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by

MICHAEL MASSOURAKIS

A dissertation submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1983

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This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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TO THE MEMORY OF MY FATHER

Abstract

INFLATION AND STABILIZATION IN A SMALL OPEN
ECONOMY: THE CASE OF GREECE, 1960-1980

by

MICHAEL MASSOYRAKIS

Advisor: Professor Alvin Marty

Two models are developed and tested with data of the Greek economy for the period 1960-1980. The first theoretical construct adopts a generalized exchange rate regime approach to domestic inflation, the rate of change of the nominal exchange rate and flows of international reserves, within the framework of the monetary approach to the balance of payments. The degree of flexibility of the exchange rate regime is explicitly modelled and estimated for the Greek economy. The second model deals with short run macroeconomic stabilization problems when the economy is continuously disturbed by price shocks which tend to temporarily dislocate the manifestations of inflationary pressure from their long run paths as analyzed in the first model and to destabilize real output from its full-employment level. Monetary accommodation and nominal exchange rate policies are assessed as stabilization tools and their opportunity costs are evaluated with respect to the Greek economy.

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CHAPTER I

INTRODUCTION

The inflationary process, as an economic phenomenon, has attracted considerable amount of theoretical and empirical attention. There is widespread agreement among economists that inflation is basically a monetary phenomenon. There is some discord as to whether the monetary process actively generates inflationary pressures or rather passively validates inflationary disturbances. But the long-run monetary character of inflation could hardly be disputed.

In an open economy, monetary pressures of domestic or foreign origin will be reflected in the long run, not only in the rate of domestic inflation, but also in the state of the balance of payments and in the relative position of the domestic currency vis-a-vis foreign currencies. In the short run, moreover, unanticipated inflationary disturbances may affect the real side of the economy and, thus, stabilization considerations become important.

In this paper, two models are developed. The first pertains to a body of theoretical propositions known as the monetary approach to the balance of payments. The model is useful in analyzing the determinants of the long-run parameters of the inflationary process. The other model is constructed to account for short-run deviations of the inflation rate and other symptoms of the inflationary pressure from trend.

The monetary approach to international adjustment processes, concerning various manifestations of monetary imbalances arising in an economically interdependent world, is a coherent set of theoretical propositions whose utility lies in providing testable hypotheses about the behavior of such monetary aggregates as the balances of payments, the rate of inflation, the exchange rate and the money supply process.

The monetary approach dates back to the writings of the philosopher David Hume (1752), while its modern revival is due to seminal contributions by Mundell (1968, 1971), Johnson (1972) and Dornbush (1973). The central propositions of the monetary approach to international adjustment restore the role of the quantity of money as the centerpiece of the theoretical analysis of balance of payments disequilibria and exchange rate determination while reiterating the monetary character of inflation and elucidating the mechanism of the international transmission of inflation.

The basic tenets of the monetary approach rest on the idea that the society exhibits a relatively stable demand for real cash balances, given the rates of growth of real output and of velocity. Any disturbance that alters the rate of growth of the money stock or the rate of inflation will set in motion forces to rectify the imbalance and reestablish the rate of growth of real cash balances. In particular, an increase in the growth of the nominal money stock will induce individuals to increase the rate of consuming goods and services so as to rid themselves from the excess cash balances. In a closed economy, the result would be a higher rate of inflation whereas, in a small open economy, part of the monetary injection will show up as inflation (money chasing non-traded goods) and part of it will take the form of a balance of payments deficit (money chasing traded goods) and/or a depreciated domestic currency and corresponding inflation in traded goods depending on the exchange rate regime in effect.

Alternatively, an increase in the world inflation rate, via "commodity arbitrage," will raise the domestic rate of inflation of traded goods to an extent depending on the exchange rate regime, and, thus, the overall domestic rate of inflation, and will induce individuals to depress temporarily their rate of consumption so as to accumulate cash balances and rebuild their money stock at the desired level. The reduced demand for traded goods will take the form of a balance of payment surplus and/or an appreciated domestic currency.

In this paper, we develop a detailed exposition of the monetary approach as applied to the case of the small open economy. Traditionally, most expositions assume either fixed or fully flexible exchange rates, sometimes coupled with a reaction function describing the central bank's policy with respect to the exchange rate. We, instead, deal with a general framework of analysis, from which the implications of fixed or fully flexible exchange rate regimes can be deduced as special cases of theoretical importance but having little bearing on the workings of the international adjustment processes, especially in the decade of the 70's and in the beginning of the 80's.

The monetary approach to the determinants of balance of payments and the exchange rate is a rather long run theoretical construct. In the short run, the economy is continuously disturbed by inflationary shocks which will tend to reduce the stock of real cash balances and appreciate the real exchange rate, both of which work to reduce aggregate demand and output below the full-employment level. The degree of flexibility of the exchange rate regime and the extent to which the monetary authorities accommodate the inflationary disturbances are instrumental in the determination of the deviation of the unemployment rate from its natural level and, thus, in specifying the parameters of persistence of the inflationary shock.

In this paper, a variant of a model developed by Taylor (1980) and Dornbusch (1982) is constructed. On a theoretical level, we are able to show that a relatively flexible exchange rate regime is more output-stabilizing than a relatively fixed exchange rate regime, and thus, exhibits larger inflation variability. The extent of the relevant effects is shown to depend critically on the degree of integration of the home country in the world market, as conditioned by the structure of trade-restrictive practices under which the economy operates. An increase in the rate of protection under a relatively flexible exchange rate regime will tend to negate the output-stabilizing forces of such an exchange rate arrangement.

Both theoretical constructs are tested empirically by using annual data on Greece covering the period 1960-1980. Greece, the 10th member of the European Economic Community, fits well the description of a small open economy, with envious records of price stability and real growth in the 1960's and pervasive monetary mismanagement coupled with episodes of severe inflationary disturbances in the 1970's. As such, it offers a good testing-theoretic ground for our purposes.

The analysis proceeds as follows. In Chapter II, a generalized exchange rate regime model of the monetary approach to the balance of payments and exchange rate is developed. In Chapter III, descriptive statistics on the Greek economy's monetary performance are presented and the theoretical model of the previous chapter is tested against sample data. In Chapter IV, a short-run model of the trade-off between the variance of output and the variance of inflation is constructed and issues of stabilization policy under alternative exchange rate regimes are explored. In Chapter V, fluctuations in economic activity and the price stability issue are addressed within the context of the Greek economy and a test of the short-run model is conducted. Finally, in Chapter VI a summary of the findings is offered and the main conclusions of the paper are discussed.

In addition, two appendices are included. Appendix A contains data and discussion on the structure and economic development performance of the Greek economy. A comparative approach is used where Greece's economic characteristics are evaluated in contrast to those of industrial and middle-income developing economies. Finally, Appendix B contains a description of the data sources and of the methodology followed in the construction of several time series utilized in the empirical tests.

CHAPTER II

In this chapter, a model of the monetary approach to the balance of payments (MABP) under a generalized exchange rate regime is developed. The model yields solutions for the rate of change of the nominal exchange rate, the domestic rate of inflation and a balance of payments proxy for a small open economy with neither fixed nor flexible exchange rates, but somewhere in between. Explicitly incorporating the degree of flexibility of the exchange rate regime, the model generates the results of the earlier literature on the monetary approach to the balance of payments under fixed or flexible exchange rates, as special cases of a crawling-peg exchange rate system.

In what follows, the model is spelled out first under the assumption that all goods are traded and then it is extended to include non-traded goods. The relation of our work to the Girton-Roper (1977) model of the MABP is explored. Then, the model is enriched by postulating a gradual adjustment process of the exchange rate and the other manifestations of inflationary pressure to the levels implied by the degree of flexibility of the exchange rate regime. This more sophisticated theoretical structure is then compared to the Blejer-Leiderman (1981) model of the crawling-peg system.

Within the general model developed in this paper, policy making on the part of the monetary authorities and with respect to the inflationary process and its manifestations is fully explicated. We show that the monetary authorities have the capacity to determine the levels of the rate of inflation, the rate of depreciation and the balance of payments deficit and, also, to minimize their variance. Finally, the opportunity costs of selecting a certain degree of flexibility of the exchange rate regime and a certain speed of adjustment of the nominal exchange rate are analyzed.

A. The Model

We postulate the following relationships in the monetary sector of the economy:

(2.1) $$M_s = m(D + R)$$

(2.2) $$M_d = P.\ell_d$$

(2.3) $$\ell_d = f(y,\pi^e)$$

where M_s is the nominal money supply, m is the money multiplier, D is the domestic component of the monetary base, R is the foreign component of the monetary base, M_d is the nominal demand for money, P is the domestic price level, ℓ_d is the demand for real cash balances, y is real income and π^e is the expected rate of domestic inflation (used as the opportunity cost of holding money).

For monetary flow equilibrium

(2.4) $$\dot{M}_s = \dot{M}_d$$

where a dot on the top of a variable indicates the percentage rate of change of this variable.

Taking the logarithms of (2.1) and (2.2), differentiating with respect to time and substituting in (2.4), we have

(2.5) $$\dot{m} + (1 - d)\dot{R} + d\dot{D} = \dot{P} + \dot{\ell}_d$$

where $d = D/(D + R)$.

Equation (2.5) expresses the equilibrium condition for the monetary sector of the economy, and can be rewritten as follows:

$$(2.6) \qquad \mu = \pi - bop$$

$$\pi \equiv \dot{P}$$

$$\mu \equiv \dot{m} + d\dot{D} - \dot{\ell}_d$$

$$bop \equiv (1 - d)\dot{R}$$

Here, μ represents the ex ante[1] supply of money in excess of the demand for real cash balances (in percentage terms) or, the domestic inflationary pressure generated by actions of the monetary authorities ($\dot{m} + d\dot{D}$) or by changes in the real sector of the economy affecting the demand for real cash balances ($\dot{\ell}_d$). The variable bop is a balance of payments proxy. It would be positive when there is a surplus in the balance of payments ($\dot{R}>0$) and negative when there is a deficit ($\dot{R}<0$). The rate of domestic inflation is indicated by π.

We now assume that domestic inflation reflects foreign inflation (π_w) via the rate of change of the exchange rate (ε), or

$$(2.7) \qquad \pi_w = \pi + \varepsilon$$

By adding (2.6) and (2.7) we get

$$(2.8) \qquad bop + \varepsilon = \pi_w - \mu$$

which corresponds to Girton-Roper exchange market pressure equation and states that for monetary equilibrium, an excess of domestic inflationary pressure (μ) over foreign inflationary pressure (π_w) will result in either equiproportionate loss of official reserves (under fixed exchange rates) or, equiproportionate depreciation of the domestic currency (under fully flexible exchange rates) or, some combination of the two (under a crawling-peg system).

We can now formalize the behavior of the monetary authorities. Suppose that a fraction δ of the monetary expansion differential $(\pi_w - \mu)$ assumes the form of a change in the rate of change of the exchange rate (ε), while the remainder $1 - \delta$ shows up as a balance of payments imbalance (bop). Then, from (2.8) we can write

$$(2.9) \qquad \varepsilon = \delta(\pi_w - \mu)$$

$$(2.10) \qquad \text{bop} = (1 - \delta)\ (\pi_w - \mu)$$

This split of the monetary expansion differential between ε and bop, effected by the monetary authorities, has consequences for the domestic rate of inflation. From (2.6) and (2.7) we can see that, given δ, π_w and μ, the domestic rate of inflation is a weighted average ^{b}b b of the domestic and foreign inflationary pressures, μ and π_w respectively.

$$(2.11) \qquad \pi = \delta\mu + (1-\delta)\ \pi_w$$

Thus, the decomposition of the monetary expansion differential, $\pi_w - \mu$, in changes in bop and changes in ε, at the same time determines the domestic rate of inflation. To put it differently, for any desired level of domestic inflation, say π^*, there is a δ^* which implies a certain decomposition of the effect of the monetary expansion differential, or

$$(2.12) \qquad \delta^* = \frac{\pi_w - \pi^*}{\pi_w - \mu}$$

In order to achieve the target rate of inflation, the monetary authorities should effect a change in the exchange rate equal to

$$\varepsilon^* = \delta^*\ (\pi_w - \mu)$$

Thus interpreted, the coefficient δ is actually a coefficient of inflationary pressure tolerance.

A few comments are in order now concerning the coefficient δ.

First, the coefficient δ is more likely to vary between zero and one. However, values below zero or above one cannot be excluded. For example, in the just described case of a negative monetary expansion differential, if the monetary authorities choose a rate of depreciation higher in absolute terms than the differential between world inflation and excess domestic monetary expansion, then the economy will get into a balance of payments surplus. In this case, δ exceeds unity and the surplus in the balance of payments comes at the expense of even higher domestic inflation.

Second, the coefficient δ can alternatively be viewed as a coefficient of flexibility of the adopted exchange rate regime.[2]

Under fixed exchange rates, $\delta = 0$, and the system of equations (2.9), (2.10) and (2.11) yields as solutions

$$\pi = \pi_w$$

$$\varepsilon = 0$$

$$bop = \pi_w - \mu$$

which are exactly the results of the monetary approach to the balance of payments under fixed exchange rates (see Johnson 1972). That is, the domestic rate of inflation cannot deviate from the world's rate of inflation and a balance of payments deficit will result if the country inflates faster than the rest of the world.

Under flexible exchange rates, $\delta = 1$, and the system yields as solutions

$$\pi = \mu$$

$$\dot{\varepsilon} = \pi_w - \mu$$

$$\dot{bop} = 0$$

which again are typical of the results of the monetary approach to the balance of payments under flexible exchange rates (see Frenkel 1976). That is, a country cannot export its own inflationary pressures ($\pi = \mu$), and the exchange rate will depreciate if the country inflates faster than the rest of the world.

We now introduce non-traded goods into the model. As before, monetary equilibrium requires that

(2.13) $$bop = \pi - \mu$$

However, we now assume that the domestic rate of inflation is a weighted average of inflation in traded goods (π_T) and inflation in non-traded goods (π_{NT})

(2.14) $$\pi = \lambda\pi_T + (1 - \lambda) \ \pi_{NT}$$

where λ is the share of traded goods in total expenditure.

It is further assumed that the prices of traded goods reflect world prices given the exchange rate, i.e.

(2.15) $$\pi_T = \pi_w - \varepsilon$$

Following Blejer and Leiderman (1981), we assume that the relative price of non-traded goods with respect to traded goods is influenced by the ex ante excess supply of real cash balances,

(2.16) $$\pi_{NT} - \pi_T = \theta(\mu - \pi)$$

where θ is the relevant elasticity.[3]

Substituting (2.15) and (2.16) into (2.14) we get the domestic rate of inflation

$$(2.17) \qquad \pi = \rho(\pi_w - \varepsilon) + (1 - \rho)\mu$$

where $\rho = \{1 + \theta(1 - \lambda)\}^{-1}$

Substituting (2.17) into (2.13), we get the monetary equilibrium condition as

$$(2.18) \quad bop = \rho(\pi_w - \varepsilon - \mu)$$

which can be written alternatively as

$$(2.19) \quad bop + \rho\varepsilon = \rho(\pi_w - \mu)$$

Eq. (2.19) is the equivalent of (2.8) in the model without non-traded goods.

Suppose now that a fraction δ of $(\pi_w - \mu)$ assumes the form of a change in the rate of change of the exchange rate, or

$$(2.20) \qquad \varepsilon = \delta\ (\pi_w - \mu)$$

with the remainder showing up as a change in the flow of official reserves per unit of the monetary base so that the money market clears,[4] or

$$(2.21) \qquad bop = \rho(1 - \delta)\ (\pi_w - \mu)$$

Substituting (2.21) into (2.17) we get

$$(2.22) \qquad \pi = \rho(1 - \delta)\ \pi_w + [1 - \rho(1-\delta)]\mu$$

Eqs. (2.20), (2.21) and (2.22) jointly determine the rate of domestic inflation, the rate of change of the exchange rate and the balance of payments imbalance.

Under fixed exchange rates, $\delta = 0$ and the system of (2.20), (2.21) and (2.22) becomes

$$bop = \rho(\pi_w - \mu)$$

$$\varepsilon = 0$$

$$\pi = \rho\pi_w + (1 - \rho)\mu$$

Thus, under fixed exchange rates, the domestic rate of inflation deviates from the world rate of inflation to an extent depending on the existence of non-traded goods. If all goods are traded ($\lambda = 1$) or the elasticity of the relative price of non-traded goods with respect to the monetary imbalance is zero ($\theta = 0$), then $\rho = 1$ and the model yields the classical results of the monetary approach under fixed exchange rates.

Under flexible exchange rates, $\delta = 1$, and the model reproduces the classical results of the monetary approach under flexible exchange rates, i.e.

$$bop = 0$$

$$\varepsilon = \pi_w - \mu$$

$$\pi = \mu$$

The above presented argument can be illustrated by making use of Figure 1.

On the vertical axis, we have ε, the rate of change of the exchange rate, with positive values representing appreciation rates and negative values representing depreciation rates. On the horizontal axis, we have bop, the balance of payments proxy, with positive values representing a surplus and negative values representing a deficit.

In such a space, we can graph equation (2.19)

$$\dot{\varepsilon} = (\pi_w - \mu)-(1/\rho)\text{bop}$$

which is a downward-sloping line (MM) intercepting the vertical axis at the value of the inflationary pressure differential, $\pi_w - \mu$, and having a slope determined by the composition of aggregate expenditure as between traded and non-traded goods and the elasticity of the relative price of non-traded goods with respect to the monetary imbalance (ρ).

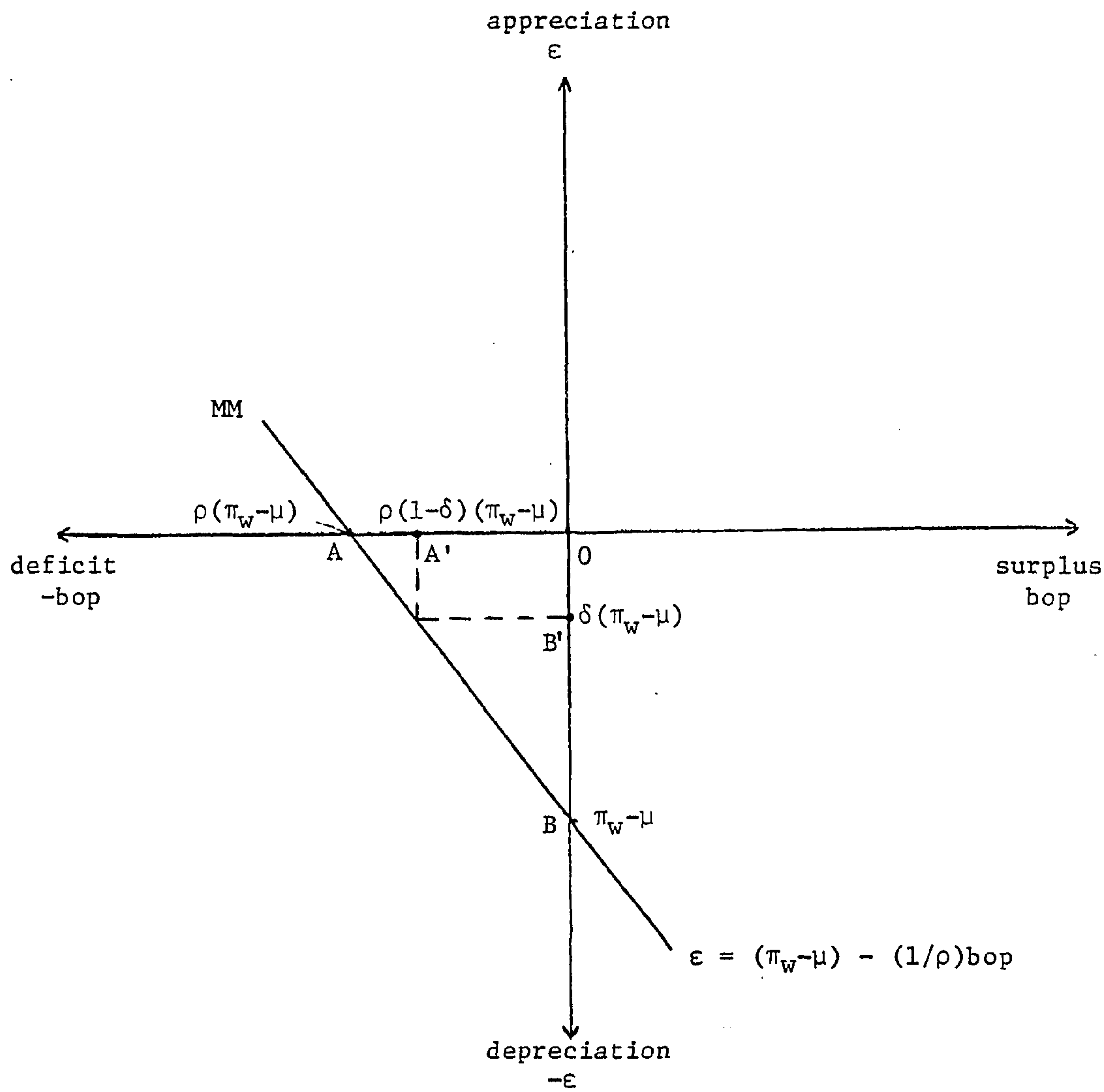
Such a line simply gives the trade-off between balance of payments and exchange rate variation. Given the location of the MM line (as determined by $\pi_w - \mu$) the monetary authorities select a desired depreciation or appreciation rate which corresponds to a certain imbalance in the balance of payments and, as we have seen above, to a certain inflation rate.

To give an example, starting from a position where $\pi_w = \mu$ (MM passes through the origin), suppose now that the small country inflates at a faster rate than the rest of the world ($\pi_w - \mu<0$). Then, MM shifts downwards. Under fixed exchange rates, the inflationary pressure differential will show up as a deficit in the balance of payments of OA. Under flexible exchange rates, the inflationary pressure differential will take the form of a rate of depreciation equal to OB. Under a crawling-peg system, the monetary authorities can select a rate of depreciation equal to OB′ $[\delta(\pi_w - \mu)]$, thus effectively accepting a deficit in the balance of payments equal to OA′$[\rho(1 - \delta)(\pi_w - \mu)]$. The particular combination selected will be a function of the desired rate of domestic inflation which largely reflects political choices and priorities.

We now turn to an examination of the Girton-Roper proposition that the exchange market pressure variable (bop + ε) is independent of its composition. If non-traded goods are present, then the Girton-Roper

Fig. 1.1

Theoretical tradeoff between the rate of depreciation of the nominal exchange rate and the balance of payments deficit for a given inflationary pressure differential.



exchange market pressure variable is not any longer independent of its composition. From (2.20) and (2.21) we get

$$(2.23) \qquad bop + \varepsilon = [1 - (1 - \rho)(1 - \delta)] (\pi_w - \mu)$$

Connolly and Da Silveira (1979), in an application of the Girton-Roper model to the Brazilian economy, effectively estimate (2.23) in an unconstrained form and then test and reject the null hypothesis that the unrestricted estimate of the coefficient reflecting the effect of $(\pi_w - \mu)$ on $(bop + \varepsilon)$ is different from unity. In principle, according to (2.23), the estimated coefficient should be less than unity so long as a less than fully flexible exchange rate regime is in effect $(0<\delta<1)$ and non-traded goods are present $(\rho<1)$. The acceptance of the results of the study by Connolly and Da Silveira imply a very high ρ and a very large δ, which may be the case with respect to the Brazilian experience[5] but certainly not the case for every economy.

Any theoretical model assuming either fixed or flexible exchange rates is mis-specified to the extent that exchange rate arrangements in the real world deviate from the extremes and are characterized by limited flexibility. One may commit serious error in applying such a model, because the imposition of unwarranted restrictions would lead one to testing hypotheses about a theoretically unsound structure. In this respect, the Girton-Roper model of the MABP deals effectively with the above-mentioned problem. By examining the behavior of the exchange market pressure variable, which is independent of its composition, as equation (2.8) demonstrates, the mis-specification problem is avoided. However, as we have shown in this section, when the distinction between traded and non-traded goods becomes operational, the exchange market pressure is sensitive to its composition and, thus, it cannot be used in the conduct of exchange rate policy. In such a case, our model is more relevant since each component of the exchange market pressure is fully determined. Even if all goods are traded, our model has utility because it highlights the fact that intervention in the foreign exchange market under a managed float or a crawling-peg system cannot be conducted without paying attention to the consequences for the domestic rate of inflation of a certain decomposition of the exchange market pressure.[6] In general, the coefficient δ would determine the deviation of the domestic rate of inflation from the rate of excess domestic monetary expansion (μ), and as such it is not neutral to policy making.

In a recent paper, Blejer and Leiderman (1981) extended the monetary approach to the balance of payments and to the exchange rate in the case of the crawling-peg system. Their model assumes a small open economy in which the monetary authorities intervene to effect necessary changes in the nominal exchange rate in order to maintain purchasing power parity. The model generates short-run deviations from PPP which are liquidated in the long-run through equilibrating flows of official reserves.

The Blejer-Leiderman (B-L) model, in terms of our notation, consists of equations (2.17) and (2.18) coupled with the assumption that the nominal exchange rate changes due to the efforts of the monetary authorities to maintain purchasing power parity. Formally, Blejer and Leiderman postulate that

$$\text{(2.24)} \qquad \varepsilon_t = \gamma \sum_{i=0}^{n} (1-\gamma)^i \, L^i \, (\pi_W - \pi)_t$$

where t is a time subscript, γ reflects the speed of adjustment of the exchange rate growth to the differential rate of inflation ($\pi_W - \pi$), and L is the lag operator ($L^i X_t = X_{t-i}$).

From (2.17), (2.18) and (2.24), they get the domestic rate of inflation, the balance of payments imbalance and the exchange rate change as functions of the exogenous variables π_w and μ,

$$(2.25)\qquad \pi_t = \frac{\rho(1-\gamma)(1-L)}{1-\gamma\rho-(1-\gamma)L}\pi_{w_t} + \frac{(1-\rho)(1-(1-\gamma)L)}{1-\gamma\rho-(1-\gamma)L}\mu_t$$

$$(2.26)\qquad bop_t = \frac{\rho(1-\gamma)(1-L)}{1-\gamma\rho-(1-\gamma)L}(\pi_w - \mu)_t$$

$$(2.27)\qquad \varepsilon_t = \frac{\gamma(1-\rho)}{1-\gamma\rho-(1-\gamma)L}(\pi_w - \mu)_t$$

The above structure can be criticized on several grounds. First, if $\rho = 1$ i.e. non-tradables are absent ($\lambda=1$) or their price is insensitive to monetary imbalance ($\theta=0$), the B-L model breaks down and fails to generate the results of the monetary approach under a crawling-peg system. Instead, the B-L model, under $\rho=1$, generates the results of the monetary approach to the balance of payments (MABP) under fixed exchange rates and when non-tradables are absent (see Johnson 1972). If $\rho=1$, then

$$\pi_t = \pi_{wt}$$

$$bop_t = (\pi_w - \mu)_t$$

$$\varepsilon_t = 0$$

One cannot escape the conclusion that the existence of non-tradables is intimately associated with the introduction and operation of a crawling-peg system! We intend to show the source of the absurdity of such a conclusion.

Second, if $\gamma=1$ i.e. the exchange rate adjusts instantaneously to the inflation rate differential $(\pi_w - \pi)$, then, the B-L model generates the results of the MABP under flexible exchange rates and when non-tradables are absent (see Frenkel 1976). If $\gamma=1$,

$$\pi_t = \mu_t$$

$$bop_t = 0$$

$$\varepsilon_t = (\pi_w - \mu)_t$$

A fundamental question emerges as to why the existence of non-tradables is immaterial to the case when the exchange rate adjusts immediately to the inflationary differential since ρ does not appear above. Another equally important question is whether the speed of adjustment of the exchange rate can be taken as a measure of flexibility of the exchange rate. We intend to provide answers to both of these questions.

We maintain that the Blejer-Leiderman (B-L) model is basically a flexible exchange rates model and its short-term behavior, while adequately representing the working of a crawling-peg system, in fact negates the long-run plausibility of such a system. For all practical purposes, flows of official reserves can take place for long periods of time, long enough to render the B-L model a special case of a more comprehensive structure, which models the degree of flexibility of the exchange rate regime as a parameter quite distinct from the speed of adjustment of the nominal exchange rate. Persistent balance of payments deficits, according to the B-L model, can only be explained by ever increasing excess ex ante domestic monetary growth (net of world inflation), which clearly might not be the case unless a flexible exchange rate regime is adopted and a gradual adjustment of the nominal exchange rate if hypothesized.

In what follows our basic model is extended to take into account of the fact that the exchange rate may adjust gradually to the level determined by the degree of flexibility of the exchange rate regime. Our extended model is then compared to the B-L model.

As previously, suppose that a fraction δ of the inflationary pressure differential is allowed by the monetary authorities to assume the form of a rate of change in the exchange rate. However, suppose that the limited adjustment of the exchange rate may take more than one period. Therefore, we assume that

$$(2.28) \qquad \varepsilon_t = \delta\beta \sum_{i=0}^{n} (1-\beta)^i L^i (\pi_w - \mu)_t$$

where $\delta\beta$ is the portion of the current inflationary pressure differential transmitted to the exchange rate in the current period. In subsequent periods, the exchange rate adjustment process is assumed to decay geometrically with the speed of adjustment equal to β.

If $n \to \infty$, eq. (2.28) can be written as

$$(2.29) \qquad \varepsilon_t = \delta B(\pi_w - \mu)_t$$

where $\quad B \equiv \dfrac{\beta}{1-(1-\beta)L}$

From (2.19), since the money market clears in each period,

$$(2.30) \quad bop_t = \rho(1-\delta B)(\pi_w - \mu)_t$$

and, thus, from (2.17) the domestic rate of inflation can be expressed as

$$(2.31) \qquad \pi_t = \rho(1-\delta B)\pi_{wt} + (1-\rho(1-\delta B))\mu_t$$

Equations (2.29), (2.30) and (2.31) determine jointly the rate of domestic inflation (π), the rate of change of the exchange rate (ε) and the absolute change in official reserves per unit of the monetary base (bop), given the world's rate of inflation (π_w), the excess domestic monetary expansion (μ), the share of tradables in total expenditure and the elasticity of the relative inflation rate of non-tradables with respect to monetary imbalance (reflected in ρ), the degree of flexibility of the exchange rate (δ) and, finally, the speed of adjustment of the exchange rate (β).

If $0<\delta<1$, Eqs. (2.29), (2.30) and (2.31) adequately describe the crawling-peg exchange rate system.

If there is international policy coordination between countries so that on the average each country inflates as much as the rest of the world, i.e. if $\pi_w-\mu=0$, then,

$$\varepsilon_t = bop_t = 0$$

and

$$\pi_t = \pi_{wt}$$

If a country decides to inflate faster than the rest of the world ($\pi_w-\mu<0$), then the domestic rate of inflation will deviate from the world's rate of inflation, the domestic currency will depreciate and a balance of payments deficit will ensue. Given the capacity of the country to run a balance of payments deficit, the exchange rate will be allowed to absorb only a fraction δ of the inflationary pressure differential with the remainder assuming the form of a depletion of the stock of official reserves. Obviously, the motivation behind such a policy on the part of the monetary authorities is the exportation of part of the domestic inflationary pressure to the rest of the world. The domestic rate of inflation will assume a value somewhere in between the world rate of inflation (π_w) and the domestic inflationary pressure (μ). The adjustment of ε_t, bop_t and π_t to the new level of the inflationary pressure differential need not be instantaneous. To reduce the variance of the inflationary process, the monetary authorities will find it desirable to allow for a gradual adjustment process by selecting the speed of adjustment β. Policy considerations are dealt with more explicitly in the next section.

Let us now demonstrate the generalization aspect of our model.

Under fixed exchange rates, $\delta=0$, and the model yields as solution

(2.32) $\varepsilon_t = 0$

(2.33) $bop_t = \rho(\pi_w-\mu)_t$

(2.34) $\pi_t = \rho\pi_{wt} + (1-\rho)\mu_t$

where the transmission of the inflationary pressure differential to the balance of payments is limited by the share of tradables in the total expenditure and the domestic rate of inflation is a weighted average of world inflation and excessive domestic monetary expansion. The higher the share of tradables, the closer the domestic rate of inflation is to the world's rate of inflation. Notice that if $\rho=1$, i.e. all goods are tradables, one gets the classical results of the MABP under fixed exchange rates, i.e.

$$\varepsilon_t = 0$$

$$bop_t = (\pi_w-\mu)_t$$

$$\pi_t = \pi_{wt}$$

Notice also that the speed of adjustment B does not appear in the equations. The actions of the monetary authorities imply that $B=0$.

Under flexible exchange rates, $\delta=1$ and our model becomes

$$(2.35) \qquad \varepsilon_t = B(\pi_w - \mu)_t$$

$$(2.36) \qquad bop_t = \rho(1-B)(\pi_w - \mu)_t$$

$$(2.37) \qquad \pi_t = \rho(1-B)\pi_{w_t} + (1-\rho(1-B)\mu_t$$

Notice that $bop_t = 0$ as long as the adjustment of the exchange rate is not completed in the current period, i.e. as long as $B=1$. The adjustment coefficient B can potentially be different from unity under flexible exchange rates if the monetary authorities actively intervene and select a low speed of adjustment so that the variance of the rate of change of the exchange rate may be kept at desirable levels. The monetary authorities' policy with respect to the speed of adjustment of the exchange rate is fully explicated in the following section.

In the case of instantaneous adjustment, i.e. $B=1$, the model yields the classical results of the MABP under flexible exchange rates, i.e.

$$\varepsilon_t = (\pi_w - \mu)_t$$

$$bop_t = 0$$

$$\pi_t = \mu_t$$

In such a case, the value of ρ(i.e. the extent to which non-tradables exist) is immaterial to the outcome since the exchange rate not only absorbs the whole inflationary pressure differential ($\delta=1$) but it also adjusts immediately ($B=1$) thus allowing no flows of reserves to occur.

It now becomes clear that a flexible exchange rates regime does not necessarily imply instantaneous exchange rate adjustment. The speed of adjustment B can diverge from unity and, still, the exchange rate regime may be characterized by full flexibility, i.e. the exchange rate adjusts fully to the inflationary pressure differential but the adjustment takes more than one period.

The system of (2.35), (2.36) and (2.37) is functionally equivalent to the B-L model in terms of dynamics. Here, as in the B-L model, due to the gradual adjustment of the exchange rate, equilibrating flows of official reserves take place, and the domestic rate of inflation deviates from the domestic rate of inflationary pressure (μ). When the adjustment is completed, flows of international reserves cease ($bop_t=0$) and the country can no longer escape the consequences of the domestically generated inflationary pressure. Notice that when B=1, $(\pi_w - \pi)_t = (\pi_w - \mu)_t = \varepsilon_t$ and purchasing power disparities disappear. Therefore, the B-L model is basically a flexible exchange rates model capable of generating simultaneous fluctuations in exchange rates and international reserves as short-run deviations from a trend characterized by PPP.

We maintain that, even in the long-run (i.e. when the adjustment of the exchange rate is complete), flows of official reserves will occur as long as the monetary authorities prevent the exchange rate from absorbing the full amount of the inflationary pressure differential $(\pi_w-\mu)$, to an extent determined by their ability to run deficits in the balance of payments (or, surpluses), given the external borrowing (or, lending) capacity of the economy. Obviously, a country cannot borrow forever. Therefore, our view of the long-run refers to a period which is not long enough such that the external borrowing capacity of the country may be exhausted.

If all goods are tradables, the B-L model breaks down yielding the results of the MABP under fixed exchange rates, wheras our model holds. If $\rho = 1$, than

B-L MODEL	OUR MODEL
$\varepsilon_t = 0$	$\varepsilon_t = \delta B(\pi_w-\mu)_t$
$bop_t = (\pi_w-\mu)_t$	$bop_t = (1-\delta B)(\pi_w-\mu)_t$
$\pi_t = \pi_{wt}$	$\pi_t = (1-\delta B)\pi_{wt}+\delta B\mu_t$

The breakdown of the B-L model is a consequence of the PPP rule, in effect. In the absence of non-tradables, domestic inflation (i.e. tradables' inflation) cannot deviate from the world's rate of inflation unless there is a change in the exchange rate. But the exchange rate changes, according to their modeling, only if there is a deviation of domestic inflation from world inflation. Thus, the presence of non-tradables is purely functional (i.e. to initiate a process of deviation of domestic inflation from the world's rate of inflation), and in the absence of non-tradables, the B-L model is non-operational.

Consider now the long-run solutions of the two models. If the adjustment of the exchange rate is completed, our model yields

$$\varepsilon_t = \delta(\pi_w-\mu)_t$$
$$bop_t = \rho(1-\delta)(\pi_w-\mu)_t$$
$$\pi_t = \rho(1-\delta)\pi w_t + (1-\rho(1-\delta)\mu_t$$

while the B-L model collapses to the classical results of the MABP under flexible exchange rates, i.e.

$$\varepsilon_t = (\pi_w-\mu)_t$$
$$bop_t = 0$$
$$\pi_t = \mu_t$$

With respect to PPP,[7] the B-L model implies

$$(2.38) \qquad \varepsilon_t = (\pi_w - \mu)_t = (\pi_w - \pi)_t$$

whereas our model fails to conform and implies

$$(2.39) \qquad \varepsilon_t = \delta(\pi_w - \mu)_t = \frac{\delta}{1-\rho(1-\delta)} (\pi_w - \pi)_t$$

Notice that the long-run deviation of the exchange rate from PPP in our model is a function of the degree of flexibility of the exchange rate (δ) and the extent to which non-tradables are present (ρ).

If $\delta=1$, i.e. if a fully flexible exchange rate regime is in effect, or if all goods are tradables ($\rho=1$), then PPP is maintained in our model as well. The existence of non-tradables and the policy priorities of the monetary authorities, as incorporated in the degree of flexibility of the exchange rate regime, make up for an explanation of the variability of the real exchange rate. Denote the rate of change of the real exchange by $\dot{r}$. Then,

$$(2.40) \qquad r_t = \varepsilon_t - (\pi_w - \pi)_t$$

Substituting for ε_t and π_t, we get

$$(2.41) \qquad r_t = -(1-\rho)(1-\delta B)(\pi_w - \mu)_t$$

Thus, persistent monetary imprudence, continuously exorcised with flows of official reserves, results in real appreciation. Notice that r_t can be also expressed as

$$(2.42) \qquad r_t = (1-\lambda)(\pi_{NT} - \pi_T)$$

Therefore, the real appreciation implies a rise in the relative price of non-tradables, which, as long as it persists, will bring about a deterioration in the exporting and import-competing sectors of the economy as factors of production move towards the non-tradables sector and demand patterns favor the tradables sector. The country's ability to participate in international trade will diminish. Thus, persistent monetary imbalances are likely to exert undesirable effects on the real side of the economy. The policy implications of real appreciation are examined in detail in the following section.

B. Policy Considerations

Our model is not constrained with specific policy rules and, thus, its functional character is not limited by the idiosyncrasies of one economy following one particular rule for a certain period of time. Such an approach has the advantage of not introducing unwarranted theoretical restrictions into the model, as the case would be if we pretend to possess a priori knowledge as to the specific policy rule in effect.

There exists an infinite number of combinations of δ and β which may represent various kinds of policy rules. We now turn to an examination of the specification of the policy parameters of the model.

In general, as soon as a target value has been assigned to one of the policy variables (i.e. the domestic rate of inflation, the rate of depreciation of the domestic currency and the absolute loss of reserves per unit of the monetary base), at the same time, the values of the other policy variables fall in place.

Suppose that the domestic economy persistently inflates faster than the rest of the world (i.e. $\pi_W - \mu < 0$) and the monetary authorities have decided on a "normal" rate of depreciation of the currency of, say, C per period on the average,

or

(2.43) $E(\varepsilon_t) = C$

where $E(X_t)$ refers to the expected value of X_t. Substituting for ε_t, (2.43) becomes

(2.44) $E(\delta B(\pi_w-\mu)_t) = C$

Assuming that the time series $(\pi_w-\mu)_t$ is stationary, we can solve for δ

(2.45) $$\delta = \frac{C}{E((\pi_w-\mu)_t)}$$

The degree of flexibility of the exchange rate regime δ, as given in (2.45) will generate the following values for our policy variables

$$\varepsilon_t = \frac{CB}{E((\pi_w-\mu)_t))} (\pi_w-\mu)_t$$

$$bop_t = \rho(1- \frac{CB}{E((\pi_w-\mu)_t)}) (\pi_w-\mu)_t$$

$$\pi_t = \rho(1- \frac{CB}{E((\pi_w-\mu)_t)}) \pi w_t + (1-\rho(1- \frac{CB}{E((\pi_w-\mu)_t)}))\mu_t$$

One can see immediately that the smaller the desired rate of depreciation is (i.e. the higher the C is), the smaller the rate of domestic inflation will be and, thus, the greater the deficit in the balance of payments. Thus, the selection of δ determines the levels of the trade-off between the balance of payments on the one hand, and, the rate of depreciation and the rate of inflation on the other hand. In general, the specification of δ determines the long-run policy-desired trends of π, ε_t and bop_t time series, which are assumed to be in equilibrium over time about a constant mean level.

Moreover, the variance of the realizations of the policy variables can be made as small as desirable by slowing down the limited adjustment process of the rate of depreciation to the inflationary pressure differential, or, the same, by spreading the impact on the rate of depreciation over a longer period of time by selecting a small β.

For example, consider the variance of ε_t

$$(2.46) \qquad Var(\varepsilon_t) = \delta^2\beta^2 \sum_{i=0}^{\infty}\sum_{s=0}^{\infty}(1-\beta)^i(1-\beta)^s \; Cov(X_{t-i},X_{t-s})$$

where $X_t \equiv (\pi_w-\mu)_t$.

Differentiating (2.28) with respect to the speed of adjustment β we have

$$(2.47) \qquad \frac{\partial Var(\varepsilon_t)}{\partial\beta} = 2\delta^2\beta \sum_{i=0}^{\infty}\sum_{s=0}^{\infty}((1-\beta)^i(1-\beta)^s - i\beta(1-\beta)^{i-1}(1-\beta)^s) \; Cov(X_{t-i},X_{t-s})$$

Since X_t is assumed to be a covariance stationary series, the covariance function $Cov(X_{t-i},X_{t-s})$ is a positive definite sequence.[8]

$$\frac{\partial Var(\varepsilon_t)}{\partial\beta} \geq 0$$

or, the monetary authorities can reduce the variance of the rate of depreciation by selecting a low speed of adjustment (β).

It can be easily proven that

$$(2.48) \qquad \frac{\partial Var(bop_t)}{\partial\beta} = \rho^2 \frac{\partial Var(\varepsilon_t)}{\partial\beta} = \frac{\partial Var(\pi_t)}{\partial\beta}$$

Therefore, the selection of a low speed of adjustment reduces the variance not only of the rate of depreciation but also of the rate of inflation and of the balance of payments variable. Notice that the effects of β on the variance of the rate of inflation and the variance of the balance of payments variable are smaller than the effect of β on the rate of depreciation to an extent determined by the existence of non-tradables. Ceteris paribus, the more integrated in the world market the domestic economy is (the larger ρ is), the less the need for gradual absorption of the inflationary differential in order that the variance of the monetary variables might be minimized.

In sum, under a crawling-peg system, given the external borrowing capacity of the economy and the stock of accumulated foreign reserves, and given a persistently negative inflationary pressure differential, the monetary authorities may opt for a rate of depreciation which does not fully reflect the inflationary differential $(\pi_w-\mu)$ and may also opt for a domestic rate of inflation which does not fully reflect the domestic inflationary pressure (μ). This is accomplished by specifying an appropriate δ. Furthermore, to provide for greater stability in the inflationary process and its manifestations, the monetary authorities given δ, may opt for a rather gradual absorption of part of the inflationary pressure differential by the rate of depreciation. This is achieved by selecting a suitable speed of adjustment β.

We can now demonstrate in more detail the policy options of the monetary authorities. Suppose that the inflationary pressure differential $X_t \equiv (\pi_w-\mu)_t$ follows an AR(1) stochastic process, that is

$$X_t = \Phi_1 X_{t-1} + \Theta + u_t \tag{2.49}$$

Then, the origin-T forecast for lead time ℓ will be

$$E(X_{T+\ell} \mid X_{T}, \ldots X_1) = \Phi_1^{\ell} X_T + (\Phi_1^{\ell-1} + \Phi_1^{\ell-2} + \ldots + \Phi_1 + 1)\Theta \tag{2.50}$$

Therefore, if the monetary authorities desire a long-run "normal" rate of depreciation equal to a constant C, that is, if

(2.51) $$\lim_{\ell \to \infty} E(\varepsilon_{T+\ell}) = C$$

then, they should select a δ such as

(2.52) $$\lim_{\ell \to \infty} E(\varepsilon_{T+\ell}) = \delta\beta \sum_{i=0}^{\infty} (1-\beta)^{i} \cdot \lim_{\ell \to \infty} E(X_{T+\ell} | X_{T}, \ldots X_{1}) = C$$

(2.53) or,

$$\delta = \frac{C(1-\Phi_1)}{\Theta}$$

With respect to the variance of the inflationary process, if the inflationary pressure differential follows an AR(1) process, the variance of ε_t (2.46) becomes

(2.54) $$Var(\varepsilon_t) = \frac{\delta^2 \beta 6_u^2}{(2-\beta)(1-\Phi_1{}^2)} \left(\frac{1+(1-\beta)\Phi_1}{1-(1-\beta)\Phi_1}\right)$$

If the monetary authorities allow the exchange rate to adjust immediately to $\delta(\pi_w - \mu)_t$ that is, if β=1, then the variance of the exchange rate will be at a maximum equal to

(2.55) $$Var(\varepsilon_t) = \frac{\delta^2 6u^2}{1-\Phi_1{}^2}$$

If, therefore, the monetary authorities also desire to reduce the variance of the inflationary process to an acceptable minimum, say Z, then they should select a β such as

(2.56) $$\frac{\delta^2 \beta 6u^2}{(2-\beta)(1-\Phi_1{}^2)} \; \frac{1+(1-\beta)\Phi_1}{1-(1-\beta)\Phi_1} = Z$$

Upon determination of optimal values for the coefficients δ and β as above, the monetary authorities announce and enforce a rate of depreciation equal to a geometrically declining distributed-lag representation of the inflationary pressure differential. Applying the Koyck transformation to (2.28), we have

$$(2.57) \qquad \varepsilon_t = \delta\beta(\pi_w-\mu)_t + (1-\beta)\varepsilon_{t-1}$$

At the end of period t-1, the policy-makers formulate an expectation for the inflationary pressure differential of next period t as

$$(2.58) \qquad E(\pi_w-\mu)_t = \Phi_1(\pi_w-\mu)_{t-1} + \Theta$$

and, thus, the rate of depreciation announced by the monetary authorities for period t will be equal to its forecasted value, or

$$(2.59) \qquad \varepsilon_t = E(\varepsilon_t) = \delta\beta\Phi_1(\pi_w-\mu)_{t-1} + \Theta + (1-\beta)\varepsilon_{t-1}$$

A final note is now in order. In this section the emphasis has been placed on the management of the inflationary process rather than on a policy to reduce the inflationary manifestations of excessive domestic monetary expansion. In the light of the analysis in this section, a policy of gradual disinflation of the economy may be accompanied by appropriate inflationary management so that the additional degrees of freedom available to the monetary authorities provide for greater flexibility in the implementation of such a policy.

Another aspect of our model deserves attention. The exportation of the domestic inflationary pressure not only depletes the stock of official reserves and raises the level of external indebtedness of the country, but also has undesirable effects on relative prices.

From (2.16) and (2.31), the rate of change of the relative price of non-tradables with respect to tradables can be expressed as

$$(2.60) \qquad (\pi_{NT}-\pi_T)_t = - \theta\rho(1-\delta B)(\pi_w-\mu)_t$$

In the case where the country inflates persistently faster than the rest of the world ($\pi_w-\mu<0$), the relative price of non-tradables will be rising. This will cause a transfer of factors of production towards the non-tradables sector and away from the tradables sector. At the same time, demand patterns will be changing. The demand for tradables will rise at the expense of a decline in the demand for non-tradables. Both effects will bring about a deterioration in the exporting and import-competing sectors of the economy.

As long as $\delta<1$, the long-run solution of the model implies a continuous rise in the relative price of non-tradables, since the exchange rate never depreciates by the full amount of the inflationary pressure differential and, thus, the tradables' inflation always falls short of the level that could protect their relative competitiveness vis-a-vis non-tradables. The further away from fully flexible exchange rates the system is, the more pronounced the decline in the relative price of tradables will be. Under fixed exchange rates ($\delta=0$), since the entire amount of the inflationary pressure differential is absorbed in official reserves flows, the relative price of non-tradables will be rising faster than under any other kind of exchange rates regime arrangement. Here, we encounter one argument in support of a fully flexible exchange rates regime. Under fully flexible exchange rates ($\delta=1$) and in the long-run ($B=1$), the relative price of non-tradables with respect to tradables remains unaffected by the relative monetary imprudence of the domestic authorities vis-a-vis the rest of the world. In the short-run, the authorities may allow relative prices to change in order to reduce the variance of the exchange rate fluctuations. Such a system of exchange rates arrangement minimizes the negative impact of the inflationary pressure differential on the export and import-competing sectors of the economy. However, the monetary authorities will have to face the policy trade-off between reducing the variance of the domestic inflationary process and adversely affecting key sectors of the economy.

Another implication of (2.60) is that a country which inflates at a slower rate than the rest of the world will be building up its export and import-competing sectors as the terms of trade between non-tradables and tradables turn against non-tradables. If $\pi_W-\mu>0$, then $\pi_{NT}-\pi_T \leq 0$. Under flexible exchange rates and in the long-run ($\delta B=1$), $\pi_{NT}-\pi_T=0$. As long as $\delta<1$, the relative price of tradables will be rising and under fixed exchange rates, the maximum relative price effect will be attained.

Again, relative prices are invariant with respect to fully flexible exchange rates when the long-run is the period of analysis. However, an inflation-shy country may deliberately attempt to improve its trade performance by strengthening the forces which work to promote the export and import-competing sectors of the economy. In this case, a less flexible exchange rates regime will be preferrable to a more flexible one. On the contrary, the inflation-prone country has an interest in greater exchange rate flexibility which tends to weaken the forces which work to undermine the export capacity of the economy and its ability to successfully compete with imported commodities. Therefore, there may be no accident behind the impressive trade performance of inflation-shy countries like W. Germany and Japan as well as the deplorable record of inflation-prone countries like Great Britain and Italy.

It is the persistence of the negative inflationary differential which will lead to the weakening of the trading capacity of the economy. If the inflationary pressure differential became negative only temporarily, then, the switching of production and consumption patterns, caused by the rise in the relative price of non-tradables, would reverse the relative price change back to the original level. If monetary imprudence continues, however, the above described process will be frustrated and, thus, the relative price of non-tradables will be continuously rising. The process which works to imperil the export and import-competing sectors of the economy cannot go on forever. However, it can go on for a very long period of time, at least as long as the country can afford to run a deficit in its balance of payments, and this is the period of analysis relevant to our study.

C. Concluding Remarks

In this chapter, a model incorporating the basic tenets of the monetary approach to the balance of payments has been constructed. The novelty of the model rests on the explicit specification of the degree of flexibility of the exchange rate regime as a parameter in the system and its distinction from the speed of adjustment of the nominal exchange rate. This innovation has allowed us to generalize the monetary approach to exchange rate regimes which are not characterized by either fixed or flexible exchange rates.

Footnotes for Chapter II

1. This terminology is used by Blejer (1977). The ex post supply of nominal balances is determined by the public's reaction to a change in the ex ante nominal stock of money.

2. Notice that the degree of flexibility of the exchange rate regime is defined in relative terms with respect to the inflationary pressure differential. For example, a rate of depreciation of 10% during a certain period when the inflationary pressure differential is -20% would represent a more flexible exchange rate regime than the same rate of depreciation during another period when the inflationary pressure differential is -30%. In the first case, 1/2 of the inflationary pressure differential is absorbed in exchange rate variation while, in the second case, 1/3 of the inflationary pressure assumes the form of currency depreciation.

3. According to Blejer and Leiderman "the elasticity θ is a function of the elasticity of substitution between traded and non-traded goods in consumption and production and of the income elasticity of the non-traded goods." See Blejer and Leiderman (1981), p. 135, fn.6.

4. The portion of $\pi_w-\mu$ which is not absorbed either by bop or ε, that is,

$$(1-\rho)(1-\delta)(\pi_w-\mu)$$

shows up as higher inflation if $\pi_w-\mu<0$, or lower inflation if $\pi_w-\mu>0$, than the rate of inflation which would result if non-traded goods were absent.

Proof:

$$\begin{aligned}(1-\rho)(1-\delta)(\pi_w-\mu) &= (1-\delta)(\pi_w-\mu)-\rho(1-\delta)(\pi_w-\mu)\\ &= (1-\delta)\pi_w-(1-\delta)\mu-\text{bop}\\ &= (1-\delta)\pi_w-(1-\delta)\mu-(\pi-\mu)\\ &= [(1-\delta)\pi_w+\delta\mu]-\pi\end{aligned}$$

If $\pi_w-\mu \lesseqgtr 0$, then $[(1-\delta)\pi_w+\delta\mu]-\pi \lesseqgtr 0$.

5. As a matter of fact, the coefficient ρ has been estimated by Blejer and Leiderman for Brazil to be .958. See Blejer and Leiderman (1981), p. 145. Also, a low δ is implied by the exchange rate policy experience of Brazil, where ever since 1961 a pegged exchange rate system had been in effect till 1968 when a crawling-peg was introduced and has remained operational ever since. See Blejer and Leiderman (1981), p. 143 and, also, Connolly and Da Silveira (1979), p. 452.

6. In other words, our model provides a rationale for the particular choice of decomposition of the exchange market pressure by the monetary authorities.

Footnotes for Chapter II (cont'd)

7. There is no strong empirical support for the PPP theory. The real exchange rate has not remained constant despite the predictions of the PPP on the contrary. Kravis and Lipsey (1978) have presented devastating evidence against the PPP in a comprehensive study of exchange rate adjusted national price levels. Dornbusch (1980), in a status report on exchange rate economics, comments that "not only does the short-term exchange rate deviate from a PPP path, but there are also cumulative deviations from that path that show substantial persistence." The Balassa (1964) - Samuelson (1964) argument that real exchange rates change due to differential productivity growth between the sectors of tradables and non-tradables has received considerable support by the evidence in Kravis and Lipsey (1978) and, lately, by Hsieh (1982) using a time series approach.

8. See Dhrymes (1980), pp. 398-99.

CHAPTER III

In this chapter, the model introduced in Chapter II is tested with Greek data, 1960-1980. In the following sections, first, descriptive statistics on the Greek economy are presented to serve as the background for the empirical investigation; second, estimation procedures are analyzed and, finally, empirical results are presented and evaluated.

A. The Monetary Performance of the Greek Economy

In the post-World War II era, the sixties and the seventies stand preeminent as periods of significant economic change in an international scale. For Greece, the 1960s was marked by high rates of real growth and monetary stability whereas the 1970s, in sharp contrast to earlier years, was characterized by unprecedented inflationary pressures, slower real growth and, towards the end of the period and the beginning of the 1980s, by virtual stagnation accompanied by unabated inflation.

Table 3.1 contains summary statistics of the facts to be explained. Means and standard deviations of several key variables are computated and presented for two consecutive periods, 1961-70 and 1971-80.

Money growth increased substantially in the 1970s with respect to the 1960s (1960s: 15.6%, 1970s: 19.2%) while, at the same time, real output growth slowed down considerably (1960s: 7.3%, 1970s: 4.6%). Over the period, income velocity has been falling, reflecting an increasing degree of monetization of the economy during a period of rapid economic development. The rate of decline of income velocity was substantially reduced in the 1970s (-1.7%) from that of the 1960s (-5.2%). This can be attributed partly on the progressive maturity of the development process and, partly probably on the positive influence of inflationary expectations which accompanied the turbulent 1970s. Given the changes in velocity

Table 3.1

Summary statistics of the real and nominal variables under consideration (in percentages).

Variable	1961-1970		1971-1980	
	Mean	Standard Deviation	Mean	Standard Deviation
Money Growth	15.6	2.0	19.2	2.4
Nominal GDP Growth	10.4	2.3	17.5	4.2
Real GDP Growth	7.3	2.7	4.6	3.5
Domestic inflation (DIN)	2.1	1.8	14.5	7.9
World inflation (WIN)	2.0	1.6	8.4	5.3
Growth of nominal effective exchange rate (GER)	-.4	.8	-6.2	3.9
Change in central bank domestic credit as % of reserve money (DOM)	11.5	3.0	20.5	10.2
Change in central bank foreign assets as % of reserve money (BOP)	1.2	3.2	-1.6	8.5

<u>Note</u>: For definitions of variables, see Appendix B.

and real output and in accordance with the quantity theory of money, the rate of inflation jumped from an average 2.1% for the 1960s to a substantially higher level (14.5) for the 1970s, putting thus an end to a long period of monetary stability.

The average increase in the Greek rate of inflation from the 1960s to the 1970s was much larger than the corresponding increase in world inflation (≡ inflation of major trading partners of Greece) from 2.0% to 8.4%. The inflationary differential led to an effective depreciation of the Greek currency (an average -6.2% per year rate of depreciation in the 1970s). The depreciation of the Greek currency by an almost equal to the inflationary differential amount in the 1970s constitutes prima facie evidence of the validity of the purchasing power parity (PPP) doctrine as a theory of long-run exchange rate determination. The change in central bank's domestic credit component as % of reserve money almost doubled in the 1970s (20.5%) with respect to the 1960s (11.5%). Given the reduction in the demand for real cash balances growth as real output growth faltered, such an enormous increase created inflationary pressures of unprecedented proportions. Not only the domestic rate of inflation bore witness of the monetary imbalance, but the balance of payments deteriorated as well.

The change in central bank's foreign assets as % of reserve money (a proxy for the balance of payments), while positive (1.2%) on the average for the 1960s, was negative (-1.6%) for the 1970s, indicating persistent balance of payments deficit. The figure for the 1970s (-1.6%) is, however, highly understating the magnitude of the foreign sector imbalances. The reason is the unusually high inflow of capital that took place in 1972 (see Fig. 3.1) when the expected devaluation of the U.S. dollar made people eager to get rid of their dollar holdings. A substantial amount of these flows ended up in the non-Western economies. The change in foreign assets of the Bank of Greece as % of reserve money climbed to a staggering 16.6% in 1972. Excluding this unusually high magnitude, the balance of payments proxy for the 1970s was -3.6%. Also, during the same year (1972), the monetary authorities restricted domestic credit expansion to counterbalance the huge capital inflow. As a result, the 1972 change of the domestic component of the base as % of reserve money was almost zero (.8%). If we exclude this unusually low magnitude, the average change in the 1970s was 22.8% annually.

The manifestations of inflationary pressure not only reached higher levels in the 1970s relatively to the 1960s, but also their variability was much more pronounced. Table 3.1 is instructive on that score too.

An interesting fact which emerges from Table 3.1 is the stability of money growth. The standard deviation of money growth remained almost unchanged as between the two decades. Given the fact that the standard deviation of domestic inflation in the 1970s was more than three times as high as that of money growth, one wonders as to the validity of the monetarist doctrine that money causes prices. A more careful look, however, will reveal to the reader that the variance of the central bank's domestic credit component variable, which, according to the monetary approach to the balance of payments, is the relevant monetary variable under the control of the monetary authorities, was much higher than the variance of the domestic inflation rate, a fact which is consistent with monetarist contentions.

Given the high variability of the domestic credit component of the monetary base and the low variability of overall money growth, one is led to expect a relatively high negative covariance between the domestic credit component growth and the central bank's foreign assets growth.

This is, indeed, the case (see Table 3.2). Such a negative covariance is consistent with diverse explanations among which the monetary approach to the balance of payments provides a coherent all-around set of credible propositions.

Table 3.2 shows the covariances among variables entering our theoretical model of the monetary approach for the two subperiods.

The figures for the 1970s are consistent with the monetary approach to the balance of payments. The only disconcerting covariance sign is the one between world inflation and balance of payments which was negative. This largely reflects the effect of oil-price shocks in the 1970s and the huge balance of trade deficits ensued. Our model is developed under the assumption that the relative price of importables in terms of exportables remains fixed over time. This is, in fact, the assumption that allows us to treat tradables as a composite commodity. Thus, our model is not capable of capturing the negative effects on the balance of payments of the oil-price disturbances of the 1970s except to the extent that domestic and foreign monetary accommodation of the oil-price shocks would generalize the upward pressure in some prices (to a different degree domestically and abroad), and, thus, affect the balance of payments in the prescribed by the monetary approach way. Of course, the negative covariance between world inflation and the Greek balance of payments cannot be considered evidence against the monetary approach. After all, the monetary approach postulates a positive covariance between the balance of payments and the difference of world inflation from excessive domestic monetary expansion, something which is not captured in the simple covariance between world inflation and balance of payments.

The figures for the 1960s appear perverse. The covariances are generally close to zero and have signs which, at first hand, are in con-

Table 3.2

Covariance measures of selected pairs of variables (in percentages)

	1961-1970	1971-1980
Cov(DOM, DIN)	-.33	41.95
Cov(DOM, BOP)	.49	-81.11
Cov(DOM, GER)	.41	-12.18
Cov(WIN, DIN)	1.65	38.66
Cov(WIN, BOP)	-2.21	-29.03
Cov(WIN, GER)	-.11	6.42

For an explanation of the names of the variables, see Table 3.1.

tradiction to the monetary approach to the balance of payments. For example, central bank's domestic credit expansion is positively correlated, while world inflation is negatively correlated, to the balance of payments deficit and the rate of effective depreciation of the currency. As discussed above, the covariances presented are not the ones strictly dictated by the monetary approach. It is not the domestic credit expansion or the world inflation which are correlated with the domestic rate of inflation, the balance of payments and the rate of change of the effective exchange rate, but rather the differential between world inflation and excessive domestic monetary expansion, which, in turn, is unobserved since its measurement involves the growth of the demand for a desired stock of real cash balances. The true flavor of the monetary approach cannot be detected by simple covariance measures but rather by rigorous empirical work which incorporates all the restrictions implied by the theory. And this is where we turn next.

B. Estimation procedures

For econometric purposes, we consider two systems of equations corresponding to the basic theoretical model with and without the gradual adjustment hypothesis.

The first system consists of stochastic counterparts of the equations (2.3), (2.20), (2.21), and (2.22) of the theoretical model respectively,

(3.1) $$\ell og(\ell_d)_t = \ell o + \ell_1 \cdot \ell og y_t + \ell_2 \cdot \pi_t^e + u_{1t}$$

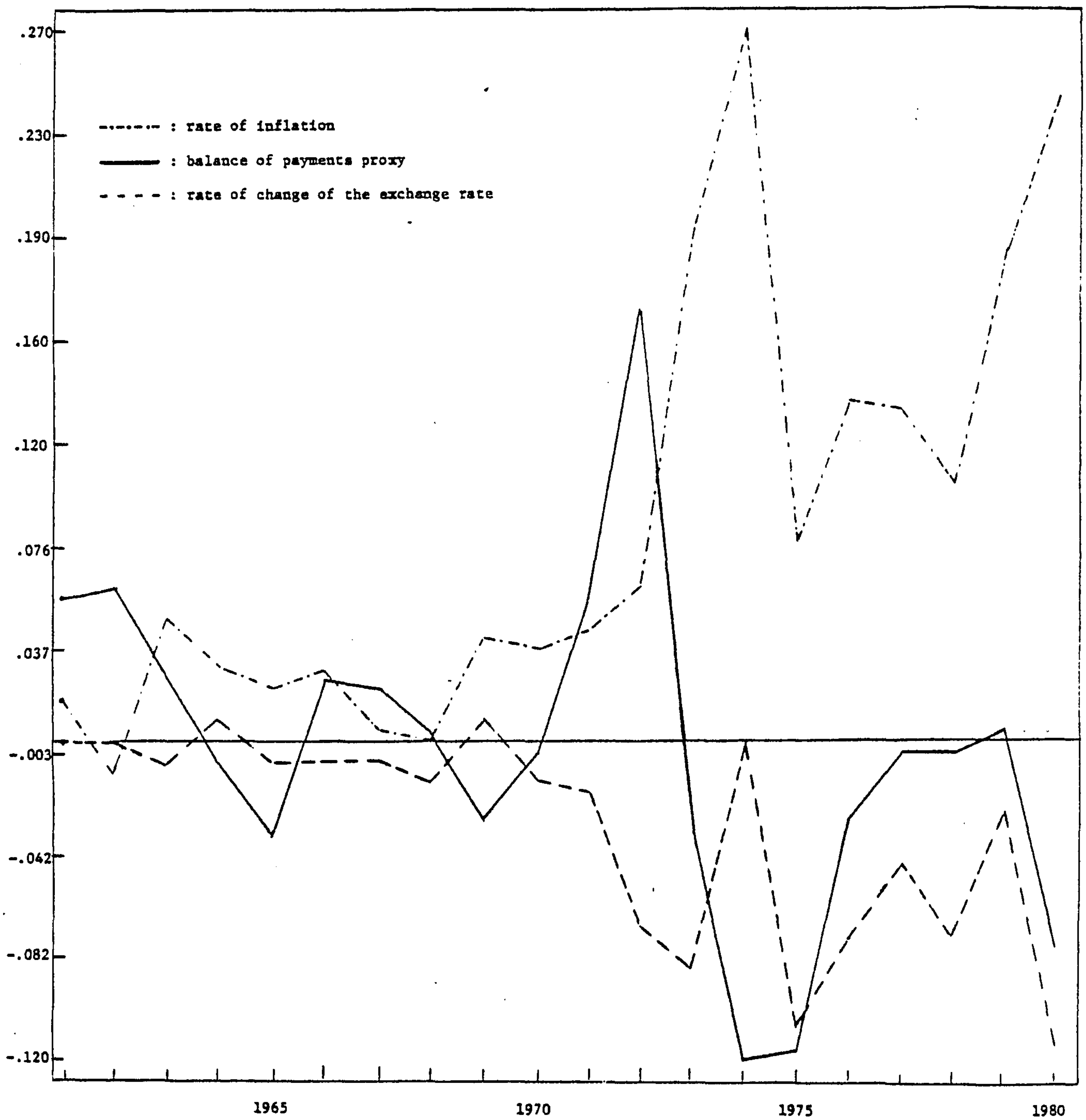
(3.2) $$\varepsilon_t = \delta(\pi_w - \mu)_t + u_{2t}$$

(3.3) $$bop_t = \rho(1-\delta)(\pi_w - \mu)_t + u_{3t}$$

(3.4) $$\pi_t = \rho(1-\delta)\pi_{wt} + [1-\rho(1-\delta)]\mu_t + u_{4t}$$

Fig. 3.1

Selected manifestations of inflationary
pressure in the Greek economy, 1961-1980.



Source: See Appendix B.

where u_{it} (i=1,2,3,4) are serially uncorrelated error vectors with zero mean and constant variance-covariance matrix. The above system reflects contemporaneous adjustments of the variables.

The second system consists of stochastic counterparts of the equations (2.3), (2.29), (2.30) and (2.31) of the theoretical model, respectively.

$$(3.5) \qquad \ell og(\ell d)_t = \ell o + \ell_1 \cdot \ell og y_t + \ell_2 \cdot \pi_t^{\,e} + v_{1t}$$

$$(3.6) \qquad \varepsilon_t = \delta B(\pi_w - \mu)_t + v_{2t}$$

$$(3.7) \qquad bop_t = \rho(1-\delta B)(\pi_w - \mu)_t + v_{3t}$$

$$(3.8) \qquad \pi_t = \rho(1-\delta B)\pi w_t + [1-\rho(1-\delta B)]\mu_t + v_{4t}$$

where $B \equiv \dfrac{\beta}{1-(1-\beta)L}$ and L is the lag operator ($L^i x_t = x_{t-1}$). As before, v_{it} (i=1,2,3,4) are serially uncorrelated error vectors with zero mean and constant variance-covariance matrix. The second system of equations incorporates the hypothesis of gradual adjustment of the variables.

Both systems were estimated under the restriction that μ_t is identically equal to

$$(3.9) \qquad \mu_t \equiv \dot{m}_t + (d\dot{D})_t - [\ell og(\ell d)_t - \ell og(\ell d)_{t-1}]$$

Since desired cash balances (ℓd) is not an observable variable, we hypothesized a gradual adjustment of the stock of real cash balances to its desired level, that is,

$$(3.10) \qquad \ell og(M/P)_t - \ell og(M/P)_{t-1} = k[\ell og(\ell d)_t - \ell og(M/P)_{t-1}]$$
$$0 < k \leq 1$$

Substituting (3.10) into (3.9) and, then, (3.9) into the first and the second system of equations, we get respectively

$$(3.1)' \quad \ell og(M/P)_t = k\cdot\ell o + k\cdot\ell_1\cdot\ell og y_t + k\cdot\ell_2\cdot\pi^e_t + (1-k)\ell og(M/P)_{t-1} + u'_{1t}$$

$$(3.2)' \quad \varepsilon_t = \delta\pi_{wt} - \delta E_t + u'_{2t}$$

$$(3.3)' \quad bop_t = \rho(1-\delta)\pi_{wt} - \rho(1-\delta)E_t + u'_{3t}$$

$$(3.4)' \quad \pi_t = \rho(1-\delta)\pi_{wt} + [1-\rho(1-\delta)]E_t + u'_{4t}$$

d for the contemporaneous adjustment system, and

$$(3.5)' \quad \ell og(M/P)_t = k\cdot\ell o + k\cdot\ell_1\cdot\ell og y_t + k\cdot\ell_2\cdot\pi^e_t + (1-k)\ell og(M/P)_{t-1} + v'_{1t}$$

$$(3.6)' \quad \varepsilon_t = \delta B\pi w_t - \delta BE_t + v'_{2t}$$

$$(3.7)' \quad bop_t = \rho(1-\delta B)\pi w_t - \rho(1-\delta B)E_t + v'_{3t}$$

$$(3.8)' \quad \pi_t = \rho(1-\delta B)\pi w_t + [1-\rho(1-\delta B)]E_t + v'_{4t}$$

for the gradual adjustment system, where

$$E_t \equiv [\dot{m}_t + (d\dot{D})_t - \ell_1(\ell og y_t - \ell og y_{t-1}) - \ell_2(\pi^e_t - \pi^e_{t-1})]$$

$$u'_{1t} = k \cdot u_{1t}$$

$$u'_{2t} = u_{2t} + \delta(u_{1t} - u_{1t-1})$$

$$u'_{3t} = u_{3t} + \rho(1-\delta)(u_{1t} - u_{1t-1})$$

$$u'_{4t} = u_{4t} - [1-\rho(1-\delta)](u_{1t} - u_{1t-1})$$

$$v'_{1t} = k\cdot v_{1t}$$

$$v'_{2t} = v_{2t} + \delta B(v_{1t} - v_{1t-1})$$

$$v'_{3t} = v_{3t} + \rho(1-\delta B)(v_{1t} - v_{1t-1})$$

$$v'_{4t} = v_{4t} - [1-\rho(1-\delta B)](v_{1t} - v_{1t-1})$$

The second system cannot be estimated as is since it contains the infinite lag operator L. Applying the Koyck transformation on (3.6)′

(3.7)′ and (3.8)′ the second system can be written as

$$(3.5)'' \quad \ell og(M/P)_t = k\cdot\ell o + k\cdot\ell_1\cdot\ell og y_t + k\cdot\ell_2\cdot\pi_t^e + (1-k)\ell og(M/P)_{t-1} + v''_{1t}$$

$$(3.6)'' \quad \varepsilon_t = \delta\beta\pi w_t - \delta\beta E_t + (1-\beta)\varepsilon_{t-1} + v''_{2t}$$

$$(3.7)'' \quad bop_t = \rho(1-\delta\beta)\pi w_t - \rho(1-\delta\beta)E_t - [\rho(1-\beta)\pi w_{t-1} - \rho(1-\beta)E_{t-1}] + (1-\beta)bop_{t-1} + v''_{3t}$$

$$(3.8)'' \quad \pi_t = \rho(1-\delta\beta)\pi w_t + [1-\rho(1-\delta\beta)]E_t - [\rho(1-\beta)\pi w_{t-1} + (1-\rho)(1-\beta)E_{t-1}] + (1-\beta)\pi_{t-1} + v''_{4t}$$

where
$$v''_{1t} \equiv v'_{1t}$$
$$v''_{2t} \equiv v'_{2t} - (1-\beta)v'_{2t-1}$$
$$v''_{3t} \equiv v'_{3t} - (1-\beta)v'_{3t-1}$$
$$v''_{4t} \equiv v'_{4t} - (1-\beta)v'_{4t-1}$$

to which now estimation methods can be applied.

Since the disturbances of the structural equations are correlated with each other, and since a priori restrictions on the coefficients had to be imposed across equations and, given the non-linearity of some of the parameters of the systems, a full information maximum likelihood estimator was used for estimation of both systems.

Before estimating the two systems, a proxy for expected inflation had to be constructed. Using a variant of the rational expectations hypothesis, it is postulated that economic agents form their expectations by using least-squares predictors of inflation, given the available information which is relevant for predicting inflation according to economic theory. Observations for π_t^e were obtained as the fitted values of the inflation rate regressed on past values of itself, world inflation, growth rate of real output, and past values of a variable summing the rate of change of the money multiplier and the rate of change of the domestic component of the base weighted by its share in it.[1] Since the model itself is not utilized to generate expectations, additional cross-equation restrictions on the coefficients are not accounted for, and thus we expect our estimates to be "good" but not "best."

C. Empirical results

We now present the estimates of the parameters of the model. Given the nature of the theoretical structure, the two versions of the model were estimated for two distinct time periods loosely corresponding to fundamentally different structures of the Greek economy. All estimates are based on yearly data for Greece covering the time period 1960-1980. The two subperiods considered are: 1962-1972 and 1970-1980 for the contemporaneous adjustment model (first system), and 1962-1973 and 1970-1980 for the lagged adjustment model (second system). The change in the sample size of the first period was deliberate in order that the invariance of the results with respect to sample size may be assessed. The second period was kept fixed in size as between the tests of the two systems since any attempt to alter the sample size would bring us further into a period fundamentally different and thus weaken the interpretation of the results. The meager number of observations makes these results conspicuously deficient. However, their indicative character is indispensably valuable in testing our theoretical model.

In Tables 3.3 and 3.4, the estimates of the coefficients of the two subperiods are presented.

The coefficients of the demand for real cash balances equation reveal the structural transformation of the Greek economy during the last twenty years. The income elasticity of demand for real cash balances has been falling from close to 2 in the 1960s to about 1.2 in the 1970s, implying a slowing down in the rate of decline of velocity.[2] This has been the experience of the advanced economies in comparable states of development.[3] The semi-logarithmic elasticity of demand for real cash balances with respect to expected inflation has been rising in absolute terms from the 1960s to the 1970s, indicating either a growing awareness of the dictates of rational economic behavior or, alternatively, that the expected rate of inflation is a poor proxy for the opportunity cost of holding money in a non-inflationary environment, as was the case in Greece in the 1960s, and a good proxy in a highly volatile inflationary period as was the case in the 1970s. Another interesting result concerns the speed with which actual cash balances adjust to desired levels. In the 1960s, the coefficient was close to zero and insignificant, while in the 1970s it was close to unity and statistically significant. Again, one can interpret the phenomenon of the differential in the speed of adjustment between the two periods in terms of the transition from a mild and highly stable inflationary environment in the 1960s to a largely unstable one in the 1970s.

The coefficient ρ, reflecting the composition of domestic expenditure with respect to traded and non-traded goods (λ), as well as the sensitivity of the relative price of non-traded goods to excess ex ante nominal supply of money (θ), appears to have increased somewhat between the two periods and is less than one as expected. Of course, the rise in ρ does reflect underlying changes in λ or θ. One would expect the share of traded goods in national expenditure to rise over time as the economy gets more and more integrated in the world market. Also, because of that, the elasticity of substitution in consumption and production between traded and non-traded goods would be expected to rise and, thus, the relative price elasticity of non-traded goods to monetary imbalances to decline. A rise in λ

Table 3.3

FIML Estimates of the Model

A. Contemporaneous Adjustment System, 1962-1972

Estimated Coefficients		t-statistic
k	.142	1.07
ℓ_o	-6.234	-4.10
ℓ_1	2.047	12.18
ℓ_2	.441	1.02
ρ	.781	15.46
δ	-.451	7.92

Log of likelihood function: 121.844

1. $\ell og(M/P)_t = k\ell o + k\ell_1 \ell ogy_t + k\ell_2 \pi^e_t + (1-k)\ell og(M/P)_{t-1}$

rho = .652 (2.30), Theil's inequality coef.: .003

2. $\varepsilon_t = \delta(\pi_w - \mu)_t$

D.W. = 2.52, Theil's inequality coef.: .358

3. $bop_t = \rho(1-\delta)(\pi_w - \mu)_t$

D.W. = 2.08, Theil's inequality coef.: .471

4. $\pi_t = \rho(1-\delta)\pi w_t + [1-\rho(1-\delta)]\mu_t$

D.W. = 2.07, Theil's inequality coef.: .185

B. Gradual Adjustment System, 1962-1973

Estimated Coefficients		t-statistic
k	.170	1.42
ℓo	-5.486	-3.89
ℓ_1	1.883	9.07
ℓ_2	.864	1.56
ρ	.773	17.70
δ	-.551	-7.95
β	1.014	8.98

Log of likelihood function: 120.138

Table 3.3 (cont'd)

1. $\ell og(M/P)_t = k\ell o + k\ell_1 \ell ogy_t + k\ell_2 \pi_t^e + (1-k)\ell og(M/P)_{t-1}$

D.W. = 1.21 , Theil's inequality coef.: .006

Durbin-h= 1.50

2. $\varepsilon_t = \delta\beta(\pi_w-\mu)_t + (1-\beta)\varepsilon_{t-1}$

D.W. = 2.34 , Theil's inequality coef.: .316

Durbin-h=-.64

3. $bop_t = \rho(1-\delta\beta)(\pi w-\mu)_t - \rho(1-\beta)(\pi w-\mu)_{t-1} + (1-\beta)bop_{t-1}$

D.W. = 1.33 , Theil's inequality coef.: .631

Durbin-h = 1.26

4. $\pi_t\ -\rho(1-\delta\beta)\pi w_t + [1-\rho(1-\delta\beta)]\mu_t$

$-\rho(1-\beta)\pi w_{t-1} - (1-\rho)(1-\beta)\mu_{t-1} + (1-\beta)\pi_{t-1}$

D.W. = 1.63 , Theil's inequality coef.: .153

Durbin-h = .69

Table 3.4

FIML Estimates of the Model

A. Contemporaneous Adjustment System, 1970-1980

Estimated Coefficients		t-statistic
k	1.016	3.32
ℓo	-2.261	-3.29
ℓ_1	1.265	12.24
ℓ_2	-.534	-2.17
ρ	.810	5.98
δ	.403	2.06

Log of likelihood function: 79.526

1. $\ell og(M/P)_t = k\ell o + k\ell_1 \ell og y_t + k\ell_2 \pi_t^e + (1-k)\ell og(M/P)_{t-1}$

D.W. = 1.37 , Theil's inequality coef.: .003

Durbin-h= cannot be imputed

2. $\varepsilon_t = \delta(\pi_w - \mu)_t$

D.W. = 1.85 , Theil's inequality coef.: .461

3. $bop_t = \rho(1-\delta)(\pi_w - \mu)_t$

D.W. = 1.06 , Theil's inequality coef.: .361

4. $\pi_t = \rho(1-\delta)\pi w_t + [1-\rho(1-\delta)]\mu_t$

D.W. = 1.30 , Theil's inequality coef.: .172

B. Gradual Adjustment System, 1970-1980

Estimated Coefficients		t-statistic
k	1.296	1.99
ℓo	-2.195	-2.63
ℓ_1	1.249	10.38
ℓ_2	-.291	-.81
ρ	.912	4.36
δ	.583	1.57
β	.583	2.37

Log of likelihood function: 80.145

Table 3.4 (cont'd)

1. $\ell og(M/P)_t = k\ell o + k\ell_1 \ell ogy_t + k\ell_2 \pi_t^e + (1-k)\ell og(M/P)_{t-1}$

D.W. = 1.32 , Theil's inequality coef.: .004

Durbin-h = cannot be imputed

2. $\varepsilon_t = \delta\beta(\pi_w - \mu)_t + (1-\beta)\varepsilon_{t-1}$

D.W. = 2.27 , Theil's inequality coef.: .389

Durbin-h = -.77

3. $bop_t = \rho(1-\delta\beta)(\pi_w-\mu)_t - \rho(1-\beta)(\pi_w-\mu)_{t-1} + (1-\beta)bop_{t-1}$

D.W. = 1.62 , Theil's inequality coef.: .249

Durbin-h = 1.09

4. $\pi_t = \rho(1-\delta\beta)\pi w_t + [1-\rho(1-\delta\beta)]\mu_t$

$-\rho(1-\beta)\pi w_t - (1-\rho)(1-\beta)\mu_{t-1} + (1-\beta)\pi_{t-1}$

D.W. = 1.48 , Theil's inequality coef.: .159

Durbin-h = 1.47

and a fall in θ both make up for a rise in ρ, which conforms to the experience of the Greek economy.

The coefficient δ, i.e. the degree of flexibility of the exchange rate regime appears to be rising between the two periods as one would expect as the economy moves from a rather fixed exchange rate regime in the 1960s to a rather flexible one in the 1970s. The difference of δ from zero reflects the particular policy in effect with respect to the exchange rate.

Ever since 1954 and up to the first quarter of 1975, the Greek drachma had been uninterruptedly tied to the U.S. dollar.[4] Then, a crawling-peg system was adopted under which the monetary authorities periodically change the nominal exchange rate in accordance with the dictates of economic policy and given the external borrowing capacity of the economy.[5]

With respect to the effective exchange rate, we can distinguish two periods. In the 1960s and approximately up to 1971, the effective exchange rate had exhibited limited movement fluctuating around a slightly downward trend (see Fig. 3.1). With the end of the Bretton Woods era, the effective exchange rate index registered substantial downward movement, since the Greek monetary authorities reacted to the crisis of the U.S. dollar by preserving the old parity to the dollar! Finally, in 1975, a new policy was adopted. As the dollar was becoming stronger and Greece's domestic inflationary pressures were mounting, the disengagement of the drachma from the U.S. dollar became a vital necessity.

In the 1960s, Greece exhibited a positive inflationary differential, i.e. the Greek economy was inflating at a slightly lower rate than the rest of the world. Despite this, the effective exchange rate was slowly depreciating over the period. As a consequence, the balance of payments surplus exceeded the inflationary pressure differential or, the same, δ, was negative. Now, since the Greek drachma was uninterruptedly tied to the U.S. dollar, one cannot talk about a conscious policy with respect to the selection of δ, i.e. the degree of flexibility of the exchange rate regime. Rather, the specification of the degree of flexibility was implicit in the decision of the monetary authorities to fix the parity of the currency with respect to the U.S. dollar.

In the 1970s, the Greek economy was inflating at substantially higher rate than the rest of the world (almost 10 percentage points higher). Such a large inflationary pressure could not possibly be absorbed in balance of payment deficits and, therefore, the monetary authorities began a process of steady devaluation partially accepting the inflationary consequences of their monetary imprudence. The coefficient δ was estimated to be .403 (with a standard deviation of .195) in the contemporaneous adjustment system and .583 (with a standard deviation of .371) in the lagged adjustment version. To interpret these numbers, consider the following example assuming that $\delta = .403$. In the contemporaneous adjustment model, an increase in excess domestic monetary expansion (μ) by one percentage point, with world inflation remaining constant, will cause a deterioration in the balance of payments with foreign exchange reserves dropping by the equivalent of .483 ($\equiv .81[1-.403]$) billion drachmae per 100 billion drachmae of monetary base, while the rate of depreciation will increase by .403 ($\equiv 1-.597$) percentage points and the rate of inflation by .517 ($\equiv 1-.483$) percentage points.

With respect to the speed of adjustment coefficient β, the picture which emerges is consistent with our theoretical expectations. The speed of adjustment was close to one for the 1960s and close to .6 for the 1970s. The decline of the speed of adjustment as between the two periods reflects the deliberate efforts of the monetary authorities to reduce the variance of the inflationary process during a period of highly volatile and unstable inflationary episodes.

For the period of the 1960s, the speed of adjustment coefficient was 1.014 (with a standard deviation of .113). With 95% confidence, the coefficient β cannot be lower then .952. Whatever its value, it is very close to unity, rendering the lag distribution for the period under consideration not terribly distinguishable from that of the contemporaneous adjustment system.

The lag distribution in the 1970s is much more interesting. To fully assess the effects of current and lagged rates of excess domestic monetary expansion (μ) and world inflation (π_W) on the rate of depreciation, the balance of payments and the domestic rate of inflation, the reduced-form estimates of the gradual adjustment system are computed and presented together with their standard errors on Table 5.

The picture emerging out of Table 5 is characteristic of the structure and the performance of the Greek economy as conditioned by the inflation management policies of the Greek authorities. To illustrate the functioning of the model, it is best to employ a simple example. Suppose that world inflation is zero ($\pi_W = 0$) and the monetary authorities create domestic credit at a rate appropriate to satisfy the growth of the demand for real cash balances ($\mu = 0$). In this kind of world, domestic inflation is zero, the stock of foreign reserves remains unchanged and the exchange rate does not vary. Now, suppose that the monetary authorities create domestic credit at a rate which is 10 percentage points higher than the rate warranted by the growth of demand for real cash balances ($\mu = 10$). After all the adjustments have taken place, domestic inflation will stand at 6.2 per cent, foreign reserves will drop by 3.8 per cent and the exchange rate will depreciate by 5.8 per cent. Now, suppose that while $\mu = 10$, world inflation jumps from zero to 10 per cent and stays there. In this case of relative monetary prudence, domestic inflation will be 10 per cent, and, since the inflationary pressure differential (π_w-μ) is zero, the balance of payments will be in equilibrium and the exchange rate will not be changing. It is as if the economy is closed. In more general terms, if $\pi_w = \mu$, about 62 per cent of domestic inflation can be attributed to domestic inflationary pressure while 38 per cent can be accounted for by foreign inflationary pressures. In reality, the excessive domestic monetary expansion rate is usually much higher than world inflation. This implies that the domestic influence above is understated while the foreign influence is overstated. For the sake of an example, μ can be calculated for 1980 using the estimated coefficients and actual values of the variables involved, to be 22 per cent while world inflation was 12 per cent. According to our results, after all the adjustments have taken place, the rate of inflation will be 18 per cent $[(.62)(.22) + (.38)(.12) = .18]$, 75 per cent of which can be attributed to domestic factors and the rest to foreign influences. A difference of 10 percentage points between μ and π_W will produce such a result. This result is rather important because it shows unequivocally the large influence of domestic monetary management on domestic inflation. Oil-price shocks can hardly be blamed for the persistently high rates of inflation Greece experienced in the 1970s. The well-known fact of monetization of ever-increasing (since 1972) government budget deficits relative to gross national product growth is basically responsible for the rapid expansion of the domestic component of high-powered money relative to the demand for real cash balances.

So far we have discussed the overall effects of excessive domestic monetary expansion and world inflation on the rate of depreciation, the balance of payments and the rate of domestic inflation. In the short run,

TABLE 3.5

Estimates and standard errors of distributed lag coefficients in the gradual adjustment model, 1970-1980

(1) $\varepsilon_t = (.340 + .142L + .059L^2 + .025L^3)(\pi_w - \mu)_t$

(1.88) (1.34) (.81) (.56)

sum of infinite series of coefficients: $\delta B = .583$

(2) $bop_t = (.602 - .129L - .054L^2 - .022L^3)(\pi_w - \mu)_t$

(7.06) (1.10) (.75) (.54)

sum of infinite series of coefficients: $(1-\delta B) = .380$

(3) $\pi_t = (.602 - .129L - .054L^2 - .022L^3)\pi w_t$

(7.06) (1.10) (.75) (.54)

sum of infinite series of coefficients: $\rho(1-\delta B) = .380$

$+ (.398 + .129L + .054L^2 + .022L^3)\mu_t$

(4.66) (1.10) (.75) (.54)

sum of infinite series of coefficients: $1-\rho(1-\delta B) = .620$

however, a fundamentally different picture emerges from an examination of the lag distributed patterns exhibited in Table 5. The first period (impact) effects tend to be rather large. While in the long run 38 per cent of the inflationary pressure differential assumes the form of a balance of payments deficit while 58 per cent shows up as depreciation of the exchange rate, in the first year a larger proportion of the inflationary pressure differential is absorbed in balance of payments (60 per cent) and a smaller proportion (34 per cent) in exchange rate depreciation. This conforms to our theoretical expectations of gradual adjustment of the rate of depreciation to the level dictated by the degree of flexibility of the exchange rate regime, so that the variance of the inflationary process is controlled. In subsequent time periods, the balance of payments gets into surpluses (coefficients have negative signs). Before an explanation is offered, the domestic rate of inflation should be brought into the analysis.

The impact effect of world inflation on domestic inflation, point for point, is larger than that of excessive domestic monetary expansion. About 40 per cent of this year's domestic inflationary pressure and about 60 per cent of this year's rate of world inflation make up this year's rate of domestic inflation. Thus, in the short run, world inflation exercises a stronger influence on domestic prices than domestic monetary imprudence. The reason for that might be the fact that changes in world prices via arbitrage are transmitted to domestic prices of traded goods rather quickly while excessive domestic monetary expansion affects the prices of traded goods through a depreciation of the exchange rate which, as we have seen above, only gradually adjusts to its long-run value. We now turn to an examination of the lag structure of the domestic inflation equation. The coefficients of the excessive domestic monetary expansion are positive reflecting the gradual effect of money on the prices of non-traded goods directly and of traded goods indirectly through depreciation of the exchange rate. The coefficients of the lag distribution of world inflation become negative after the first period, reflecting the fact that, ceteris paribus, world inflation induces subsequent appreciations of the exchange rate which will tend to reduce traded goods inflation and thus overall domestic inflation as well. However, those negative effects on domestic inflation are more than counterbalanced by the positive effects of excessive domestic monetary expansion and, thus, the net effect on domestic inflation will be positive. This subsequent rise in the rate of inflation will tend to reduce the stock of real cash balances and, ceteris paribus, to create a surplus in the balance of payments as individuals reduce spending in an effort to reconstitute their stock of real cash balances to the desired level.

We now turn to other aspects of our empirical investigation.

To test the validity of the theoretical restrictions, the model was estimated again in its unconstrained form as follows:

$$\ell og(\ell_d)_t = \ell o + \ell_1 \cdot \ell og y_t + \ell_2 \cdot \ell og \pi_t^e + w_{1t}$$

$$\varepsilon_t = \beta_1(\pi_w - \mu)_t + d \cdot n \cdot \varepsilon_{t-1} + w_{2t}$$

$$bop_t = \gamma_1(\pi_w - \mu)_t + d \cdot n \cdot bop_{t-1} + w_{3t}$$

$$\pi_t = \alpha_1 \cdot \pi w_t + \alpha_2 \cdot \mu_t + d \cdot n \cdot \pi_{t-1} + w_{4t}$$

where d is a dichotomous variable assuming the value 0 if the contemporaneous adjustment system is estimated and the value 1 if the gradual adjustment system is estimated; n is the rate of decay of the hypothesized distributed lag process.

A likelihood ratio test was constructed for each subperiod. The likelihood ratio statistic

$$-2\ell og_e(L^c/L^u)$$

is asymptotically[6] distributed as $\chi^2(q)$ where q is the number of restrictions, L^c is the maximum of the likelihood function of the constrained system and L^u is the maximum of the likelihood function of the unconstrained system. The results appear in Table 6. Based on these results, we conclude that, for the 1960s, the null hypothesis of the validity of restrictions is rejected at the 5 per cent significance level, though the restrictions in the gradual adjustment model cannot be rejected at the 1 per cent significance level. Moreover, the null hypothesis cannot be rejected for the 1970s when the conditions capable of generating our theoretical structure are more faithfully reproduced in the data, since the monetary authorities' choice of the degree of flexibility of the exchange rate was rather explicit.

Our final point is in order now. As we mentioned in the theoretical section of our paper, the Girton-Roper exchange market pressures variable is not independent of its composition. According to our results, and given (2.23), the sensitivity of exchange market pressure (bop + ε) with respect to the inflationary pressure differential ($\pi_w - \mu$) is calculated for the 1960s to be equal to .682 and for the 1970s equal to .886, which conform to our theoretical expectations that those two figures would be below unity and the 1970s figure would be larger than the 1960s one since the degree of flexibility of the exchange rate regime was higher in the former period. Simple statistical inference tests do support the above propositions.[7] Thus, for the same level of inflationary pressure differential, a higher level of exchange market pressure results under a more flexible exchange rate regime than under a less flexible one, to an extent depending on the share of non-traded goods in expenditure as well as the elasticity of the relative price of non-traded goods with respect to monetary imbalance (ρ).

Table 3.6

Likelihood ratio statistics for testing the significance of the theoretical restrictions of the model.

	1960s	1970s
Contemporaneous adjustment model	25.49	7.77
b Gradual adjustment model	13.25	7.10

Critical values: $\chi^2_{.05}(4) = 9.488$

$\chi^2_{.01}(4) = 13.277$

In this chapter, empirical evidence in support of our model has been presented. Overall, the sample information seems to be consistent with our theoretical structure. The monetary approach to the balance of payments seems to hold with respect to the Greek data.

Footnotes for Chapter III

[1]The following two equations were used after consistent estimates of the parameters had been obtained by OLS:

1962-1973

$$\pi_t = .120 + .496\pi_{t-1} + 1.171\ \pi w_{t-1} - .788(\dot{m}+d\dot{D})_{t-1} - .071\ \dot{y}_{t-1}$$

(3.21) (.59) (1.35) (3.47) (.13)

$\bar{R}^2 = .66$, D.W. = 1.88

1968-1980

$$\pi_t = -.075 + 2.227\pi_{t-1} - 1.903\pi w_{t-1} - .006\ (\dot{m}+d\dot{D})_{t-1} + 1.657\ \dot{y}_{t-1}$$

(1.27) (5.56) (2.76) (.05) (2.87)

$\bar{R}^2 = .78$, D.W. = 2.54

[2]These estimates conform to the estimates obtained by other authors investigating the demand for money in the Greek Economy. See Brissimis and Leventakis (1981).

[3]See McKinnon (1973), ch. 8.

[4]With the brief exception of the last quarter of 1973 when the drachma was temporarily revalued with respect to the U.S. dollar.

[5]In 1975, the drachma was officially tied to a basket of currencies (of its major trading partners). However, as the data reveal, the behavior of the nominal exchange rate has been rather spasmodic, with sudden jumps which imply an abandonment of the basket as a guide for setting the nominal exchange rate.

[6]Again, we should remind the reader about the deficiency of our sample in terms of size.

[7]A t-test was conducted for the statistical significance of the

difference. The value of t was -4.9 (t_c = -1.7, d.f. = 20, α = .05) and thus we could not reject the null hypothesis that the 1960s sensitivity figure was smaller than the 1970s one. Also, t-tests were conducted for the difference of the two figures from unity. Here, for the 1960s figure, $t_{60s} = -4.07$ and for the 1970s figure, $t_{70s} = -1.07$ (t_c = 1.81, d.f. = 10, α = 10). Thus, the 1970s figure was very close to one while the 1960s figure was significantly different from one.

CHAPTER IV

In this chapter, we are interested in modeling deviations of the overall inflationary process from its long-run equilibrium path which is here represented by the long-run solutions of the model presented in Chapter II. That is, we assume that in the long run, the domestic rate of inflation, the rate of depreciation of the exchange rate and the flows of international reserves are all functions of the excess domestic monetary expansion and the world rate of inflation. In the short run, however, we do recognize the presence of other factors which will tend to disturb the inflationary process. To the extent that the disturbances persist, the real side of the economy is affected and stabilization policy considerations become important.

Consider the domestic rate of inflation. In the long run, it is a weighted average of domestic excess monetary expansion and world inflation, the weights being critically determined by the degree of flexibility of the nominal exchange rate regime. In the short run, however, autonomous cost-push factors of domestic and/or foreign origin will be in effect conditioning the inflationary process. We specifically refer to money wage rate demands or oil-price shocks which will tend temporarily to raise the domestic rate of inflation above the level consistent with monetary forces of indigenous character and/or inflationary pressures of a monetary nature originating abroad. If, for whatever reason, the inflationary disturbance persists for a certain period of time, then the real exchange rate will tend to appreciate and the stock of real cash balances will tend to fall, effectively depressing the level of aggregate demand and output.

In this chapter, a theoretical model of short-run output and price dynamics is presented and fully explicated. Stabilization policy considerations are explicitly dealt with and the relevant tradeoffs are adequately explored.

A. The Model

In an open economy, inflationary shocks not only have the potential of destabilizing output (as in a closed economy) but may affect the conditions of external equilibrium. We consider the latter effect first.

An upward deviation of the inflation rate from trend will tend to reduce the balance of payments surplus and, given the exchange rate policy in effect, will also tend to raise the general level of depreciation associated with smaller balance of payments surpluses. If the Marshall-Lerner condition is satisfied, then, an increase in the domestic price level, given the nominal exchange rate, will reduce the value of net exports and thus reduce the balance of trade surplus.

We postulate that

$$(4.1) \qquad f = \bar{f} - n(\pi_{-1} - \bar{\pi}) + w$$

where f is the sum of balance of payments surplus (bop) and the rate of change of the nominal exchange rate (ε), measured in units of foreign currency per unit of domestic currency, π_{-1} is the domestic rate of inflation lagged one period, a bar indicates the secular trend of variables (policy desired long-run trends given the past history of the economy) and w is a disturbance term reflecting shifts in tastes and technology as affecting the composition of aggregate expenditure. The coefficient n reflects the responsiveness of the external equilibrium conditions to inflation shocks and it is determined by the structural idiosyncracies of the economy. For example, the higher the degree of openness of the economy, the larger the share of imports in total expenditure and, thus, the stronger the impact of an upward deviation of domestic inflation from trend on the balance of payments as substitution towards foreign goods takes place, so that the larger n becomes. Also, the coefficient n is a negative function of the degree of effective tariff protection and, in general, of the trade-restrictive practices in effect in the economy under consideration. The coefficient n will be positive as long as the Marshall-Lerner condition is satisfied.

Given the long-run desired rate of domestic inflation $\bar{\pi}$, the authorities will be prepared to offset any potential depreciation of the nominal exchange rate up to a certain extent by using the stock of foreign reserves. Assume that a portion δ' of the impact of the inflationary shock takes the form of depreciation of the currency and, thus, $1-\delta'$ of the impact shows up as a balance of payments deficit. Then we can write

$$(4.2) \qquad bop - \overline{bop} = -(1-\delta')n(\pi_{-1}-\bar{\pi}) + w_1$$

$$(4.3) \qquad \varepsilon - \bar{\varepsilon} = \delta' n(\pi_{-1}-\bar{\pi}) + w_2$$

where $bop-\overline{bop}$ and $\varepsilon - \bar{\varepsilon}$ are the deviations of the balance of payments and the rate of change of the nominal exchange rate from their trends respectively, and w_1 and w_2 are error terms. The coefficient δ' can be thought of as the short-run degree of flexibility of the nominal exchange rate and reflects the extent to which the monetary authorities are prepared to defend the relative competitiveness of domestic output or, the same, to attempt to validate the cost-push forces.

We now postulate that real output is demand-determined with aggregate demand depending on the stock of real cash balances and the real exchange rate.[1] Thus,

$$(4.4) \qquad y - \bar{y} = \beta\left[(m-\bar{m})-(\pi_{-1}-\bar{\pi})\right] - \gamma\left[(\varepsilon-\bar{\varepsilon})+(\pi_{-1}-\bar{\pi})\right] + z \quad , \quad \beta,\gamma>0$$

where y is the rate of change of real output and m is the rate of growth of the nominal stock of money, and z is a disturbance term reflecting unanticipated velocity shocks or errors in the implementation of the monetary policy. According to (4.4), aggregate demand can be raised either by an increase in the stock of real cash balances or by a real depreciation of the domestic currency.[2] Obviously, the operational character of (4.4) crucially depends on sluggish price adjustment. Therefore, our model does not assume full flexibility in money wage rates and prices. However, the cause of price rigidity is left unspecified so that it might not be confined within the limits of highly unrealistic schemes. One may fruitfully think of the persistence of price disturbances as the outcome of staggered wage contracts a la Taylor (1979).

An inflationary disturbance, therefore, will tend to reduce real cash balances, for given growth of the money stock, and appreciate the real exchange rate, for given growth of the nominal exchange rate, causing a fall in aggregate demand and output. However, the inflationary shock will affect the balance of payments and the rate of change in the nominal exchange rate by virtue of (4.2) and (4.3). The deterioration in the balance of payments implies a fall in the stock of foreign reserves and, thus, of the money supply (in percentage terms), tending to amplify the negative effect of the inflationary disturbance on aggregate demand and output. On the other hand, the depreciation of the nominal exchange rate will tend to dampen the appreciation of the real exchange rate due to the inflationary shock, thus partially offsetting the potential fall in aggregate demand and output. If the depreciation of the nominal exchange rate is insufficient to keep the real exchange rate constant, an inflationary shock will tend to lower aggregate demand and real output, unless its effects are mitigated by monetary accommodation.

By definition, monetary growth is caused either because of growth in the domestic component of the monetary base and the money multiplier (dom) or because of growth in the stock of foreign reserves (bop). Thus, we can write

$$(4.5) \qquad m - \bar{m} \equiv (dom-\overline{dom}) + (bop-\overline{bop})$$

Now, suppose that the domestic component of the monetary base deviates from trend due to monetary accommodation deliberately undertaken on the part of the monetary authorities to stabilize the economy. Then, we can write

$$(4.6) \qquad dom - \overline{dom} = \lambda(\pi_{-1}-\bar{\pi}) + w_0$$

where λ is the coefficient of accommodation, which is expected to be positive unless the monetary authorities disaccommodate when λ could in fact be negative, and w_0 is an error term.

Substituting (4.2) and (4.6) into (4.5) and then (4.3) and (4.5) into (4.4), we get

$$(4.7) \qquad y - \bar{y} = -[\beta\ (1+\delta n-\lambda) + \gamma(1-(1-\delta)n)](\pi_{-1}-\bar{\pi}) + e$$

$$(4.8) \qquad y - \bar{y} = -\alpha(\pi_{-1}-\bar{\pi})+ e$$

where

$$(4.9) \qquad \alpha = \beta[1+(1-\delta')n-\lambda] + \gamma(1-\delta' n)$$

$$e = \beta w_3 - \gamma w_2 + z \quad \text{and} \quad w_3 = w_0 + w_1$$

The response of output to inflationary shocks depends both on the rate of monetary accommodation ($\partial\alpha/\partial\lambda = -\beta<0$) and on the degree of flexibility of the exchange rate regime ($\partial\alpha/\partial\delta' = -(\beta+\gamma)n<0$). The greater the rate of monetary accommodation (the higher λ is) and the greater the rate of depreciation of the nominal exchange rate (the larger δ' is), the lower α will be and, thus, the greater the insulation of aggregate demand and output from inflationary disturbances. Given the degree of flexibility of the nominal exchange rate (δ'), an increase in the stock of nominal cash balances by an appropriate amount can counteract the fall of the real cash balances and the tendency of the real exchange rate to appreciate, thus preserving aggregate demand and output close to full-employment. The amount of monetary accommodation needed is lessened as the degree of flexibility of the nominal exchange rate rises. This tends to maintain the real exchange rate on trend and, thus, does not cause a loss of reserves. Assuming $d\alpha=0$ and β, γ and n constant, we can get

$$(4.10) \qquad \frac{d\lambda}{d\delta'} = -\frac{(\beta+\gamma)n}{\beta} < 0$$

which shows the character of the relationship between nominal exchange rate flexibility and monetary accommodation policies.

The negative response of output to inflationary shocks, given the initial growth of money supply, is also dependent on factors summarized in the coefficient n which measures the responsiveness of external equilibrium conditions to the inflationary shocks and reflects the degree and the structure of integration of the domestic economy into the world market. From (4.9), we have

$$(4.11) \qquad \frac{\partial\alpha}{\partial n} = \beta(1 - \frac{\beta+\gamma}{\beta}\delta')$$

Notice that the effect of n on the stability of output depends on the degree of flexibility of the nominal exchange rate since movements in the nominal exchange rate are in part determining factors of the real exchange rate. As δ' assumes values from zero (fixed nominal exchange rates) to one (fully flexible nominal exchange rates), the value of $\partial\alpha/\partial n$ fluctuates from positive to negative being zero at $\delta' = \beta/(\beta+\gamma)$. Thus, as the economy develops and gets integrated into the world economy, the coefficient n will tend to rise because the share of imports in national expenditure will tend to increase and the walls of protectionism will tend to tumble down progressively. As n rises, a relatively flexible exchange rate regime will be output-stabilizing while a relatively fixed exchange rate regime will be output-destabilizing. As a matter of policy, for the responsiveness of output to inflationary shocks to remain unchanged, the monetary authorities should adopt an exchange rate regime of some flexibility, with the coefficient of flexibility, δ', set equal to the relative elasticity of aggregate demand to the stock of real cash balances with respect to the sum of elasticities of aggregate demand to the stock of real cash balances and to the real exchange rate ($\delta' = \beta/\beta+\gamma$). Ceteris paribus, growing interdependence of the world's economies will tend to undermine the fixity of the exchange rates because of the growing impact of inflationary shocks on national output through the channels of balance of payments and exchange rates as affecting aggregate demand. The more the authorities allow the inflationary shocks to affect the exchange rate rather than the stock of foreign reserves, they simultaneously mitigate the tendency for the real exchange rate to appreciate and the stock of real cash balances to fall and, thus, they effectively reduce the negative impact of the inflationary shock on the stability of real output. Also, under conditions of strong interdependence of the world economies, a move away from free trade and towards protectionism would tend to negate the output-stabilizing properties of a relatively flexible exchange rate regime.

So far, we have examined the impact of the inflationary disturbances on aggregate demand and real output and we have identified the channels through which the inflationary shock affects the economy. In general, the inflation shock will cause a larger deficit in the balance of payments and greater rate of depreciation of the domestic currency and a downward deviation of output from trend. The extent of output variability can be successfully minimized by monetary accommodation, given the flexibility of the exchange rate, the degree of openness of the economy, and the elasticities of aggregate demand with respect to the stock of real cash balances and the real exchange rate.

The induced slack in the economy as well as the larger balance of payments deficit and the higher rate of depreciation are the very forces which will work automatically to return prices on trend and hence output at its potential level. We should examine how the self-correcting forces of the economy operate and why interventionist policies on the part of the monetary authorities will tend to raise the persistence of inflation, interfering with the automatic stabilizing forces of the economy.

We postulate that

$$\pi = \pi_{-1} + c(y-\bar{y}) + \theta(f-\bar{f}) + u \qquad (4.12)$$

that is, a downward deviation of output from trend will tend to reduce inflation with respect to the last period's rate of inflation and the same will be true for a downward deviation of f from trend or, the same, for a larger than trend balance of payments deficit and a higher than trend rate of nominal depreciation of the domestic currency ($f \equiv bop + \varepsilon$). The term u captures all kinds of shocks not reflected in output and the conditions of external equilibrium.

That the slack of the economy will slow down the rate of inflation is based on sound theoretical and empirical foundations. In terms of the staggered contracts model of Taylor (1979), the slack of output is taken into consideration in the wage formation process and results in a certain pattern of persistence of inflationary disturbances which is more prolonged if output deviations from trend are minimized through monetary accommodation. Indeed, in the limit, the price level becomes a random walk and its variance infinite. Workers do respond to the prospect of unemployment, their response being conditioned by their expectations as to the extent that the monetary authorities stand ready to stabilize aggregate demand and output.

We now advance the hypothesis that the wage formation process is sensitive not only to the stability of output but also to the stability of balance of payments and exchange rate variation. The conditions of external equilibrium of the economy, responding to an inflationary disturbance, ceteris paribus, will exert an influence on the level of aggregate demand and output. Thus, the resulting slack of the economy, as a factor influencing the inflation rate in the next period, does incorporate the effects of a greater balance of payments deficit and a higher rate of nominal depreciation. We do maintain, however, that given the slack of the economy, a larger deviation of balance of payments deficit from trend and a larger deviation of nominal depreciation from trend, will tend to reduce faster the inflation rate back to trend. Consider two economies experiencing the same inflationary disturbance. The economy which is more integrated in the world economy will experience a larger balance of payments deficit and a higher rate of depreciation of its currency. Suppose that the monetary authorities in the two economies follow monetary accommodation policies which preserve real output on trend. We, then, maintain that the inflation rate does not remain at the level of the initial inflationary disturbance but rather is mitigated in next periods, falling faster towards trend in the economy which experienced the greater balance of payments deficit and the higher rate of depreciation. The reason for this pattern of persistence is that workers and employers are not concerned only with the expected level of aggregate demand when participating in the wage formation process, but also with the conditions of external equilibrium. The prospect of a deficit in the balance of payments and concurrent (or, subsequent) nominal depreciation of the domestic currency, in general, will make the workers and the employers more "careful" in setting wages, not only because the stock of real cash balances and the real exchange rate may be adversely affected with respect to aggregate demand, but also because the domestic prices of imported goods will tend to rise for two reasons. A deviation of the balance of payments deficit from the policy-desired trend on the one hand will force the government to adopt policies, usually in the form of tariffs and quotas and other restrictive mechanisms, common to less advanced though not rare in more advanced countries, which tend to raise the price of imported commodities, and on the other hand will raise expectations of a future nominal depreciation. A deviation of the rate of nominal depreciation from trend tends to inflate the prices of imported goods directly. To the extent that imported commodities enter into the consumption baskets of workers, directly (consumption goods) or indirectly (imported machinery, raw materials, etc. used in the production of domestically consumed commodities), the workers will be reluctant in maintaining high wages and therefore the persistence of inflation will be reduced.

Thus, we have identified two channels through which the inflationary disturbance will be mitigated - unemployment and higher prices for imported commodities. The extent to which the stability of balance of payments deficit and the rate of nominal depreciation will mitigate the inflation rate in subsequent periods, independently of their effects through aggregate demand, is determined by the economy's integration in the world markets. Unlike output, the stability of the balance of payments deficit and the rate of nominal depreciation does not depend on accommodative policies on the part of the monetary authorities but rather is an inescapable datum of the structure of the economy, though the choice between manipulating the stock of foreign reserves or the nominal exchange rate may have consequences for the speed with which prices of imported commodities will rise.

Assembling all the pieces together, we have

$$f = \bar{f} - n(\pi_{-1} - \bar{\pi}) + w \tag{4.13}$$

$$y = \bar{y} - \alpha(\pi_{-1} - \bar{\pi}) + e \tag{4.14}$$

$$\pi = \pi_{-1} + c(y - \bar{y}) + \theta(f - \bar{f}) + u \tag{4.15}$$

Substituting (4.13) and (4.14) into (4.15), we get

$$\pi - \bar{\pi} = (1 - \alpha c - n\theta)(\pi_{-1} - \bar{\pi}) + s \tag{4.16}$$

where $$s = c(\beta w_3 - \gamma w_2 + z) + \theta(w_1 + w_2) + u$$

Equation (4.16) illustrates the automatic mechanism of adjustment. A one percent π-shock will result in $1 - \alpha c - n\theta$ percent deviation of π from $\bar{\pi}$ in the next period and in $(1 - \alpha c - n\theta)^2$ percent in the period after the next and so on. As long as $0 < 1 - \alpha c - n\theta < 1$, the π-shock eventually degenerates. The coefficient $1 - \alpha c - n\theta$ reflects the degree of persistence of the inflationary disturbance. Notice that the monetary authorities can reduce the persistence of inflation by being less accommodative or by reducing the degree of flexibility of the exchange rate regime both of which imply a higher α.

Taking variances in (4.13), (4.14) and (4.15) and denoting $1 - \alpha c - n\theta \equiv \rho$, we have

$$(4.17) \qquad \sigma_{\pi}^2 = \frac{1}{1-\rho^2} \cdot \sigma_s^2$$

$$(4.18) \qquad \sigma_y^2 = \frac{\alpha^2}{1-\rho^2} \cdot \sigma_s^2$$

$$(4.19) \qquad \sigma_f^2 = \frac{n^2}{1-\rho^2} \cdot \sigma_s^2$$

Differentiating (4.17), (4.18) and (4.19) with respect to α, we get

$$(4.20) \qquad \frac{\partial \sigma_{\pi}^2}{\partial \alpha} = \frac{-2c\rho\sigma_s^2}{(1-\rho^2)^2} < 0$$

$$(4.21) \qquad \frac{\partial \sigma_y^2}{\partial \alpha} = \frac{2\alpha\left[1-\rho(1-n\theta)\right]\sigma_s^2}{(1-\rho^2)^2} > 0$$

$$(4.22) \qquad \frac{\partial \sigma_f^2}{\partial \alpha} = \frac{-2n^2c\rho\sigma_s^2}{(1-\rho^2)^2} < 0$$

Thus, an increase in the rate of monetary accommodation or an increase in the degree of flexibility of the exchange rate regime (both of which will tend to reduce α), will reduce the variance of output at the expense of an increase in the variance of inflation and the variance of the sum of nominal depreciation and balance of payments deficit.[3] These results extend Taylor's (1980) concept of a tradeoff between the variance of output and the variance of inflation in a closed economy to a tradeoff between the variance of output and the variance of the inflationary process as a whole (i.e. including flows of reserves and changes in the nominal exchange rate as well as changes in prices) in an open economy.

The implication of the above-mentioned results is that for a given degree of integration of the domestic economy in the world market (i.e., for a given n), a relatively flexible exchange rate regime is more prone to inflation and to instability in the conditions of the external equilibrium and less prone to output instability than a relatively fixed exchange rate regime. However, as n rises over time, these unequivocal results are somewhat weakened. To examine the effects of n on the variability of output, prices and conditions of external equilibrium, we can differentiate (4.17), (4.18) and (4.19) with respect to n

$$(4.23) \qquad \frac{\partial \sigma_{\pi}^2}{\partial n} = \frac{\partial \sigma_{\pi}^2}{\partial \alpha} \beta \left(1 - \frac{\beta+\gamma}{\beta} \delta'\right)$$

$$(4.24) \qquad \frac{\partial \sigma_{y}^2}{\partial n} = \frac{\partial \sigma_{y}^2}{\partial \alpha} \beta \left(1 - \frac{\beta+\gamma}{\beta} \delta'\right)$$

$$(4.25) \qquad \frac{\partial \sigma_{f}^2}{\partial n} = \frac{\partial \sigma_{f}^2}{\partial \alpha} \beta \left(1 - \frac{\beta+\gamma}{\beta} \delta'\right)$$

Thus, under a relatively fixed exchange rate regime (δ' is close to zero) and as n rises over time, the variance of the inflationary process will be reduced while the variance of output will rise. On the other hand, under a relatively flexible exchange rate regime (δ' is close to one), as n rises, the variance of output will be reduced while the variance of the inflationary process will rise. Of course, for a wide range of values of δ', ambiguity becomes the principal element in any conclusions relating to the effects of n on the variance of output and prices.

We conclude, therefore, that a relatively flexible exchange rate regime is more prone to output stability (without being necessarily more prone to inflation) while a relatively fixed exchange rate regime is less prone to inflation (without being necessarily less prone to output stability). Also, a relatively flexible exchange rate regime is more prone to instability in the conditions of external equilibrium than a relatively fixed exchange rate regime.

B. Concluding Remarks

The basic ideas introduced in this chapter can be summarized as follows:

a) Inflationary shocks not only destabilize output but they also affect the balance of payments and the nominal exchange rate.

b) The way the government responds to an inflationary shock conditions the persistence of the disturbance.

c) Workers respond to unemployment conditions as well as to perspective rises in prices of imported commodities.

Given this framework, an empirical investigation will be undertaken in the following chapter again using Greek sample data from the period 1960-1980.

Footnotes for Chapter IV

1. The real exchange rate is defined as $P/(P_w/e)$ where Pw is the foreign price of traded goods, P is the domestic price level and e is the nominal exchange rate expressed in terms of foreign currency per unit of domestic currency. In terms of percentage changes and deviations from trend, the real exchange rate should be written as

$$(\varepsilon - \bar{\varepsilon}) + (\pi - \bar{\pi}) - (\pi_w - \bar{\pi}_w)$$

In our formulation of (4.4), we have assumed implicitly that $\pi_w = \bar{\pi}_w$ since a policy-desired trend for world inflation cannot be possibly defended as an operational concept. Thus, world inflation does affect the real exchange rate but not its deviations from trend.

2. According to our model in Chapter II, real appreciation of the exchange rate assumes the form of a rise of the relative price of nontraded goods if the economy persistently inflates faster than the rest of the world. In the absence of full flexibility of the prices of nontraded goods, unemployment will rise. To see why this is the case, consider the following argument. On the production side, resources move out of production of traded goods into the production of nontraded goods. Thus, supply of traded goods falls while supply of nontraded goods rises. On the demand side, absorption of traded goods rises while absorption of nontraded goods falls. Thus, demand for traded goods rises while demand for nontraded goods falls. Therefore, for the economy as a whole, there should be an excess demand for traded goods, which will be absorbed, for example, as a balance of trade deficit under fixed exchange rates, and an excess supply of nontraded goods which will result in unemployment if the prices of nontraded goods are not fully flexible.

3. If the system is stable $\rho<1$ and, thus, $\partial\sigma^2_\pi/\partial\alpha<0$ and $\partial\sigma^2_r/\partial\alpha<0$. With respect to the effect of monetary accommodation on output,

$$\frac{\partial \sigma^2_y}{\partial \alpha} \gtreqless 0 \text{ if } \frac{1}{\rho} \gtreqless 1-n\theta \quad \text{or} \quad n\theta \gtreqless 1-\frac{1}{\rho}$$

But since $\rho<1 \rightarrow 1/\rho>1 \rightarrow 1-1/\rho<0$ and, thus, for $\partial\sigma^2_y/\partial\alpha>0$ to hold

$$n\theta>1-\frac{1}{\rho} < 0$$

which is true since $n\theta>0$.

CHAPTER V

In this chapter the model outlined in the previous chapter is tested against Greek data covering the period 1960-1980. To provide a background for the empirical work, a discussion on the volatility of output and prices is provided and the empirical Phillips-curve relationship is briefly explored. Then, estimation procedures are analyzed and the empirical investigation of our theoretical model is presented and evaluated. Finally, stabilization policy issues relating to the options and alternative choices open to the Greek monetary authorities are discussed.

A. Prices and Quantities: the case of Greece, 1960-1980.

For most of the countries in the world, the decade of the seventies represents a period of dismal macroeconomic performance which, however, merits attention because of its extraordinary character. For the world economy as a whole, real output growth declined while inflation rates rose to unprecedented high by historical standards levels. On the other hand, the decade of the sixties, compared to the seventies, appears to be a period of relatively great prosperity. Greece, as a developing and maturing economy, did not remain untouched by the vicissitudes of the world economy. Thus, we now turn to a descriptive analysis of the macroeconomic performance of the Greek economy.

To measure the slack of the economy, the GDP gap was used since the rate of unemployment per se is not estimated by the Greek statistical authorities. This unemployment proxy together with the domestic inflation rate appear on Fig. 5.1 and in the form of the empirical Phillips curve on Fig. 5.2.

Following a period of excessive aggregate demand (1960-1961), the Greek economy was close to full-employment and stable prices by 1962. In the following four years (up to 1966), stagflationary tendencies made their

Fig. 5.1

Domestic Inflation and GDP gap: Greece, 1961-1980.

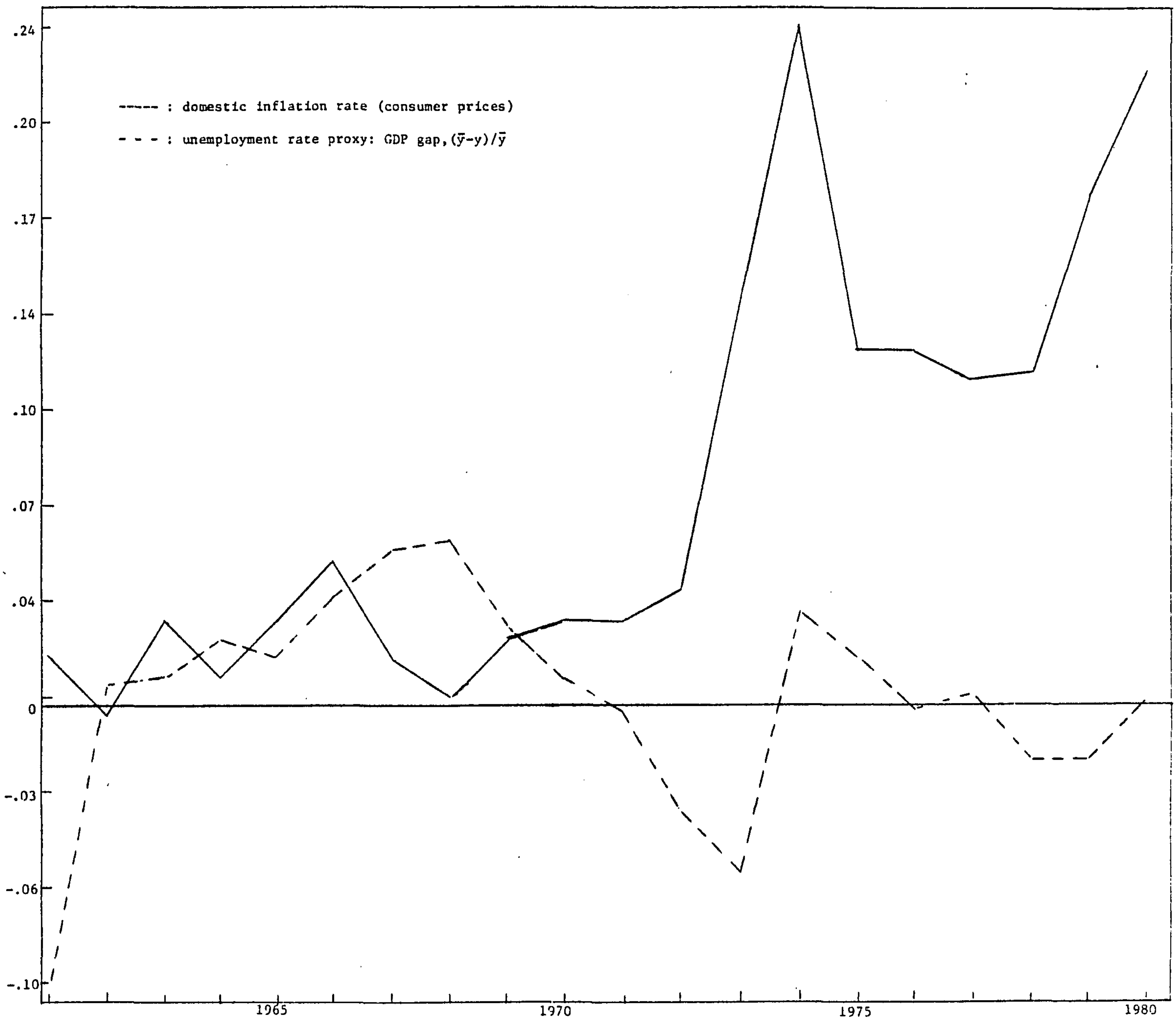
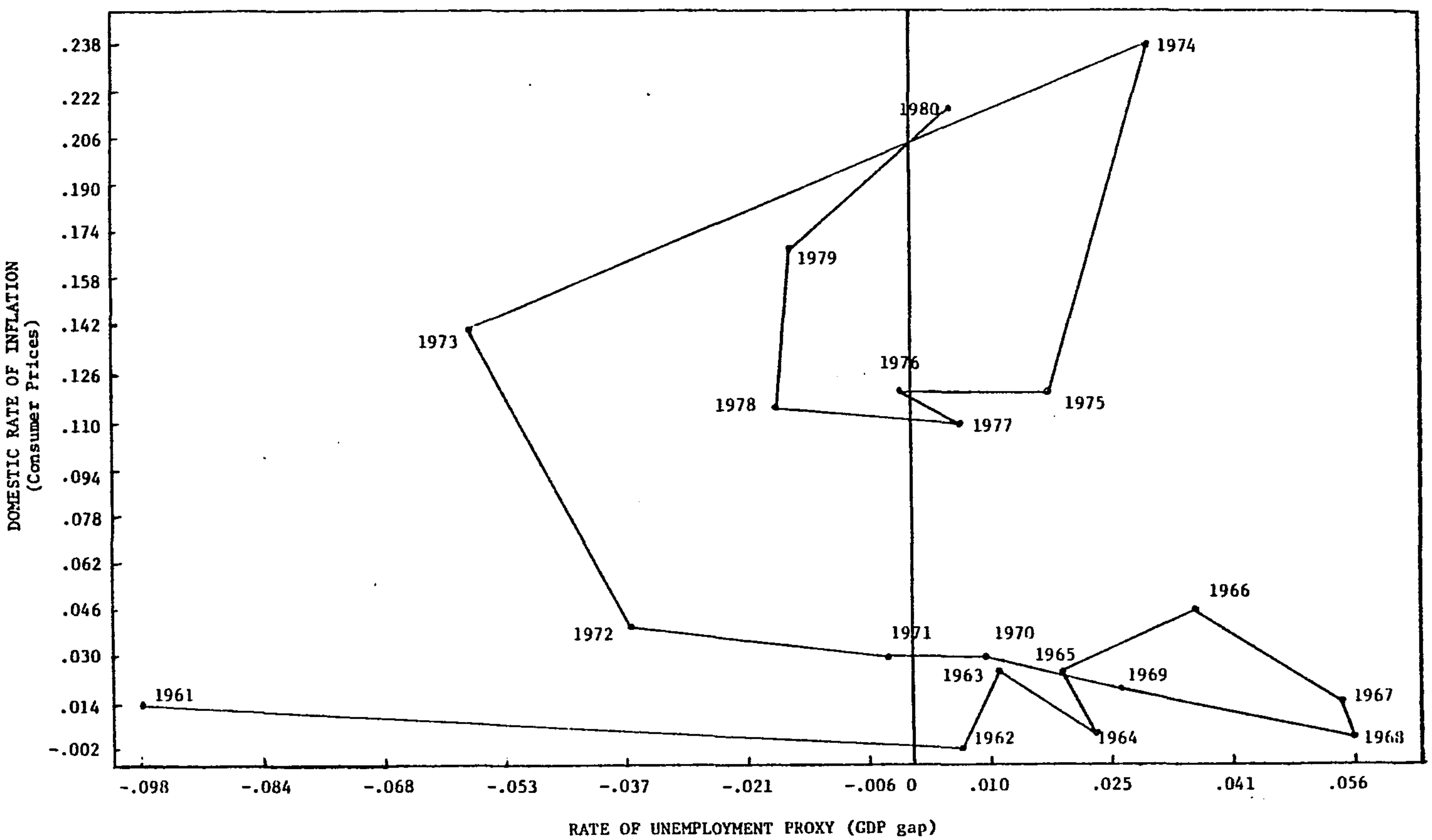


Fig. 5.2

Empirical Phillips curve: Greece, 1961-1980.



appearance, probably associated with cost-push factors operating in a period of transfer of power from the political right to center-left. The increase in unemployment and its persistence till 1968, in combination with the disciplinary influence of the military dictatorship regime established in 1967, eventually weakened the resistance of money wages and, thus, the rate of inflation dropped in a classical Phillips-curve fashion. The operation of cost-push factors between 1963 and 1966, as well as the subsequent curbing of money wage demands, can be evidenced in Fig. 5.3. Money wage growth jumped from approximately 5 per cent in 1963 to almost 12 per cent in 1966, only to drop below 7 per cent by 1968. Inflation followed the same pattern in a period of falling money supply growth. Again from Fig. 5.3, the growth of M3 dropped from 19 per cent in 1963 to about 13 per cent by 1966.

The recovery began in 1968 on the demand side of the economy with the money supply growing at ever increasing rates. Unemployment was falling rapidly while prices were rising and again the Phillips-curve was in operation. By 1971, the economy was close to full-employment with an inflation rate stabilized around the 2.5 per cent per year level. However, the stimulation of the economy proceeded beyond the full-employment level. The rate of unemployment fell well below the natural rate, creating the preconditions for another round of stagflation during the adjustment period back to full employment.

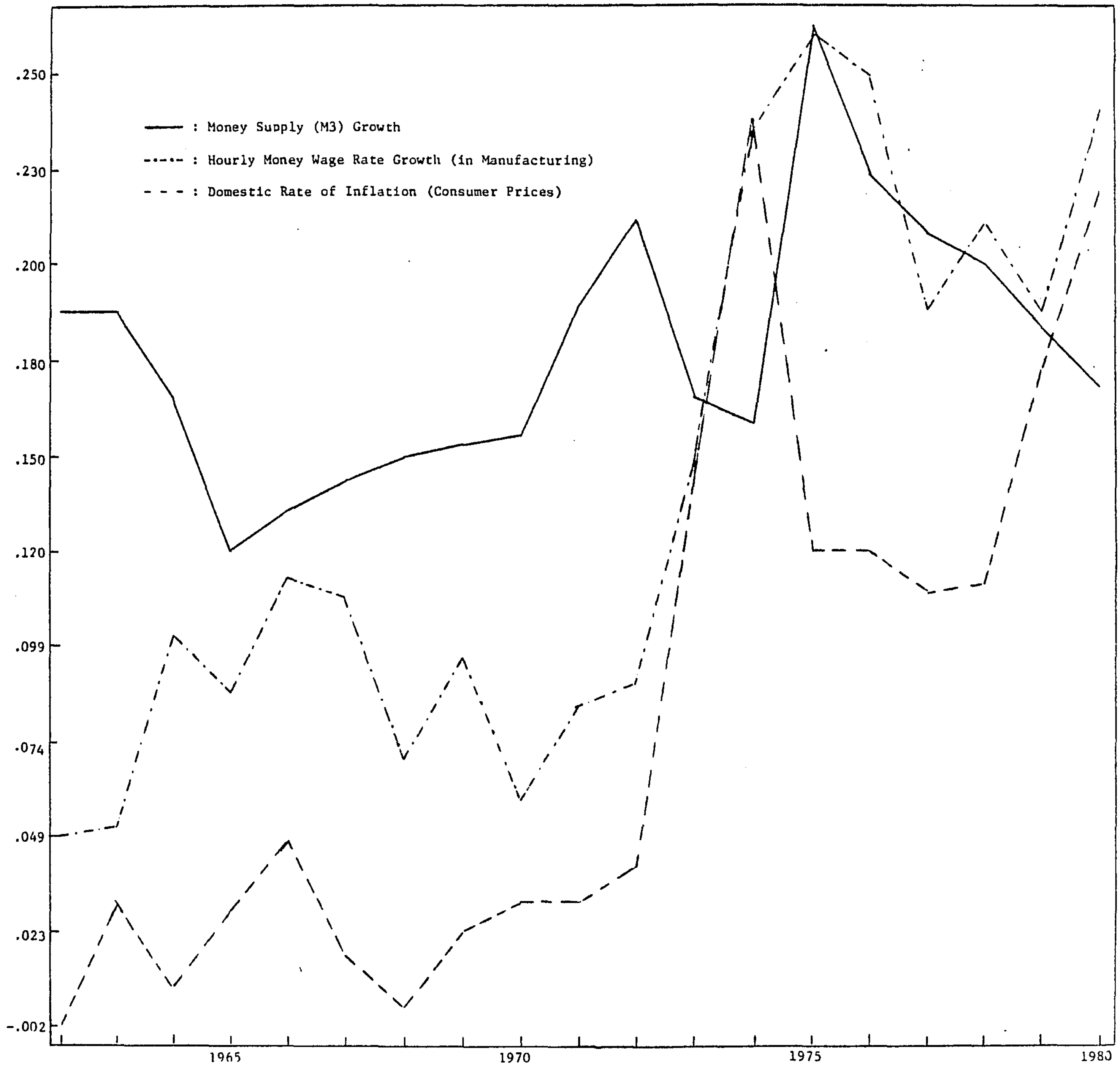
However, during the same period OPEC was in the making. So, the aggregate supply function began to shift upwards not only due to the inflationary pressure which is the normal aftermath of a period of excessive aggregate demand but also because of autonomous cost-push factors associated with the oil-price shock of 1973-1974. Within a year, the Greek economy had entered a recessionary gap accompanied by skyrocketing inflation. The Greek monetary authorities, reacting to the inflationary environment, attempted successfully to reduce monetary growth in 1973 and 1974, which only aggravated the recession without really succeeding in arresting inflation, though one should recognize the moderating influence that slower monetary growth exercised on the inflationary process (the 1974 inflation rate might have been even higher than the actual 24 per cent had the monetary authorities remained idle in the face of the unprecedented inflationary pressure). During the shock, money wage inflation kept in pace with general price inflation (Fig. 5.3).

The year 1974 is an important benchmark year not only because of extraordinary economic disturbances but also because the military regime was replaced by a democratic government which, though controlled by the political right, was under heavy pressure to redress the shrinkage of the real wage growth associated with the last years of dictatorial rule (Fig. 5.3). Thus, in 1975, the rate of inflation dropped significantly as the price of oil stabilized while money wage growth maintained its momentum as inflationary expectations, generated out of the recent past inflationary environment as well as the current substantial increase in monetary growth, fed into the money wage demands of the workers. The increase in monetary growth was initiated on the part of the monetary authorities in response to the 1974 recession. It was a classic expansionary demand policy to pull the economy out of the recession.

During 1976 and 1977, the economy was around the full-employment level with inflation stabilized around 11-12 per cent with money wage growth around 19-21 per cent. The money supply growth slowed down considerably without again the monetary authorities making any progress towards reducing the rate of inflation.

Fig. 5.3

Selected measures of inflation: Greece,1962-1980



In 1978, the economy entered a situation of overemployment generating some inflationary pressure which was destined to be augmented and amplified by the second OPEC-caused oil-price shock of 1979. By 1980, the Greek economy was back to full-employment only to slip into a deeper recession in 1981.

The above-presented description was intended to provide the reader with only limited information on the macroeconomic performance of the Greek economy. By no means do the preceding pages constitute a comprehensive analysis of the multi-faceted economic phenomenon of the business cycle. After 1974, a redistribution of income away from profits and towards wages took place which cannot be explained by traditional macroeconomic analysis. Such structural changes are outside the scope of this paper, though they deserve the attention of further scientific inquiry.

We now turn to the empirical investigation of the theoretical model presented in Chapter IV.

B. Empirical Investigation

Estimation Procedures

For econometric purposes, the following specification of the model presented in Chapter IV is adopted:

$$
\begin{aligned}
bop - \overline{bop} &= -(1-\delta')n(\pi_{-1}-\overline{\pi}) + w_1 \\
\varepsilon - \overline{\varepsilon} &= -\delta' n(\pi_{-1}-\overline{\pi}) + w_2 \\
m - \overline{m} &= -[(1-\delta')n-\lambda](\pi_{-1}-\overline{\pi}) + w_3 \\
y - \overline{y} &= \beta[(m-\overline{m})-(\pi_{-1}-\overline{\pi})]-\gamma[(\varepsilon-\overline{\varepsilon})+(\pi_{-1}-\overline{\pi})] + z \\
\pi &= \pi_{-1} + c(y-\overline{y})+\theta[(bop-\overline{bop})+(\varepsilon-\overline{\varepsilon})] + u
\end{aligned}
$$

The above specification allows all the coefficients relevant for stabilization policy to be estimated, and thus the trade-off faced by the policymakers to be explored.

The deviations from trend variables are simply the residuals from least squares regressions on a constant and a time variable.

For econometric purposes, the output variable is assumed to be represented by the GDP gap, defined as the ratio of the least squares residuals of real GDP on a constant and a time variable to the fitted values of real GDP. The GDP gap is used as a proxy for the unemployment rate which is not calculated by the Greek statistical authorities.

Due to cross-equation correlation of the error terms, and since certain restrictions have to be imposed on the coefficients and, finally, given the non-linearity of certain parameters, a non-linear system method of estimation is used. Full information maximum likelihood results are not significantly different from non-linear least squares. Furthermore, the non-linear multivariate technique is selected because it allows the variance-covariance matrix of the residuals to be retrieved in order that it might be used for further investigation.

Empirical Results

We now present the estimates of the parameters of the model. All estimates are based on yearly data for Greece covering the time period 1960-1980. Two subperiods are considered: 1963-1971 and 1972-1980. The number of observations is clearly deficient, and one should treat the results with utmost caution.

The estimates of the coefficients for the two periods are presented in Tables 5.1 and 5.2.

The 1960s

The estimated coefficients for the 1960s reflect the failure of the Marshall-Lerner condition to hold throughout the period.

The coefficient n is negative indicating that an inflationary disturbance leads to an increase in net exports and thus improves the trade balance.

Such an outcome might be realized if the import and export elasticities are small enough so that a fall in the relative price of imports causes a rise in the volume of imports and a fall in the volume of exports which are sufficiently weak to be outweighed by the price effect and thus to lead to an improvement in the trade balance. Under balanced trade and infinite supply elasticities, the Marshall-Lerner condition requires that the sum of import and export elasticities is greater than unity in absolute terms. To explore further the issue, an attempt was made to calculate the import and export elasticities for the two subperiods. The results are reported in Table 5.3. Volume indices of Greek imports and exports were regressed on Greek real income and world real income respectively, as well as on relative prices. Although the results are not robust, they seem to indicate a tentative acceptance of the failure of the Marshall-Lerner condition to hold. In particular, the export elasticity in the 1960s is positive and highly insignificant, which suggests that the demand for Greek exports during that period was perfectly inelastic. This is not unlikely, given the fact that the composition of Greek exports in the 1960s was heavily weighed with raw materials and agricultural commodities whose demand is generally characterized by significant price inelasticity. As manufacturing's share in total Greek exports increased in the 1970s, the demand for Greek exports became more price elastic, though still in the inelastic range. With respect to import demand, the price inelasticity of the 1960s continued in the 1970s, though somewhat reduced.

Since real income is held constant, however, the estimated price elasticities are compensated price elasticities capturing only the substitution effect. It can be shown that the income effect is reflected in the marginal propensity to import and thus, the Marshall-Lerner condition

TABLE 5.1

Non-linear least squares estimates of the model, 1963-1971

Variables	Estimated Coefficient	T-Statistic
δ'	-.299	-7.62
n	-1.499	-5.82
λ	-1.346	-7.83
β	.883	5.29
γ	-.379	-1.19
c	-.006	-.03
θ	-.478	-3.17

Log of likelihood function : 150.37

1. $bop - \overline{bop} = -(1-\delta')n(\pi_{-1}-\overline{\pi})$

D.W. = 1.72 Theil's inequality coefficient : .569

2. $\varepsilon - \overline{\varepsilon} = -\delta' n(\pi_{-1}-\overline{\pi})$

rho = -.636 (-9.64) Theil's inequality coefficient : .456

3. $m - \overline{m} = -\{(1-\delta')n-\lambda\}(\pi_{-1}-\overline{\pi})$

rho = .553 (9.18) Theil's inequality coefficient : .602

4. $y - \overline{y} = \beta\{(m-\overline{m})-(\pi_{-1}-\overline{\pi})\}-\gamma\{(\varepsilon-\overline{\varepsilon})+(\pi_{-1}-\overline{\pi})\}$

D.W. = 1.38 Theil's inequality coefficient : .442

5. $\pi = \pi_{-1} + c(y-\overline{y}) + \theta\{(bop-\overline{bop})+(\varepsilon-\overline{\varepsilon})\}$

D.W. = 2.22 Theil's inequality coefficient : .300

TABLE 5.2

Non-linear least squares estimates of the model, 1972-1980

Variables	Estimated Coefficient	T-Statistic
δ'	-.002	-.02
n	1.070	4.40
λ	1.186	5.92
β	.032	.32
γ	.372	4.11
c	.081	.16
θ	.564	4.36

Log of likelihood function : 108.24

1. $bop - \overline{bop} = -(1-\delta')n(\pi_{-1}-\overline{\pi})$

   D.W. = 1.98 Theil's inequality coefficient : .386

2. $\varepsilon - \overline{\varepsilon} = -\delta' n(\pi_{-1}-\overline{\pi})$

   rho = -.726 (-2.95) Theil's inequality coefficient : .486

3. $m - \overline{m} = -\{(1-\delta')n-\lambda\}(\pi_{-1}-\overline{\pi})$

   D.W. = 1.32 Theil's inequality coefficient : .783

4. $y - \overline{y} = \beta\{(m-\overline{m})-(\pi_{-1}-\overline{\pi})\}-\gamma\{(\varepsilon-\overline{\varepsilon})+(\pi_{-1}-\overline{\pi})\}$

   D.W. = 2.20 Theil's inequality coefficient : .298

5. $\pi = \pi_{-1} + c(y-\overline{y}) + \theta\{(bop-\overline{bop})+(\varepsilon-\overline{\varepsilon})\}$

   D.W. =1.59 Theil's inequality coefficient : .180

TABLE 5.3

Regression Results (OLS or ARI)

$$\log M = a_0 + a \log y + a_2 \log MP$$

$$\log X = b_0 + b_1 \log y^* + b_2 \log XP$$

Variables	1963-1971		1972-1980	
	logM	logX	logM	logX
Constant	1.513 (1.06)	-10.566 (1.81)	2.957 (1.67)	-8.339 (3.70)
logy	1.176 (18.84)		1.023 (6.01)	
logMP	-.530 (1.76)		-.659 (1.29)	
$\log y^*$		2.846 (8.82)		3.482 (7.33)
logXP		.377 (.37)		-.698 (1.85)
D.W./rho	1.84	2.04	-.711 (2.13)	.603 (2.04)
$\bar{R}^2$	.981	.945	.999	.982

Note: Numbers in parenthesis are T-statistics

M : volume of imports
X : volume of exports
y : Greek real income
y^*: Foreign real income
MP : Greek import price index/Greek wholesale price index
XP : Greek export price index · exchange rate/Foreign wholesale price index

requires that the sum of compensated domestic and foreign import elasticities plus the sum of domestic and foreign marginal propensities to import exceed unity (Dornbusch, 1980). With respect to the Greek marginal propensity to import, we can obtain an estimate by utilizing the definition of the income elasticity as the ratio of the marginal to the average propensity to import. The average propensity to import can be readily calculated from the national income accounts. For the 1960s it was about .181 and for the 1970s approximately .236. Given the income elasticities reported in Table 5.3, the Greek marginal propensity to import is calculated to be .21 for the 1960s and .24 for the 1970s.

With respect to the foreign marginal propensity to import commodities of Greek origin, the same technique could be used. However, given the estimated income elasticities as reported in Table 5.3, and given the fact that the average propensity to import Greek commodities must be practically insignificant[1], the marginal propensity must be also insignificant and would contribute very little if anything towards the verification of the Marshall-Lerner condition if estimated.

Thus, the sum of import and export compensated price elasticities plus the Greek marginal propensity to import is estimated to be .74 for the 1960s and 1.60 for the 1970s.

The coefficient δ' is, as expected, negative indicating the fact that, during the dollar standard period, the effective nominal exchange rate slightly depreciated despite the fact that the balance of payments was in surplus. That is, an inflationary disturbance in the 1960s would normally cause a balance of payments surplus and, if the Drachma was not continuously pegged to the U.S. Dollar, an appreciation of the currency. Since the Drachma was effectively depreciating, the balance of payments surplus was larger than otherwise and thus $\delta'<0$.

The coefficient of monetary accomodation (λ) is negative and above unity. Given the values of δ' and n, a one percentage point deviation of the inflation rate from trend will cause $1.92 \equiv (1.29)(1.49)$ percentage points deviation of bop from trend in the next period. The coefficient of monetary accomodation was -1.34, implying that the monetary authorities were responding to the inflationary shock, and to the ensuing balance of payments surplus, by restricting the growth of the domestic component of the base so that it fell below trend by 1.34 percentage points.

Given the fact that the nominal rate of depreciation rose by $.43 \equiv (-.29)(-1.49)$ percentage points, the real exchange rate (in percentage terms) was appreciating, tending to raise aggregate demand and output. Normally, a real appreciation would lower aggregate demand and output as demand is diverted from domestic goods to foreign goods. But, in the 1960s, the Marshall-Lerner condition did not hold. Therefore, the inflationary disturbance will improve the trade balance by more than the depreciation of the exchange rate worsens it, and, thus, aggregate demand and output will rise. This is the reason why the coefficient γ is negative. Notice, also, that the elasticity of aggregate demand with respect to the real exchange rate (γ) is insignificant statistically, implying that changes in the terms of trade made relatively little if any contribution towards destabilizing the economy. On the other hand, the surplus in the balance of payments tended to raise the stock of real cash balances and therefore monetary disaccomodation (λ=-1.34) was necessary to preserve aggregate demand and output around the full-employment level. Given the elasticity of aggregate demand with respect to the stock of real cash balances (β=.55), it turns out that the dis-accomodative policy was sufficiently strong to preserve full-employment (as a matter of fact, a one percentage point of inflationary disturbance led to only .02 percentage points reduction in aggregate demand and output).

Since the inflationary disturbance is not allowed to create a slack in the economy, the natural self-correcting forces of adjustment are arrested. The coefficient c, which reflects the response of the rate of inflation to the level of slack in the economy, is for all practical purposes equal to zero. According to Taylor (1981), the coefficient c is a positive function of coefficient α. The higher the stability of aggregate demand, the less the workers weigh the prospect of unemployment in making money wage decisions, and thus the longer it takes for the inflation rate to return to trend. The highly insignificant value of c also implies that factors other than the slack of the economy may be more instrumental in affecting the money wage formation process. According to Taylor, c will be small if contracts are prevalent in influencing the inflationary process. This seems to be the case in Greece, where collective bargaining operates at the national level and is the main force behind the money wage formation process. Thus, the slack of the economy is not an important factor affecting the inflationary process in the presence of widespread contracting practices.

Finally, the coefficient θ is significantly negative, implying that a larger than trend balance of payments surplus will have a dampening effect on inflation. A negative θ is inconsistent with the discussion in the theoretical part of the paper. However, it can be explained when one considers the failure of the Marshall-Lerner condition to hold. If this is the case, an inflationary disturbance will cause a surplus in the balance of payments and thus restrictions on trade will be loosened. This will tend to reduce the prices of imported commodities and thus the workers will become less demanding with respect to increases in their money wages. Therefore, the inflationary process will be mitigated in the next periods until the rate of inflation returns to trend.

The 1970s

In the 1970s, we get conventional results which conform to the theoretical expectations.

The degree of flexibility of the exchange rate is larger than in the 1960s, though still very small. This may imply that inflationary disturbances are not allowed to affect in the short-run the rate of depreciation, but they are rather absorbed in changes in reserves (δ'=-.002). This is consistent with the observed discontinuity process of sudden devaluations followed by the Greek monetary authorities.

The coefficient n is positive as expected, implying that an inflationary disturbance worsens temporarily the trade balance and raises the rate of depreciation.

Monetary accomodation is positive and slightly greater than unity (λ=1.186), implying that, given the stability generated through an increase in the rate of depreciation, the balance of payments deficit is neutralized in terms of its effect on the stock of real cash balances, by appropriate monetary accomodation. Given the structural parameters β and γ, a one percentage point inflation shock causes a decline in aggregate demand from trend of .39 points ($\alpha \equiv .39$). Therefore, in the 1970s the accomodative policies of the Greek monetary authorities fell short of completely stabilizing aggregate demand and output because the cost of such a policy in terms of inflation variability probably exceeded the benefit of a high employment situation. Notice that the elasticity of aggregate demand with respect to the stock of real cash balances (β) is statistically insignificant while the elasticity of aggregate demand with respect to the real exchange rate (γ) is significant. This might reflect the relative importance of shocks in the real exchange rate as elements destabilizing the level of aggregate demand and output, as opposed to shocks in the stock of real cash balances. In other words, the monetary authorities had been responding to inflationary shocks to a greater extent by using domestic credit expansion than changes in the nominal exchange rate. Again, as in the 1960s, the coefficient c is highly insignificant. The coefficient θ is positive, reflecting the fact that a larger than trend balance of payments deficit or rate of depreciation will tend to raise the prices of imported commodities and thus making the workers more "careful" in setting money wages.

An attempt was also made to estimate the postulated tradeoff between the variance of inflation and the variance of output contained in our theoretical model. This basically involves the computation of the relevant variances (4.17 and 4.18) by using the estimated coefficients and the variance-covariance matrix of the residuals of the system.

For the decade of the sixties, our attempt was frustrated because of coefficient c, the elasticity of inflation with respect to the slack in the economy, carried the wrong (negative) sign which rendered the effect of α on σ^2_π positive instead of the theoretically correct negative (see equation 4.17). The coefficient c was also highly insignificant. Under these conditions, it would be prohibitively wrong in terms of procedure to attempt to estimate the tradeoff.

For the decade of the seventies, however, our attempt was successful. Given the estimated values of the coefficients, the standard deviation of inflation was 5.5 percentage points, while the standard deviation of output was 2.2 percentage points. Then, we allowed successively the coefficients δ' and λ to assume values within two standard deviations from their mean value and, for each value assumed, estimates of the variances of inflation and output were obtained. While the one parameter was changing, the other was kept constant at its estimated by the system value. Linear functions were fitted to the series of the variances of inflation and output and, thus, the slopes of the tradeoff lines were estimated. The slope of the tradeoff, with δ' changing, was -.0346625 with a standard deviation of .0000904515 while, with λ changing, the slope was -.0346573 with a standard deviation of .0000289369. The tradeoff line in both cases was almost flat and the slopes indistinguishable from each other. Changing δ' and λ within two standard deviations of their mean values, therefore, was judged to be insufficient and the experiment was repeated by allowing this time δ' to assume values from -.5 to 1 and λ from 0 to 1.5. With λ changing, the slope of the tradeoff was -.0342193 (s.d.: .000020245) and, with δ' changing, the slope was -.0348181 (s.d.: .000274980). The tradeoff lines were very flat but, here, a statistically significant difference emerged.[2] Our findings imply that, ceteris paribus, the cost of reducing the variance of output in terms of raising the variance of inflation is smaller when monetary accomodation is the stabilization tool rather than when the rate of depreciation of the exchange rate is deliberately changed to prevent the real exchange rate from appreciating following an inflationary disturbance .Or, the same, in order to reduce the variance of inflation, a policy of lower degree of flexibility of the nominal exchange rate is to be preferred to a policy of lowering the degree of monetary accomodation if low variability of output is a desirable goal of economic policy. The above results are consistent with the estimated relatively greater ability of δ' to affect the stability of output (α) than that of λ.

Whatever the relative strengths of different stabilization policies, the tradeoff between the variance of inflation and the variance of real output is highly inelastic which implies that if the authorities attempt to reduce the variability of output, very little is sacrificed in terms of raising the variability of prices. This is an interesting result of our analysis. It is an outcome consistent with the previously observed inability of the slack in the economy to affect the rate of inflation, inability attributed to the predominance of contracts in the Greek labor market (annual collective bargaining agreements at the economy level at least for minimum money wage rates has been the usual practice). In other words, an inflationary shock will subside eventually at a rate largely independent from the extent to which a slack in the economy is generated given the degree of activism of economic policy and the structure of the economy. The above also vindicates our theoretical position about the importance of the balance of payments and the rate of nominal depreciation as factors conditioning the speed with which the inflation rate returns to trend after a disturbance.

C. Conclusion

In this chapter, a short-run model of the tradeoff between the variances of inflation and real output was tested with Greek data. The theory was generally supported by the sample, though the results should be interpreted with caution due to the limited number of observations available for our study. Within this context, the conclusions which follow should be treated as tentative.

a) The Marshall-Lerner condition seems not to be satisfied for the 1960s in the case of the Greek economy. This has the implication that a real appreciation of the exchange rate would boost aggregate demand and output and cause a surplus in the balance of trade.

b) In the 1960s, the monetary authorities relied exclusively on monetary disaccomodation for stabilization purposes. With the exchange rate pegged to the U.S. Dollar, the effective nominal exchange rate was depreciating, strengthening the surplus in the balance of payments and, thus, making monetary disaccomodation a necessary policy for preventing overemployment and, thus, keeping inflation at low levels. On the other hand, in the 1970s both monetary accomodation and allowing greater flexibility of the nominal exchange rate have been used as stabilization tools.

c) For the 1970s, a tradeoff between the variance of inflation and the variance of output was imputed, which can be used to shed some light into the relative importance of alternative stabilization policies. In particular, it was found that exchange rate policies were more potent than monetary policies in terms of stabilization of the economy and, also, that stabilizing the rate of inflation would imply a destabilization of output to an extent which is prohibitively costly in terms of social welfare.

Footnotes for Chapter V

1. For example, in 1980 the average propensity to import Greek commodities in West Germany, the major trading partner of Greece, was approximately .0017, implying a marginal propensity of about .0060.

2. The T-statistic for the statistical significance of the difference of the slopes was estimated to be 12.1 (n=31), which implies thet the slopes come from two distinct populations.

CHAPTER VI

EPILOGUE

In this chapter, drawing upon the theoretical conclusions and the empirical results of the present study, we intend to further explore stabilization issues by integrating short-run and long-run policy considerations and also to make certain policy recommendations within the context of the Greek economy.

At present, the Greek economy persistently inflates faster than the rest of the world. The main cause of the domestic inflationary pressure is the monetization of public debt issued to finance uncommonly large budget deficits. Domestic inflation, balance of payments deficits and a depreciationg nominal exhange rate are the basic manifestations of the inflationary pressure differential as between Greece and the rest of the world. Moreover, an implication of the persistence of the inflationary differential is that the real exchange rate is gradually appreciating tending to raise the natural rate of unemployment. Thus, in the long run, the export and import-competing sectors of the economy will decline in size while the trend growth of real output will be depressed.

In the short-run, however, stabilization policies remain still pertinent as money wage demands and/or autonomous price increases of imported raw materials and intermediate goods tend to destabilize real output. Monetary accommodation and above trend nominal depreciation of the exchange rate become relevant policies to reverse the tendency of the stock of real cash balances to fall below and the tendency of the real cash exchange rate to rise above trend due to the price disturbance. The Greek monetary authorities can reduce the variance of real output around the full-employment level at a relatively low cost in terms of raising the variance of domestic inflation. However, reducing the variance of inflation is a rather costly policy in terms of real output lost and in terms of the human misery accompanying unemployment.

We contend that the primary task of Greek policy makers should be to mitigate the inflationary pressure and to reduce the high variability of inflation and its negative effects on business confidence and investment activity. Policies to reduce the variability of inflation should be instituted. Since the cost of these policies with respect to unemployment will be high, a parallel effort to reduce the budget deficit should be undertaken so that excessive domestic monetary expansion is limited, the long-run appreciation of the real exchange rate is arrested, and thus, the dynamism of the economy in terms of real growth is restored. Periodic nominal depreciations of the exchange rate cannot improve the long-run competitiveness of the Greek economy although their effectiveness in stabilizing real output can certainly be defended in the short-run. This study has presented evidence that monetary imprudence does not contribute only to the creation of an inflationary environment but also has significant effects on the real side of the economy in terms of raising the natural rate of unemployment. Stagnation and inflation are two endemic phenomena of modern Greek economic life. If any progress is to be made on these fronts, fundamental changes in the way the Greek state intervenes in economic processes should be effected. An economist can only make a plea for discipline and hope for understanding of the rational forces which shape human affairs.

APPENDIX A

Structure and Performance of the Greek Economy, 1960-1980: A Comparative Approach

The end of World War II found the Greek economy devastated in terms of loss of human lives and destruction of national wealth. The subsequent Civil War (1947-1949) exerted a further toll on productive resources and weakened the material base of the economy even more. It was not until the beginning of the 1950's that the reconstruction effort began and Greece embarked upon the path of a conscious industrialization process.

In this appendix, an attempt is made to present a comprehensive picture of the characteristics and outcomes of the post-war development effort, as manifested in the real side of the economy as well as in the relative position of Greece in the international division of labor.

Between 1960 and 1980, the Gross National Product (GNP), in per capita terms, had been growing at a 5.8% average annual rate. By 1980, the per capita GNP, in 1980 U.S. dollars, was 4380. This impressive by international standards growth record of the Greek economy (Table A.1) was not, however, accompanied by deep structural changes. On the production side, the Greek economy exhibits the structure of an average developing middle-income oil-importing economy. However, the Greek economic structure is more-than-average biased towards services and less-than-average biased towards industry (Tables A.2, A.3,and A.4). Despite such seemingly disadvantageous structural weakness, Greece was able to more than triple its GNP per capita during the period of twenty years between 1960 and 1980. The typical developing economy experiences only a doubling of its per capita GNP over the same period.

Greece did not encounter any unfavorable pressures from population growth. Population had been growing at a rate which is more typical of an advanced industrial economy than of a country whose production structure bears clearly the marks of a nonindu trialized economy. Due to heavy emigration of Greek workers to Western Europe and the United States, especially in the decade of 1960's, the growth of labor force did not keep pace with population growth but rather fell substantially behind even that of the advanced market economies (Table A.2).

On the demand side, the structure of expenditure in the Greek economy did not deviate to any considerable extent from that of other countries, developing or industrial alike (Tables A.5 and A,6). One salient feature of the Greek economy had been the remarkable slowdown of the capital formation process in the 1970's. Between 1970 and 1980, gross domestic investment had been growing at a 2 per cent average annual rate, which compares favorably to the record of the industrial countries but is very poor next to the record of developing countries. However, between 1960 and 1970, gross domestic investment had been growing at an outstanding 10.4 per cent per year, which outstripped the performance of the rest of the world on the average.

In both the 1960's and 1970's, Greek imports and exports had been growing fast by international standards (Table A.7). The deficit in the balance of trade as a share in gross domestic product had been persistently higher than in the average developing country (Table A.5). The terms of trade for Greece deteriorated considerably over the twenty year period under consideration, but the decline was almost half that suffered by the average developing oil-importing economy (Table A.7).

The structure of imports had been basically one of a typical developing economy. One important difference had been the greater share of imported machinery and transport equipment in total Greek imports than that of the average developing country, which is a manifestation of the kind of stuctural anomalies that have plagued the Greek economic development effort (Table A.8). The structure of Greek exports reveals also some of the peculiarities of Greek development. Primary sector exports comprised the 90 per cent of Greek exports in 1960 but only 24 per cent in 1979. The growth of manufactured export commodities had thus been significant. Emphasis was placed on textiles while exports of machinery and transport equipment were limited to a mere 4 per cent of total exports by 1979 (Table A.9).

Finally, over the period, trade with the Third World increased substantially whereas trade with the industrial countries and the centrally planned economies deteriorated in relative terms (Table A.10).

TABLE A.1

GROSS NATIONAL PRODUCT PER CAPITA

	U.S dollars 1980	Average annual growth (percent) 1960-1980
Industrial MarketEconomies	10320	3.6
Middle-Income Oil-Importing Economies	1580	4.1
Greece	4380	5.8
Israel	4500	3.8
Yugoslavia	2620	5.4
Turkey	1470	3.6
Portugal	2370	5.0
Spain	5400	4.5

Group figures are weighted averages.

Growth rates are in real terms.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.2

POPULATION AND LABOR FORCE
Average annual rate of growth (percent)

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Population			
1960-70	1.0	2.4	.5
1970-80	.8	2.3	.9
Labor Force			
1960-70	1.2	2.0	<.05
1970-80	1.3	2.2	.6

SECTORAL DISTRIBUTION OF LABOR FORCE
Percentage of labor force

	Industrial Market Economies	Middle-Income Oil- Importing Economies	Greece
Agriculture			
1960	18	59	56
1980	6	42	37
Industry			
1960	38	16	20
1980	38	22	28
Services			
1960	44	25	24
1980	56	36	35

Group figures are weighted averages.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.3

STRUCTURE OF PRODUCTION

Distribution of Gross Domestic Product (percent)

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Agriculture			
1960	6	23	23
1980	4	15	16
Industry			
1960	40	32	26
1980	37	37	32
Manufacturing			
1960	30	23	16
1980	27	23	19
Services			
1960	54	45	51
1980	62	48	52

Group Figures are weighted averages.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.4

GROWTH OF PRODUCTION

Average annual growth rate (percent)

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Gross Domestic Product			
1960-70	5.2	5.8	6.9
1970-80	3.2	5.6	4.9
Agriculture			
1960-70	1.4	3.5	3.5
1970-80	1.4	2.8	1.7
Industry			
1960-70	5.9	7.8	9.4
1970-80	3.1	6.6	5.3
Manufacturing			
1960-70	5.9	7.5	10.2
1970-80	3.2	6.2	6.4
Services			
1960-70	4.8	5.7	7.1
1970-80	3.5	5.7	5.7

Group figures for Gross Domestic Product are weighted averages.

Group figures for sectoral magnitudes are median values.

Industry includes Manufacturing.

Source: World Development Report 1982, IBRD, 1982

TABLE A.5

STRUCTURE OF DEMAND

Distribution of Gross Domestic Product (percent)

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Public Consumption			
1960	15	12	12
1980	17	14	16
Private Consumption			
1960	63	69	77
1980	60	68	64
Gross Domestic Investment			
1960	21	21	19
1980	23	27	28
Gross Domestic Saving			
1960	22	19	11
1980	22	21	20
Exports of Goods and N.F.S.			
1960	12	14	9
1980	20	22	19
Resource Balance			
1960	1	-2	-8
1980	-1	-6	-8

Group figures are weighted averages.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.6

GROWTH OF CONSUMPTION AND INVESTMENT

Average annual growth rate (percent)

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Public Consumption			
1960-70	4.5	6.1	6.6
1970-80	3.7	6.4	6.9
Private Consumption			
1960-70	4.5	5.5	7.1
1970-80	3.4	5.1	4.5
Gross Domestic Investment			
1960-70	5.9	7.9	10.4
1970-80	1.6	6.6	2.0

Group figures are median values.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.7

GROWTH OF MERCHANDISE TRADE

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Average annual growth rate (percent)			
Exports			
1960-70	8.5	7.1	10.8
1970-80	5.8	4.1	11.8
Imports			
1960-70	9.5	7.3	10.8
1970-80	4.4	3.8	5.3
Terms of Trade (1975=100)			
1960	98	109	109
1980	94	83	93

Group figures are median values.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.8

STRUCTURE OF MERCHANDISE IMPORTS
Percentage share of merchandise imports

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Food			
1960	22	14	11
1979	12	10	10
Fuels			
1960	11	10	8
1979	22	20	21
Other Primary Commodities			
1960	24	16	16
1979	10	8	7
Machinery and Transport Equipment			
1960	16	29	44
1979	23	29	38
Other Manufactures			
1960	27	31	21
1979	33	33	24

Group figures are weighted averages.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.9

STRUCTURE OF MERCHANDISE EXPORTS
Percentage share of merchandise exports

	Industrial Market Economies	Middle-Income Oil-Importing Economies	Greece
Fuels, Minerals and Metals			
1960	11	15	9
1979	10	14	21
Other Primary Commodities			
1960	23	68	81
1979	15	35	33
Textiles and Clothing			
1960	7	5	1
1979	5	12	17
Machinery and Transport Equipment			
1960	29	2	1
1979	36	12	4
Other Manufactures			
1960	30	10	8
1979	34	26	25

Group figures are weighted averages.

Source: World Development Report 1982, IBRD, 1982.

TABLE A.10

MERCHANDISE TRADE BY AREA
(Percentage of total)

AREA	Imports c.i.f. 1961	Imports c.i.f. 1971	Imports c.i.f. 1978	Exports f.o.b. 1961	Exports f.o.b. 1971	Exports f.o.b. 1978
Total OECD	78	82	55	62	72	61
OECD Europe	59	60	45	48	60	55
Germany	18	19	14	19	20	21
France	--	--	--	5	9	7
Italy	6	9	10	3	9	11
U.K	10	7	4	8	4	4
North America	13	10	6	15	10	5
Japan	8	10	13	--	--	--
Centrally Planned Economies	7	5	8	24	13	12
Other	21	13	37	13	15	27
Oil-Exporting Economies	4	2	9	--	--	--

-- : unimportant trading partner

Source: OECD, Economic Surveys, Greece, Aug. 1980 hg hg
IMF, Direction of Trade, several issues

APPENDIX B

Measurement of Variables and Sources of Data

The world's rate of inflation π_w is a weighted average of the rates of inflation of the major trading partners of Greece (Germany, Italy, France, U.K., U.S.A., Japan), the weights being the shares of imports from plus exports to each trading partner in the total imports plus exports of Greece. The rates of inflation of the trading partners are first logarithmic differences of relevant WPIs of these countries. All WPIs were from IFS.

The exchange rate variable ε is the first logarithmic difference of an effective exchange rate index constructed as the weighted average of foreign currency per domestic currency exchange rate indexes of the major trading partners of Greece (with 1975=100), the weights being the same ones used in the construction of the world's inflation rate. All data are from IFS (line rf) and are period averages.

For chapter III, the domestic price level is measured by the wholesale price index (line 63 of IFS). The WPI is preferred because it better reflects prices of tradables than the CPI. In the context of our empirical work, the nontraded goods should be thought of as tradables which in fact are not traded because of transportation barriers or prohibitive tariffs and quotas. Since the same price index is used to deflate nominal cash balances, and since the WPI does not contain services, the additional assumption of constant relative prices between nontraded tradables and services is required. The domestic rate of inflation is calculated as the first logarithmic difference of the WPI.

For chapter IV, the domestic price level is measured by the consumer price index (line 64 of IFS). The CPI is preferred here because it represents more accurately the cost of living which is the relevant variable towards which workers react when they formulate their money wage demands. The domestic rate of inflation is here as well calculated as the first logarithmic difference of the CPI.

Real output is measured by real GDP at 1975 prices (line 99b.p of IFS).

The money stock is measured by M3 (line 34 + line 35 of IFS). Arithmetic averages of quarterly data are used since the yearly series published are end of period data.

The balance of payments variable, bop, is constructed as a ratio of the yearly absolute change in net foreign assets of the Bank of Greece (ΔRE), (Monthly Bulletin of the Bank of Greece, end of period data) to the monetary base (B), (line 14 of IFS) calculated from quarterly series in the same way as the money stock.

The excess domestic monetary expansion variable, $\mu \equiv \dot{m}+d\dot{D}-\dot{\ell}d$ is constructed as follows: $\dot{m}$ is the first logarithmic difference of the ratio of the money stock to monetary base; $d\dot{D} \equiv \frac{\Delta D}{B}$, the absolute change in the domestic component (ΔD) of the monetary base, calculated as $\Delta BA - \Delta RE$, where ΔBA is the yearly absolute change in the monetary base (end of period data), divided by the monetary base (B) calculated as above; finally, $\dot{\ell}_d$ is unobserved and its measurement is explained fully in chapter III.

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