future outcomes (his subjective distribution), conditional on the available information, coincides with the actual probability distribution conditional on that information (p.4).

Muth (1961) created the REH and showed how it could be applied to specific problems. Muth's concept was used in macroeconomics seriously. Walter (1971) showed that the effect of money on prices would be substantially quickened by RE. Lucas (1972a,b), Sargent and Wallace (1975), Fischer (1977) and Phelps and Taylor (1977) argued about the impacts of stabilization policy under rational expectations.

In the New-Classical theory, suppliers confuse an unexpected rise in the general price level with a rise in their own relative price and accordingly supply more output as the general price level rises unexpectedly; once they know what the true price level was, they correct their previous error, but because of adjustment costs they can only do so gradually. Lucas (1972a,b) argued that under RE (unlike adaptive expectations) if information on money is available, monetary expansion could not raise output above the natural rate on average. A positive relationship between output and money or price movement (Phillips curve) can occur because of mistakes made by individuals in estimating current information and the relative price movements. This *surprise* supply function is used by Sargent and Wallace (1975) to illustrate that only monetary surprise can affect output, monetary plans can only affect prices.

It is important to consider different versions of the Lucas expectation augmented Phillips curve that so-called the Lucas supply hypothesis and the Sargent-Wallace supply hypothesis, because of their different effects on stabilization policy debates. The first version is that set out in Lucas (1972a) and reproduced in for example Barro (1976), and Barro and Fischer (1976), namely:

$$y_t - y^* = \alpha\,(p_t - E_t\, p_{t+1}) \qquad (1.9)$$

where α is positive and $E_t\, p_{t+1}$ is the expectation of the price level formed at time t for time t+1. The positive response of supply to the unanticipated price term is rationalized as an effect of speculation over time associated with the intertemporal substitutability of leisure.

The second version is that set out in for instance Sargent and wallace (1975), Sargent (1973,1976) and is as follows:

$$y_t - y^* = \alpha\,(p_t - E_{t-1}\, p_t) \qquad (1.10)$$

The rational for 1.10 is that suppliers of labour and goods mistakenly interpret surprise increase in the aggregate price level as increases in the relative prices of the labour and goods they are supplying. This is because suppliers receive information about the prices of their own goods faster than the aggregate price level.

One of the main criticisms about derivation of the Lucas and Sargent-Wallace sort of supply hypothesis, that is based on only the goods market, has been argued by

Minford and Peel (1983) and Minford (1992). They have considered the goods and labour markets and reconstructed the derivation within a stylized macro framework and then suggested an alternative contract-based derivation of the Phillips curve, in which wages are set by contract but prices adjust flexibly.

We turn to the impact of stabilization policy under New-Classical Phillips curve, with regard to both the goods and labour markets. Suppose, firms' profit maximization leads to a downward sloping demand for labour, in which the marginal product of labour equals to real wage ($f' = W/P$)[7].

The complete Phillips curve derivation is illustrated in figure 1.3. The labour supply depends on expected prices, p^e (as well as permanent real wage, w^*, and the real interest rate, r, both considered constant). The labour demand by firms depends on their own actual prices, which are observable. An increase of p from $p_0 = p^e$ to p_1, with workers continuing to expect prices of $p^e = p_0$. This raises labour demand to D′D′ but leaves the supply curve unchanged. The rise in prices pushes the wages up, then employment expands and more output is produced by supplying more labour to firms who are actually enjoying lower real wage costs.

Suppose p_1 is unchanged in the next period and p^e rises to this new level, then SS too shifts upwards. Finally, as a result of expected prices adjustment, actual and expected real wages will be same, as well as labour supply and demand, as starting point. The long-run Phillips curve obtained when $p = p^e$, is shown as p^*p^* and is vertical.

[7] Suppose labour is the only variable factor, so the price is equal to marginal cost condition, $P=W/f'$; if f is a normally behaved production function, f' will be as labour input increases.

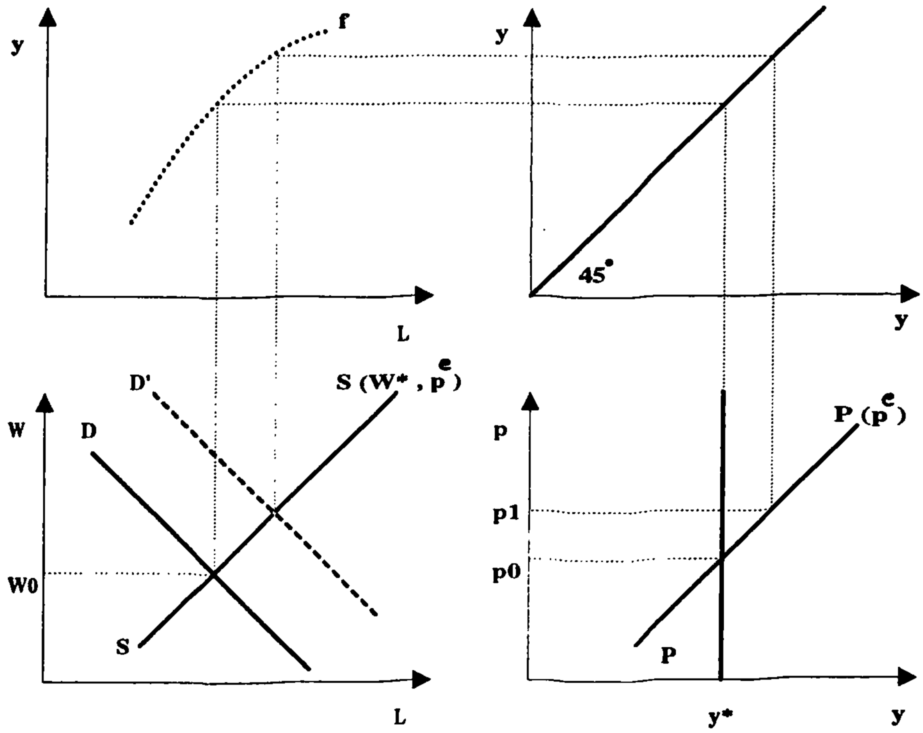


Figure 1.3: The New Classical Phillips curve

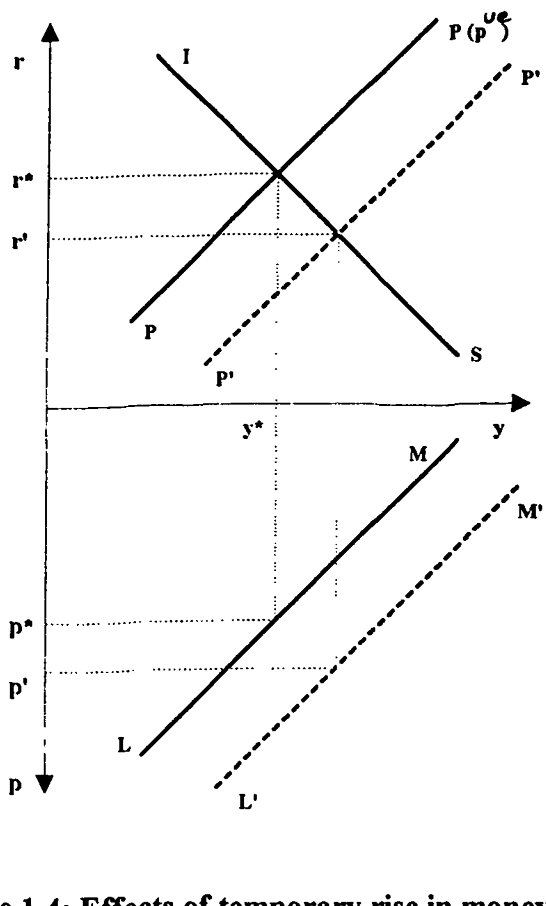


Figure 1.4: Effects of temporary rise in money supply

Figure 1.4 shows the equilibrium and the effects of stabilization policy, such as a temporary rise in money supply, under IS-LM-PP framework. The LM curve shifts rightwards raising prices unexpectedly, which in turn shifts the PP to the right. The fall in interest rates raises money demand and causes the LM back to the equilibrium.

As above arguments, due to Sargent-Wallace sort of supply hypothesis, stabilization policy has no impact on either real output or unemployment in the New-Classical equilibrium models, if they embody a supply function relating deviations of output to surprise movements in the price level, and further with regard to identical information sets of private and public agents, and their ability to act on these information sets. So, stabilization of output in the context of RE models is feasible with one of conditions such as, signal extraction from local prices (partial information), intertemporal substitution in supply induced by real interest rates, information asymmetries, or long-run non-contingent contracts. The general proposition then is that rational expectations do not rule out staibilization policy, but rather they alter its impact.

1.3 The aims and plan of the thesis

The object of this thesis is to analyze the impact of stabilization policy in an *oil-exporting-developing* economy under rational expectations macroeconomic model , through a study of the Iranian economy.

The research is concerned with the construction of a macroeconomic model for the purpose of simulating and forecasting the major macroeconomic variables of Iran as an oil exporting developing country. Expectations are given a key role and modelled by the rational expectations method. In this way the model uses an effective methodology for analyzing the effects of alternative government policies under conditions of structural change, within the empirical limitations of building a *fully structural* model. The model is based on new-classical equilibrium theory and the *supply-side* economy and provides an explanation of the *natural rates* of output, real exchange rate, real wages and unemployment. The impacts of monetary and fiscal policies under different methods of government deficit financing, and policy responses to the oil-prices shocks as main external disturbances in an oil-exporting economy examine. Hence, chapters 2 and 3 explain the general characteristics of oil-exporting-developing economies and in particular, the Iranian macroeconomy on the basis of historical data, according to policy-making restrictions in the last decade in this economy. Chapter 4 deals with the structure of the rational expectations macroeconomic model of Iran. Chapter 5 discusses the results of estimating the behavioral equations and testing the full structural model through historical tracking method. Chapter 6 deals with the central policy issue of stabilization and the impacts of different policies examine. Chapter 7 explain the macroeconomic effects of oil prices shocks and oil sector booming that is one of the main topics of recent natural resource economics as the *Dutch Disease*. Finally, we turn to Chapter 8 which considers the main results and findings of this research as conclusions.

CHAPTER TWO

OIL-EXPORTING-DEVELOPING COUNTRIES (OEDCs)

2.1 Analytical framework of OEDCs economies

This chapter examines the main macroeconomic features of Oil-Exporting-Developing Countries (OEDCs) and the oil price determination regarding to OPEC behaviour.

Developing countries with only a limited range of exports, typically primary products (e.g. oil), face greater oscillations in their terms of trade than developed economies. Mineral exports tend to be among the most volatile and, since such highly specialized exporting countries tend to have high ratios of exports and imports to GDP, mineral exporters are prone to exceptionally large fluctuations in national income. Because a large proportion of natural rent on rich mineral deposits usually accrues to producer governments, the conduct of fiscal and monetary policies are central in the terms of trade movements.

Hagen (1973) developed a simple analytical framework to describe OEDCs economies. In this scheme the economy consists of five players: 'the farm', 'the fount', 'the market', 'the bank', and 'the rest of the world'. The stylized facts of the players in these economies may be explained as follows:

(1) The fount (oil) is the single most dominating product that constituted over 50% of gross national product, and about 90% of government revenue and generated more than 95% of foreign exchange income. The government is the owner

of this underground asset and oil is exported to the rest of the world.

(2) A portion of the oil proceeds is used to import goods and services from the rest of the world. This high degree of interdependence with the rest of the world indicates that these economies are small and open in which they are vulnerable to world volatility. To insulate from volatility, governments subsidized imported goods and services indirectly by domestic currency appreciation and directly by budgetary support programs.

(3) The bank basically refers to the printing press of the government reacting to the initial domestic currency injection by the owner of the fount (government). It reflects the government's desire to transfer part of its real resources from the fount to the rest of the economy. Thus, the domestic currency created by bank is backed by foreign currency generated by the fount. This transfer process of real resources from the fount to the rest of the economy (market) provides the forthcoming resources (revenue) of the government to meet its commitments (expenditures). Government budget deficit may be financed by money through the bank, that is another source of changes in money supply. The domestic money supply generated by oil revenues is mostly spent in the Market. This boosts aggregate demand and bids up the prices.

(4) A higher rate of change in non-oil real gross domestic is achieved by attempts to increase the rate of domestic capital formation and by importing capital goods and services from the rest of the world. In comparison with non-oil-exporting LDCs, the OEDC is able to act by this way because it lacks serious financial constraints and foreign exchange bottlenecks. According to the structuralist view, the crucial problem

for an OEDC is its degree of *absorptive capacity*[8]. This may prohibit the growth of non-oil real GDP and intensify the inflationary pressure. The problem lies in the inefficiency of existing real capital and its nonsignificant contribution to the growth of non-oil real GDP. In other words, the rate of capital formation in the OEDC is relatively high, but efficient use of capital requires a high quantity and quality of complementary factors include physical infrastructure and human resources as well as financial, social, political, and cultural institutions. Thus, the supply side of economy in non-oil sector does not grow at a sufficient rate to balance the increasing aggregate demand.

2.2 Dutch Disease

A number of papers have recently analyzed the way in which oil export booms affect production in other sectors of the economy[9]. Most of these studies have focused on the behaviour of the real exchange rate as the main transmission mechanism from the booming sector to the rest of the economy. This literature, which has come to be known as the Dutch Disease literature, has examined that a commodity export boom (based on the large-scale exploitation of natural resource discoveries or a rise of commodity price), will generally impact on the intersectoral allocation of production factors. This impact is through the real appreciation of the domestic currency and then, increased production of non-tradable goods and a decline in production and

[8] As Adler (1965) definition, absorptive capacity may be defined as the amount of investment, or that rate of gross domestic investment expressed as a proportion of GNP, that can be made at an acceptable rate of return, with the supply of co-operate factors considered as given.

[9] See e.g. Corden (1984) and the papers in this volume; Neary and Wijnbergen (1986); and Purvis (1990).

employment of the rest (non-boom) tradable sector.

Neary and Wijnbergen (1986) and Edwards (1986) argued monetary considerations of the Dutch Disease rather than the allocation of real resources aspects. In this case, commodity export booms can also have important short-run monetary effects, which will spill over to the real exchange rate. For example, an oil export boom will typically result in a balance of payments surplus and in the accumulation of international reserves. If this increase in reserves is not sterilized, the monetary base will increase and an excess supply of money may develop. Hence, the final effect will be inflation that is one of the mechanism through which the real appreciation will actually take place.

During the oil shocks of the 1970s, that oil prices quadrupled over 1973-4 and then redoubled in 1979-80, the main objectives common to most oil-exporting governments were:

(a) growth and modernization of the non-oil economy;
(b) diversification away from oil as a sole source of foreign exchange.

The *ex ante* range of choice facing exporting governments was wide: saving abroad, domestic investment, public consumption or private consumption effected through transfers, subsidies or cuts in non-oil taxes. As Alan (1986), oil windfalls after 1973 were mostly transformed into domestic public investment with some spillover to public and private consumption which increased after 1978. However, the yield on much domestic investment has probably fallen and its supply-side growth impact has been moderate, because it has generally not succeeded in providing an autonomous source of income and purchasing power to supplement or replace oil. Domestic public investment was mainly large-scale and often in the form of complex projects. Considering the main objectives, it appears that most of these countries were highly oil-dependent before 1972 and remain so. Even in those that have successfully promoted industry, a common problem is the *nature* of industrial growth, which is import-orientated and dependent on oil exports for imported intermediates. So, the goal of self-sustaining non-oil development is far from being attained.

2.3 Inflation in Oil-Exporting-Developing Countries

The average rate of inflation in OEDCs has been 5% per annum in the last two decades. Hidden in this modest rate of inflation in the past two decades are inflation rates of 15% in 1974 and 10% in 1980 in response to the oil price shocks in the 1970s. These economies are small and open that import 30-60% of their needs. To insulate from world inflation, governments introduced subsidy programs costing 20-35% of their total expenditure. Consequently, inflation decelerated significantly in these countries between the 1970s and the 1980s. However, the decline in oil prices in the early 1980s and the continuing rise in the cost of the subsidy program resulted in budget deficits and money supply expansion without any efficient monetary policy.

As many empirical works (e.g. Morgan, 1979; Noorbakhsh, 1990; and Salih, 1993), in the oil exporting countries, fiscal policy is the primary determinant of domestic liquidity, therefore, there is a close relationship between budget deficits, money supply expansion, (13% per annum over the period 1970-90), and inflation.

The growth of government expenditures in the major oil exporting countries has been more rapid than the growth in their revenues. The ratio of government expenditure to gross domestic product jumped from 27 percent in 1972-73 to 40 percent in 1975 (after the first oil shock), and it has continued to rise. Hence, the higher rate of inflation in OEDCs since 1973 is more likely caused by faster growth in the money supply created by the explosion in oil prices. So, purely monetary inflation is one variety of the inflation in these economies.

In the next section, the oil price instability, as a most important factor for oil-exporting economies, in the framework of OPEC behaviour will examine.

2.4 Oil price determination and OPEC behaviour

An historical overview:
Oil as a exhaustible resource

In 1960, when five major oil exporters, Iran, Saudi Arabia, Venezuela, Kuwait and Iraq joined together to form the Organization for Petroleum Exporting Countries, certain observations were on the founder's minds. First, they were aware about the substantial economic rents in the world oil market. The gap between the low marginal production cost of oil and the price consumers paid for refined petroleum products was indeed large and only a small portion could be explained by transportation, refining, and marketing costs.

Second, OPEC founders were quite disturbed that producing country taxes per barrel had been declining systematically since 1957. The decline in these revenues could be traced on to the declining world price of oil, which in turn resulted from the increasingly competitive nature of the world oil market due to the entry of many new firms.

A third reality facing the OPEC founders was that 1960 world supply/demand conditions greatly limited its set of possible actions. The decade of the 1950s had witnessed the discovery of numerous giant fields, increasing reserves far faster than the ability of oil consumption to reduce existing reserves. World productive capacity substantially exceeded demand and the reserves were sufficient to quickly expand productive capacity still further. In contrast to present conditions whereby OPEC supplies two-thirds of non-communist oil demand, in 1960, these same countries supplied less than half of such demand.

Before to consider alternative models of OPEC behaviour, it must be noticed to the production and pricing of nonrenewable resources (e.g. see Solow, 1974; Dasgupta and Heal, 1979; and for an review see Cremer and Salehi-Isfahani, 1991). The fundamental assumption underlying this theory is that resource owners are wealth maximizers attempting to produce the resource in a manner that will maximize the present value of the asset. In cases involving the use of nonrenewable products, the decision to produce a barrel of oil today depends on the possibility of producing it an some time in the future. In effect, the decision to produce today results in an opportunity cost or a user cost. Thus, in the nonrenewable case, marginal costs (MC) in period t are modified to include the marginal production costs (MC_t^P) and user costs (U_t)[10]. Thus,

---

[10] User costs, which show the opportunity cost of forgoing producing today, are obtained by simply subtracting marginal production costs from marginal revenue:

$$U_t = MR_t - MC_t^P$$

Since U_t represents the opportunity value of selling the last barrel in period t, the producer may decide to switch production to some other period where user costs are higher. In fact, if the producer maximizes its long run profit, it should be indifferent between producing the last barrel now or at any future period.

$$U_0 = U_1 / (1+r) = ... = U_T / (1+r)^T \quad ; \quad r: \text{ discount rate}$$

the problem facing the wealth-maximizing producer is to schedule production over time that user costs, with discount rate of r, hold the same.

User costs are conditioned on future supply and demand conditions. Even though nothing may affect demand or productive capacity in the present period, if producers revise their expectations of the future, resulting in a new discounted user cost, the price in the current period can change sharply.

Hotelling (1931) in his famous article, first argued about this model. He considered, to simplify his analysis, a case where marginal production costs are zero. Under competition, price equals marginal costs, which in this case include only the user costs. Substituting prices for user costs yields:

$$P_0 = P_1 / (1 + r) = P_2 / (1 + r)^2 = ...= P_T / (1 + r)^T \quad (2.1)$$

or equivalently, prices will rise by the rate of discount:

$$P_1 = P_0 (1 + r) \quad (2.2)$$

$$P_2 = P_1 (1 + r) \text{ ; and so on.}$$

Thus, under competitive market conditions, the price of oil should be expected to rise at rate r, the rate of interest.

For the monopolist facing zero production costs, Hotelling notes that marginal revenues, which will be less than price, will rise over time at rate of interest:

$$MR_0 = MR_1 / (1+r) = MR_2 / (1+r)^2 = ...= MR_T / (1+r)^T \quad (2.3)$$

Obviously with marginal revenues rising, prices will rise, but the rate of increase depends on the nature of the demand curve. In the usual textbook case of the linear demand curve, the initial price will be higher under monopoly and rise at a slower rate than under competition. Thus, the monopolist's high initial price promotes to more production and lower prices in the future than the competition case.

Another aspect of Hotelling's paper was that he considered the case of monopolist facing a demand curve which had a constant elasticity at every point. Hotelling demonstrates that the monopolist's price path is identical to that of competitive market.

As Griffin and Teece (1982), demand for oil is not a static function with constant elasticity. It is an empirical fact that the long run demand schedule is much more price elastic than short run. Since, a monopolist can exploit the short run inelasticity of oil demand by changing an initially high price. A second and more fundamental objection is that Hotelling's model assumes a fixed and homogeneous stock of oil reserves available at zero cost. When one recognizes that the stock of oil reserves is expansible at higher prices, monopoly and competitive solutions will differ dramatically.

As the literature, the main point to be considered is that user costs play an influential role in oil price determination, irrespective of monopoly or competition cases. Since user costs are based on expectations of present and future supply and demand conditions, it is important to look at five such factors which influence producer's expectations of user costs. In this line, the size of the reserve base, the presence of a backstop fuel, rates of discount, the magnitude of the long run price elasticity of oil demand and the rate of world economic growth are remarkable. It is clear that any one price path requires explicit expectations about the above factors and changes in any one of these factors can cause substantial shifts in the price path.

Models of OPEC behaviour

The analysis in the last section focused on the extraction decision of a single producer under monopoly conditions or of many producers under conditions of competition. However, the monopoly problem is considerably more complex if the extraction of monopoly rents requires cooperative behaviour among a number of producers. Coordination mechanisms are needed to control production and/or pricing decisions. Cartels provide the organizational structure within which necessary restrictive arrangements are executed and enforced.

In this section, various monopolistic and competitive models of the world oil market are analyzed briefly. As shown in Table 2.1, these models can be first categorized along two dimensions: models which assume oil producers follow wealth maximization (monopoly or competition case) and those which consider nonwealth-maximizing behaviour (target revenue model and political model).

Table2.1: Models of OPEC behaviour

1 Wealth - Maximizing Models	Monopoly: Core Producers Model
	Competition
2 Nonwealth-Maximizing Models	Target Revenue Model
	Political Model

One interpretation of OPEC is that the core producers set the price, allow the other members to sell all they wish, and supply the remaining demand. The core producers are thus *swing producers*, absorbing demand and supply fluctuations in order to maintain the monopoly price.

Another view of OPEC behaviour is based on competition and market determinants of the oil price through purely economic operations. This view finds its justification in the concept of commoditization, a concept which seems to imply that commodities are exclusively the affair of spot and futures markets. Johany (1978) and Mead (1979) discussed that the oil price before and after 1973-74 are best explained by this way because of the transfer of control over production policies from companies to the host countries and the change in ownership patterns which occurred in the early 1970s.

According to the target revenue model, OPEC are as a collection of nation states whose oil production decisions are made with reference to the requirements of the national budget. More formally, oil revenues can be considered as the source of funding for potential investment projects. In this case, if oil production decisions are made in order to meet the investment objective (target), then increases in the world price in the current period will tend to result in reduced production in the current period, and conversely. The supply schedule thereby generated will have the wrong slop, that it will be backward bending, at least over the relevant range.

Based on the political model of OPEC behaviour, the nation states are simultaneously concerned with extending their political influence, assuring their own security, as well as maximizing the wealth from their oil reserves. As Moran (1982) asserts that political and security concerns affect the economic decisions and where they have conflicted, the former have dominated.

There are many limitations about all the above models and none of them explain OPEC behaviour and the most fundamental question - what determines the price of oil? - has not been answered completely. Here, following Mabro (1992) some aspects of the oil market are examined that have not been considered clearly in the most studies.

OPEC, residual demand and oil price instability

The facts about petroleum are that the average costs of production are generally low relative to the comparable costs of other fuels and on the other hand, the marginal costs of production from existing facilities are sometimes lower for the other sorts of energy (e.g. nuclear, gas) than oil. If we assume competitive market structures in energy, the price of every fuel would equal both average and marginal costs in equilibrium. The low oil price would constitute an effective barrier against investment in natural gas projects, capital intensive nuclear plants and so on. Economic substitution against oil is not significant because of cost advantage. Recall also that there is no alternative for oil in all aspects of its uses. The demand curve for oil would therefore be inelastic, since low elasticity is reflection of constrained substitutability.

There are some other facts to be noticed. First, governments consider energy as a strategic commodity. They usually protect substitutes particularly when their countries are endowed with coal or gas resources or they may become interested in developing a nuclear sector. Secondly, the low demand elasticity for certain petroleum products tempts governments to impose a high tax on the sales of these products. Thirdly, oil producing countries faced with an inelastic demand for oil, and observing that the protection afforded to substitutes in some countries and the high taxes imposed on petroleum products mean that consumers are prepared to pay much more than the low competitive price, would clearly see the possibility of forming a coalition with the purpose of obtaining higher revenues from their oil.

All that justifies to form an OPEC in 1960, as an oligopoly of the Stackelberg type (see Newbery, 1981). Inside OPEC producers divide into two groups, a core and a fringe, while every producer outside OPEC belongs to the fringe. As Mabro (1992) we need to introduce distinction relating to the state of the market which at times is characterized by excess supplies and at times by excess demand. The core has the power to set prices but only when the oil market is slack. When the market is tight, (e.g. in 1973 and 1979-80), prices are set by the market and not by the core producers.

The core producers can set either a supply plan (e.g. since 1987) or a price (between 1973 and 1985). A supply plan must consider the effect it will have on the market price. This means that the core attempts through the supply plan to push the oil price towards a target zone. For any given demand schedule, the resulting price depends on both the core's supply plan and the supplies of fringe producers, all of whom are price takers. The core producers can assume that fringe producers would produce to capacity in the short term, but they cannot ignore the price effect on capacity in the longer term. In practice, this would only be true if they were indifferent to the price that results from their production policies. Therefore, supplies from fringe producers at any point in time are closely determined by the volume of export capacity and by price expectations formed before the capacity comes on stream.

Thus, both supply or price setting approach, are based on the core of OPEC expectations for the volume of *residual demand* for its oil associated with price target zone. As a main complication, it is almost impossible to assess in advance the behaviour of residual demand because the price of crude oil in the market is not the only variable which determines the supply schedule of fringe producers, as mentioned earlier, and the final demand for oil products from which the demand for crude oil derives, that depend mainly on to income growth, excise taxes and various energy policies.

This analysis stresses that residual demand is the critical variable for core producers. It argues that the crude oil price (whether fixed directly or resulting from a production plan) which is the only instrument available for achieving revenue objective, does not regulate residual demand as directly and effectively as cartel theory assume. Residual demand is the difference between global demand and supplies from the fringe both of which are also responsive to several powerful factors other than prices. Thus, supply and demand developments which are only partially influenced by prices will sometimes involve excess demand and at other times low rates of capacity utilization in the core producing and may result in significant price instability.

CHAPTER THREE

MACROECONOMIC FEATURES OF THE IRANIAN ECONOMY

3.1 Introduction

As a result of the oil price shocks, the 1979 revolution, and the eight- year imposed war with Iraq, fundamental changes have occurred in Iran's macroeconomic variables. The data over the period 1979 to 1993 clearly show that the country's dependence on oil exports as a source of foreign exchange and government revenues, has not been reduced significantly. Instead, in the face of falling oil revenues and the country's increasing international isolation with regard to government's unwillingness to use foreign debt, the government has adopted a severe import control policy through selective tariffs and quotas, strict control of private and public imports by means of import licenses, and the direct control of foreign exchange allocation on government agencies. The result has been a high level premium on the U.S. dollar in the *black* (free) market, a highly overvalued *official* exchange rate, a substantial increase in rent-seeking activities at the expense of production, misallocation of resources, and loss of output and industrial capacity.

Some of these developments may have been unavoidable and may be the result of forces outside the control of the government. But the ambiguity of economic system and the lake of effective economic management through the consistent macroeconomic policies, created opportunities for rent-seeking activities with very harmful consequences for the performance of the real economy.

3.2 The Oil impacts on GDP structure

Iran is a significant exporter of oil, accounting for around 13.5 percent of OPEC output and 4.7 percent of world output. Figures 3.1 and 3.2 show the Iranian GDP trend and its components as each sector's percentage contribution to total GDP. In 1993, the share of agriculture, oil, and manufacturing sectors in total GDP, accounted the same percentage around 20 percent and services for another 40 percent. Employment in the agriculture accounts about 22 percent of the total, manufacturing (including oil) 27 percent and services for 51 percent (figure 3.3).

Ever since world war II, revenues from oil exports have played a significant role in the development of the Iranian economy. As figure (3.4), the share of oil exports in Iran's total exports throughout most of the postwar period has been in excess of 85 percent. The oil price rise of 1973-74 brought about a dramatic increase in the share of oil exports, and for the most of the period from 1974 to 1985 oil exports accounted for over 97 percent of total exports. The doubling of oil prices in the period immediately after the revolution helped to maintain the dominance of oil exports in Iran's foreign trade, and it is not until the collapse of oil prices in 1986 that there is a significant decline in the ratio of oil exports to total exports. While important steps have been taken recently to boost non-oil exports, the fall in the share of oil exports over the past few years has been primarily due to the collapse of oil prices. The overall picture, therefore is dependency on oil exports revenues.

Over the post-revolutionary period, 1979-90, because of the war and the collapse of oil prices in 1986, the government has followed the 'import compression' policy whereby imports are programmed annually in a foreign exchange budget to match the government's expected annual foreign exchange revenues from oil and non-oil exports. Under this policy imports are largely determined by the expected availability of foreign exchange reserves and do not necessarily respond to the condition of demand. The real imports of Iranian economy over the period 1983-89 declined by an average annual rate of 12 percent. The degree of import compression in post-revolutionary Iran can also be clearly seen in figure (3.5), where the ratio of imports to gross domestic product (GDP) is given for the years 1974-90. The movement of this ratio (also known as the propensity to import), that fell from its peak of 22.2 percent in 1977 to its all-time low of 8.9 percent in 1988, can be explained by restriction of foreign exchange revenues (figure 3.4) and its impact on structural change that happened in composition of gross domestic product. Of course as figure (3.2) in this period, the structure of GDP has changed because of contraction of the import-oriented sectors (non-services sectors) and expansion of the services sector.

Because of the existence of close dependency between the capital goods imports and domestic investment (figure 3.6), the decline in the share of capital goods imports has had important implications for the country's productive potential, especially in the industrial sector. Between 1979 and 1988 real gross domestic capital formation (both private and government) declined by an average annual rate of 5.1 percent. The fall in the real investment was particularly severe during the years 1985-88, when the import control policy was applied most severely. Over this period real investment fell, on average, by 17.3 percent per annum (figure 3.7). These figures together with the higher than usual rate of capital depreciation experienced during the 1980s because of the war, imply a substantial reduction in the country's capital stock, which would take years to reverse.

Finally, the policy of import compression has not been successful in preventing the deterioration in the balance of payments (figure 3.8). For most years the current account has shown a deficit. The overall cumulative deficit on the current account over the 1980-90 period amounted to 17.6 billion U.S. dollars. This represents around 3.5 percent of Iran's GDP in 1988 and is not a large sum by any standards. However, it highlights the inadequacy of a trade policy based on the control of imports.

3.3 Fiscal policy, Money supply and Inflation

As a main feature of the government's budget structure, and in order to examine the impact of fiscal policy on the domestic economy, it should be considered that a substantial volume of external receipts and payments passes directly through the government's budget. Figure 3.9 shows the components of the government budget, in which oil revenues have continued to play an important role. Over the 1980-93 period, oil revenues have ,on average, accounted for about 50 percent of government's total revenues. This is appreciably below the average figure of 70 percent obtained for the 1971-79. It is also important to note that a large part of the government's non-oil revenues over the past years has indirectly linked to the government's oil revenues. Indeed, the government revenues from oil exports until 1992 have been converted to Rials at the official fixed exchange rate. In 1993, because of devaluation of the domestic currency, the share of oil revenues in total government revenues accounted about 66.3 percent.

The government expenditures highly depends on the oil revenues. A major structural change in government expenditures took place in 1975, after the first oil prices shock, with public sector expenditures not only increasing, but increasing significantly with respect to oil revenues. On the other hand ,as Looney (1986) has argued, while there was a major impact of oil revenues on the government's expenditure patterns, the private sector did not seem to have been affected to a great extent. Therefore, investment opportunities generated by the export sector were in general not fully exploited and that output of most of the non-oil sectors was not responsive to changes in the rate of change in exports.

In Iran economy, monetary expansion has occurred mostly by creation of money in order to finance the fiscal deficit. Figures (3.10) and (3.11) represent the relationship between the government deficit, money supply, and inflation. Continuing rapid growth in government spending resulted in sharp increases in domestic money supply and intensification of inflationary pressures. As the figures, money supply (M1) expanded at an accelerating rate from 1972, reaching a peak growth rate of 60 percent in 1975. The inflation rate accelerated sharply from 4 percent in 1972 to 25 percent in 1976. Consumer price data indicate an inflationary pattern similar to that displayed by money supply, for subsequence periods.

The primary economic objective of Iran, same as other oil exporting countries, since the oil price rises of late 1973 has been to secure rapid growth in the non-oil sectors but the above figures perhaps reflecting the view that longer-term economic and social goals will best be achieved within a framework of reasonable financial stability. Of course, policies to augment aggregate supply have played a considerable role in the recent growth performance (the average growth rate of GDP over the last five years is around 6 percent), but the oil exporters are still characterized by the major features of less developed countries: insufficient infrastructure, limited skilled labour, inadequate developmental institutions, widespread illiteracy, and a large proportion of the population in economic sectors with low productivity. Oil revenues remove the financial constraint to development but does not remove others. In brief, measures to augment aggregate supply involving the easing of key bottlenecks have a critical, but limited, role to play in restoring domestic financial stability. They need to be accompanied by appropriate fiscal and monetary policies.

3.4 Exchange Rate Policy

Over the past decade the Iranian economy has been suffering from serious macroeconomic imbalances. We have already seen that even with the import compression policies implemented by government, it has not possible to stop the deterioration in the country's balance of payments position. And despite government subsidies on food, and other essential consumption goods, consumer prices have been rising at an accelerating rate. The rate of increase in the consumer price index, which had fallen to 6.8 percent in 1985, has been on the increase over since. The consumer price inflation amounted to 23.7 percent in 1986, 27.7 percent in 1987, and 28.9 percent in 1988. It is also important that these figures hide the inflationary pressures that are present in the country, but are currently suppressed through various government rationing schemes and price controls. While some of the main forces behind the macroeconomic imbalances have been outside the control of the government, a major factor contributing to the disequilibrium in the economy has been the inconsistency between the government's macroeconomic policies and the fixed exchange rate regime.

The official exchange rate in Iran has been fixed at Rls 92.3 per one SDR since may 1980. This exchange rate is applied the all government imports and oil exports. In addition to this basic official exchange rate, since 1989 to 1992 the authorities have also introduced a *preferential* rate (Rls 420 = U.S $1) and a *competitive* rate (Rls 800 = U.S $1) that apply to specified imports, and a *service* rate (Rls 845 = U.S $1) that applies to certain categories of invisible such as travel, education, and medical services. All other foreign exchange transaction, whether for invisible imports or capital transfers, are carried out in the free market at a freely floating rate over this period. In 1993, the exchange rate policy changed from fixed to floating regime by unification of fixed and free market exchange rates (Rls 1780 = U.S $1). In early 1994 because of a fall in oil prices and foreign exchange supply, and on the other hand, the monetary consequences of inefficient government fiscal policy, the domestic currency depreciated again dramatically (Rls 2400 = U.S $1). As a policy response to the inflationary consequences of depreciation, floating exchange rate regime changed to a dual exchange rate system and the government followed its import control policy.

Therefore, since 1979 the Iranian economy has experienced the multiple exchange rates. In this exchange rate system, portfolio decisions are strongly influenced by the difference between the free and fixed rates, or the exchange rate premium. As figure (3.12), over the period 1979-90, the premium (the black market rate for U.S. dollar over the official rate) has been rising at an average annual rate of 42.1 percent, and in 1990, the black market rate for the dollar reached its peak at over 20 times the official rate.

The private sector decisions on what proportion of wealth to hold in assets denominated in foreign currency often depend on the expected rate of devaluation of the free rate. Under multiple or dual exchange rate system, even if no current account transactions are subject to the free rate, changes in the free nominal rate will influence the real exchange rate. On the other hand, the system works in almost the same way as a regime of unified predetermined rates, because multiple fixed nominal exchange rates are perfectly equivalent to a unified exchange rate system with taxes on certain external transactions (Dornbusch, 1986a). In this case, inconsistent macroeconomic policies will result in a loss of international reserves and an overvaluation of the real exchange rate.

3.5 The real Exchange Rate Movements

In recent years the distinction between nominal and real exchange rates has been increasingly important. Where as the nominal exchange rate is a monetary concept that measures the relative price of two moneys, the real exchange rate is a real concept that measures the relative price of two goods. The real exchange rate (RER) is defined as the relative price of tradable with respect to non-tradable goods at the same currency. The RER is a good proxy for a country's degree of competitiveness in international markets. Indeed, the RER measures the cost of domestically producing the tradable goods.

The policy literature on real exchange rates uses numerous definitions of the RER (Edwards,1988). Here, the bilateral RER is examined as the relative price of tradable to non-tradable goods, measured in the same currency. In practice, however, these prices need to be proxied by available price indices. So, the consumer prices has been used. As Edwards (1989) explains, this is not ideal, but because our interest is to analyze the RER trend, it seems unlikely that the general conclusion regarding to the trend of RER will be significantly influenced by the particular choice of the proxies for tradable and non-tradable goods.

Figure (3.13) represents the bilateral real exchange rate for the Iranian Rial in terms of the U.S. dollar regarding to the official fixed exchange rate over the period 1971-90. There is a definite downward trend in the RER since 1972, showing a real appreciation of the official rate during the 1972-90. Over the period 1979-90 (post-revolutionary period) a real appreciation of the Iranian Rial is around 12.3 percent per annum, as compared to the figure of 6.6 percent for the 1971-78 period.

The massive overvaluation of the Rial, particularly after 1979, under strict foreign exchange controls, has generated high levels of premia on the black market for dollars, in which there is no any benefits for applicable multiple exchange rate system for the economy. As Dornbusch (1986) has argued the multiple exchange rate system can be used successfully as a strictly transitory policy to offset the unfavourable impact of changes in capital account transactions, if the official and the black market rates are not allowed to diverge significantly for any length of time. Figure (3.14) shows the Iranian real exchange rate regarding to free rate in the black market over the period

1979-90. The divergency of official from the black market rate, as a marginal rate, is too significant. In this case the economic system becomes subject to serious microeconomic as well as macroeconomic distortions.

This misalignment as arguments of Krueger (1978) and Edwards (1985c), has created extensive opportunities for rent-seeking activities and result in considerable misallocation of resources. The high level of the black market premium have had important adverse consequences for the real economy and have made the task of controlling import costs through a policy of maintaining a fixed official exchange rate impossible. Over the past decade about 95 percent of the country's foreign exchange revenues has been achieved by government. In countries, where the government is a net purchaser for of foreign exchange, high levels of the black market premia cannot be sustained for long as exports turn to smuggling and other illegal means to avoid surrendering their export proceeds to the authorities. Eventually the redistribution of rent from exporters to importers will be occurred. Furthermore, in case of imperfect Iran's local capital market, RER misalignment also has promoted speculation and usually generates massive capital flight out of the country, that it can substantially reduce the social welfare (cuddington, 1986).

The important point about trend of RER is that the real appreciation started after first oil price rising in 1973 and continued in the post-revolutionary period that was accompanied by second oil price shock. The consumer prices over the period 1970-78 (before revolution) and over the 1979-90 has been rising by an average annual of 12.3 and 18.4 percent, respectively, while the average annual growth rate of consumer prices of G7 countries (as a foreign prices index), over the same periods is 8 and 4.7

percent (figure 3.15). Hence, one of the paradoxical features was that the Iranian economy as a net exporter of oil (same other OEDCs), experienced considerable problems adjusting to the oil prices increase which, on standard microeconomic grounds, should have made the economy better off. These adjustment problems often took the form of a decline in the level of activity in the non-oil export-oriented and import-competing manufacturing, agricultural and even service sectors. Conversely, industries that cater for the home market as a result of trade protection or that possess monopolistic price-setting powers in their export markets may benefit from the rise in home demand. This experience is now commonly referred to as the *Dutch Disease*, whereby a booming resource sector is presumed to lead a contraction of the non-boom sector via the loss of *competitiveness* due to appreciation of the domestic currency. It must be emphasized that a necessary condition for reestablishing real exchange rate equilibrium is ending the inconsistent macroeconomic policies that generated the overvaluation.

Figure 3.1

Gross Domestic Product

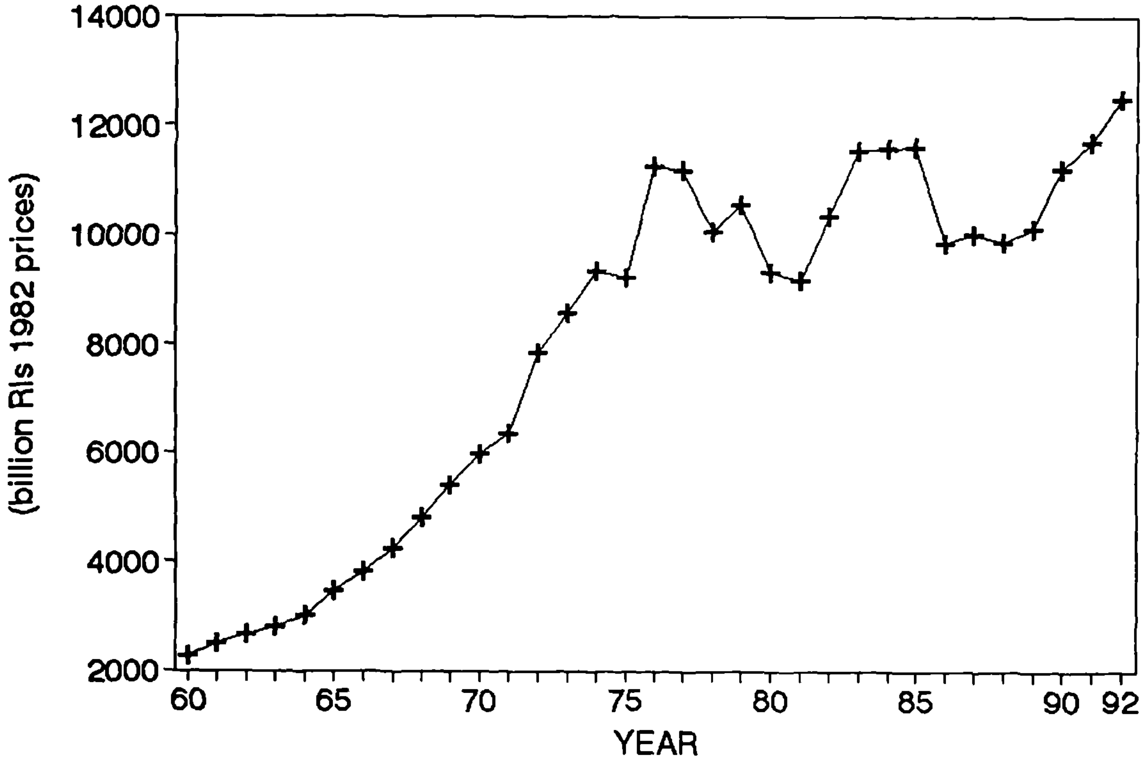
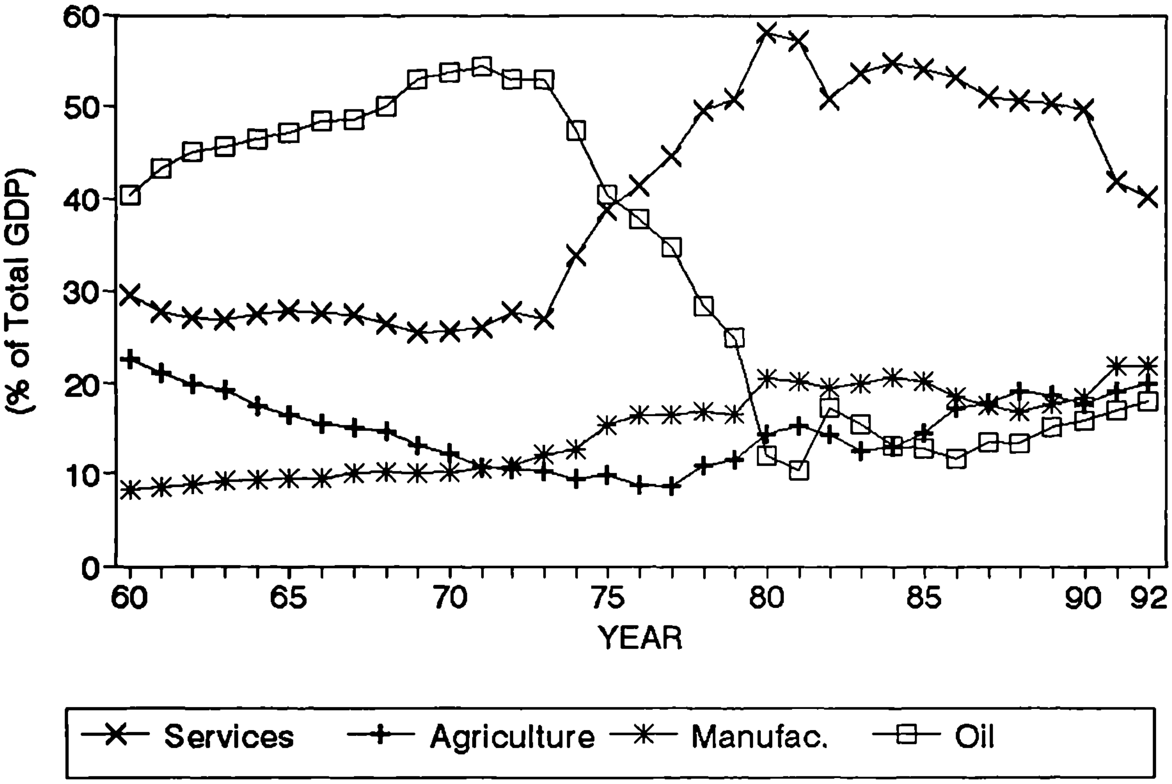


Figure 3.2

Components of GDP



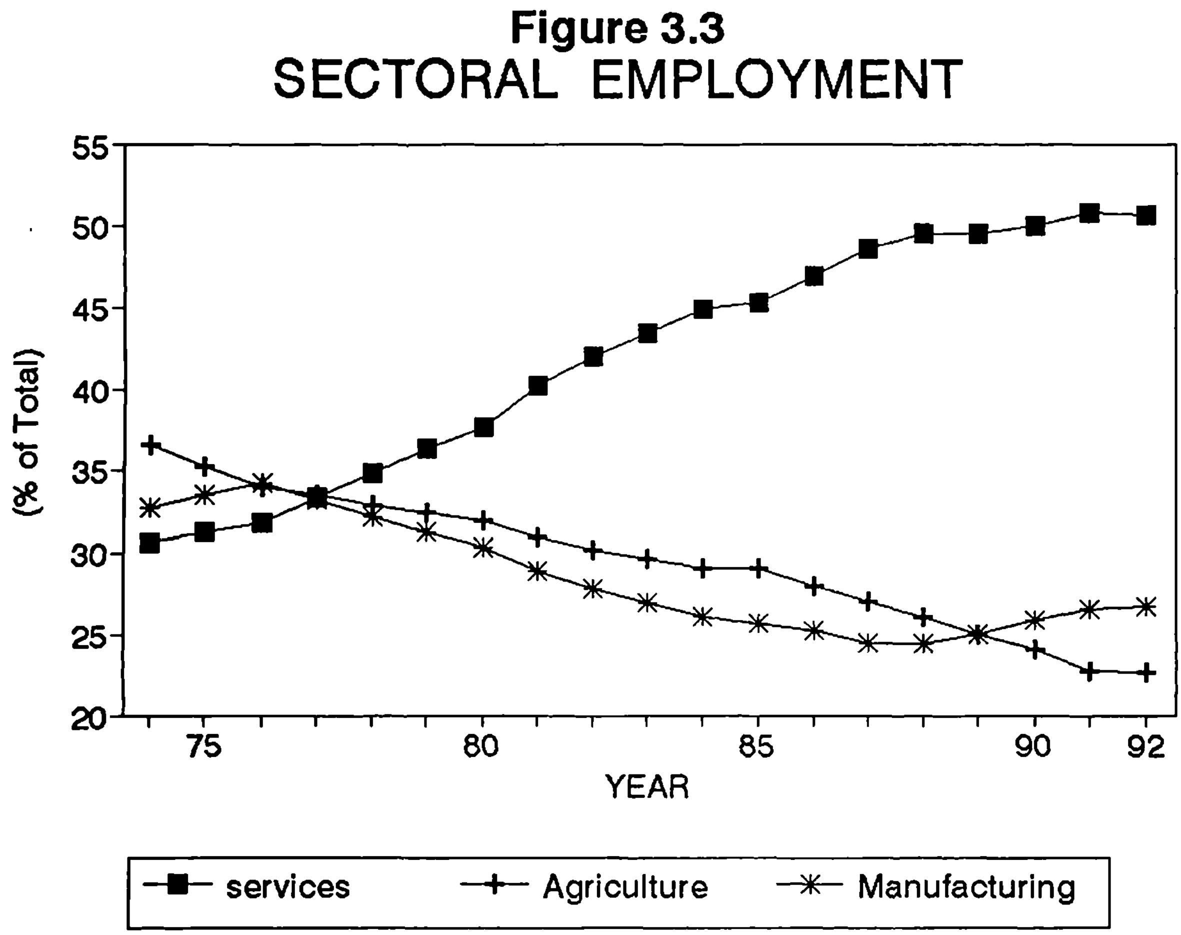


Figure 3.3
SECTORAL EMPLOYMENT
55
50
45
40
35
30
25
20
(% of Total)
75
80
85
90
92
YEAR
services
Agriculture
Manufacturing

Figure 3.4
EXPORTS

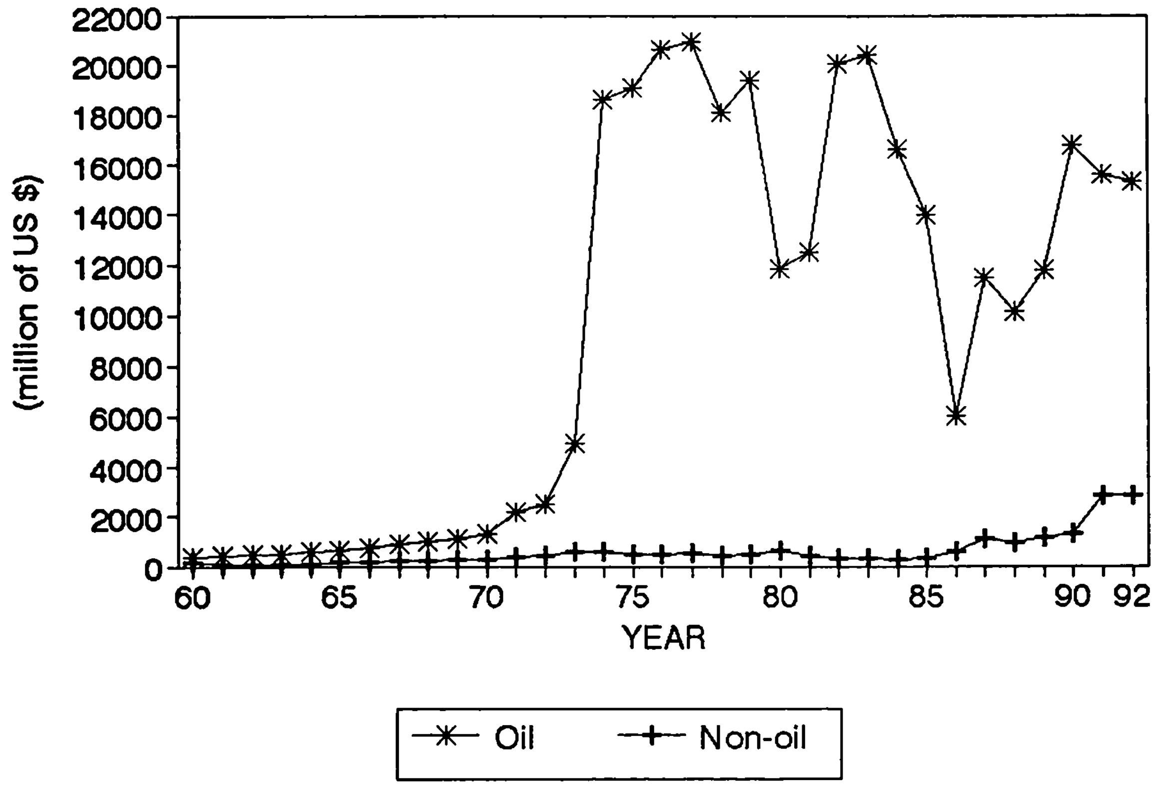


Figure 3.5
IMPORTS

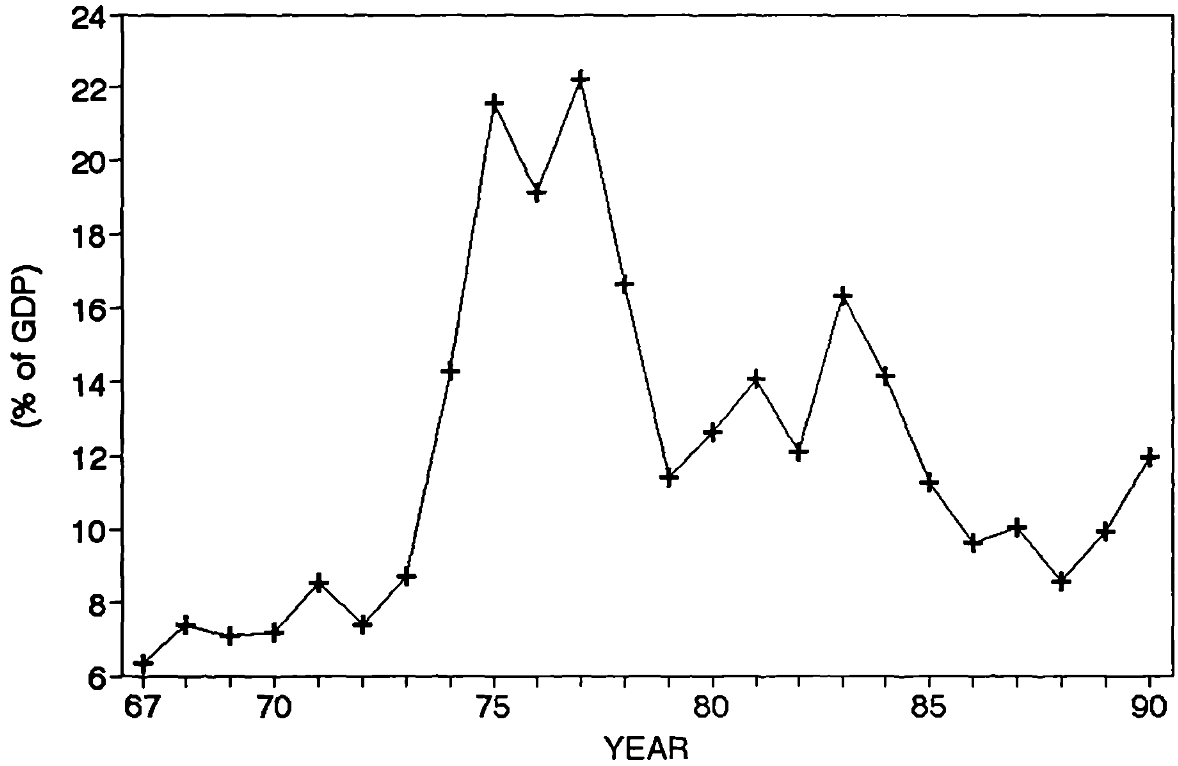


Figure 3.6

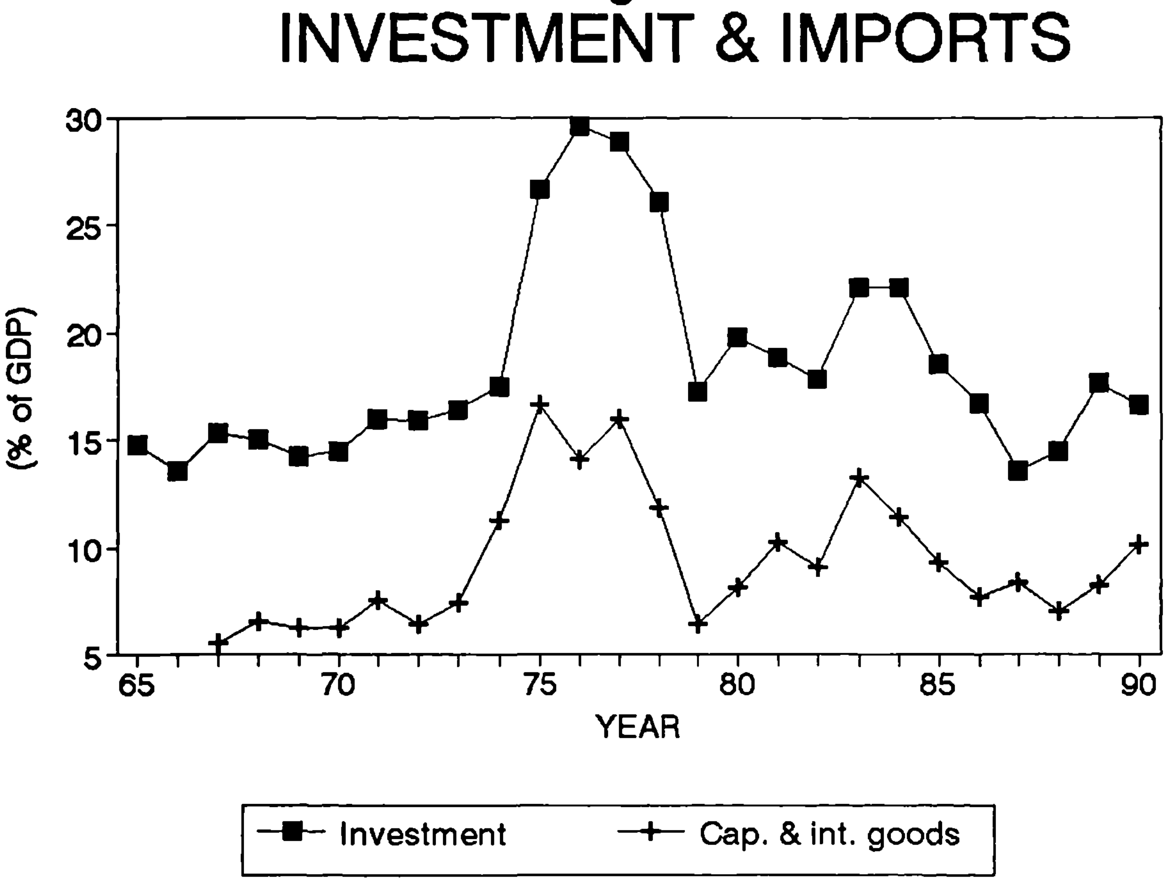

INVESTMENT & IMPORTS
30
25
20
15
10
5
(% of GDP)
65
70
75
80
85
90
YEAR
Investment
Cap. & int. goods

Figure 3.7

TOTAL INVESTMENT

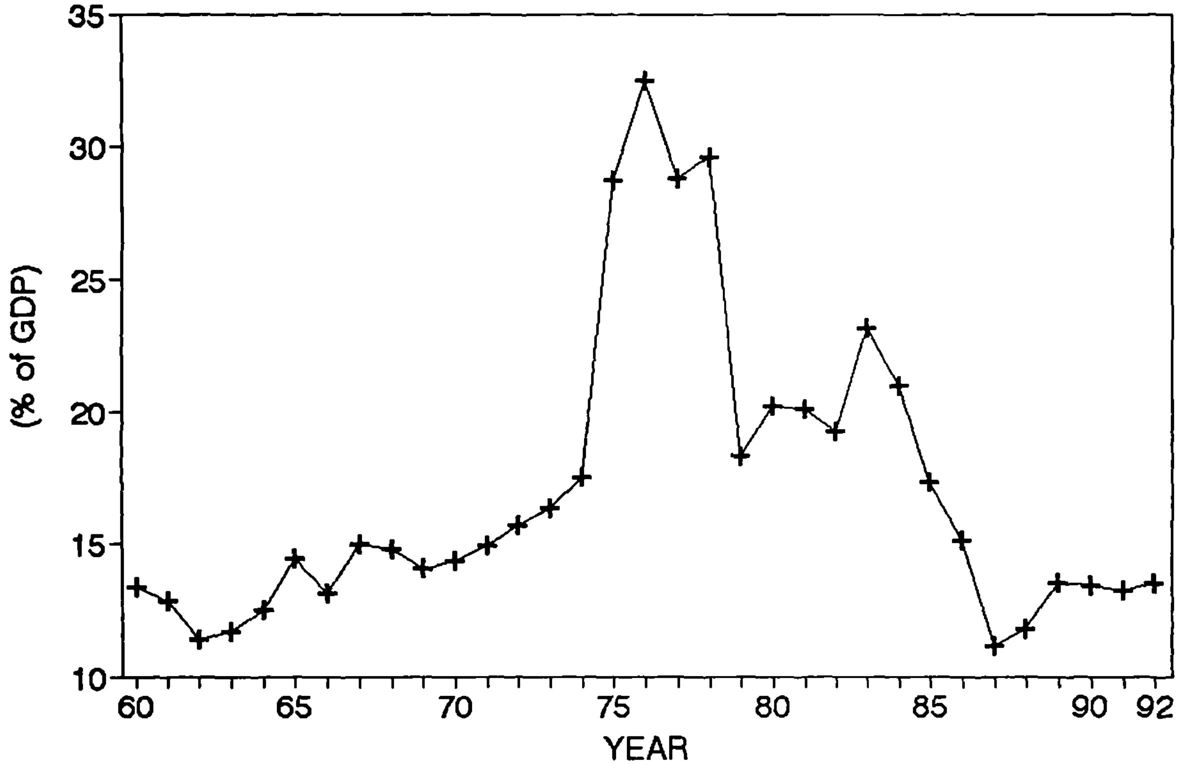


Figure 3.8

CURRENT ACCOUNT (including TOT)

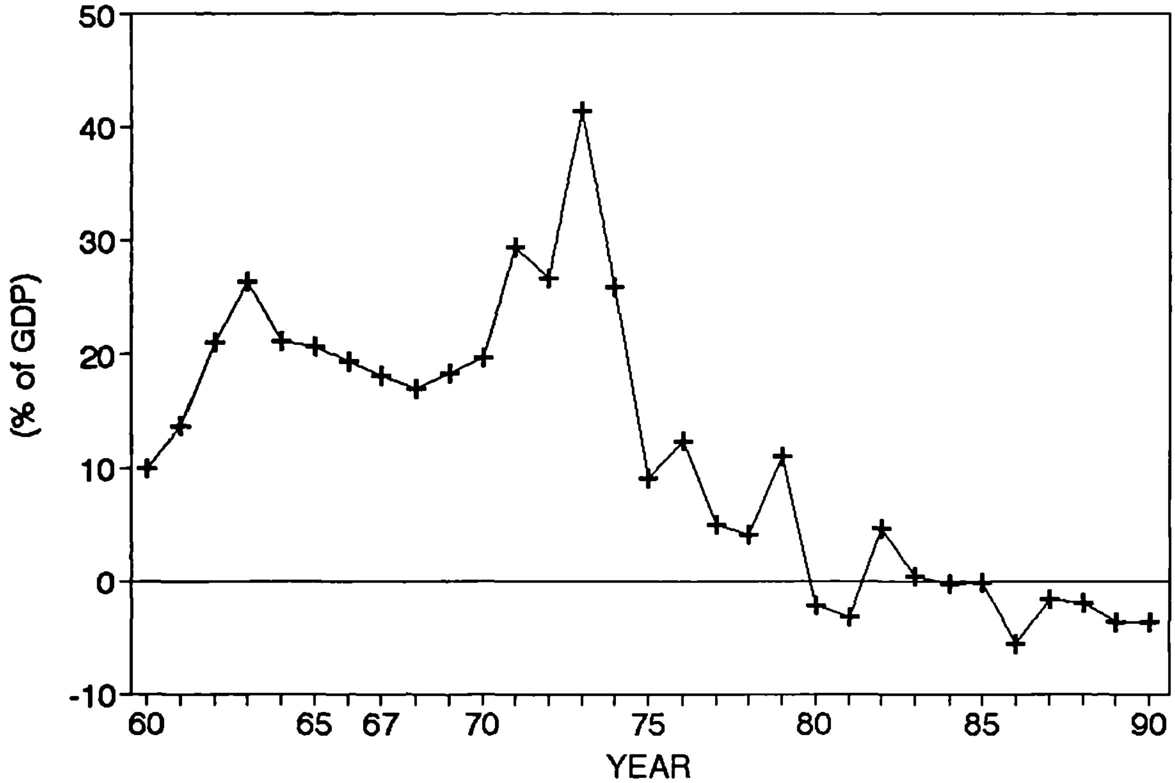


Figure 3.9

Components of Gov. Budget

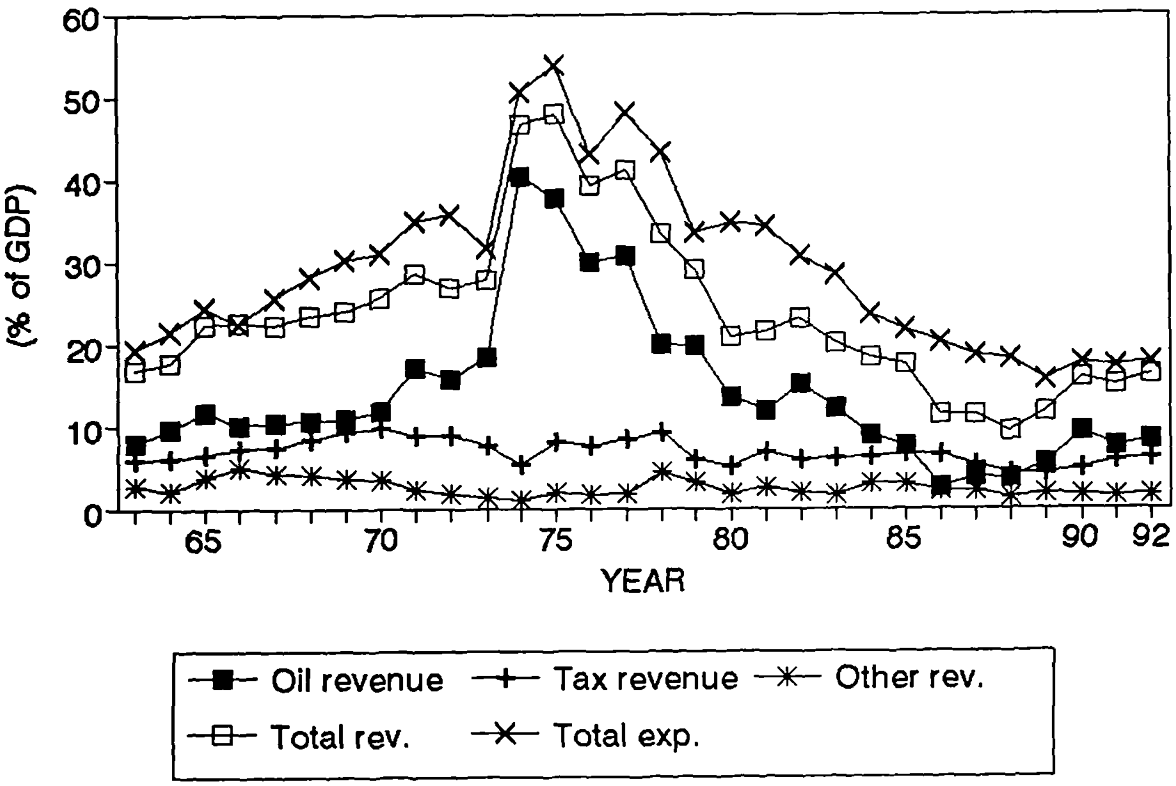


Figure 3.10

MONETARY BASE

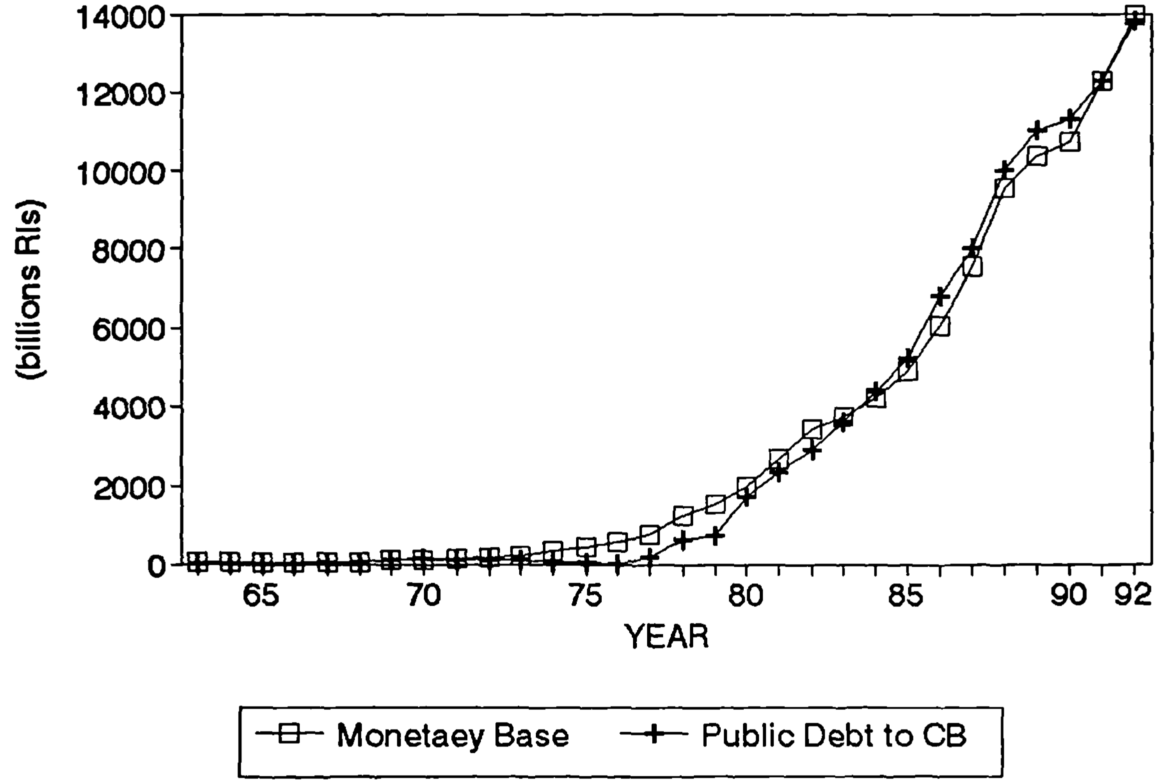


Figure 3.11
MONEY SUPPLY & INFLATION

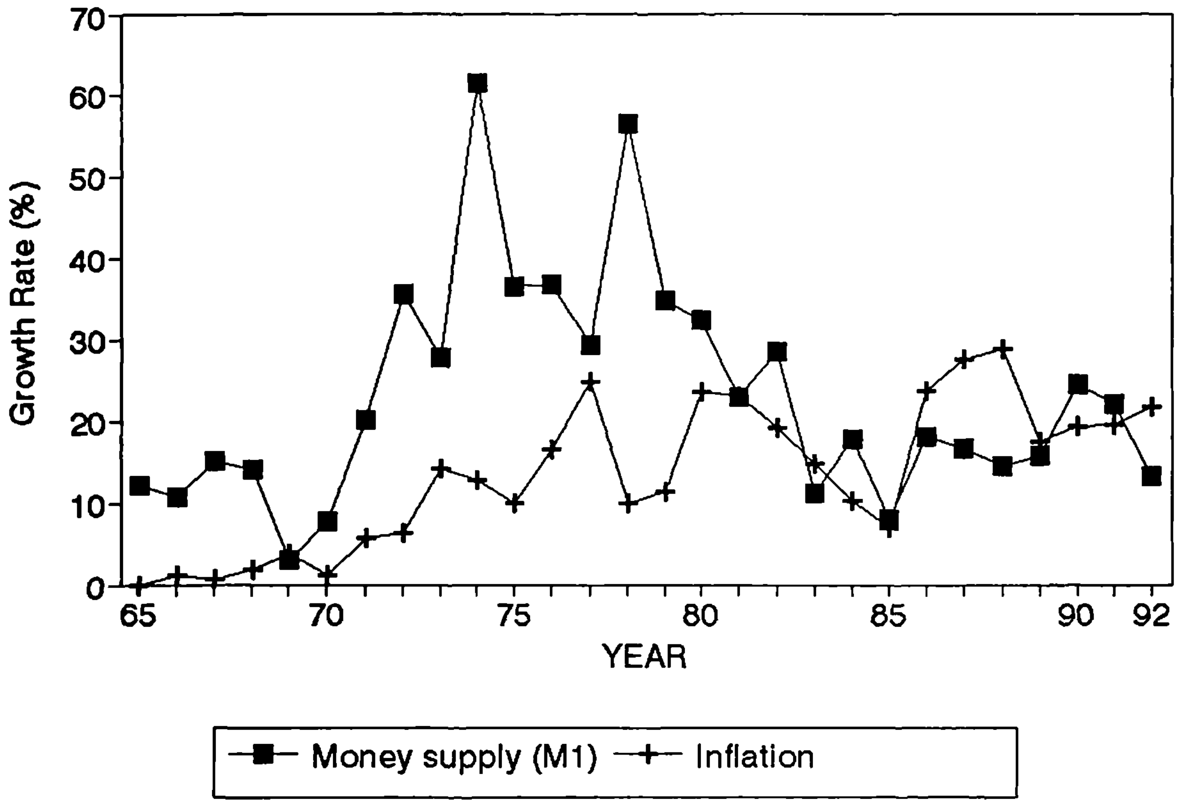


Figure 3.12
FREE MARKET EXCHANGE RATE PREMIUM

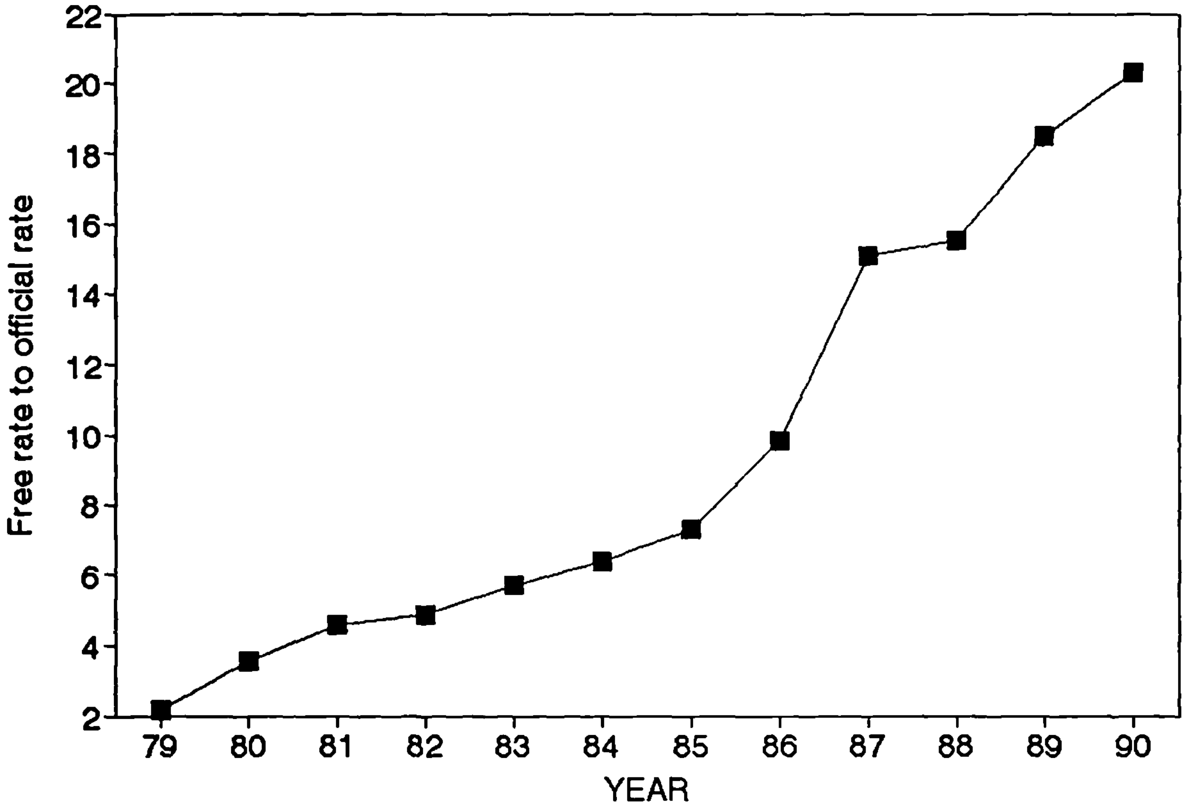


Figure 3.13

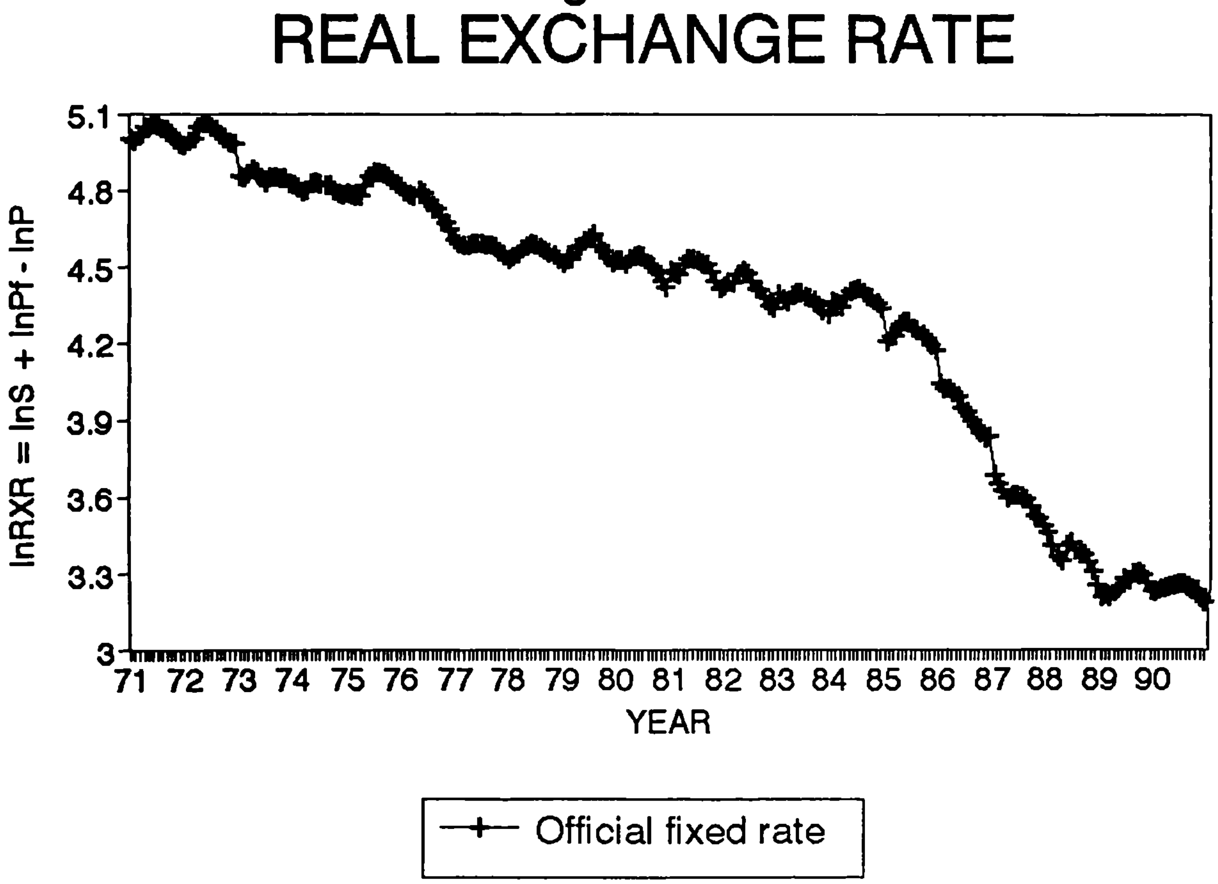

REAL EXCHANGE RATE
lnRXR = lnS + lnPf - lnP
5.1
4.8
4.5
4.2
3.9
3.6
3.3
3
71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
YEAR
Official fixed rate

Figure 3.14
REAL EXCHANGE RATE

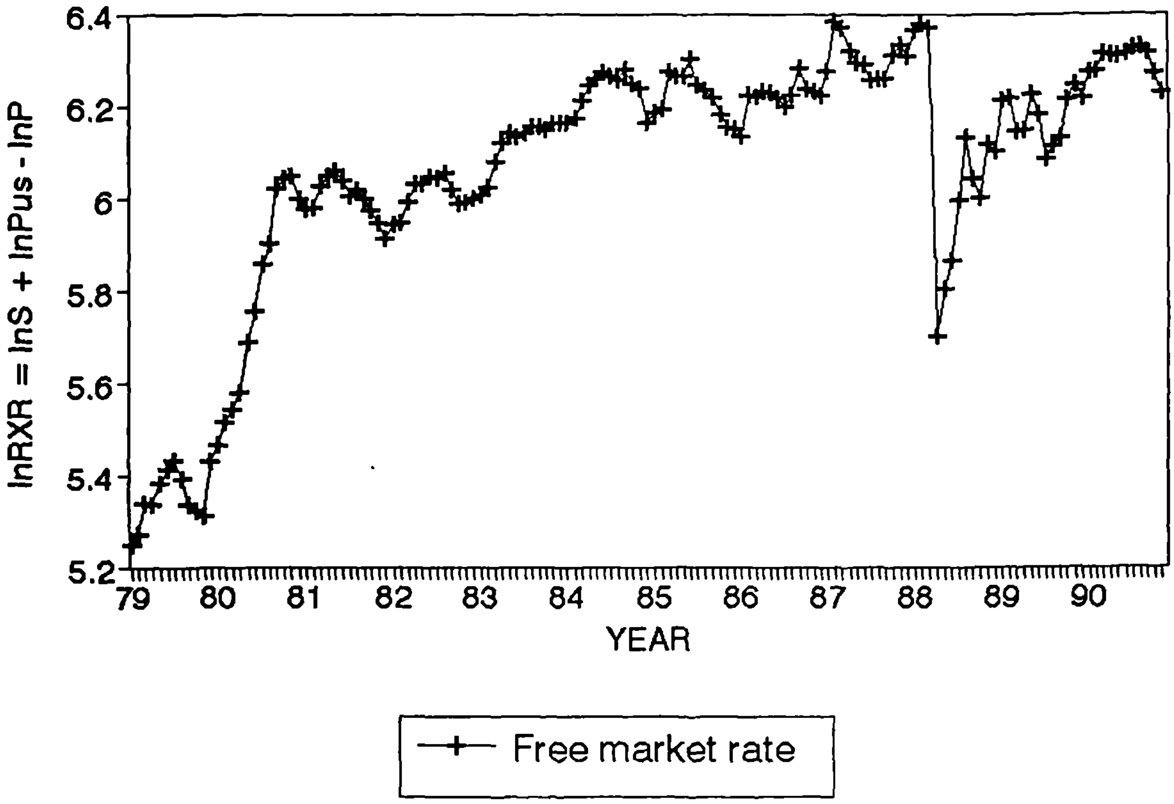
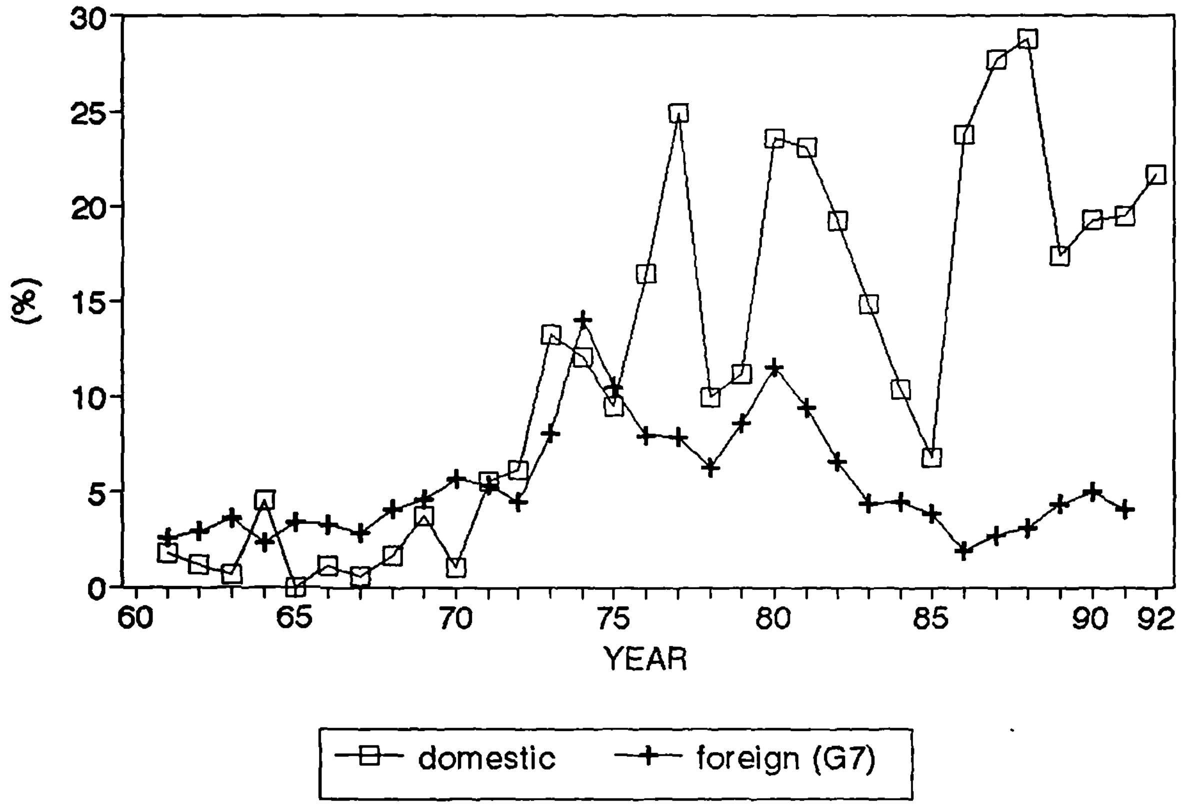


Figure 3.15

DOMESTIC & FOREIGN INFLATION



CHAPTER FOUR

STRUCTURE OF THE IRANIAN MACROECONOMIC MODEL UNDER RATIONAL EXPECTATIONS

4.1 Introduction: Model listing

The model's basic structure can be described in familiar macroeconomic terms. There is a demand (IS) curve and a supply or Phillips (PP) curve for goods; a demand (LM) curve and a supply curve for money (MS). The nature of the Phillips curve is contract-based derivation under rational expectations, in which wages are set one period ahead by contract but prices adjust flexibly. The duall exchange rates system, (official and parallel market rates), is considered as an exchange rate policy. Uncovered interest parity with the rational expectations solution determines the real interest differential as a fraction of the parallel real exchange rate. The oil supply plan is consistent with the oil price target, for any demand schedule. The oil residual demand, that depends on exogenous variables and are imperfect correlated with the oil prices, is the critical variable for OPEC or the core producers, thus, the oil market is most competitive when the market is tight and OPEC plays an effective role when the market is weak by directing the oil price towards a target level or zone.

Terminal conditions are used for selecting the unique stable path. It is assumed that all markets clear in each (annual) period. Hence the model belongs to the equilibrium or ′new classical′ class of rational expectations models.

We begin by listing the model's structure in detail (Table 4.1).

Table 4.1: Model listing

Aggregate demand

$$y = c + \Delta g + \delta\, g_{-1} + eg + (x - Im) + tot \quad (4.1)$$

Non-durable consumption function

$$\log c = C0 + C1.\log c_{-1} + C2.\log w + C3.E\log (y/y^*)_{+1} + C4.r_l \quad (4.2)$$

Demand for physical assets

$$\log g = G0 + G1.\log g_{-1} + G2.\log \theta + G3.E \log (y/y^*)_{+1} + G4.r_l \quad (4.3)$$

Government budget constraint

$$psbr = eg - T.y - Oil_R / p - \alpha.y + RDI \quad (4.4)$$

Government expenditure

$$\Delta \log eg / y = E0 + E1.\Delta \log (eg / y)_{-1} \quad (4.5)$$

Government oil revenues in terms of Rial

$$Oil_R = (1 - \gamma) . Oil_D . S_{of} + \gamma . Oil_D . S_f \quad (4.6)$$

Government oil revenues in terms of Dollar

$$Oil_D = Oil_x . Oil_p \quad (4.7)$$

Real debt interest

$$RDI = R_l . b + R_{fl} . b_f \quad (4.8)$$

Financial assets

$$\theta = \theta_{-1} + psbr - \Delta b_f - DEVAL_\theta - DEVAL_f \quad (4.9)$$

Table 4.1: Continued.

Financial assets devaluation

$$DEVAL_{\theta} = b_{-1} . (\Delta \log p + \Delta R_l) + m_{-1} . \Delta \log p \quad (4.10)$$

$$DEVAL_f = b_{f\,-1} . (\Delta \log p_f + \Delta \log RXR + \Delta R_{fl}) \quad (4.11)$$

Money Demand

$$\log m = D0 + D1 . \log m_{-1} + D2 . \log y + D3 . R_s \quad (4.12)$$

Money Supply

$$\Delta \log M = S0 + S1 . \Delta \log MB \quad (4.13)$$

Monetary Base

$$\log MB = M0 + M1 . \log MB_{-1} + M2 . \log CBLP \quad (4.14)$$

or $\Delta MB = M0 + M1 . \Delta CBLP + M2 . \Delta CBFA$

Central Bank net Loans to Public Sector

$$CBLP = CBLP_{-1} + PSBR \quad (4.15)$$

Central Bank net Foreign Assets

$$CBFA = CBFA_{-1} + XM \quad (4.16)$$

Price level

$$\Delta \log p = \Delta \log M - \Delta \log m \quad (4.17)$$

Wealth identities

$$w = g + \theta \quad (4.18)$$

Government bonds

$$b = \theta - m \quad (4.19)$$

Table 4.1: Continued.

Total Export

$$x = Oil_R / p_{oil} + Noil_x \tag{4.20}$$

Oil Export

$$\log Oil_x = O0 + O1.\log y_f + O3.\log p_{oil} \tag{4.21}$$

Non-Oil export

$$\log Noil_x = N0 + N1 . \log (Noil_x)_{-1} + N2 . (1 - \beta) . \log RXR_{of} + N3 . \beta . \log RXR_f \tag{4.22}$$

Import

$$\log Im = I0 + I1.\log y + I2.\log RXR_w \tag{4.23}$$

Current Account (including Terms of Trade)

$$xm = x - Im + tot \tag{4.24}$$

Balance of Payments

$$\Delta b_f = -xm - DEVAL_f \tag{4.25}$$

Terms of Trade

$$\mu = (Oil_R / p_{oil}) / \left[(Oil_R / p_{oil}) + Im \right] \tag{4.26}$$

$$p_w = \mu . p_{oil} + (1 - \mu) . p_f \tag{4.27}$$

$$tot = \left[(Oil_R - Im .p_f) / p_w \right] - \left[(Oil_R / p_{oil}) - Im \right] \tag{4.28}$$

Weighted average of Real Exchange Rates

$$\log RXR_w = R0 + R1.\log (RXR_w)_{-1} + R2 . \log (y/y^*) + R3 . \log (y/y^*)_{-1} + R4.\log RW \tag{4.29}$$

Table 4.1: Continued.

Free Market Real Exchange Rate

$$\log RXR_f = \left[\log RXR_w - (1 - \sigma) \,.\, \log RXR_{of} \right] / \sigma \qquad (4.30)$$

Free Market Nominal Exchange Rate

$$\log S_f = \log RXR_f - \log p_f + \log p \qquad (4.31)$$

Official Real Exchange Rate

$$\log RXR_{of} = \log S_{of} + \log p_f - \log p \qquad (4.32)$$

Official Nominal Exchange Rate

$$\Delta \log S_{of} = S_0 + S_1 \,.\, \log P_{oil} / P_f$$

Real Wage

$$\log RW = W0 + W1.\log RW_{-1} + W2.\log u + W3.(\log p - E \log p) \qquad (4.33)$$

Unemployment

$$\log u = U0 + U1.\log prod + U2.\log wpop + U3.\log RW + U4.\log y \qquad (4.34)$$

Capital Asset Pricing

$$r_{fl} = r_{\$l} + \lambda.(b_f / y) \qquad (4.35)$$

$$r_{fs} = r_{\$s} + \lambda.(b_f / y) \qquad (4.36)$$

$$r_l = r_{fl} + \left[E (\log RXR_f)_{+5} - \log RXR_f \right] / 5 \qquad (4.37)$$

$$r_s = r_{fs} + \left[E (\log RXR_f)_{+1} - \log RXR_f \right] \qquad (4.38)$$

$$R_s = r_s + E \,\Delta \log p_{+1} \qquad (4.39)$$

$$R_l = r_l + E \left[\Sigma \;\; \Delta \log p_{+i} / 5 \right] \qquad (4.40)$$

Table 4.1: Continued.

Equilibrium equations:

Output

$$\log y^* = Y0 + Y1.t \tag{4.41}$$

Real Exchange Rates

$$\log RXR_w^* = (R0 + R4.\log RW^*) / (1 - R1) \tag{4.42}$$

Real Wage

$$\log RW^* = (W0 + W2.\log u^*) / (1 - W1) \tag{4.43}$$

Unemployment

$$\log u^* = U0 + U1.\log prod + U2.\log wpop + U3.\log RW^* \tag{4.44}$$

Government Policy:

$$\Delta\ (eg/y) = u_1 \tag{4.45}$$

$$\Delta\ T = u_2 \tag{4.46}$$

$$\Delta \log M^* = \Delta \log p^* + \Delta \log y^* \tag{4.47}$$

$$\Delta \log p^* = (psbr_T / \theta_T) - \left[(\theta_T + b_{fT}) . (\Delta \log y^* / \theta_T) \right] - (b_{fT} / \theta_T) \Delta \log p_{fT} \tag{4.48}$$

Table 4.1: Continued.

Exogenous variables:

Tax Rate

$$\log T = T0 + T1.\log T_{-1} \qquad (4.49)$$

Working Population

$$\Delta\log wpop = P0 + P1 \,.\, \Delta\log wpop_{-1} \qquad (4.50)$$

Labour Productivity

$$\Delta\log prod = L0 + L1 \,.\, \Delta\log prod_{-1} \qquad (4.51)$$

Oil Price

$$\Delta\log (p_{oil} / p_f) = p0 + p1 \,.\, \Delta\log (p_{oil} / p_f)_{-1} \qquad (4.52)$$

Foreign Prices

$$\Delta\log p_f = F0 + F1 \,.\, \Delta\log (p_f)_{-1} \qquad (4.53)$$

Real Long and Short-Run US Interest Rates

$$r_{\$l} = r0 + r1 \,.\, (r_{\$l})_{-1} \qquad (4.54)$$

$$r_{\$s} = r3 + r4 \,.\, (r_{\$s})_{-1} \qquad (4.55)$$

Table 4.1: Continued.

Variable Definitions:

Δ	Difference operator
log	Natural logarithm
*	Equilibrium value of model
$E_{-j}\,(x_{+i})$	Rational Expectation formed at time t-j on information available, of x at time t+i
y	Real gross domestic product (1982 prices)
c	Private sector non-durable consumption(1982 prices)
δ	Depreciation rate
g	Private sector stock of physical assets(1982 prices)
eg	Government spending (1982 prices)
xm	Trade balance including terms of trade effects
RXR_w	Weighted average of free market and official real exchange rates
RXR_{of}	Official real exchange rate
RXR_f	Free market real exchange rate
S_{of}	Official nominal exchange rate (Rials per US Dollar)
S_f	Free market exchange rate (Rials per US Dollar)
α	Other government revenues to GDP
β	= 0 for 1967-86, = 1 for 1987-...
γ	Proportion of Gov. oil revenue ($) converted by free market exchange rate

Table 4.1: Continued.

σ	Proportion of imports valued by free market ER
w	Total private sector wealth (1982 prices)
Rs , rs	Nominal,Real short-run interest rate
Rl , rl	Nominal,Real long-run interest rate
$Noil_x$	Real non-oil exports (1982 prices)
Im	Real goods imports (1982 prices)
θ	Private sector financial assets (1982 prices)
psbr	Public sector borrowing requirement (1982 prices)
T	Overall tax rate
Oil_R	Gov. Oil revenue in terms of Rial
Oil_D	Gov. Oil revenue in terms of Dollar
Oil_x	Annual volume of oil exporting (million barrels)
P_{oil}	Oil price index (1982=100)
Oil_p	Oil price ($ per barrel)
b	Government bonds
b_f	Foreign debt
m	Real money (m1) (1982 prices)
M	Money supply (M1)
p	Price level on domestic goods (1982=100)
p_f	Foreign (G7) consumer price index (1982=100)
y_f	Foreign (G7) GDP

Table 4.1: Continued.

R_{fs} , r_{fs}	Foreign nominal, real short-run interest rate (to be paid on foreign debt)
R_{fl},r_{fl}	Foreign nominal, real long -run interest rate (to be paid on foreign debt)
$r_{\$l}$,$r_{\$s}$	Real long and short US interest rate
RW	Real wage rate, (1982=100)
u	Unemployment in '000.
prod	Labour productivity (1982=100)
$deval_{\theta}$	Private financial assets devaluation
$DEVAL_f$	Foreign debt devaluation
wpop	Working population in '000.
u_i	Error processes
T	subscript denotes value at terminal date
t	time (years)
tot	terms of trade
RDI	Real debt interest
MB	Monetary base
CBLP	Central bank net loans to public sector
CBFA	Central bank net foreign assets

4.2 Aggregate Demand (The IS curve)

Equations (4.2), (4.3), (4.5) and (4.24) determine the components of demand which then enter Equation (4.1), the GDP identity, to give the IS curve. Equation (4.2) relates non-durable consumption, c, to total wealth, w, expected future income, according to forward expected deviation of income (y) from its natural rate (y*), and real interest rates, r_l.

As Keynes's theory (1936), the level of real disposable income is the most important determinant of consumption. Therefore, according to this theory, consumption depends on income such that, for a given rise in income, consumption will rise by some fraction of the rise in income. As a result of a great statistical work, it was discovered that there is an important difference in the relationship between consumption and income in the short run as compared with the long run. The long-run data revealed that consumption is proportional to income. The short-run data revealed that although consumption and income move in the same direction, the relationship between two is not proportional.

This problem led to a more refined formulation of the theory of the consumption function by Friedman (1957) who developed the *permanent income hypothesis* and Modigliani (1975) who developed the *life-cycle hypothesis*. These two contributions, that have more similarities, may be reasoned through borrowing and lending. By recognizing of this possibility, Modigliani and Friedman suggested that the ultimate constraint on how much consumption an individual can undertake is the amount of that individual's wealth. In the Modigliani's version of the theory the individual attempts to smooth out the path of consumption over the lifetime, even though income received would vary from year to year. In Friedman's version of the theory, families are assumed to live forever and seek to smooth consumption both over lifetimes of individual family members and across generations.

Because of connection between income and wealth, the life-cycle and permanent income hypotheses of consumption are generalizations of the Keynesian theory. They both say that consumption depends on current disposable income and on all future (discounted) disposable income. Other things being equal, the larger that current disposable income is, the larger wealth is, and the greater will be the level of consumption. The larger that future disposable income is, other things being equal, the larger wealth is, and the greater will be current consumption. As a result, stock of wealth and forward expected future output have main roles in specification of the consumption function of the model.

Equation (4.3) relates the stock of goods demanded, g, (including fixed capital, consumer durable goods, and inventories) to the stock of financial assets, θ, forward expected future output deviation from its natural rate, y/y^*, and long run real interest rate. This ´portfolio balance´ formulation stresses the role of goods as a way of holding wealth rather than as a productive instrument.

Equation (4.5) is a simple autoregressive equation for the government spending on goods and services.

Equations (4.21), (4.22), and (4.23) determine the components of foreign trade which then enter Equation (4.24), the current account identity. Total real export (4.20), is given by oil export, deflated by oil price index, and non-oil export. Equation (4.21), the oil export in volume terms, represents a reduced form of supply and demand functions for the Iranian crud oil export that is related to the world gross domestic product and the real oil price. Here the assumptions about the oil price and supply determination are based on the results of Chapter two. OPEC is not a sophisticated cartel, nevertheless, has a major influence on the oil market because it dominates the supply side and, in most circumstances, can reduce or increase supplies on a significant scale. This means that the core attempts through the supply plan to affect the oil price towards a target level or , more realistically, towards a target zone. The oil market has the freedom to let prices fluctuate in response to news, to occasional imbalances between supply and demand, or to arbitrary operations of trading games, but it does not have the freedom to bring prices down to the competitive cost floor. As a result of this behaviour when the oil market is tight the oil prices are set by the market. The core of OPEC has the power to set prices only when the oil market is slack.

Equation (4.52) assumes a long term path for the oil price in which its growth rate is same with the foreign inflation. In other words the long term real oil price is constant. This implies the price path (as a target level or a target zone) consistent with expectations, based on the past market behaviour, about the future volume of residual demand[11] given demand schedules and the production of the fringe producers. It is almost impossible to predict the behaviour of residual demand when setting a price or a price target. Residual demand is affected by exogenous variables, (e.g. political, war, unexpected changes in the volume of production capacity of fringe producers,

[11] As Chapter two, residual demand is the difference between global demand and supplies from the fringe both of which are also responsive to several powerful factors rather than prices.

unexpected changes in the final demand for oil products from which the demand for crude oil derives), which are partially influenced by the crude oil price.

According to the Iranian exchange rate policy, as it was described in Chapter three, the economy has experienced the dual exchange rates system since 1979. All government imports and oil exports are valued by the official exchange rate, where other foreign exchange transaction such as some private sector imports, non-oil exports (since 1987) and capital transfers are carried out in the free market. Hence, Equation (4.23) relates the total real imports to the output and the weighted average of official and free real exchange rates, RXR_w;

$$RXR_w = \sigma . RXR_f + (1 - \sigma) . RXR_{of} \tag{4.56}$$

Non-oil exports, Equation (3.22), is determined by the official real exchange rate over the period 1979-86 ($\beta = 0$), and the free real exchange rate since 1987 ($\beta = 1$).

The most important parameter (σ) for finding out of the weighted average of dual exchange rates is the proportion of total imports that is priced by free market rate. The movement of domestic import goods prices (p_m) can be considered for this purpose. Assuming an exponential averaging for domestic import price, p_m may be written as:

$$p_m = A (S . p_f)^{1-\sigma} . (E . p_f)^{\sigma} . e^{u} \tag{4.57}$$

where A is a fixed parameter, S and E are the official and free exchange rates, respectively, and p_f is the foreign price index. An estimated of a σ may be obtained from the simple log-linear equation as:

$$\log (p_m / S.p_f) = \log A + \sigma . \log (E / S) + u \tag{4.58}$$

4.3 The supply-side of the model (The PP curve)

The supply side of the model is given by Equations (4.29), (4.33), and (4.34). Equation (4.29) is a Phillips curve for the open economy that relates the real exchange rate to the real wage, the output deviation from equilibrium and the adjustment cost term. For derivation of this equation first the *perfect competition* model of current account, following Minford (1992), is described briefly and then we turn to underpinning of the Phillips curve via goods and labour markets.

Figures 4.1 and 4.2 explain the perfect competition open economy supply curve. In this model we take non-traded goods prices, P_{NT}, as given; traded goods prices, P_T, are of course set by world market conditions. We assume that a devaluation, not offset fully by a rise in home prices, will rise P_T relative to P_{NT}. So, domestic demand (D) for traded and non-traded goods depends on relative prices, P_{NT}/P_T.

Figure 4.1 shows the demand for labour by traded and non-traded goods industries, where the non-traded demand is assumed to be more elastic than the traded and the capital stock is given. Suppose:

$$\pi = P_{NT}^{1-\alpha} \, . \, P_T^{\alpha}$$

$$W/\pi = (W \, / \, P_{NT}).(P_{NT} \, / \, P_T)^{\alpha} \quad \text{and}$$

$$W/\pi = (W \, / \, P_T).(P_{NT} \, / \, P_T)^{-(1-\alpha)}$$

where π is a weighted average of traded and non-traded goods and P_{NT}/P_T is the real exchange rate, e. As e rises, at a given W/π, the real producer wages relative to the real consumer wages rise for the traded goods sector, to w'_T, but fall for the non-traded sector, to w'_{NT}. Overall, the demand for labour rises. Finally, we use figure 4.2 to drive the supply (OS) and current account (XM) curves. The XM curve is derived

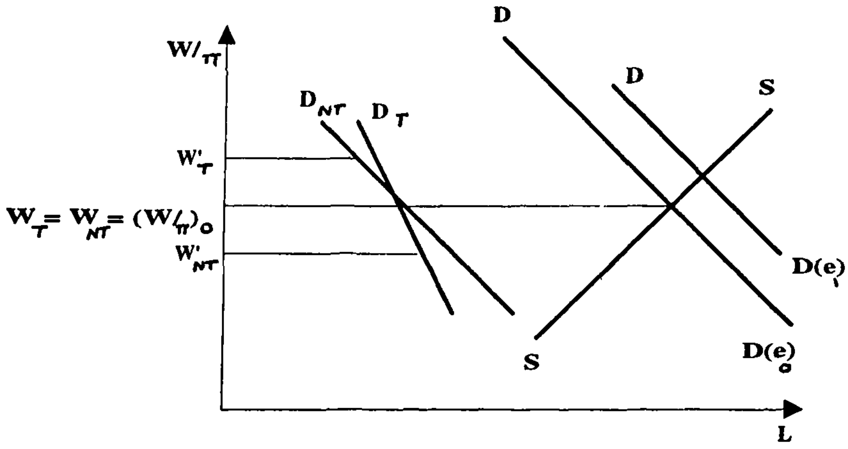


Figure 4.1 The labour market under perfect competition model

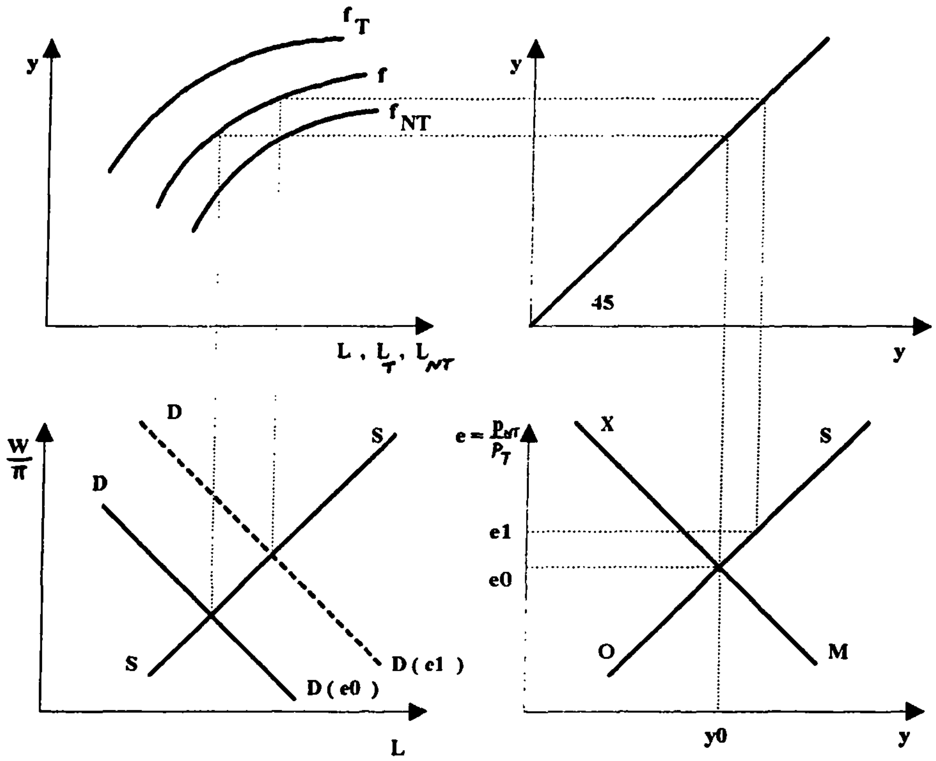


Figure 4.2: Supply-side of the economy under perfect competition model.

by varying D and tracing out the e values for which there is intersection between demand and supply for traded goods (current account equilibrium). According to figure 4.2, we can draw the relationship as between e and y. General equilibrium is at the intersection of the XM and OS curves. Therefore, the Phillips curve for an open economy may be written as:

$$y = y^{*} + \delta_1 (p - E_{-1} p) + \delta_2 (e - e^{*}) + \delta_3 (y - y^{*})_{-1} \tag{4.59}$$

The Phillips curve:

contract-based derivation with flexible price

Equation (4.59), with some partial relationship between output deviations from equilibrium, $y - y^{*}$, and unexpected inflation, refers to the Phillips curve in the New-Classical literature. As both Lucas (1972b) and Sargent and Wallace (1975) this sort of the Phillips curve can be derived from rational expectations, full market-clearing, and information asymmetries conditions. Here, we discuss about an alternative contract-based derivation of the Phillips curve, in which wages are set one period ahead by contract but prices are flexible. Minford and peel (1983) suggested this way to underpin the Phillips curve via both goods and labour markets and we follow by extension of this route for an open economy.

In this analysis the effect of surprise inflation on output is regarding to the factor costs changes in which factor use is shifted between periods according to relative real profit in the two periods, suitably discounted by the real rate of interest. So the Phillips curve can be written as:

$$y = y^* + \Phi_1 \left[(p - C) - (E_{-1} p_{+1} - E_{-1} C_{+1} - r) \right] + \Phi_2 (e - e^*) + \varepsilon_1 \quad (4.60)$$

where p - C = - w, (w: real wage). The above equation is used into the following stylized macro framework.

$$y = y^* + \Phi_1 (E_{-1} w_{+1} - w + r) + \Phi_2 (e - e^*) + \varepsilon_1 \quad (4.61)$$

$$y - y^* = - \alpha_1 (r - r^*) + \alpha_2 (e - e^*) + \varepsilon_2 \quad (4.62)$$

$$L_S = \beta_0 + \beta_1 (w + p - E_{-1} p) + \beta_2 (r - E_{-1} w_{+1} + w + p - E_{-1} p) + \varepsilon_3 \quad (4.63)$$

$$L_D = \gamma_0 + \gamma_1 y + \gamma_2 \text{prod} + \gamma_3 (w + p - E_{-1} p) + \varepsilon_4 \quad (4.64)$$

$$U = L_S - L_D \quad (4.65)$$

$$\bar{m} + \varepsilon_5 = y + p - \mu.R \quad (4.66)$$

$$R = r + E_{-1} p_{+1} - E_{-1} p \quad (4.67)$$

$$r = r^* - E_{-1} e_{+1} + E_{-1} e \quad (4.68)$$

Equation (4.63) is, following Lucas (1972a), the Fisherian labour supply hypothesis of Lucas and Rapping (1969) and it is clear that the link between the real and nominal sectors is through ($p - E_{-1} p$).

According to the Iranian unemployment figure that considers as unemployed those who state that they are seeking work, it is assumed that unemployment figure reflects search and workers react to the wage offers they obtain in the light of their wages expectations. As a result of the contract-based assumption of the model that regards unemployment as non-voluntary, then unemployment is the difference between the supply of labour and the demand (Equation 4.65).

In case of the wage setting one period ahead by contract, the nominal wage will be the expected real wage solution of the (4.63) and (4.64), plus the expected price level, or:

$$W = E_{-1}\, p + (\beta_1 + \beta_2 - \gamma_3)^{-1} \cdot \left[\gamma_0 - \beta_0 + \gamma_1 E_{-1}\, y + \beta_2 (E_{-1}\, w_{+1} - E_{-1}\, r) + \gamma_2 \text{ prod} \right] \qquad (4.69)$$

Using deviations from equilibrium, (4.69) can be rewritten as:

$$(\beta_1 + \beta_2 - \gamma_3).\, E_{-1}\, w = \gamma_1 E_{-1}\, y + \beta_2 E_{-1}\, w_{+1} - \beta_2 E_{-1}\, r \qquad (4.70)$$

and substituting for E_{-1} r and E_{-1} y from the expected values of (4.61) and (4.62), we obtain (4.71):

$$E_{-1}\, r = \left[- \Phi_1 (E_{-1}\, w_{+1} - E_{-1}\, w) + (\alpha_2 - \Phi_2) E_{-1}\, e \right] / (\alpha_1 + \Phi_1)$$

$$E_{-1}\, y = - \alpha_1 E_{-1}\, r + \alpha_2 E_{-1}\, e$$

$$\delta_1 E_{-1}\, w + \delta_2 E_{-1}\, w_{+1} + \delta_3 E_{-1}\, e = 0 \qquad (4.71)$$

where;

$$\delta_1 = (\beta_1 + \beta_2 - \gamma_3) . (\alpha_1 + \Phi_1) + (\beta_2 \Phi_1 - \gamma_1 \Phi_1 \alpha_1)$$

$$\delta_2 = \gamma_1 \Phi_1 \alpha_1 - 2 \beta_2 \Phi_1 - \beta_2 \alpha_1$$

$$\delta_3 = \gamma_1 (\alpha_1 \alpha_2 - \alpha_1 \Phi_2 + \alpha_2) - \beta_2 (\alpha_2 - \Phi_2)$$

It follows from (3.71) that:

$$E_{-1}\, w = E_{-1}\, w_{+1} = E\, w_{+1} = E_{-1}\, r = E_{-1}\, y = E_{-1}\, e = 0$$

We can now write:

$$w = E_{-1}\, w + (W - E_{-1}\, W - p + E_{-1}\, p) = E_{-1}\, p - p \qquad (4.72)$$

since

$$W = E_{-1}\, W \quad \text{and} \quad E_{-1}\, w = 0$$

So, it can be seen that (4.61) is a Phillips curve, which we may write:

$$y - y^* = \Phi_1 (p - E_{-1} p + r - r^*) + \Phi_2 (e - e^*) + \varepsilon_1 \qquad (4.73)$$

and also, Equation (4.29) in the model is a Phillips curve with different arrangement.

4.4 Money equilibrium (The LM curve)

The LM curve is given by Equations (4.12) to (4.17). In Equation (4.12) the demand for real money (M1) balances, m, is related to the output and short-term nominal interest rates, R_s. In this model M1, that is determined by monetary base (4.13), is chosen as the aggregate money supply because bank deposits are *inside money* and they are both assets and liabilities of the private sector, therefore, are not included in the private sector net financial wealth.

Equation (4.14) relates the monetary base, MB, (or *high powered money*, consisting of the notes and coins issue plus commercial bank's deposit with the Central Bank), to the Central Bank net loans to the public sector (government and public corporations), CBLP, and the Central Bank net foreign assets, CBFA. The main source of changes of CBLP can be explained by the public sector borrowing requirement, PSBR, as in Equation (4.15). As Chapter two, in the oil exporting countries, fiscal policy is the primary determinant of money supply and inflation, so there exists a close relationship between budget deficits and money supply expansion. Nevertheless, during the oil boom, the role of the Central Bank net foreign assets, (4.16), because of the current account surplus (in case of non-sterilization effect of current account) is also important in money supply determination. Finally, inflation is determined by money supply identity, Equation (4.17).

4.5 Government budget constraint and external debt

Equations (4.4), (4,9), (4,10), and (4.11) define the government budget constraint and external debt effects. It is assumed that financial assets are denominated in government bonds and domestic money. Private sector holdings of foreign money and bonds may exist; but they are formally treated as holdings of government bonds, the proceeds of which are invested in turn in foreign bonds. Currency substitution will show up in the demand for domestic monetary base.

At present, government bonds do not exist. This assumption is made to allow us to evaluate the effects of different financing policies for government deficits. However, the decline in oil prices in the early 1980s and the continuing rise in the cost of the subsidy program resulted that some oil- exporting-developing governments introduced deficit financing by issuing treasury bills to cover the gap between oil revenue and total expenditure and increasing the role of monetary policy and its effect on inflation in these countries.

Equation (4.4) defines the public sector borrowing requirement, psbr, as equal to difference between government spending, (includes the real debt interest, Equation 4.8), and total government revenues (e.g oil, tax, and other revenues). Equation (4.8) is an approximation to the debt interest identity, relating changes in debt interest to the changes in interest rates and the stocks of financial assets.

Equation (4.9) relates the change in private sector financial wealth, θ, to changes in its counterparts, public sector debt and net foreign debt (via the psbr and b_f), plus valuation effects due to changes in prices and interest rates ($DEVAL_\theta$ and $DEVAL_f$).

Both bonds and currency are devalued by inflation with a unit coefficient and by changes in interest rates. Foreign debt is devalued by inflation, and changes in interest rates and real exchange rate, (where RXR = the real exchange rate = $\log S + \log P_f - \log P$, and S is the value of a unit of foreign currency in terms of domestic currency).

Given that private agents will demand real money, m, and real financial assets, θ, real bonds, b, are then determined by Equation (4.19). Equations (4.35) and (4.36) are real short and long-term interest rates to be paid on foreign debt. To obtain an estimate of the extra risk premium generated by rising debt as Minford and Walter (1989), the experience of debtor countries can be used by regress their interest differential against their ratio of foreign debt to GNP. This relationship relates the deficits and debt to real interest rates and so back to the real economy. In case of the Iranian economy, during the period of this study, because foreign debt is not significant, it is assumed that interest rate paid on foreign debt is equal to the foreign safe asset return.

4.6 Efficient market equations

The efficient market equations are (4.37) and (4.38). These equations relate real interest rates to the (parallel market) real exchange rate. The model calculates the real exchange rates, (Equations 4.29 and 4.30), and forces the real interest rate differential to offset the expected capital gain or loss from real exchange rate changes.

4.7 Terminal conditions of the model

One of the main implications about the rational expectations models with expectations of future variables is the non-uniqueness and unstable solution paths[12]. This problem has typically been solved. As arguments of Muth (1961), Sargent and Wallace (1973), Minford et al. (1979), and Peel (1981), this sort of models need an additional restriction for stability. The additional restrictions or *terminal conditions* cause that expected inflation about future periods in a specific point be equal (e.g. $P^e_{t+i} = P^e_{t+i-1}$; $i \geq N+1$). Terminal condition has the effect in the model for selecting the unique stable path with the *saddlepath* property, so-called because any deviation from this path is unstable. This condition sometimes is referred as the *ruling out speculative bubbles.*

The following terminal conditions are imposed to the model for long-run equilibrium:

(i) $\Delta(b_f / y) = 0$: the foreign debt ratio cannot be rising indefinitely.

(ii) $\Delta(\Delta\log p) = 0$: inflation too must not rise indefinitely.

(iii) $\Delta(\theta/y) = 0$: this is enforced by the need for private spending plus government spending to equal the natural rate of GDP.

(iv) $\Delta RXR = \Delta R = \Delta R_f = 0$

(v) We use the same terminal inflation rate as Minford and Walter (1989) that must be enforced by monetary policy, which is consequently not free in the long run. At

[12] See for example, Black (1974), Blanchard (1979), Burmeister (1980a,b), Brock (1975), Flood and Garber (1980a,b), Gourieroux, Laffont and Monfort (1979), Sargent and Wallace (1973), Shiller (1978) and Taylor (1977).

terminal date, the government budget constraint can rewritten as:

$$psbr + R_s.b + R_f.b_f - b.\Delta\log p - m.\Delta\log p - b_f.\Delta\log p_f = \Delta\theta + \Delta b_f$$

We solve the model for $\Delta\log p$ at the terminal date with rearranging of the above equation in terms of real interest rates, ($r = r_f$ at terminal date), so terminal inflation is as:

$$\Delta\log p_T = (psbr_T / \theta_T) - \left[(\theta_T + b_{fT}) . (\Delta\log y_T / \theta_T) \right] - (b_{fT} / \theta_T) . \Delta\log p_{fT} \qquad (4.74)$$

(vi) One issue about bond-financed deficits in models with wealth effects, is the possibility of instability. In other words the question is about relationship between money and deficits. Minford (1992) argued that under rational expectations augmented Blinder and Solow's (1973) model, there is no reason why the short-run components of monetary policy should be influenced by fiscal policy. However, the steady state component of the money supply rule is quite different.

For simplicity assume a long-run growth rate of zero ($\Delta\log y_T = 0$), although this does not affect the argument, from (4.74) we obtain:

$$\Delta\log p_T = (psbr_T / \theta_T) - (b_{fT} / \theta_T) . \Delta\log p_{fT} \qquad (4.75)$$

If in steady state both real interest rates and inflation are constant, then we have:

$\Delta R_T = 0$

$\Delta\log \theta_T = 0$

$$\Delta\log M = \Delta\log M_T = \Delta\log p_T \tag{4.76}$$

then from (4.75) and (4.76) we have:

$$\Delta\log M_T = (psbr_T / \theta_T) - (b_{fT} / \theta_T) . \Delta\log p_{fT} \tag{4.77}$$

As (4.77) monetary and fiscal policy in the long run have to be consistent. This implies that money and nominal bonds must be growing at the same rate.

CHAPTER FIVE

ESTIMATION AND HISTORICAL TRACKING OF THE MODEL

5.1 Estimation method

The assumption of rationality in the model implies that expectations are based on all available information, including the structure of the model. Consequently, for estimation a reasonable proxy for expectational variable is required. McCallum (1976) argued that one such observable proxy for the unobservable expectational variable is the actual variable. This estimation procedure is the *errors-in-variables* (EVM) method, in which the expected variable is replaced by the realized (observed) value, and the latter is treated as an additional endogenous variable of the model (see Appendix 5.1).

An alternative approach that has been used for estimation of simultaneous equation models with rational expectations is the so-called *substitution method* (SM) where the rationally-expected variables are replaced by forecasts based on a restricted reduced form (see Hansen and Sargent, 1980; and Wallis, 1980).

Wickens (1982, 1986) emphasizes many advantages of the EVM approach over the substitution method. He shows that in a non-linear model the additional non-linearity in the parameters introduced due to the SM will make the estimation technique hopelessly complicated. He also demonstrates that the EVM is in general more robust than SM in cases where the variables in the information set are incomplete. Moreover, EVM is relatively easy to implement, and to repeated experimentation with different specifications of the model. In addition, Wickens (1986) shows that until the type of rational expectations solution exhibited by the model is known, it will not be possible to select the appropriate fully efficient SM estimator.

The method that we have used, is a variant of a single equation method due to McCallum (1976) or EMV. In this method, the expectations variables are replaced by a prediction from a least squares regression on a subset of the information set available at the time of expectation. This can be regarded therefore as instrumental variables estimation, where the subset forms the set of instruments.

The variation in application arises from the choice of instruments. However, the closer the subset to the true subset determining the expectations and the more restricted by the true model the coefficients used, the greater the efficiency of the equation estimates and so the closer to SM (substitution method), the consistent and efficient estimator.

5.2 Simulation method

The model is solved by a computer algorithm described by Matthews and Marwaha (1981) which forces the expectations entering the model's equations to be equal to the model's forecasts. For example, given information for 1993, assumed to be available to all agents, the algorithm first guesses a set of expectations as initial values, solving the model for 1994; after then checking for equality between the initial expectations and the solved forecasts, it alters the expectations set gradually into line until convergence. However, in a rational expectations model, the forward expectations terms tend to induce an infinite number of unstable paths. Therefore, to ensure that the algorithm picks the unique stable path, the forecast values and expectations at the end of horizon are set at equilibrium, as terminal conditions. The use of terminal conditions has the effect of setting the starting values of the unstable roots to zero asymptotically, thereby ruling out unstable paths. It is necessary for the terminal date to be large, in order to reduce the sensitivity of the model to variations in the terminal date (for the complete solution algorithm see Appendix 5.2).

5.3 Model Parameters

Behaviourial equations

This section reports the parameters and diagnostics of behaviourial equations which were estimated by the instrumental variable (IV) method. The estimated coefficients are all of the expected signs and they are statistically significant at the 5% level.

For the behaviourial equations, the following diagnostic tests are considered:

(i) LM test (Breusch-Godfrey): Lagrange Multiplier statistic for testing of the null hypothesis of no residuals serial correlation up to order 2.

(ii) ARCH test: Engles's test for autocorrelated squared residuals.

(iii) F-test (Goldfeld-Quandt): testing of the null hypothesis of no heteroscedasticity.

(iv) Chi^2 test (Breusch-Pagan): testing of the null hypothesis of no heteroscedasticity.

(v) RESET test: F-test for misspecification or to detect the choice of an inappropriate functional form.

(vi) Normality test: Chi^2 test for the null hypothesis of residuals normality.

According to the 5% critical values of the F and Chi^2 distributions, the estimated equations pass all of the considered statistical tests satisfactory. Tables 5.1 to 5.13 represent the estimation results.

Table 5.1 Non-durable consumption function

Sample based on observations 1966-90
Dependent variable is log c

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	-0.27729	0.14323	-1.936
log c_{-1}	0.70587	0.067849	10.404
log w	0.29139	0.065278	4.464
*E*log $(y/y*)_{+1}$	0.39180	0.10625	3.687
D75*	0.18414	0.035061	5.252

$R^2 = 0.99629$

$\sigma = 0.033890$

Testing for second order residual autocorrelation:

Chi^2 (2) = 4.4243

Testing for ARCH:

Chi^2 (1) = 0.23943

Normality test:

Chi^2 (2) = 1.1116

Testing for Heteroscedastic errors:

Chi^2 (8) = 13.408 , F (8,11) = 1.464

Misspecification test (RESET test):

F (1,19) = 0.00647

* D75: Dummy variable for 1975, the first oil shock's impact.

Table 5.2 Demand for physical assets

Sample based on observations 1966-90
Dependent variable is log g

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	0.91345	0.18116	5.042
log g_{-1}	0.86254	0.05199	16.590
log θ	0.065776	0.02718	2.420
r_1	-0.99902	0.48075	-2.078
D79*	-0.033121	0.00644	-5.139

$R^2 = 0.99949$

$\sigma = 0.010774$

Testing for second order residual autocorrelation:

Chi^2 (2) = 1.0268

Testing for ARCH:

Chi^2 (1) = 0.84008

Normality test:

Chi^2 (2) = 0.18238

Testing for Heteroscedastic errors:

Chi^2 (8) = 8.547 , F (8,11) = 0.62223

Misspecification test (RESET test):

F (1,19) = 1.0304

* D79: Dummy variable for 1979, the Iranian revolution event.

Table 5.3 Weighted average of real exchange rates

Sample based on observations 1970-90
Dependent variable is log RXR_w

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	2.6571	0.42708	6.222
log $(RXR_w)_{-1}$	0.44638	0.08888	5.022
log (y/y*)	-0.69384	0.18518	-3.747
log $(y/y*)_{-1}$	-0.27418	0.15362	-1.785
log RW	-0.15639	0.049425	-3.164
D79*	-0.22749	0.052825	-4.307
D85**	0.19143	0.069278	2.763

$R^2 = 0.96656$
$\sigma = 0.046529$

Testing for first order residual autocorrelation:

Chi^2 (1) = 3.4271

Testing for ARCH:

Chi^2 (1) = 1.3466

Normality test:

Chi^2 (2) = 0.11267

Misspecification test (RESET test):

F (1,13) = 0.17876

* D79: Dummy variable for 1979, the Iranian revolution event.
** D85: Dummy variable for 1985, the third oil price shock.

Table 5.4 Money demand

Sample based on observations 1965-90
Dependent variable is log m

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	-1.3268	0.25828	-5.137
log m_{-1}	0.88906	0.05674	15.668
log y	0.27224	0.04498	6.052
R_s	-1.1565	0.56725	-2.039
D79*	0.21481	0.04258	5.044
D74**	-0.27082	0.03415	-7.930

$R^2 = 0.99825$
$\sigma = 0.039654$

Testing for second order residual autocorrelation:

Chi^2 (2) = 1.7929

Testing for ARCH:

Chi^2 (1) = 1.2564

Normality test:

Chi^2 (2) = 0.97616

Testing for Heteroscedastic errors:

Chi^2 (10) = 9.2809 , F (10,9) = 0.44622

Misspecification test (RESET test):

F (1,19) = 0.014878

* D79: Dummy variable for 1979, the Iranian revolution event.
** D74: Dummy variable for 1974, the first oil price shock.

Table 5.5 Real wage

Sample based on observations 1970-90
Dependent variable is log RW

Regressor	Coefficient	Standard error	*t* value
Constant	1.1617	0.21097	5.507
log RW_{-1}	0.87963	0.02821	31.18
log u	-0.16189	0.02890	-5.602
log p - Elog p	-0.90398	0.11064	-8.170
D74*	0.11060	0.01818	6.081
D86**	-0.08276	0.02463	-3.359

$R^2 = 0.9930$

$\sigma = 0.022739$

Testing for first order residual autocorrelation:

Chi^2 (1) = 2.5879

Testing for ARCH:

Chi^2 (1) = 0.08026

Normality test:

Chi^2 (2) = 0.74537

Misspecification test (RESET test):

F (1,14) = 0.460

* D74: Dummy variable for 1974, the first oil price shock.

** D86: Dummy variable for 1986, the third oil price shock.

Table 5.6 Unemployment

Sample based on observations 1970-90
Dependent variable is log u

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	-23.759	6.4516	-3.683
log RW	0.13997	0.03837	3.647
log y	-3.7526	1.8294	-2.051
log wpop	5.2044	1.5784	3.297
log prod	3.6796	1.8582	1.980
D86*	0.02232	0.00895	2.494

$R^2 = 0.9991$

$\sigma = 0.009039$

Testing for first order residual autocorrelation:

Chi^2 (1) = 2.9861

Testing for ARCH:

Chi^2 (1) = 0.80208

Normality test:

Chi^2 (2) = 0.31673

Misspecification test (RESET test):

F (1,14) = 0.064174

* D86: Dummy variable for 1986, the third oil price shock.

Table 5.7 Non-oil export

Sample based on observations 1966-90
Dependent variable is log $Noil_x$

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	-3.8176	1.3056	-2.924
$\log(Noil_x)_{-1}$	0.52794	0.09841	5.364
$(1-\beta) . \log RXR_{of}$	1.2517	0.34801	3.597
$\beta.\log RXR_f$	0.90511	0.26098	3.468
D81*	-0.45647	0.11584	-3.940

$R^2 = 0.976188$

$\sigma = 0.123607$

Testing for second order residual autocorrelation:

$Chi^2 (2) = 0.79818$

Testing for ARCH:

$Chi^2 (1) = 1.571$

Normality test:

$Chi^2 (2) = 0.46093$

Testing for Heteroscedastic errors:

$Chi^2 (8) = 4.1025$, $F (8,11) = 0.2171$

Misspecification test (RESET test):

$F (1,19) = 0.01282$

* D81: Dummy variable for 1981, starting of the Iran-Iraq war.

Table 5.8 Oil export

Sample based on observations 1970-90
Dependent variable is log Oil_x

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	0.88555	0.41857	2.116
$\log(Oil_x)_{-1}$	0.85521	0.06202	13.789
$\log P_{oil} / P_f$	-0.13995	0.048262	-2.900

$R^2 = 0.95886$

$\sigma = 0.133638$

Testing for second order residual autocorrelation:

$Chi^2 (2) = 0.028466$

Testing for ARCH:

$Chi^2 (1) = 1.4639$

Normality test:

$Chi^2 (2) = 0.43338$

Testing for Heteroscedastic errors:

$Chi^2 (8) = 3.819$, $F (8,9) = 0.31469$

Misspecification test (RESET test):

$F (1,17) = 3.324$

Table 5.9 Imports

Sample based on observations 1970-90
Dependent variable is log Im

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	-16.114	3.1030	-5.193
log y	2.9247	0.33826	8.646
log RXR_w	-0.75528	0.16538	-4.567
D75*	0.58151	0.11325	5.135
D79**	-0.50770	0.11310	-4.489

$R^2 = 0.95558$

$\sigma = 0.105415$

Testing for first order residual autocorrelation:

Chi^2 (1) = 0.26939

Testing for ARCH:

Chi^2 (1) = 0.50872

Normality test:

Chi^2 (2) = 0.43325

Misspecification test (RESET test):

F (1,15) = 0.67057

* D75: Dummy variable for 1975, the first oil price shock.

** D79: Dummy variable for 1979, the Iranian revolution event.

Table 5.10 Monetary base

Sample based on observations 1970-90
Dependent variable is log MB

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	1.4306	0.32481	4.404
log MB_{-1}	0.72412	0.10291	7.036
log CBLP	0.12268	0.06468	1.896

$R^2 = 0.99822$

$\sigma = 0.063677$

Testing for second order residual autocorrelation:

$Chi^2\ (2) = 0.10204$

Testing for ARCH:

$Chi^2\ (1) = 0.40805$

Normality test:

$Chi^2\ (2) = 0.48464$

Testing for Heteroscedastic errors:

$Chi^2\ (7) = 10.676$, $F\ (7,10) = 2.3635$

Misspecification test (RESET test):

$F\ (1,17) = 0.90723$

Table 5.11 Money supply (M1)

Sample based on observations 1970-90
Dependent variable is $\Delta \log M$

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	0.061251	0.015576	3.932
$\Delta \log MB$	0.81204	0.052990	15.324

$R^2 = 0.96045$

$\sigma = 0.024001$

Testing for second order residual autocorrelation:

$Chi^2\ (2) = 2.2674$

Testing for ARCH:

$Chi^2\ (1) = 0.027717$

Normality test:

$Chi^2\ (2) = 0.34372$

Misspecification test (RESET test):

$F\ (1,18) = 0.090015$

Table 5.12 Official nominal exchange rate

Sample based on observations 1970-90
Dependent variable is $\Delta \log S_{of}$

Regressor	**Coefficient**	**Standard error**	**t value**
Constant	0.028197	0.01061	2.656
$\log P_{oil} / P_f$	-0.081525	0.046224	-1.864

$R^2 = 0.95180$

$\sigma = 0.032022$

Testing for second order residual autocorrelation:

$Chi^2 (2) = 0.26511$

Testing for ARCH:

$Chi^2 (1) = 1.2492$

Normality test:

$Chi^2 (2) = 0.66672$

Testing for Heteroscedastic errors:

$Chi^2 (9) = 13.991$, $F (9,10) = 4.8853$

Misspecification test (RESET test):

$F (1,19) = 3.324$

Table 5.13 Equilibrium output trend[13]

Sample based on observations 1959-93
Dependent variable is log y^*

Regressor	**Coefficient**	**Standard error**	***t* value**
Constant	1.7777	0.10674	16.655
t	0.09859	0.001540	64.024
$D_1 . (t - t_1)$	-0.10127	0.003666	-27.617
$D_2 . (t - t_2)$	0.026199	0.009485	2.762

[13] As the output trend and Chow test of equality between sets of coefficients in two linear regressions (Chow, 1960), there are two significant structural breaks during the 1960-93 period. The Chow F-test for two estimated parameters (intercept and trend) and 31 degrees of freedom is 168.2 thus the null hypothesis that both groups of observations (1959-77 and 1978-93), belong to the same regression model is rejected.

The structural break in 1977 (the Iranian revolution event) is continued by the imposed Iran-Iraq war during the years 1980-88 and the third oil price shock in 1986. Within the framework of the five year economic development plan during the years 1989-93, the output has been rising at an average annual rate of 7.0 percent. This rate of growth is achieved mostly by maximal utilization of idle capacities. Thus, 1988 can be considered as another structural break point in the output trend.

Such a model with continuous shift in the trend is called a *piecewise linear model*, (see Pindyck and Rubinfeld, 1981, ch.5), and in this case it consists of three straight line segments. Thus, for estimation of the natural (equilibrium) output trend we use the following model:

$$\log y^* = c_0 + c_1 . t + c_2 . D_1 . (t - t_1) + c_3 . D_2 . (t - t_2)$$

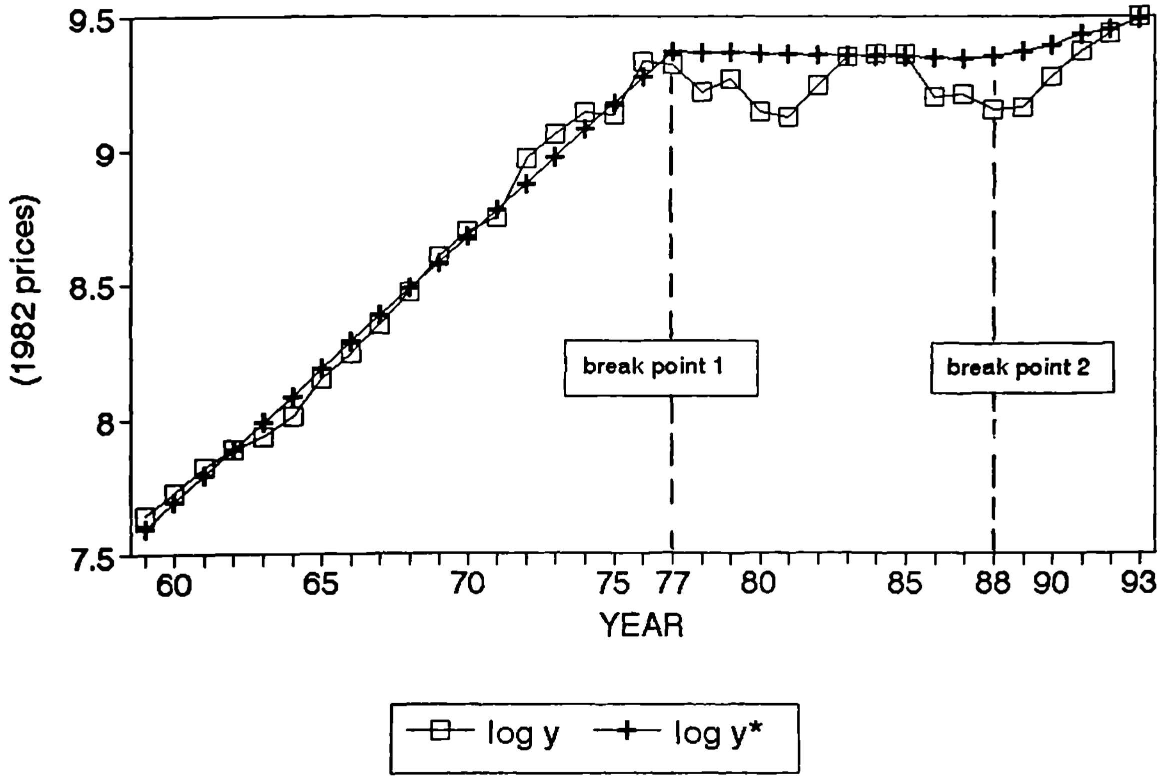
$$D_1\text{: Dummy variable } \begin{cases} 0 & t \leq t_1 \\ 1 & t_2 > t > t_1 \end{cases}, \quad t_1 = 1977$$

$$D_2\text{: Dummy variable } \begin{cases} 0 & t \leq t_2 \\ 1 & t > t_2 \end{cases}, \quad t_2 = 1988$$

Figure 5.0 represents the y and y^* trends.

Figure 5.0

Equilibrium output trend



Exogenous variables

Although econometric theory has a great deal to say about the processing of time series data, there is a narrower definition of time series modelling, in which some time series are modelled exclusively in terms of their own past behaviour as the only systematic information.

Following the ideas of Box and Jenkins (1970), one can describe the practical construction of a time series model in terms of three steps, namely, identification, estimation, and diagnostic checking. In this context, identification is the process by which one finds a specific member of the class of ARIMA (Autoregressive Integrated Moving Average) models, which has theoretical characteristics that correspond as closely as possible to the characteristics of the observed time series.

Having identified an appropriate model, the next step is to estimate unknown parameters. Finally, with the estimated model available, it is necessary to conduct some ex-post checks. These are primarily concerned with ensuring that estimated residuals have no remaining systematic behaviour. Time series models are of course built with some purpose in mind. Here, the objective is to find a relatively simple means of forecasting future values for the exogenous variables, without the need to specify a structural econometric model. Therefore, the stationary test is most important in this line.

Table 5.14 represents the identification, result of estimation, and diagnostic tests of the ARIMA processes for modelling of the exogenous variables.

Table 5.14 Exogenous Variables Processes

Var.	**Model ARIMA (p,d,q)**	**Cons.**	**Φ_1**	**Unit root *t* test**
log T	ARIMA (1,0,0)	0.99925 (3.58)	0.49490 (3.46)	-3.535
log wpop	ARIMA (1,1,0)	0.00161 (2.93)	0.06257 (12.6)	-3.370
log P_f	ARIMA (1,1,0)	0.01835 (3.87)	0.62090 (7.78)	-4.755
log P_{oil} / P_f	ARIMA (1,1,0)	-0.00643 (-0.214)	-0.06828 (-2.10)	-3.891
log eg/y	ARIMA (1,1,0)	0.02530 (1.25)	0.24707 (2.74)	-5.322
log prod	ARIMA (1,1,0)	0.03486 (2.81)	0.20620 (1.81)	-6.572
rs_{us}	ARIMA (1,0,0)	0.00595 (1.95)	0.67233 (7.68)	-3.743
rl_{us}	ARIMA (1,0,0)	0.003692 (2.19)	0.80118 (14.2)	-3.543

1 *t* statistic bracketed.

2 As the Dickey-Fuller t test, for sample size n=25, the 5% critical value is 3.00.

5.4 Model Validation: Historical tracking

In constructing a multi-equation simulation model, the evaluation criteria become more complicated than a single-equation regression model. The fact that there are several equations means that high statistical significance for some equations may have to be balanced against low statistical significance for other equations. Even more important, the model as a whole will have a dynamic structure which is much richer than of any one of the individual equations of which it is composed. Thus even if all the individual equations fit the data well and are statistically significant, we have no guarantee that the model as a whole will reproduce those same data series closely.

The essential criterion that is used to evaluate a simulation model is the fit of the individual variables in a *simulation context.* In this way to test the performance of the model is based on to perform an historical simulation (i.e. a simulation through the estimation period or *ex post* forecast) and examine how closely each endogenous variable tracks its corresponding historical data series. The measures that are most often used are as follows:

(i) Mean percent error = $1/T \sum (y^s_t - y^a_t)/y^a_t$

(ii) Root Mean Square error = $\sqrt{1/T \sum [(y^s_t - y^a_t)/y^a_t]^2}$

(iii) $U = \sqrt{1/T \sum (y^s_t - y^a_t)^2} / [\sqrt{1/T \sum (y^s_t)^2} + \sqrt{1/T \sum (y^a_t)^2}]$

U (Theil's *inequality coefficient*) is a useful simulation statistic related to the RMS simulation error and applied to the evaluation of historical simulations or *ex-*

post forecasts (see Theil, 1961 and 1966).

(iv) Another important criterion is how well the model simulates *turning points* or rapid changes in the actual historical data.

(v) Even if a model tracked well (i.e. had a small RMS simulation and forecast errors for most or all of the endogenous variables), one would also want to investigate whether or not it responds to shocks (e.g. large changes in exogenous variables or policy parameters) in a manner consistent with economic theory and with empirical observations. Thus the *dynamic response* of the model is another evaluation criterion (the impact of some different shocks will be discussed in the next chapter).

Historical tracking of the rational expectations model

In models with rational expectations, dynamic historical tracking may be classified into two categories. First, forecasts and therefore expectations are strictly conditional. The exogenous variables are known subject to error, meaning that the exogenous variables themselves are expectations conditional on the starting values and some empirically defined data generating process. In this case forecast errors therefore are a compound of errors in forecasting exogenous processes and model specification errors because the model is fed information of exogenous and endogenous variables up to and including period t-1. Conditional forecasts are then generated for period t, to $t+N$.

Second, model errors are obtained by extending exogenous variable information to include the current period and allowing the model to solve for current endogenous variables, as well as future forecasts in the light of this extra information, thus in this case the current exogenous variables are given to the model and not forecast as above.

For the first exercise, the exogenous variables were projected from starting values in period *t*-1 by ARIMA processes (Table 5.14). Table 5.15 presents summary error statistics for one period ahead forecasts, where Table 5.16 shows the forecast errors of the model for the second exercise, which the exogenous values are given for current year (*t*) and predicted for period *t*+1

to *t*+*N* by ARIMA processes.

As the model errors in the second case, that as expected they are lower than the first exercise, and also as figures 5.1 to 5.10, the model captures trends and turning points successfully thus, in terms of historical simulation the model can be said to perform satisfactorily.

Table 5.15: Errors on forecasts one year ahead

Variable	**Mean error (%)**	**Root mean sq. error (%)**	**Theil's inequality coefficient**
y	1.72	6.71	0.03277
c	3.19	6.45	0.03119
g	-0.97	3.29	0.01457
m	0.31	6.61	0.02925
inf (% pa)	-1.71	7.04	0.22164
RXR	6.36	12.9	0.05067
RW	7.42	7.15	0.03817
u	9.58	11.6	0.04804
xm[1] (% of GDP)	0.91	5.51	0.39581
xm[2] (% of GDP)	0.28	4.98	0.16751

1 Current account including terms of trade
2 Current account excluding terms of trade

Table 5.16: Errors for current year given current exogenous values

Variable	Mean error (%)	Root mean sq. error (%)	Theil's inequality coefficient
y	0.10	1.77	0.00863
c	0.20	3.96	0.02070
g	0.33	1.54	0.00679
m	0.75	2.21	0.01166
inf (% pa)	0.54	2.22	0.07092
RXR	0.20	3.03	0.01329
RW	-2.77	6.12	0.03180
u	-1.21	3.26	0.01737
xm[1] (% of GDP)	-0.33	1.86	0.16058
xm[2] (% of GDP)	-0.37	1.33	0.04878

1 Current account including terms of trade
2 Current account excluding terms of trade

Figure 5.1
NON-DURABLE CONSUMPTION

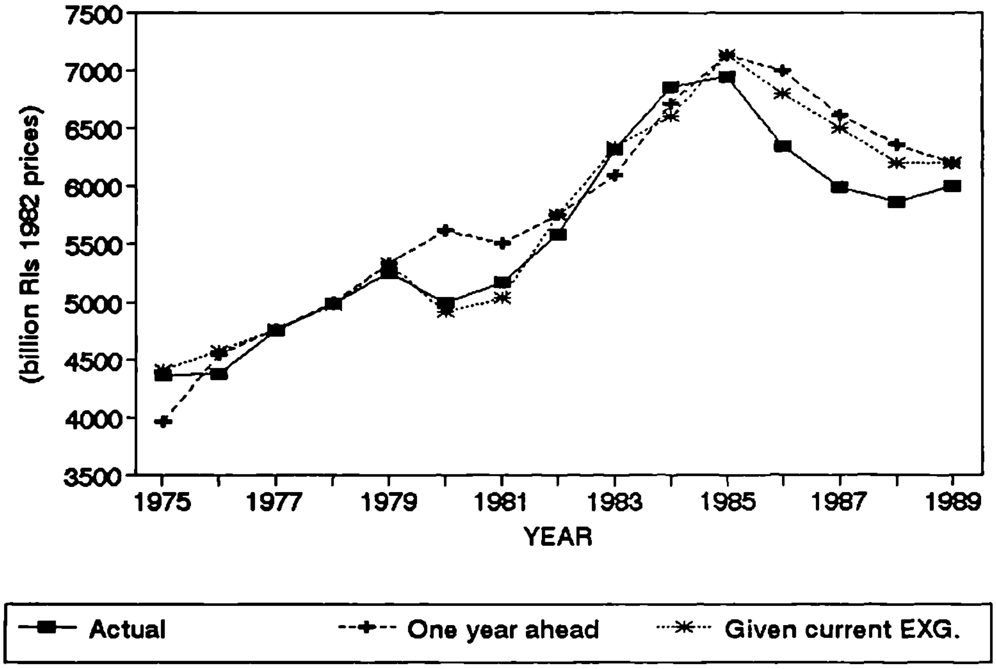


Figure 5.2
PRIVATE PHYSICAL ASSETS

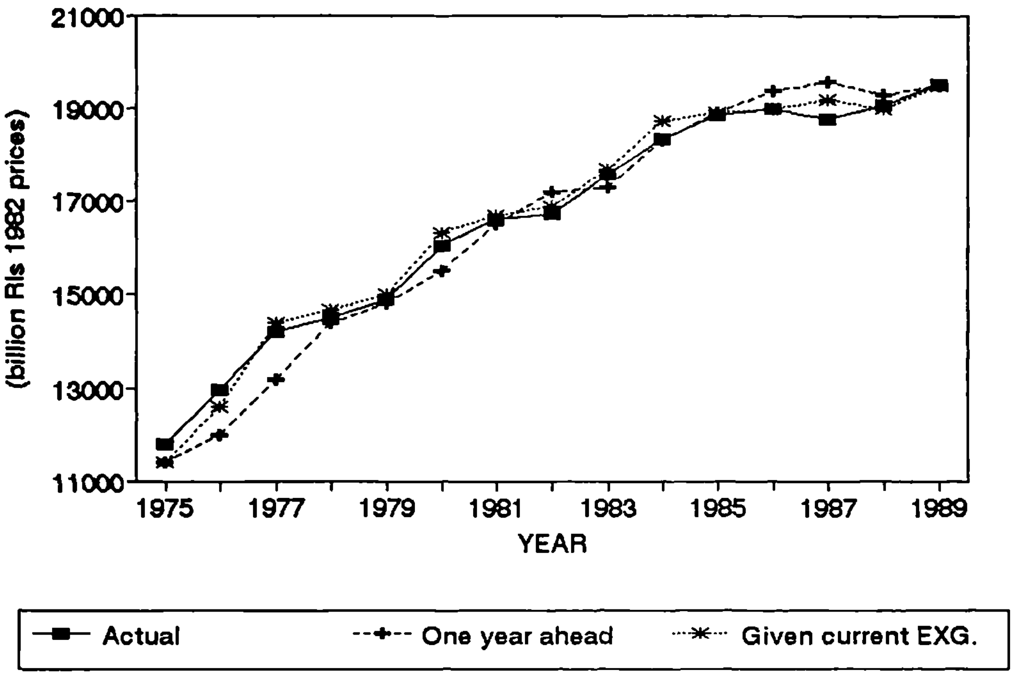


Figure 5.3
REAL MONEY GROWTH

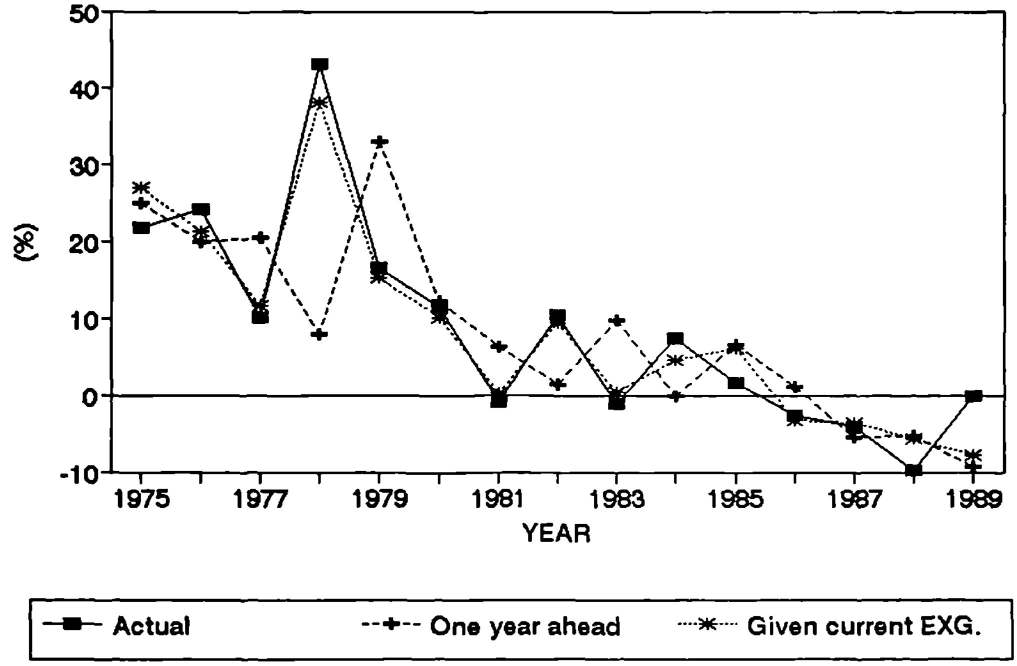


Figure 5.4
OUTPUT GROWTH

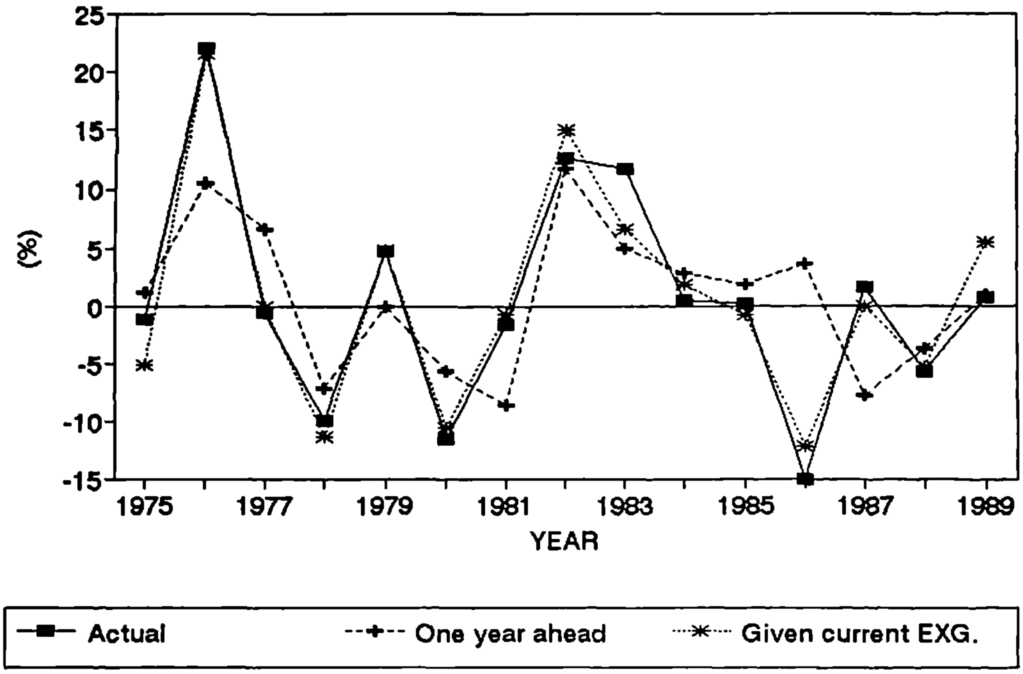


Figure 5.5
INFLATION

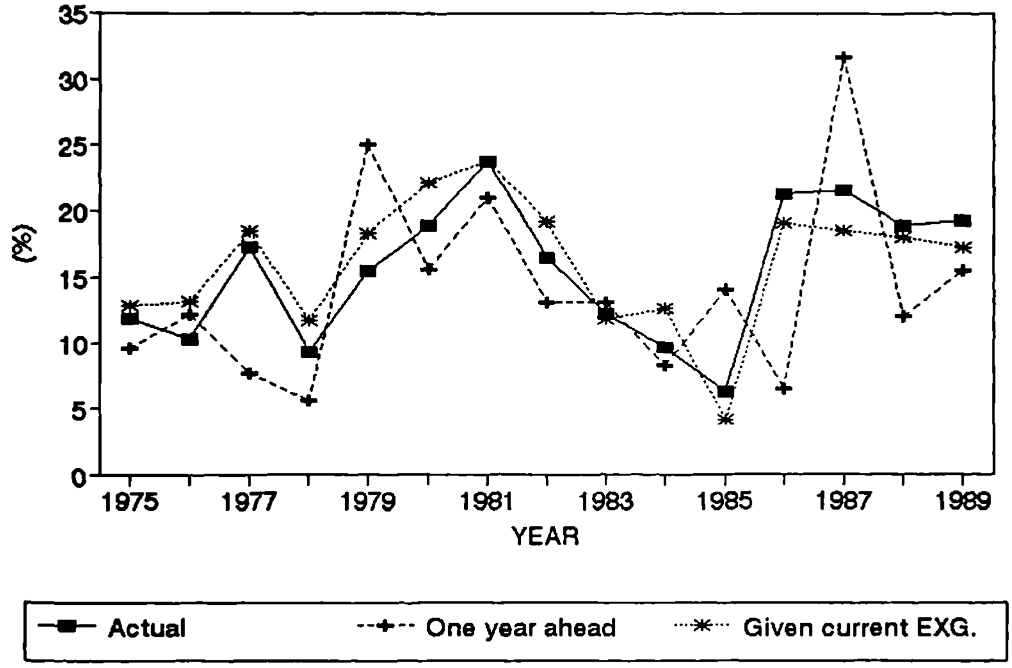


Figure 5.6: REAL EXCHANGE RATE
(log RXR = log S + log Pf - log P)

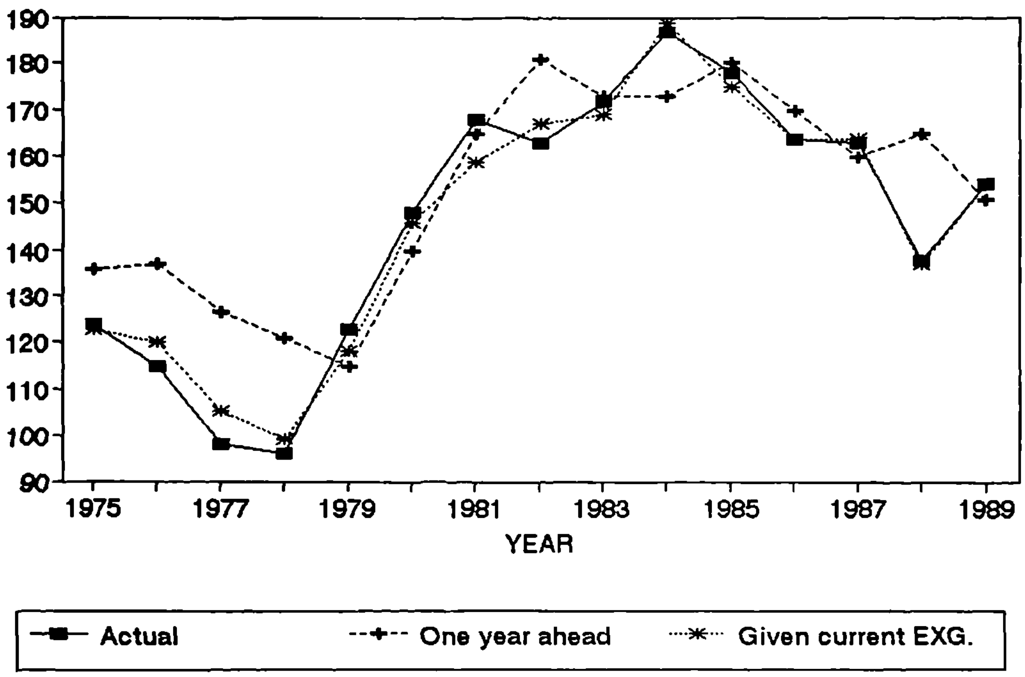


Figure 5.7
REAL WAGE

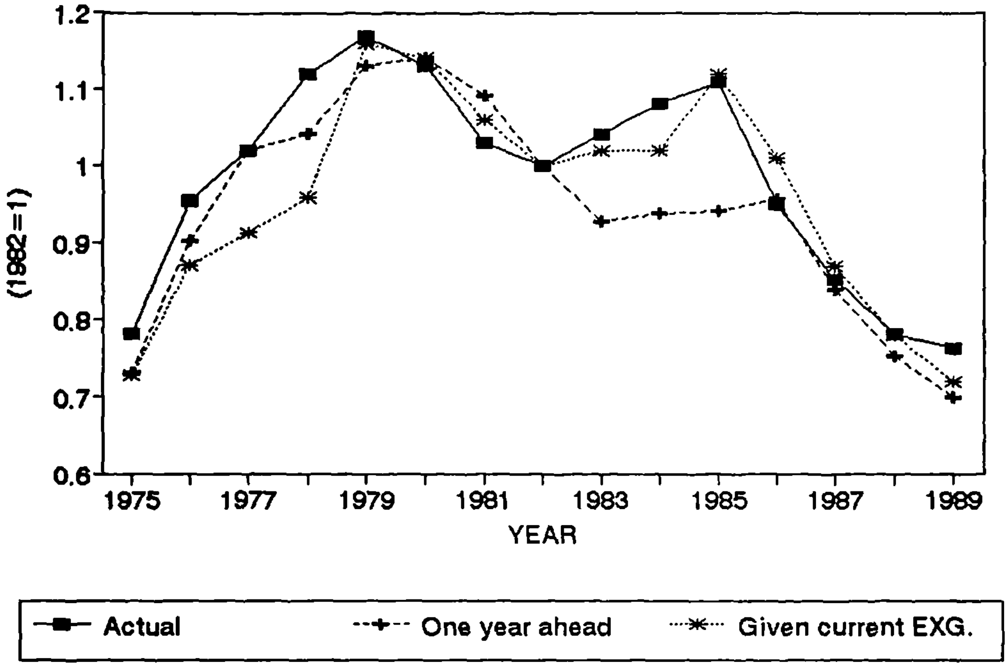


Figure 5.8
UNEMPLOYMENT

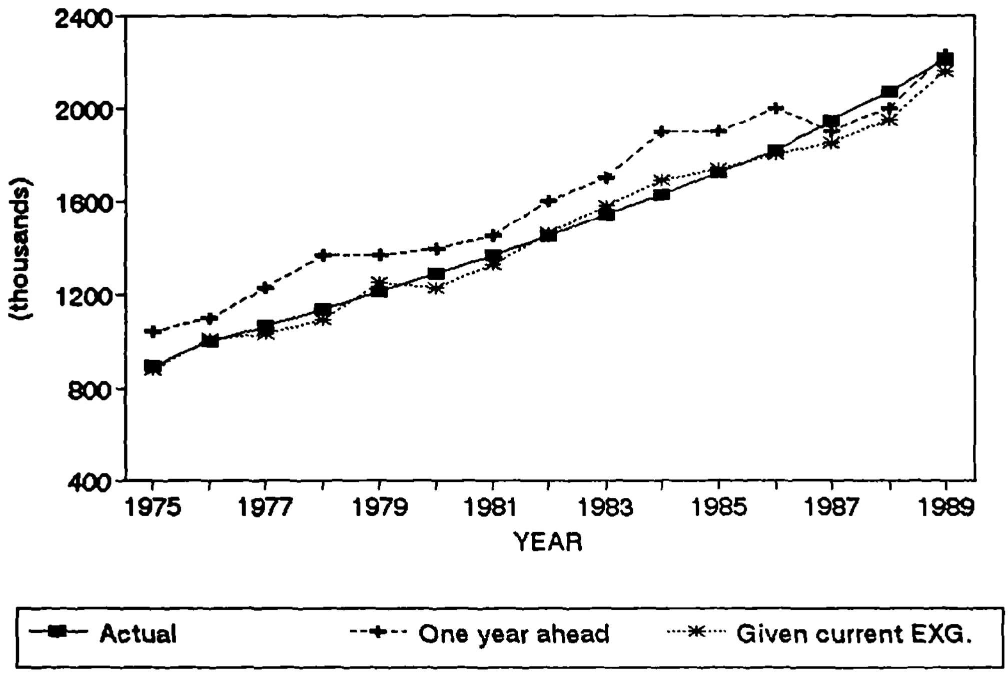


Figure 5.9: REAL CURRENT ACCOUNT
(excluding terms of trade)

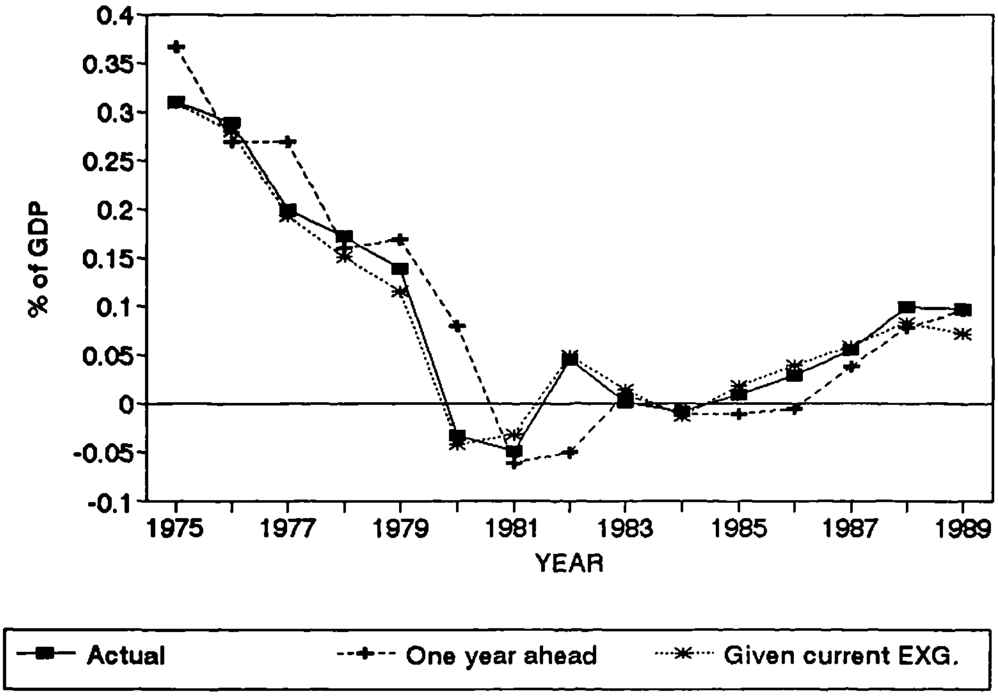
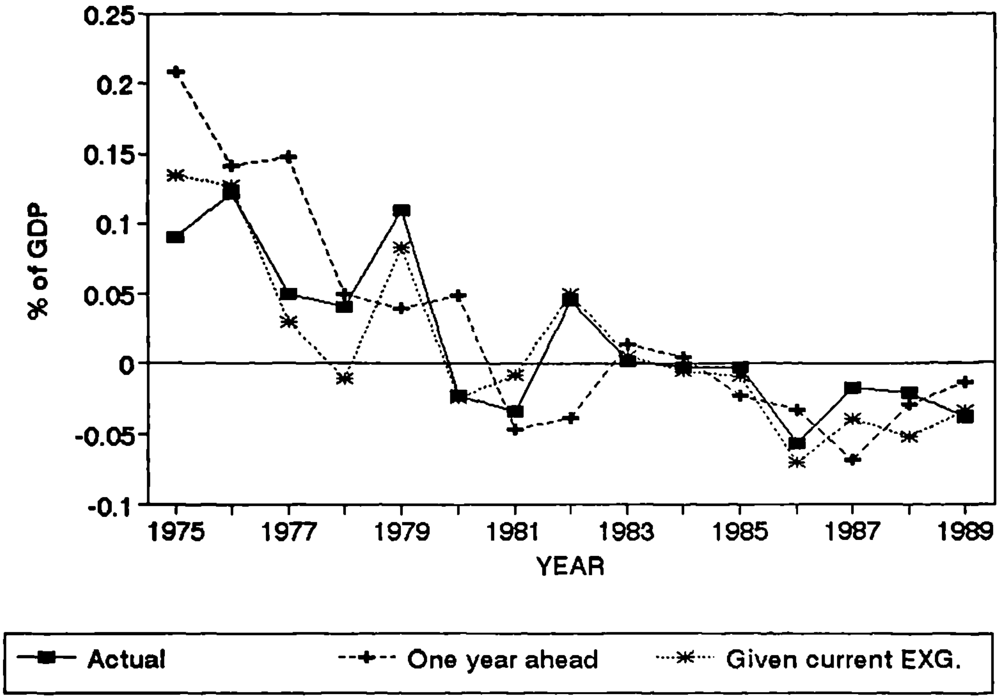


Figure 5.10: REAL CURRENT ACCOUNT
(including terms of trade)



Appendix 5.1

Estimation of Expectations Variables: (The EVM method)

In the simplest case, assume the following relationship with an explanatory variable reflects values of an endogenous variable that are expected by market participants who form expectations rationally.

$$y_t = \alpha\, y^e_{t+1} + \Sigma\, \beta_k\, x_{tk} + \varepsilon_t \qquad (1)$$

where y^e_{t+1} is the (unobservable) expected value of y at time t+1 that is at t. The x's represent additional explanatory variables important in the determination of y. These variables are assumed to be generated by a vector autoregressive stochastic process that is independent of the process generating the disturbances. These are taken to have the classical properties: the ε_t are independent and identically distributed with mean zero and variance σ^2_t. (1) can be written in matrix notation as follows:

$$y = y^e\, \alpha + X\, \beta + \varepsilon \qquad (2)$$

Here, y, y^e, and ε are T x 1, X is T x K, β is K x 1, and α is a scalar. The object is to estimate α and β; it remains to specify how y^e is formed.

Let y_{+1} denote the one period ahead values of y, so that y^e will represent anticipated values of y_{+1}. Then the rational expectations hypothesis, due to Muth (1961), specifies that:

$$y^e = E\,(y_{+1} \mid \Phi) = y_{+1} - \eta \qquad (3)$$

where η is a random vector (with the classical properties) that is uncorrelated with information Φ. The relevant available information, according to the rationality hypothesis, consists of present and past values of the variables actually involved in the process in question. Thus, in this case:

$$\Phi = [X, X_{-1},...,X_{-n}, y_{-1}, y_{-2},...,y_{-n}]$$

where X_{-i} represents values of X lagged i periods. Accordingly, if the conditional expectation in (3) is linear, we have:

$$E\,(y_{+1} \mid \Phi) = X\delta_0 + X_{-1}\delta_1 + ... + X_{-n}\delta_n + y_{-1}\theta_1 + ... + y_{-n}\theta_n \qquad (4)$$

Using (3) and presuming that (4) is stable, we could substitute for the lagged values of y and obtain:

$$E\,(y_{+1} \mid \Phi) = Xd_0 + X_{-1}d_1 + ... + \xi \qquad (5)$$

where ξ is a term involving observed values of η_{-2}, η_{-3}, ... and also the parameters of (4).

Finally, we can eliminate the unobservable vector y^e, thereby obtaining the two-equation system:

$$y = y_{+1}\,\alpha + X\,\beta + u \qquad (6)$$

$$y_{+1} = X\delta_0 + X_{-1}\delta_1 + ... + X_{-n}\delta_n + y_{-1}\theta_1 + ... + y_{-n}\theta_n + \eta \qquad (7)$$

where $u = \varepsilon - \alpha\,\eta$. Alternatively, we could have:

$$y_{+1} = Xd_0 + X_{-1}d_1 + ... + \nu \;\; ; \;\; (\nu = \eta + \xi) \qquad (8)$$

as the second equation in the system. In either case, given assumptions, u will not be correlated with X, X_{-1} ,... or with y_{-1}, y_{-2},.... Thus equation (6) can be consistently estimated by the instrumental variable technique, with the instrument for y_{+1} being the predicted vector y_{+1} obtained from the least- squares regression of y_{+1} on a matrix Z of variables selected from Φ.

Appendix 5.2

The Solution Algorithm of the Model

In order to understand how the algorithm works, consider a set of simultaneous non-linear structural equations as:

$$F\ (y_t, y_{t-1}, x_{t-1}, u_t) = 0 \qquad (1)$$

where, y_t is a vector of endogenous variables, y_{t-1} a vector of lagged endogenous variables, x_t a vector of exogenous variables, and u_t a vector of stochastic disturbances with mean zero and constant variance.

Setting the disturbance terms equal to their expected values and solving for the reduced form, we have:

$$y_t = H\ (x_t\ , y_{t-1}) \qquad (2)$$

Partitioning equation (2) for endogenous expectational variables (y^1) and the others (y^2), we obtain:

$$y^1_t = h^1\ (\ x_t\ ,\ y^1_{t-1}\ , E\ y^2_{t+j}) \qquad (3)$$

$$y^2_t = h^2\ (\ x_t\ ,\ y^2_{t-1}\ ,\ E\ y^2_{t+j}) \qquad (4)$$

where $E\ y^2_{t+j}$ denotes the rational expectation of y^2 formed in period t for period t+j.

The algorithm uses starting values for the vector $E\ y^2_{t+j}$ which, together with values for the fully exogenous variables, are assumed to extend over the whole solution period. The solution ensures that the expectational values stored in the vector $E\ y^2_{t+j}$ converges to the values predicted by the model for y^2 in period t+j.

For simplicity, assume that the solution period extends from t=1 to t=T, and that expectations are formed for one period ahead only. The convergence of the expectational values towards the model's predicted values follows a Jacobi algorithm, which can be described as:

$$E\,(y^2_t\,,\,k+1) = E\,(y^2_t\,,\,k) + q\left[\,(y^2_t\,,\,k) - E\,(y^2_t\,,\,k)\,\right]$$

$$0< q <1 \quad , \quad t = 1, 2, \ldots , T \qquad (5)$$

for the k-th iteration, with the objective of minimizing the residual vector R_t, defined as:

$$R_t = \text{abs}\,(y^2_t - E\,y^2_t) < L \qquad t = 1, 2, \ldots T$$

where q is the step length and L is some pre-assigned tolerance level.

It is obvious that since E y^2_t is stored in period T-1, for t+T the end period expectational variable remains undetermined. We require a value for y^2_{T+1} which lies outside the domain of the solution period.

The solution method follows a backward recursive substitution process, similar to a dynamic programming problem. However, an optimal solution for period T is not firstly obtained before moving to backward to T-1. In this case the solution vector is approached simultaneously for all t=1, 2, ... T, but convergence follows a backward process. It is clear, by continuous backward substitution, that the end period solution for y^2 depends on the vector of exogenous variables for all periods, on the lagged (starting) values of y^2 given at the beginning of the solution period and on the fixed set of terminal conditions. And also, the starting period solution for y^2 depends in the same way on all future values of the exogenous variables, the initial lagged values of y^2 and the set of terminal conditions.

CHAPTER SIX

STABILIZATION POLICY AND POLICY EVALUATION

6.1 Introduction

Lucas (1976) asserts that it is probably impossible to use existing econometric models to evaluate the consequences of alternative policy scenarios. This arises because the parameters of the model are likely to change under alternative policy regimes and it may not be possible to determine the new correct values of the parameters at the time of the policy change. It also follows that the Lucas critique provides an explanation for the observed instability in coefficients of econometric models. Hence estimated parameters derived under old policies are inappropriate in simulating new policies[14].

Clearly, regarding to the Lucas critique, the appropriate procedure for the model builder is to ensure that the estimated equations in the model are behaviourial equations whose predictions are stable across regime changes and that expectations are explicitly modelled. As Minford and Peal (1983) argument, this problem is easier to solve in principle than in practice.

One reaction to this problem, such as Hansen and Sargent (1980), Sargent (1978, 1981), has been to assert that only the parameters of preferences and technology will

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[14] There are examples for the Lucas critique in Lucas (1976), Begg (1982), Cuthbertson and Taylor (1987), and Minford (1992).

be regime invariant and that macroeconomists should therefore estimate these parameters. The purpose of this sort of works, with little empirical attempts and too restricted for macroeconomic policy evaluation, is to retrieve the aggregate parameters of utility and production functions at the microeconomic level for intertemporal optimizers subject to budget and technology constraints[15].

Another reaction has been to model expectations explicitly[16]. According to this argument the parameters of structural equations will change as regimes change, but the major impact of regime change will be felt in the expectations variables rather than the parameters themselves.

Sims (1979) and Wallis (1980) argued that there is no practical possibility of policy evaluation and the best way is the estimation of time series models. However, it is clear that time series models are not structural and cannot be used for fully evaluation or forecasting when regimes change, but they are relatively cheap for forecasting when regimes are constant.

When there is no satisfactory alternative for policy evaluation, the second line of arguments are more significant, that to model expectations as a half-way house can carry out useful policy evaluation and forecasting under conditions of structural change.

Thus, with this consideration we turn to examine the impacts of stabilization policies in the Iranian economy under the rational expectations model. To explain how

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[15] About the literature of representative agent models see Sargent (1987) and Minford (1992).

[16] This approach has been adopted for example in the Liverpool model, see Minford and Peal (1983) and Minford *et al* (1984). Other examples are Blanchard and Wyplosz (1981), Taylor (1979a), and Holly and Zarrop (1983).

the model behaves, we consider the responses to, a monetary, a fiscal, and a external (oil price) shock, using the diagrammatic presentation based on the *LM-IS-PP* and *WW* (financial assets) or *XX* (current account) curves and on the simulation results.

6.2 A Stylized Version of the Model

In order to understand the interactions in the model, it is helpful to have a stylized framework in diagrammatic form. As Chapter 4, there are in fact five main sets of relationships embedded in the model:

(*i*) Aggregate supply (*PP* curve). This can be written as:

$$\log y = AS\ (RXR\ ,\ \ p - Ep\ ,\ \ (y\text{-}y^{*})_{-1}) + \log y^{*}$$

(*ii*) Aggregate demand (*IS* curve). We can write this as:

$$y = AD\ (RXR\ ,\ \theta/y\ ,\ r_f\ ,\ eg\ ,\ T,\ P_{oil}\ /\ P_f)$$

(*iii*) Money equilibrium (*LM* curve).

$$p = LM\ (y\ ,\ \ RXR\ ,\ \ r_f,\ ,\ M)$$

(*iv*) Uncovered interest parity.

$$r = r_f + E\ RXR_{+1} - RXR \qquad ; \qquad RXR = S + P_f - P$$

(S: The parallel market exchange rate, positive change is an depreciation)

(*v*) Long term external balance (*XX* curve).

$$0 = XX\ (y\ ,\ \ RXR\ ,\ \ r_f\ \ ,\ P_{oil}\ /\ P_f)$$

This condition can also be used to supply the private sector financial wealth relative to GDP (*WW* curve):

$$\Delta (\theta / y) = (psbr + r \,.\, b + r_f \,.\, b_f - m \,.\, \Delta \log p) / y$$

$$- ((\theta + b_f) / y) \,.\, \Delta \log y - \Delta (b_f / y)$$

The model moves back into steady state by external deficits reducing private sector assets and so aggregate demand until there is again external balance.

The above five stylized and summary equations contain the essential elements for understanding the model. In the output/real exchange rate[17] quadrant, the *PP* curve slopes upwards and is shifted to the right by unanticipated inflation (the Phillips curve effect). The *IS* curve slopes downwards, with exogenous shift terms such as government spending and world conditions, it shifts to the right as private financial assets rise. The *XX* curve slopes downwards and its slope depends on trade elasticities to real exchange rate, RXR. The *LM* curve slopes downwards in the price/income quadrant and it shifts outwards with a lower RXR and with exogenous rises in world interest rates and money supply.

6.3 Monetary Policy

According to the supply side of the model, the monetary transmission process depends crucially on the responsiveness of real wages to price changes, the relationship between real wages and real exchange rate, the impacts of real

[17] Here same the model positive change of the nominal exchange rate is a depreciation of the home currency.

depreciation of the domestic currency on output, and finally on the movements of real financial assets.

The estimated parameters of the model, (Chapter 5), show that the effect of real wages on the real exchange rate, as its low coefficient, is not high. It can be explained first by the structure of the Iranian non-oil production function in which the capital stock is utilized mostly by imported raw materials (as dependency of the economy to imported goods through the oil export) rather than labour.

Secondly, as the current account of such oil exporting economy that imports are financed mostly (more than 90 percent) by the oil export revenue, real depreciation is not too effective (as low trade elasticities to real exchange rate). On the other hand, the real exchange rate is related only to non-oil export goods that are less than 10 percent of total exports.

The result of a monetary shock is illustrated in Figures 6.1 and 6.2. An unanticipated rise in the money supply (once-for-all) shifts the *LM* curve outwards. This raises prices, which shift the *PP* curve outwards and reduces the real value of financial assets, θ, shifting the *IS* curve inwards. The output expansion (the Phillips curve effect) is offset by *IS* curve movements (as reduction of the real value of financial assets). Thus, in the short run an unanticipated monetary policy is ineffectiveness but there is a sharp rise in prices, a depreciation in real exchange rate and a fall in nominal interest rates.

Subsequently, the economy settles on the stable path back to equilibrium shown by the arrows in Figure 6.1. The stable path then is characterized by the *PP* curve shifting leftwards and the *IS* curve first shifting leftwards as the real value of financial assets, θ, falls, and then, once *IS/PP* intersection is to the left of the *XX* curve,

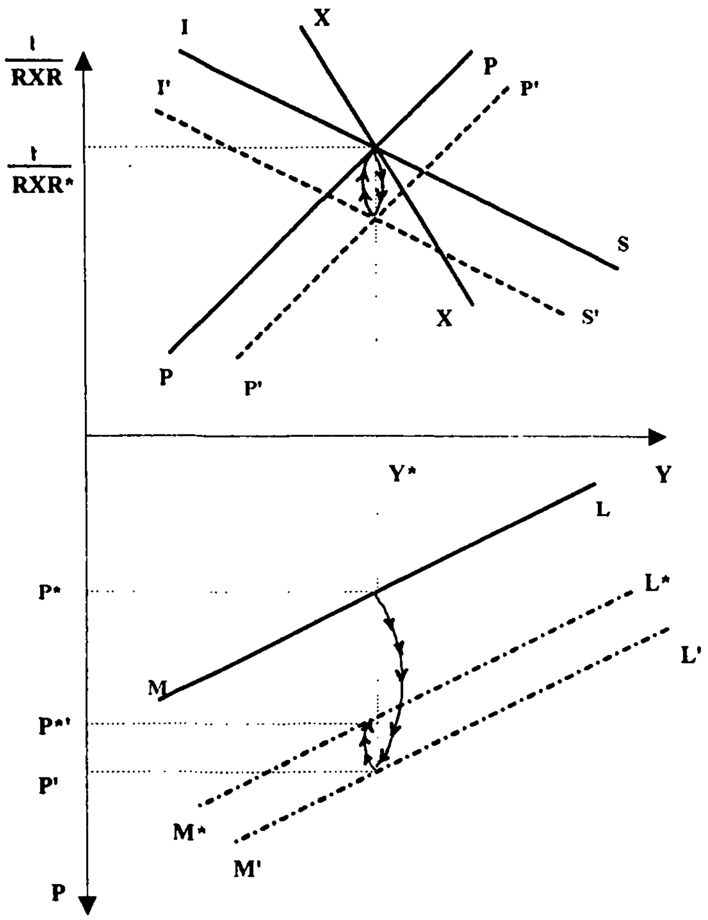
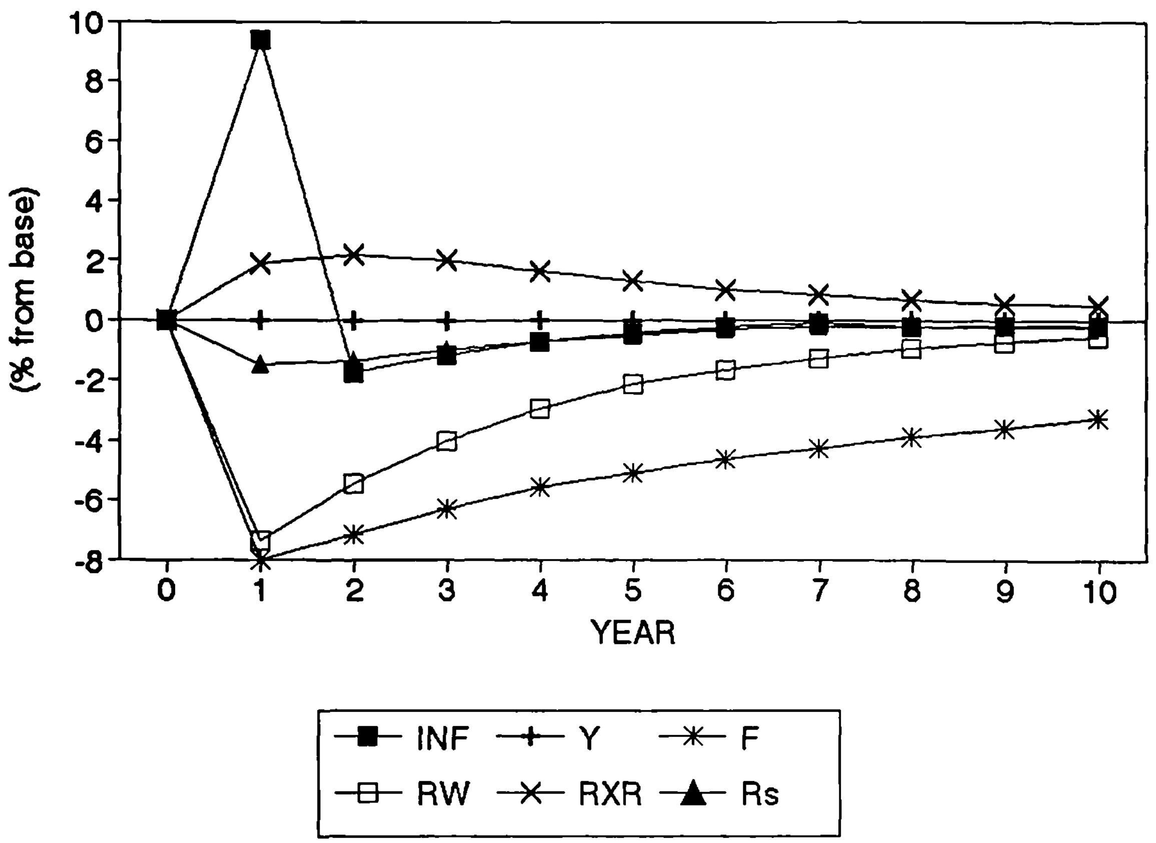


Figure 6.1: Once-for-all rise in money supply.

Figure 6.2: Once-for-all rise in money supply by 10%, in year one



shifting rightwards up the *PP* curve. the *LM* curve shifts back to its long-run position (L^*M^*), as the effect of rising wealth dominates that of settling interest rates. In equilibrium the economy returns to exactly the same real and nominal interest rates, real exchange rate, real financial assets and output as before but the price level (*P*) is higher by the rise in money supply. Figure 6.2 shows this path in a simulation of the full model for a 10 percent rise in the money supply, for the main variables.

The simulation results show that the effect of surprise inflation, (because of an unanticipated monetary shock feeding through the contract based Phillips curve), on output is not too significant but it is positive. On the other hand, this positive effect is offset by a wealth effect. Thus, based on the Iranian economic structure, a once-for-all rise in money supply, (an unanticipated shock, with unchanged government spending), has no short or long-run effects on output.

6.3 Government Budget Deficits Financing

To examine of the fiscal policy effectiveness, a key factor is the method of financing. In this model two basic ways of financing sustained deficit are considered, by bonds or money. However, in both ways the terminal condition set in the model forces the growth of bonds and money to be equal in steady state (balanced financing)[18].

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[18] For more details about balanced financing in the steady state, see Chapter 4.

Temporary rise in government expenditure:

Money financed deficit

In a temporary money financed deficit (Figure 6.3), the *LM* curve moves out and generates strong rises in prices. This shifts the *PP* curve out and depreciates RXR. However, the *IS* curve shifts outwards because the direct expansionary effects of government spending well dominate the negative wealth effects (due to higher p). The *IS/PP* intersection will then produce a current account deficit. When the shock is withdrawn, the lower θ remains, pushing *IS* to the left. The economy then moves along the path picked out by the *IS/PP* intersection. The *LM* curve shifts out further as RXR returns to equilibrium.

Figure 6.4 shows the simulation result of the temporary money financing as a rise in government expenditure by 1 percent of GDP. Money financed deficit in the short run causes the real exchange rate depreciation (0.5%), the positive output (0.8%), the inflationary shock (2.5%), that depresses real wages, the current account deficit and so high foreign debt, and the private financial assets reduction.

Temporary rise in government expenditure:

Bond financed deficit

In a temporary bond financed deficit (Figure 6.5), the *IS* curve shifts rightwards to I'S'. This appreciates RXR and causes a low inflation which shifts the *PP* and LM curves a little outwards. The current account goes into deficit and θ rises because the real public sector deficit more than offsets the effect on private assets of this external deficit. When the shock is withdrawn, the *PP* curve shifts back as real wages return to equilibrium. The *IS/PP* intersection from then on gradually returns to the original equilibrium, as θ falls given the continuing current account deficit. Meanwhile, the LM curve shifts out to L*M* as RXR returns to equilibrium.

Figure 6.6 shows the simulation of the temporary bond financing as a rise in government expenditure by 1 percent of GDP. Inflation is not affected significantly (0.3%). There is a slight rise in real interest rates , fall (appreciation) in the real exchange rate (0.5%), positive output (0.8%) and a current account deficit while the deficit is occurring. In steady state there is no change.

Permanent rise in government expenditure:

Money, bond, and balanced financed deficit

In Figure 6.7 a permanent deficit financed by bonds and money growing at the same rate (*balanced financed*) is illustrated. The *LM* curve shifts out and continues to shift out period by period. The *PP* curve shifts out because of the resulting unanticipated inflation. The negative wealth effects are offset by the positive effects on *IS* of higher public spending and *IS* shifts, a little, outwards. The current account goes into deficit and the *IS/PP* intersection lies on the right of the *XX* curve. Balanced financing ensures that once inflation has settled down to its steady state rate, the *IS/PP* intersection is driven back to equilibrium by financial assets, θ, recovering.

The simulations on the model shown here consist of:

(*i*) a permanent deficit expansion with pure bond financing for the first five years, followed by balanced finance. This can be thought of as combining Figures 6.5 and 6.7.

(ii) a permanent deficit expansion with pure money financing for the first five years, followed by balanced finance, a combination of Figures 6.3 and 6.7.

In Figures 6.8 to 6.14 we show the main features of such policy simulations. The key point that emerges is that the degree of money financing in the short run (which is taken to be five years for simulation) crucially affects the real exchange rate, the current account, and so foreign debt, the path of inflation, and output. The effects of short-run money financing can be described as follows:

The more short-run money financing

(i) The more depreciated the real exchange rate will be during transition. The greater inflationary shock depresses real wages and increase competitiveness (lowers relative non-traded goods prices).

(ii) The smaller the current account deficit, the lower is foreign debt during transition.

(iii) The higher is inflation short-run, but because of terminal conditions, terminal inflation is lower.

(iv) The lower the size of output multipliers over the transition period, because the inflation tax is higher. Of course, the pattern of multipliers within this lower overall average is also shifted; there are higher impact multipliers the higher is money financing in the short-run, because there is a bigger inflationary shock causing a consequently larger unanticipated shift in the supply curve. Thus, there are no any stable relationships between the sustained higher deficit and output multipliers.

Table 6.1 summarizes the main results of different deficit financing policies based on the simulation of a temporary or a permanent rise in government expenditure. The key point in different deficit financing policies is the trade off between pure bond financing and pure money financing. Bond financing with good short-term performance, high output multipliers and low inflation, but at the expenses of poor long-term performance because of the foreign debt, forces higher long-run monetization and lower long-run output. A permanent bond financing policy can generate an unsustainable level of foreign debt. In this case a stable solution for the economy can be found only by imposing tax changes or rates of monetization.

In all cases the judgement of markets in assessing policy prospects, is very important. When a deficit policy appears to markets to be unsustainable, then markets assess the long-term prospects on the basis of sustainable policy outcomes that can be expected by markets. However, in the short-term violent changes of direction increase uncertainty which will cause a crisis of confidence reflected in sharp movements of money and interest rates. Thus, in the simulations of a permanent expansion of deficit we have arbitrarily chosen five years as the period for transitional policy before the balanced finance steady state policy is reached.

Table 6.1: Main simulation results from deficit policy.

	Permanent			Temporary	
	Money financed	Bond financed	Balanced finance	Money financed	Bond financed
Output multipliers (one year)	+	+	+	+	+
Output multipliers (six years)	weak +	weak +	weak +	0	0
Current account (short-term)	weak -	-	weak -	-	-
Current account (over six years)	0	-	weak -	0	0
Inflation (short-term)	strong +	+	+	strong +	weak +
Inflation (long-term)	+	+	+	0	0
Real exchange rate[1] (one year)	+	-	weak +	+	-
Real exchange rate (six years)	weak +	-	weak +	0	0

1 log RXR = logS + $\log P_f$ - logP, positive ΔlogS is an depreciation of the home currency.

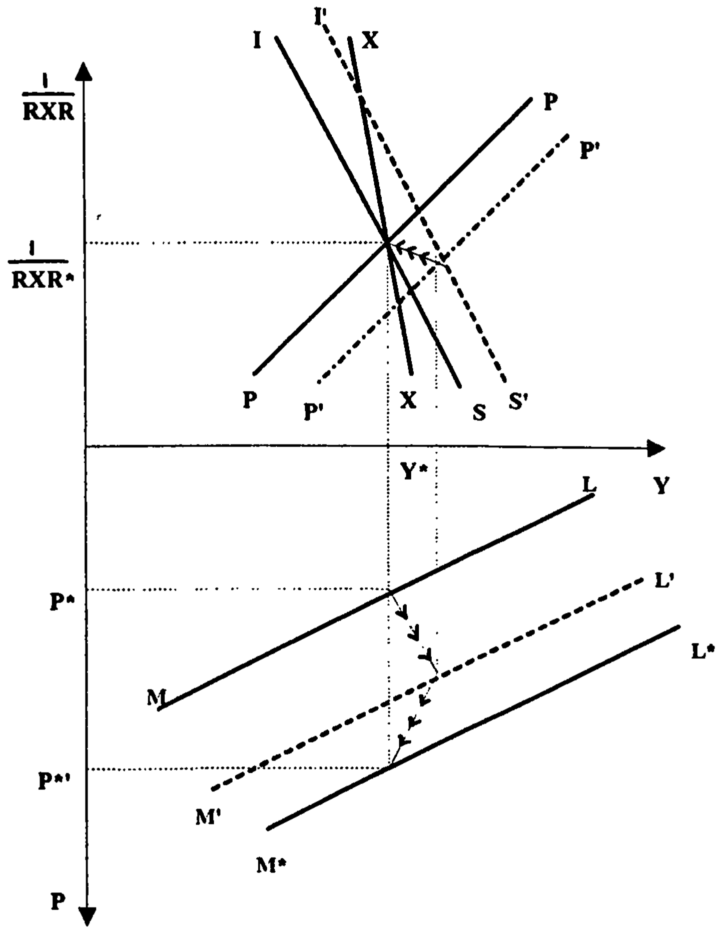
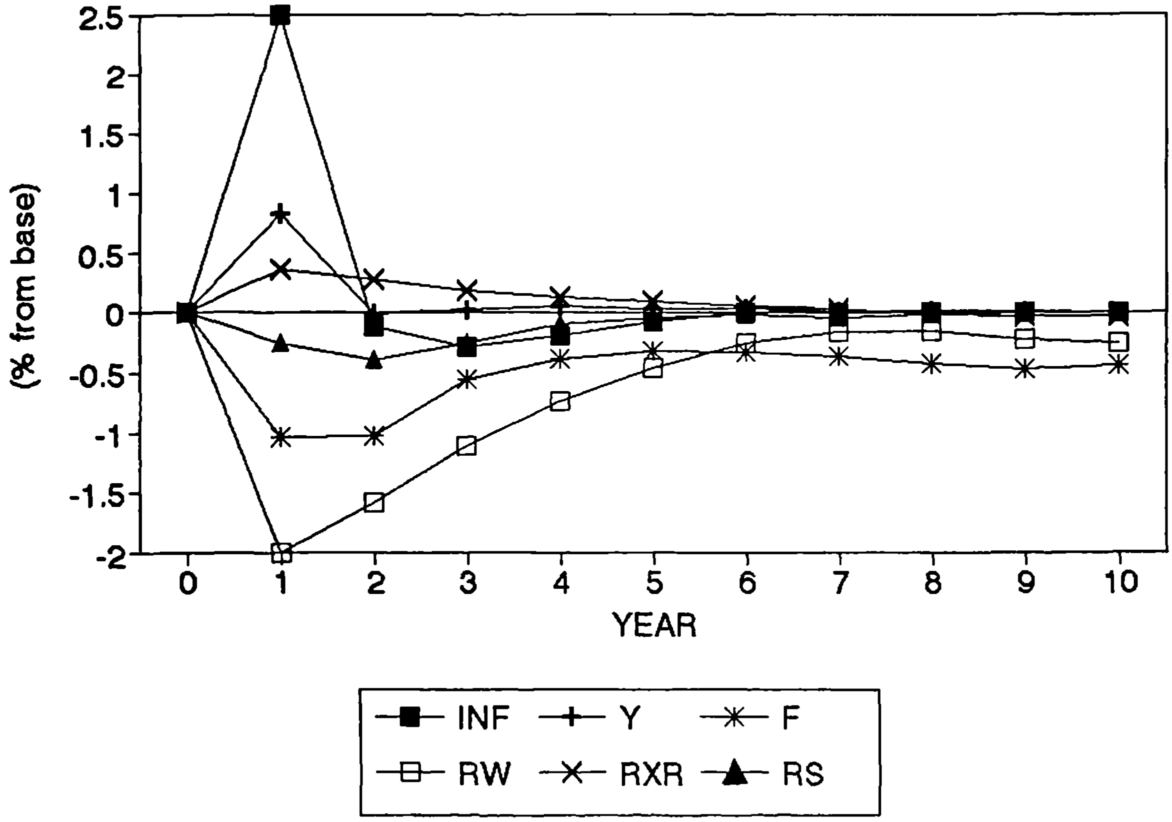


Figure 6.3: Temporary money financed deficit.

Figure 6.4: Money financed deficit
Temporary rise in gov. exp. (1% of GDP)



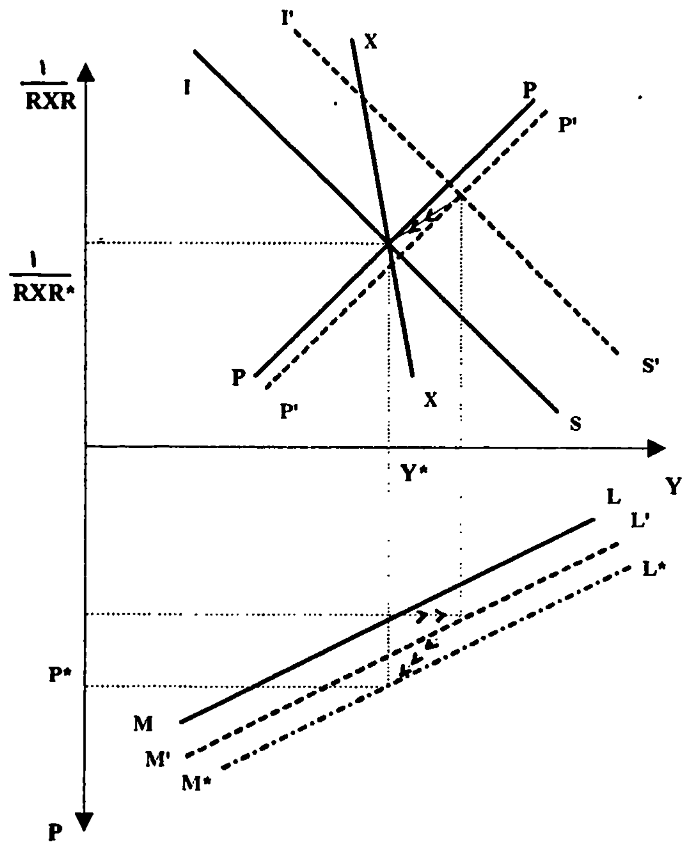
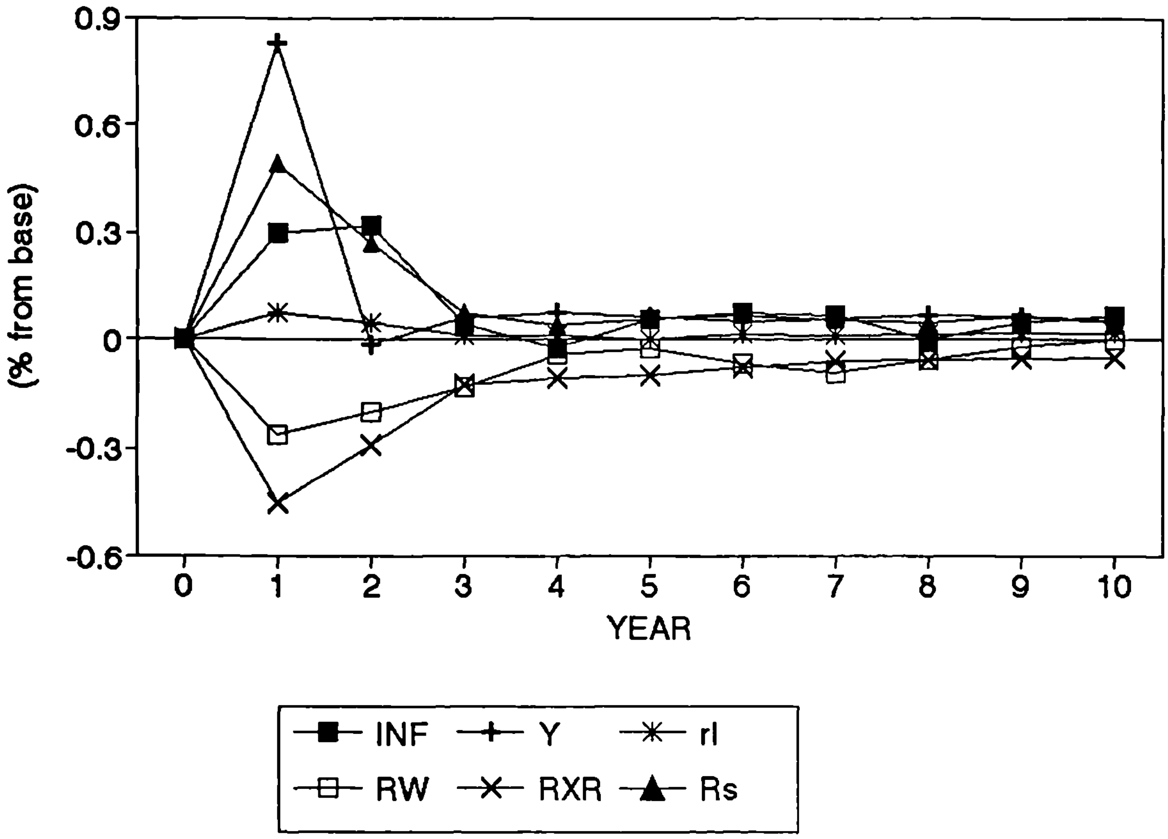


Figure 6.5: Temporary bond financed deficit.

Figure 6.6: Bond financed deficit
Temporary rise in gov. exp. (1% of GDP)



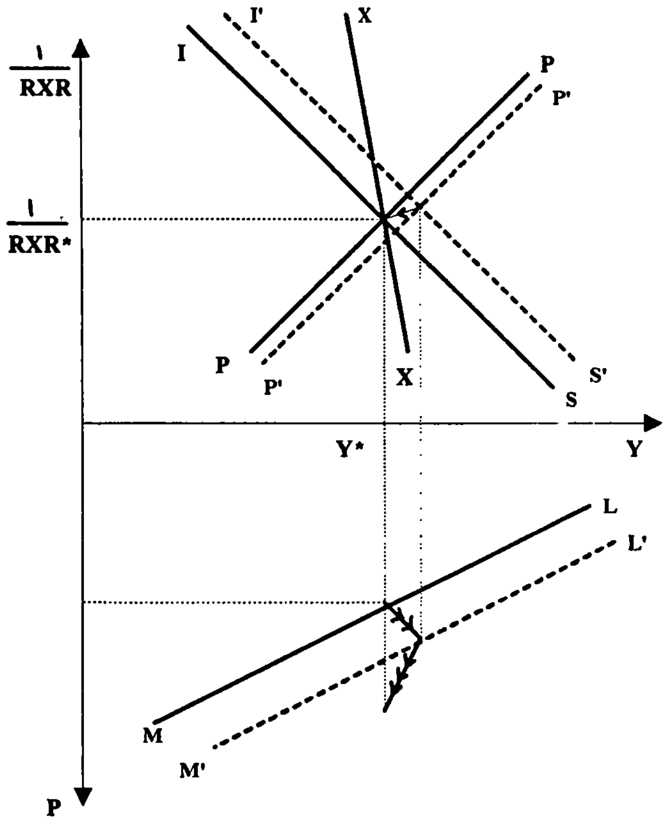


Figure 6.7: Balanced finance permanent deficit.

Figure 6.8: OUTPUT
Permanent rise in gov. exp. (1% of GDP)

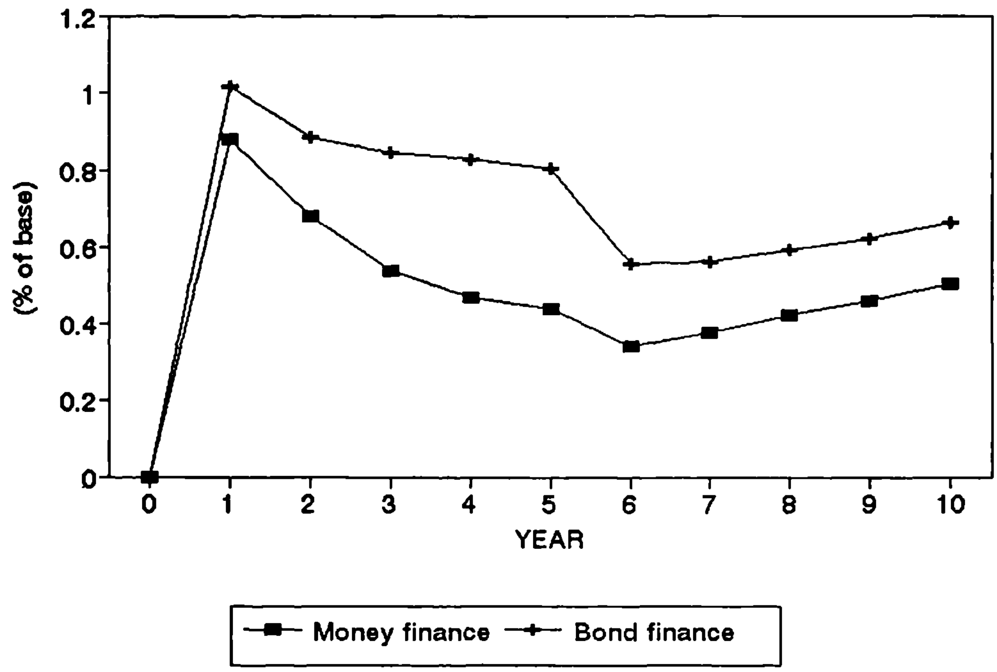


Figure 6.9: INFLATION
Permanent rise in gov. exp. (1% of GDP)

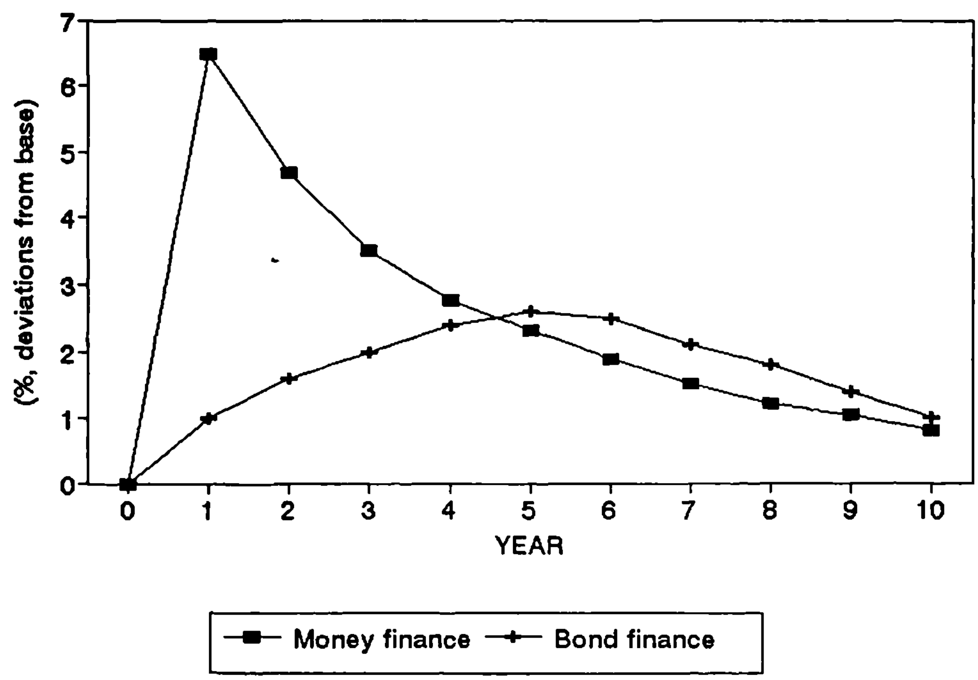


Figure 6.10: NOMINAL INTEREST RATE
Permanent rise in gov. exp. (1% of GDP)

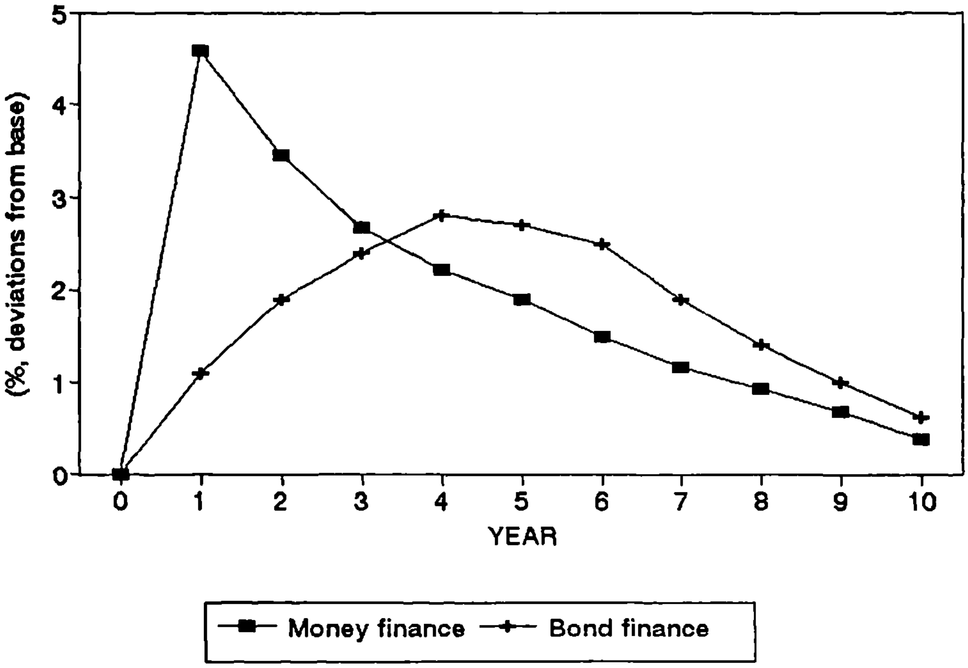


Figure 6.11: REAL INTEREST RATE
Permanent rise in gov. exp. (1% of GDP)

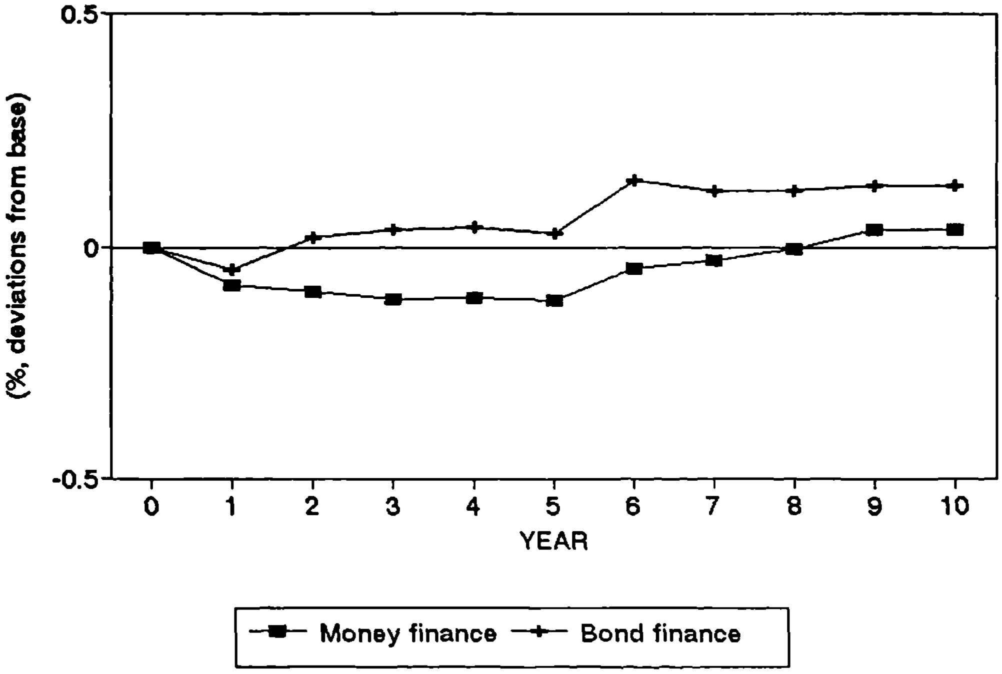


Figure 6.12: REAL EXCHANGE RATE
Permanent rise in gov. exp. (1% of GDP)

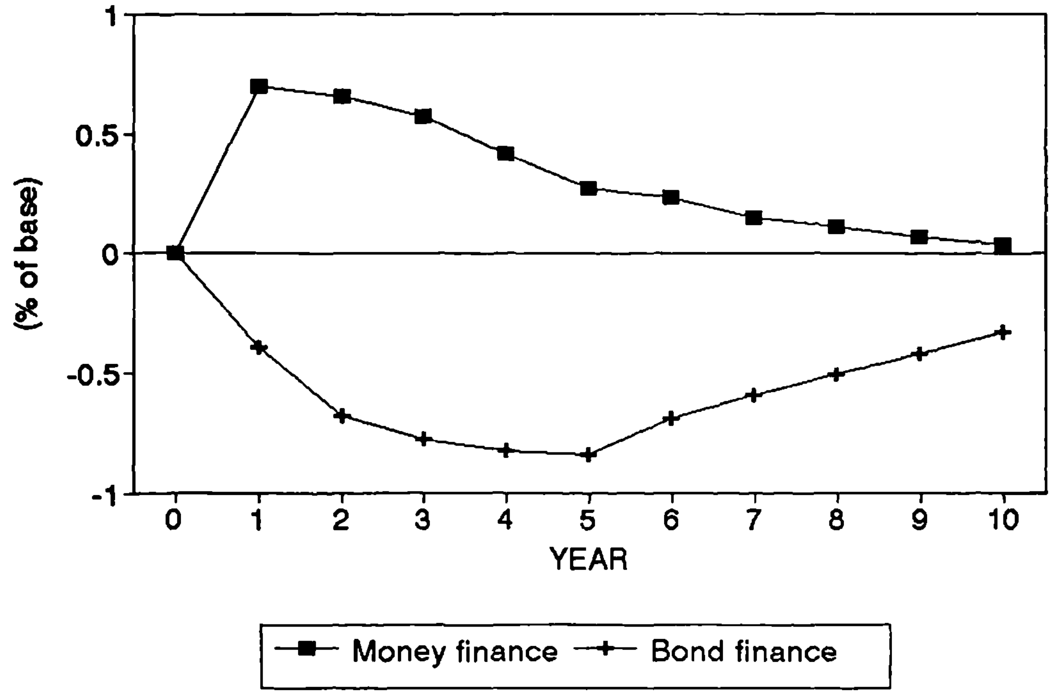


Figure 6.13: NOMINAL EXCHANGE RATE
Permanent rise in gon. exp. (1% of GDP)

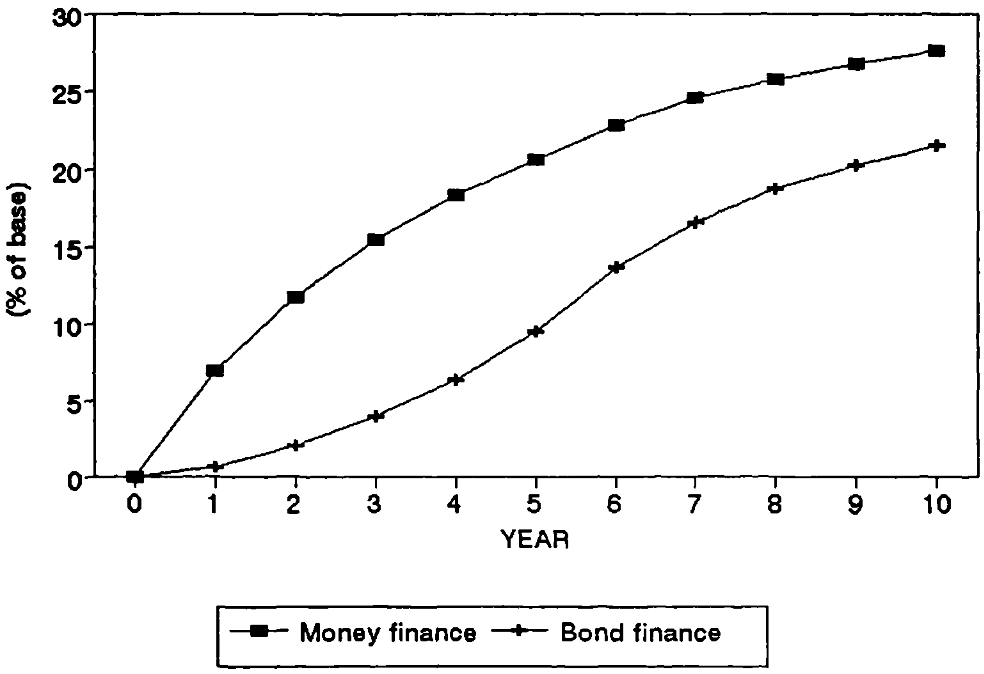
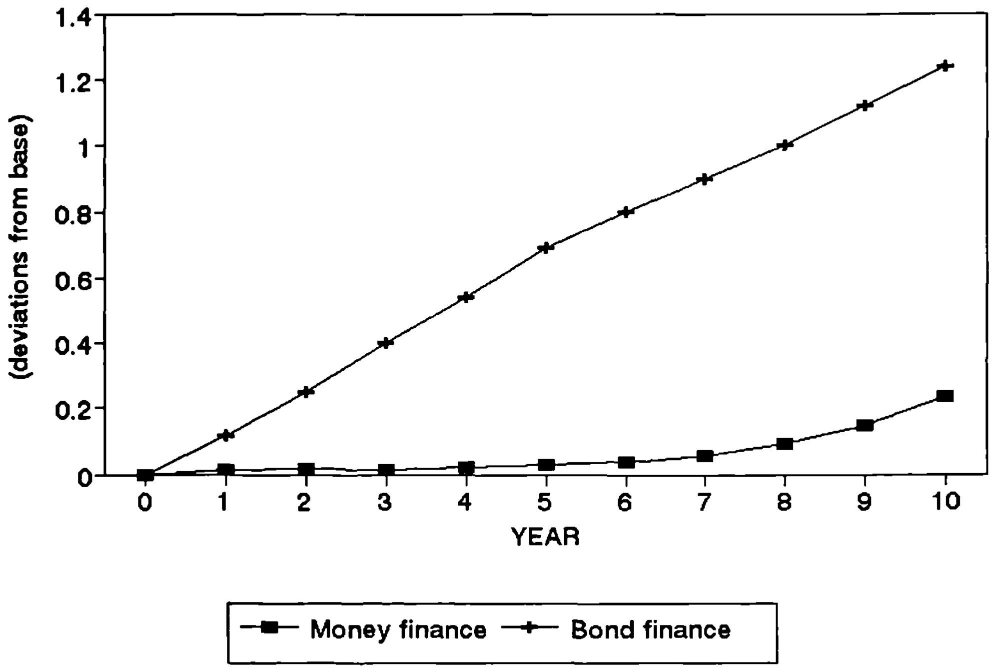


Figure 6.14: FOREIGN DEBT (% of GDP)
Permanent rise in gov. exp. (1% of GDP)



CHAPTER SEVEN

POLICY RESPONSE TO THE OIL PRICES SHOCK AND DUTCH DISEASE ANALYSIS

7.1 A Temporary Fall in the Oil Price

Large swings in the price of oil which have occurred during the past two decades have substantially affected the Iranian economy. This section explores the macroeconomic effects of a large fall in the price of oil. The scenario for the oil price trend and OPEC behaviour is based on the discussion of Chapter 4, thus the real oil price (the crud oil price deflated by foreign prices) is constant. Figure 7.1 shows the oil price path with a temporary fall in the real oil price by 30 percent in year one.

The macroeconomic consequences

Figures 7.2 and 7.3 represent the macroeconomic impacts of a fall in the oil price. There is no economic policy response in this scenario. The current account moves into deficit and so rises the foreign debt. As a high dependency of government expenditure to the oil export, the government deficits to GDP rise 2.5% because of a dramatic fall in the government oil revenue. It is assumed that there is no change in foreign exchange reserves and government deficits finance by pure monetization as a dominant fiscal policy of the government during the last two decades. Thus, oil price shock boosts inflation initially more than 5% and causes an initial drop in output about 2% because of the negative wealth effect (due to higher price which is offset by the positive Phillips curve effect) and direct effect of current account deficits.

The real exchange rate depreciates 2.5% initially and then moves to the steady state level gradually. However, the nominal exchange rate overshoots 8% and then settles in its equilibrium level with 5% depreciation in subsequent periods.

In the light of these experiences a debate can be arisen over how monetary and fiscal policy should respond. In the next simulation we consider an automatic sterilization policy in order to keep the money supply unchanged. As money supply determination, the monetary consequences of the current account deficits could be offset by money financing of government deficits, which are exactly equal to foreign exchange reserves changes in an oil exporting economy.

Figures 7.4 and 7.5 represent the macroeconomic impacts of the sterilization policy. Inflation rises slowly over the first three years up to 0.5% and then backs to equilibrium gradually in subsequent years. As a low inflation, there is no significant phillips curve effects and private financial assets reduction, thus the output drops same the last simulation. The real exchange rate depreciates 1.5% initially and then moves to steady state, where the nominal exchange rate changes the same initially but depreciates more in the subsequent years (as positive inflation), and finally settles in 2%.

The empirical result shows that money growth targeting (e.g. zero target) as a monetary policy response to oil price shock can improve the economic performance by causing a low inflation and low depreciated exchange rates.

Figure 7.1: Once-for-all fall in Oil price by 20% , in year one

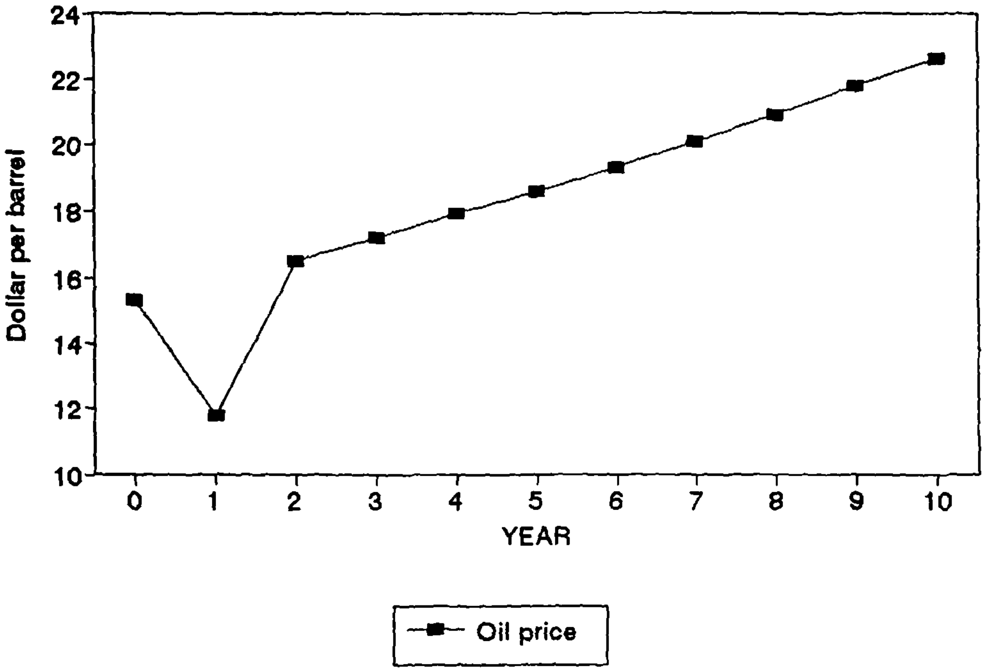


Figure 7.2: Temporary Oil price shock
Money financed deficit

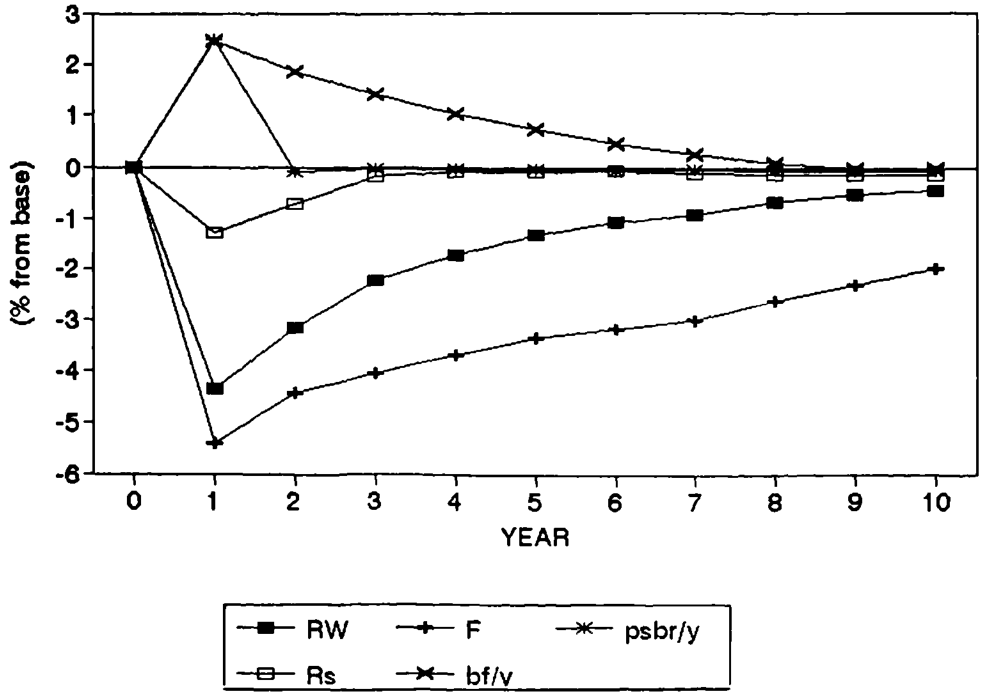


Figure 7.3: Temporary Oil price shock
Money financed deficit

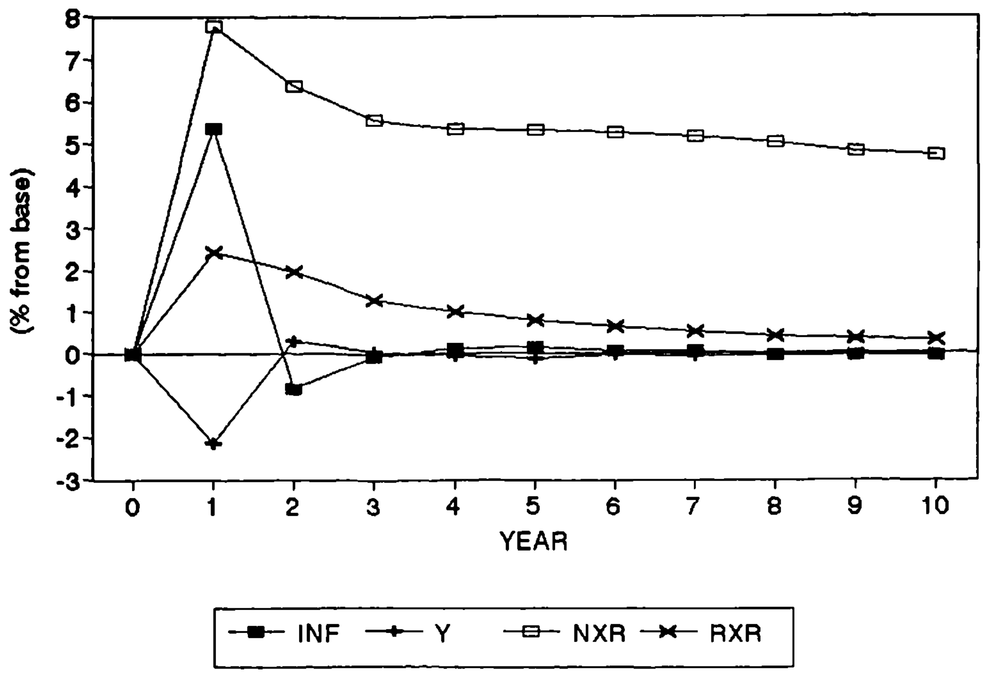


Figure 7.4: Temporary Oil price shock

Sterilization policy effects

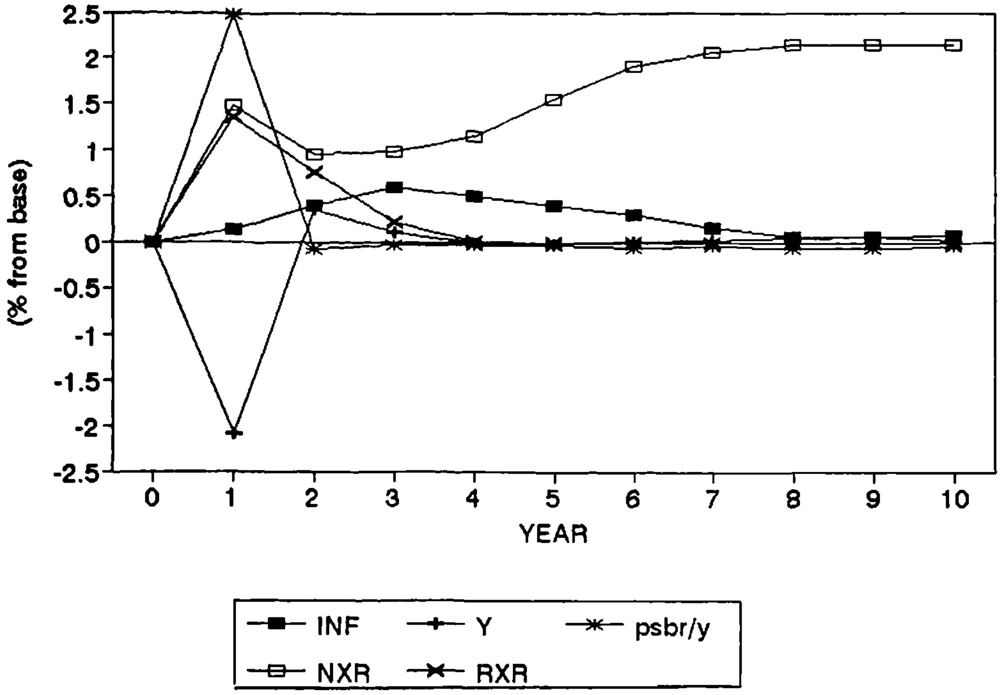
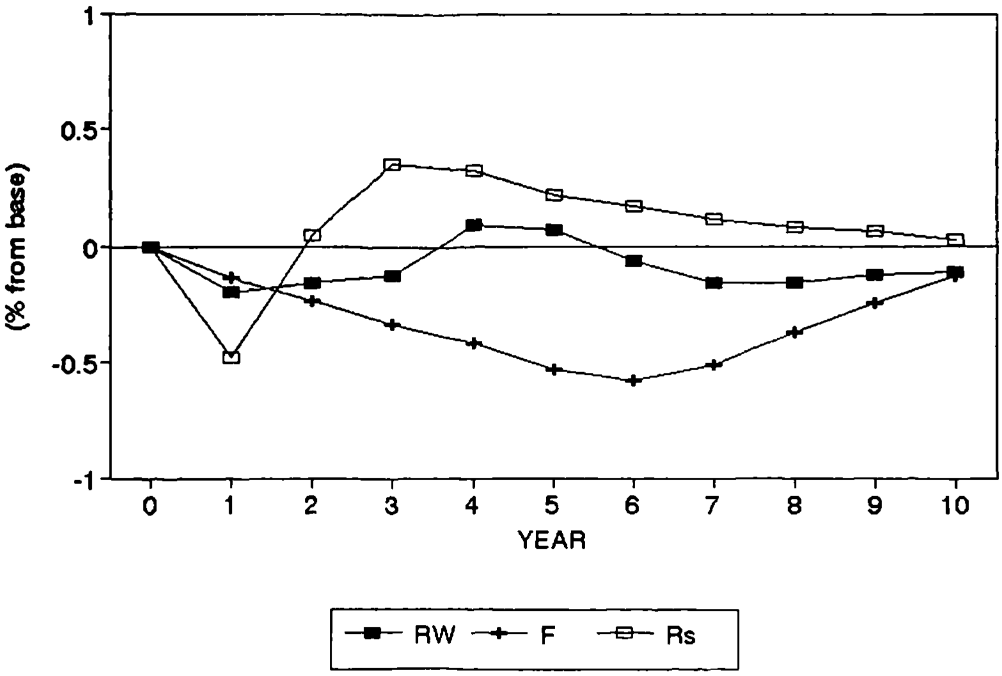


Figure 7.5: Temporary Oil price shock

Sterilization policy effects



7.2 Oil Sector Boom: Dutch Disease Analysis

Introduction

The objective of this section is the empirical study of natural resource booms, by reviewing the theoretical models which have been used to analyse different aspects of the Dutch Disease. The large-scale exploitation of natural resource (e.g. oil) discoveries or an exogenous increases in the prices, is a real rather than a monetary shock to an economy. Its primary impact falls on the level of real income and on the intersectoral allocation of factors of production.

For the most OPEC economies, during the first and second oil price shocks, the windfalls[19] amounted to 24 percent of output in the non-oil sector. In these countries government consumption increased quite substantially and the non-oil sector did not perform well and contrary to policy makers' goals, the non-oil sector did not grow faster than its historical rate. Moreover, the share of the non-oil sector in production actually declined in most of these countries.

The extent of real appreciation after 1972, (the first shock), for the most of these economies are significant. Relative to their average levels during 1970-72, trade-weighted real exchange rates (defined as the ratio of the domestic price levels of the oil exporters to those of their trading partners) converted at average exchange rates were 10 per cent higher during 1974-8, 21 percent higher over 1979-81 and almost 40 percent higher during 1982-83.

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[19] About oil windfalls of oil-exporting countries and their use during higher oil prices see Gelb (1986).

As Gelb's (1986) study, Iran has experienced a large windfall, 36.7 per cent of non-oil GDP between 1974 and 1977 which was reflected in fiscal revenues. On the other hand, non-oil taxes remained fairly steady as a proportion of non-oil income over the first price rise (6.5%) and it decreased slightly with the second because import volumes and trade taxes did not continue to expand. The Iranian government same other oil-exporting developing governments with weak fiscal systems did not take advantage of fiscal respite to set in place non-oil tax systems capable of rising revenues efficiently for the post-oil boom period. In Chapter three we have examined the impacts of oil sector to the Iranian GDP and the real exchange rate appreciation thus, we turn to explain the overall consequences of the Dutch Disease and different policy responds to this disease.

Some Consequences of Dutch Disease

The windfall gains of oil-exporting countries from higher oil prices, which increase their domestic expenditure, has some consequences. First, real exchange rates will appreciate. Secondly, this is associated, in the medium term, with a shift in production structure towards the non-traded sectors, an effect commonly termed the Dutch Disease and leading to greater dependence on oil for foreign exchange. Thirdly, increased domestic investment should raise growth. This might have a negative effect on the real exchange rate appreciation and sectoral composition of non-oil output depending on the efficacy and distribution of capital formation and the factor intensity of various sectors.

The real appreciation that follows the oil boom constitutes a crucial element in all Dutch Disease models. In most cases this real appreciation stems directly from the income effect generated by the boom. The price of oil increases, real income goes up, a proportion of this higher income is spent on non-tradables and the real exchange rate appreciates. As a result production of non-tradable goods increases and production and employment of the rest (i.e. non-boom) tradable sector decline.

It is mentioned in many models to *deindustrialization* as a main consequences of Dutch Disease. However, it is important not to be misled by labels. The key features of the sectors that may be expected to decline are that they are exposed to foreign competition and have little or no ability to set their own prices. Thus, export-oriented agriculture or even service sector may be squeezed and conversely, industries that cater for the home market as a result of trade protection or that have monopolistic price-setting powers in their export markets may benefit from the rise in home demand.

A necessary condition for generating unemployment as another consequence of oil sector boom, is the degree of wage rigidity. In addition, two issues are crucial. The first is the weight of non-traded goods in the consumption basket of wage-earners. If this is sufficiently large, then real wage stickiness will give rise to transitional unemployment following a resource boom.

There are, however, a variety of other important instances where this type of phenomenon is present. Perhaps the most important one is related to the effects of capital inflows on the real exchange rate. As Edwards (1986) the real exchange rate deprotection usually follows the liberalization of the capital account of the balanced of payments. In that regard the recent experiences of the countries of the Latin America are particularly relevant. In the 1970s the capital account in Argentina, Chile and Uruguay, as a part of economic liberalization reforms, was liberalized. Following these reforms all three countries were flooded with foreign capital. As a consequence of this massive inflow of capital, (a fraction of which was used to finance the expansion of the non-tradable sector), the real exchange rate experienced a steep appreciation and the traditional tradables sector was greatly hurt.

Simulation Results of the Oil Sector Boom

In this section, we examine the macroeconomic impacts of Dutch Disease in the Iranian economy by simulation of the model. We consider a short-run oil sector boom as a result of a rise in the oil prices by 20 percent in first five years of simulation period.

In these simulations, as regards to the monetary consequence of oil sector boom and also to consider the oil revenue spending in the supply side of the economy, we have changed the monetary base, MB, and the equilibrium level, or capacity of the economy, y^*, equations of the model.

The new monetary base equation describes the process of money creation relating to Central Bank lending to the public sector, and to the foreign reserves. This assumption captures the fact that in the Iranian economy the creation of money is an important source of financing for government deficits, and also considers the foreign reserves effects, due to current account surplus, during the oil sector boom.

In order to capture the impacts of oil sector boom to capacity of the economy in the long-run (y^*), in policy respond simulation, y^* depends on the real oil prices rather than the time trend.

Figure 7.7 represents the simulation of the oil sector boom in a short-term. The real oil price rises by 20% in year one, the price level is fixed in first five years, and then returns to original level in year six (figure 7.6). As a result output rises more than 2 percent per annum during the shock mostly because of direct effects of the oil export boom and government spending. One of the main features of the Iranian economy, as Chapter two, is that a change in oil prices simultaneously affects not only the balance of payments current account position, but also and more importantly the government budget, since oil and non-oil income are taxed at substantially different rates. As monetary consequences of current account surplus, (or non-sterilization policy), monetary base rises that causes unexpected inflation about 2.5 percent in the year one which gradually returns to the original equilibrium. The real exchange rate appreciates during the shock and when the shock is withdrawn then returns to the steady state level. The short-term nominal interest rates rise initially and then fall gradually because of expected appreciation in the real exchange rate and on the other hand, expected low inflation. Thus, there is a fall in real balances that moves back to the original steady state.

The overall result, (real exchange rate appreciation), can be illustrated by same diagrammatic method of Cuthbertson and Taylor (1987)[20] through the phase diagram in figures 7.8 and 7.9.

Assume the saddle-path in real exchange rate and real money, (RXR , m), space with the original equilibrium at point A, (constant level of competitiveness, constant foreign prices, and the long-run level of real money). Now consider the effects of a long-run shock in the oil price, (a rise by 20 percent in year one and then fixed real price level in subsequent years, figure 7.10). The equilibrium real exchange rate

[20] Cuthbertson and taylor's (1987) analysis in Chapter 5 about the effects of a natural resource discovery, (oil) on the real economy is based on a version of Buiter and Miller's (1982) model.

appreciates immediately, and as high inflation (due to current account surplus and non-sterilization policy) and high nominal interest rates the real money falls. In the long-run, competitiveness must have worsened because the permanent income value of current oil production affects the demand for non-oil output, with y^* fixed. Clearly, the long-run equilibrium real money stock must be higher because of the increased transactions component of the money demand.

The dynamics of the economy are illustrated in figure 7.8. The system is initially in long-run equilibrium at point A. Following the shock and after the overshooting of the RXR to point B, the long-run equilibrium is at point C, and hence there is a shift in the saddle-path to pass through this point.

Regarding to the rational expectations assumption, now consider agents actually know that the high oil prices fall and would therefore eventually return to its original equilibrium level. Assume that the real oil prices will be returned in exactly six-periods' time (e.g. figure 7.6). Agents therefore know that the correct, stable position for the economy to be on immediately after the oil prices are returned is somewhere on the original saddle-path, through point A.

Considering the arrows of motion of the new saddle-path in figure 7.9, it can be seen that if the economy moves to any point between A and B, it will eventually arrive back on the original saddle-path. However, there will be a unique point between A and B (point E in figure 7.9) such that it takes exactly six periods to arrive back on the original saddle-path (at point F). Thus, if the oil shock will eventually be withdrawn, the economy will find itself in long-run equilibrium at point A. In the short-run, however, there will be a real exchange rate appreciation and high inflation (in case of non-sterilization policy).

Figure 7.6: The oil sector boom
(A short-run rise in the oil prices)

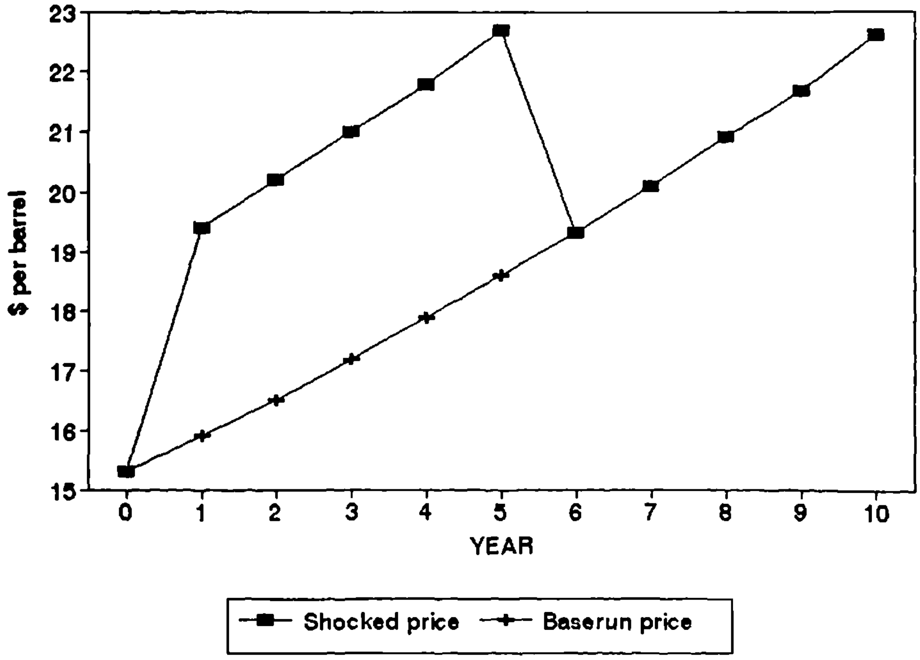
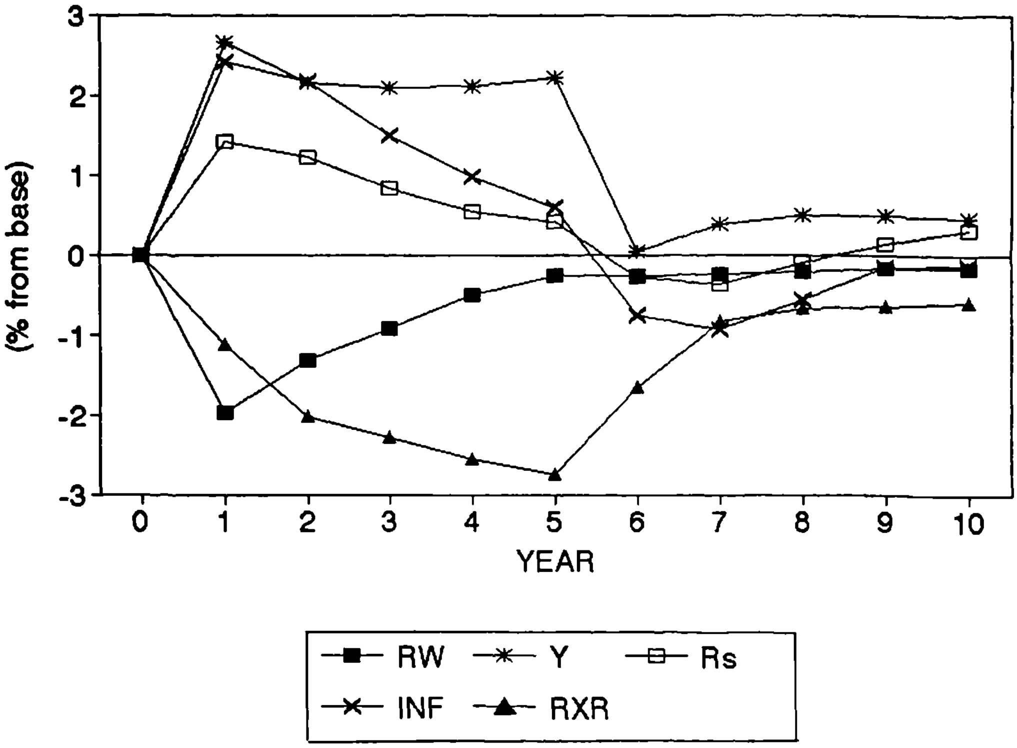


Figure 7.7: The effect of oil boom
(A short-run rise in the oil prices)



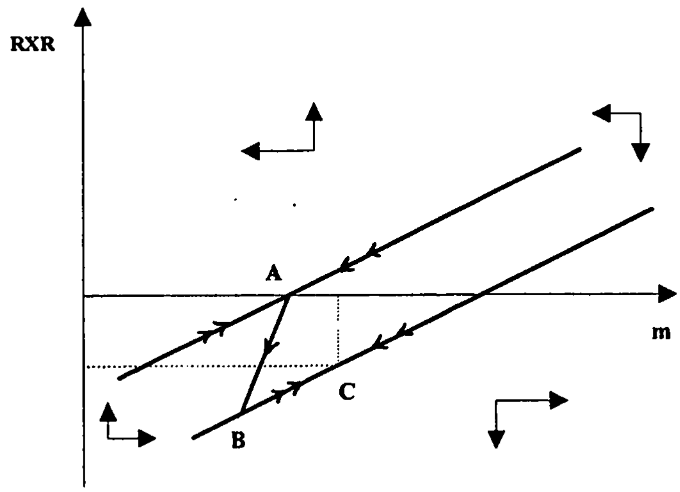


Figure 7.8: The effect of a permanent oil sector boom.

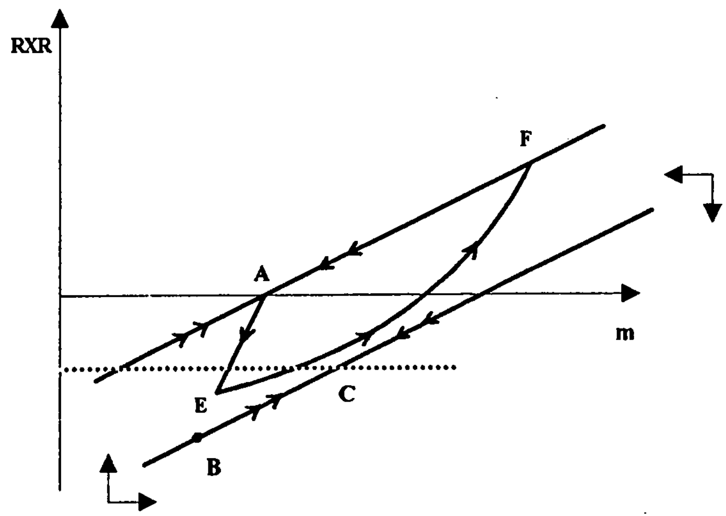


Figure 7.9: The effect of a short-run oil sector boom.

Policy Response To Dutch Disease

Policy responses to Dutch Disease phenomenon may be classified in two categories. First, monetary mechanisms in the short-run and secondly, structural changes in the supply side of the economy. Commodity export booms can have important short-run monetary effects, which will spill over to the real exchange rate. The oil sector boom will typically result in a balance of payments surplus and in the accumulation of international reserves. If this increase in reserves is not sterilized, the monetary base will increase and an excess supply of money may develop. In this case the final effect will be inflation. This increase in the price level will, in general, be one of the mechanisms through which the real appreciation will actually take place. It is possible, however, for the short-run increase in the rate of inflation to exceed what is required to bring about the equilibrium real appreciation generated by the export boom.

In the Dutch Disease context, two aspects of monetary policy require attention. The first relates to the money supply, the second to the exchange rate. It has been argued that a resource boom which is met by a restrictive monetary policy may lead to a recession (Buiter and Purvis, 1983; Neary and van Wijnbergen, 1984). Neary (1985) has called the mechanism giving rise to this the liquidity effect of a resource boom. Essentially, if the nominal stock of money remains constant, the spending effect of the boom is dampened by the increase demand for real balances. The exact channels depend on the exchange rate regime and on price and wage adjustment mechanism.

Of course the extent of the real appreciation depends on the marginal propensity to spend on non-tradables. It is important to notice, however, that if substitution effects are allowed the other possible results emerges. If it is assumed that the excess demand for non-tradable goods depends both on the relative prices of non-oil tradables and oil, and if it is assumed that oil and non-tradables are complements, an oil boom can result in a real depreciation rather than a real appreciation.

Here we argue about alternative ways of spending oil revenues in LDCs which might be preferable in order to smooth the benefits of the oil windfall over time. Consider a dominant exporter of an exhaustible natural resource (i.e. oil). It can do three things with the resource. It can leave it underground. It can extract it and export it. It can extract it and feed it into domestic production of goods and services. As regards savings and investment the country can invest in building up domestic capital and it can hold foreign assets. Assume that the country in question is small in the international capital market. In dynamic equilibrium the nation will clearly allocate the resource that the domestic rate of return on investment equals the international interest rate that is assumed exogenously given. So it must be analyzed what policy will keep the domestic rate of return pegged to it.

Of course domestic capital accumulation along an equilibrium path depends on domestic substitution possibilities between durable capital and resource input, and it also depends on domestic technological progress, but the main point is that resource input into domestic production (as well as resource exports) must decline to zero in the long-run because the resource is exhaustible. As regards the latter, expansion and protection (or promotion) of export-oriented manufacturing sector by rising the optimal level of subsidy seems most important policy respond to the oil sector boom.

This sort of intervention policy at the industrial or sectoral level can be justified because there is some market failure which implies a divergence between private and social valuations.

Of course the simulation of such policy is not completely possible by the model, so for simplicity, we consider spending of the oil revenue for expansion of supply-side of the economy during the oil sector boom. Assume that capacity of the economy, y^*, or the long-run equilibrium output, is related to the real oil price (oil price deflated by foreign price), thus in this case y^* is not fixed and increased during the oil sector boom.

Figure 7.11 represents the effects of a long-run rise in the oil prices (real prices rise by 20% in year one and fixed in subsequent years, figure 7.10). As regards the long-run shock, output rises and settles in 5% growth rate in the steady state, $y = y^*$. The real exchange rate depreciates initially and then returns to the original equilibrium. As a high real income, the real money rises and offsets the effect of current account surplus on inflation, thus there is a negative inflation (-1%) during the shock.

As a final point it should be added that not only our model but also other theoretical and empirical models in Dutch Disease literature are highly incomplete. Many other issues need to be taken into account to enhance our understanding of the process of structural change, in the oil-exporting developing economies, resulting from the oil sector boom and no doubt further works will emerge to fill this gap.

Figure 7.10: Oil sector boom
(A long-run rise in the oil prices)

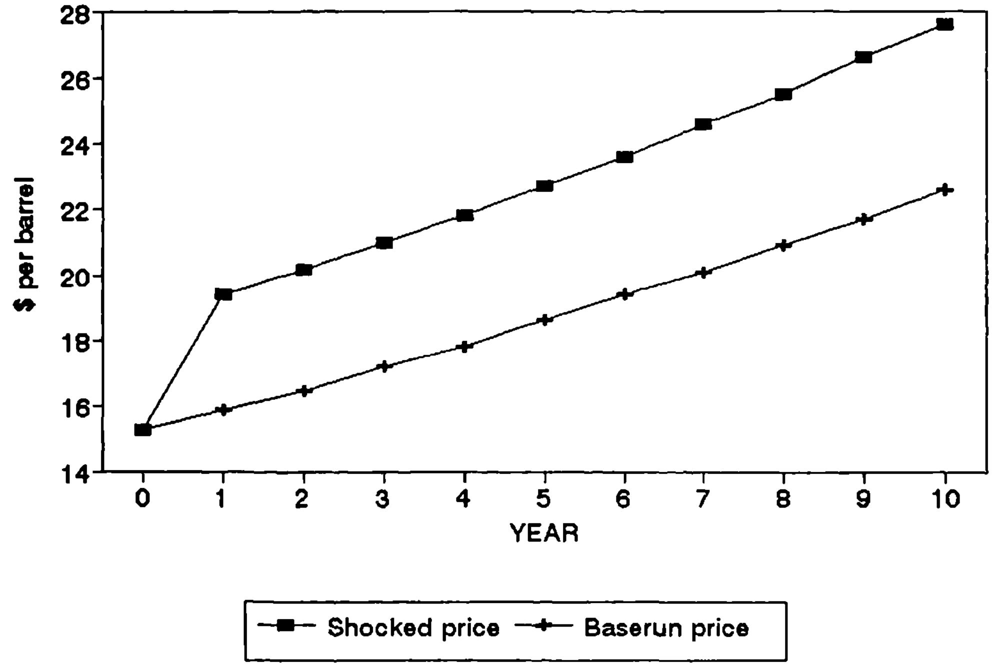
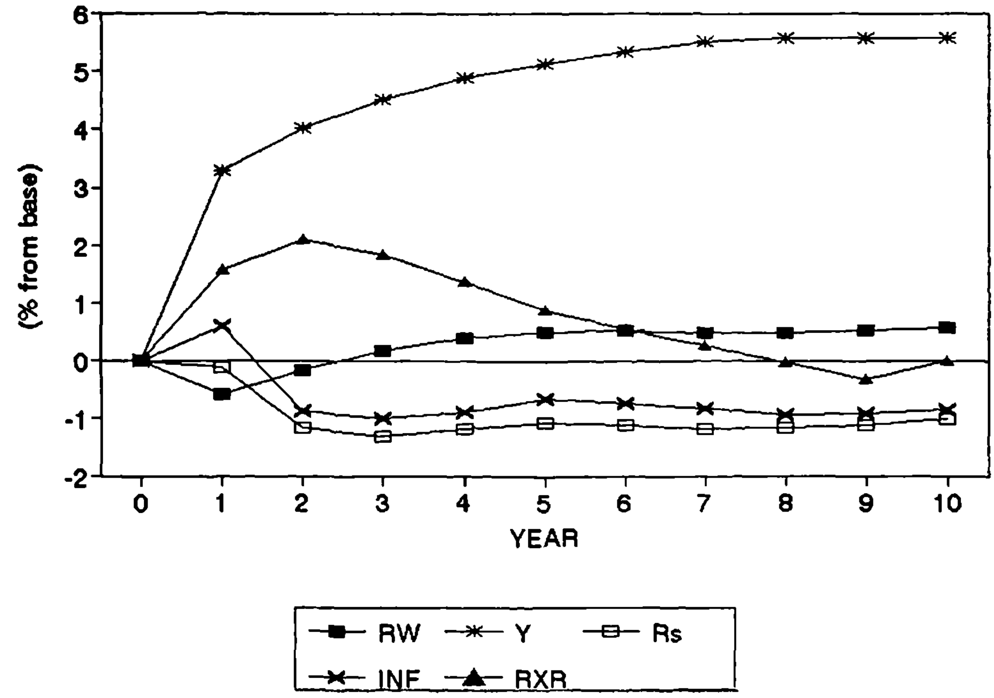


Figure 7.11: Oil sector boom
Policy response to RXR appreciation



CHAPTER EIGHT

SUMMARY AND CONCLUSIONS

8.1 OBJECTIVES OF THE STUDY

The object of this thesis is to analyze the impact of stabilization policy in an *oil-exporting-developing* economy under a *rational expectations* macroeconomic model, through a study of the Iranian economy.

The research is concerned with the construction of a macroeconometric model for the purpose of simulating and forecasting the major macroeconomic variables of Iran as an oil-exporting developing country. Expectations are given a key role and modelled by the rational expectations method. In this way the model uses an effective methodology for analyzing the effects of alternative government policies under conditions of structural change, within the empirical limitations of building a *fully structural* model.

We examined the impacts of monetary and fiscal policies under different forms of government deficit financing, and policy response to the oil prices shock. Hence, Chapters 2 and 3 explained the general characteristics of oil-exporting-developing economies and the Iranian macroeconomy in particular. Chapter 4 explained the structure of the rational expectations macroeconomic model of Iran. Chapter 5 discussed the results of estimating the behaviourial equations and testing the full structural model through historical tracking method as an acceptable method for model validation. Chapter 6 examined the central policy issue of stabilization and the impacts of different economic policies. Chapter 7 explained the macroeconomic effects of oil prices shocks and the oil sector booming, known in recent natural resource economics as the *Dutch Disease.*

8.2 STRUCTURE OF THE MODEL

The model is based on new-classical equilibrium theory and the *supply-side* economy and provides an explanation of the *natural rates* of output, real exchange rate, real wages and unemployment. Terminal conditions are used for selecting the unique stable path. The nature of the Phillips curve is contract-based derivation under rational expectations, in which wages are set one period ahead by contract but prices adjust flexibly. The dual exchange rates system, (official and parallel market rates), is considered as an exchange rate policy. Uncovered interest parity with the rational expectations solution determines the real interest differential as a fraction of the parallel market real exchange rate.

Of course, at first sight, it seems that in the Iranian economy interest rates are only domestic market-determined, because of financial repression and capital controls, but our results confirm that in spite of legal and/or political restrictions on capital movements, foreign interest rates and expected changes in real exchange rates have a key role to play in interest rates determination[21].

The model considers wealth (financial and physical assets), the government budget constraint and external debt effects. It is assumed that financial assets are denominated

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[21] Also see Haque *et al* (1993 and 1990) about estimation of a macroeconomic model with rational expectations and capital controls for developing countries. Their empirical analysis suggest that, on average, developing countries have exhibited a high degree of capital mobility and relative prices play their conventional macroeconomic roles in these countries.

in government bonds and domestic money. Private sector holdings of foreign money and bonds may exist; but they are formally treated as holdings of government bonds, the proceeds of which are invested in turn in foreign bonds. Currency substitution will show up in the demand for domestic monetary base. At present, government bonds do not exist. This assumption is made to allow us to evaluate the effects of different financing policies for government deficits.

According to oil price determination and OPEC behaviour, we assume that the oil supply plan is consistent with the oil price target for any demand schedule. The oil residual demand, that depends on exogenous variables and are imperfect correlated with the oil prices, is the critical variable for OPEC or the core producers, thus, the oil market is most competitive when the market is tight and OPEC plays an effective role when the market is weak by directing the oil prices towards a target level or zone, that is assumed to be a constant real oil price level (oil price deflated by foreign price).

8.3 THE MAIN POLICY LESSONS OF RESEARCH

Macroeconomic Management

Historical tracking results of the model in the case of a one period ahead forecast by using information of exogenous and endogenous variables up to and including period t-1, and extopolating data on exogenous variables to include the current period as extra information assert important macroeconomic management lessons. The huge gap between forecast errors in these two cases (figure 8.1) indicates instability of the economy and shows that the Iranian economy is influenced by shocks in every period in which they are not expected by economic agents. As an appropriate comparison with a stable economy, figure 8.2 represents the forecast errors of the Liverpool model for the UK economy in same cases.

These results emphasise first, that government policies should be as *predictable* as possible; higher variances reduce welfare. Secondly, government policies should be as *credible* as possible (i.e. be expected to remain in place as promised for a long period into the future). Clearly, lack of credibility and predictability causes more time inconsistency problem in economic policy making and eventually more instability in the economy.

Monetary Policy

According to the supply side of the model, the monetary transmission process depends crucially on the responsiveness of real wages to price changes, the relationship between real wages and real exchange rate, the impacts of real depreciation of the domestic currency on output, and finally on the movements of real financial assets.

The estimated parameters of the model show that the effect of real wages on the real exchange rate, as its low coefficient, is not significant. It can be explained first by structure of the Iranian non-oil production function which capital stock is utilized mostly by imported raw materials (as dependency of the economy to imported goods through the oil export) rather than labour. Secondly, real depreciation is not too

Figure 8.1
THE RE MODEL OF IRAN

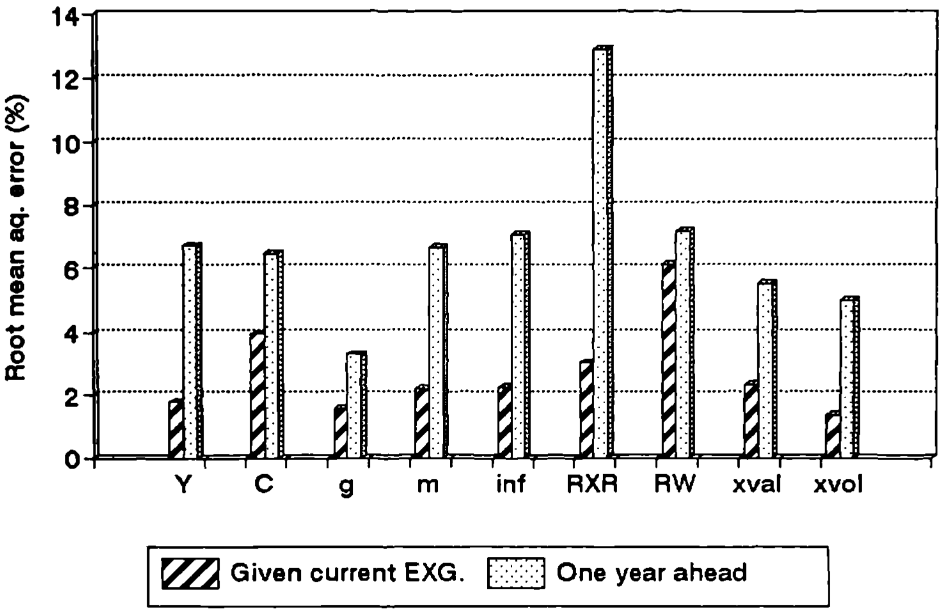
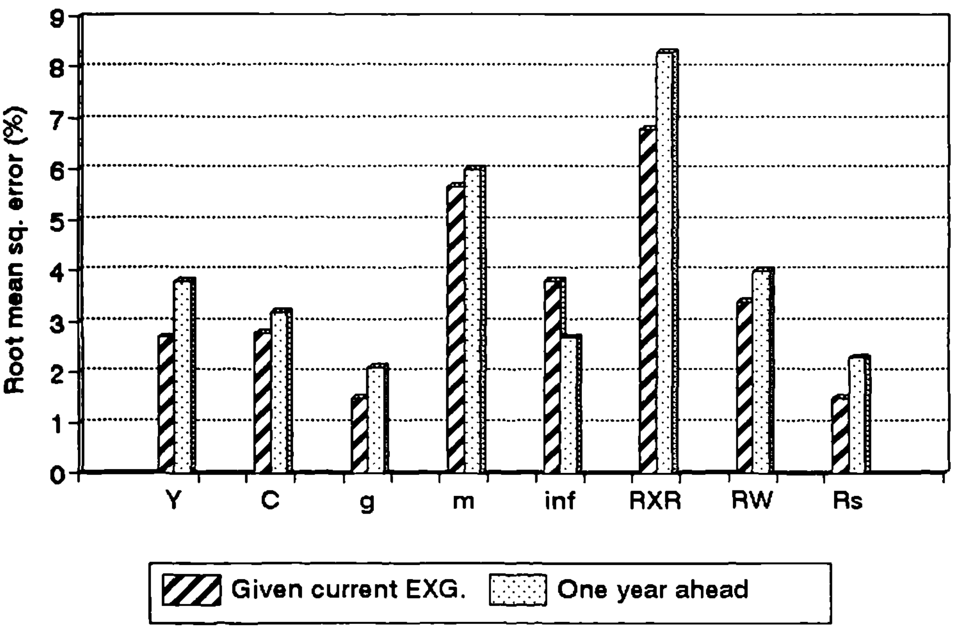


Figure 8.2
THE LIVERPOOL MODEL OF THE UK



effective because trade elasticities to real exchange rate are low, and on the other hand, the real exchange rate is related only to the non-oil export goods that is less than 10 percent of total exports.

The simulation results show that the effect of surprise inflation, (because of an unanticipated monetary shock), through the contract based Phillips curve, on output is not too significant but it is positive. On the other hand, this positive effect is offset by a wealth effect. Thus, a once-and-for-all unanticipated rise in money supply, with unchanged government spending, has no short or long-term effects on output, but there is a sharp rise in prices, a depreciation in real exchange rate and a fall in nominal interest rates in the short-run.

Fiscal Policy

The simulations of different forms of government deficit financing show that the degree of money financing in the short run (which is taken to be five years for simulation) crucially affects the real exchange rate, the current account and so foreign debt, the time path of inflation, and output. The effects of short-run money financing can be described as follows:

The more short-run money financing

(i) The more depreciated the real exchange rate will be during transition. The greater inflationary shock depresses real wages and increase competitiveness (lowers relative non-traded goods prices).

(ii) The smaller current account deficit, the lower is foreign debt during transition.

(iii) The higher inflation is short-run, but because of terminal conditions, terminal inflation is lower long-run.

(*iv*) The lower the size of output multipliers over the transition period, because the inflation tax is higher. Of course, the pattern of multipliers within this lower overall average is also shifted; there are higher impact multipliers the higher is money financing in the short-run, because there is a bigger inflationary shock causing a consequently larger unanticipated shift in the supply curve. Thus, there are no any stable relationships between the sustained higher deficit and output multipliers.

The key point in different deficit financing policies is the trade off between pure bond financing and pure money financing. Bond financing with good short-term performance, high output multipliers and low inflation, but at the expenses of poor long-term performance because of the foreign debt, forces higher long-run monetization and lower long-run output. A permanent bond financing policy can generate an unsustainable level of foreign debt. In this case a stable solution for the economy can be found only by imposing tax changes or rates of monetization.

In all cases the judgement of markets in assessing policy prospects, is very important. When a deficit policy appears to markets to be unsustainable, then markets assess the long-term prospects on the basis of sustainable policy outcomes that can be expected by markets. However, in the short-term violent changes of direction increase uncertainty which will cause a crisis of confidence reflected in sharp movements of money and interest rates. Thus, in the simulations of a permanent expansion of deficit we have arbitrarily chosen five years as the period for transitional policy before the *balanced finance* steady state policy is reached. In other words, monetary and fiscal policy in the long run have to be consistent. This implies that money and nominal bonds must be growing at the same rate.

Interest Rates Policy

Iranian economy same some other developing economies is suffering from inefficient interest rates and financial liberalization policies. As a result of financial repression, (a phrase popularized by McKinnon, 1973; and Shaw, 1973; to describe policies that distort domestic capital markets), real deposit and lending rates are negative that cause adverse consequences for the development of the financial system and for saving and investment generally. The gap between official banking system interest rates and free credit market rates has generated overall and selective credit ceilings. Of course, the higher gap causes the higher influence of the economy from free market and this is confirmed by the significant estimated interst elasticities of real money and real physical assets.

As a remedy, the standard approach suggests establishing positive real rates of interest on deposits and loans by eliminating interest rate ceilings and direct credit allocations and pursuing price stabilization through appropraite macroeconomic and structural policies. The true scarity price of capital could then be seen by savers and investors, leading to a reduced dispersion in profit rates among different economic sectors, improved allocative efficiency, and higher output growth (e.g. see Leite and Sundararajan, 1990).

Clearly, with macroeconomic instability large changes in the prices of goods and factors of production lead to increased variance and positive covariances in returns on investment projects; that is, many or all investment projects would be affected adversly by poor macroeconomic performance. This situation reduces the socially desirble level of real interest rates in the banking sector, and makes financial liberalization more difficult, (see McKinnon, 1988), mostly because of high uncertainty in the economy that increases imperfect information, moral hazard and adverse selection[22] problems in credit market.

In this case, low real lending interset rates have been observed. Where macroeconomic instability interacts with ineffective bank supervision and also with bank-based capital market (case of many LDCs with no equity market), in the presence of moral hazard, banks may well set interest rates at higher and riskier levels (as has been observed in several developing countries in Latin America and Asia, see e.g. Corbo and de Melo, 1985; Cho and Khatkhate, 1989; and Atiyas, 1989).

In case of the Iranian economy with high inflation and macroeconomic instability and on the other hand, with ineffective bank supervision, interest rate liberalization should be gradual. At the same time strong macroeconomic policies with low inflation targeting through an improvement in the financial position of government must be persued. Only after its borrowing requiements are reduced to manageable levels will the government be able to engage in a meaningful interest rate policy in framework of the strong banking system supervision.

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[22] For details about *Credit Rationing models* see Stiglitz and Weiss (1981); Fried and Howitt (1980); Mankiw (1986); and Hillier and Ibrahimo (1993).

Exchange Rate Policy

Since 1979 the Iranian economy has experienced the multiple exchange rates. Over the period 1979-90, the premium (the black market rate for U.S. dollar over the official rate) has been rising at an average annual rate of 42.1 percent, and in 1990, the black market rate for the dollar reached its peak at over 20 times the official rate.

In this exchange rate system, portfolio decisions are strongly influenced by the difference between the free and fixed rates, or the exchange rate premium. The private sector decisions on what proportion of wealth to hold in assets denominated in foreign currency often depend on the expected rate of devaluation of the free rate. Under multiple or dual exchange rate system, even if no current account transactions are subject to the free rate, changes in the free nominal rate will influence the real exchange rate. On the other hand, the system works in almost the same way as a regime of unified predetermined rates, because multiple fixed (official) nominal exchange rates are perfectly equivalent to a unified exchange rate system with taxes on certain external transactions (Dornbusch, 1986). In this case, inconsistent macroeconomic policies will result in a loss of international reserves and an overvaluation of the real exchange rate.

The bilateral real exchange rate for the Iranian rial in terms of the U.S. dollar, regarding to the official fixed exchange rate, over the period 1971-90 represents a definite downward trend since 1972, showing a real appreciation of the official rate during the 1972-90. Over the period 1979-90, (post-revolutionary period), a real appreciation of the Iranian rial is around 12.3 percent per annum, as compared to the figure of 6.6 percent for the 1971-78 period.

The massive overvaluation of the rial, particularly after 1979, under strict foreign exchange controls, has generated high levels of premia on the black market for dollars, in which there is no any benefits for applicable multiple exchange rate system for the economy. As Dornbusch (1986) has argued the multiple exchange rate system can be used successfully as a strictly transitory policy to offset the unfavourable impact of changes in capital account transactions, if the official and the black market rates are not allowed to diverge significantly for any length of time. Of courese, where the divergency of official from the black market rate is too significant the economic system becomes subject to serious microeconomic as well as macroeconomic distortions.

This misalignment as arguments of Krueger (1978) and Edwards (1985c), has created extensive opportunities for rent-seeking activities and result in considerable misallocation of resources. The high level of the black market premium have had important adverse consequences for the real economy and have made the task of controlling import costs through a policy of maintaining a fixed official exchange rate impossible.

Over the past decade about 95 percent of the country's foreign exchange revenues has been achieved by government. In countries, where the government is a net purchaser for of foreign exchange, high levels of the black market premia cannot be sustained for long as exports turn to smuggling and other illegal means to avoid surrendering their export proceeds to the authorities. Eventually the redistribution of rent from exporters to importers will be occurred. Furthermore, in case of imperfect Iran's local capital market, real exchange rate misalignment also has promoted speculation and usually generates massive capital flight out of the country, that it can substantially reduce the social welfare (cuddington, 1986).

The simulation results of our model show the key policy implications of dual exchange rate system, (the model considers weighted average exchange rates of official and parallel markets for imports and parallel market rate for non-oil export estimations). Expansionary monetary and fiscal (with money financing deficits) policies are associated with a more depreciated parallel exchange rate, (through changes in both the transactions and portfolio components of the unofficial demand for foreign currency), while displaying a more persistent pattern. This is because partial rationing in the official market for foreign exchange prevents the balance of payments from playing fully its offsetting role on the money supply. The depreciation in the parallel rate helps eliminate excess real money balances and restore macroeconomic equilibrium. As a consequence, the inflationary impact of expansionary policies is larger, and the output effect is smaller, than they would be an economy without foreign exchange rationing.

The second major implication of exchange rate policy based on the simulations of the model is, that an official devaluation has no short or long-run effect on the premium, (because the parallel exchange rate depreciates proportionately), if official real exchange rates remain unchanged due to offsetting of devaluation effect by expected inflation. Only real exchange rate devaluation results an appreciation in parallel market rate[23].

Montiel and Ostry (1991) argued about macroeconomic implications of real exchange rate targeting in developing countries. A main result of their study is that choosing a target for the real exchange rate that avoided increasing the rate of inflation would involve detailed knowledge of a variety of structural relationships in the economy, something most policymakers would find difficult to obtain. Also the experience of exchange rate policies in developing countries during the 1980s, as Corden's (1993) study, show that making an exchange rate commitment is risky because there may be a failure of discipline or of credibility, or both. This hapenes mostly because of foreign exchange intervention as such is pointless in a regime of monetary targets since it will have to be exactly offset by changes in domestic credit (Minford, 1981). In other words, targeting on both money supply and real exchange rates are inconsistent.

All these debates indicate that the Iranian dual exchange rate system must be moved towards the unified floating regime. Of course, because the initial level of the premium is high, this reform should be set by the feasible speed of monetary and fiscal reforms (improvement of government deficit position, low monetary growth and low inflation targeting). Accelerating rates of depreciation above prevailing inflation in the absence of credible fiscal and monetary policies could result in perverse black market premium response.

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[23] These results are confirmed by some other studies about dual exchange rate system in developing countries, e.g. see Pinto (1991), Agenor (1990) and Kamin (1988).

Policy Response to a Temporary Fall in the Oil Prices

Large swings in the price of oil which have occurred during the past two decades have substantially affected the Iranian economy. The simulation results of a temporary fall in the real oil price show that the macroeconomic consequences of oil price shock are important. The current account moves into deficit and so rises the foreign debt. As a high dependency of government expenditure to the oil export, the government deficits to GDP rise because of a dramatic fall in the government oil revenue. It is assumed that there is no change in foreign exchange reserves and government deficits finance by pure monetization as a dominant fiscal policy of the government during the last two decades. Thus, inflation rises and the real exchange rate depreciates initially and then moves to the steady state level gradually. However, the nominal exchange rate overshoots and then settles in its equilibrium level with depreciation in subsequent periods. There is an initial drop in output about because of the negative wealth effect (due to higher price which is offset by the positive Phillips curve effect) and direct effect of current account deficits.

In the light of these experiences a debate can be arisen over how monetary and fiscal policy should respond. We considered an automatic sterilization policy in order to keep the money supply unchanged. As money supply determination, the monetary consequences of the current account deficits could be offset by money financing of government deficits, which are exactly equal to foreign exchange reserves changes in an oil exporting economy. The macroeconomic impacts of sterilization show that this policy causes the same output but low inflation and low depreciated exchange rates. Thus, money growth targeting (e.g. zero target) as a monetary policy response to oil price shock can improve the economic performance.

Oil Sector Boom: Dutch Disease Analysis

The simulation of the oil sector boom represented the consequences of Dutch Disease phenomenon in the Iranian economy. As a rise in the real oil prices in short-term, output rises during the shock mostly because of direct effects of the oil export boom and government spending. One of the main features of the Iranian economy is that a change in oil prices simultaneously affects not only the balance of payments current account position, but also and more importantly the government budget, since oil and non-oil income are taxed at substantially different rates. As monetary consequences of current account surplus, (or non-sterilization policy), monetary base rises that causes unexpected inflation which gradually returns to the original equilibrium. The real exchange rate appreciates during the shock and when the shock is withdrawn then returns to the steady state level. The short-term nominal interest rates rise initially and then fall gradually because of expected appreciation in the real exchange rate and expected low inflation. Thus, there is a fall in the real balances that moves back to the original steady state.

The real appreciation that follows the oil boom constitutes a crucial element in all Dutch Disease models. It is mentioned in many models to *deindustrialization* as a main consequences of Dutch Disease. However, it is important not to be misled by labels. The key features of the sectors that may be expected to decline are that they are exposed to foreign competition and have little or no ability to set their own prices. Thus, export-oriented agriculture or even service sector may be squeezed and conversely, industries that cater for the home market as a result of trade protection or that have monopolistic price-setting powers in their export markets may benefit from the rise in home demand.

A necessary condition for generating unemployment as another consequence of oil sector boom, is the degree of wage rigidity. In addition, two issues are crucial. The first is the weight of non-traded goods in the consumption basket of wage-earners. If this is sufficiently large, then real wage stickiness will give rise to transitional unemployment following a resource boom.

Policy responses to Dutch Disease phenomenon may be classified in two categories. First, monetary mechanisms in the short-run and secondly, structural changes in the supply side of the economy. Commodity export booms can have important short-run monetary effects, which will spill over to the real exchange rate. The oil sector boom will typically result in a balance of payments surplus and in the accumulation of international reserves. If this increase in reserves is not sterilized, the monetary base will increase and an excess supply of money may develop. In this case the final effect will be inflation. This increase in the price level will, in general, be one of the mechanisms through which the real appreciation will actually take place. It is possible, however, for the short-run increase in the rate of inflation to exceed what is required to bring about the equilibrium real appreciation generated by the export boom. Of course, in the Dutch Disease context, two aspects of monetary policy require attention. The first relates to the money supply, the second to the exchange rate. In other words, the exact channels depend on the exchange rate regime and on price and wage adjustment mechanism.

There are alternative ways of spending oil revenues in LDCs which might be preferable in order to smooth the benefits of the oil windfall over time. Consider a dominant exporter of an exhaustible natural resource (i.e. oil). It can do three things with the resource. It can leave it underground. It can extract it and export it. It can extract it and feed it into domestic production of goods and services. As regards savings and investment the country can invest in building up domestic capital and it can hold foreign assets. Assume that the country in question is small in the international capital market. In dynamic equilibrium the nation will clearly allocate the resource that the domestic rate of return on investment equals the international interest rate that is assumed exogenously given. So it must be analyzed what policy will keep the domestic rate of return pegged to it.

Of course domestic capital accumulation along an equilibrium path depends on domestic substitution possibilities between durable capital and resource input, and it also depends on domestic technological progress, but the main point is that resource input into domestic production (as well as resource exports) must decline to zero in the long-run because the resource is exhaustible. As regards the latter, expansion and protection (or promotion) of export-oriented manufacturing sector by rising the optimal level of subsidy seems most important policy respond to the oil sector boom.

This sort of intervention policy at the industrial or sectoral level can be justified because there is some market failure which implies a divergence between private and social valuations.

Of course the simulation of such policy is not completely possible by the model, so for simplicity, we consider spending of the oil revenue for expansion of supply-side of the economy during the oil sector boom. Thus, in this case capacity of the economy, y^*, or the long-run equilibrium output, is related to the real oil price (oil price deflated by foreign price).

Empirical result of the model represented that as a long-run rise in the oil prices, output rises and settles in a higher growth rate than original equilibrium, $y=y^*$. The real exchange rate depreciates initially and then returns to the original equilibrium. As a high real income, the real money rises and offsets the effect of current account surplus on inflation, thus there is a low negative inflation during the shock.

Oil Prices and OPEC Policy

By assumption of the oil prices instability as one of main sources of economic shocks, there are some factors which may be taken into account to improve the OPEC strategy. It suggests that the core producers need to concern themselves with long and medium-term forces and developments that influence the volume of residual demand. It is not sufficient to focus exclusively on the current state of the market and to limit the scope of the policy to *ad hoc* changes in prices or production programs.

The broader approach that is required involves three important elements. First, attempts can be made to anticipate the impact of certain exogenous factors on residual demand. Of course, there are events such as wars and accidents which cannot be easily predicted. Other developments such as an exogenous increase in fringe supplies can be anticipated. It is also possible to form a view in advance on the future effects of energy and macroeconomic policies of consuming countries on demand. The assessment will never be very accurate but may usefully signal the direction of changes.

Secondly, the relationship between oil price changes and the growth of the world economy deserves continuing study. This relationship is critical because it determines to a large degree the short/medium-term impact of oil prices on demand.

Thirdly, the core producers need an explicit policy relating to capacity expansion because they cease to be price makers when they run out of production capacity. It is thus essential to plan capacity expansion in such a way that a reasonable cushion is always maintained. This requires great attention to good forecasting and a degree of co-ordination among core producers on investment in capacity. Another element that as a core producers policy can be set is a safety net. Mabro (1992) argued that the core producers would be able to cope more easily with the low residual demand situation if they were then able to enlarge the size of the core because attempts to secure the co-operation of others through persuasion usually fail and attempts to force producers to join the core group through a price war cause damage to all parties. Thus the classic co-operative solution is to set up a compensation scheme or safety net.

As a final point it should be added that our model is highly incomplete. Many other issues need to be taken into account to enhance our understanding of the process of structural change, in the oil-exporting developing economies, and no doubt further works will emerge to fill this gap.

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