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NASKARIS, GEORGE NAPOLEON  
MONETARY ASPECTS OF THE BALANCE OF PAYMENTS  
THEORY: THE GREEK EXPERIENCE 1957-1976.  
CITY UNIVERSITY OF NEW YORK, PH.D., 1979

CDPR, 1979 NASKARIS, GEORGE NAPOLEON  
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MONETARY ASPECTS OF THE BALANCE OF PAYMENTS THEORY:  
THE GREEK EXPERIENCE 1957-1976

by

GEORGE NAPOLEON NASKARIS

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

1979

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

14 May 1979 —  
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TO THE RESTLESS, MIGRATING, AND  
CREATIVE SPIRIT OF MY RACE

## ABSTRACT

MONETARY ASPECTS OF THE BALANCE OF PAYMENTS THEORY:

THE GREEK EXPERIENCE 1957-1976

by

George Napoleon Naskaris

Advisor: Professor Elliot Zupnick

The thesis deals with the monetary approach to the Balance of Payments as it applies to the Greek economy.

The approach considers the balance of payments a monetary phenomenon. Basically it states that reserves flow in (out) when residents desire to accumulate money balances faster (slower) than the rate at which policy actions and other domestic factors are increasing the stock of money. Thus an excess supply of (demand for) money is associated with a deficit (surplus).

We start our analysis with the investigation of the money market. Here we consider extensively the supply of and demand for money.

Next, we look into the goods and assets markets. This we do by testing for the Unified Market Hypothesis, i.e., whether the domestic inflation rate and returns for real assets converge to those of the rest of the world.

Finally we bring together the monetary variables from the demand for and supply of money equations and by defining the Balance of Payments as the flow of foreign reserves we develop and estimate the "monetary" Balance of Payments equation.

## ACKNOWLEDGEMENTS

The completion of this thesis and all the other requirements for the Doctor of Philosophy degree is not my work alone. As far as the thesis is concerned I am indebted to Professors Elliot Zupnick, Michael Grossman, and Alvin Marty and my fellow students Anthony Cassesse and Nurhan Helvacian for the help and guidance they offered. As far as the over all completion is concerned I am indebted to Michael Grossman for his encouragement, support, and understanding.

I wish to thank Professor Donald Gordon and my friend Roy Andersen for giving me hope, in the beginning, when I had doubts. I also want to thank the taxpayers for subsidizing my education, and my friends for putting up with my erratic behavior.

Finally I want to thank a little old woman for having taught me to choose aggression over regression in the face of adversity, without this nothing would have been finished.

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## CHAPTER I

### INTRODUCTION

The balance of payments is an economic indicator. It indicates to the responsible authorities how the nation is performing in the world market. Its value can be positive (surplus), zero, or negative (deficit). When it is positive, foreign reserves flow in; when negative, they flow out. For a nation with an open economy, the direction of the flow of foreign reserves becomes important. Foreign trade transactions require "hard currencies". For any such economy, short-run deficits can be financed either by existing "currencies" or by borrowed ones. On the other hand, long-run deficits cannot, either because "currencies" will run short or because lending institutions will refuse to lend. Therefore, the balance of payments position is of importance to the responsible authorities.

Many theories have been developed to provide us with an approach to the solution of balance of payments problems. Classical economics was dominated by the "Elasticities Approach". Under this approach, balance of payments adjustments required knowledge of the elasticities of demand and supply curves of imports and exports of the countries involved. The approach did not make use of monetary variables. Then came the Keynesian revolution and with it a series of approaches starting with Keynes' own "Incomes Approach".<sup>1</sup> These approaches tried to incorporate monetary variables in their effort to provide us with

solutions to balance of payments problems. The trend in these approaches had been toward the use of more monetary variables. The culmination of this trend has been the development of the "Monetary Approach to the Balance of Payments Theory". This new approach uses only monetary variables and it treats payments disequilibria as purely monetary phenomena.

The origins of this approach can be found in the writings of David Hume, but the modern development is associated with the name of Robert A. Mundell.<sup>2</sup> Basically it states that reserves flow in (out) when residents desire to accumulate money balances faster (slower) than the rate at which policy actions and other domestic factors are increasing the stock of money. Thus an excess demand for money is associated with a surplus and an excess supply with a deficit. The one-to-one correspondence between the disequilibrium in the money market and the balance of payments is the result of the basic assumption of the theory of fixed exchange rates and Walras law.<sup>3</sup>

Basic to this approach is the relationship between Foreign Reserves at the Central Bank and the domestic money supply. Changes in the Foreign Reserves will cause changes in the money supply in the same direction. Under a fixed exchange regime, the flows of these reserves are not under the control of the monetary authorities and, therefore, control of the money supply is weakened, unless sterilization is effective.

The demand for money, in the general form, is

$$M^d = PL(r, y) \quad (1)$$

where  $P$  = price level

$r$  = rate of interest

$y$  = income

The supply of money equation is

$$M^s = mH \quad (2)$$

with  $H = F + D$  (3)

thus  $M^s = m(F + D)$  (4)

where  $m$  = money multiplier

$H$  = monetary base

$F$  = foreign reserves

$D$  = domestic credit

Equilibrium in the money market implies

$$M^s = M^d$$

or  $m(F + D) = PL(r, y)$  (5)

Differentiating (5) logarithmically, we obtain

$$d \log m + d \log(F + D) = d \log P + d \log L$$

or

$$dm/m + dF/(F+D) + dD/(F+D) = dP/P + (L_y/L)dy + (L_r/L)dr \quad (6)$$

where  $L_y$  and  $L_r$  are the partial derivatives of  $L$  with respect to  $y$  and

$r$ . Consider, now, the two terms that include  $L_y$  and  $L_r$  separately.

The term  $(L_y/L)dy$  can be rewritten as:

$$\left(\frac{\partial L}{\partial y}\right)\left(\frac{y}{L}\right)\left(\frac{dy}{y}\right)$$

This, however, is the income elasticity of demand for money multiplied by the percentage change in income, i.e.,

$$\eta_y \left(\frac{dy}{y}\right) \quad (7)$$

Similarly, the term  $(L_r/L)dr$  can be rewritten as:

$$\left(\frac{\partial L}{\partial r}\right)\left(\frac{r}{L}\right)\left(\frac{dr}{r}\right)$$

Again we can see that this is the product of the interest elasticity and the percentage change in interest, i.e.,

$$\eta_r \left(\frac{dr}{r}\right) \quad (8)$$

The terms  $dF/(F+D)$  and  $dD/(F+D)$  on the left side of (6) can be rewritten as follows

$$\frac{dF}{F+D} = \left(\frac{F}{F+D}\right)\left(\frac{dF}{F}\right) \quad (9)$$

$$\frac{dD}{F+D} = \left(\frac{D}{F+D}\right)\left(\frac{dD}{D}\right) \quad (10)$$

Let  $\gamma = \frac{F}{F+D}$  and  $(1-\gamma) = \frac{D}{F+D}$  then we can rewrite (9) and (10)

as follows: 
$$\frac{dF}{F+D} = \gamma \left(\frac{dF}{F}\right) \quad (9)'$$

and 
$$\frac{dD}{F+D} = (1-\gamma) \frac{dD}{D} \quad (10)'$$

Substituting (7), (8), (9)', and (10)' into (6), we obtain:

$$\frac{dm}{m} + \gamma \frac{dF}{F} + (1 - \gamma) \frac{dD}{D} = \frac{dP}{P} + \eta_y \left( \frac{dy}{y} \right) + \eta_r \left( \frac{dr}{r} \right) \quad (11)$$

Let us now use  $g_x$  to denote percentage change in variable  $x$  then (11) becomes:

$$g_m + \gamma g_F + (1 - \gamma) g_D = g_P + \eta_y g_y + \eta_r g_r \quad (11)'$$

Solving (11)' for  $g_F$ , we get:

$$\gamma g_F = g_P + \eta_y g_y + \eta_r g_r - g_m - (1 - \gamma) g_D \quad (12)$$

Equation (12) is the balance of payments equation under the Monetary Approach. If the last two terms of the equation decrease in value, i.e. if the monetary policy is contractionary, then a balance of payments surplus will be caused, given monetary equilibrium. On the other hand, if monetary policy is expansionary then a deficit may be caused. We can also see in the above equation that the higher the rate of inflation, i.e. the larger the value of  $g_P$ , the higher the reserve inflow will be. The same holds for economic growth.

In the following chapters, we shall try to support (or refute) the above statements with empirical findings. Chapter II will consider money supply, its determinants, its relationship with balance of payments and the unique characteristics of the Greek money market.

Chapter III will deal with the demand for money and other related concepts. Here we shall first consider the relationship between the stock of money and income and then present and analyze the empirical findings from the regressions on demand for money equations.

Chapter IV will deal with the integrated market hypothesis. Here we shall consider the small country hypothesis, i.e., that prices and interest rates are determined exogenously.

The last chapter, Chapter V, will bring together the money supply and money demand and through them give a monetary interpretation to the balance of payments. Here we shall also consider policies that the monetary authorities may undertake for balance of payments adjustments.

Footnotes for Chapter I

<sup>1</sup>For an historical presentation of the various approaches, see H. G. Johnson, "The Monetary Approach to Balance of Payments Theory" Journal of Financial and Quantitative Analysis, VII (March, 1972), 1555-72.

<sup>2</sup>Mundell, R. A., International Economics, (New York: The MacMillan Company, 1968), Chapters VIII-XI.

<sup>3</sup>Walras' law states that excess demand in the goods, bond, and money markets must add up to zero. Applying the law to the balance of payments, we can say that excess demand for money must be zero.

CHAPTER II  
SUPPLY OF MONEY

In this chapter we shall present a framework within which the various factors influencing the money stock in an open economy can be analyzed.

The framework of analysis is basically similar for all economies--developed, less developed, or underdeveloped. However, the money supply process is highly differentiated, depending on a variety of factors such as the openness of the economy, the level of development of the financial markets, their degree of integration, and so on.

First, we shall consider the relationship between foreign assets and the stock of money. This relationship is the cornerstone of the monetary approach to the balance of payments theory.

Next, we shall consider certain institutional aspects of the Greek monetary system and discuss their effects on the money supply process.

Finally, we shall present an analysis of the actual behavior of the money supply, the base money, and the money multiplier during the period under consideration.

A. The Model

The money supply model used in the present study borrows from the works of Brunner and Meltzer,<sup>1</sup> Willms,<sup>2</sup> and Genberg.<sup>3</sup>

Most of the studies on open economy money supplies start with the same basic model:

$$M^S = mH \quad (1)$$

where  $m$  = some money multiplier

$H$  = base money

The money multiplier is a function of the portfolio allocation parameters of the commercial banks and the public as well as some policy parameters. The definition of the multiplier is fairly standard (we shall consider this in more detail later on in the chapter). The base money is an elusive concept. Ideally, it should be defined in such a manner that the monetary authorities should have control over it. This objective leaves room for some variation in the definition across monetary systems.

#### 1. Determinants of the Base Money

As mentioned above, the monetary base can be and has been defined in a variety of ways by different authors depending not only on the judgement of the particular author but also on the various rules and regulations different Central Banks may have.

In our analysis, we shall define base money as currency in circulation (CC) plus commercial banks reserves (BR).<sup>4</sup> However, we shall also use a second definition which includes the one above plus the deposits of the private sector at the Central Bank (PD).<sup>5</sup> Arithmetically, these two definitions can be expressed as follows:

$$H = CC + BR \quad (2)$$

$$H' = CC + BR + PD \quad (3)$$

It will be helpful to consider a simplified presentation of the consolidated balance sheet of the Central Bank in order to see how changes in the base money can come about and also how the base is related to the balance of payments through the foreign assets of the Central Bank.

<u>Assets</u>	<u>Liabilities</u>
F	CC
...OA...	BR
.....	OL
<hr style="width: 50%; margin: 0 auto;"/>	<hr style="width: 50%; margin: 0 auto;"/>
TA	TL

where F = Foreign Assets of Central Bank

OA = All other Assets

OL = All other Liabilities

TA = Total Assets

TL = Total Liabilities

By definition  $TA = TL$ , therefore

$$F + OA = CC + BR + OL \quad (4)$$

From (2) and (4) we have

$$H = F + (OA - OL)$$

let  $OA - OL = D$ , then

$$H = F + D \quad (5)$$

From (3) and (4) we obtain a similar definition

$$H' = F + D' \quad (6)$$

where  $D' > D$  since  $H' > H$ .

In both (5) and (6), F is the foreign source component and D the domestic source component of base money. Since the balance of payments position determines the level of foreign assets of the Central Bank, the money supply is related to the balance of payments through the foreign asset channel.

If we differentiate (5) [or (6)] totally, we have

$$dH = dF + dD \quad (7)$$

This last expression tells that a change in the base money can come either from a change in the foreign source component or the domestic source component.

In a fixed exchange rate system, the foreign assets of the Central Bank become an exogenous variable. Therefore, the only part of the base they can control is the domestic source. This now becomes an instrument. It is through changes in this component that the sterilization process occurs.

As mentioned above, there is some variation in the definition of base money. Genberg<sup>6</sup>, in one of his definitions, includes the Foreign Assets of Commercial Banks. He does this because the Swedish Central Bank includes these Assets in its Foreign Assets. Willms<sup>7</sup>, on the other hand, gives two definitions of base money. One is similar to ours and one he calls net monetary base, which equals our definition plus net foreign assets of banks and the public. Willms shows that the German monetary authorities have a better control over the net than over the general monetary base.

## 2. Determinants of the Money Multiplier

We mentioned earlier that the money multiplier depends on the portfolio allocation parameters of the commercial banks and the public as well as some policy parameters. We shall now explain this dependence.

We shall use two definitions of the money supply--the "narrow" and the "broad":

$$M1 = CC + DD \quad (8)$$

$$M2 = CC + DD + TD \quad (9)$$

where DD = Demand Deposits at commercial banks

TD = Time Deposits at commercial banks<sup>8</sup>

From (1), (2), and (8) we have

$$m1 = \frac{CC + DD}{CC + BR}$$

divide both numerator and denominator of the right side by DD. Hence

$$m1 = \frac{CC/DD + DD/DD}{CC/DD + BR/DD}$$

Let  $k = CC/DD$  be the public's desired currency-demand deposit ratio and  $R = BR/DD$  the commercial banks' desired reserve-demand deposit ratio, then

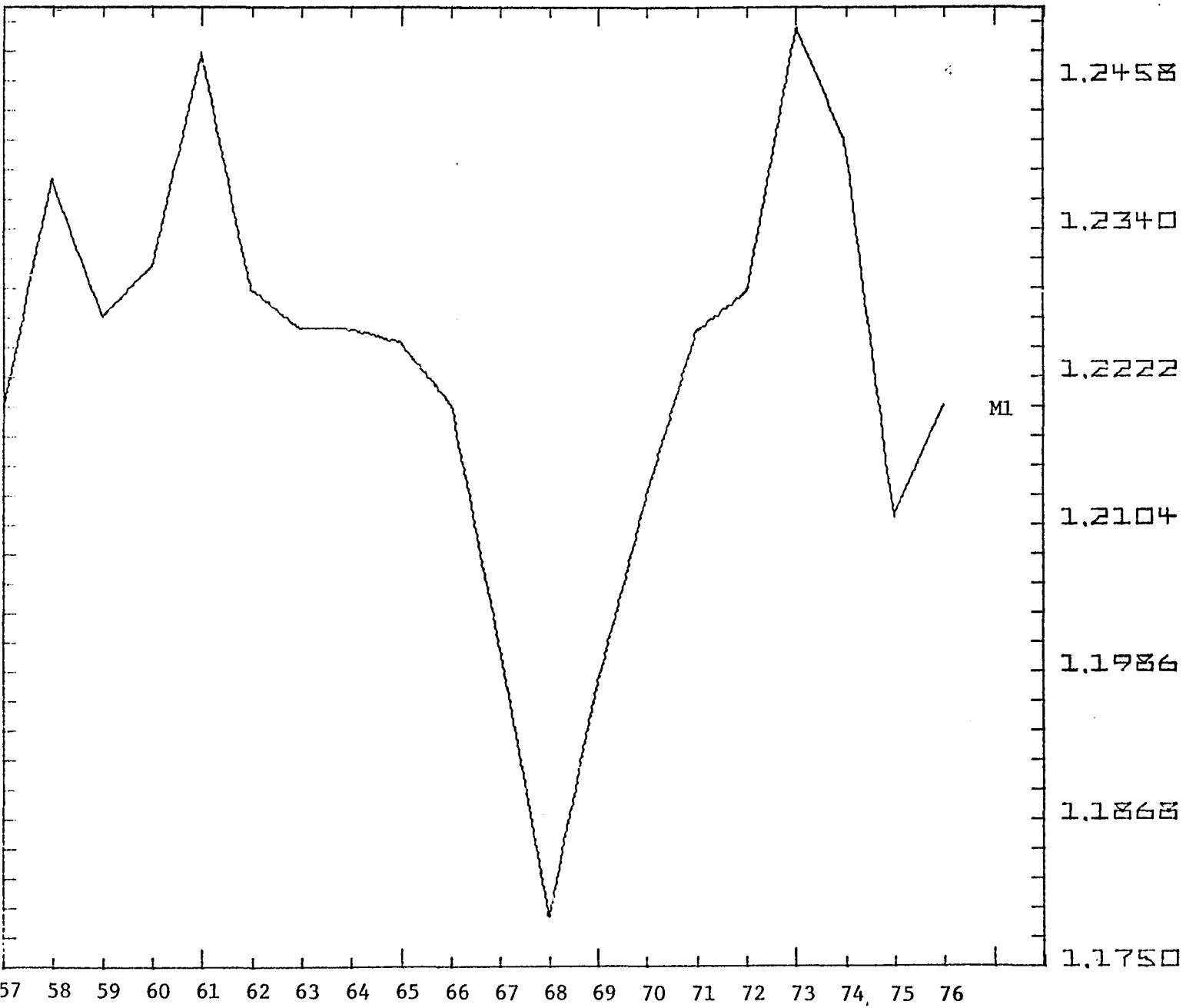
$$m1 = \frac{k + 1}{k + R} \quad (10)$$

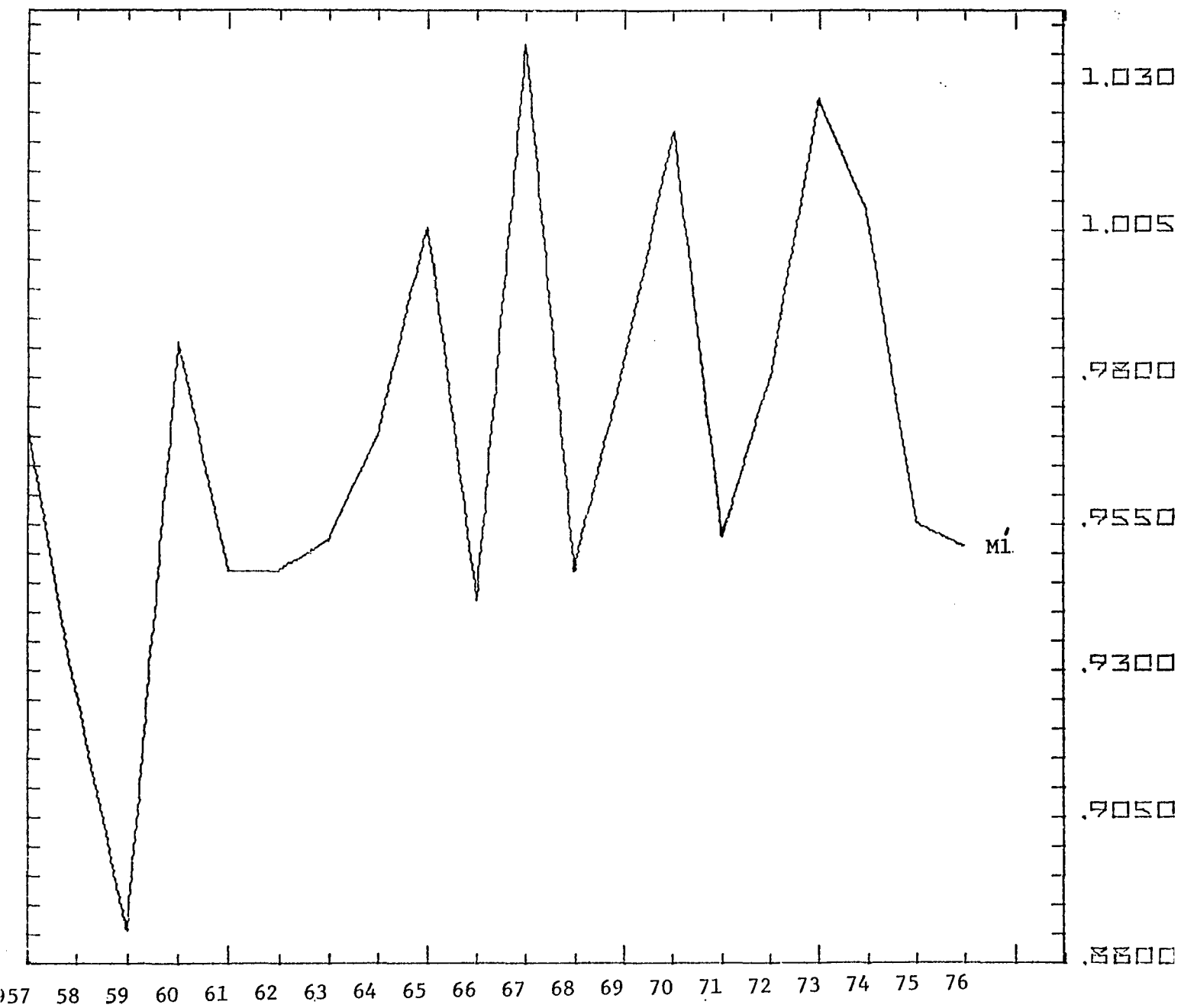
from (1), (3), and (8) we obtain

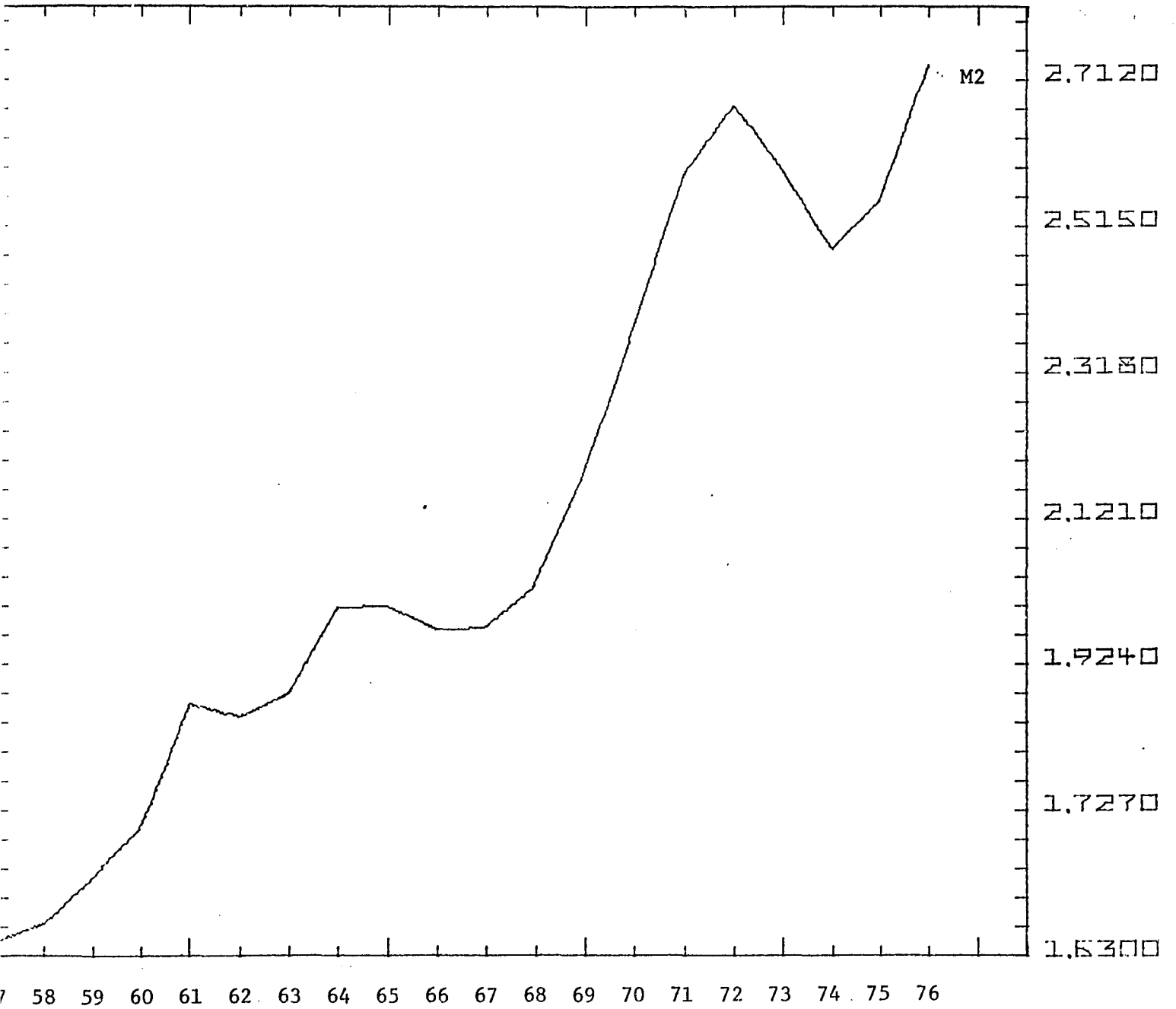
$$m1' = \frac{k + 1}{k + R + P} \quad (11)$$

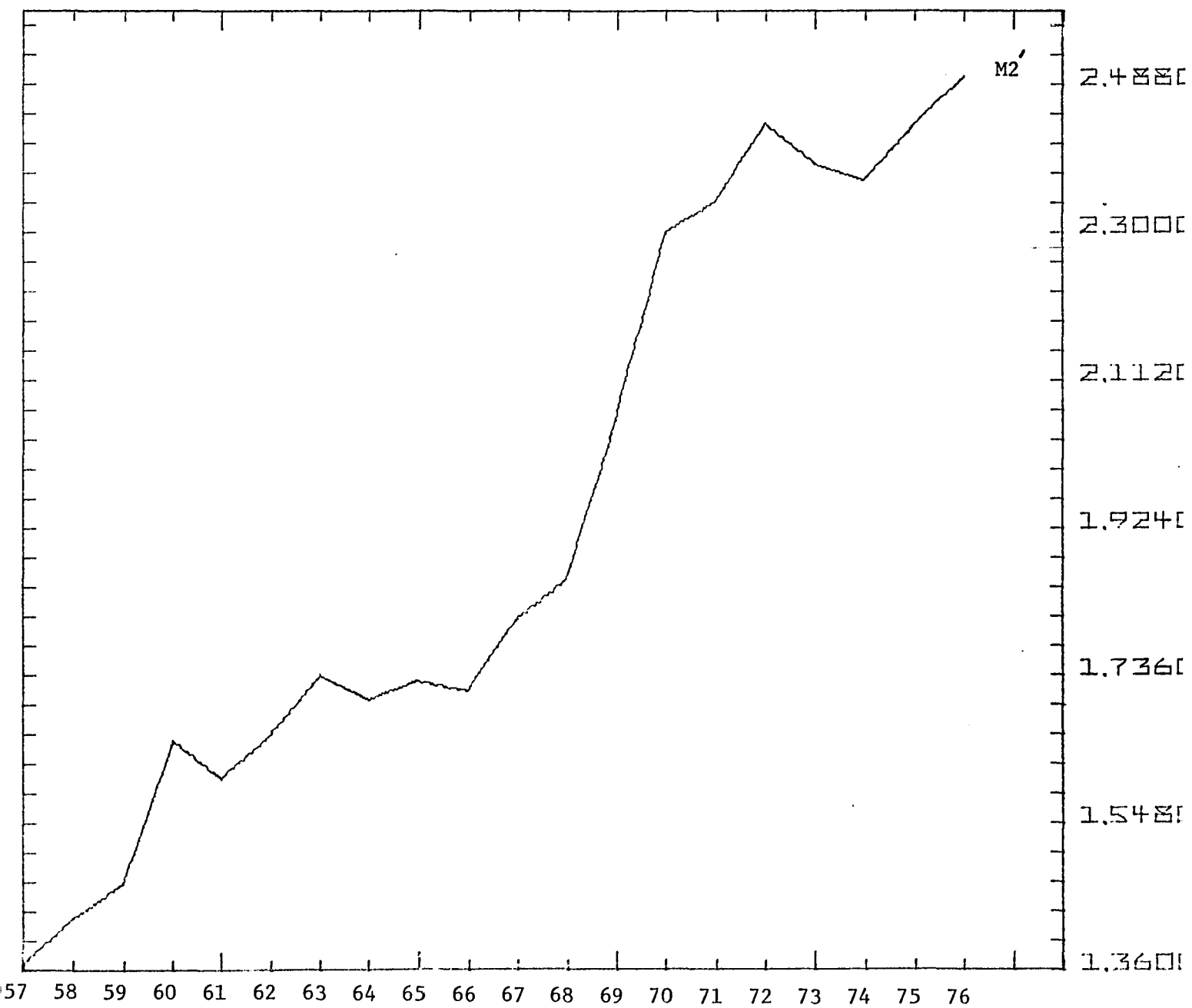
Various Money Multipliers  
One Year Moving Averages

For definitions see main text.









where  $P = PD/DD$  is the public's desired central Bank deposit-demand deposit ratio.

Similarly,<sup>9</sup> from (1), (2), and (9) we have

$$m_2 = \frac{k + T + 1}{k + R_1(T + 1)} \quad (12)$$

and from (1), (3), and (9)

$$m_2' = \frac{k + T + 1}{k + P + R_1(T + 1)} \quad (13)$$

where  $T = TD/DD$  is the public's desired time deposit-demand deposit ratio and  $R_1 = BR/(DD + TD)$  is the commercial banks' desired reserve-demand plus time deposit ratio.

## B. Institutional Aspects

### 1. Private Money Markets

The Greek money market is very primitive. There are no active markets for government securities, call loans, and saving deposit certificates. The only two active markets are the Athens Stock Exchange and Commercial Banks.

The stock exchange was created in 1876, but it has always played a minimal role in providing risk capital for the development of the economy.<sup>10</sup> There are many reasons for this imperfection. Some are given in the following quotation:

. . . of the 100 largest--on the basis of capital employed-- industrial firms, the shares of only 35 of them are listed on the Athens Stock Exchange, while in many cases only a small part of the shares of these firms becomes the object of stock market transactions. Obviously, therefore, the central problem of the Greek Stock Market is the insufficient supply of attractive shares, mainly because of the

family character of the majority of Greek firms. . . . It should be noted that, although dealings in shares account for the largest part (about 85 percent) of the aggregate value of dealings on the Athens Stock Exchange, they represent a very small part (3.6 percent) of the total current value of the shares listed on the Athens Stock Exchange. This small percentage suggests that those controlling societies anonymes are reluctant to permit a wider dispersion of shares.<sup>11</sup>

This control of the supply of stocks by the families or the societies anonymes owning controlling interests in the companies represented on the stock market, combined with the lack of faith by the public in the operations of the market, do not allow a free interaction of demand and supply and, hence, prices and dividends are distorted. The responsibility for the provision of risk capital has been carried by commercial banks and the Central Bank.

As of 1972, there were fifteen commercial banks operating in Greece, eight of them domestic and the remaining foreign. All the foreign banks were branches of major multinational banking corporations from North America.

The commercial banking industry in Greece is highly concentrated. The two largest domestic banks, the National Bank of Greece and the Commercial Bank of Greece, control about 84% of the industry's assets and about 86% of its deposits.<sup>12</sup>

Only commercial banks issue demand deposits. Commercial bank deposits are of three kinds: demand, time, and saving. Time deposits are also issued by other institutions such as the Agricultural Bank of Greece, the National Mortgage Bank, the Consignations and Loans Fund and the Postal Savings Bank. However, these deposits are not included in our definition of time deposits.

## 2. Government Regulatory Agencies

The Bank of Greece is the Central Bank of Greece. It was established in 1928. Up to that time, the National Bank of Greece, now the largest commercial bank, acted as the Central Bank.

The Bank of Greece functions as a corporation with a few modifications in its charter. For example, the board of directors is not elected by the general assembly, but, rather, appointed by the government for four year terms. The Bank is run by the Governor, the Deputy Governor and nine consultants. These consultants are elected by the stockholders for three year terms.

The functions of the Bank are: issuance of bank notes, regulating the flow of money supply, supervision of commercial banks, control of the foreign exchange transactions, and carrying out financial transactions for the public sector. Besides accepting the reserve deposits of the commercial banks, the Central Bank also accepts deposits from the private sector.

The agent responsible for monetary and credit policy is the Currency Committee, established in 1946. Its members are the ministers of Coordination, Finance, Agriculture, Trade, and Industry, and the governor of the Bank of Greece. The role of this Committee is very important because of the absence of a pre-established legal framework limiting monetary action such as minimum and maximum reserve requirements, ceilings on government borrowing etc.<sup>13</sup>

## 3. Policy Instruments

The instruments in the hands of the monetary authorities are basically two: the reserve ratio and the interest rates. The discount rate and Open Market Operations are used very ineffectively. As

was mentioned above, there is no active market for Open Market Operations. However, when Government Securities are issued, the banks have to purchase them in order to assist the government in financing certain projects. Commercial banks are required by law to hold 20% of their demand and saving deposits in government securities.

The bulk of commercial bank deposits at the Central Bank are non-interest bearing. The volume that are interest bearing is small in relation to total deposits.

In its attempt to influence the foreign holdings component of the monetary base, the monetary authorities have relied on strict control of international capital movements. These controls, however, are not very effective. Considering the amount of foreign investment in Greece, we may say that these controls are ineffective because the flow of funds across the Greek border by multinationals cannot be monitored effectively.

### C. Determinants of the Greek Money Supply in 1957-1976.

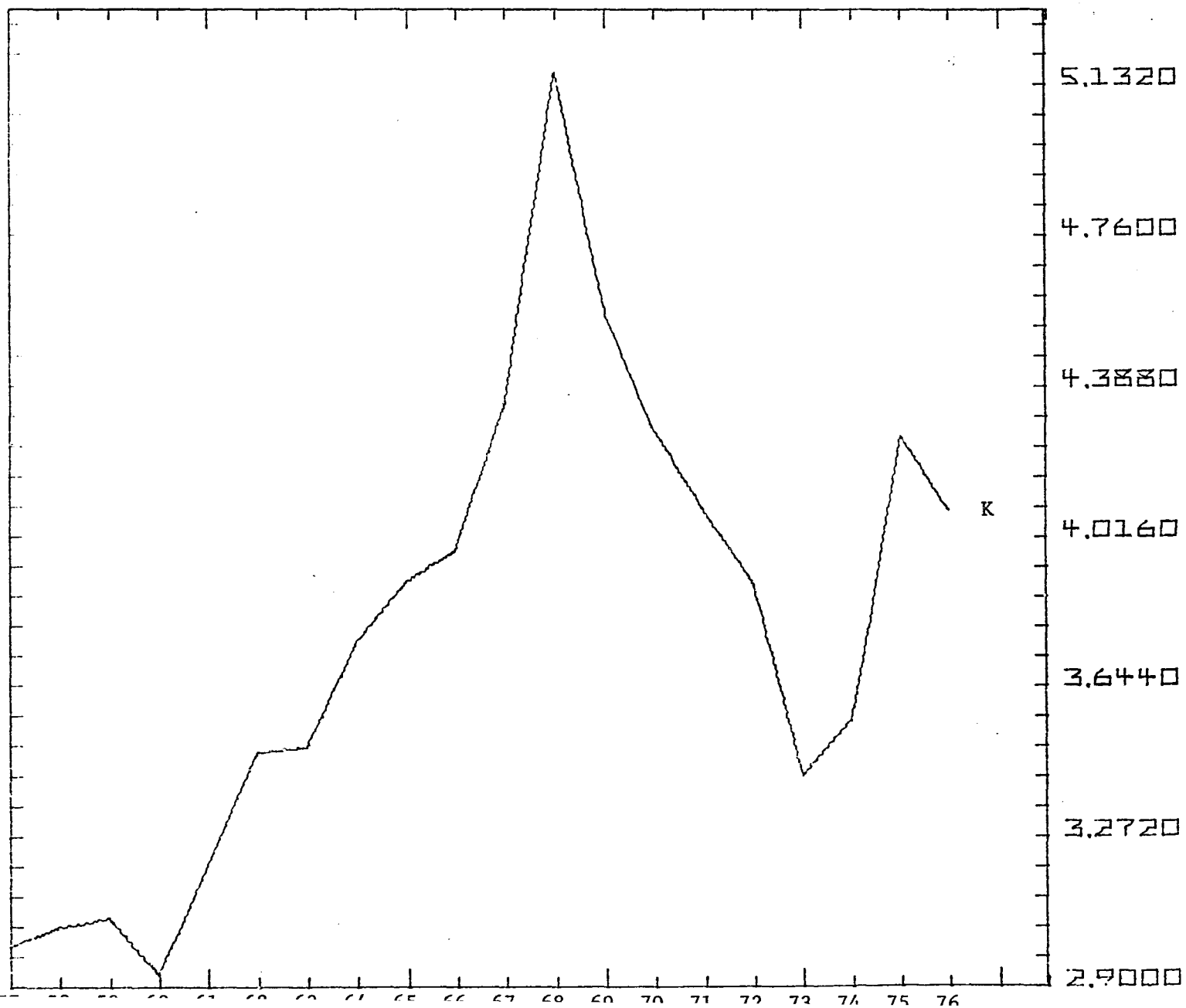
Using the basic equation  $M^S = mH$ , we shall first determine the division of the growth in  $M$  between changes in the multiplier and changes in the base money, and, second, discuss the determinants of the base money. Lastly, we shall discuss the determinants of the multiplier.

We are using two definitions for base money,  $H$  and  $H'$ . As mentioned earlier, this gives rise to two multipliers for the narrowly defined money supply and two for the broadly defined one. Since the denominator of (11) is greater than the denominator of (10), and since the denominator of (13) is greater than that of (12), we can say that  $m_1 > m_1'$  and  $m_2 > m_2'$ .

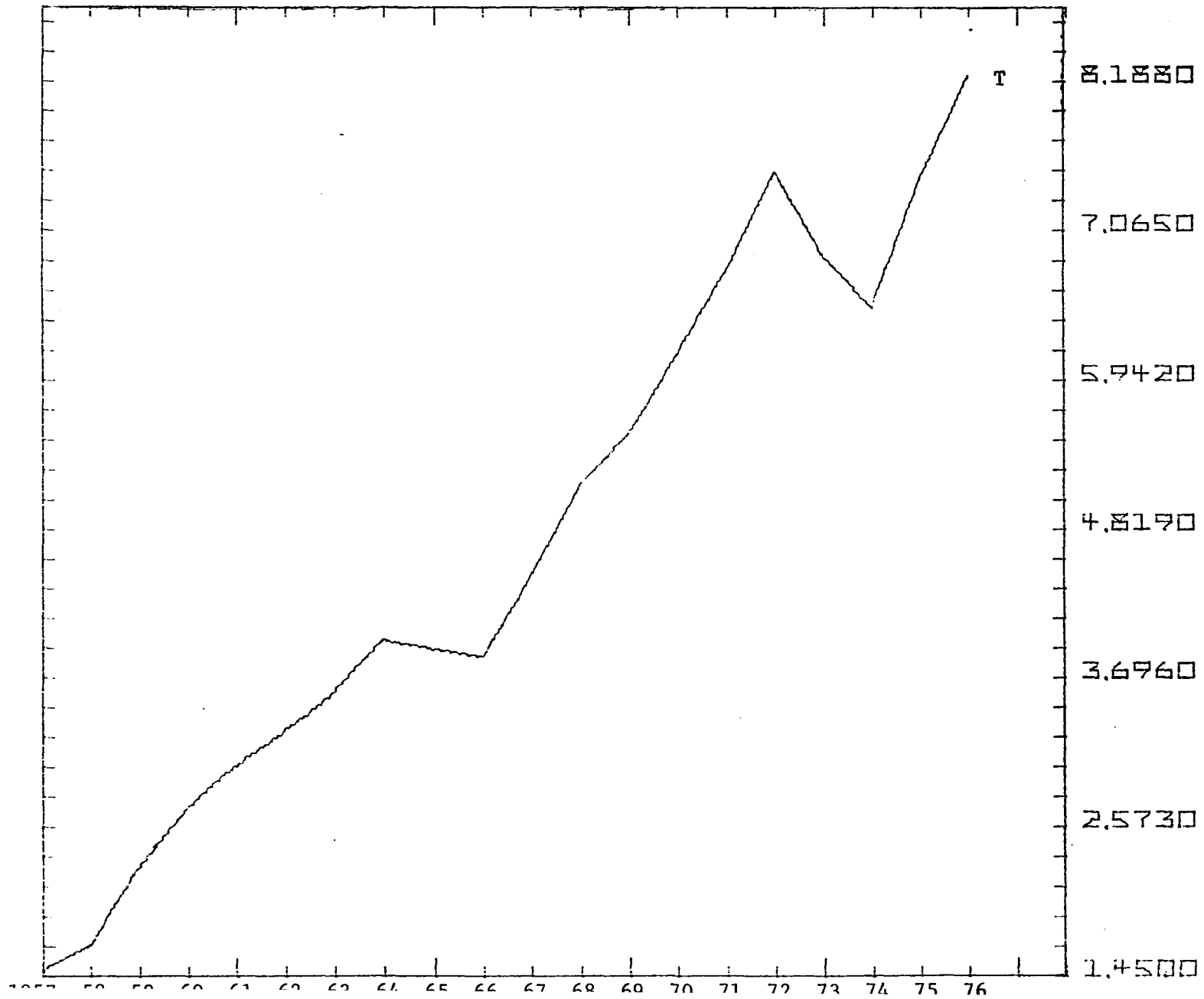
Component Parts of Money Multipliers  
One Year Moving Averages

For definitions see main text.

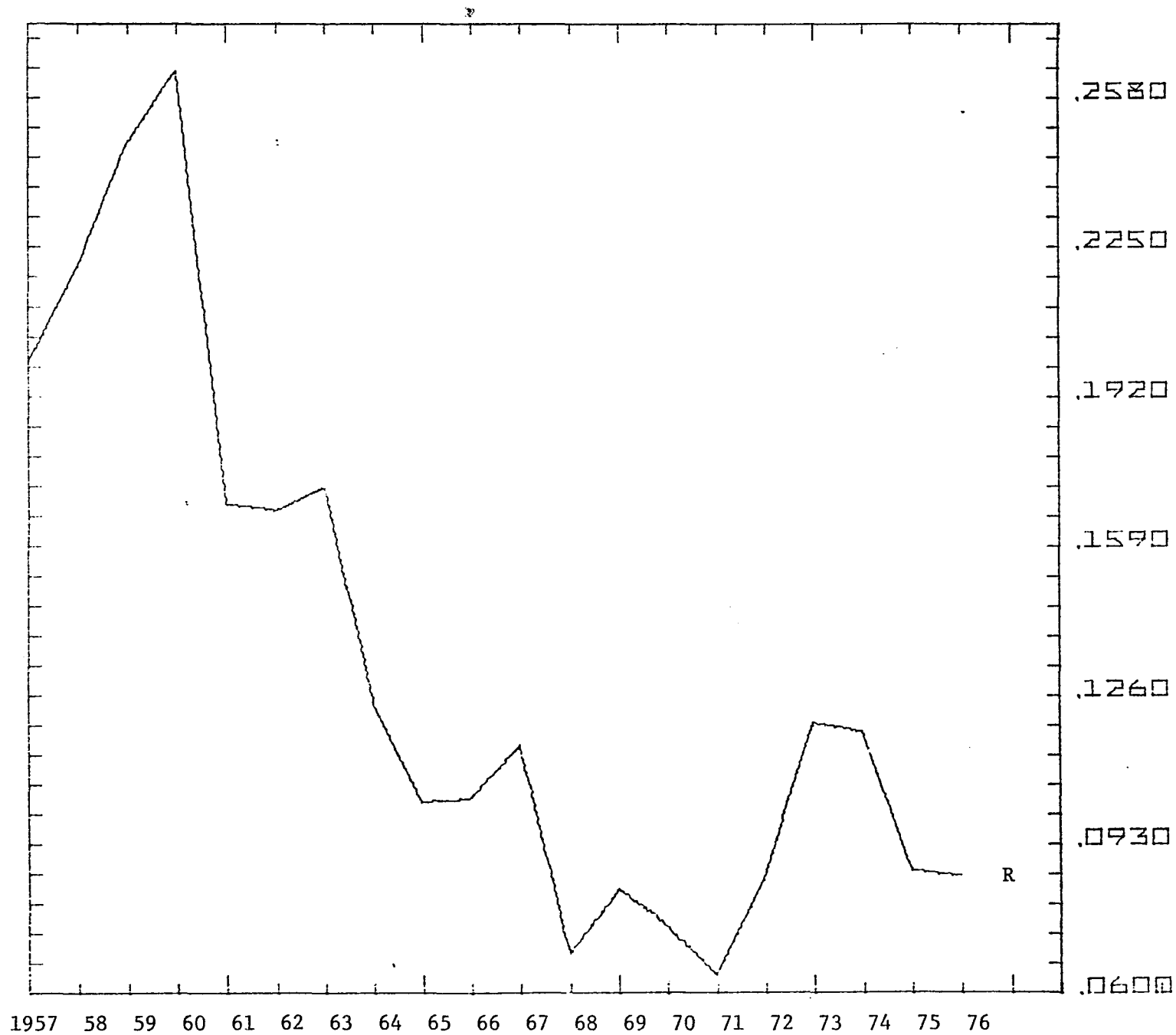
Currency-Demand Deposit Ratio



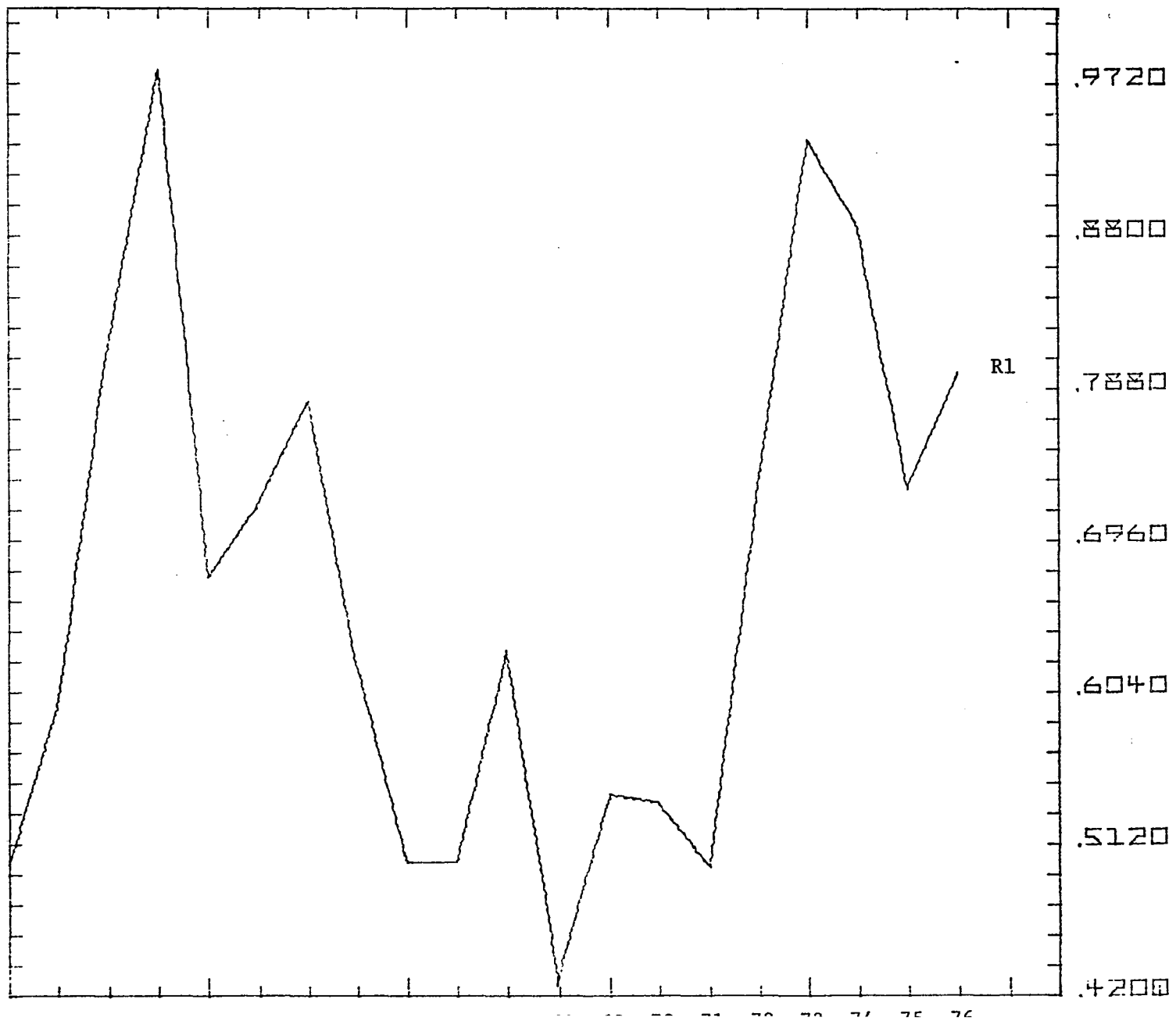
Time Deposit-Demand Deposit Ratio



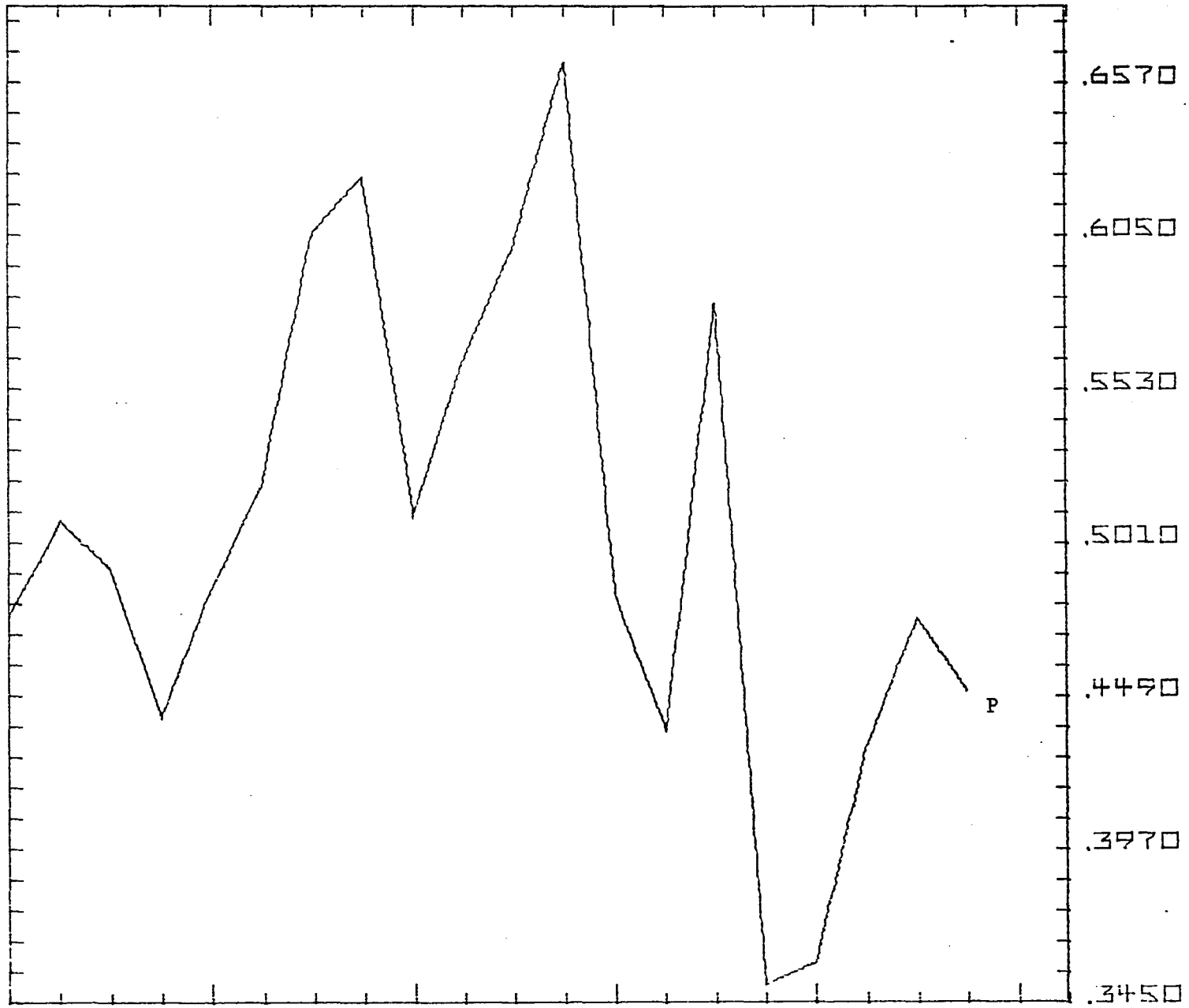
Reserves-Demand Deposits Ratio



Reserves-Total Deposits Ratio



Deposits at Central Bank-Demand Deposits Ratio



In table 1, we show the average yearly rates of growth in  $M_1$ ,  $m_1$ ,  $m_1'$ , and  $H$ ,  $H'$  for several periods. Whether we use the standard definition of base money,  $H$ , or the official definition,  $H'$ , we observe that the base is the main contributor to the growth of the money supply for almost all periods considered. The money multiplier,  $m_1$ , showed increases and decreases during these periods, while  $m_1'$  had negative growth rates for all periods. The overall growth in  $m_1$  was .02 (or .02%) while the overall growth for  $m_1'$  was  $-.10$  (or  $-.10\%$ ). Base money grew at steady rates, independent of definition. The average growth rate was 13.77% for  $H$  and 13.58% for  $H'$ . Money supply grew at high rates for all periods. The average rate was 13.47%. Considering the overall growth rates in  $M_1$ ,  $H$ ,  $H'$ ,  $m_1$  and  $m_1'$ , we can see that the base has contributed almost all the growth in the money supply.

In table 2, we present the average yearly rates of growth of  $M_2$ ,  $m_2$ ,  $m_2'$ ,  $H$ , and  $H'$  for the same periods. Again, we see that the base money, independent of which definition is used, is the main contributor to the growth of the money supply. However, contrary to the trend in the previous table, the contribution of the money multiplier becomes significant. While  $m_1$ , as we saw before, fluctuated around zero,  $m_2$  grows constantly. The period 1967-1971 saw the  $m_2$  money multiplier realize its highest annual growth rate: 7.20%. While, overall,  $m_1$  contributed about  $-1\%$  to the growth of  $M_1$ ,  $m_2$  contributed about 18% to the growth of  $M_2$ .

In table 3, we analyze the contributions of  $F$ ,  $D$ ,  $D'$  on  $H$  and  $H'$ . We observe that there is little difference in the contributions of  $F$ ,  $D$ , on  $H$  and  $F$ ,  $D'$  on  $H'$ . For both  $H$  and  $H'$ , we notice that the domestic source component is the dominant one. However, the foreign source

Table 1

Average Growth Rates of Money (M1),  
Base Money, And Multiplier

<u>Period</u>	<u>M1</u>		<u>H</u>		<u>H'</u>		<u>m1</u>		<u>m1'</u>		<u>Base</u>		<u>Multiplier</u>	
	10.26	10.10					.45				98%		4%	
57 - 61	10.26				10.76						105%		-5%	
	11.13	11.44					-.15				103%		-1%	
62 - 66	11.13				11.23						101%		-1%	
	6.43	6.04					.43				94%		7%	
67 - 71	6.43				8.12						126%		-26%	
	14.47	15.14					-.65				105%		-4%	
72 - 76	14.47				15.08						104%		-4%	
	12.33	12.23					.15				100%		1%	
57 - 66	12.33				12.64						102%		-2%	
	12.55	12.85					-.10				102%		-1%	
67 - 76	12.55				13.41						107%		-7%	
	13.47	13.77					.02				102%		0%	
57 - 76	13.47				13.58						101%		-1%	

Proportion of  
Growth Rates in Money  
Attributable to:

For each variable, the growth rates were calculated using the formula:

$$\left[ \frac{\log x_2 - \log x_1}{\text{NUMBER OF YEARS IN PERIOD}} \right] \times 100$$

where the subscripts 2 and 1 indicate the beginning and end observations respectively.

Table 2Average Growth Rates of Money (M2),  
Base Money, and Money Multiplier

<u>Period</u>	<u>M2</u>	<u>H</u>	<u>H'</u>	<u>m2</u>	<u>m2'</u>	<u>Proportion of Growth Rates in Money Attributable to:</u>	
						<u>Base</u>	<u>Multiplier</u>
57 - 61	13.94	10.10	10.76	3.80	3.18	72%	28%
	13.94					77%	23%
62 - 66	11.89	11.44	11.23	0.45	0.66	96%	4%
	11.89					94%	6%
67 - 71	13.24	6.04	8.12	7.20	5.12	46%	54%
	13.24					61%	39%
72 - 76	15.55	15.14	15.08	0.41	0.47	97%	3%
	15.55					97%	3%
57 - 66	14.90	12.23	12.64	2.67	2.26	82%	18%
	14.90					85%	15%
67 - 76	16.53	12.85	13.41	3.78	3.22	77%	23%
	16.63					83%	17%
57 - 76	16.59	13.77	13.58	2.82	3.01	83%	17%
	16.59					82%	18%

for each variable, x, the growth rates were calculated using the following formula:

$$\left[ \frac{\log x_2 - \log x_1}{\text{NUMBER OF YEARS IN PERIOD}} \right] \times 100$$

where 1 and 2 denote the final and initial values for the period.

Table 3

Determinants of Base Money:  
Percentage Contribution of the Domestic and Foreign Components

Period	H		H'	
	F	D	F	D
57 - 61	29	71	27	73
62 - 66	0	100	0	100
67 - 71	44	66	37	63
72 - 76	10	90	9	91
57 - 66	10	90	9	91
67 - 76	31	69	29	71
57 - 76	27	73	25	75

Each contribution was calculated as follows:  $\frac{z_2 - z_1}{w_2 - w_1}$   
where  $z = F, D, \text{ or } D'$ ;  $w = H \text{ or } H'$ .

Subscripts 1 and 2 denote initial and final values.

Table 4

Contributions of Currency-, Reserve-, and Time-  
Demand Deposit Ratios to the Growth in the Multiplier

	1957 - 1966		1967 - 1976		1957 - 1976	
	m1	m2	m1	m2	m1	m2
k	-209.9%	-76.3%	80.3%	6.6%	-228.4%	-30.3%
R (or R1)	109.5%	-11.1%	30.6%	-164.5%	127.2%	-223.0%
T		212.5%		64.7%		145.6%
rounding error	.45%	25%	11%	6.8%	.85%	7.7%
Growth rate of m	.15%	2.67%	-0.10%	3.78%	0.02%	2.82%

The growth rates were calculated with the use of the following two formulas.

$$1. \quad \frac{dm1}{m1} = dk \left[ \frac{\bar{R}-1}{(\bar{k}+1)(\bar{k}+\bar{R})} \right] - dR \left[ \frac{1}{(\bar{k}+\bar{R})} \right]$$

$$2. \quad \frac{dm2}{m2} = dk \left[ \frac{(\bar{T}+1)(\bar{R}-1)}{(\bar{k}+\bar{T}+1)[\bar{k}+\bar{R}](\bar{T}+1)} \right] - dT \left[ \frac{(\bar{R}-1)(\bar{k}+1)}{(\bar{k}+\bar{T}+1)[\bar{k}+\bar{R}](\bar{T}+1)} \right] \\ - dR \left[ \frac{\bar{T}+1}{\bar{k}+\bar{R}(\bar{T}+1)} \right]$$

where  $dx = x_2 - x_1$ , and  $\bar{x} = (x_2 + x_1)/2$

$x = m, k, R, T$

component is strong. Overall the domestic component contributed about 75% of the base and the foreign about 25%. Of importance here are the periods 1962-1966 and 1967-1971. During the first period, the foreign component was almost zero for both definitions, and for the second period it became 44% and 37% respectively for H and H'. These are the highest of all periods.

Finally, in table 4,<sup>14</sup> we present the contributions of currency-, reserve-, and time-deposit ratios to the growth in the multiplier. We shall consider m1 first. The desired currency-demand deposit ratio declined at the overall rate of 228%. This information may tell us something about what happened to the time-, saving- and demand deposits. We would expect them to have increased. On the other hand, the desired reserve-demand deposit ratio increased strongly. If we now consider m2 again, we see that the k ratio has declined, in general. R1 has also declined. However, the T ratio, the desired time-demand deposit ratio has increased. This confirms the statement made above that the decline in k may mean an increase in time deposits relative to demand deposits.

#### D. Conclusion

In this chapter we have presented a brief analysis of the money supply process in Greece. We used two concepts of money supply, the "narrow" one and the "broad" one. By using these concepts we gave two specific definitions of money supply as, first, the product of a "narrow" money multiplier and the base money, and, second, as the product of a "broad" money multiplier and base money, where base money was defined as the sum of a foreign reserve component and a

domestic credit component. Then we discussed the determinants of the money multipliers and base money and provided an analysis of their behavior. Of interest here were the results on the behavior of the multipliers. The "narrow" multiplier grew at an extremely low rate, almost zero. This is consistent with the monetary approach. The "broad" multiplier grew at a high rate which is inconsistent with the monetary approach.

We also presented some information about the institutional framework in Greece. Our investigation showed that the money market is not developed, and that, as far as the stock market is concerned, its behavior is not only controlled by a few families and societies anonymes but also does not represent a wide spectrum of corporations. Further, we saw that the instruments in the hands of the monetary authorities, for the control of the money supply, are limited. The most commonly used instrument, by the developed economies, namely the open market operations, is not a developed instrument in Greece. When the government needs financing capital, the Central Bank sells securities to commercial banks which are required by law to hold 20% of their demand and saving deposits in government securities. This phenomenon introduces two problems: first, it renders inappropriate the use of the yields of these securities for a measurement of the opportunity cost of holding cash balances and, second, it makes the process of sterilization difficult.

Footnotes for Chapter II

<sup>1</sup>Brunner, Karl and Allan H. Meltzer, "Some Further Investigations of Demand and Supply Functions for Money", Journal of Finance, XIX (May, 1964), 240-283.

<sup>2</sup>Willms, Manfred, "Controlling Money in an Open Economy: The German Case", Federal Reserve Bank of St. Louis Review, LIII (April, 1971), 10-27.

<sup>3</sup>Genberg, Hans, "Aspects of the Monetary Approach to Balance of Payments Theory: An Empirical Study of Sweden", unpublished Ph.D. Dissertation, Department of Economics, University of Chicago, 1974.

<sup>4</sup>This definition of base money is what Friedman, Schwartz, and Cagan have called High-powered-money.

<sup>5</sup>The Central Bank of Greece can lawfully accept noninterest bearing deposits from the private sector. This is the reason for the second definition of base money.

<sup>6</sup>Ibid., p. 57

<sup>7</sup>Ibid., p. 18

<sup>8</sup>In Greece, commercial banks also accept saving deposits. Therefore, by TD we denote both time and saving deposits.

<sup>9</sup>Derivation of (12). We have  $M2 = m2H$ . Hence:

$$m2 = \frac{M2}{H} = \frac{CC + DD + TD}{CC + BR}$$

where  $CC = kDD$ ,  $TD = TDD$ , and  $BR = R1(DD + TD)$ . If we make the appropriate substitutions above, we obtain

$$m2 = \frac{kDD + DD + TDD}{kDD + R1(DD + TDD)}$$

Divide through by DD and we obtain (12)

$$m2 = \frac{k + T + 1}{k + R1(T + 1)}$$

<sup>10</sup>Psilos, D. D., "Capital Markets in Greece", Center for Economic Research, research monograph series no.9, Athens, Greece, 1964, p. 168.

<sup>11</sup>The Bank of Greece, Report of the Governor, 1976.

<sup>12</sup>Zitridis, Z. X., "The Banking System in Greece", Bank of Greece, research monograph series no.17, Athens, Greece, 1973.

<sup>13</sup>Zolotas, X., Monetary Equilibrium and Economic Development, (Princeton University Press, 1965) pp. 45-93.

<sup>14</sup>Derivation of the formulas used for the construction of table 4.

$$a) \quad m1 = \frac{k+1}{k+R}$$

$$\log m1 = \log(k+1) - \log(k+R)$$

$$d \log m1 = d \log(k+1) - d \log(k+R)$$

$$\text{or} \quad \frac{dm1}{m1} = \frac{dk}{k+1} - \frac{dk+dR}{k+R}$$

$$\text{or} \quad \frac{dm1}{m1} = \frac{dk(R-1)}{(k+1)(k+R)} - \frac{dR}{k+R}$$

$$b) \quad m2 = \frac{k+T+1}{k+R(T+1)}$$

$$\log m2 = \log(k+T+1) - \log[k+R(T+1)]$$

$$d \log m2 = d \log(k+T+1) - d \log[k+R(T+1)]$$

$$\frac{dm2}{m2} = \frac{d(k+T+1)}{k+T+1} - \frac{d[k+R(T+1)]}{k+R(T+1)}$$

$$\text{or} \quad \frac{dm2}{m2} = \frac{dk+dT}{k+T+1} - \frac{dk+(T+1)dR+RdT}{k+R(T+1)}$$

$$\text{or} \quad \frac{dm2}{m2} = dk \left[ \frac{(T+1)(R-1)}{(k+T+1)[k+R(T+1)]} \right]$$

$$- dT \left[ \frac{(R-1)(k+1)}{(k+T+1)[k+R(T+1)]} \right] - dR \left[ \frac{T+1}{k+R(T+1)} \right]$$

## CHAPTER III

### THE DEMAND FOR MONEY

In this chapter we shall consider the demand for money in Greece and certain related concepts.

First, we shall consider briefly the business cycles and try to relate domestic fluctuations to the fluctuations of the OECD countries' combined business cycles.

Next, we shall try to establish the causal relationship between the stock of money and the income level.

Finally, we shall estimate various demand for money functions and discuss the findings.

#### A. Business Cycles in Brief

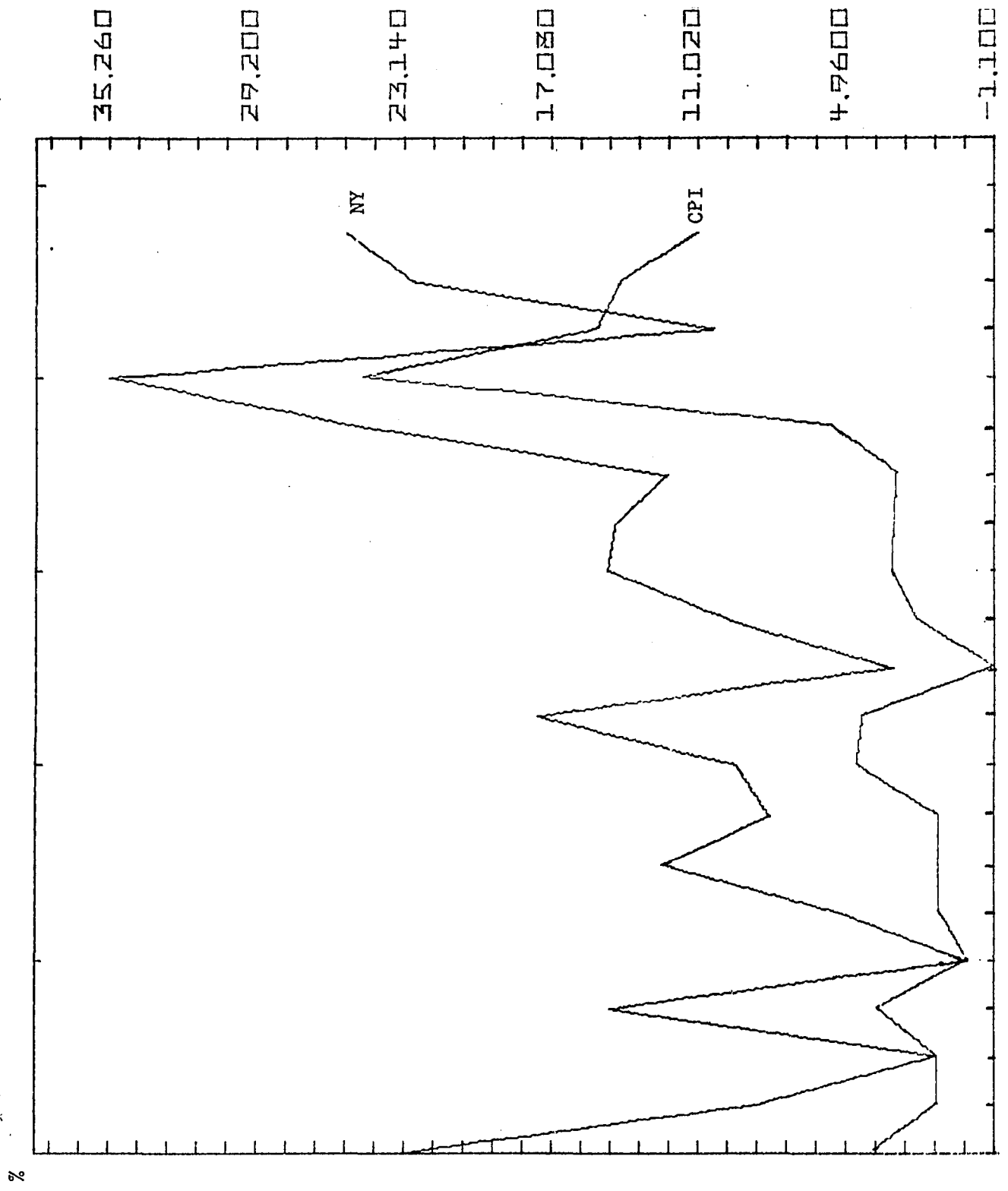
The period under consideration covers the years from 1957 to 1976. The nominal income growth rates in this period fluctuated widely. The maximum rate was achieved in 1973 and was 35.39% while the minimum occurred in 1961 and was almost zero. The period's average annual growth rate was 13.69%. The first three quarters of the over-all period saw average annual growth rates in the neighborhood of 10% while the last quarter saw growth rates of 24%.

We can see what the fluctuations in business activities have been by considering figure 1. There have been four major business slumps. The first during 1958-1959, the second in 1961, the third in 1967, and the fourth in 1974. Two minor slumps occurred in 1964 and

**Figure 1**

**Rates of change of yearly averages of Nominal Income (NY) and the Consumer Price Index (CPI).**

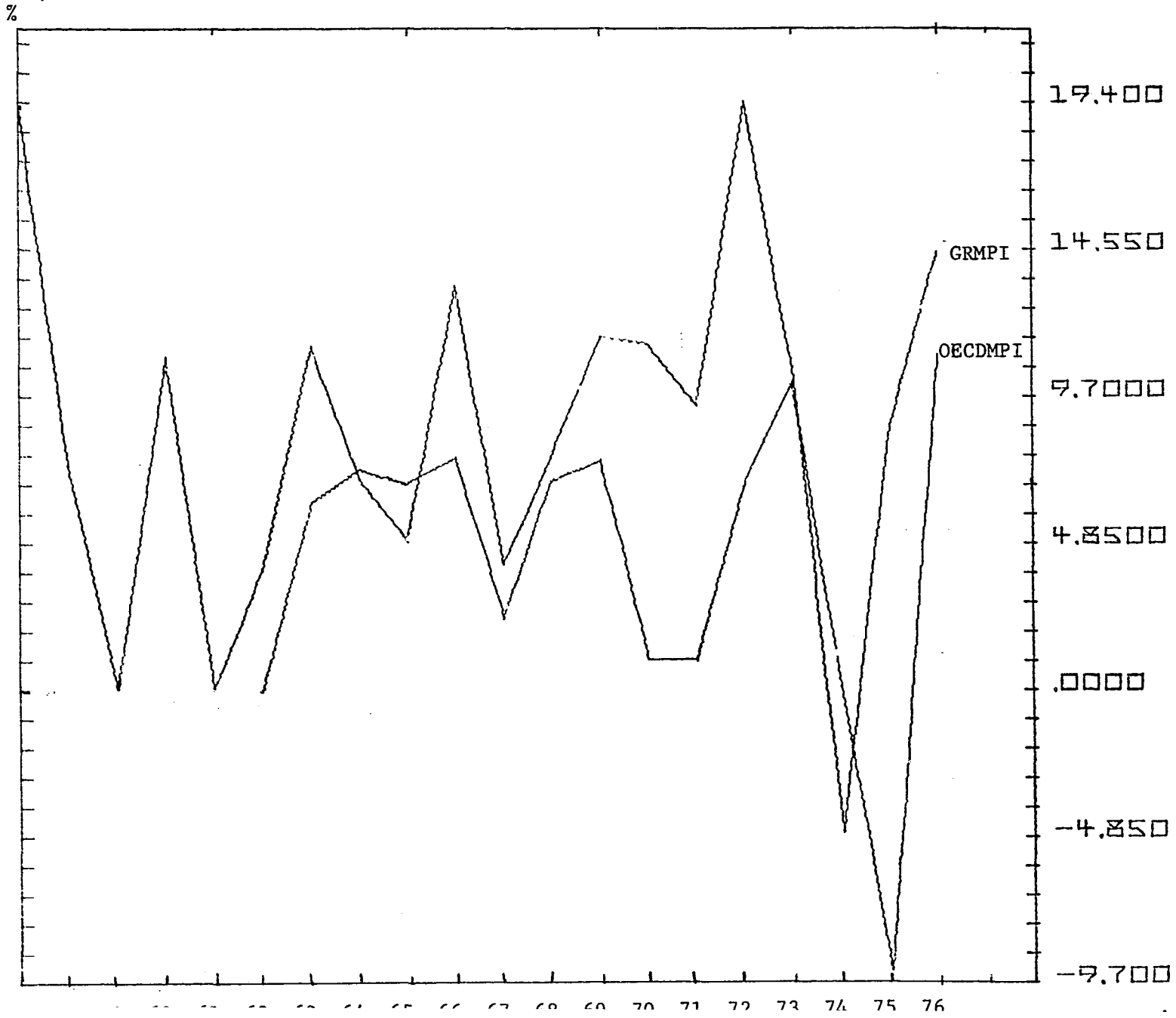
**Source: See appendix on Data**



**Figure 2.**

**Yearly changes in the manufacturing production of Greece (GRMPI)  
and the OECD countries (OECDMPI)**

**Source: See Appendix on Data**



1971. Changes in policies followed by the monetary authorities can explain a portion of the fluctuations in domestic business activities. However, as we can see from figure 2, fluctuations in the international business cycle can explain the remaining portion. Figure 2 shows the annual growth rates in manufacturing production for Greece and the OECD countries combined. The OECD weighted average growth rates are calculated from 1963 on, the reason being that the index used was not available before that year. However, we can see that the degree of correspondence between the two plots is high.

Real output, as measured by the manufacturing production, grew at the annual rate of 8.25% during the period of analysis. The maximum rate of growth occurred in 1957, 19.24%, and the minimum in 1974, -4.75%.

The price level, as measured by the Consumer Price Index, grew at an average annual rate of 5.17%. However, this rate is misleading because during most of the period covered the inflation rate was very low while it accelerated only for a small period at the end. The minimum growth rate occurred in 1967, -1.07%, and the maximum in 1973, 24.83%. The first three quarters of the overall period realized rates of 2%, while the last five years realized average rates of 14%. The behavior of the price level is shown in figure 1.

#### B. The Income-Money Relationship

In this section we shall consider the relationship between Income and Money, i.e., we shall try to establish the direction of causality between these two variables.

**Figure 3.**

**Rates of change of quarterly data of Nominal Income (QNY) and the  
Stock of Money (QMI)**

**Source: See Appendix on Data**

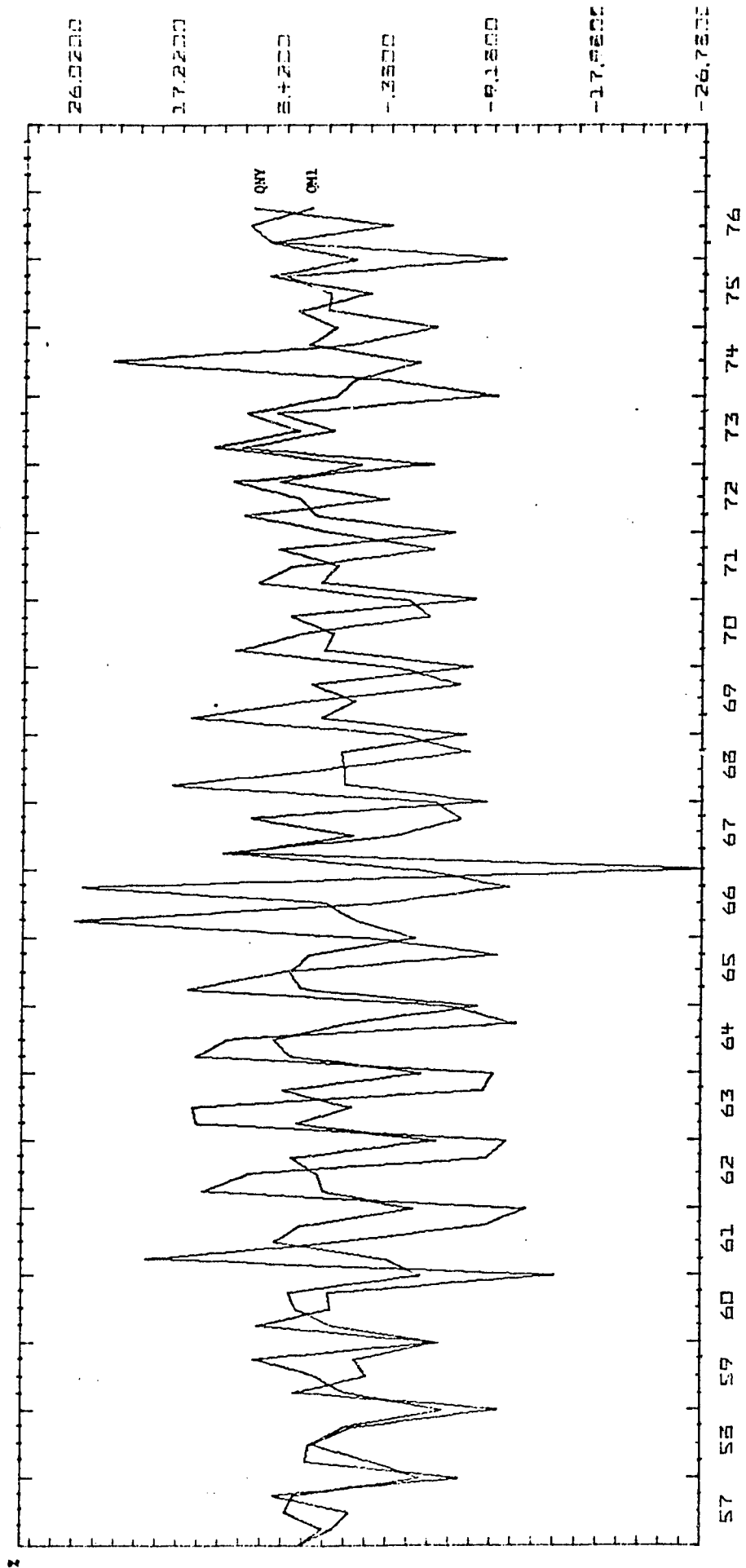


Figure 4.

Rates of change of yearly averages of Nominal Income (NY) and the Stock of Money (M1).

Source: See Appendix on Data



First, we shall consider the time plots of these variables, shown in figures 3 and 4, in order to see whether there is a pattern of leads or lags in their growth rates. Two time paths are shown, one for annual growth rates and the other for quarterly rates. Each figure shows both a time plot for the money stock, as measured by the narrow definition of the money supply, and income, measured as the sum of the growth rates of manufacturing production and consumer prices. Close consideration of these two figures does not provide us with any convincing evidence on which variable leads and which one follows. As can be seen during some periods, one variable leads and the other follows and during other periods the order is reversed. Hence, the graphical presentation is not adequate for a decision on causality. Some other method will have to be used to answer this question. Such a method exists. It is a test developed by Sims<sup>1</sup> which builds on theory developed by Granger.<sup>2</sup>

According to Granger, series  $Z_t$  causes series  $W_t$ , if past values of  $W_t$  and  $Z_t$  help in better predicting current  $W_t$ . Granger's test makes use of the values of the explained sum of squares in the following manner: We perform two regressions; first, we regress  $W_t$  on past values of  $W_t$  and past values of  $Z_t$  and second we regress  $W_t$  on past values of  $W_t$  alone; if the explained sum of squares for the first regression is larger than that of the second then we accept the null hypothesis that  $Z_t$  causes  $W_t$ .

The test developed by Sims is similar to the above. Consider two series  $W_t$  and  $Z_t$ . Regress  $W_t$  on past, current, and future values of  $Z_t$ . If  $Z_t$  causes  $W_t$ , then future values of  $Z_t$  in the regression will have zero coefficients. Causality, of course, may not

be just unidirectional, i.e., from  $Z_t$  to  $W_t$ , it could also be bidirectional, i.e., even though it may have been shown that  $Z_t$  causes  $W_t$  the reverse may also be true, Hence we can change the order of the variables in the regression equation and perform the test again in order to establish any reverse causality.

According to Sims we should run the following regressions:

$$W_t = \alpha + \sum_{i=0}^n \beta_i Z_{t-i} \quad (1)$$

and

$$W_t = \alpha + \sum_{i=0}^n \beta_i Z_{t-i} + \sum_{j=1}^n \gamma_j Z_{t+j} \quad (2)$$

In equation (1) we regress current values of  $W$  on past and current values of  $Z$ . In equation (2) we are regressing current values of  $W$  on past, current, and future values of  $Z$ . The objective here is to test for the insignificance of the future coefficients of  $Z$ . If these coefficients are insignificantly different than zero, then we accept the null hypothesis and say that  $Z$  causes  $W$ . If, however, these coefficients are significantly different, then we reject the null hypothesis in favor of the alternative one, i.e.  $Z$  does not cause  $W$ . The above test establishes unidirectional causality (or lack of it). In order to test for causality (or lack of it) in the opposite direction we need change the order of dependence of the variables and perform the same test. The possible outcomes are either that  $Z$  causes  $W$  and  $W$  does not cause  $Z$ , or that  $Z$  causes  $W$  and  $W$  causes  $Z$ , or that  $Z$  does not cause  $W$  and  $W$  causes  $Z$ .

The instrument we use to establish causality is the  $F$ -statistic.

$$F_{k-r, n-k} = \frac{(ESS_2 - ESS_1)/(k-r)}{RSS_2/(n-k)}$$

Where  $ESS_2$  is the explained sum of squares from equation (2),  $ESS_1$  is the explained sum of squares from equation (1),  $k$  is the total number of variables in equation (2) and  $r$  is the total number of variables in (1). Therefore,  $k-r$  is the number of leading variables in (2). If the above  $F$  value, i.e., the calculated value of the  $F$  test, is less than the critical value we obtain from statistical tables, then we accept the null hypothesis. Otherwise, we reject it in favor of the alternative.

In regressions of this type, we are faced with the problem of serial correlation of the error terms. The cause of this problem is the fact that we are leaving out some of the variables that contribute to the explanation of the dependent variable. If we apply Ordinary Least Squares to the given variables, then the coefficients of estimation will be Best, Linear, Unbiased, and inefficient. In order to make them efficient, we either have to use Generalized Least Squares or Ordinary Least Squares on a set of transformed variables. The method we will employ is the latter one. The technique we use is the Cochrane Orcutt iterative one<sup>3</sup> and the transformation makes use of the first order autocorrelation parameter  $\hat{\rho}$ .

The Sims test was applied to money and income variables. We use two definitions of money supply the narrow (M1) and the broad (M2).<sup>4</sup> We also use two definitions of income: the one we have mentioned earlier in this section and the other one given by the real gross domestic product (GDP). In the regressions we use the growth rates of the given variables. The maximum number of leads used is three, while the lag was set at three periods. The data used was adjusted and quarterly. The

gross domestic product data was interpolated from annual data (this series was not adjusted). This last variable was interpolated because no such quarterly data exists.

The results of the regressions are presented in tables 1 and 2. Table 1 relates money in both definitions to the first definition of income. In equations (1) - (4), we regress income on money (M1). The calculated F tests are less than the critical values, therefore we accept the null hypothesis that future coefficients are insignificantly different than zero and, hence, that money causes income. In equations (5) - (8) we are reversing the order of dependence and regress money (M1) on income. The results again support the null hypothesis, i.e., income causes money. These two results make our test inconclusive. In equations (9) - (12), we regress income on money (M2). Again, the results support the null hypothesis. Similarly, in equations (13) - (16), we regress money (M2) on income and the results obtained once more support the null hypothesis. Thus the test once more is inconclusive. Therefore, when we relate the growth rates in nominal income, measured as the sum of the growth rates of manufacturing production and consumer price indices, to the growth rates of both definitions of money supply, the tests are inconclusive.

Next, we use the growth rates of the second definition of income to see whether the results from relating this definition to the growth rates of both definitions of money can determine a line of causality. These results are presented on table 2. Equations (1) - (4) regress income on money (M1) and equations (5) - (8) reverse the order and regress money (M1) on income. The values of the calculated F tests again lead to inconclusion. However, in equations (9) - (12) in which

Table 1

F-test on Coefficients of Leading Values

$$W_t = \alpha + \sum_{i=0}^n \beta_i Z_{t-i} + \sum_{j=1}^m \gamma_j Z_{t+j}, \quad n=3$$

<u>Equation</u>	<u>Dependent Variable</u>	<u>Independent Variable</u>	<u>Leads</u>	$\hat{p}$	<u>R<sup>2</sup></u>	<u>F-statistic</u>
1		M1	0	-.1656	.2892	
2		M1	1	-.1680	.3248	F <sub>4,74</sub> = .0028
3		M1	2	-.1452	.3280	F <sub>4,73</sub> = .0031
4		M1	3	-.0998	.3900	F <sub>4,72</sub> = .1525
5	M1		0	-.3776	.4221	
6	M1		1	-.3769	.4245	F <sub>4,74</sub> = .0002
7	M1		2	-.3798	.4276	F <sub>4,73</sub> = .0004
8	M1		3	-.3897	.4295	F <sub>4,72</sub> = .0007
9		M2	0	-.4287	.1804	
10		M2	1	-.4414	.1909	F <sub>4,74</sub> = .0007
11		M2	2	-.4473	.1914	F <sub>4,73</sub> = .0007
12		M2	3	-.4478	.2260	F <sub>4,72</sub> = .0033
13	M2		0	.0018	.0348	
14	M2		1	.0040	.0355	F <sub>4,74</sub> = .0029
15	M2		2	-.0007	.0364	F <sub>4,73</sub> = .00009
16	M2		3	.0199	.0417	F <sub>4,72</sub> = .0004

\* significantly different than zero at  $\alpha = .05$

$\hat{p}$  is the first order autocorrelation parameter.

Table 2

F-test on Coefficients of Leading Values

$$W_t = \alpha + \sum_{i=0}^n \beta_i Z_{t-i} + \sum_{j=1}^m \gamma_j Z_{t+j}, \quad n = 3$$

<u>Equation</u>	<u>Dependent Variable</u>	<u>Independent Variable</u>	<u>Leads</u>	$\hat{p}$	$R^2$	<u>F-statistic</u>
1		M1	0	-.0925	.0401	
2		M1	1	-.0905	.0523	F <sub>4,74</sub> = .0007
3		M1	2	-.0904	.0535	F <sub>4,73</sub> = .0008
4		M1	3	-.0904	.0536	F <sub>4,72</sub> = .0008
5	M1		0	.0460	.0083	
6	M1		1	.0489	.0119	F <sub>4,74</sub> = .0002
7	M1		2	.0510	.0125	F <sub>4,73</sub> = .0002
8	M1		3	.0513	.0131	F <sub>4,72</sub> = .0003
9		M2	0	.0023	.2528	
10		M2	1	-.0064	.9917	F <sub>4,74</sub> = 4.821*
11		M2	2	-.0064	.9917	F <sub>4,73</sub> = 4.889*
12		M2	3	-.0063	.9917	F <sub>4,72</sub> = 4.889*
13	M2		0	-.1644	.3683	
14	M2		1	-.1550	.4104	F <sub>4,74</sub> = .0039
15	M2		2	-.1441	.4222	F <sub>4,73</sub> = .0051
16	M2		3	-.1426	.4283	F <sub>4,72</sub> = .0058

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\*significantly different than zero at  $\alpha = .05$

$\hat{p}$  is the first order autocorrelation parameter

we regress income on money (M2), the calculated F tests are greater than the critical ones for all the leads used, both at 95% and 99% levels. Therefore, we reject the hypothesis that money (M2) causes income. In equations (13) - (16), we inverse the order of dependence of these two variables. The F tests found here are less than the critical ones and thus we accept the hypothesis that income causes money (M2). Of interest in equations (10) - (12) are the very high values of the  $R^2$ 's.

The results presented in the previous tables make us conclude that if the broad definition of money is the most appropriate one and if the interpolated annual data of gross domestic product is a good measurement of income in Greece, then changes in income cause changes in the money supply; i.e., the money stock is demand determined. This conclusion, if accepted, says something about the responsibilities of the monetary authorities. If the money stock is demand determined, then the monetary authorities need not concentrate on controlling its level. They can very well worry about other matters such as the balance of payments position.

### C. The Demand for Money in an Open Economy

Essential to the monetary approach to the balance of payments is the concept of the Demand for Money. We shall now consider the factors determining this demand in Greece.

#### a. Estimation

The model used is quite standard. It posits that real money balances (M/P) are a function of the rate of interest (r) and income (y),

i.e.,

$$M/P = f(r,y) \quad (1)$$

The real money balances variable is defined either as the ratio of the narrow money supply (M1) and the consumer price index (CPI) or the broad money supply (M2) and the CPI.

The interest rate variable is an elusive one. Most of the studies on demand for money use the yield on short-term and long-term government securities as the representative interest rate. Modigliani, Rasche, and Cooper<sup>5</sup> have argued that the short-term yield on such securities is the best measure of the opportunity cost of holding cash balances. However, this yield cannot be used in our study because it does not exist in the Greek money market. As has been mentioned above, Open Market Operations is not an instrument of monetary policy in Greece. Other economists, Genberg,<sup>6</sup> Hamburger,<sup>7</sup> Hamburger and Wood<sup>8</sup> have used the yield on equity as a measure of this cost. Again, this yield would be irrelevant in our study for reasons presented earlier. As a measure of this opportunity cost, we shall use a weighted average of the interest rates on time deposits (TD) and Saving Deposits (SD).<sup>9</sup> This will be used as the nominal rate of interest. However, these interest rates are controlled; therefore, we will use the expected rate of inflation as an alternative measurement of the same cost.<sup>10</sup> Since we are dealing with an open economy, the interest rate vector should be expanded to include foreign interest rates. This is possible because we are assuming a certain degree of substitutability between domestic and foreign assets. This extended vector will include the US short-term and long-term yields on government securities and the Eurodollar rate on three month deposits.

The last variable involved is income. The income constraint is defined in two distinct ways: real income, as measured by the gross domestic product in 1970 prices, and permanent income. This last measure is a moving average of the manufacturing production index.<sup>11</sup>

Equation (3) takes the specific form

$$\log (M/P)_t = \alpha + \beta \log (Y/P)_t + \gamma \log r_t + u_t \quad (4).$$

The method of estimation is the Cochrane-Orcutt Iterative technique. This method was chosen in order to take into account any serial correlation problems that may exist in the residual terms. The data used was both quarterly and annual. The quarterly data was seasonally adjusted.

## b. Results

We shall now report and discuss the results of the estimation.

### i) Quarterly Data

Table 3 lists the results from regressing real money balances (narrow and broad definitions) on real income and four different definitions of the opportunity cost of holding cash balances: nominal rate of interest (NR), long-term US yield on government securities (LRUSR), short-term US yield on government securities (SRUSR), and the expected rate of inflation (EINF). In equations (1) - (4), in which money is defined in its narrow sense, the income elasticities are all positive, as expected, but significantly greater than unity. The interest rates are all negative and, with the exception of SRUSR, significantly less than zero. The one corresponding to the LRUSR is very large in absolute value. The values of the  $R^2$ 's are very large. In equations (5)-(8),

Table 3  
Demand for Money: 1957-1976, Quarterly Data  
Cochrane-Orcutt Iterative Technique

<u>Equation</u>	<u>Dependent Variable</u>	<u>Constant</u>	<u>Real Y</u>	<u>Nominal R</u>	<u>LRUSR</u>	<u>SRUSR</u>	<u>EINF</u>	<u>R<sup>2</sup></u>	<u>D-W</u>	<u>rho</u>	<u>SER</u>
1	R M1	-21.409 (-2.517)	1.809 (6.833)	-.246 (-.100)				.954	1.828	.961	1.38
2	R M1	-27.342 (-2.279)	1.818 (6.859)		-2.444 (-.627)			.954	1.831	.956	1.377
3	R M1	-20.686 (-3.733)	1.811 (6.829)			-.037 (-.039)		.954	1.831	.961	1.38
4	R M1	-24.612 (-7.976)	2.775 (10.473)				-.628 (-15.48)	.960	2.107	.509	1.286
-----											
5	R M2	-27.459 (-2.149)	1.013 (3.096)	-.439 (-.144)				.976	1.159	.98	1.719
6	R M2	-34.988 (-2.213)	1.023 (3.131)		-3.551 (-.724)			.976	1.173	.979	1.714
7	R M2	-27.34 (-2.786)	1.018 (3.112)			-.422 (-.366)		.976	1.162	.98	1.718
8	R M2	-18.266 (-7.096)	2.197 (10.026)				-1.438 (-63.93)	.986	2.117	-.26	1.34

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The numbers in parenthesis are t statistics.

rho is the first order autocorrelation parameter.

Table 4  
Demand for Money: 1957-1976, Quarterly Data  
Cochrane-Orcutt Iterative Technique

<u>Equation</u>	<u>Dependent Variable</u>	<u>Constant</u>	<u>Permanent Y</u>	<u>Nominal R</u>	<u>LRUSR</u>	<u>SRUSR</u>	<u>EXINF</u>	<u>R<sup>2</sup></u>	<u>D-W</u>	<u>rho</u>	<u>SER</u>
1	R M1	-6.613 (-.721)	.388 (4.761)	-.448 (-.164)				.943	1.576	.965	1.539
2	R M1	-11.17 (-.852)	.389 (4.782)		-2.115 (-.483)			.943	1.582	.963	1.537
3	R M1	-5.429 (-.913)	.388 (4.762)			.034 (.033)		.943	1.58	.966	1.538
4	R M1	-2.406 (-.905)	.542 (6.332)				-.357 (-3.93)	.951	2.003	.939	1.415
-----											
5	R M2	-16.602 (-1.308)	.064 (.667)	-.615 (-.190)				.974	1.021	.979	1.820
6	R M2	-22.877 (-1.418)	.066 (.695)		-3.232 (-.622)			.974	1.029	.979	1.816
7	R M2	-15.639 (-1.701)	.065 (.676)			-.334 (-.274)		.974	1.021	.974	1.819
8	R M2	-.975 (-.657)	.721 (5.753)				-1.624 (-61.362)	.977	2.024	.102	1.677

we define money in its broad sense. Here the income elasticities are positive and insignificantly different than unity, with the exception of (8). The interest rate elasticities are all negative. Those in equations (6) and (8) are excessively large. Again the  $R^2$ 's are very high.

Table 4 lists the results from regressing real money balances (narrow and broad definitions) on permanent income and the same four definitions of the opportunity cost we used above. Equations (1) - (4) use money in its narrow sense. The income elasticities are positive but significantly less than unity (at the same time, significantly greater than zero). The interest rate elasticities are negative with the exception of the one in equation (3) corresponding to the SRUSR. In value they are all significantly less than zero, while the one corresponding to the LRUSR is very large in absolute value. The  $R^2$ 's are very high. Equations (5) - (8) use the broad definition of money. Here the income elasticities are positive and significantly less than unity (insignificantly greater than zero). The interest rate elasticities are negative. Those of equations (6) and (8) are excessively high. The  $R^2$ 's are very high.

#### ii. Annual Data

Next we used annual data. Table 5 reports the results from regressing real money balances ( $M1/P$ ) on real or permanent income and nominal interest rate or the Eurodollar rate.<sup>12</sup> Equations (1) and (4) cover the 1957 to 1976 period while equations (2), (3), (5), and (6) the 1963 to 1976 period. Equations (1), (2), and (3) regress real balances on real income, nominal interest rates and the Eurodollar rate.

Table 5

Demand for Money: 1957-1976 (or 1963-1976) Annual Data  
Cochrane-Orcutt Iterative Technique

<u>Equation</u>	<u>Dependent Variable</u>	<u>Constant</u>	<u>Real Y</u>	<u>Permanent Y</u>	<u>Nominal R</u>	<u>Euro\$ R</u>	<u>R<sup>2</sup></u>	<u>DW</u>	<u>rho</u>	<u>SER</u>
1	RM1	1.151 (.327)	.787 (2.938)		.036 (.342)		.991	2.201	.887	.056
2*	RM1	-3.435 (-2.363)	1.129 (11.439)		-.004 (-.039)		.981	1.880	.261	.043
3*	RM1	-3.384 (-3.837)	1.124 (16.105)			-.013 (-.642)	.982	1.892	.284	.042
4	RM1	-8.777 (-8.620)		1.469 (21.698)	-.391 (-3.927)		.991	1.445	.432	.053
5*	RM1	-5.101 (-3.037)		1.209 (10.907)	-.249 (-2.077)		.979	1.837	.242	.046
6*	RM1	-1.598 (-1.310)		.991 (10.205)	.019 (.793)		.973	1.823	.417	.052

Numbers in parentheses are t statistics

\* indicates period 1963-1976

Table 6

Demand for Money: 1957-1976 (or 1963-1976)  
Annual Data, Cochrane-Orcutt Iterative Technique

<u>Equation</u>	<u>Dependent Variable</u>	<u>Constant</u>	<u>Real Y</u>	<u>Permanent Y</u>	<u>Nominal R</u>	<u>Euro\$ R</u>	<u>R<sup>2</sup></u>	<u>DW</u>	<u>rho</u>	<u>SER</u>
1	RM2	-11.462 (-19.712)	1.738 (43.861)		-.228 (-3.473)		.993	1.877	.034	.057
2 *	RM2	-8.604 (-8.858)	1.549 (24.032)		-.056 (-.807)		.992	1.946	-.017	.036
3 *	RM2	-7.908 (-12.777)	1.504 (30.665)			-.0137 (-.737)	.992	1.805	.136	.036
4	RM2	-11.610 (-13.433)		1.720 (29.983)	-.371 (-4.302)		.995	1.626	.405	.047
5 *	RM2	-10.739 (-8.676)		1.649 (20.397)	-.383 (-4.176)		.992	1.731	.114	.038
6 *	RM2	-5.468 (-3.569)		1.322 (10.865)	.026 (1.109)		.983	1.641	.523	.053

The income elasticity of equation (1) is positive and insignificantly different than unity. However the interest rate elasticity is positive and insignificantly different than zero. The same variables for the shorter period give us again positive income elasticity, but now the interest rate elasticity is negative, as expected, and insignificantly different than zero. Equation (3) gives us a positive income elasticity which is insignificantly different than unity and a negative interest rate elasticity which is insignificantly different than zero. We see here that the Eurodollar rate behaves very similarly to the nominal interest rate. Therefore, if the nominal interest rate, as defined in this text, can be used as a measurement of the opportunity cost of holding real cash balances, then the Eurodollar rate can also be used for the same measurement. Equations (4), (5), and (6) regress real balances on permanent income and the same interest rates as above. Equation (4), which covers the whole period, gives a positive income elasticity but significantly greater than unity, while the nominal interest rate elasticity is of the negative sign and significantly less than zero. Equations (5) and (6), which cover the shorter period, yield positive income elasticities insignificantly different than unity. The first gives a negative interest rate elasticity, but the second gives a positive one and insignificantly different than zero. These results are not very satisfactory. The  $R^2$ 's for equations (1) - (6) are very high, indicating a good fit.

Table 6 regresses real money balances (M2/P) on the same variables and covers the same periods used in the previous set of regressions. The results, however, are not very good. The income elasticities are positive but significantly greater than unity for both

definitions of income. The interest rate elasticities are of the negative sign with the exception of the Eurodollar rate in equation (6) which is positive. The  $R^2$ 's are very high.

### c. Conclusions

Some of the results presented in tables 3 - 6 conform to those found by other studies. In regressions using quarterly data, the real income variable behaves better than the permanent income one, particularly when M2 is the dependent variable. In these regressions, the income elasticities fall within the range of 1 and 1.3, which has been established as the acceptance range by other researchers on money demand in open economies, such as Bean<sup>13</sup>, Genberg<sup>14</sup>, Zecher<sup>15</sup>, Hamburger<sup>16</sup>, Hamburger and Wood.<sup>17</sup> Of the interest rate elasticities, the nominal and the US short-term yield provide the best performance, i.e. negative in sign and very small in value. These elasticities fall in the same range as those found by the same researchers mentioned above as well as Meltzer<sup>18</sup> and Laidler.<sup>19</sup>

In regressions using annual data, again, real income outperforms the permanent income. The best results are obtained where we use M1 as the dependent variable. The nominal rate of interest gives us the best coefficients.

Footnotes for Chapter III

<sup>1</sup>Sims, Christopher A., "Money, Income, and Causality," American Economic Review, LXII (Sept. 1972), 540-52.

<sup>2</sup>Granger, C. W. J., "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," Econometrica, XXXVII (July, 1964), 424-38.

<sup>3</sup>For a detailed presentation of this technique, see Cochrane, D., and G. H. Orcutt, "Application of Least Squares Regressions to Relationships Containing Autocorrelated Error Terms", Journal of the American Statistical Association, Vol. 44, pp. 32-61, 1949.

<sup>4</sup>M1 is defined as Currency in Circulation plus Demand Deposits by the public and the public sector in commercial banks.

M2 is defined as M1 plus Time Deposits and Savings Deposits at Commercial Banks.

<sup>5</sup>Modigliani, F., R. Rasche, and J. P. Cooper, "Central Bank Policy, the Money Supply, and the Short-term Rate of Interest," JMCEB, (May, 1970), 166-218.

<sup>6</sup>Genberg, H., "Aspects of the Monetary Approach to the Balance of Payments Theory: An Empirical Study of Sweden," Unpublished Ph.D. dissertation (1974), University of Chicago.

<sup>7</sup>Hamburger, M. J., "The Demand for Money in an Open Economy: Germany and the United Kingdom," JME (1977), 25-40.

<sup>8</sup>Hamburger, M. J. and G. E. Wood, "Interest Rates and Monetary Policy in Open Economies," Paper presented at the December 1977 AEA meeting.

<sup>9</sup>Let  $T = TD + SD$ ,  $r_1$  = interest rate on TD,  $r_2$  = interest rate on SD, then  $rw = (TD/T)r_1 + (SD/T)r_2$

<sup>10</sup>The expected rate of inflation series was obtained with the use of the adaptive expectations model developed by Cagan. [See Cagan, P., "The Monetary Dynamics of Hyperinflation" in studies in "The Quantity Theory of Money", edited by Milton Friedman, 1956, 37-39.

$$\pi_t^* = (1 - e^{-b}) \sum_{x=-T}^t \pi_x e^{bx} e^{-bt}, \quad t \geq 0$$

where

$\pi_t^*$  = expected rate of inflation at period  $t$

$\pi$  = actual rate of inflation

$b = (\pi - \pi^*) / \pi^*$  is the adaptive expectations coefficient. The value of  $b$  was chosen to be .1. This choice was made because it gave the highest  $R^2$ 's.

The  $\pi^*$  series was generated for the period from 1972 I to 1976 IV, because during this period the inflation rate was high enough to justify its use. Before 1972 I, the actual rate was used as a proxy, because it was fairly low and constant.

<sup>11</sup>This index was chosen because neither Gross National Product, nor Gross Domestic Product, nor Industrial Production Index are available in quarterly form. Greece has been an agricultural country, more so at the beginning of the period we are studying than later on. The author is aware that using the manufacturing production index as a proxy of real output may be a poor estimate.

<sup>12</sup>The Eurodollar rate series starts in 1963. In order to make some meaningful comparisons, we use the other variables involved in two ways: first, for the overall period 1957-1976, and second for the 1963-1976 period.

<sup>13</sup>Bean, D., "International Reserve Flows and Money Market Equilibrium, the Japanese Case," in The Monetary Approach to Balance of Payments, London, 1975.

<sup>14</sup>Genberg, H., "Aspects of the Monetary Approach to Balance of Payments Theory, An Empirical Study of Sweden," in the Monetary Approach to Balance of Payments, London, 1975.

<sup>15</sup>Zecher, R., "Monetary Equilibrium and International Reserve Flows in Australia," in the Monetary Approach to Balance of Payments, London, 1975.

<sup>16</sup>Hamburger, ibid.

<sup>17</sup>Hamburger and Wood, ibid.

<sup>18</sup>Meltzer, A. H., "The Demand for Money: The Evidence from the Time Series," JPE, vol. 71 (June 1963) 219-246.

<sup>19</sup>Laidler, D. E. W., The Demand for Money: Theories and Evidence, (Scranton, Pa.: International Textbook Company, 1969).

CHAPTER IV  
THE UNIFIED MARKET HYPOTHESIS

A. Introduction

The fundamental assumption made by the monetary approach to the balance of payments is that in a world of fixed exchange rates the price level and the rates of return to real assets, for any country, move very closely together with those of the rest of the world; i.e. they are exogenously determined. This is known as the unified market hypothesis.

Our task in this chapter will be to test the validity of this hypothesis. A complete test would require comparing both goods and assets markets. However, data of the assets market for Greece is neither complete nor reliable, for reasons explained in Chapter II. Therefore, the test will be applied on data from the goods markets alone, i.e. price series. The test we perform will compare price series of Greece to those of the rest of the world.<sup>1</sup>

B. The Convergence of Inflation Rates

1. Factors Affecting the Rate of Inflation

If countries are closely tied together economically, then international price arbitrage should prevent wide divergence in their rates of inflation, all other things remaining constant. Theoretically, the monetary approach would advise us that the variation in inflation rates

across countries should be insignificant. In reality, however, this may not hold true because of changes that may occur in all the other factors that we would like to remain constant.

Many factors could cause a divergence in the rates of inflation across countries. We shall consider three of them: differences in the growth rates of national incomes and money supplies and adjustments of the exchange rates.<sup>2</sup> As we shall see, these factors have neither remained constant nor have they moved together.

Table 1 presents the growth rates in national incomes (measured by Gross National Products in 1970 prices) for all the countries of the "world" plus Greece. Three time periods are considered: the overall period 1957-1976, and two subperiods 1957-1971 and 1972-1976. The choice of subperiods was made using the acceleration in the rates of inflation as a criterion. As is evident from this table, income growth rates across countries are not the same in any one of the periods considered. There is a wide variation with the UK consistently realizing the lowest growth rates and Japan the highest. In all three periods the Greek growth rates have been above the world average and are second only to the Japanese.

Table 2 presents the growth rates of the money supplies of the same countries and for the same periods. The growth rates again vary. The US realized the lowest growth rates while Japan the highest. Italy and Greece had the second and third highest growth rates respectively. Of interest is the last period, 1972-1976. During this period, which is characterized by the highest inflation rates of the overall period, Greece realized the highest expansion in its money supply, 15.69% more than three percentage points above the second

highest, Italy, and more than 10 percentage points above the lowest, the US. Again, for all periods the Greek average was above the world average.

The third factor that can cause a divergence in inflation rates is adjustments in the exchange rates. The Greek drachma (Dr) official was pegged to the US dollar during the time interval under consideration. The official exchange rate was 30 drachmas per dollar. The effective exchange rate was the same up to the second quarter of 1975 and then depreciated to over 35 Dr per dollar. This consistency in the Greek exchange rate does not mean much, however, because the exchange rates in countries throughout the world have all changed vis-a-vis the dollar. The most notable of these changes are seen in the Deutch Mark and the Japanese Yen. The official rate of the former appreciated by 43% and that of the latter by 26% during the overall period under consideration.

The adjustments in the exchange rates, combined with the divergence in the growth rates of the national incomes and the money supplies, should undermine the convergence of the inflation rates.

Table 3 lists the average growth rates in the price levels (measured as the first logarithmic differences of the CPI's) across countries. The overall average rate of inflation in Greece was 4.8%. This number, however, can be very misleading. From 1957 to 1971, Greece realized the lowest inflation rates in the "world"--2.10% annually--, and then from 1972 to 1976 the average growth rate expanded to 15.85%, the highest of all countries.

It is evident from the information provided above that the factors affecting the inflation rates have neither remained constant

Table 1Average Growth Rates (%) of Real GNP

	1957-1976	1957-1971	1972-1976
France	4.43	4.91	2.50
Germany	4.00	4.52	1.91
Greece	5.86	6.55	3.12
Italy	4.52	4.76	3.57
Japan	8.06	9.04	4.13
United Kingdom	2.38	2.61	1.45
United States	3.09	3.39	1.91
World Average	4.62	5.11	2.65

Table 2Average Growth Rates of Money Supplies (M1)

	1957-1976	1957-1971	1972-1976
France	9.43	9.02	10.95
Germany	8.10	8.30	7.52
Greece	13.00	12.32	15.69
Italy	13.41	13.71	12.16
Japan	14.95	15.64	12.17
United Kingdom	5.94	4.73	10.76
United States	4.16	4.02	4.69
World Average	9.86	9.68	10.56

Table 3Average Growth Rates in CPI's

	1957-1976	1957-1971	1972-1976
France	5.74	4.68	9.99
Germany	3.22	2.53	5.98
Greece	4.85	2.10	15.83
Italy	5.63	3.35	14.74
Japan	6.28	4.59	13.02
United Kingdom	5.98	3.68	15.21
United States	3.53	2.48	7.71

nor grown together. By considering the variation in the growth rates of the various CPI's, we may expect a degree of divergence in the Greek inflation rate and the world inflation rate.

## 2. Hypothesis Testing and Empirical Findings

Our objective is to compare the inflation rate of Greece at time  $t$  to that of the rest of the world. The inflation rate for any given country will be defined as the first logarithmic differences of its consumer price index with 1970 = 1.00. However, a problem arises when we want to define the world inflation rate. There is no such time series as the world Consumer Price Index. Different researchers have used various definitions for the world inflation rate. Genberg (1974)<sup>3</sup> used a simple arithmetic average of the CPI's of the countries that made up his "world". Later on (1977)<sup>4</sup>, he developed a new definition in which the world rate of inflation becomes a weighted average of the CPI's involved, where for weights he used the ratio of country  $i$ 's national income (Gross National Product) to that of the world (all incomes are expressed in 1970 prices and are converted to a common currency, dollars), where the income of the world is defined as the sum of the individual national incomes. Wood and Williamson (1976)<sup>5</sup> and Jonson (1976)<sup>6</sup> used the US rate of inflation as a proxy to the world's rate. In our study, we shall use all three definitions so that possible points of importance can be discussed.

Two different methods of hypothesis testing will be used: the Analysis of Variance and simple regression. In the Analysis of Variance test we will use as the "world" inflation rate the simple arithmetic mean. In the second test we will use all definitions.

a. The Analysis of Variance Procedure

This method of testing for the convergence of inflation rates compares the variation in inflation rates across countries with the variation within countries. The comparison is made along the following lines:<sup>7</sup>

Suppose we have a set of T observations on a variable  $\pi$  and that these observations are classified by some criterion into N groups (countries). The observations are  $\pi_{it}$  with  $i = 1, \dots, N$  and  $T = 1, \dots, T_i$ , where  $T_i = \sum_{i=1}^N T_i$ . Let  $\bar{\pi}_i$  denote the mean of the  $\pi$ 's in group i and  $\bar{\pi}$  the overall mean of all the  $\pi$ 's.

The classification is relevant if the group means differ significantly from one another and hence the overall mean. A measurement of comparison is provided by the variation of the  $\pi$ 's about their group means. A test of the null hypothesis that the classification is irrelevant (i.e., inflation rates across countries do not differ) is based on the following ratio of mean squared deviations:

$$F = \frac{\sum_{i=1}^N T_i (\bar{\pi}_i - \bar{\pi})^2 / (N - 1)}{\sum_{i=1}^N \sum_{t=1}^{T_i} (\pi_{it} - \bar{\pi}_i)^2 / (T - N)}$$

If this ratio is large, then the classification is relevant, i.e., the group means differ significantly from one another as compared with the variation of the observations within these groups. If, on the other hand, the ratio is small, we accept the null hypothesis that the classification is irrelevant. In our case, this simply means that the inflation rates do not differ across countries.

The above procedure was applied to quarterly data. Three different time periods were used: 1957 I- 1976 IV; 1957 I- 1971 IV;

and 1958 I - 1967 III. (The CPI series used here started from 1956 IV so that we have 80 quarterly observations for each inflation series.) The second and third time periods were chosen because of unique phenomena that characterized them. During the second interval, the inflation rate was relatively low for all the countries concerned and during the third interval, the exchange rates of the countries involved remained officially constant. In the first two periods, the values of the CPI's that corresponded to a quarter in which the exchange rate was changed were deleted. As the definition of world inflation rate, we used a simple arithmetic average of the involved CPI's with the exclusion of Greece. The results are presented in table 4. The critical F values given in the last column do not support the null hypothesis. The calculated F values exceed significantly the critical values. The null hypothesis is not supported in any one of the time intervals.

Table 4

F-statistics for the Convergence of Inflation

<u>Period</u>	<u>F- ratio</u>	<u>Critical Values of F</u>	
		5%	1%
1957 I - 1976 IV	$F_{6,553} = 4.037$	$F_c = 2.12$	2.85
1957 I - 1971 IV	$F_{6,448} = 5.66$	$F_c = 2.12$	2.85
1958 I - 1967 III	$F_{6,266} = 5.66$	$F_c = 2.14$	2.90

The reasons for the rejection may be many and complex. However, by considering the information presented by tables 1, 2, and 3 we may have anticipated a significant divergence in the rates of inflation. Also, the definition of world inflation may not be good enough. In order to eliminate any suspicion that the econometric technique used

did injustice to the data, another technique was also employed.

#### b. The Regression Procedure

Let  $\pi_{gt}$  stand for the rate of inflation in Greece at time  $t$  and  $\pi_{wt}$  for the rate of inflation in the world at the same time. We can test for the convergence of inflation rates by regressing  $\pi_{gt}$  on  $\pi_{wt}$  as follows:

$$\pi_{gt} = a + b\pi_{wt} + u_t$$

where  $a$  is a constant used to capture the effects of the factors mentioned above and  $u_t$  is a disturbance term. If the convergence hypothesis holds, then the slope coefficient  $b$  must be insignificantly different than unity.

We applied this technique to both quarterly and annual data. The quarterly data was seasonally adjusted. Two time periods were analyzed, one covering 1957 I to 1971 IV (1957 to 1971 for the annual) and the other covering 1957 I to 1976 IV (1957 to 1976 for the annual). The first period was chosen because of its low inflation rates across countries.

#### i. Quarterly results

Three different definitions of world inflation were used. First, we defined it as a weighted average of inflation rates where for weights we used the share of each country's national income in the world income. The results from using this definition are shown in table 5, equations (5), (6), (11) and (12). The values of the constant terms in equations (5) and (11) are insignificantly greater than zero. The slope coefficients for equations (5) and (6), which cover the low

inflation years, are insignificantly different than unity. Thus, we can say that for the period 1957 I to 1971 IV, using this particular definition of world inflation, the Greek inflation rate converges to that of the rest of the world. The slope coefficients of equations (11) and (12), which cover the whole period, are significantly greater than unity. Thus, for the overall period, the convergence hypothesis does not hold. The  $R^2$ 's for all the equations are relatively high.

Next, we defined the world inflation rate as a simple arithmetic average of all the inflation rates involved, excluding the Greek one. These results are given by equations (3), (4), (9) and (10). The values of the constant terms in equations (3) and (9) are insignificantly different than zero. The slope coefficients for equations (3) and (4), which cover the low inflation period, are significantly less than unity (and significantly greater than zero). The slope coefficients of equations (9) and (10), which cover the whole period, are significantly less than unity (insignificantly greater than zero). The  $R^2$ 's of equations (3) and (4) are high, those of equations (9) and (10) are extremely low.

Finally, we use the US inflation rate as a proxy to the world inflation rate. These results are given by equations (1), (2), (7) and (8). The values of the constant terms in equations (1) and (7) are insignificantly greater than zero. The slope coefficients of equations (1) and (2), the low inflation period, are relatively close to unity but significantly less than it. The slope coefficients of equations (7) and (8) are significantly less than unity (significantly larger than zero). The  $R^2$ 's of equations (1) and (2) are very high, while those of (7) and (8) are very low.

Table 5

Quarterly Regressions of Inflation Rates

<u>Equation</u>	<u>Dependent Variable</u>	<u>Independent Variable</u>	<u>Constant</u>	<u>Slope Coefficient</u>	<u>R<sup>2</sup></u>
1	$\pi_{gr}$	$\pi_{us}$	0.000 (.283)	.835 (28.51)	.928 *
2	"	"		.835 (28.74)	.928 *
3	$\pi_{gr}$	$\pi_w$	-.001 (-.125)	.611 (29.001)	.934 *
4	"	"		.611 (29.246)	.934 *
5	"	"	.018 (1.462)	.846 (1.023)	.687 * ✓
6	"	"		1.110 (5.983)	.692 * ✓
7	$\pi_{gr}$	$\pi_{us}$	.006 (1.651)	.000 (.611)	.005 +
8	"	"		.000 (.605)	.029 +
9	$\pi_{gr}$	$\pi_w$	.026 (1.651)	.001 (.708)	.006 +
10	"	"		.001 (.704)	.028 +
11	"	"	.014 (1.620)	1.71 (8.65)	.832 +
12	"	"		2.658 (9.325)	.738 +

\* indicates 1957 I - 1971 IV period

+ indicates 1957 I - 1976 IV period

The values in the parentheses are t statistics

✓ insignificant different than 1 at  $\alpha = .05$

### ii. Annual results

Two different definitions of world inflation were employed here. First, we weighted the annual inflation rates of each country using the ratio of national income (GNP in 1970 prices) and the world income. The results from these regressions are shown in table 6, equations (3) through (6). The values of the constant terms of equations (3) and (5) are insignificantly greater than zero. The slope coefficients of equations (3) and (4), the low inflation rate period, are insignificantly larger than unity. Those of equations (5) and (6), the overall period, are significantly greater than unity. The  $R^2$ 's are relatively high for all the equations. We can say here that the annual data, when using this particular definition of world inflation rate, supports the convergence hypothesis for the low inflation rate period and does not for the overall period.

Finally, we tried another version of the world rate of inflation. We multiplied the domestic CPI's by a new form of weight,  $w = e/e_{70}$ , with  $e$  being the exchange rate series and  $e_{70}$  being the exchange rate for year 1970, which is the base year for all the CPI's. By doing this, we are converting the individual CPI's to dollar equivalent ones. Then we calculated the inflation rates as the first logarithmic differences of these corrected CPI's and used their simple arithmetic average as the world inflation rate. The results from these regressions are listed in equations (1) and (2) of table 6. The value of the constant term is insignificantly greater than zero. The slope coefficients are relatively close to unity but significantly less than it. The  $R^2$ 's are relatively high.

Table 6  
Annual Regressions of Inflation Rates

<u>Equation</u>	<u>Dependent Variable</u>	<u>Independent Variable</u>	<u>Constant</u>	<u>Slope Coefficient</u>	<u>R<sup>2</sup></u>
1	$\pi_{gr}$	$\pi_w$	.004 (.427)	.746 (8.168)	.789 *
2	$\pi_{gr}$	$\pi_w$		.756 (8.747)	.785 *
3	$\pi_{gr}$	$\pi_w$	.013 (1.450)	.835 (.994)	.679 +✓
4	$\pi_{gr}$	$\pi_w$		1.161 (6.136)	.671 +✓
5	$\pi_{gr}$	$\pi_w$	.016 (1.65)	1.65 (8.81)	.803 *
6	$\pi_{gr}$	$\pi_w$		2.725 (9.598)	.713 *

\* indicates 1957 through 1976 period

+ indicates 1957 through 1971 period

The values in the parentheses are t statistics

✓ insignificant different than 1 at  $\alpha = .05$

### C. Conclusions

The two econometric techniques used in this chapter to test the unified market hypothesis in Greece failed to support the hypothesis for the overall period. The failure was independent of the "world" inflation rate definition used. The reasons for this may lie in the pronounced divergence in the growth rates of money supplies and real incomes of the countries involved during the high inflation period of 1972 I to 1976 IV. When we used the second econometric technique, however, for the low inflation rate period, 1957 I to 1971 IV, we found better results. Both for quarterly and annual data, when the world inflation rate was defined as a weighted average of individual inflation rates, with each weight being the share of each national income in the world national income, the hypothesis held true. The fact that the hypothesis holds for the low inflation period which is three-fourths of the overall period gives support to the validity of the hypothesis.

Thus we may conclude that the world monetary system may have been in disequilibrium in the last four years of our study and this may have contributed to this divergence of the inflation rates. This disequilibrium may have caused lags in the adjustment of world prices through the international arbitrage mechanism.

Footnotes for Chapter IV

<sup>1</sup>The rest of the world is made up of France, Germany, Italy, Japan, United Kingdom and the United States. As the selection criterion we used the volume of trade.

<sup>2</sup>For a comprehensive presentation of other factors, consider Genberg, H., "The Concept and Measurement of the World Price Level and Rate of Inflation", Journal of Monetary Economics, 3 (1977), 231-252 and Genberg, H., "Aspects of the Monetary Approach to Balance of Payments Theory: An Empirical Study of Sweden", unpublished Ph.D. Dissertation, Department of Economics, University of Chicago, 1974.

<sup>3</sup>Genberg, H., ibid.

<sup>4</sup>Genberg, H., ibid.

<sup>5</sup>Williamson, J., and Geoffrey E. Wood, "The British Inflation: Indigenous or Imported?", AER (Sept., 1976), 520-531.

<sup>6</sup>Jonson, P. D., "Money and Economic Activity in the Open Economy: The United Kingdom, 1880-1970", J.P.E., 84 (1976), 974-1011.

<sup>7</sup>For a comprehensive discussion of the analysis of variance procedure, see Scheffé, H., The Analysis of Variance (New York: John Wiley and Sons, 1959).

CHAPTER V  
RESERVE FLOWS AND MONETARY EQUILIBRIUM

In the introductory chapter we stated that the monetary approach to the balance of payments theory is a general equilibrium approach, i.e., it assumes equilibrium in the money, goods and assets markets. In the second and third chapters we considered the money market, namely, the supply of and demand for money. In the supply chapter, we showed the relationship between foreign reserves held at the central bank and the supply of money via the route of the monetary base. Here we also found that the narrow money multiplier remained almost constant over the period of analysis, which agrees with the monetary approach, while the broad multiplier grew at relatively high rates. In the demand for money chapter, first, we tried to establish the causal relationship between the money stock (defined either in its narrow sense,  $M_1$ , or its broad sense,  $M_2$ ) and income (defined either as nominal or real). Here, we showed that when the money stock is defined as  $M_1$ , then neither does income cause money nor money cause income. Therefore, in this case, we may assume that income is exogenously determined. On the other hand, when the money stock was defined as  $M_2$  we saw that real income causes money, i.e., the money stock is determined by demand conditions. Then we estimated demand for money functions. The estimates we obtained indicated that for quarterly data the real income and the nominal and U.S. short-term government securities yield gave us the best results when  $M_2$  was used as the dependent

variable. The permanent income series performed very poorly in these regressions. In annual regressions, real income again performed well. The permanent income series performed better in these regressions. In the fourth chapter we considered the unified market hypothesis. Here we showed that the hypothesis holds for the 1957 to 1971 period but not for the overall period.

In this chapter we will bring together the money supply and money demand equations and, by assuming monetary equilibrium, generate the balance of payments equation. We shall then use this equation to see whether the monetary approach explains reserve flows in Greece. The data we are going to use in the regression is annual because one of the key variables--outstanding government debt--does not exist in quarterly form for the whole period under consideration.

#### A. Estimation

In Chapter I, we showed that the balance of payments equation, under the monetary approach, can be written as

$$y g_F = \alpha_0 + \alpha_1(1-y)g_D + \alpha_2 g_m + \alpha_3 g_p + \alpha_4 g_y + \alpha_5 g_r + U \quad (1)$$

where  $g_x$ ,  $x = F, D, m, p, y,$  and  $r$ , indicates percentage change in the variable and  $y$  and  $(1-y)$  are the shares of foreign reserves and domestic credit in the monetary base, respectively. Since the equation has been derived logarithmically, the coefficients become elasticities. Coefficient  $\alpha_1$  is the domestic credit elasticity. The model predicts that it should be insignificantly different than minus one. Coefficient  $\alpha_2$  is the money multiplier elasticity. The model predicts that it should be insignificantly different than minus one.

Coefficient  $\alpha_3$  is the price elasticity and coefficient  $\alpha_4$  is the income elasticity. The model predicts that they should be insignificantly different than unity. Finally, coefficient  $\alpha_5$  is the interest elasticity. The model predicts that it should be a small negative number in the neighborhood of zero. If we assume that the monetary authorities do not sterilize reserve changes and if further we assume that real income, prices, and interest rates are exogenously determined then we can apply Ordinary Least Squares to equation (1). The above implies that the monetary authorities have no control over any nominal or real variables in the economy except the domestic component of the monetary base and via equation (1) the international reserves. Provided that the above assumptions hold, then  $\alpha_1$  above should be equal to negative unity, so that a \$1 increase in D leads to a \$1 decrease in F. On the other hand, if the monetary authorities sterilize, then we cannot use Ordinary Least Squares because we will be faced with simultaneous equation bias. Instead, Two-Stage Least Squares must be used to correct the bias problem. In this case, the balance of payments equation becomes

$$\gamma g_F = \alpha_0 + \alpha_1(1-\gamma)g_D + \alpha_2g_m + \alpha_3g_p + \alpha_4g_y + \alpha_5g_r + U \quad (2)$$

$$(1-\gamma)g_D = b_0 + b_1g_F + b_2g_{GD} + U'$$

where  $b_2$  is the coefficient of the government outstanding debt term.

The second equation above can be called the government reaction equation.

The monetary approach is a long run theory. Applications of the model to the Australian economy by R. Zecher (1975)<sup>1</sup>, the Swedish economy by H. Genberg (1975)<sup>2</sup>, the Japanese economy by D. Bean (1975)<sup>3</sup> and the Spanish economy by M. Guitian (1975)<sup>4</sup>, provide us with results

supporting the model. Quarterly data was used for the Australian, Japanese and Swedish cases. The real income elasticity of demand for nominal balances was positive and insignificantly different than unity. The price elasticity was negative relatively small for Australia and Japan. The three studies, which used quarterly data, applied a long run theory to short run data and obtained good results. Some reasons for this are given by S. P. Magee (1976)<sup>5</sup>.

In our analysis, we shall estimate coefficients for equations (1) and (2).

#### B. Results

First, we shall analyze the results from the Ordinary Least Squares regressions. These estimates are listed on Table 1 and some of them are impressive. The coefficient  $\alpha_1$ , which corresponds to domestic credit, is negative and insignificantly different from unity in almost all the equations. The coefficient of the money multipliers,  $\alpha_2$  (terms  $g_{m1}$  and  $g_{m2}$ ) are negative and significantly less than zero. The coefficient  $\alpha_3$  which corresponds to the price variable is significantly less than unity (significantly larger than zero). This result, however, was anticipated from the conclusion arrived at in the previous chapter. The real income elasticity (term  $g_{ry}$ ) is high but significantly less than unity. The permanent income elasticity is high but, again, significantly less than unity. The nominal interest rate elasticities (term  $g_{nr}$ ) are almost all negative and insignificantly less than zero. The U.S. short-term yield elasticity is insignificantly different from zero. The  $R^2$ 's are all very high and the Durbin-Watson statistics indicate no serial correlation.

Table 1: Reserve Flows 1957 - 1976 Annual Data

$$\gamma g_F = \alpha_0 + \alpha_1(1-\gamma)g_D + \alpha_2g_m + \alpha_3g_p + \alpha_4g_y + \alpha_5g_r + u$$

Equa.	Dep. Var.	Constant	(1- $\gamma$ ) $g_D$	$g_{m1}$	$g_{m2}$	$g_p$	$g_{ry}$	$g_{py}$	$g_{nr}$	$g_{sr}$	$R^2$	DW	SER
1	$g_F$	.0865 (3.401)	-1.049 (-5.165)	-.4490 (-1.547)		.542 (1.785)	.748 (18.445)		-.0347 (-.2602)		.999	1.725	.0588
2	$g_F$	.0842 (3.514)	-1.050 (-5.161)	-.4428 (-1.533)		.5837 (2.339)	.745 (20.300)			.0085 (.1819)	.999	1.769	.0588
3	$g_F$	.0880 (3.661)	-1.065 (-5.548)	-.4652 (-1.697)		.4544 (1.588)		.7445 (19.591)	-.0162 (-.1305)		.999	1.574	.0555
4	$g_F$	.0891 (3.928)	-1.065 (-5.544)	-.4678 (-1.717)		.4350 (1.876)		.7456 (21.578)		.005 (-.121)	.999	1.569	.0555
5	$g_F$	.1038 (3.761)	-1.095 (-5.405)		-.607 (-1.779)	.490 (1.632)	.7610 (18.381)		-.0514 (-.3901)		.999	1.876	.0575
6	$g_F$	.1001 (3.882)	-1.094 (-5.374)		-.5910 (-1.736)	.5608 (2.286)	.7497 (20.599)			-.0079 (-.1736)	.999	1.979	.0577
7	$g_F$	.1062 (4.104)	-1.115 (-5.864)		-.6370 (-1.991)	.3980 (1.417)		.7578 (19.690)	.0007 (.0064)		.999	1.629	.0538
8	$g_F$	.1073 (4.484)	-1.118 (-5.942)		-.662 (-2.106)	.4088 (1.834)		.7518 (22.402)		-.023 (-.553)	.999	1.687	.0532

Values in parentheses are t statistics

Table 2: Two-Stage Least Squares Estimates of the Parameters in

$$\gamma g_F = \alpha_0 + \alpha_1(1-\gamma)g_D + \alpha_2g_m + \alpha_3g_p + \alpha_4g_y + \alpha_5g_r + u$$

$$(1-\gamma)g_D = b_0 + b_1 g_F + b_2 g_{GD} + u'$$

Equa.	$\alpha_0$	$\alpha_1$	$\alpha_{2(m1)}$	$\alpha_{2(m2)}$	$\alpha_3$	$\alpha_{4(RY)}$	$\alpha_{4(PY)}$	$\alpha_{5(NR)}$	$\alpha_{5(SR)}$	$b_0$	$b_1$	$b_2$
1	-.0157 (-.078)	-.0174 (-.009)	-.165 (-.249)		-.085 (-.056)	.553 (2.002)		-.081 (-.384)		.098 (3.689)	-.245 (-4.588)	.014 (.218)
2	-.237 (-.199)	-2.145 (-.192)	.572 (.148)		.427 (.079)	.292 (.195)		.097 (.296)		.097 (3.710)	-.244 (-4.599)	.154 (.241)
3	.075 (.472)	-.900 (-.618)	-.457 (-.890)		-.137 (-.134)		.709 (3.140)	-.002 (-.013)		.097 (3.678)	-.243 (-4.578)	.016 (.245)
4	.011 (.023)	-.288 (-.063)	-.246 (-.160)		.002 (.001)		.628 (1.018)		.024 (.187)	.097 (3.691)	-.243 (-4.583)	.017 (.258)
5	-.012 (-.110)	-.001 (-.001)		-.090 (-.154)	-.051 (-.035)	.557 (4.002)		-.071 (-.348)		.093 (3.539)	-.239 (-4.498)	.021 (.325)
6	-.114 (-.371)	-.857 (-.348)		.413 (.276)	.271 (.103)	.471 (1.462)		.076 (.567)		.094 (3.617)	-.241 (-4.547)	.019 (.299)
7	.031 (.430)	-.410 (-.744)		-.331 (-.886)	-.055 (-.062)		.639 (6.909)	-.002 (-.014)		.093 (3.524)	-.238 (-4.481)	.023 (.360)
8	-.005 (-.029)	-.110 (-.080)		-.143 (-.176)	.061 (.049)		.604 (3.354)		.028 (.401)	.093 (3.593)	-.239 (-4.524)	.021 (.326)

Values in parentheses are t statistics.

Next, we shall analyze the results from the Two-Stage Least Squares regressions. The coefficients from these regressions are listed in Table 2. The coefficients of the domestic credit term,  $\alpha_1$ , are all negative but almost all of them significantly different than unity. The coefficients of the price variable,  $\alpha_3$ , mixed in sign and all of them significantly different from unity. The real income elasticities, coefficient  $\alpha_4(RY)$ , are all positive and significantly less than unity (significantly greater than zero). The permanent income elasticities coefficient  $\alpha_4(PY)$ , are higher than those of real income, but significantly less than unity. The nominal rate of interest elasticities, coefficient  $\alpha_5(NR)$ , are all negative and insignificantly greater than zero. Those of the U.S. short-term government yield are all positive and insignificantly greater than zero. The coefficients of the government reaction function are listed on the right hand side of the table. The coefficients  $\beta_1$  are all negative as expected, but significantly less than unity. The poor estimates in this equation may be the result of misspecification in the government reaction function.

The reason we used Ordinary Least Squares first was that the monetary authorities do not sterilize reserve changes. The results we obtained from that equation were far superior to those we obtained by using Two-Stage Least Squares which make the assumption that the monetary authorities sterilize these changes. We may say that the sterilization hypothesis does not hold, which may be true because the Greek monetary authorities do not use open-market operations as an effective instrument of monetary policy. If we compare our results from the Ordinary Least Squares regressions to those of other researchers in the field, for example, D. Bean (1975) and R. Zecher (1975),

we can say that ours are not any weaker.

With some reservations, we may conclude that the monetary approach to the balance of payments can explain reserve flows in Greece.

Footnotes to Chapter V

<sup>1</sup>Bean, D., "International Reserve Flows and Money Market Equilibrium, The Japanese Case," The Monetary Approach to the Balance of Payments (London, 1975).

<sup>2</sup>Genberg, H., "Aspects of the Monetary Approach to the Balance-of-Payments Theory, An Empirical Study of Sweden," The Monetary Approach to the Balance of Payments (London, 1975).

<sup>3</sup>Guitian, M., "The Balance of Payments as a Monetary Phenomenon, Empirical Evidence, Spain 1955-71," The Monetary Approach to the Balance of Payments (London, 1975).

<sup>4</sup>Magee, Stephen P., "The International Monetary Mechanism: Recent Problems and Evidence. The Empirical Evidence on the Monetary Approach to the Balance of Payments and Exchange," American Economic Review, Vol. 66, No. 2 (May, 1976) pp. 163-170.

<sup>5</sup>Zecher, R., "Monetary Equilibrium and International Reserve Flows in Australia," The Monetary Approach to the Balance of Payments, (London, 1975).

## CHAPTER VI

Data Appendix

We shall now elaborate briefly on the data, i.e., their definitions, sources, and technical manipulations.

The data used in this study was collected from published sources and therefore will not be reproduced here. The sources used were: The Monthly Statistical Bulletin of the Bank of Greece [1]; The International Financial Statistics of the International Monetary Fund [2]; The Industrial Production Quarterly Supplement to Main Economic Indicators of the Organization of Economic Cooperation and Development [3]; and the Industrial Production, Historical Statistics of the OECD [4]. Various issues of these publications were used.

a. Definitions and Sources.

1. Monetary Data

These data were obtained from sources [1] and [2]. We assumed that the monetary sector was made up by the Central Bank, the Treasury, and Commercial Banks.

Narrow Money (M1): Currency in circulation plus demand deposits of the public and the public sector in commercial banks.

Broad Money (M2): M1 plus time deposits and savings deposits at commercial banks.

Monetary Base (H): Currency in circulation plus deposits of commercial banks at central bank (we also gave another version of the monetary base in which we included the above plus the deposits of the public in the central bank).

International Reserves (F): Gold plus SDRS plus foreign exchange at central bank plus net reserve position at the fund.

Government Debt (GD): This is the stock of the outstanding government debt. Quarterly observations for this series did not exist before 1970.

## 2. Interest Rates and Price Data.

These data were collected from sources [ 1 ] and [ 2 ].

Nominal Rate of Interest (NR): This was generated as a weighted average of the interest rates on time deposits and saving deposits where each weight is the share of the individual deposit in total deposits (time deposits plus saving deposits).

The series used to generate NR were collected from source [ 1 ]. All other measurements of the interest rate used in the demand for money regressions were collected from [ 2 ].

The Consumer Price Index was used as a proxy for the price series. All the CPI series used in this study were collected from source [ 2 ].

## 3. Income Data.

Sources [ 2 ], [ 3 ], and [ 4 ] were used for these data. Neither the Gross National Product, nor the Gross Domestic Product, nor the Industrial Production Index series are offered in quarterly form (of these the latter is offered in quarterly form but not for the overall period). On those occasions that we needed quarterly data for income, real or nominal, we used the manufacturing production index (MPI) for the former and the sum of the growth rates in (MPI) and CPI for the latter. However, we also interpolated the annual GDP series to generate an

alternative measurement of income. The MPI data were collected from source [ 4 ], the GDP from source [ 2 ]. The OECD weighted average growth rates in manufacturing production were obtained from source [ 3 ]. The permanent income series was created as a seventeen quarter moving average of the MPI. The procedure was similar to that suggested by Friedman.<sup>1</sup>

b. Data Manipulation

All quarterly data used in this study was seasonally adjusted. The method of adjustment used was the Ordinary Least Squares.<sup>2</sup>

Footnotes to the Appendix on Data

1. Milton Friedman, A Theory of the Consumption Function (Princeton, Princeton University Press, 1937) pp. 144-46.
2. For a thorough presentation of this technique see Michael C. Lovell, "Seasonal Adjustment of Economic Time Series and Multiple Regression Analysis," Journal of American Statistical Association, LVII (December, 1963) 993-1010.

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