MACRO-ECONOMETRIC MODELS FOR GREEK ECONOMY : A COMPARATIVE AND CRITICAL REVIEW

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1. INTRODUCTION

Over the last twenty years several macroeconometric models have been produced for the Greek economy. All of them are the product of individual research and have been constructed independently of the monetary authorities and government organisations[2]. The first type of models developed for the Greek economy were in line with the broad consensus among economists that the Keynesian-type of model best explains the working of the economy. However, within the last decade economic research has moved from the standard Keynesian macroeconomic analysis to pay more attention to the structure of the monetary sector and its role within the context of macroeconomic policy. Throughout the I960's and 1907's,

1. This paper has been adapted from chapter 1 of my PH.D thesis (1982). The author is much indebted to Professor Patrick Minford and Ken Holden for their helpful comments and suggestions on an earlier draft. I also thank Ken Cleaver for his assistancee in the preparation of the final draft. However the author remains solely responsible for the views expressed and any remaining errors.

2. The centre of Planning and Economic Research has been preparing short - term forecasts on the Greek economy. A shortrun econometric model is utilised containing 20 behavioural equations and 20 identitise. The first stage of the forecasting process is the formulation of projections for 10 Gross Domestic Product categories, 5 aggregate demand categories, imports, exports and prices of each category. These forecasts are combined into an aggregate demand projection which is then equilibrated with a forecast of the aggregate supply of goods and services. The Centre's forecasts are currently restricted to goverment and we were unable to receive details of the models,

particularly in the United States, many economists criticized the Keynesian ideas and supported a view that stressed the efficiency of the free market mechanism and the importance of money in economic policy. Therefore, it is not surprising that research about the Greek economy in the 1970's has emphasized the structure and development of the Greek monetary sector and its role within a macroeconometric model.

The objective of this section is to reveal the essential features of the various Greek models, rather than to give a detailed account of the specification and parameter estimates of the equations. In addition, we are concerned with the simulation properties, which will show up the differences between the models.

The models[3] we have selected to examine were chosen as representative of the work that has been carried out so far. In addition through these models we can examine the evolution of the ideas about the working mechanism of the Greek economy. The six models we have selected can be classified into two broad categories, according to the importance attached to the monetary sector in each model. The first category, under the generic title of «Real Models» encompasses four of the reviewed models, they have the special feature that their structure depends heavily on the demand and/or supply factors of the real sector. The monetary sector is either absent, or plays a non-essential role within the models. The two models by Pavlopoulos (1966) and Scheidell and Tsoublekas (1974), hereafter referred to as PAV and ST. are demand determined models with a very simplistic structure. Whilst the remaining two models by Vernadakis (1978), hereafter referred to as Vern., and Tsoris (1976) bring explicitly into their analysis the supply side of the real sector, together with a more detailed examination of the demand side.

The second category, under the title of «Monetary Models», includes the final two models for review. Both the models try to explore the mechanisms of the monetary sector and its links with the real one, but they use rather different approaches. The model by Kasmas (1972) is built upon the analysis of sources of the monetary base, whereas the other model by Avramidis (1972), hereafter referred to as Avr., takes the opposite approach with analysis being based upon the uses of the monetary base.

3. The reason we have excluded from our review the model recently developed by KATOS (1979) is that the latter belongs to the growth models category. In brief the model utilises the simple Keynesian income - expenditure framework which is then extended to accomodate growth considerations such as birthrate, deathrate and the rate of technological change.

2. BASIC CHARACTERISTICS OF THE MODELS

In this section we will point out some general technical characteristics and also the details of each model's individual sectors. In the next section we will discuss the overall structure of the model. Table 1 provides us with the technical features of the models. The next four tables, 2 to 5, give more details on an equation by equation basis, and help us to understand the differences in disaggregation among the models.

Only two models reviewed have production functions. Tsoris model relates the output (value added) per man to capital per man and treats employment endogenously. Vern. model relates output (value added) with capital stock and labour, the latter being exogenous. Production in Tsoris model is dis-aggregated to five sectors namely Agriculture, Manufacturing, Construction and the rest of the economy whilst Vern. breaks down the output into agricultural, manufacturing, construction, mining and services.

In examining tables 1 to 5 it is clearly possible to differentiate between these six models reviewed on the basis of several possible criteria of demarcation e.g. degree of dissagregation, presense or absense of explicit supply side etc. Each of these potential classifications would be useful and insightful in some way but are not further pursued here in favour of what is deemed to be a more fundamental demarcation which is based on their underlying theoretical framework. Such a demarcation appears to be more productive for the purposes of comparison and analysis because it places emphasis upon the working mechanism and essential structure of the Greek economy as envisaged by each author. Such a demarcation procedure underlines our differentiation between the six models reviewed into the broad categories of Real or Monetary model .An examination of these categories will now be made.

3. «REAL MODELS»

3.i. Pavlopoulos Model

The model developed by Pavlopoulos was the first econometric model of the Greek economy. The structure of the model is extremely simplistic. It is a strict demand-orientated model with income being determined by aggregate demand.

TABLE 1

GENERAL CHARACTERISTICS OF GREEK MODELS

MODEL	Total number of equations	Behavioural Equations	Identities	Exogenous Variables	of which		Data Base	Sample Period	Estimated Method
					Dummy	Lagged Endogenous			
PAV	17	12	5	27	4	5	Annual	1949 - 1959	OLS-2SLS
ST.	20	15	5	24	-	6	Annual	1955 - 1970	OLS
VERN	32	21	11	69	4	7	Annual	1953 - 1966	OLS-Principal Component
TSORIS I	90	51	39	39	1	12	Annual	1955 - 1970	OLS-2SLS
TSORIS II	91	52	39	40	1	12	Annual	1955 - 1970	OLS-2SLS
KASMAS	19	13	6	22	3	7	Annual	1955 - 1966	OLS-2SLS
AVRAM	42	30	12	45	3	11	Annual	1954 - 1968	OLS-2SLS

TABLE 2

CONSUMPTION FUNCTION OF GREEK MODELS

MODEL	Income Variable	Monetary Variable	Relative Prices	Other	Lag Structure	Dis-Aggregation
PAV.	Agricultural Non-agricultural	-	-	-	One period discrete	Total private
ST.	National income	Real liquid assets (M3)	-	-	One period discrete	Total private
VERN.	Disposable income	-	-	-	-	Durable Non-durable and services
TSORIS	Disposable income	-	-	-	One period discrete	Total private
KASMAS.	Disposable income	Wealth	-	Wealth lagged two periods	One period discrete	Total private
AVRAM.	Disposable income	-	-	Lagged disposable income	-	Total private

TABLE 3

INVESTMENT FUNCTIONS OF GREEK MODELS

MODEL	Demand Variable	Monetary Variables	Stock level	Other	Lag Structure	Dis-aggregation
PAV.	GNP	-	Capital stock lagged one period	3 year moving average of marriages	discrete	Plant Equipment Residential
ST.	Imports	Bank credit	-	Time trend average marriages	discrete	Agricultural Construction Manufacturing Public utilities Other services
VERN.	Output disposable income	Bank credit	Capital stock every category	Direct foreign investment	discrete	Agricultural Manufacturing Mining Dwelling Other services
TSORIS.	GNP Disposable income	Discount rate Bank credit	Capital stock lagged one period	-	discrete	Agricultural Construction Manufacturing Rest
KASMAS.	GDP	Discount rate	-	dummy	-	Total private
AVRAM.	GDP	Bank credit	-	dummy	-	Agricultural Construction Mining Rest

TABLE 4

PRICE SECTOR OF GREEK MODELS

MODEL	(IPD = Implicit price deflator) Price level	Unit Labour Cost	Monetary Variables	Foreign Prices	Other Exogenous Prices	Other
PAV.	IPD of Agriculture IPD of consumption	-	-	Import price index	dummy	Indirect taxes to consumption
ST.	IPD of gross domestic fixed investment	-	-	-	Price of imports	Time trend
VERN.	IPD of non-agricultural output	-	-	-	IPD of Agriculture, output	Lagged dependent
	IPD of Consumption	-	-	-	-	IPD of non-agricultural output
TSORIS I	IPD of GNP IPD of consumption	- Nominal wages	-	-	-	IPD of consumption labour productivity, timetrend
TSORIS II	IPD of GNP IPD of consumption	- -	- -	- -	- -	Nominal GNP/real GPP IPD of GND
KAGNAS	-	-	-	-	-	-
AVRAM.	IPD of private consumption	-	velocity of money stock	Import prices	-	Rate of taxation on total consumption
	IPD of total consumption	-	-	-	IPD of public consumption	
	IPD of GNP	-	velocity of money stock	Import prices	-	Rate of indirect taxation on GNP

TABLE 5

IMPORT FUNCTION OF GREEK MODELS

MODEL	Dis-aggregation	Monetary Variables	Price Variable	Demand Variable	Other Exogenous
PAV.	Total	-	-	GNP	-
ST.	Consumption, Agriculature machines, Raw materials, Public utilities, Other	Domestic credit - Domestic credit - -	- Export price IPD of investment IPD of investment Price of imports	Consumption GNP, investment GNP Investment Investment	Lagged investment - - - -
VERN.	Consumer goods, Investment goods, Raw Materials	- - -	Pmc/Pc *	Disposable income Gross investment Output in manufacturing sector	Lagged investment Lagged investment Lagged investment
TSORIS	Food, (1) Machinery and transport equipment, (2) Raw materials, (3) Manufacturing goods, (4) Services (5)	- - - - -	P1/p ** P2/p ** P3/p ** P4/p ** P5/p **	GNP GNP GNP GNP GNP	- - - - -
KASMAS	Total	-	-	GNP	-
AVRAM.	Total	-	-	GNP	Dummy, Time trend

* Pmc = Implicit price index for consumption goods imported
* Pc = Implicit price index for private consumption
** Pi = Implicit price index fot i category of import, i = 1, 2, 3, 4, 5
** p = Implicit price index for GNP

This income/expenditure approach involves several problems. First, it is dificult to give a rigorous interpretation to the findings unless you accept that the espply side reacts promptly and adequately every time aggregate demand changes, therefore it is being implicitly argued that demand creates its own supply. This in turn implies that we always have an excess supply of labour and excess productive capacity. The price sector of the model explains the two implicit price deflators of agricultural output and private consumption. However, their structural equations are not based upon any kind of theory. The first deflator is determined by a dummy variable and the stock of agricultural output, which is itself determined by the difference in supply and demand for the agricultural product both of which are deemed to be endogenous. These three equations comprise the agricultural subsector of the model.

The second deflator is simply related to the first and to the import price. The sectoral breakdown is insufficient as the model totally ignores the monetary sector and incompletely discusses and represents the fiscal and foreign sectors and the important links among the sectors. Therefore, the whole model boils down to three essential structural equations.

(1) $E = G + f(Y)$

(2) $Y = E + EX - IM$

(3) $IM = f(Y)$

Y = income (GNP)

E = total expenditure

G = government expenditure

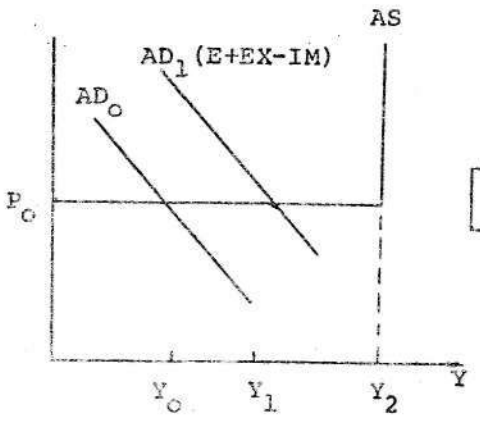
EX = exports

IM = imports

The above system of equations, it is obvious, represents the equilibrium in the goods market, or in terms of an IS — LM framework the IS curve. The money market as we have already mentioned is not specified and that makes the model undetermined in an IS — LM framework. However, we can easily depict diagram-

matically the Keynesian nature of the model in terms of aggregate demand and suplly curves (see Figure 1) or in a simple Flow diagram as shown in Flow diagram 1.

FIGURE 1



AD = aggregate demand
AS = aggregate supply

FLOW DIAGRAM 1

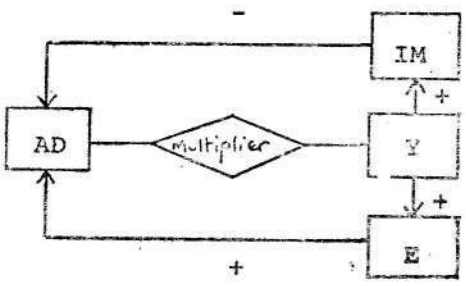


TABLE 6

TRUNCATED MULTIPLIERS FOR ΔG AND ΔEX OF THE PAVLOP. MODEL

	ΔG = 1 billion Dr.			ΔEX = 1 billion Dr.	
	1 year	5 year	8 year	1 year	5 year
Consumption	0.727	1.989	2.158	0.727	0.963
Imports	0.89	0.176	0.186	0.090	0.643
GNP	1.466	2.959	3.144	1.466	1.401
GNI	1.363	2.674	2.835	1.363	1.262
Implicit deflator of private consumption	.0004	.0010	0.0010	.0004	.0004

From the above diagrammatical representation of equation (1) to (3), it is clear that the «driving force» of the economy is aggregate demand. Therefore it is not difficult to trace the behaviour of the model under any change in any one of its exogenous components of aggregate demand. It is a simple mutilplier calculation problem. In Table 6 we reproduce the results for a sustained increase in government speding (AG) and a sustained increase in exports (ΔEX).

As we can see from Table 6 the economy responds similarly to both kinds of shocks. In both cases the impact multipliers for all the endogenous variables are exactly the same and the size of the income multiplier is signigicantly above unity. This is again what we would expect from a simple demand-oriented model. According to Figure 1, when ADo(due to the change in government spending or exports) shifts to AD1 the economy expands and the income increases from Yo to YI by the full textbook multiplier. However we notice that in the case of the increase in exports the impact on the economy is comparatively curtailed. This phenomenon is due to the negative impact on income generated by the substantial increase in imports induced by the initial wake of the increase in income. Overall, the model's simplistic structure makes it useful for pedagogical purposes rather than analytical and policy purposes, as the author himself admits «the limitation of our model for policy purposes in a developing economy are painfully obvious» (p. 298 - 299). Whatever the structural and theoretical deficiencies we must give credit to it not only because it was the first model of the Greek economy, but also Pav. presented an interesting discussion of the relatively important agriculture sector for the Greek economy.

3.2. **Scheidel** and Tsoublekas Model

The second model which belongs to the «Real Model» category does not differ in any fundamental sense from the Pav. model already examined. The ST. model is fully demand determined with its structure founded upon orthodox Keynesian ideas. Therefore the present model, shares the already noted common problems of such demand oriented model e.g. the lack of the supply side. In addition both models express all variables at constant prices and provide no price sector to determine the domestic price level. So the models implicitly have assumed a fixed price level situation which of course renders their analysis very short-run in nature, whilst no analysis is provided for the monetary and public sectors. The obvious, but not important to their essential structure, differences are the degree of dis-

sagregation, the estimation period employed and the introduction of some new additional explanatory variable by the present model.

According to the authors, the main purpose of the present model is to emphasise the «relationship between domestic investment and international trade» (p. 1). Towards this objective, total investment and imports have been dissagregated into five interrelated categories. The five investment functions are given the theoretically unconventional form of being made dependent upon the correspondong categories of imports and bank credit. It appears that there is no economic rational behind the basic formulation of the investment function. In turn the import functions are determined by income and domestic credit whilst with the addition of three export functions the foreign sector of the models is completed. However the form given to the export functions is theoretically questionable and empirically unsatisfactory. First, contrary to the conventional economic theory, exports are assumed to be determined by domestic demand factors such as foreign investment whilst the factors usually deemed to be relevant such as fore.gn income and prices are not considered. Secondly, although exports are treated as endogenous, all the explanatory variables employed are either exogenous or lagged endogenous which render exports effectively exogenous as made obvious from simulations. Finally, the estimation of the three export functions is unsatisfactory since the three lagged investment explanatory variables do not contribute significantly, as shown by their t-statistics, to the explanation of exports. It is only the other exogenous variables, namely time trend, which contributes significantly to the explanation of exports variation.

Finally, a conventional form of consumption function together with the national income identity close the model. In addition to the representation of the national income in the consumption function there is a surrogate for the influence of wealth on consumption. This influence is proxied by the broad definition of money stock (M 2). However the role of the wealth surrogate, due to the absence of the monetary and price sectors, is very limited, whilst its presence is completely out of the model's character.

Overall, the model, despite its aformentioned peculiarities, remains basically a Keynesian demand-determined model, whilst the choice of the explanatory variables apparently derives from an ad-hoc basis or best-fit criterion rather than by appeal to any conventional economic theory. As for the estimation of the model, it is necessary to point out that 14 out of 40 estimated coefficients, (excluding constants), are not statistically significantly different from zero,

The St. model can be presented in an aggregate form by the following system of equations.

$$Y = E + EX - IM$$
$$E = F\ (Y,\ W,\ IM,\ CR)$$
$$M = F(Y,\ CR)$$
$$X = F(Time,\ I)$$

Y = national income
E = expenditure
EX = exports
IM = imports
W = wealth
CR = domestic credit
I = investment

The above system of equations determines the IS curve, but the absence of the monetary sector renders the model, in a Hicksian IS - LM framework, underdetermined. However, we can represent, as we have done in the case of PAV. model, its basic working mechanism in terms of aggregate demand and supply (see Diagram 1). Total aggregate demand, AD line, is the driving force of the economy, while aggregate supply is implicitly assumed to adjust passively. The size and direction of the final (total) impact a change in the aggregate demand will exert upon income is determined by the size and direction of the multiplier effect that every individual component of aggregate demand will have on income. The multiplier links are also presented in Flow Diagram 2.

FLOW DIAGRAM 2

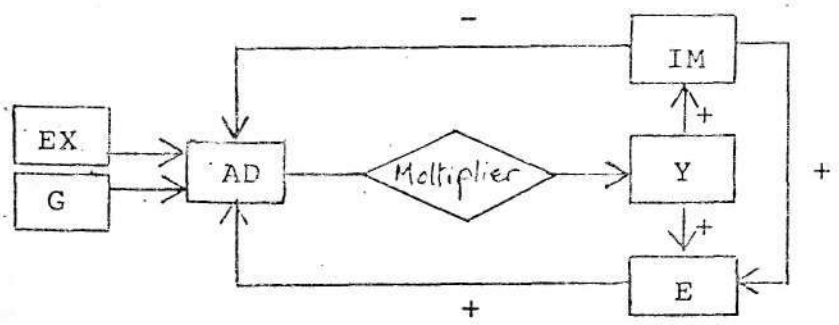


TABLE 7
SELECTED MULTIPLERS OF THE ST. MODEL

	An increase in government spending			An increase in bank credit to housing sector			An increase in bank credit to importing sector		
	Impact	5 year	Long -run	Impact	5 year	Long -run	Impact	5 year	Long -run
Consumption	1.45	3.69	3.25	0.76	1.92	1.92	-5.30	-18.20	-16.70
Investment	0.22	0.28	0.13	0.64	0.66	0.66	2.46	1.77	2.61
Imports	0.36	0.72	0.63	0.18	0.37	0.37	5.62	5.58	5.95
Exports	0.00	0.10	0.08	0.00	0.05	0.05	0.00	0.28	0.39
G.N. Income	2.32	4.35	3.82	1.21	2.26	2.26	-8.45	-21.74	-19.69

In the case of the three policy experiments carried out with the present model, the impact, 5 year and long-run multiplier of individual aggregate demand components are reproduced in Table 7. These results, allowing for the already noted peculiarities of the model, are basically in agreement with the standard textbook income multiplier analysis. However, comparing these results with the ones from PAV. model, in the case of the common policy experiment of increase in the government spending we observe that although the results qualitatively agree, the size of the impact and long-run multipliers are comparatively much higher in the present model. This difference could be attributed to two factors. First, it is the utilisation of almost completely different periods in estimating the model which might have produced different estimates for the various marginal propensities. Second, and more important, it is the earlier mentioned form of investment function which allows the income-induced increase in imports to have a positive impact on investment which in turn outweighs the initial negative impact the former exerts on income. The second and third multiplier exercises carried out are dealing with an increase in credit to the manufacturing and housing sectors respectively. Surprisingly, the latter experiment provides quite the opposite effects on the economy compared with the former. This is of course due to the arbitrary use of the bank credit variables within the model. The increase in bank credit to housing sector, which is a determinant of the investment in construction sector, exerts a positive impact effect on total investment which in turn triggers off the multiplier process, with an ultimately positive effect on national income. On the contrary, the increase in bank credit to importing sector, which is a determinant of the level of imports, directly increase total imports which in turn initiate a negative multiplier process. Despite the increase in investment due to the increase in imports, the multiplier remains negative with an estimate of—19.69 long-run multiplier for national income. This is rather an exaggeration of the possible effect a change in bank credit can have on national income. It is rather the result of employing monetary variables in the model on an ad - hoc basis without properly linking them with an explicitly specified monetary sector, which in turn interelates with the rest of the economy. There are certain constraints, real and monetary that the economy has to conform to and the absence of them from a model can lead to unacceptable results. In the present model for example, the assumed sustained increase in bank credit to importing sector keeps deteriorating national income because on the one hand there is not an explicit supply side into which the increased investment feeds back, and on the other hand the limits imposed by the level of foreign exchange reserves on how long imports can expand are ignored. Therefore for the satisfactory and consistent treatment of the monetary variables we need to specify the monetary sector and its constraints as well as the real and foreign sectors, their interrelations and any constraints within and across those sectors.

Overall then, although the author's original idea of emphasining the international economic relationships of Greece is welcomed, unfortunately its incarnation into a model is un successful. The structure of the model is not only partly theoretically unsupported but also incomplete. Although the specification of the foreign sector in terms of exports and imports is broadly acceptable, their specific functions for both exports and imports are theoretically unfounded and incomeplete. We need a comprehensive model which will incorporate and explicitly specify the monetary, the real and the foreign sectors and their interrelationships.

3.3. Vernadakis Model

The next model we examine also belongs to the «Real Model» category. It again emphasises the real sector of the economy but brings into the picture both the demand for and the supply of goods and services. The total production has been divided into four sectors, namely Agriculture, Manufacturing, Mining and Services. The ouput of the Agriculture sector is determined by its own lagged value, the exogenous price index (implicit deflator) of agriculture output and two dummy variables. This formulation effectively renders the agricultural output exogenously determined. In addition we could argue that it is relative prices rather than the employed absolute price to which the suppliers of agricultural output respond to. The output of services is clearly demand-determined with disposable income being its major determinant. The production fuctions for the other two sectors' output (value added) have the familiar neoclassical form with the level of capital stock and employment being the explanatory variables. Contrary to the conventional Keynesian models, in which the production function given the capital stock is used to determine the level of employment, this model treats the level of employment as being exogenous. A reasonable question then is what is the role of the production functions in the model. The answer the author gives is that «the reasons we have such a function in the model is only as a predictive function not atruly behavioural explanation» (Vernadakis 1974, p. 48). Again, however, it is not clear what is meant by «predictive function» and how it differs from a «truly behavioural explanation». Furthermore in another section he argues that «Here, production function determines the lever of output itself with the abundant factor - labour - taken as exogenous. Total output (value added) determines income and the income generating approach then starts affecting demand» (p 129). So it is argued that income is supply determined. However, with the output of Agriculture sector being exogenously determined, as previously ar-

gued, and the output of services being clearly demand - determined whilst the labour in manufacturing and mining production functions is treated as exogenous, it is not possible for income to be supply determined. It is still an open question what exactly the production functions are needed for. With domestic output of the different sectors being either exogenous or demand - determined we could argue that the model remains basically a demand - determined one with a similar structure to the previously examined models. The differences being that the income components have been further disaggregated whilst at the same time new ideas about possible sociological and demographic factors affecting the components of aggregate demant have incorporated into the VERN. model. These factors included the institution of dowry and its content, the superstition against getting married on a leap year and the problem of immigration. Therefore the real sector of the model can be presented in an aggregate form as follows :

$$(1) \qquad E = G + f\,(Y,\ Pci/p,\ FI)$$

$$(2) \qquad Y = E + EX - IM$$

$$(3) \qquad IM = f\,(Y)$$

Where E = total expenditure

G = government spending

Pci/p = ratio of implicit price index of i^{th} consumption category to implicit price index of total consumption

EX = exports

IM = imports

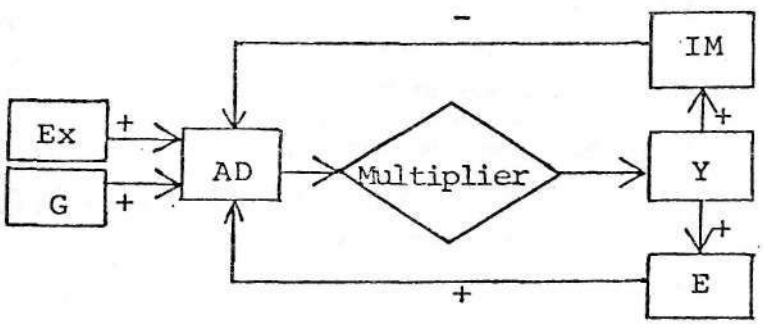
FI = foreign investment

From the above summary of Vern. model we observe that expenditure varies proportionately with income and inversely with relative prices (Pci/p) which are used in the consumption functions. The import functions use as additional arguments to the level of disposable income, the investment in and output of the manufacturing sector in order, according to the author, to capture the fact that most of the capital and raw material used by that sector is imported. However, since output itself is demand-determined, the import function (3) is shown a function of income only.

Price determination is one again treated in an unsatisfactory manner, a point admitted by the author. Both the implicit price deflator of private consumption and of non-agricultural output depend upon each other, their lagged values and the exogenous price deflator of agricultural output Therefore the way the price equations have been established means they play no major role in the model, for they are effectively isolated from the rest of the model.

The monetary sector is entirely absent from the model whilst the two equations dealing with indirect taxes and social security taxes serve only to complete the income (GNP) identity to close the model rather than adequately represent the fiscal sector. Therefore, the system of equations (1) to (3) represent the basic, structure of the model, the latter also presented in Flow Diagram 3.

FLOW DIAGRAM 3



AD = Aggregate demand

Next we consider the model's performance under different policy experiments carried out by the author. In Table 8 we reproduce the multiplier effects that a sustained increase in government's spending by one billion drachma, exerts upon the economy.

TABLE 8

TRUNCATED MULTIPLIERS FOR A SUSTAINED CHANGE IN GOVERNMENT SPENDING OF THE VERN. MODEL

	1 year	5 years	8 years	10 years
Consumption	0.62	1.33	1.47	1.48
Investment	0.024	0.085	0.096	0.095
Imports	0.32	0.53	0.56	0.56
GNP real	0.86	1.55	1.65	1.66
Output in:-				
Manufacturing	0.00	0.005	0.007	0.007
Mining	0.00	0.003	0.006	0.007
Agriculture	0.25	0.930	1.131	1.173
Services	0.00	0.000	0.000	0.000
GDP real	0.25	I.030	1.270	1.230

The interesting features of the results in table 8 which support our earlier arguments about the exogeneity of agricultural output and reinforce our belief of the demand orientation of the model, is on the one hand that the agricultural output remains completely unaffected and on the other hand any change in GDP is identified with the change in output in services which is demanf - determined.

Comparing the results in Table 8 with those of the Pav. and St. models, we observe that although qualitatively they agree, the income (GNP) multiplier is comparatively lower in the present model. This divergent effect on the GNP could be explained by the different estimates of the injections (consumption and investment multiplier) to and leakages (import multiplier) from national income. These different estimates compared with the Pav. model, would be the result of utilising a different time period for estimating the model, but compared with the St. model which employs almost the same period, is rather the result of the peculiar structure of the investment function in St. model.

The sequence of multiplier effects can be traced in Flow Diagram 3 which compared with Flow Diagram 2 makes obvious the major differences between St. and the present model.

The next policy experiment considered is a sustained one percent increase in the implicit deflator of the domestic agricultural output (Pa), the latter being a determinant of the domestic demand for, and the supply of, agricultural output- Table 9 summarizes the results.

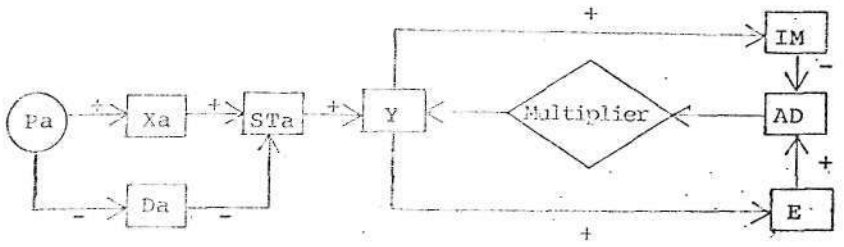
TABLE 9

TRUNCATED MULTIPLIERS FOR A SUSTAINED 1 PERCENT INCREASE IN Pa OF THE VERN. MODEL

	1 year	5 years	10 years
Consumption	0.161	0.578	0.810
Investment	0.005	0.015	0.033
Imports	0.096	0.252	0.321
GNP real	0.245	0.744	1.043
Output in manufacturing	0.000	0.000	0.000
Output in mining	0.000	0.000	0.000
Output in agriculture	0.000	0.325	0.416
Output in services	0.066	0.338	0.538
GDP real	0.066	0.663	1.043

In the above experiment the major changes take place within the agricultural sector and then transfer to the rest of the economy. The transmission channel is the stock of agricultural output (Sta). The latter, due to the excess supply of agricultural output induced by the change in Pa, is substantially increased, and such an increase automatically feeds into GNP identity and again we witness the witness the multiplier process, with an impact multiplier of only 0.24 and a long-run (10 years) just above unity (1.043).

FLOW DIAGRAM 4



Xa = supply of agricultural output
Da = demand for agricultural output
Sta = stock of agricultural output

The above sequence of causal events can be easily traced in Flow Diagram 4.

However such a policy experiment raises several questions about itself and the results. First the price of agricultural goods is treated as being under the control of the Greek authorities ignoring the fact that Greek agricultural products are traded within the world markets for such products and, in addition, the absence of any monopolistic power of Greek agricultural goods implies that the price of Greek agricultural products has to move in line with world prices. Secondly, even if we accept that the Greek authorities are capable of supporting an increase in the price of their agricultural goods over world prices this support would involve a financial burden for the government which will probably affect the level of budget deficit and the balance of payments. However these consequences are not considered by the structure of the model. Finally, the increase in the stock of agricultural goods, not only is not allowed to feedback into the production decision process but also is unreaiistically assumed that it is not or cannot be sold to the foreign markets and benefit the Greek balance payment situation.

The final policy experiments conducted examined the effects of a once and for all and a sustained increase of one billion drachma in direct foreign investment, the variable being used as one of the investment's determinants. The multiplier results are reproduced in Table 10.

From Table 10 it is obvious that in both cases although the impact multiplier of income is negative (—0.777) for the GNP, paradoxically is positive (0.159) for

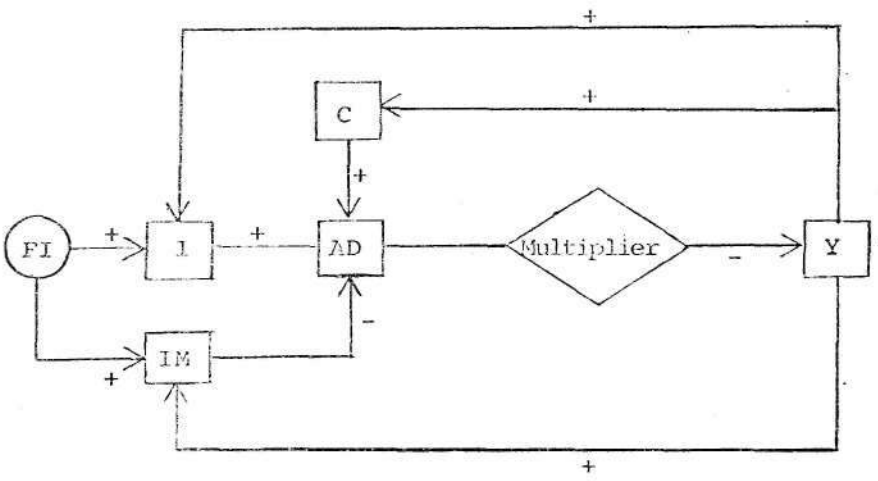
TABLE 10

TRUNCATED MULTIPLIERS FOR AN INCREASE IN DIRECT FOREIGN OF VERN. MODEL

	Once and for all change					Sustained change		
	1 Year	3 Years	4 Years	5 Years	10 Years	1 Year	5 Years	10 Years
Consumption	0.082	0.458	0.532	0.59	0.50	0.082	1.724	3.452
Investment	0.752	0.045	0.036	-0.051	0.019	0.752	1.233	0.890
Imports	1.828	0.581	0.682	0.43	0.32	1.828	3.183	4.138
GNP real	-0.077	0.199	0.082	0.30	0.228	-0.077	0.308	1.345
GNP real	0.159	0.976	1.035	1.00	0.662	0.159	2.612	5.926

the GDP. This surprisingly diametrically opposed behaviour of those two similar concepts of national product is of course a unique feature of the model. The initial increase in direct foreign investment has a direct positive effect on imports as well as on investment (manufacturing), but with the latter being estimated much lower than the former. The ultimate result is a negative impact multiplier for GNP, whilst GDP impact multiplier is positive due to the increase in manufacturing production triggered off by the increase in investment. This sequence of multiplier chains can be seen in Flow Diagram 5.

FLOW DIAGRAM 5



C = domestic consuption
I = domestic investment
FI = direct foreign investment

After the first period the behaviour of the economy is different. In the case of the once and for all increase, most of the variables experience dampened oscillations of varying amplitudes and duration whilst this is not observed in the use of the sustained increase.

Another feature common to the last two experiments is that the multiplier although it becomes positive after the first year, it remains distinctively

lower than the multiplier of GDP. This unexpected divergent responds to the foreign investment shock by these almost identical concepts of national output, a!th ugh it can be partly justified by the fact that GDP is measured at constant factor prices whilst the GNP is measured at market prices; it is primarily due. to the ambiguous role production functions have been assigned within the model Throughout the period the positive impact the increase in investment has on the GNP is almost counter balanced by the strong negative impact the increase in imports has on the GNP. The result is a small increase in the GNP. On the contrary, GDP multiplier fully reflects not only the positive effects the increase in investment has on the output through the increase in capital stock, but also the increase in output on services induced by the small increase in GNP. Therefore, although the national output (GNP) in Vern. model is effectively demand determined as a result of the misuse of the production functions the impulses that GNP and GDP are receiving are distinctively different in size.

Overall then, the models' claim that it is a supply determined model is not supported by its structure and the results derived from it. It is unsatisfactory in terms of price sector modelling and incomplete in terms of monetary and fiscal sector treatment. The model's attempt to capture the impact of the foreign sector on the domestic economy through the investment - import relationships is deemed to be incomplete and unsatisfactory on economic theory criteria. As in the St. model case we need to analyse the monetary, the fiscal and foreign sectors together, taking into account both the existing constraints with in and across sector while at the same time attention must be given to the influences the external trade and monetary relationships of Greece with the rest of the world have on domestic economic conditions.

3.4. Tsoris Model

The last econometric model to be considered in the «Real Model» category was developed by Tsoris (1976) and is, to our knowledge, the largest model produced for the Greek economy. In fact Tsoris has developed two models—hereafter referred to as Tsoris I and Tsoris II—which differ only in the way the price level is determined. Accordingly all of our comments except those related to the price sçctor, will be equally applicable to both versions I and II,

The Tsoris mode! introduces and analyses both the aggregate demand for and aggregate supply of domestic output in great detail and in this respect it seems to be similar to the Vern. model. However there are two distinctive differences between these two models. First, and most important, employment in the Tsoris model, contrary to the Vern. model, is determined endogenously by the supply of output and real wages. Therefore in the Tsoris model the role of the production functions is quite clear, that is to determine the level of employment in each sector into which the production has been dissaggregated. Secondly, and this is a unique feature compared to the models we have reviewed and will be reviewing, is that the final demand by destination by the input/output method, is converted to the final demand by sector of origin. In this respect the Tsoris bears a striking resemblance to planning models which by using the technological coefficienst estimated from an input/output matrix, can determine the required level of production and employment of different sectors in order to satisfy the exogenously projected final demand of public and private sectors.

In addition the Tsoris model presents a more satisfactory analysis of certain aspects of the Greek economy which had been previously ignored or incompletely treated. First there is an explicit examination of the financial sector, secondly there is a more adequate representation of the price sector and finally there is a detailed analysis of government's revenue which represents almost half of the total model.

The structure of the aggregate demand side of the Tsoris model is similar to the structure of the models already reviewed with some minor differences in the level of dissaggregation in the components of aggregate demand. Therefore it is possible to summarise the Tsoris demand side by the following system of equation.

$$(1) \qquad E = G + f\,(Yd,\ r)\ CR)$$

$$(2) \qquad Yd = E + EX - IM$$

$$(3) \qquad Ex = f\,(Yw)$$

$$(4) \qquad IM = f\,(Yd,\ Pi/p)$$

Where E = expenditure

Yd = aggregate demand (GNP)

r = rediscount rate

CR = domestic credit

G = government expenditure

EX = exports

IM = imports

Yw = world income

Pi = price index of i^{th} import category

P = GNP price deflator

From the summary of the Tsoris model we can identify that expenditure (E) varies directly with the availability of credit[4] and inversely to the rediscount rate which is used in the investment function as a proxy for the cost of financing capital[5]. Exports and imports have a conventional form and depend upon relative prices and economic activity at home and abroad.

Aggregate supply of domestic output in the Tsoris model is derived from the four production functions estimated for each sector into which the economy has been dissaggregated. The production functions relate the ratio of output to employment i.e. the output per man with the ratio of capital employment, i.e. the capital per man.

4. In the TSORIS model and the next two models we review, domestic credit enters as an explanatory variable in the investment functions. However, it is not always clear whether financial factors such as Bank Credit enter in as a constraint on the rate of investment rather thait as a determinant of the desired stock of capital. On this problem see UNCTAD (1973).
5. The inclusion of the rediscount rate amongst the explanatory variables in the investment function is innappropriate. The reasons for this as well as the role of other interest rate will be examined when discussed the next «monetary» model,

We can therefore write :

(5) $Y^s = f(k, Ld)$

Where Y^s = aggregate supply (GDP)

k = capital stock

L^d = employment

The role of the production function, given the fact that capital stock is determined by the investment function, is to effectively complete the system with regard to the level of employment. Therefore we can write :

(6) $L^d = f(Y, w/Pc)$

Where W = wage rate

Pc = price deflator of private consumption

L^d = demand for labour (employment)

Equation (6) is derived from the marginal productivity condition of a Cobb-Douglas production function under the assumption of profit maximization. It is of course implicitly assumed that the suppply of labour is perfectly elastic up to the limit imposed by the labour force. Finally, the real sector is completed by the identity which determines the change in stocks (ST) as the adjustment factor between aggregate supply (Y^s) and aggregate demand (Y^d) and we can write :

(7) $ST = Y^s - Y^d$

However, the determination of stocks as in identity (7) has the drawback that it contains not only the statistical discrepancy between income and expenditure accounts, but also the estimation errors of all other equations estimated in the model[6]. It is also implicitly assumed that any excess demand for or supply of

6. On this point and other estimation problems in modellings developing countries see UNCTAD (1973).

output, both in the short - run and in the long-run can only be accommodated via adjustment in stocks. Finally, the model's approach fails to reflect the real world fact that the decision to increase or decrease stocks is a joint decision with the level of production and the influence of the former should be allowed to feed back into production process. The system of equations (1) to (7) represents an analysis of the real sector in Tsoris model. They are effectively the IS curve in a Hicksian IS — LM framework.

The structure of the monetary sector of the model is very simple. There are four equations which explain the demand for the four categories of private bank deposits (real)[7] the latter being deemed functions of income and an exogenous interest rate. They could be considered as representing the demand for the broad definition of money stock. Therefore we could write the demand for money of the Tsoris model as :

$$(8) \qquad TD = M^d = f(Y, r)$$

Where TD = total private bank deposits

M^d = demand for money (real)

The problem with this type of the demand for money function is that an important component, namely currency, is not included and therefore not explained.

The money supply in the Tsoris I is not considered at all, whilst in the Tsoris II it is treated explicitly as exogenous and its role is to determine the nominal income (GNP). If Tsoris I model is to be consistent with equilibrium in money markets it would appear neccesary to implicitly assume that the money supply is deemed to passively respond to a change in the demand for money. This assumption effe, ctively renders the money supply to be demand - determined i.e. endogenous which contradicts the author's agument that the money supply can be completely controlled by the Greek economic authorities.

7. The financial sector in TSORIS model also includes an equation which explains the supply of Bank loans to private sector. There are two major problems with this equation. First the demand for credit is not specified and hence the model becomes incomplete. Furthermore the equation is cutt off from the rest of the model with supply of credit being determined residually. Second, the specification of the equation is incorect because in addition to GNP it also includes the rediscount rate. The latter as we explain in the next nodel is an irrelevant factor for the banks credit policy.

In Tsoris II, with money supply clearly exogenous the monetary equilibrium condition, although not explicit in Tsoris II, can be defined as Md = Ms (9). Combining the monetary equilibrium condition (7) with equation (8) we can derive the LM curve within the IS — LM framework. Therefore the whole structure of the Tsoris model can be represented by framework.

Finally, the treatment of price formation needs some attention. It is already observed that this is the major difference between Tsoris I and Tsoris II. Both I and II use the same price indices, namely the implicit deflator of private consumption (Pc) and the implicit deflator of GNP (P). In Tsoris I Pc is determined by cost factors such as nominal wages by labour productivity and a time trend. The other price, P. is simply a function of Pc. The Real wage is determined by labour productivity which in turn is defined as the arithmetic average of output per man for the three sectors, manufacturing, construction and the rest of the economy. We can therefore write[8]:

$$(10) \qquad Pc = f(PR, W, t)$$

$$(11) \qquad W/Pc = f(PR)$$

Where: PR = labour productivity (Y^s/L)

t = time trend

Combining (10) and (11) we can see that price (Pc) is effectively determined by the labour productivity $\frac{Y^s}{L}$.

---

8. The actual estimated price and wage equations of TSORIS I are as following:

$$Pc = 1.0539 + 0.01437*t + 0.0000134*W - 0.0000091*PR \qquad R2 = 0.978$$
$$(2.7) \qquad (-1.9) \qquad DW = 1.703$$

$$P = -0.4652 + 1.464*Pc \qquad R2 = 0.986$$
$$(31.0) \qquad DW = 1.190$$

$$W/Pc = -3.264 + 0.5891*PR \qquad R2 = 0.987$$
$$(31.9) \qquad DW = 1.142$$

Numbers in parentheses are t-statistics.

In Tsoris II prices are claimed to be determined by the quantity theory. The monetary flavour of Tsoris approach is that money supply determines the nominal income (GNP), which together with real income defines the GNP price deflator as follows :

as follows :

$$(10a) \qquad P = \frac{GNP^*}{GNP}$$

$$(11a) \qquad GNP^* = f(M^s)$$

Where GNP^* = GNP nominal

Real wages are determined as in Tsoris I. This kind of price formation introduces two problems. First, the quantity theory represents a long-run analysis of price determination. In the short-run a change in money supply will affect both price (P) and real income (GNP) whereas in the long-run only prices (P). However, the identity (10a) which determines the price level cannot capture the short-run phenomenon. In fact, as the simulations of the model reveal, the price level as determined by identity (10a) behaves in an unusual way. Second, this approach to price formation fails to consider the fact Greece is a small country in relation to the rest of the world and that the authorities have maintained a fixed exchange rate regime throughout the period under examination. Therefore it is a mistake to consider that the money supply could be controlled by the monetary authorities. The Central Bank cannot control both the exchange rate and the money supply at the same time. As long as they peg the exchange rate, the authorities lose control over the money supply[9]. This situation is analogous to the case where the authorities cannot control the money supply and interest rate at the same time. One instrument must be «sacrificed» for the control of the other.

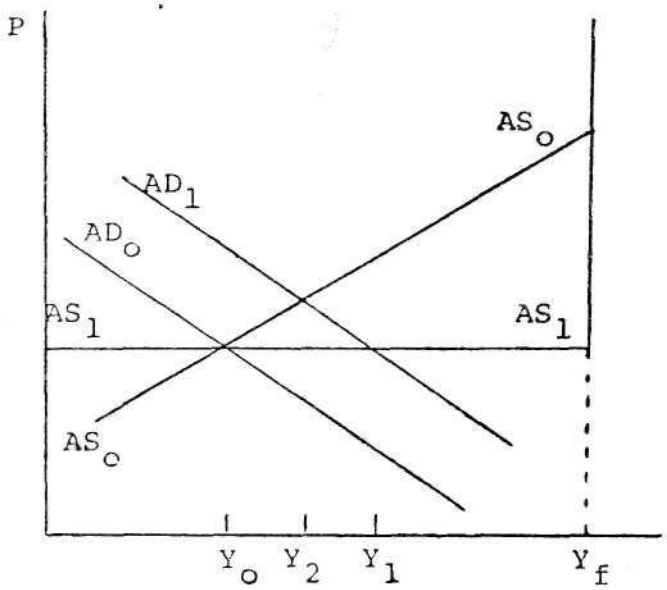
Overall it seems that the different specification of the price level in Tsoris II does not affect its essential structure which remains the same as in Tsoris I. This

9. This statement is dependent upon the numbers of and the effectiveness of policy instruments available to the monetary authorities. Therefore it must be further qualified to the extent that the authorities excersice trade and exchange controls. This issue is fully examined within the context of the Greek stabilisation policies in KARAPAPAS (1982) ch. 4.

together with other probiems can be seen from the policy simulation results which we next consider.

From Tables 11 and 12 we observe that under Policies A, B and C both models behave almost identically. The multipliers impact and dynamic for the real GNP are marginally different. However in the case of policy B which is the only comparable policy experiment with the previous three models reviewed, the multipliers for real GNP are significantly lower. This divergence can be explained diagrama tically as in Figure 2.

FIGURE 2



AD = aggregate demand
AS = aggregate supply
Yf = full employment income
P = price level

In the case of the previous three models where income is strictly demand determined the supply curve AS1 is assumed perfectly elastic. Therefore when aggregate demand shifts from ADo to AD1, due to a change in governement spending, the economy expands from Yo to Yl. However, in the case of Tsoris model the supply curve ASo is positively sloped and this reduces the income expansion to Y2.

From a dose examination of Tables 11 and 12 we observe that although the income multipliers under Policies A, B and C are almost identical in Tsoris I and

TABLE 11

IMPACT AND STEADY STATE MULTIPLIERS

MODEL I

	POLICY A		POLICY B		POLICY C	
	1962	1970	1962	1970	1962	1970
Consumption	0.122*[b]	.360	.120*	.328	-.364	-.179
Investment	0.017	.103	.016*	.078	-.049	-.006
Imports	0.104*	.175	.105*	.155	-.004	-.009
GNP real	0.325*	.410	.328*	.362	-.008	-.021
GNP nominal	0.362*	.562	.365*	.501	-.011	-.031
P	-	-	-	-	-	-
Pc	-	-	-	-	-	-
Employment	0.00788	.00769	.00477*	.00313	-.0601	.00006

POLICY A = 1 billion increase in domestic credit
POLICY B = 1 billion increase in government investment
POLICY C = 1 billion increase in direct taxes
POLICY D = 1.3 billion increase in money supply stock

* Figures bearing an asterist are multipliers of the year 1963

[1] All policies refer to once and for all change

Multiplier is the ratio of the difference between control and disturbed solution to the change in the exogenous variable

TABLE 12

MPACT AND STEADY STATE MULTIPLIERS[1]

Model II

	POLICY A		POLICY B		POLICY C		POLICY D	
	1962	1970	1962	1970	1962	1970	1962	1970
Consumption	.086*	.257	.083*	.234	-.356	-.184	.503	.011
Investments	.780	.096	.011*	.072	-.049	-.007	.068	-
Imports	.050*	.084	.050*	.074	-	-.006	.706	-
GNP real	.324*	.405	.327*	.358	-.004	-.025	.007*	.006
GNP nominal	-	-	-	-	-	-	4.92	-
P	-.000003*	-.000003	-.000003*	-.000003	-	-	.00004	-
Pc	-.000002	-.000003	-.000002*	-.000002	-	-	.00003	-
Employment	.007859	.007704	.00481	.00481	.00027	.00012	-.000075	.00013

POLICY A = billion increase in domestic credit
POLICY B = 1 billion increase in government investment
POLICY C = 1 bilion increase in direct taxes
POLICY D = 1.3 billion increase in money supply stock

– Figures bearing an asterist are multipliers of the year 1963

1 All policies refer to once and for all change

Multiplier is the ratio of the difference between control and disturbed solution to the change in the exogenous variable.

Tsoris II, prices respond completely differently. In Tsoris I prices do not respond at all under any of the policies whilst in Tsoris II prices under Policies A and B experience a decrease, as the small negative multipliers of —0.000003 and —0.000002 for P and Pc respectively indicate, while under Policy C the price response is negligible to be reported. This divergent behaviour of prices in Tsoris I and I can be considered only as the result of the different ways prices are determined in Tsoris I and II. In the former, as equation (10) and (1)) show, unless there is a change in the labour productivity $\left(\frac{Y^s}{L}\right)$, price will not change. Therefore the impulses generated by Policies A, B and C are transmitted, by the multiplier process to the aggregate demand whilst the aggregate supply is barely affected and consequently productivity $\frac{Y^s}{L}$ remains constant. The result is unchanged prices.

In Tsoris II since price (P) is defined as in identity (10a), a change either in nominal GNP or in real GNP will change the price. Nominal GNP will change only if its only determinant, money supply, changes. Therefore under Policies A and B the induced increase in real GNP, the same as in Tsoris I, by definition makes the price level fall whilst under Policy C the very small decrease in GNP has a negligible, which is not reported by Tsoris, positive effect on price level. In the case of Policy D, i.e. a once and for all increase in money supply, during the first period the large positive impact it has on nominal GNP makes by definition the price level increase. After the first period the price level returns to its original level as implied by the zero long-run multiplier. However the initial increase in real GNP by a multiplier of 0.007 is sustained as implied by the 0.006 long-run multiplier. Therefore the long-run implications of Policy D is an increase in real GNP and an unchanged price level. Such results however contradict the broadly accepted conventional monetary theory of price and income determination. Moreover in Tsoris II, under Policies A and B the fall in prices, together with the increase in employment implies an upward sloped Philips Curve which is a **rather hard** to accept result.

Another factor which contributes to the theoretically unconventional results of the Tsoris model is that it does not take into account any other effects, except those on aggregate demand, that the Policies A, B, C, and D might have on the other sectors of the economy. For example in Policy A an increase in domestic

credit not only affects, as the author argues, investment, but it also has a direct effect on money supply and therefore on the money market equilibrium which in turn has further repercussions for the balance of payments. In the case of Policy B for a consistent and complete analysis of the effects such a policy has on the economy we must specify the means of financing such an increase in government expenditure and explicitly model the effect it has on the monetary and foreign sectors. Therefore it would be desirable to have a more complete picture of the economy by specifying certain constraints which have to be satisfied within each sector and across them and explicitly analyse the inter-links between the monetary, foreign and real sector.

Overall then the model is characterised by its tendency to emphasise the real sector of the economy. However within this context the model has substantially improved compared to the previous models since both demand and supply side have consistently been modelled. Furthermore the model, together with the input/output technique is used for planning exercises which are useful. However questions such as what are the economic implications of an increase in budget deficit, of a change in domestic credit, and how the external environment impinges upon the Greek economy are not asked, or given a consistent answer. To answer these questions in a consistent manner it is necessary to recognise first the importance of the monetary sector in the context of conducting and understanding macroeconomic policy and second the importance of the international economic environment, within the «small-open» Greek[10] economy is operating, for the degree of autonomy over domestic economic destiny. The importance of the monetary sector has been recognised and embodied in the research work which we will review next under the heading of <• Monetary Models».

•

4. «MONETARY MODELS»

4.1. Kasmas Model

Kasmas represents the first model of this category. It is an attempt to integrate the real and monetary sectors and their interrelationships within a small

10. For an analysis and empirical results for the different measures of smallness and openess of the Greek economy see KARAPAPAS (1982).

econometric model[11]. The real sector of the model is highly aggregated compared with the previous models. It is a simple income-expenditure model, which can be represented by the following equations :

$$(1) \qquad E = G + f(Y, W, r, CR)$$

$$(2) \qquad Y = E + EX - IM$$

$$(3) \qquad IM = f(Y)$$

Where
- E = total expenditure
- Y = GNP
- EX = exports
- IM = imports
- G = government spending
- W = wealth proxied by the sum of currency and all private deposits
- CR = credit
- r = rediscount rate

From the above system of equations we observe that expenditure changes proportionately with income and real wealth, which makes expenditure vary inversely with the price level, but this phenomenon is not explained in the model. Expenditure also varies inversely with the nominal interest rate and proportionately with credit, since both variables are used as arguments in the investment functions.

The monetary sector explains both the demand for and the supply of money. The demand for money (M1) is decomposed into its two basic components, namely,

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11. To do justice to KASMAS (1972) it is necessary to note that the model presented here is only a small part of his research, the latter part of which dealt mainly with an empirical analysis of the demand for and supply of money in Greece and of the role of the Greek monetary policy.

currency and demand deposits. The equations (for currency and demand deposits) take conventional form with income and the interest rate being the explanatory variables. Therefore we can write an implicit demand for money function as :

$$(4) \qquad (CUR + DD) = M^d = f\ (Y,\ r)$$

Where CUR = currency

DD = demand deposits

In addition, there are two equations to explain saving and time deposits. The supply of money is not explicitly explained, but instead the monetary base becomes endogenous via the following identity :

$$(5) \qquad B = RR + ER + CUR$$

Where B = monetary base

ER = excess reserves

RR = required reserves

CUR = currency

The excess and required reserves held by banks are explained in terms of bank deposits and interest rates. There is also an equation to explain the supply of credit by commercial banks. In this function a variable constructed by the author tries to capture the effect of the quantitive controls on the lending capacity of thn banks.

The whole model then, boils down to a simple IS—LM framework with the IS curve derived from equations (1) to (3) and the LM curve from equations (4) and (5), with the implicit equilibrium condition M^d = mB. Surprisingly enough, there is no price formation mechanism. Moreover, the exogenity of all the interest rates employed, together with the absence of prices do not allow the monetary sector to play a deterministic role within the model.

It only describes the interrelations amongst bank reserves, bank deposits and bank credit. The influences that the developments in the monetary sector

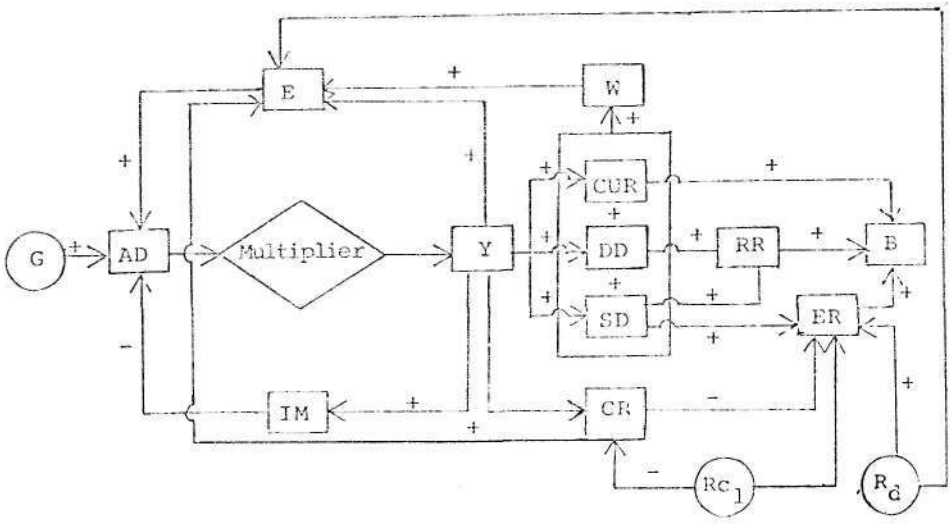
exert upon the price level, inflation external equilibrium and ultimately on growth, are not captured by the present model.

The two interesting features of the model are firstly the link between consumption and the monetary sector through a wealth variable and secondly the endogeneization of the monetary base and hence of the money supply (M1) via the explicit explanation of the required and excess reserves[12]. What seems to be rather questionable in the structure of the model is the appropriate use of interest rates as explanatory variables almost in every function. However it is important to bear in our minds that interest rates (for loans and deposits), within the context of the Greek economy, are completely controlled by the monetary authorities. Changes in the structure of the interest rates have been frequently utilized by Central Bank's Authorities but not in the sense of pursuing an interest rate policy. Such changes have been much more used as a psycological weapon to indicate the Central Bank's intention rather than due *to* their effectiveness. Indeed a number of reasons have rendered the interest rates and in particular the rediscount rate the least relevant factor to be considered as influencing lending and borrowing decisions taken up by Commercial Banks. First, it is the strong liquidity position of the latter since the 1956 large influx of private deposits. As a result, the Commercial Banks' dependence upon Central Bank's funds was greatly reduced. Second, the fixity of the lending interest rates at a lower than the free— market determined level — in order to provide incentives for a higher level of capital investment — has created an excess demand for credit. The latter in turn could only be satisfied by Commercial Banks utilisation of available rediscount facilities.

This has resulted in a situation where the provision of the rediscount funds was left entirely upon the willingness of the Central Bank's authorities than upon the level of the rediscount rate. Thirdly, as a result of the above situation, rediscount and loan funds made available by the Central Bank were the product of how good were the relationships between each Bank and Central Bank rather than upon the level of the rediscount rate. For all those reasons we would argue that interest rates, in the context of the Greek financial system, are not such an important but rather misleading factor in evaluating and explaining bank and private investment behaviour. The following flow diagram will help us to understand the working of the η resent model, as well as to trace easily the changes under diffeiments.

12. The analysis of the money supply determination within the money-multiplier framework and in terms of the monetary base uses was frequently employed in the fifties and sixties. For such a typical analysis see JORDAN (1969) while for a review of such studies see RASCHE (1976).

FLOW DIAGRAM 6



AD = aggregate demand
DD = demand deposits
SD = saving deposits
G = government spending
Rc1 = interest rate on loans provided by C. Banks a weighted average of a numerous interest rate for each category of loan
Rd = rediscount rate

Variables in a circle are exogenous

We now turn to examine the model's behaviour under three alternative policies. Table 13 summarises the quantitative information for those policy experiments conducted.

The results in Table 13 refer only to the first period response of the economy since the steady state multipliers are not reported by the author. Therefore it is not possible to assess the stability of the model in terms of Table 13. Under Policy A the multiplier results are straightforward for the GNP and GNI. There is a direct positive impact on aggregate demand and through the multiplier proces.

GNP expands; the reaction of the monetary sector can be traced in Flow Diagram 6- The increase in GNP induces an increase in the demand for currency and in various bank deposits. The results in Table 13 show an increase in the demand for imoney, by a 0.6108 multiplier which is implicitly satisfied by an equal increase η monetary base.

TABLE 13

IMPACT MULTIPLIER FOR KASMAS MODEL

	POLICY A	POLICY B*	POLICY C*
Consumption	0.9943	-947.2	-478.3
Investment	0.1865	-1010.9	-570.7
M Imports	0.4618	-393.4	-222.1
GNP	2.1824	-1859.5	-1049.8
GNI	1.7893	-1524.5	-860.7
B = (RR+ER+CUR)	0.6108	-293.5	-112.1
M = CUR+DD	0.6108	-293.5	-112.1

POLICY A = A billion increase in government spending
POLICY B = A 1% increase in rediscount rate
POLICY C = A 1% increase in loan rate
– these are absolute changes

This sequence of events indicates how money supply is endogenised in this model. It is assumed to react in a Kaldorian passive way, always satisfying the changes in the demand for money which in turn are induced by changes in the «real» economy.

In the rnext two Policies, B and C, as the results indicate there is strong negative impact effect on the level of economic activity. In the case of Policy B, the increase in rediscount rate has a negative effect on the fixed investment which in turn trigger off a negative multiplier process with an ultimate fall in GNI. Furthermore the decrease in demand for money following the decrease in GNI is again assumed to be absorbed by a decrease in money supply (monetary base). Finally in the case of Policy C the economy responds similarly but with the negative multi-

puer initiated by the decrease in fixed investment due to the decrease in credit the latter induced by Policy C. However, these strong negative effects on GNP in the case of Policies B and C, seem to be somewhat exagerated. The Central Bank of Greece has always arguedt hat the rediscount rate was never used for policy purposes[13] but more important its effectiveness as a policy instrument was also very limited during the period on which the model was estimated for reasons already explained.

The author reports additional problems when the interest rate on saving or time deposits was increased in his last two policy experiments. The text suggests that although the actual figures are not reported, a significant decline in economic activity. This however once more reaffirms the problems which we are encountering when interest rates are used so extensively in an attempt to model the Greek financial and real sector together. The problem is basically that these are nominal interest rates fixed by Greek monetary authorities and therefore they do not correspond to market clearing rates determined by the forces of supply and demand. We would then argue that all the problems reported about the model originate mainly from the inappropriate use of interest rates. Another problem of the model seems to be the way in which the money supply is endogenised. We believe that a much more rewarding approach on marcoeconomic policy ground would be the analysis of the monetary base in terms of its uses rather than in terms of its sources. However, this does not mean that we do not need both elements that is the analysis of demand for and supply of the money stock. The present model by concentrating on the semand side, managed to present the mechanism by which bank reserves, bank deposits and real sector are interrelated, without providing any insight into macroeconomic implications of the monetary sector. Such an approach cannot capture the influences the internal and external sectors exert on the monetary sector equilibrium which in turn affects the rest of the economy.

13. Characteristically in the Annual report for the year 1971, Greek Bank Authorities declared that a) «the manipulation of the rediscount rate was more important as an indicator of monetary policy than as an instrument of functional significance» p. 86, and b) interest rate policy has not up to now been used to any considerable extent as an instrument of monetary value, changing or maintaining interest rates is not therefore amply suggestive of the short-run policy followed» (p. 87).

4.2. Avramides Model

The last of the models to be examined is Avramides (1972) and it is the second model which gives special emphasis to the financial sector of the Greek economy. The model includes both a financial and a real sector of the economy and attempts to integrate them within the framework of a macroeconomic model for the Greek economy.

The real sector of the economy is examined within a simple aggregated income exenditure framework. The author argues that «the level of aggregate expenditure determines GNP» (. 56) and therefore the real sector of the model could be presented as a simple system of equation similar to that of the real demand - determined models. Therefore we can write :

(1) $E = G + f(Y, CR)$

(2) $Y = E + EX - IM$

(ύ) $EX = f(Y)$

(4) $IM = f(Y)$

Where E = total expenditure

G = government expenditure

Y = GNP real

CR = domestic credit

EX = exports

TM = imports

Private expenditure depends on income and the domestic credit expansion with the latter being used as a major determinant of the private fixed investment. Imports are as usual determined by domestic demand factors but paradoxically in AVR. model exports are also considered as solely determined by demand factors. This is rather an unconventional formulation since the most relevant factors such as foreign demand and relative prices are not considered.

The financial sector of the model is based on the analysis of the money supply identity. Changes in money supply (M1) are decomposed to the following :

$$(5) \qquad \Delta M^s = \Delta R + \Delta DCEG + [\Delta DCEP - (\Delta SD + \Delta TD + \Delta RD]$$

Where M^s = money supply (M1)

R = foreign exchange reserves

$DCEG$ = domestic credit expansion to government

$DCEP$ = domestic credit expansion to private sector

SD = private saving deposits

TD = private time deposts

RD = private restricted deposits

Δ = change in variable

$\Delta DCEP - (\Delta SD + \Delta TD + \Delta RD)$ = change in net domestic credit expansion to private sector

It is obvious that a change in the money supply, in the above identity, is defined in terms of its uses[14] rather than in terms of its sources. This approach is indeed, completely different from the money multiplier approach that Kasmas employs The Avr. approach has the advantage that if it is appropriately exploited it can become more elucitive and insightful in understanding the inter-sectors relations within the working mechanism of the Greek economy. Unfortunately Avr. failed to do that. The assumed exogenety of the first two important components of the Greek money supply, namely foreign exchange reserves (R) and domestic credit expansion to government (DCEG) has severely limited the policy and analytical perspective of his analysis. According to Avramides the financial sector examines only «the determinants of the flow of long - term credit from the financial institutions to the private sector and the determinants of the flow of money... from individuals to the financial institutions» (p 128). Therefore what the financial sector

14. The analysis of money supply determination by its sources was popularised in the mid - seventies within the small - open - fixed - exchange rate economy framework. See BANK OF ENGLAND (1969), COBHAM (198J) and COGHLAN (1978, 1981).

deals with is the analysis of the network of interrelations between different categories of private deposits (SD, TD, RD) and different categories of domestic credit long - term and short - term provided by commercial or non-commercial banks Accordingly the hypothesis sustained is that credit provision by financial institutions can be explained by the inflow of deposits (private and government) whilst the latter depend mainly on the real domestic income. In other words the functions of the financial sector on the one hand describe the proportion of a change in bank deposits which is used up by the banks to perform their lending activities and on the other hand describe the response of each category of bank deposits, according to their income elasticity, to a change in national income. Therefore the model of the financial sector *it* is rather a descriptiona! than an analytical approach to the examination of the Greek monetary sector. The Avr. method appears to lack any direct relevance in the realm of macroeconomic policy. For such purposes it is useful to consider the R and DCEG components of the money supply as being determined within the model and to relate them with the developments in the balance of payments, the public sector budget policy and the domestic monetary conditions. The variable, namely the net domestic credit expansion to the private sector, can be considered as being controlled, and therefore exogenous, by the monetary autorities. An argument founded on the fact that the Greek Monetary Authorities through a strict and complicated system of credit control, have succeeded in regulating, if not the distribution at least the overall expansion of cred it to the private sector is.

The model is completed with the demand for money (Ml) function which is implicitly derived from the estimated demand for currency and demand deposits and has the following conventional form :

$$(6) \qquad (CUR + DD) = M^d = f(Y, r)$$

Where M^d = demand for money (M1)

CUR = currency circulation

DD = demand deposits

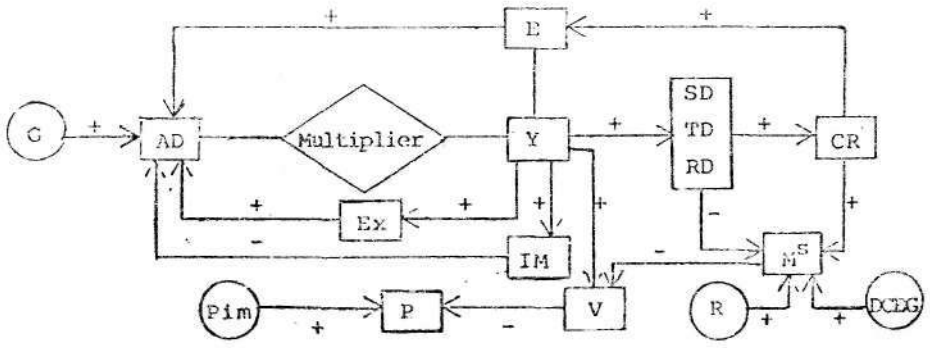
r = interest rate (exogenous)

15. For an account of the credit control means and their sucess within the overall Greek monetary policy pursued see HALIKIAS (1978) COURAKIS (1981) and CHARISSOPOULOS (1980).

The demand for money equation (6), together with identity (5) and the monetary equilibrium, $M^s = M^d$, represents the LM curve in an IS — LM framework. The IS curve can be derived from equations (1) to (4).

From the above exposition of the model we can observe that a channel through which the monetary sector can affect the real one, is the domestic credit channel. Domestic credit directly affects investment expenditures which through the multiplier process affects real income. The change in the real income in turn affects the demand for bank deposits which determine the bank's capacity to lend and that triggers off another round of multiplier process. This mechanism and the links between the real and financial sector can be seen in the following flow diagram.

FLOW DIAGRAM 7



Pim = price of imports
P = general price level (GNP deflator)
V = income velocity of money stock

Variables in a circle are exogenous

In Flow Diagram 7 we notice that the general price level is determined by the income velocity of money and the import price. The income velocity, defined as the ratio of income (Y) to money stock (M1), is a major determinant of both the deflator (P) and the deflator of private consumption (Pp) as explained in the model. The third price, namely the deflator of total consumption is a linear function of (Pp) The interesting feature of these price equations is the inclusion of a monetary variable, the income velocity, which performs reasonably well.

The author justifies the inclusion of the velocity in the price equations in the sense that «change in the level of income velocity of circulation of M influences the genera! price level as well as Pp in the sense that they reveal an increase or decrease in the levé! of M above or below the level required, given a certain level of Y» (p 55). Although the presence of the income velocity in the price equations is theoretically valid, the actual specification and attempted estimations in the AVR. model embody several problems. Firstly, it is not clear what is the reason for estimating a velocity function and what it represents. If it represents the demand for money then (a) it is not correctly specified with money stock being used as an explanatory vasiable and (b) it is redum dand since the demand for money has already been implicitly estimated as equation (5). Secondl, with «the velocity defined as the ratio of Y/M» (p39) this effectively makes it an identity rather than a behavioural equation. Therefore it seems impossible to estimate the income velocity with Y and M being used as the major explanatory variables. However AVR succeeds in estimating such a function. We must point out thai income velocity data reported at page 250 under the column V do not agree with figures one will, derive for V using the data reported for V at page 245 and for M at page 250. So it is not clear how the figures of V have been derived. Finally, the actual estimation of this function is unsatisfactory !6 Real output and money stock are statistically insignificant both in :he OLS estimation and 2 SLS estimation methods. Furthermore, as the Durbin Watson statistic of 0.48 indicates, autocorrelation is an apparrent problem.

The author does not report any policy simulation results conducted with his model but only devotes a chapter for discussing the predictive accuracy of the model in terms of structural and reduced form equations.

Overall then, although the analysis of the net domestic credit to private sector is usefull for certain analytical purposes this approach appears to lack any direct

16. The actual estimated velocity function is as following :

$$V = 9.434 + 2.475*Z2 + 0.037*Y - 0.442*M + 6.122*F2$$
$$(2.29) \quad (2.65) \quad (0.51) \quad (1.53) \quad (1.17)$$
$$R2 = 0.917 \qquad DW = 0.479$$

Where

Z2 = Dummy variable

F2 = Ratio of credit granted from Special Credit Institutions to credit grandet by Commercial Banks.

R2 = Adjusted multiple correlation coefficient

DW = Durbin - Watson statistic

relevance to the macroeconomic policy. The promising approach by AVR has not been carried out completely and its potential benefits in terms of macroeconomic issues have not been fully exploited. The absense of a careful analysis of the relation between the different components of money supply and their relation with the foreign and real sector of the economy have confined AVR model to descriptional analysis.

5. CONCLUSIONS

Having reviewed the Greek macsoeconometrsic models in this paper it seems that our demarcatory principle between Real and Monetary models is fully justified.

In the first category of Real models, the four models reviewed have a very close affinity with the basic characteristics of the traditional Keynesian models. They are all founded upon the real/flow and income/expenditure principles while they differ only in the degree of dissaggregation and the suggested causal relationships between various components of aggregate demand or/and supply. However, all four models fail to make any adequate reference to the monetary sector and to its relevance for the working of the Greek economy. This indeed constitutes a major weakness of these models.

During the 1970's we observe a change in the analytical approach employed in the attempted modelling of the Greek economy. Our second category of Monetary-models reflects this change, which was basically an attempt to integrate the monetary sector into a macroeconometric model of Greece. Such an attempt underlies the research of Kasmas and Avramidis. Those developments, of course, were encouraging and very welcomed since they constitute an improvemnt on a theoretical basis over the Real - models. However the practical implementation of their approach, as we have earlier argued, is not wholly satisfactory and complete. As the models stand now are somehow inadequate for policy making guidance. Prices, output, exports and imports all have fairly arbitrary relationships with various monetary aggregates ; these however relationships are not constrained to any clear overview of macroeconomic design. The lack of such «macroeconomic» consistency is mainly, we suspect, due to the fact that the models reviewed have endeavoured to exlore and model the role of the Greek monetary sector within the economy without due reference to the complexities arising from the Greek economy involvement in international trade. The inadequate treatment of the monetary sector in combination with the lack of any extended analysis of the increa-

singly important for the Greek economy foreign sector rendered the attempts by Kasmas and Avramidis sterile in terms of understanding the role and efficiency as well as the limitation of the Greek monetary factors and policy respectively. In fact the tendency to model the foreign sector in a rudimentary form and in isolation from monetary sector is a major weakness shared by all the Greek models reviewed.

The advances in economic theory, in the last two decades, especially in the area of modelling «open» economies have emphasized and empirically established[17] that «international linkages between national economies influence, in fundamentally important ways, the effectiveness and proper conduct of national macroeconomic policies» (Frenkel and Mussa (1980), ρ 257) and therefore the course of economic indicators.

In the case of the Greek economy, trade linkages with the rest of the world as well as international monetary arrangements such as the fixity of the exhange rates, are so strong to be ignored or underplay their role in the functioning of the economy.

We believe that apart from the so frequently used Keynesian foreign-trade multiplier mechanism in the Greek models there are much more important linkages especially monetary ones, with the rest of the world which impinge upon Greek economic perfomance. The proper explotation of those «linkages», we further believe, that will definitely assist towards a more complete and theoretically consistent macroeconometric model for the Greek economy. [18].

17. For the basic theoritical and empirical work on the ûSmall - Open» economy see FRENKEL and JOHNSON (1976) and IMF (1976).

Î8. The framwork of the «small-open-fixed-exchange-rate economy «has been recently employed in analysing and modelling the Greek Economy by DEMOPOULOS (1981) and KARÀPAPAS*(1982). The former study provides analytical results whilst the latter constructs and estimates a complete structural macroeconomic model.

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