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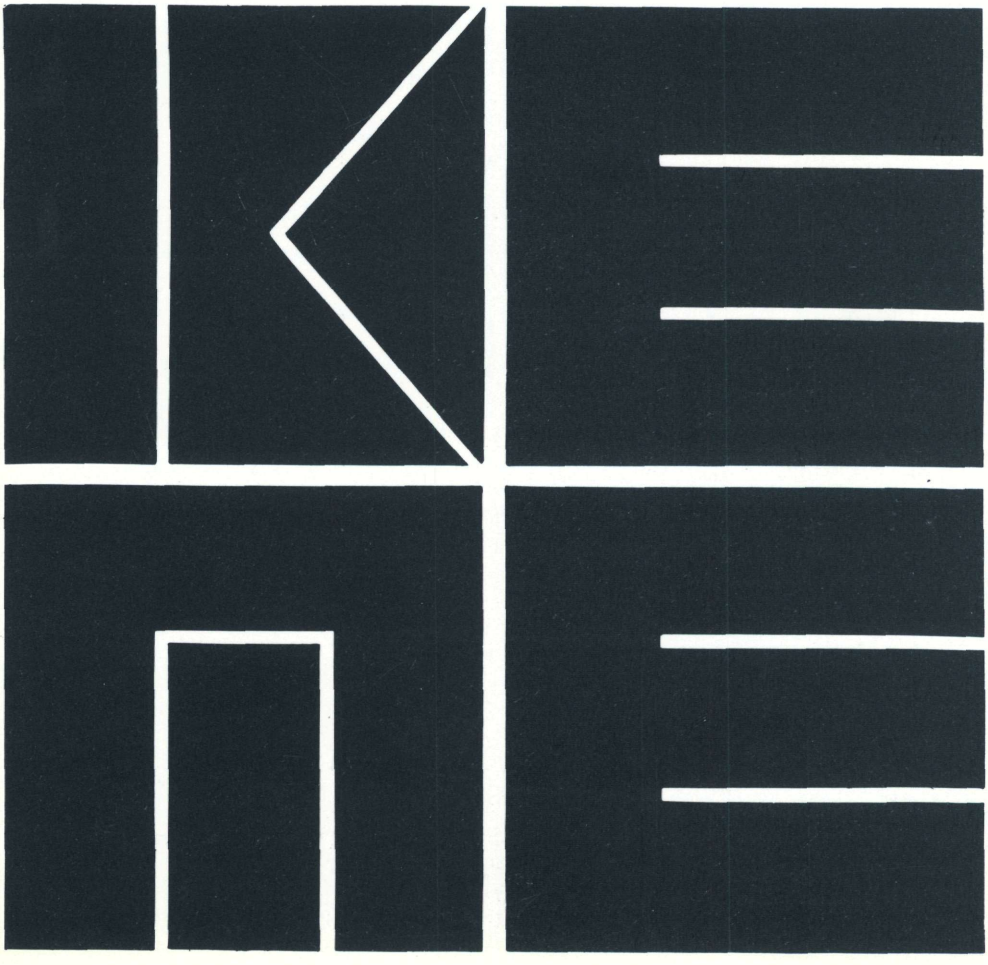
**E. Petoussis**

## A Dynamic Framework for Testing the Monetary Approach to the Balance of Payments



Athens 1984

# A Dynamic Framework for Testing the Monetary Approach to the Balance of Payments

CENTRE OF PLANNING AND ECONOMIC RESEARCH

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# A Dynamic Framework for Testing the Monetary Approach to the Balance of Payments: The Case of Greece

**E. Petoussis, Ph.D.**

Athens, December 1984

*Opinions or value judgements expressed in this book are those of the author and do not necessarily represent those of the Centre of Planning and Economic Research.*

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# *PREFACE*

*In this series KEPE publishes lectures delivered at the Centre, shorter studies of a more general interest, and reprints of articles published by our staff in well-known greek and foreign journals.*

*The paper that is presented here is based on a lecture that the author gave at KEPE in January, 1984. It is also based on the author's Ph. D. thesis submitted to the London School of Economics in 1981.*

*The paper is set to explore the links between the money market and the balance of payments in Greece, within the framework of a small analytical model that considers explicitly the full range of financial flows irrespective of their origin. Such links, if found powerful, have important consequences for policy making.*

*Another interesting aspect of the paper is its methodological approach. The empirical part of this paper conducted at LSE under the guidance of Professors Sargan and Hendry, seriously challenges earlier econometric work in a way that produces many interesting applications in various areas of economic theory.*

*Thus even though this paper focuses on the monetary approach to the balance of payments it provides an analytical framework that can be readily generalized.*

*Professor LOUKA T. KATSELI*
*Scientific Director*

*Centre of Planning*
*and Economic Research*

*December 1984*

## *ACKNOWLEDGEMENTS*

*The dispute between Keynesians and monetarists is an old one. It has taken different forms and survived until today in different areas of economic theory. When it does not involve different ideological convictions, the difference between the two approaches lies primarily in the assumptions that are used. One, and perhaps the only, common framework within which different assumptions can be brought together and evaluated is one that takes explicitly into account the time dimension; after all what is a "long-run" theory and how relevant is it for policy making?*

*Such a framework is set in the paper. The objective is to provide a type of synthesis between the two approaches in the area of the monetary theory of the balance of payments. The emphasis is on the methodology that is adopted to reconcile the long-run character of the theory with short-run data.*

*The test that this paper proposes is based on a detailed dynamic model of the financial sector and takes into account all sources of disturbance of the private sector's stock equilibrium. Results obtained for the Greek economy establish the usefulness of such an approach and the validity of the theory in general. Yet they cast doubt on the practical relevance of the latter in the short run.*

*This paper has been written when I was at the London School of Economics. I received valuable help and advice from Willem Buiter, James Davidson, David Hendry, Brian Hindley, Chris Pissarides and the participants of the Money and Macroeconomics Workshop (LSE) where an earlier version of the paper has been presented. I am particularly grateful to Richard Pierse for providing me with his computer programs for the non-linear estimation and simulation of the model.*

*Finally I am grateful to Louka Katseli for the opportunity she gave me to present this paper, first at a lecture at KEPE and now in this publication.*

*MANOS PETOUSSIS*

*December 1984*

CONTENTS



TABLES

# 1. INTRODUCTION

The object of an empirical test of the monetary approach is to investigate the existence of a causal relationship between the money market and the balance of payments under fixed exchange rates. The main problem involved seems to be the reconciliation of such a long-run theory with short-run data (i.e., available observations at some point in time). This paper attempts to provide a theoretically and empirically consistent framework to deal with this problem.

The framework is derived from a detailed model of the financial sector and explicitly takes into account all sources of disturbance of the private sector's stock equilibrium. This method is presented as an alternative to simple tests investigating the money (or credit) - reserves relationship (e.g. empirical papers surveyed in Magee, 1976) or causality statistical tests (e.g. Feige and Johannes, 1981).

Finally, empirical evidence for the Greek economy (1960-77) is presented. It is investigated whether some propositions, developed and tested mainly in the context of developed countries, can be valid and useful for economies with less developed financial sectors or heavy intervention of the authorities in the credit market.

# 2. THE THEORETICAL BACKGROUND

Monetary-approach theorists have focused on the reconciliation of the different balance-of-payments theories[1]. In the context of an empirical test, however, the main issue is how to reconcile the long with the short run. On the one hand, we have a set of assumptions which are meaningful in the long run only: the stability of the demand for money-the central assumption-as well as perfect commodity arbitrage and capital markets; perfect flexibility of prices and, consequently, full employment; and the inability of governments to pursue sterilisation policies continuously. On the other, we have the short-run setting of a particular series of observations over a certain period. All the theoretical and statistical problems of conventional tests seem to arise from the invalid imposition of the above assumptions on such a setting.

At the analytical level, the underlying theory must be sufficiently generalised if it is to be confronted with "real-world" data. Abstractions from reality for the sake of unambiguous results will in general be inappropriate for empirical analysis. Some specifications of the monetary approach must be questioned in this context.

The relevant theory has pointed out the budget constraint imposed on a country by the balance of payments. But the budget constraints of the various sectors of the ecomony are usually neglected. Firstly, the analysis that incorporates the government budget in the tradition of Christ (1968) emphasises the influence of this constraint on the stock equilibrium of the private sector in the same way that the monetary approach concentrates on the impact of external flows on the same stock equilibrium (see also Currie, 1976). The same is true for the budget constraint of commercial banks and the way in which they balance their assets and liabilities. Recourse to ex-post accounting identities can be very misleading. When both supply and demand are considered, a change in the volume of credit must be accompanied by a change in some other variable or parameter in the system. The cost of credit cannot be ignored.

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1. For a short-run synthesis, see Frenkel, et al. (1980).

Another important aspect of the monetary analysis is the exogeneity of domestic credit. The issue has two different and not necessarily interrelated facets. It may refer to the ultimate control of domestic credit by the authorities; or, to the independence of credit from the external sector. Such problems cannot be adequately discussed in the obscure framework of the standard formulation, where credit C is a virtually undefined concept, derived residually from the simple identity

$$\Delta M = \Delta C + \Delta R \qquad (2.1)$$

(where M is money and R foreign reserves)

To clarify this point we can use the budget constraints of the banking and the public sector (the latter includes the central bank), as well as the definition of broad money, to derive[2]:

$$\Delta M = (\Delta G + \Delta A - \Delta G_{PR} - \Delta NFL_B - \Delta G_F - \Delta NDL_B) + \Delta R \qquad (2.2)$$

where $\Delta G$ is the budget deficit, A the banks' credit to the private sector, $G_{PR}$ private holdings of government securities, $NFL_B$ net foreign liabilities of banks, $G_F$ government foreign borrowing and $NDL_B$ non-deposit liabilities of banks.

Compare now (2.1) with (2.2); domestic credit expansion is identified with the terms in the bracket in (2.2). But an increase in government foreign borrowing ($G_F$), say, would cause an increase in C as defined above, as well as an equal and offsetting change in R; M would not change. Therefore, a change in reserves tells us nothing about M; apart from the conventional problem of the most appropriate definition of the balance of payments, the definition implied by (2.2) is not even operational for our purposes.

On the other hand, we can replace $\Delta R$ by its components, i.e. the current account (CA), the capital account of the private and banking sectors ($\Delta NFL_{PR}$ and $\Delta NFL_B$ respectively) and government foreign borrowing ($\Delta G_F$) to obtain:

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2. The full set of identities is presented for Greece below. For further discussion see Currie (1976), Coghlan (1981) and Petoussis (1981). Note that the concept of broad money is used throughout this paper.

$$\Delta M = (\Delta G + \Delta A - \Delta G_{PR}) + (CA + \Delta NFL_{PR}) - \Delta NDL_B \qquad (2.3)$$

The first bracket can be identified with domestic credit; the second with the external flow into the money stock ($\Delta NDL_B$ can be treated as a residual item). Domestic credit has a clear theoretical content now and is shown to be determined by the independent decisions of the government, the banking and the private sectors. A change in the first bracket implies no *automatic* change in the second - unlike (2.2) - although independency between the two is still not ensured. The government may first look at the balance-of-payments position before deciding about the level of the budget deficit. Banks may first consider their foreign liabilities position before determining $\Delta A$. In the same way, $\Delta G_{PR}$ may be related to $\Delta NFL_{PR}$. This facet of exogeneity has been ignored by the monetary approach. It also shows how limited the scope of "causality" analysis is in this context, as in Feige and Johannes (1981).

Identity (2.3) can also provide the basis for an analytic treatment of the sterilisation issue. In the short run, the government can offset the impact of external flows by operating on $\Delta G$ directly and on $\Delta G_{PR}$ or $\Delta A$ indirectly. The first alternative means running budget deficits of equal magnitude but opposite sign to external flows. The second corresponds to open market operations and the third to restrictions of advances through direct or indirect intervention in the credit market.

But the appropriate disaggregation of the money identity is closely related to the context within which the money supply process is analysed.

The money stock has been conventionally treated in model building as though determined either by demand or by supply. The first method is implicit in the monetary approach: the stock of money is determined by a demand function and domestic credit is a policy variable; the equilibrating role is thus attributed to external flows. The second method endogenises the components of money, i.e. the right-hand side of (2.3), so that the stock of money is determined residually. The implicit assumption is that whatever amount of money is supplied by the various sectors of the economy is willingly held. This method runs into the same problems as the simplest monetarist formulations:

an identity is used as if it were a behavioural relationship. A disequilibrium analysis is therefore necessary (see, for instance, Bergstrom, 1976 and Goodhart, 1979).

Such an approach is also consistent with the nature of money; being a means of payment, it is present in all market transactions. In a sense it is the mirror of each transaction. Thus a disequilibrium in any other market is bound to be reflected on the money market before any sort of adjustment takes place. But money also acts as a buffer in an uncertain, "imperfect" world. This means that individuals do not immediately adjust to the desired level but temporarily allow their money holdings to be above or below that level. They accept money even though they do not desire to retain ownership of it. For example, consider an individual who shifts from one asset into another, from bonds into a physical asset, say. His money holdings in the period between the two transactions will not be related to income (and other standard demand-for-money arguments) in any systematic way. In that sense they represent a disequilibrium demand.

In what follows we concentrate on the components of money (right-hand side of 2.3). But the discrepancy between the desired and the actual money stock is explicitly allowed to feed back into the supply process at each and every point in time.

# 3. A DYNAMIC MODEL OF THE FINANCIAL SECTOR OF GREECE

The monetary hypothesis is tested for Greece within the theoretical framework set in the previous section. We concentrate on the financial sector, treating real income as exogenous. This approach is in the spirit of Melitz and Sterdyniak (1978) and Davidson and Keil (1981), although data availability was also a basic reason for this limitation. But we also test, and reject, the hypothesis that our results suffer from an endogeneity bias (see Section 4).

The government budget deficit is also treated as exogenous, since fiscal policy in Greece seemed to be determined by development considerations and political commitments rather than Keynesian considerations of aggregate demand. The model is presented in Table 1 and divides the economy into four sectors: the public sector which includes the central bank; the banking sector which consists of commercial banks and special credit institutions; the private and the foreign sectors.

The empirical approach chosen is closely related to the theoretical background of the model. The underlying strategy is to "impose" on the system the long-run predictions of the theory, although always subject to the appropriate testing procedure, and to allow the most general possible response pattern for the short run which seems to be the basic area of disagreement among different schools of thought.

A conventional demand-for-real-balances function is postulated by (3.1). Note that the choice of the individual is only between spending and holding money in the form of currency and deposits, since private holdings of securities are extremely limited. Therefore, expected inflation is the only opportunity cost; $r_d$ is the own interest rate fixed by the authorities -a weighted average of rates on deposits.

But what we are interested in is the implicit long-run demand for money and not $M_t^d$, which is itself subject to various disequilibrium disturbances. Therefore, (3.1´) is actually estimated; then its long-run solution[3] - and *not* the residual term - is substituted in the simultaneous

3. For the derivation see Hendry and Mizon (1978).

block of equations.

(3.2) describes the determination of the external component of money as defined in Section 2. This composite variable was negative in Greece throughout the period under consideration; it is multiplied by $-1$, so that its logarithm can be defined. If in the short run the arguments of CCA and $NFL_{PR}$ are different or have a different lag structure, there is still ground for estimating two separate equations. But the bulk of private capital inflows in Greece consists of long-term capital associated with a few large investment projects. The decisions concerning these investments and the completion of the projects are spread over quite long periods, so that it is difficult to associate $NFL_{PR}$ with current economic conditions, at least in the short run.

The long-run arguments in (3.2) are the discrepancy between desired and actual money stock, a purchasing-power-parity effect and an "indicator" (INDR) of the foreign position of the country as a proxy of direct government intervention. Such a variable can be the flow (or stock) of foreign reserves or the flow (or stock) of the external component of money scaled by nominal income. In the short run we have a general response pattern consisting of changes in real income, money, domestic and foreign rates of inflation.

A set of exchange-rate dummies (ERD) is also included. The drachma was pegged to the dollar until 1975 and thus followed the two devaluations of the latter in 1971 and 1973. In 1975 a policy of flexible intervention in the exchange market was established. But what actually happened was that, after an initial jump, the exchange rate exhibited only minor fluctuations in the rest of the period under consideration. Exchange rates are, therefore, treated as fixed with three dummies for the changes in the exchange-rate path (see further discussion in the next section).

(3.3) is a reaction function for the authorities' foreign borrowing. $G_F$ is assumed to be determined by external sector considerations: it prevents a potential outflow of reserves. (What we can call "official settlements balance", i.e. the sum of the current account plus the private and the banking sector's capital accounts, has always been in deficit). It is also related to the government's financing requirements; what cannot be financed domestically has to come from the foreign sector. Interest rates are not included. The government has no other alterna-

TABLE 1

The Model of the Financial Sector of Greece

$$\ln(M^d/P) = g\,[\ln y,\ \Delta\ln P,\ \ln(1 + r_d)] \tag{3.1}$$

$$\Delta\ln(M^d/P) = g^*\,[\Delta\ln y,\ \Delta^2\ln P,\ \Delta\ln(1+r_d),\ SEAS;\ \ln(M/yP),\ \Delta\ln P,\ \ln(1+r_d)] \tag{3.1'}$$

$$\Delta\ln[-(CCA+NFL_{PR})] = f_1\,[\Delta\ln y,\ \Delta\ln M,\ \Delta\ln P,\ \Delta\ln P^*,\ ERD,\ SEAS;\ \ln(M^d/M),\ \ln(P^*/P),\ \ln INDR] \tag{3.2}$$

$$\Delta\ln G_F = f_2\,[\Delta\ln CS,\ \Delta\ln G,\ ERD,\ SEAS;\ \ln CS,\ \ln G,\ \ln(G_F/yP)] \tag{3.3}$$

$$\Delta\ln A = f_3\,[\Delta\ln D,\ \Delta\ln LR,\ \Delta\ln(1+r_a),\ SEAS;\ \ln(A/D),\ \ln LR,\ \ln(1+r_a)] \tag{3.4}$$

$$\Delta\ln Cu = f_4\,[\Delta\ \ln yP,\ \Delta\ln(1+r_d),\ \Delta^2\ln P,\ SEAS;\ \ln(Cu/yP),\ \ln(1+r_d),\ \Delta\ln P] \tag{3.5}$$

$$\Delta\ln P = f_5\,[\Delta\ln M,\ \Delta\ln y,\ \Delta\ln(1+r_d),\ \Delta\ln P^*,\ SEAS;\ \ln(M^d/M),\ \ln(P^*/P),\ \ln(y^p/y)] \tag{3.6}$$

$$G + H + NCR_{BG} + NOA_{BG} = G_B + G_{PR} + G_F + Cu \tag{3.7}$$

$$A + G_B + NOA_B = D + NFl_B + NCR_{BG} \tag{3.8}$$

$$R = CCA + NFL_{PR} + NFL_B + G_F \tag{3.9}$$

$$M = D + Cu \tag{3.10}$$

$$CS = CCA + NFL_{PR} + NFL_B \tag{3.11}$$

All variables can appear lagged as well.

The "long-run" effects are distinguished from the "short-run" ones by a semi-colon(;) and are assumed lagged by at least one period.

## NOTATION

Endogenous variables

| | |
|---|---|
| R | foreign reserves |
| $G_F$ | public borrowing from the foreign sector |
| Cu | currency in circulation |
| A | advances and loans by the banking sector |
| D | deposits with the banking sector |
| M | broad money ($M^d$ is the desired money stock) |
| $(CCA + NFL_{PR})$ | cumulated current account plus net foreign liabilities of the private sector |
| CS | cumulated "official settlements balance" |
| P | domestic prices |
| $G_B$ | holdings of government securities of the banking sector |

Exogenous variables

| | |
|---|---|
| G | stock of government "debt" (cumulated budget deficits) |
| $NCR_{BG}$ | net credit to the banks by the Bank of Greece |
| $NOA_{BG}$ | net other assets of the Bank of Greece |
| $NOA_B$ | net other assets of the banking sector |
| $NFL_B$ | net foreign liabilities of the banking sector |
| $G_{PR}$ | holdings of government securities of the private sector |
| y | real income |
| $y^p$ | potential income |
| P* | foreign prices in domestic currency |
| LR | liquidity ratio of the banking sector |
| $r_d$ | interest rates on deposits |
| $r_a$ | interest rates on banks' advances |
| INDR | "indicator" of the foreign position of the country |
| ERD | set of exchange-rate dummies |
| SEAS | set of seasonal dummies |

tive but to resort to the foreign sector. Moreover, $G_F$ consists mainly of long-term capital. Given the various guarantees that are required by lenders, the long bargaining period that precedes each loan and the political considerations involved, it is difficult to attribute any important role to interest rates. Finally, the stock of foreign debt, scaled by nominal income, provides an additional long-run effect: a larger foreign debt involves a heavier burden as well as lower credibility and has to be taken into account.

Equation (3.4) describes the supply of credit by the banking sector. Its determination is to a large extent an empirical issue, given the uncertainty of the relevant literature. The Greek case presents some further complications. First, we have the special credit institutions which account for about 50 per cent of total credit. They are under the control of the state and responsible for the financing of certain sectors (e.g. agriculture). Second, state authorities not only set the price of loans (interest rates) but attempt to directly control the quantities as well: a complicated system of incentives for some types of loans and credit ceilings for others dominate the credit market.

The loans granted by special credit institutions are a typical case of credit rationing, the interest rates charged being lower than those of the commercial banks. The hypothesis of credit rationing seems to be valid for the rest of the banks as well; the high degree of intervention on the part of the authorities and the lack of a developed financial market, which means that the demand for credit cannot be satisfied by any alternative source, are the primary causes of this. But we also attempted to test this proposition indirectly by estimating a conventional demand-for-credit function for commercial banks. This form was rejected by the data.

From the point of view of the suppliers, credit has to be considered in conjunction with $G_B$, i.e. the banks' holdings of government securities. Interest rates and liquidity considerations determine the composition of the banks' portfolios to a limited extent only. $G_B$ and ordinary reserve requirements are fixed by the authorities according not only to the quantity of deposits but also to the quantity and type of loans.

In (3.4) deposits D have been used as a proxy for liabilities (D is endogenous through identity 3.8). The data suggest that, on the average, funds equal to $G_B$ are redistributed from the commercial banks to the special credit institutions in the form of credit by the bank of Greece ($NCR_{BG}$). Moreover, the net foreign liabilities of banks

$NFL_B$, mainly deposits in foreign exchange by emigrants, are very small compared to total deposits and exogenously determined. They are, therefore, eliminated so as to avoid non-linearity problems in the solution of the system.

LR is a liquidity ratio used as a proxy for direct government intervention and defined as follows ($D_B^{BG}$ denotes the banks' deposits with the Bank of Greece):

$$LR = (D_B^{BG} + G_B) / (D + NCR_{BG} + NFL_B)$$

This ratio is policy-determined since the authorities can operate on both the numerator and the denominator. Finally, $r_a$ is the exogenously determined price of loans (a weighted average of rates on various types of loans).

(3.5) is the demand for notes and coins. Interest rates on deposits are included, since the cheque system has very limited application in Greece, so that the process of substitution between currency and savings deposits may take place directly. Similarly, substitutability between currency and physical goods is tested through the inclusion of the expected rate of inflation (proxied by $\Delta \ln P$).

(3.6) describes the determination of the inflation rate. In a closed economy, a monetary model like the one considered here would postulate the price level as a long-run function of the excess demand for money. In an open economy, if we accept that the "law of one price" holds in the long-run, domestic prices must simultaneously be equal to foreign prices (a weaker formulation is that $P^*/P$ is equal to a constant, not necessarily unity). Since the attainment of equilibrium is not instantaneous, three disequilibrium effects were tested: the purchasing-power-parity effect, $P^*/P$; the disequilibrium in the money market, $M^d/M$; and the disequilibrium in the goods market, captured by the discrepancy between potential and actual cutput, $y^p/y$ (see appendix for definitions). In the short run the usual rich response pattern is allowed.

# 4. THE RESULTS

The model was estimated using seasonally unadjusted quarterly data covering the period 1960i-1977iv, although the last eight observations were kept for predictions. As a standard procedure all equations were estimated by OLS, starting with a maximum lag of 8 quarters for all variables. Sequential testing proceeded by using t - and F - tests along the lines of the "from general to specific" specification procedure of Hendry, Mizon and others (see e.g. Mizon, 1977).

Consider first the demand for money. An extensive specification search gave equation (4.1′) in Table 2. A 2nd degree Almon-type polynomial was used for the error correction mechanism M/Y. The lack of alternative financial assets seems to be behind the slow adjustment of M. After a supply shock (e.g. due to credit expansion), equilibration of demand with supply cannot take place through portfolio readjustment. All the necessary adjustment has to come about through consumption and this tends to be a rather long process.

Setting the growth rates of the variables to their sample means we can derive the implicit long-run function. In (4.1) individual elasticities are of the expected magnitude; the high income elasticity confirms the results of other researchers and is a direct result of the structure of the financial market.

Having established the stability of money demand we can use the fitted values of (4.1) to estimate the rest of the equations. The stochastic ones were specified by OLS and subsequently estimated by three-stage least squares along with the five identities. These identities were log-linearised using a Taylor series expansion around sample means so as to avoid a non-linear-in-the-variables system. Table 2 presents the estimates along with the results of two dynamic simulations.

The significant and negative coefficient of the excess demand for money in (4.2) comes clearly in support of the monetary hypothesis in its "weakest" version. The role of the money market in influencing the balance of payments is confirmed; but other variables - changes in real income and the domestic and foreign rates of inflation - are also important in the short run. The purchasing-power-parity term also exerts a long-run effect, although the "indicator" variable, under alternative definitions, proved insignificant.

In (4.2) and (4.3) the dummy variable for the switch from fixed to adjustable exchange rates proved significant, unlike the dummies for the two de facto devaluations of the drachma when it was pegged to the dollar. The openness of the Greek economy and the rapid changes in prices and expectations in the early seventies seem to explain the high sensitivity of domestic to foreign prices, which is consistent with the above finding. Note also that most of the tradeable goods in Greece are denominated in dollars. In fact, we reestimated these equations from the beginning of the period up to 1975ii and from 1971iii up to 1975ii; we then performed a Chow test for parameter constancy. We obtained $F_{11,31} = .89$ for (4.2) and $F_{9,35} = 1.12$ for (4.3). The hypothesis of structural instability was comfortably rejected thus justifying our treating the period 1971-75 as one of fixed exchange rates.

The rest of the results were as theoretically expected and present no problem. The model as a whole fits and predicts well on the basis of the criteria used. Note only that the data supported the change in the excess demand for money rather than the level in (4.6). This may seem to suggest that in the long run prices depend only on the excess demand for goods and are not affected by the money market. This "contradiction" can be easily resolved if the lack of an alternative liquid asset is taken into consideration; an excess demand for money will always be reflected in an excess demand for goods. Finally, note that the $\Delta \ln y$ term has been reparameterised without any loss of generality as $\Delta \ln(y^p/y)$, so as to distinguish explicitly between demand and supply forces in the goods market.

As mentioned above, the current change in income which enters into (4.2) and (4.6) was treated as exogenous. In order to test this proposition indirectly, we reestimated these equations using instrumental variables. The coefficients (and the standard errors in brackets) for $\Delta \ln y_t$ were .135(.029) for 4.2 and .230(.048) for 4.6. The corresponding OLS coefficients were .100(.027) and .163(.045) respectively, i.e. not significantly different. This provides some evidence against the hypothesis that our results suffer from an endogeneity bias.

The estimated Model I involves six restrictions on the demand-for-money elasticities in (4.2) and (4.6). We also estimated it without any restrictions at all (Model II) as well as with three cross-equation restrictions imposed on the demand arguments as suggested by Davidson and Keil, 1981 (Model III). The relevant likelihood-ratio tests gave

TABLE 2

Estimation of Model I

DEMAND FOR MONEY; dependent variable $\Delta 1n(M/P)_t$

| $\Delta 1ny_{t-3}$ | $\Delta 1n(1+r_d)_{t-3}$ | $\Delta 1nP_t$ | $\Delta 1nP_{t-1}$ | $\sum_{i=5}^{8} 1n(M/P)_{t-i}$ | $\sum_{i=5}^{8} 1ny_{t-i}$ | $1n(1+r_d)_{t-4}$ |
|---|---|---|---|---|---|---|
| .121 | 2.278 | −.838 | −.355 | −.173 | .279 | .468 |
| (3.03) | (3.67) | (9.25) | (3.73) | (3.39) | (3.37) | (1.99) |

(4.1′)

$R^2$= .924 s= .0054 LM(5)= 5.64 Ch(8,40)= .41 FT(8)= 5.62

IMPLICIT LONG-RUN DEMAND FOR MONEY (abstracting from seasonal dummies)

$$(M/P) = .041\ y^{1.61}\ (1+P)^{-6.90}\ (1+r_d)^{2.71} \qquad (4.1)$$

FOREIGN SECTOR; dependent variable $\Delta 1nF_t$, where $F = -(CCA + NFL_{PR})$

| $\Delta 1ny_t$ | $\Delta 1ny_{t-1}$ | $\Delta 1nP_t$ | $\Delta 1nP^*_{t-3}$ | $\Delta 1nF_{t-1}$ | $1n(M^d/M)_{t-4}$ | $1n(P^*/P)_{t-6}$ | ERD |
|---|---|---|---|---|---|---|---|
| .100 | .066 | .493 | −.064 | .270 | −.017 | −.039 | .122 |
| (4.41) | (2.80) | (6.80) | (2.27) | (3.74) | (1.86) | (1.65) | (12.41) |

(4.2)

$R^2$= .861 s= .0090 LM(5)= 5.89 $PRMSE_1$= .20 $PRMSE_2$= .10

FOREIGN BORROWING; dependent variable $\Delta 1nG_{F,t}$

| $\Delta 1nCS_t$ | $\Delta 1nG_t$ | $\Delta 1nG_{F,t-1}$ | $1n(G_F/yP)_{t-4}$ | $1nG_{F,t-4}$ | ERD |
|---|---|---|---|---|---|
| .012 | .301 | −.287 | −.232 | .053 | .138 |
| (2.74) | (2.12) | (2.91) | (4.11) | (3.60) | (2.46) |

(4.3)

$R^2$= .565 s= .0541 LM(5)= 4.84 $PRMSE_1$= .66 $PRMSE_2$= 1.90

TOTAL ADVANCES; dependent variable $\Delta 1nA_t$

| $\Delta 1nD_t$ | $\Delta 1nLR_t$ | $1n(A/D)_{t-1}$ | $1nLR_{t-1}$ | $1n(1+r_a)_{t-4}$ | (4.4) |
|---|---|---|---|---|---|
| .324 | .301 | −.265 | −.092 | .227 | |
| (5.48) | (5.38) | (5.26) | (3.40) | (1.76) | |

$R^2$= .810 s= .0084 LM(5)= 10.21 $PRMSE_1$= .81 $PRMSE_2$= .13

DEMAND FOR CURRENCY; dependent variable $\Delta 1nCu_t$

| $\Delta 1nyP_{t-2}$ | $\Delta 1nyP_{t-3}$ | $\Delta 1nyP_{t-4}$ | $\Delta 1nCu_{t-1}$ | $1n(Cu/yP)_{t-4}$ | (4.5) |
|---|---|---|---|---|---|
| .234 | .296 | .254 | −.454 | −.185 | |
| (2.16) | (3.01) | (2.35) | (3.93) | (3.82) | |

$R^2$= .801 s= .0376 LM(5)= 10.49 $PRMSE_1$= .63 $PRMSE_2$= .38

RATE OF INFLATION; dependent variable $\Delta 1nP_t$

| $\Delta 1nM_t$ | $\Delta 1n(y^p/y)_t$ | $\Delta nP_{t-1}$ | $\Delta 1nP^*_{t-1}$ | $\Delta 1n(M^d/M)_{t-4}$ | $1n(y^p/y)_{t-1}$ | $1n(P^*/P)_{t-2}$ | (4.6) |
|---|---|---|---|---|---|---|---|
| .333 | −.172 | .486 | .205 | −.038 | −.190 | .138 | |
| (2.20) | (4.33) | (5.03) | (4.64) | (3.13) | (3.87) | (4.02) | |

$R^2$= .745 s= .0138 LM(5)=3.52 $PRMSE_1$= .58 $PRMSE_2$= .98

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(4.1´) was estimated by OLS and (4.2) through (4.6) by 3SLS along with the five identities. A constant term and three seasonals have been included in all the above equations.
The coeffecient of determination $R^2$, the standard error of the regression s and the Lagrange multiplier test for higher order autocorrelation LM (a $x^2$- test with 5 degrees of freedom here) correspond to the OLS estimation. The same is true for the Chow test for parameter constancy Ch (an F-test) and the asymptotically equivalent forecast test FT (a $x^2$- test). $PRMSE_1$ is the percentage mean square error of the dynamic simulation over the estimation period and $PRMSE_2$ the relevant statistic for the dynamic simulation over the forecasting period. In brackets the absolute t-ratios.

$x_6^2$= 7.68 (I against II) and $x^3$= .26 (I against III). The restrictions implied by I cannot be rejected.

# 5. CONCLUSIONS

Our dynamic model of the financial sector of Greece provided the framework for a consistent test of the monetary approach and established a causal link between the money market and the balance of payments. But the above link proved rather weak, implying a multiplier of .023 and a median lag of 5.6 quarters. At the same time other, more traditional determinants of the balance of payments did seem to exercise a strong effect. Therefore, there is no justification for the authorities being primarily concerned with monetary disequilibria, at least in the short run.

The explanation for such a result must be sought in Greece's ability to keep on borrowing abroad, in order to finance its budget deficits. Such a process has the effect of a de facto neutralisation of external flows without at the same time inducing any automatic corrective forces by changing the private sector's net financial assets. The inflow of foreign credit can be ensured to the extent that it is primarily used to expand the productive capacity of the country and not for consumption purposes.

A straightforward generalisation of the above results would be rather risky. But the framework of the Greek financial sector is quite similar to that of other less developed economies or small European countries where the authorities intervene heavily in the credit market. It has been demonstrated that a valid test of the monetary approach is possible and useful in such a context.

# APPENDIX

## DATA DEFINITIONS AND SOURCES

Unless otherwise stated, our standard source was the Monthly Statistical Bulletin of the Bank of Greece. Data series that have not been adequately explained in the main text or are not readily available are described here.

1. *Real income:* A quarterly series was constructed by projecting the index of industrial production on yearly data of GNP *(National Accounts of Greece).*
2. *Potential income:* The logarithm of real income was regressed on the time trend, a constant and three seasonals; the maximum error was then added. In that way we obtained a variable which is always close to, but above, the actual one.
3. *Broad money:* "Money" plus "quasi money", International Monetary Fund, *International Financial Statistics.*
4. *Cumulative variables:* Mainly balance-of-payments variables. Since stock data are not available, they were constructed by cumulating the relevant flow variables appearing in the balance-of-payments accounts. For most of the series we have data since 1948 only. Accordingly, the beginning-of-period stock is the sum of the flows from 1949i to 1959iv. The same procedure was followed for all stock variables with the exception of foreign reserves. In this case the actual rather than a constructed series was used; the "errors and omissions" account was adjusted accordingly.
5. *Current account:* As defined in the Bulletin, but net of donations.
6. *Government foreign borrowing:* This item includes borrowing by both the Government and the Bank of Greece. The flow data were estimated from the "Balance of Payments: Basic Global Data" tables in the Bulletin to ensure consistency with the rest of the cumulative variables.
7. *Holdings of securities of the private sector:* Constructed by subtracting the holdings of securities of the banking system from the total issues of bonds.
8. *Stock of government debt:* To ensure consistency with the rest of the stock variables again, it was estimated from the budget constraint.
9. *Price index:* The consumer price index was used.

## REFERENCES


BERGSTROM A. *Statistical Inference in Continuous Time Economic Models.* North Holland, Amsterdam, 1976.

CHRIST C. "A simple macroeconomic model with a government budget restraint" in *Journal of Political Economy,* 76 (1968), pp. 53-67.

COGHLAN R. "Money supply in an open economy" in *Applied Economics,* 13 (1981), pp. 181-191.

CURRIE D. "Some criticisms of the monetary analysis of balance of payments correction" in *The Economic Journal,* 86 (1976), pp. 508-520.

DAVIDSON J. and KEIL M. "An econometric model of the money supply and balance of payments in the United Kingdom", ICER Discussion Paper. London School of Economics, 1981.

FEIGE E.L. and JOHANNES J.M. "Testing the causal relationship between the domestic credit and reserve components of a country's monetary base" in *Journal of Macroeconomics,* 3 (1981), pp. 55-76.

FRENKEL J.A., GYLFASON T. and HELIWELL J.F. "A synthesis of monetary and Keynesian approaches to short-run balance-of-payments theory" in *The Economic Journal,* 90, (1980), pp. 582-592.

FRENKEL J.A. anad JOHNSON H.G. *The Monetary Approach to the Balance of Payments.* London: G. Allen and Unwin Ltd., 1976

GOODHART C.A.E. "Money in an open economy" in Ormerod P., ed., *Economic Modelling.* London: Heinemann Educational Books, 1979.

HENDRY D.F. and MIZON G.E. "Serial correlation as a convenient simplification, not a nuisance" in *The Economic Journal,* 88 (1978), pp. 549-563.

MAGEE S.P. "The empirical evidence on the monetary approach to the balance of payments and exchange rates" in *American Economic Review,* 66 (1976), pp. 163-170.

MELITZ J. and STERDYNIAK H. "An econometric study of the British monetary system" in *The Economic Journal,* 89 (1978), pp. 874-896.

MIZON G.E. "Model selection procedures" in Artis M.J. and Nobay A.P., eds. *Studies in Modern Economic Analysis.* Oxford: Basil Blackwell, 1977.

PETOUSSIS E. "Short-run data and long-run theories: testing the monetary approach to the balance of payments" (mimeo) London School of Economics, 1981, forthcoming in Kredit and Kapital.

## IN THE SAME SERIES

1. V. F. Filios, *Socioeconomic Accounting.* Athens 1984 (in Greek only).
2. Th. Gamaletsos. *Habit Formation and Inflation in Demand Analysis: A System Wide Approach,* Athens 1984.
3. A. Kostakis. *An Analysis of the Factors of Success in the Lyceun Entrance Examinations* (1981). Athens 1984 (in Greek only).