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POLICY ANALYSIS WITH AN ECONOMETRIC MODEL FOR THE GREEK ECONOMY: 1960-1985

by

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Thesis presented to the School of Graduate Studies of the University of Ottawa as partial fulfillment of the requirements for the degree of Doctor of Philosophy (Economics)

UNIVERSITÉ D'OTTAWA
UNIVERSITY OF OTTAWA

To H. J., G. G., and K. D.

Ars longa, vita brevis

(The art is long, but life is short)

ABSTRACT

This dissertation concerns the construction and application of an annual econometric model for the Greek economy. The economy of Greece has progressed in the development process, but it still faces problems of a long-term, structural nature. These structural problems, as well as other characteristics of an economic and institutional nature, should be incorporated into the model.

The basic objectives in constructing this model are first, by following a "pragmatic and institutionalized" approach, to take into account the country-specific institutional factors and internal rigidities of the economy; second, to emphasize the relationship between the availability of credit and private investment; third, to incorporate sectors which were not adequately treated in previous models of the Greek economy (including the international and the price sectors); fourth, to conduct a number of policy analysis experiments using variables central to the model.

The model consists of 39 equations (26 structural and 13 identities), it is non-linear in variables and has been estimated with the method of principal components of predetermined variables.

The model has been tested by subjecting it to prediction

error analysis from a fully dynamic simulation, both inside and outside the sample period, and its performance was judged satisfactory.

Four types of policy experiments were conducted. Two of them refer to the derivation of dynamic elasticities related to the international sector. In the first, based on a scenario of reducing import duties (similar to the one stipulated by the Greece-EEC association agreement), dynamic tariff elasticities were calculated. In the second, the effects of an increase in world economic activity on a number of the endogenous variables of the model were examined.

The other two experiments dealt with the calculation of dynamic multipliers for government expenditure and the volume of bank credit investment, with an emphasis on housing investment. It was found that, government expenditure was the most powerful policy variable with a peak real GNP multiplier of about 1.55. The bank credit to housing variable, on the other hand, is of particular importance since the housing sector has often been used as a means of implementing counter-cyclical economic policy. This variable was found to be the second most powerful policy variable, with a peak real GNP multiplier of about 1.4.

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CURRICULUM STUDIORUM

Christos N. Sakellariou, was born June 25, 1956, in Athens Greece. He received his B.A. degree (cum laude) in economics from the Athens Graduate School of Economics and Business in 1979, and his M.A. (Econ.) from the University of Windsor, Ontario in 1980.

CONTENTS

CHAPTER III TOWARDS THE MODEL

CHAPTER IV THE MODEL

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1 General

Econometric models are of importance for two major reasons. Firstly, they shed light on the mechanisms of the economy being examined, and secondly, they can be used as decision tools of economic policy. Klein (1971)(1) outlined the achievements of econometric models and defended their usefulness.

Over the past few years, serious questions have been raised about the use and usefulness of econometric models in evaluating alternative economic policies. One such criticism which has become the subject of heated debate is the Lucas critique. In a paper published in 1976, Lucas (2) argued that "any change in policy will systematically alter the structure of econometric models". The argument basically goes as follows. The structure of an econometric model embodies the behavior of economic agents. The decisions of economic agents, however, depend on their perceptions of the rules being followed by policy-makers. If the policy-makers change their policies, economic agents might change their behavior as well, and hence change the structure of the economy. Because of this conclusion Lucas argued that "comparisons of the effects of alternative policy rules using current macroeconometric models are invalid regardless

of the performance of these models over the sample period or in ex-ante short-term forecasting". On the other hand, Lucas viewed this critique as of only occasional significance for issues involved in using just the short-term predictions of econometric models (3).

However, not all economists agree on the severity of the Lucas critique. Some have suggested that the Lucas critique is not crucial if the policy alternatives involve simply varying the value of a policy instrument, without changing the way in which policy is executed (4). In 1982, Sims argued that the types of policy changes that are subject to the Lucas critique rarely occur (5). According to Sims, policy-makers rarely make radical changes in monetary or fiscal policy. Instead, changes in economic policies are made slowly over time, so that any resulting change in the structure of the economy would occur slowly over time as well. Sims concludes therefore, that econometric models can be used to evaluate alternative policies. Finally, while this debate is still under way, econometric models should be used with special care when large changes in economic policies are involved. As Poole has pointed out, the Lucas critique has given model-builders further impetus to refine and improve econometric models (6).

The construction of econometric models for developing economies has followed a number of other models that have been constructed for mature economies (7). These models,

constructed for economies like the United States, Holland and the United Kingdom, have the structure of the standard income-expenditure Keynesian model (8). When econometric model-building was extended to many countries in various stages of development, there was much that could be carried over from the standard model. The resulting models, although they followed the same general approach of the standard model, became more eclectic with regard to their supply-side features, which also assumed greater importance. The areas of emphasis were also different in order to reflect institutional and other differences.

The present study is concerned with the economy of Greece. Efforts towards the construction of an econometric model of the Greek economy started in the early 1960s. An overview of some of the models is presented in section 4 of this chapter. It was not before the mid-1970s, however, that a model designed to incorporate a number of structural characteristics of less developed economies was constructed for Greece by Vernardakis (9). Although this model constitutes a valuable contribution to the econometric modelling of the Greek economy, it suffers from a number of deficiencies (e.g., the sample period ends in 1967 due to a number of technical considerations, and there are deficiencies in the price and international sectors).

The model constructed in this study is intended for policy analysis. The policy experiments studied are related

to a set of policy questions that are different from those examined by previous models of the Greek economy.

1.2 Modelling a Less Mature Economy

The concept of a less mature economy as used in the present study (10) falls in the context of an economy which has advanced towards industrialization. In its advance towards industrialization this economy has achieved a sustained rate of growth, but is nevertheless facing problems which are of a long-term, structural nature, specifically those pertaining to the composition of investment, the agricultural and manufacturing sectors, the balance of payments, and the capital market. As a result of these long-term, structural problems (which are discussed in section 2 of chapter II), such an economy tends to be more fragile and hence more vulnerable to adverse shocks than an economy for which such problems are absent.

Historically, in the case of economies with an industrial sector that is technologically capable of producing more output than it actually does (such as the U.S. economy), the problem has been one of generating sufficient effective demand. Otherwise, such an economy tends to go into a recession (11). For the less developed economies the problem is often different. Demand does not tend to be a binding constraint. It is supply that responds inadequately to changes in demand and is limited in its capacity to expand

production. The supply side, therefore, should receive a different treatment in a model for a less developed economy. This different treatment should focus specifically on the sectors which are fundamentally different in kind, namely, the traditional agricultural sector and the modern (compared to agriculture) manufacturing-mining sector. Taking into account the structural characteristics of less mature economies, one will have to modify the structure of the "basic" Keynesian model (although retaining some of its characteristics) (12). In the case of the model constructed in this study, the treatment of the income-generating sector (production of goods and services) differentiates between agriculture, industry, and services. However, this sector - income-generating sector - is of secondary importance in the functioning of the whole model. This is a result of the way the model was closed, and it implies an expenditure determined model.

There is a number of characteristics shared by most of the less mature economies, such as the small size of the producing units; the predominant, although declining, role of the primary sector; the weak industrial sector; the growing service sector; and an almost non-existent capital market. In particular, in most of these economies financial sources consist principally of a few commercial banks. As is well known, commercial banks are most suited to provide short rather than long-term loans, and in general this appears to fit the requirements of service sector firms

(13). It follows that the service sector should not have supply problems and output in this sector will generally be determined by demand.

The role of manufacturing and mining in less developed economies is fundamentally different from what it is in developed economies. Here demand patterns are influenced through the "demonstration effect" (emulation of consumption behaviour in the developed economies) and, to these new demand patterns, the local industry then has to adapt. Thus, imports in these economies perform an additional function, that of forming demand patterns, a function which is fulfilled by domestic industry in an industrialized economy (14). As a result, it is desirable that the foreign sector have a central role in a model for a less mature economy.

When constructing a model for an economy which does not share all the characteristics of an advanced industrial economy (no rigid classification is implied here), it is essential to adopt a "pragmatic and institutionalized approach" (15). Among the general criteria to be adopted are the following:

a) The model should reflect internal rigidities.

b) It should incorporate both long-run growth aspects and short-run cyclical swings in output and prices.

c) The main institutional factors specific to the country under study should be explicitly taken into account.

In short, with such an approach, the model should adequately explain trade with an emphasis on the composition of exports and imports of goods and services. The sectoral composition of production (primary, secondary, tertiary) should also be taken into account, as should be the importance of income distribution, prices, and inflation.

1.3 The Purpose of the Present Study

The present study deals with the construction of an econometric model of the Greek economy which is intended to serve a number of objectives. Relying on the relative abundance and quality of data as well as on easy access to information that was not available in the 1960s, a model is proposed to accomplish the following objectives:

First, I intend the model to reflect the structural problems, peculiarities, and characteristics of the Greek economic and social life.

Second, I include sectors not adequately treated in previous attempts to model the Greek economy, including a price sector and export equations.

Third, this model emphasizes the relationship between the availability of credit and private investment, which has been disaggregated into four categories.

Finally, besides serving the purpose of a descriptive

device, the model has been geared to policy analysis using variables which are central to it.

1.4 Earlier Models of the Greek Economy

The first attempts to model the Greek economy were in the early 1960s, by D. Suits (16) in 1964 and by P. Pavlopoulos (17) in 1966.

Many difficulties were encountered in constructing these early models. Perhaps the most important was the existence of a small amount of usable data for the period before and immediately after World War II (up to the early 1950s). In the model by Suits, the time series used consisted of twelve observations or less (the typical time series covered the period 1951 to 1961), while in the one by Pavlopoulos, eleven observations (1949-1959) were used. Another problem was caused by the fact that, over the sample period, the Greek economy was characterized by a rapid and sustained rate of growth, which in turn resulted in severe correlation among the various time series. In particular, in the model by Suits, the problem was so serious that "statistical formulations based on different theoretical explanations of behaviour differ insignificantly in their explanatory power" (18). This caused a serious identification problem that could be removed only by waiting for more data.

The Pavlopoulos model consists of 17 structural equations. The model is intended to describe consumers' and investors' behavior, and it also includes an agricultural sub-model. It is an effective demand model and so, except for agriculture, the treatment of production is inadequate. In particular, the level of non-farm income in the model is determined as a residual. As a result, it is not possible to link its two investment equations to the stock of capital. Thus the sectoral breakdown is insufficient, while the foreign sector consists of one aggregate import function.

A valuable contribution to the modelling of a less developed economy is the work by N. Vernardakis (19) with its case study of Greece. In his 32-equation, 14-observation model, he attempts to incorporate some desirable features of models for less developed economies. He emphasizes supply-side considerations through the income-generation approach. In fact, his was the first model for Greece that explicitly modelled a sector generating income. Following Pavlopoulos, Vernardakis treated the agricultural sector separately with a 3-equation sub-model. Manufacturing and mining is explained with a production function which depends on capital and labour. Finally, output in services was demand determined. Due to the fact that data series for the pre-1968 period were not consistent with those for the post-1968 period (a problem which ceased to exist only after his model was completed), Vernardakis's model covers the period 1953 to 1966 even though it was built in the

mid-1970s. Other important deficiencies, besides the small sample size, were the absence of a price sector, the inadequate treatment of the international sector and some problems due to the absence (or low quality) of data for certain variables. Finally, Vernardakis's choice of method to close the model is not the ideal one: the GNP deflator, appearing as an identity (and thus endogenized), performs the function of bringing together the expenditure and production sides, while this deflator does not appear anywhere else in the model. As a result, whenever the model is subjected to a demand shock (e.g., when deriving multipliers), all the adjustment in reconciling the expenditure with the production side is through the GNP deflator.

In recent years, two government research institutions have been working with their own econometric model. In 1978 the Center of Planning and Economic Research (20) constructed a quarterly model. It consists of 40 equations, 20 of which are stochastic and 20 definitional (21). The other is a model constructed at the Bank of Greece in 1980. Although the exact form of the model is mot made available to the public, some information about this model was obtained from a publication concerning the predictive accuracy of the model (22). It consists of 172 equations, of which 105 are identities. It is an annual model for the period 1958 to 1976, intended for short-term forecasting and policy analysis. The model is similar in structure to other

macroeconomic models for advanced industrial countries, which reflect the standard Keynesian income-expenditure approach. Despite the size of the model, it has investment equations only for agriculture and housing. All other private investment is exogenously determined. The decomposition of the international sectors is also limited to two categories of exports (manufactures and non-manufactures) and two categories of imports (machinery and transport equipment, and all other imports).

In the chapters to follow, an econometric model for the Greek economy is put forward, then tested and applied in a number of policy experiments. Chapter II of this study gives a description of the developments during the last 25 years, focusing on the structural problems and weaknesses that accompanied the growth of the Greek economy.

Chapters III and IV deal with the construction of an econometric model for the Greek economy. Chapter III discusses the equation-by-equation specification of the model, while in chapter IV the final model, including its structure and logical ordering, is presented.

In chapter V the model's performance as a predictive device is evaluated, both inside and outside the sample period. Finally, chapter VI analyses the results and implications of seven sets of policy changes which involve government expenditures, bank credit to investment (particularly housing), import duties, and foreign activity.

NOTES

(1) Klein, L.R., "Forecasting and Policy Evaluation Using Large-Scale Econometric Models", in Intriligator, M.D. (ed.), Frontiers of Quantitative Economics, vol. 1, Amsterdam, North Holland, 1971, pp. 133-160.

(2) Lucas, R., "Econometric Policy Evaluation: A Critique", in "The Phillips Curve and Labour Markets", Journal of Monetary Economics, Supplement Series, no. 1, 1976, p. 41.

(3) Lucas, R., ibid, p. 41.

(4) See Sims, C.A., "Policy Analysis with Econometric Models", Brookings Papers on Economic Activity (1: 1982), pp. 107-152; or Sims, C.A., "Macroeconomics and Reality", Econometrica vol. 48, no. 1, 1980, pp. 1-48.

(5) See Sims, C.A., Brookings Papers on Economic Activity (1:1982).

(6) Poole, W., "Summary and Evaluation", in After the Phillips Curve: Persistence of High Inflation and High Unemployment, Federal Reserve Bank of Boston, Conference Series No. 19, 1978, pp. 212-213.

(7) The notion of a "mature" economy has been used by M. Evans in his econometric model of the Israeli economy; see Evans, M. "An Econometric Model of the Israeli Economy: 1952-1965", Econometrica, vol. 38, no. 5, 1970, pp. 624-660.

(8) Klein, L.R., "Theories of Effective Demand and Employment", Journal of Political Science, vol. 15, no. 2, 1947, pp. 108-131.

(9) Vernardakis, N., Econometric Models for the Developing Economies, Saxon House, (Westmead, Farnborough, England), 1978.

(10) Although the terms "less mature" and "less developed" economy are used interchangeably here, the study deals with an economy which fits the description of this paragraph of the text.

(11) Klein, L.R., "What Kind of Macroeconometric Model for Developing Economies?", Econometric Annual of the Indian Economic Journal, vol. 13, no. 13, 1965, pp. 313-324.

(12) One such model is that of M. Evans for the Israeli economy, (Evans (1970), op. cit.).

(13) Vernardakis (1978), op. cit., p. 8.

(14) Allen, A.G., The Structure of Industry in Britain: A Study in Economic Change, (Longmans, London) 1961, ch.3.

(15) UNCTAD Staff, "Models for Developing Economies", in Ball, R.J., (ed.), The International Linkage of National Economic Models, North Holland, Amsterdam, 1973, p. 112.

(16) Suits, D. B., An Econometric Model of the Greek Economy. Center of Planning and Economic Research, Athens, 1964.

(17) Pavlopoulos, P., A Statistical Model for the Greek Economy, 1949-1959, North Holland, Amsterdam, 1966.

(18) Suits (1964), op. cit., p. 20.

(19) Vernardakis (1978), op. cit.

(20) Avramides, U., Gamaletsos, T., Prodromides, K., Skoutzos, T., Touribabas, N., Medium Term Macroeconomic Model of the Greek Economy, Center of Planning and Economic Research, Athens, 1979, mimeo.

(21) No further information concerning this model was obtained. The model is unpublished and the Centre of Planning does permit its distribution.

(22) Garganas, N., "An Evaluation of the Predictive Accuracy of the Bank of Greece Model of the Greek Economy", Greek Economic Review, vol. 5, no. 2, 1983, pp. 101-120.

CHAPTER II

THE GREEK ECONOMY: CHARACTERISTICS AND PROBLEMS

2.1 General

The total area of Greece is approximately 132,000 square kilometers, of which 29.7% consists of agricultural land. In 1981 the population was 9.74 million.

The total work force in 1981 was 3.38 million, almost one million of which are employed in the primary sector and slightly over one million in the secondary sector. The development and industrialization of the last two decades resulted in a rapid shift of the distribution of employment away from agriculture and into industry and services. Employment in the secondary sector rose from 19% in 1961, to 30% in 1981 (1).

As Table 1 shows, the contribution of the agricultural sector to total real GDP was 14% in 1983 (compared to 25% in 1963), and it has been able to meet most of the population's needs in foodstuffs. Furthermore, it is a significant source of foreign exchange from exports of agricultural products. Agriculture is heavily dependent on crop production with a share of 72% in the total. The remaining 28% is accounted by livestock production. The main crops are cereals, fruits, industrial crops, vegetables, and olive oil. In livestock production the most important component is meat,

comprising 62% of the total.

In manufacturing, the production basket consists mainly of light consumer goods, mostly produced by small-scale, family-oriented establishments. These primarily cater to the domestic market, although exports of manufactures as a percentage of total exports have been increasing over time. The manufacturing industry is concentrated around the large cities, mainly Athens.

The developments in the manufacturing sector during the last two decades were significant. Its contribution to real GDP rose from 14% in 1960 to 31% in 1983. Furthermore, during the same period the share of manufacturing production that is exported rose from slightly more than 2% in the early 1960s, to about 15% in the late 1970s.

TABLE 1

GDP By Major Sector
Billions of 1970 Drachmas and Percent of Real GDP

	1963		1968		1973		1978		1983	
Sector	DR	%	DR	%	DR	%	DR	%	DR	%
Agriculture	40	25	41	19	51	16	57	15	58	14
Industry	40	25	65	30	114	35	131	33	129	31
Services	79	50	112	51	164	49	207	52	231	55
Total	159		218		329		395		418	

Source: National Accounts of Greece

The service sector consists of output in transportation, communications, housing, trade, public administration, health, education, and miscellaneous services. The share of output in services has been steadily increasing, reaching a high of 55% of total real GDP in 1983.

Productivity growth in both industry and agriculture lags far behind the pace achieved in the main European economies, despite the progress that has resulted from improvements in technology, the level of education, and increased specialization of the work force.

Investment by firms in manufacturing is mainly financed with credit from the (mostly government-controlled) powerful banking system, while the weight of internal financing is low. On the other hand the capital market is almost non-existent, with an Athens stock exchange heavily dominated by public-sector and banking issues. This tends to reinforce the family character of manufacturing establishments. In particular, in the period after 1975 (for which detailed statistics are available), not only were banks the main source of credit for Greek manufacturing, but funds from this source rose from 36.8% in 1975 to 43.1% in 1978, while the share of financing fron own funds and non-bank credits declined (2). Furthermore, compared with other countries for which data were obtained, while the share of short-term bank credit in total funds employed in the Greek manufacturing was 20.1% in 1975, the same figure for Great Britain was 7%,

11.7% for Italy, 7.7% for Belgium, and as low as 5.6% for Australia (3). Among the factors which have contributed to the dependence of manufacture on financing from the banking system are the way corporate profits are taxed. Enterprises are taxed not on total profits but only on undistributed profits. In this way corporate taxation does not provide incentives for growth through retained earnings and by doing so, it throws the burden of financing on the banking system, given the embryonic state of the capital market (4).

The performance of gross fixed investment during the period under study is far from consistent. The growth of fixed investment was spectacular through the 1960s with an average real growth rate of about 10% a year, transforming a once low level of investment into a satisfactory one, mainly through the use of domestic savings (5). But with the world economic crisis of 1973-74 hitting the Greek economy, investment fell rapidly. Increased energy prices, uncertainty, volatile exchange rates, and the general slowdown of economic activity in the OECD countries contributed to a decline in expected profitability in Greece, and hence capital formation. Real fixed investment exhibits a sharp fall of 25.5% in 1974 over 1973, and has since stagnated at pre-1973 levels. Over the 1973-1981 period, real gross fixed investment was declining at an average annual rate of 2%. During the same period, GDP at constant prices grew by an average of 3.6%. The share of real gross investment in GDP increased from 22.5% in 1960 to

27.4% in 1970, and subsequently dropped to 19.4% in 1981.

Table 2 reminds us that the sectoral composition of investment between housing, industry, agriculture, and services has undergone significant changes over the last twenty years. Developments were characterized by a decline in the share of housing investment from 31% in 1961, to 24% in 1982, and an increase of investment in services from 34% to 42% over the same period. In other respects, developments followed their historical trend with the share of agriculture declining from 14% to around 7%, and the share of industry increasing to 27% (from about 21%).

Private investment constitutes the bulk of total investment in Greece. Over the decade of the 1970s, private investment was more than three times the level of public investment. Furthermore, the share of public investment in total government spending fell from 23% in 1970, to 14% in 1981. According to the Greek government's announced five-year plan for 1983 to 1987, modernization of the infrastructure will require relatively high rates of growth of public investment, which can be achieved only through a drastic shift in resource allocation away from government consumption, given the limited availability of financing especially after 1973.

TABLE 2

Distribution of Real Gross Investment by Sector (%)

Sector	1963	1973	1982
Agriculture	14	10	7
Industry	21	25	27
(of which			
Manufacturing)	13	16	19
Housing	31	31	24
Services	34	34	42
	100	100	100

Source: National Accounts of Greece

Trade deficits during the 1960-1981 period were consistent and worsening, in both nominal and real terms. The trade deficit at current prices was increasing at an average rate of about 15% per year, while in constant prices, the rate of increase of the trade deficit was approximately 5.5%. During the same period the ratio of exports to imports was improving. The ratio of nominal exports to nominal imports of commodities increased from 38% in 1960 to over 50% in 1981, while the ratio of real exports to imports increased from 41% to 69% during the same period (6).

As to the composition of exports and imports, traditional exports such as food, beverages, tobacco and raw materials have declined from 90% of total exports in the early 1960s to 36% in 1981 (the sum of "Foodstuffs" and "Other Raw

Materials, Oils and Fats" in Table 3). During the same period, the share of exports of manufactured products increased from 10% in 1963 to 53% in 1982. Exports of petroleum products in particular were almost non-existent in the early 1960s, while in 1982 accounted for about 11% of total real exports. On the imports side, Table 4 reveals that the changes were less drastic. An exception was the share of fuels, minerals and lubricants which increased from 10% in the early 1960s to about 30% in 1982. The rest of imports in 1982 are consumer goods (25%), raw materials and intermediate goods (29%), and capital goods (16%).

TABLE 3

Exports by Product Category
(% of Total Real Exports)

Product category	1963	1973	1982
Foodstuffs	66	29	27
Other Raw Materials, Oils and Fats	24	15	9
Fuels	0	14	11
Manufactures	10	42	53

Source: National Statistical Service of Greece

The increase in energy prices after 1973 has caused the share of fuel and mineral imports to increase from 13% in 1973 to 30% in 1982, while the observed increase in fuel exports is related to the post-1966 gradual development of the oil refining industry. On the other hand, the decline in the share of imports of raw material and intermediate goods reflects the slowdown of domestic investment activity in the post-1973 period.

TABLE 4

Imports by Product Category
(% of Total Real Imports)

Product Category	1963	1973	1982
Consumer Goods	25	22	25
Raw Materials and Intermediate goods	42	37	29
Minerals, Fuels	10	13	30
Capital Goods	24	28	16

Source: National Statistical Service of Greece

As shown in Table 5, the terms of trade (ratio of export to import prices of commodities) in the 1960s and until 1973 fluctuated around a value of slightly more than one (base year 1970), exhibiting an average annual improvement of 0.7%. After 1973 the terms of trade deteriorated drastically, largely due to the oil price increase, exhibiting between 1973 and 1981 an average annual deterioration of 3.5% (7). At the same time, the exchange

rate of the drachma in terms of the U.S. dollar rose from roughly 30 drachmas per U.S. dollar in 1973, to 55.4 in 1981.

Trade imbalances have been financed through surpluses in invisibles, namely emigrant remittances, shipping, and tourism, while current account imbalances have been financed by foreign capital inflows and loans from abroad.

TABLE 5

Foreign Trade of Greece: 1960-1981

Year	Ratio of Exports to Imports of Goods 1970 Prices	Balance of Trade: Billions of 1970 drachmas	Terms of Trade: Export/Import Prices
1960	40.9	-10.0	0.950
1961	40.7	-11.2	0.951
1962	40.9	-12.2	0.979
1963	35.2	-15.8	1.121
1964	34.3	-17.7	1.074
1965	30.1	-23.2	1.037
1966	35.1	-22.3	1.024
1967	42.0	-20.7	1.039
1968	37.5	-24.2	1.008
1969	38.7	-26.9	1.018
1970	41.4	-27.3	1.000
1971	39.7	-30.1	0.970
1972	43.9	-32.1	0.975
1973	43.8	-40.5	1.007
1974	52.4	-31.3	0.901
1975	59.0	-26.3	0.843
1976	63.0	-25.6	0.829
1977	58.3	-30.6	0.869
1978	64.1	-27.7	0.828
1979	58.4	-35.6	0.768
1980	62.6	-29.9	0.787
1981	69.0	-25.4	0.741

Source: National Statistical Service, Statistical Yearbook of Greece.

2.2 Structural Problems of the Greek Economy

Earlier in this study it was noted that an economy facing structural problems of a long-term nature will be more vulnerable to adverse shocks. In the context of the Greek economy this became increasingly evident during the 1970s and early 1980s following the two world oil price shocks. The first shock hit the Greek economy at the end of 1973 and by 1974, consumer expenditure, fixed investment and GDP all declined in real terms. This was preceded by rising prices and a worsening of the current account deficit by the end of 1973. Over the period 1975-1979, the Greek economy managed to overcome these disturbances and started growing again, however at slower rates than in the past. But the second oil shock of 1979 produced different consequences for the Greek economy compared to other OECD countries. While the performance of the major OECD economies was to a large extent back on track by the early 1980s, the Greek economy did not recover. Years later and well into mid-1980s, high inflation rates of over 20%, rising unemployment, further declines in fixed investment, rising trade deficits, and the danger of an inflation-devaluation cycle remain the main developments.

This difficulty of the Greek economy in recovering is largely due to the fact that the necessary solutions to a number of structural problems failed to materialize. As a result, when the world economic environment changed, the

structural problems and weaknesses, which were earlier masked in a more favourable world environment, surfaced, requiring immediate attention (8).

In the view of many contemporary students of the Greek economy, the development performance of this economy over the last few decades has lacked direction. This lack of a long-term development strategy led to an economy technologically dependent on foreign sources. Most of the investment funds were channelled to sectors less vital to the Greek economy, mainly services (where the expectation of immediate return was high). Eventually, the share of services in total real National Income surpassed the sum of the shares of industry and agriculture. This led to the creation of a manufacturing sector which was small compared to that in other countries at the same stage of development. At the same time, corrective measures were designed for short-term objectives and ranged from tax breaks to tariff protection.

The major problems facing the Greek economy at present are of a structural nature. Such problems can be identified within industry, agriculture, towards efficient sectoral allocation of investment, as well as in the balance of payments and the capital market. A brief presentation of these problems is given in the following 5 sub-sections.

2.2.1 The Structure of Investment

One fundamental problem is the low contribution of manufacturing investment in the composition of total real investment (13% in 1963, 16% in 1973, 19% in 1982, as shown in Table 2 above). This low contribution of the manufacturing sector in total investment does not appear to have been predicated on a shortage of funds (9). The insufficient level of productive investment, during the 1970s and early 1980s in particular, has also been adversely affected by the two energy crises. During this period, the fall in demand of manufactured exports seriously affected the return to investment, as well as the motivation for investment due to the uncertain business climate. Also, during the world recession of the early 1980s, international competition was impeded by the introduction of protectionist measures in a number of developed countries, further hindering the expansion of Greek exports. A prerequisite for a revival of investment activity in the exposed-competitive sectors of manufacturing seems to be the revival of profit expectations (10).

The share of housing investment in total real private investment remains high (31% in 1963 and 1973, 24% in 1982). High levels of housing investment were justified after World War II, due to the low level of housing stock and to the steady stream of internal migration to the large cities, which increased considerably the need for housing

investment.

Housing activity has been highly responsive to government controlled variables, such as the volume of bank credit to this sector and the mortgage rate. However, the emphasis on housing investment during the last few decades may have slowed the rate of economic growth, because the contribution of such investment to national product is limited compared to investment in industry which increases the productive capacity of the economy. X. Zolotas (1977) argues that the multiplier from investing a given capital sum in industry and agriculture is greater than the multiplier from investing the same sum in housing. He therefore suggests that it is desirable to reduce investment in housing and shift it to industry and agriculture. This view, however, has been challenged by A. Skouras (1985, see chapter 5, section 4).

2.2.2 Structural Problems in Manufacturing

The unhealthy state of the Greek manufacturing sector today stems directly from a variety of factors and the framework within which this sector developed after World War II, and especially in the 1960s. These factors include excessive protection, subsidization, an incredible variety of tax breaks, as well as a running stream of bank funds from the powerful banking sector, which resulted in the creation of a distorted relation between internal financing

and bank loans in a number of big industrial units. In addition, the improvement of efficiency was hindered by obstacles such as the predominance of family-owned and family-run enterprises, and the shortage of competent managers (11). The family orientation resulted in a reluctance of the owners to accept decentralization of decision making, with repercussions for the creation of a developed capital market. The shortage of competent managers, coupled with the family orientation of the typical manufacturing unit, precluded the development of enterpreneurship with productive industrial consciousness, willing and capable of seeing and exploiting business opportunities beyond those with expectations for an immediate profit.

The above mentioned distorted relation between own funds and bank loans in the financial position of a number of enterprises was a distinct characteristic from the beginning of the endeavor for industrial development. Today, own funds in the 100 larger industrial firms constitute less than 30% of total funds employed, while this ratio in other European countries is about 60 to 70% (12).

The crises of the 1970s and the loss of competitiveness of the Greek manufacturing industry brought about the need for modernization and new technology, hence the need for new investment. But financing new investment with such a debt burden for a number of industrial units requires government

intervention. It thus becomes clear that this kind of debt burden had an adverse effect on the development of the Greek industrial sector. There is indeed a suspicion that the cause of industrial development has served as an "alibi" to a number of those representing Greek industry for the acquisition of bank funds, the disposition of which remains unknown (13).

2.2.3 Weaknesses in Agriculture

Agriculture remains an important sector of the Greek economy, providing a living for 28% of the population, as of 1983, and generating 14% of real GDP. If agriculture is to take part in the process of development, its structural weaknesses, long standing and still intact, must be dealt with.

Land fragmentation continues to be the single most important obstacle in improving efficiency in agriculture. In 1978, of a total of 950,000 agricultural establishments, 61% numbered 30 acres or less, while only 5.7% were larger than 100 acres. By comparison, the average size in the EEC countries is 217 acres (14). The farm fragmentation of agricultural land holdings has contributed to the high per-unit cost of producing agricultural products since the requirement for labour and machines is significantly higher in Greece (15).

One other deficiency is the inability to bring about the necessary shifts in production patterns in response to changing world demands. An example is certain tobacco varieties, which were used by the domestic tobacco industry in the past, and are still grown although domestic and international demand has shifted towards other varieties (i.e., Burley and Virginia). The result is extensive subsidization of producer prices (16).

Finally, the modernization of agriculture through land consolidation should lower production cost and improve the competitiveness of agricultural products. For this to be achieved, a much broader role for cooperative activity at the production stage as well as in the manufacturing and trade of agricultural products is required.

2.2.4 The Balance of Payments Problem

Closely related to the already mentioned weaknesses in the composition of production and investment as well as the worsening competitiveness, is the problem of the balance of payments, which constitutes today the main restrictive factor in exercising meaningful macroeconomic policy (17). The existence of such a deficiency would normally be expected to result in a serious external imbalance. Until the early 1970s, however, the large trade deficit had been partly offset by earnings from the service sector and transfer items in the balance of payments, namely tourism,

shipping and emigrant remittances.

Given the existing restrictions, this way of covering the trade deficit would not necessarily be unfavourable in the short run. However, uncertainty about the future level of invisible receipts, and the fact that these receipts reflect cyclical, worldwide economic conditions and decisions made outside the country, makes the present structure of the balance of payments dangerous in the long run. And indeed, as if to confirm this danger, during the past few years the offseting factors from tourism, shipping and emigrant remittances have tended to diminish in importance, adversely affected by the post-1979 world recession. Earnings from transportation weakened because of the slump in the world shipping market. Receipts from tourism declined sharply following a post-1981 deterioration in price competitiveness as well as due to the worsening economic situation abroad. To the above, we can add the recent incidents of terrorist activity. Finally, emigrant remittances have also decreased steadily since 1979 due to rising unemployment and decelerating wage increases abroad. In addition, the return of emigrants may have also played a role (18); and given the expectations of a continuation of negative emigration rates (i.e., return migration), this source of foreign exchange may not continue its steady growth. Therefore, it follows that alternative ways of financing trade deficits are necessary, especially in the face of the fierce competition inside the EEC.

2.2.5 Weaknesses in the Capital Market

Very little progress has been made over the years in developing a capital market capable of performing a role similar to that in advanced economies. As noted earlier, the Athens stock exchange is heavily dominated by public-sector and banking issues (19). In the face of such an embryonic capital market, the banking system has been carrying a substantial part of the burden of financing industry's needs.

The role of commercial banks is by far more important than the rest of the financial institutions, and the said banks have been following a high-standard credit policy. This means that, while large firms have had easy access to bank funds, this has not been the case with small handicraft units. In Greece, firms with a long history of credit standing as well as with sound and marketable assets or security, receive most of the bank credit.

The practice of credit rationing and the persistence of interest rates which do not fully reflect the realities of the marketplace are not necessarily inconsistent with a profit-maximizing goal for banking institutions. The existence of a degree of inflexibility in interest rates in the presence of excess demand for bank funds could be explained by the nature of the discretionary policy practiced by monetary authorities, which in the case of Greece, consists of setting upper limits for borrowing

rates. In addition, the rationality of credit rationing can be based on a number of theoretical explanations. One of them hypothesizes a particular type of supply curve for credit (20), which is of zero or even negative interest elasticity beyond a certain interest rate. This would mean that the client cannot borrow more than a given sum of money, irrespective of the interest rate he is prepared to pay. This is attributed to the risk of default, which is an increasing function of the amount borrowed, as well as to the fact that the final wealth of the borrower is not infinite.

A more convincing theory put forward by Jaffee and Modigliani (21) intends to explain why it may be efficient for the lender to keep an interest rate which is lower than the one that equates demand and supply. They approach the problem by examining both the demand and the supply for bank funds. They show that a banking institution acting as a perfectly discriminating monopolist would charge a different rate to each customer. However, when customer differentiation is not possible, a number of customers with different risk characteristics will all be charged the same interest rate. The result is that at this common interest rate the demand for bank funds by at least some of the customers will be greater than the supply of such funds (i.e., credit rationing exists).

The inability of the lender to differentiate effectively

among customers with respect to their risk class is attributed to the high cost of doing so (22). On the other hand, the requirement of adequate security for the loan can lead to the elimination of excess demand for credit at the common interest rate.

The main consequence of credit rationing is that bank funds tend to find their way to: a) the largest firms in the industry; b) firms which have done business with the banking system in the past, while new firms (which are often the ones introducing new technology to an industry) tend to face difficulties in raising funds; c) firms that provide collateral or some other kind of security (23).

The difficulty of a small or medium sized enterprise to borrow long or medium term bank funds was reinforced by a particularly complex framework of rules and regulations governing the extension of credit, as well as by the lack of mechanisms and experienced staff capable of evaluating investment proposals. As a result, collateral, besides being a logical consequence of credit rationing, became the sole prerequisite for credit extension. This result, as well as the above mentioned consequences of credit rationing, tends to affect other characteristics besides quantity; and we have already seen that one of the results is that the largest firms receive most bank credits. The directions for improvement seem to be towards the establishment of a more comprehensive framework of rules

regarding the extension of credit, with less emphasis on collateral and other kinds of security, complemented with the utilization of staff capable of evaluating investment proposals, especially those submitted by new firms.

2.2.6 Exchange Rate Adjustment

Under fixed exchange rates and perfect international capital mobility, it is known that the economy will adjust instantaneously toward external balance, since trade deficits or surpluses can always be financed by borrowing or lending at world interest rates. Monetary policy would not have any effect on the equilibrium level of income or interest rates, in any given economy. Fiscal policy, however, is highly effective in changing income and employment, since it does not crowd out investment.

Under a system of floating exchange rate and perfect capital mobility, the money supply is in principle under the control of monetary authorities. This is obtained, however, at a loss of direct control over the exchange rate. With perfect capital mobility, fiscal policy measures adopted by a small country are not effective in changing output. An increase in government expenditures, for example, would raise aggregate demand for domestic goods and place upward pressures on domestic interest rates. This induces an inflow of capital, leading to an appreciation of the exchange rate and a switching of demand away from domestic goods. This

would offset the direct expansionary effects of increased government spending.

Over the period under consideration, two types of exchange rate regimes were in effect in Greece. Until March 1975, the Greek drachma was fixed at 30 drachmas per U.S. dollar. After 1975, the drachma was dissociated from the dollar, and its value has since been linked to a basket of currencies of trading partners and competitors. Furthermore, government controls (such as an administrative control of credit extension and interest rates as well as capital controls) were in effect during the period under study and these tend to influence the adjustment under fixed and flexible exchange rates, and the effectiveness of fiscal and monetary policy. Capital controls, such as restrictions on the amount of foreign currency the domestic residents can purchase (as is the case of Greece and other small countries), permit the domestic interest rate to be different from the world rate (imperfect capital mobility). Capital controls have the disadvantage of reducing the efficiency of international capital markets.

Under fixed exchange rates and imperfect capital mobility, an expansionary monetary policy would tend to increase income and decrease interest rates in the short run, both of which tend to worsen the balance of payments. This would lead, over time, to a decrease in the domestic money supply. Thus monetary authorities might face great

difficulty in controlling the money supply. With imperfect capital mobility and fixed exchange rates, however, expansionary fiscal policy can stimulate output and employment but raises interest rates.

Under flexible exchange rates and imperfect capital mobility, an expansionary monetary policy leads to higher output and lower interest rates, although the increase in output is smaller compared to the case of perfect capital mobility. Fiscal policy is also effective in raising output but tends to increase domestic interest rates and appreciate the domestic currency, crowding out to some extent both the investment and export sectors of the economy. The expansionary effect of fiscal policy becomes stronger as the degree of capital mobility declines.

In conclusion, during the period under study, progress has been made towards achieving objectives such as, growth of per capita national income, and exports of goods and services. However, problems of a structural nature continue to plague the Greek economy. Structural changes, vital to the Greek economy and long overdue, will be the challenge of the near future.

NOTES

(1) "The Greek Economy Today", Center of Planning and Economic Research, Athens (January 1984), p. 4.

(2) Simigiannis, G., "The Demand for Short-Term Bank Credit in Greek Manufacturing Industry",in "The Greek Economy: Research Studies and Statistical Series", Bank of Greece, Athens, 1982, p. 202.

(3) Data reprinted in Simigiannis (1982), ibid., p. 235.

(4) Vernardakis (1978), op. cit., p. 30.

(5) After World War II and during most of the 1950s, an important source of investment financing was foreign assistance programs which, through public investment, contributed to the rebuilding of the economy and the generation of income and savings. I. Adelman and H. Chenery in "Foreign Aid and Economic Development: The Case of Greece", Review of Economics and Statistics, vol. 48, no. 1, 1966, p. 9, find that the savings-investment gap ceased to be the dominant gap around 1957.

(6) Imports of ships are not included.

(7) Source: IMF, International Financial Statistics, July 1982, pp. 180-181.

(8) Bank of Greece, "The Greek Economy" vol. II, Athens, 1982, p. 10.

(9) Center of Planning and Economic Research, "Program for Economic and Social Development, 1978-82", Athens, 1979.

(10) OECD Economic Surveys, Annual Review of Greece, Paris, 1983, p. 47.

(11) Center of Planning and Economic Research (1979) op.cit.

(12) Yachnis, V., The End of Middle Class Prosperity Exantas, Athens, 1985, p. 20.

(13) An article in the newspaper "Thesaloniki" on June 10, 1983 focuses on a characteristic example of such a firm (which, to a large extent, is representative of Greek industry today). MAK METAL, founded in 1968, produces mainly pipes used in agriculture and covers 1/3 of the domestic market for the product. During the years of its operation, it has been flooded with bank loans, mainly by the National Bank and the Industrial Development Bank. In 1983 the firm's debt obligations to these institutions were over one billion drachmas. At this point the firm, experiencing serious difficulties, applied for a new loan of 300 million with the

intention of "modernizing the unit". A report by a private consulting firm, submitted to the National Bank at the request of MAK METAL, pointed out its inefficient operation (mainly due to a lack of competent management, organized marketing and public relations), but at the same time suggested that the firm showed potential and consequently recommented the provision of the loan.

(14) Yachnis (1985), op. cit., p. 27.

(15) Greece, besides having such fragmented agricultural land holdings, has a higher ratio of tractors per 1000 hectares than the United States, Soviet Union, Canada and a number of other countries. The purchase of agricultural machinery is subsidized by the government (see newspaper "TA NEA", Athens, August 26, 1985).

(16) In the case of "tsebelia", a variety of tobacco traditionally grown in Greece, 80% of the producer's price is a government subsidy, (see newspaper "TA NEA", Athens, August 26, 1985).

(17) Bank of Greece, Summary of the statement of Governor D. Chalikias at the annual shareholders meeting, Athens, April 1985.

(18) OECD Economic Surveys, Annual Review of Greece, Paris, 1983, p. 19.

(19) OECD (1983), ibid., p. 50.

(20) See Hodgman, D.R., "Credit Risk and Credit Rationing", Quarterly Journal of Economics, vol. 74, no. 2, 1960, pp. 258-278.

(21) See Jaffee, D.M, and Modigliani, F., "A Theory and Test of Credit Rationing", American Economic Review, vol. 59, no. 5, 1969, pp. 850-872. See also Jaffee, D.M., Credit Rationing and the Commercial Loan Market, John Wiley and Sons, New York, 1971.

(22) See Jaffee, D., and Russel, T., "Imperfect Information, Uncertainty and Credit Rationing", Quarterly Journal of Economics, vol. 90, no. 4, 1976, pp. 651-666.

(23) See McKinnon, R.I., "Financial Policies", in Policies for Industrial Progress in Developing Countries, published for the World Bank, Oxford Univ. Press, 1980, pp. 93-120. For a study concerning the practice of credit rationing by the Greek banking system, see Simigiannis (1982) op. cit.

CHAPTER III

TOWARDS THE MODEL

3.1 The Approach

The procedure followed in the specification and estimation stage started with the use of ordinary least squares for the first step of exploring alternative structural forms of individual equations. This has been a standard procedure followed in model construction, which results in the minimization of the risk of commiting a type II error (accepting the false hypothesis that a parameter is zero), as shown by Carter (1973) (1). In the first screening step, besides economic theory, prior knowledge of characteristic features of the Greek economy as well as extensive experimentation provided the direction. Once the alternative specifications of each equation were limited to one or two, the next step of dealing with the problem arising from simultaneity as well as that of the selection of the suitable estimation technique was undertaken.

3.2 Consumption Equations

There are fourteen categories of private consumption in Greek national accounts (2), which have here been grouped into three consumption equations. The first is for food,

beverages and tobacco; the second is for clothing-footwear, furniture, and whatever else has to do with the operation of the household (mostly semi-durables); finally the third is for services, including purchases of private automobiles, which are classified under transportation services.

From previous research on the nature of the consumption function (3) it was shown that lagged values of some of the variables involved affect current consumer behaviour. The presence of lags means that the full reaction of consumers to changes in income and other economic variables does not occur immediately but takes place gradually (4). In particular, the lag effect is attributed to the consumption habits which people form, producing an "inertia" in consumer behaviour. This "habit persistence" effect is assumed to be strongest the closest we get to the current period and gradually fades away as time elapses.

Besides income and lagged consumption, other variables that can affect consumption are: wealth in the form of liquid asset holdings of households, relative prices, and the distribution of income. The effect of liquid assets (past savings) on consumer spending would be related to the level of consumers' deferred wants. The inclusion of income distribution in the consumption equation is to account for differences in consumption patterns of different income groups. The distribution of income in Greece has a very important regional dimension. Income in the main urban,

industrial centers has been dramatically higher than that of the rural, agricultural areas and there is no indication that this gap is closing. On the other hand, over the past several decades a continuous flow of internal migration from the agricultural areas to the main urban centers - mainly Athens and Thessaloniki - has been taking place, altering the regional distribution of income in terms of the ratio of agricultural to total income. Furthermore, in Greece, data on the factor distribution of income are inadequate. Due to the above mentioned reasons, a proxy which attempts to capture the distribution of income as a regional phenomenon was used.

The general structural form of the disaggregated consumption functions is given below. This functional form was the basis in the search for the appropriate specification of individual consumption functions, starting from a simple consumption-income relationship (absolute income hypothesis).

$$\frac{Ci}{N} = a*\frac{Yd}{N*Pi} + b*\frac{Ci}{N}(-1) + c*DEPTC + d*\frac{Pi}{Pni} + e*\frac{GDPAC}{GDPC} + f*OTHER + u$$

where, a, b, c, d, e, f, are the regression coefficients and u is the stochastic term. Ci/N is per capita consumption in category i at constant prices, Yd is disposable income at current prices, Pi is the consumption deflator in the ith category, Pni is the consumption deflator covering expenditure in categories other than i (considered more

appropriate than the general consumption deflator), DEPTC is a measure of wealth in the form of savings deposits, and GDPAC/GDPC, the share of agricultural output in total output, is a proxy for regional distribution-urbanization (and hence income distribution). Finally, "other" stands for any other variable that could be relevant, such as the real interest rate, alternative lag structure for consumption, and dummy variables.

General results from experimenting with alternative specifications for the 1960-1981 estimation period were first, that the coefficient of relative prices was close to zero and in some specifications of the food-beverages-tobacco equation it produced the wrong sign; second, that the real interest rate did not add anything significant to the explanatory power of the three equations; and third, that the appropriate lag structure was a one-year lag.

In the food-beverages-tobacco equation (FBTC), the absolute income variant of the consumption function, although relatively satisfactory in terms of goodness of fit, nevertheless left a lot to be desired, as several of the residual errors were rather high and the Durbin-Watson (D-W) statistic was very low. This was to be expected since this category of consumption consists of items for which a strong "inertia" in consumer behaviour is anticipated. As a result the habit persistence hypothesis (HPH) suggested itself as the most promising specification. With the HPH,

past real consumption exerts a stabilizing effect on current consumption. When the equation specification was made to reflect the HPH, the regression results were quite satisfactory with low residual errors, and the D-W and h-statistics were such that the hypothesis of no serial correlation could not be rejected. Income distribution and other variables such as relative prices, the distribution proxy and the interest rate turned out to be unimportant for this category of consumption. The estimated equation is:

$$(3.1)\quad FBTC/N = \underset{(3.1)}{958} + \underset{(2.4)}{0.053}*YD/(PFBT*N) + \underset{(8.7)}{0.783}*FBTC(-1)/N(-1)$$

$$R\text{-}SQ = 0.9954 \quad D\text{-}W = 2.15 \quad h = -0.37$$

The propensity to consume out of disposable income is rather low, while the coefficient of lagged consumption indicates strong "inertia" in consumer behaviour. The long-run marginal propensity to consume implied by this equation is 0.24 which is comparable to the value of 0.27 obtained by Vernardakis (1978, p. 69).

In the clothing-footwear-rent-fuel-household equipment equation (CFRFHC), the consumption of the items which dominate this category (i.e., clothing-footwear, and household equipment) are almost exclusively dependent on disposable income. The simple consumption-disposable income specification resulted in a good fit and the subsequent inclusion of lagged consumption produced an insignificant

coefficient on the latter. On the other hand, it was found that the proxy for rural/urban distribution of income (share of GDP in agriculture to total real GDP) improved the equation. This is easily explained by the fact that a wide variety of goods in this category of consumption, such as household appliances and other equipment are much more affordable for the population of the large urban centers compared to that of the rural areas. The sign of the coefficient for this variable is negative, as expected, meaning that as the agricultural sector contracts, consumption of a variety of goods in this category will increase. Finally, a dummy variable was added (DUMCFR) to capture the effect of the abnormally high consumption in the years 1970 to 1972. This increased consumption stems from the price controls imposed by the military government during that period, which resulted in relatively stable prices (in the presence of inflationary pressures), until they were abandoned in 1973. The final form of the equation is:

$$\underset{(3.2)}{CFRFHC/N} = \underset{(2.8)}{372} + \underset{(10.1)}{0.199}*YD/PCFRFH*N - \underset{(-1.7)}{4653}*GDPAC/GDPC + \underset{(3.3)}{391}*DUMCFR$$

R-SQ = 0.9982 D-W = 1.63 p = 0.90

The D-W statistic indicated the presence of serial correlation, and this was also the case for every other specification examined. Consequently, the model was reestimated in order to correct for serial correlation, by estimating the autocorrelation coefficient, and by applying

the proper transformation (as given in equation 3.2 above).

In the health-transportation-communications-recreation-other services equation (HTCROC), preliminary tests indicated that, besides disposable income and lagged consumption, a variable which considerably improved the equation was a measure of wealth (DEPTC), in the form of savings deposits with the Postal Savings Bank, which in Greece is the single most important form in which non-business savings are held. The importance of this variable is most likely due to the inclusion of private automobile purchases in this category of consumption. Finally, a dummy variable for years 1975 to 1978 (DUMW) has been included in the specification. During the 1975-78 period, an increase in the relative strength of trade unions led to significant increases in wages. During this period, labor costs were the main source of inflation, and income was redistributed towards wages. The rate of increase of urban wages over this three year period was 21.6%, compared to an average increase in the price level of 12.8%.

The final form of the HTCROC equation is:

$$\underset{(3.3)}{HTCROC/N} = \underset{(1.9)}{538} + \underset{(2.8)}{0.050}*YD/PHTCRO*N + \underset{(3.4)}{0.152}*DEPTC + \underset{(5.1)}{0.483}*HTCROC(-1)/N(-1) + \underset{(5.2)}{459}*DUMW$$

R-SQ = 0.9977 D-W = 1.48 h = 1.32

With the savings deposits included in the equation, the

coefficient of lagged consumption indicates a moderate "inertia" in consumer behaviour. In the presense of lagged consumption as an explanatory variable, the h-statistic was calculated and found to be less than 1.645 (absolute value), indicating that the hypothesis of no serial correlation can not be rejected at a 95% level.

Looking at the three equations together, the total (long-run) marginal propensity to consume out of disposable income is 0.54. The difference with previous estimates of marginal propensity to consume out of disposable income in Greece, such as Vernardakis' estimate of 0.74 (Vernardakis 1978, p. 78), lies in the third consumption equation. In the present case, with the inclusion of a wealth variable, the estimates of the disposable income and lagged consumption coefficients are lower than those of previous models in which a wealth variable was not included. Indeed, experimentations with the model showed that, with the wealth variable omitted, the long-run marginal propensity to consume out of disposable income increased to approximately 0.79, much closer to Vernardakis' estimate.

3.3 Investment Equations

Private investment is disaggregated into four separate equations: manufacturing-mining, agriculture, housing, and services. Investment by the public sector is exogenous to

the model.

Manufacturing and Mining

Our analysis will focus on investment in manufacturing since it accounts for approximately 80% of investment in this category.

We can arrive at a testable equation of investment in manufacturing starting from certain assumptions concerning technology, input and output markets, depreciation, the financing of investment, and the goals of the firm. In particular we assume that:

- Technology is described by a production function of the form:

$$Q = Q(K,L),$$

with positive first derivatives and negative second derivatives with respect to K and L, where K and L are capital and labour respectively.

- The existence of competitive output and input markets, so that prices are given for the firm. This is an unrealistic but simplifying assumption.

- Capital depreciates at an exponential rate so that:

$$K(t) = K(t-1) + I(t) - \delta K(t-1)$$

where I(t) is gross investment and δ is the rate of

depreciation.

- The firm can finance its investment from two sources: profits and long-term bank credit. A third source of funds, namely the capital market is left out, given the embryonic state of the Greek capital market (5). Most manufacturing firms are of small size with family ownership of shares.

- The goal of the firm is to maximize the present value of the utility from distributed profits. In a world without uncertainty and perfectly competitive money markets this goal is equivalent to maximizing profits. But when there is uncertainty, risks or imperfections in the money market, production decisions are not independent from consumption decisions (6).

The long-term lending interest rates in Greece are not being determined by demand and supply, but are determined by policy makers who administratively set the upper limits for lending rates. The consequences of such administrative control of interest rates are that a disequilibrium between demand and supply for credit will result, leading to an excess demand or supply for credit (7).

Lending institutions, on the other hand, will consider the risk of default, the risk class of each client and the expected return of the loan, and if this were possible, would charge a different interest rate for each client (8). But the administrative control of interest rates makes this

impossible. They now face two possibilities: to practice credit rationing, or to require collateral in order to reduce risk. This second possibility is the one widely observed in the Greek money market (9).

A profit-maximizing firm therefore, with an alternative source for financing its investment projects at cost p, has the following options:

-If $p<i$ (where i is the long-term interest rate), the demand for credit is zero.

-If $p>i$, the demand for credit equals the cost of investment. It pays for the firm to borrow, distributing its profits to the shareholders. This case characterizes the Greek market for long-term credit. Interest rates are low in general (and most of the time negative in real terms in the presence of inflation), and this leads firms to finance investment with long-term loans.

Using the above mentioned assumptions, and equating the marginal product of capital to the user cost of capital, it is possible to obtain an equation for the desired capital stock. A way of deriving such a function is as follows (10): by equating the marginal revenue and marginal cost for an increase in capital by one unit we get:

$$P * y/K = C$$

where P is the price of output, y is output, K is capital, C

is the user cost of one unit of capital. Taking a particular form of a production function, namely the Cobb-Douglas one, y = a * (K)**b * (L)**(1-b), and equating the marginal product of capital with the user cost of capital we get:

$$b * (y/K) = C/P.$$

Now, we can solve for the equilibrium level of capital stock Ke) as:

$$Ke = b * P * (y/C)$$

and generalizing:

$$Ke = Ke(y,C,P)$$

Then, using the definition of investment as being the change in equilibrium capital plus depreciation, we get an investment equation which is a function of the user cost of capital, supply of output, lagged capital stock, and the price of output. Finally, lagged investment expenditure has been used as a regressor on the grounds that, in Greece as in other less developed economies where a single project can affect the level of investment substantially, such a project can seldom be carried out in a single year. It is normal to see projects begin operation two years after the beginning of construction (11).

The general functional form of the equation is thus:

PRINMC= a + b*CSMC + c*GDPMC + d*PROF + e*UC + f*PRINMC(-1) + g*OTHER + u

where PRINMC is private investment in manufacturing-mining at constant prices, CSMC is the capital stock in manufacturing at constant prices, GDPMC is the real gross domestic product in manufacturing-mining, PROF is a profit variable (either the profit rate or the volume of profits in manufacturing, as defined below), UC is the user cost of capital, and finally, as "other" I examined a bank credit variable and a proxy for foreign investment.

The user cost of capital depends on the long-term interest rate i, the alternative cost of borrowing p, as well as the corporate tax rate and the tax deductions for retained earnings. Due to the absence of available data concerning the tax variables, the long-term lending rate to manufacture adjusted for inflation was used as the measure of user cost of capital.

Two measures of profitability in manufacturing were used: one in level form and the other expressed as a profit rate. The measure of the level of profits was defined as follows: starting from figures reflecting costs of materials (value of raw materials, cost of electricity, cost of other materials, spare parts, etc), wages and salaries, and gross value added in manufacturing, an estimate of (net) value added is obtained as the difference between gross value added and the cost of materials. This represents the sum of wages and salaries, depreciation, and profits. If from this, wages and salaries and depreciation are subtracted, an

estimate of the level profits in manufacturing is obtained (PROF). From this estimate of profits, a profit rate variable (PROFR) can be derived as the ratio of profits to the total cost of production.

The first specification examined was by using the two main components of the PRINMC function suggested by theory, namely, the stock of capital and output in manufacturing-mining (CSMC and GDPMC, respectively). This equation produced significant coefficients and the correct signs; in particular both current and lagged capital stock were included as explanatory variables and they produced significant coefficients and correct signs (negative). Lagged capital stock however, performed relatively better than current capital stock. It was then found that the extension of this specification to include the profit variable (PROF) and lagged investment improved the equation considerably. The long-term interest rate was subsequently added, which produced the right sign (negative) in a number of specifications; the coefficient, however, turned out insignificant and this variable was dropped from the specification. This was to be expected, given the above mentioned characteristics of the Greek capital market, and in particular the strong indications of credit rationing practices. It was the same case for the variables for the bank credit to manufacturing and mining and the proxy for foreign investment. The insignificance of the latter came as a surprise, since many of the large investment projects are

carried out by foreign concerns. This result may be related with the difficulty of finding an appropriate variable for foreign investment (12). The final form of the equation is:

$$\underset{(3.4)}{PRINMC} = \underset{(0.9)}{670} - \underset{(-1.9)}{0.095}*CSMC(-1) + \underset{(1.8)}{0.122}*GDPMC + \underset{(2.0)}{0.11}*PROF + \underset{(4.5)}{0.648}*PRINMC(-1)$$

$$R\text{-}SQ = 0.9553 \quad D\text{-}W = 1.46 \quad h = 1.63$$

In place of the lagged capital stock, the lagged capacity utilization ratio was used as an alternative (data are available from the OECD), which gave a significant coefficient but performed worse than lagged capital stock.

The equation presented is the one which performes best, based on statistics of fit and its forecasting record, and indeed, it captures all turning points, despite the highly volatile nature of investment in the 1970s. The R-SQ is very high, higher than any other equation for investment in manufacturing in previous models for Greece that the author is aware of, and the hypothesis of no serial correlation cannot be rejected.

Housing

Historically in Greece, the share of housing investment has been in the order of 30% to 40% of total private investment expenditure. It has absorbed a considerable amount of the savings of small and average savers. This is,

at least partly, due to the lack of alternative investment opportunities and the fact that it constitutes a low-risk investment. In addition, the construction sector has been frequently used by policy makers as a means of exercising counter-cyclical policy and stimulating domestic demand. It follows that any variable related to this sector and controlled by the government would be of special importance in the specification of the equation. Such variables are the bank credit to housing and the mortgage rate.

Another variable which proved of importance is a variable related to the number of new family units. The argument is that the need for housing, from a long-run point of view, is set by the number of family units and two other factors particular to the Greek society. One is the institution of dowry, which involves a transfer on the part of the bride's family as a means of support for the couple in the first years of married life. Most of the times, this transfer is in the form of a dwelling unit. The second such factor is related to the superstition of Greek society against marrying in a leap year. This introduces a four-year cycle in the data for marriages, a cycle which is absent in the investment data. Consequently an appropriate smoothing of the series of marriages is required, if this variable is to be used in the specification (13). However, strictly speaking, we should note that, investment in housing is a function of expected marriages, not actual ones, since investment in a new dwelling unit can occur at any time

prior to the actual creation of a new family (14). Nevertheless, the lagged moving average of marriages has been included in the specification.

Other variables which are expected to influence investment in housing are: disposable income and lagged investment. The reason for the latter is that the construction of a dwelling unit normally takes more than one year to be completed.

Finally, other variables which were examined include: the regional income distribution-internal migration proxy, the stock of dwelling units, population growth and a dummy variable for the abnormal year of 1974 (end of dictatorship, Cyprus crisis).

In functional form:

PRINHC=f(Yd/Ph*N, BCHC, INTHR, LMRA, PRINHC(-1), "OTHER")

where PRINHC is private investment in housing at constant prices, Yd/Ph*N is real per capita disposable income, BCHC is the volume of bank credit to housing at constant prices, INTHR is the real mortgage rate, and LMRA is a three-year moving average of marriages lagged one year.

The capital stock is not expected to be of particular importance in explaining investment in housing, as can be concluded from the earlier discussion on the sociological characteristics of this sector of investment and the fact

that this sector attracts a large portion of savings, given the limitations on other alternative investment opportunities.

The equation finally selected is:

$$
\begin{aligned}
(3.5)\ \text{PRINHC} = {} & -22051 + 0.634*\text{BCHC} - 234.5*\text{INTHR} + 3465*\text{LMRA} \\
& \quad (-1.3) \quad (4.4) \qquad (-2.5) \qquad (2.0) \\
& + 0.259*\text{PRINHC}(-1) - 12577*\text{DUM74} \\
& \quad (1.7) \qquad\qquad (-4.8)
\end{aligned}
$$

$$\text{R-SQ} = 0.9196 \qquad \text{D-W} = 1.96 \qquad h = 0.13$$

As we can see, the coefficients of LMRA and lagged investment are of borderline significance.

Disposable income and related variables (such as a three-year moving average of disposable income) failed to produce a significant coefficient. In addition, as was expected, the statistical insignificance of the stock of capital and of population growth variables was confirmed.

The bank credit variable proved to be particularly powerful in every specification examined, while the marriages variable as well as lagged investment were of borderline importance. The over-all performance of the equation was good, especially in its ability to capture turning points.

Agriculture

Generally speaking, the basic problem in agriculture is the low per capita income, relative to the non-agricultural sector of the economy. This problem is further aggravated by the uncertainty of income due to weather conditions.

Whatever improvement in the productive capacity of this sector took place over the last few decades (mainly through increased mechanization and better irrigation techniques), extensive government subsidization of agricultural prices has always occurred. This government support is what the low-income farmers have been depending on, on a year-by-year basis. The role of government in the provision of the necessary credit to the agricultural sector has been twofold. On the one hand there is a wide network of (government controlled) Agricultural Bank offices all over the countryside. Thus, farmers have an easy access to the loan market, and the loans obtained are on "preferential" terms (low interest loans). There also exists a broad program of government price supports intended to stabilize agricultural income. This is basically done by setting agricultural prices. As a result, this will influence investment in the next period through profit expectations.

Consequently, the main determinants of investment in agriculture should be the Agricultural Bank credit variable, and lagged prices of agricultural products. Other variables included in the general specification are lagged investment

and an agricultural income variable. It should be noted that, due to the cyclical nature of agricultural production, the capital stock is not a highly relevant variable.

The general model which provided the basis for experimentation is:

$$PRINAC = a + b*ABCC + c*Pa(-1) + d*PRINAC(-1) + e*GDPAC + u$$

where PRINAC is private investment in agriculture at constant prices, ABCC is Agricultural Bank credit at constant prices, Pa is the price index of agricultural goods, and GDPAC is real gross domestic product in agriculture.

Regression results verified that the most important determinant of investment in agriculture is the bank credit variable (ABCC). Furthermore, lagged agricultural prices produced a significant coefficient, but it entered with the wrong sign. Experimentation with current year prices as well as alternative price indices did not change the sign. A possible explanation that could be provided is along the lines of the cobweb model. Furthermore, the lagged agricultural prices variable considerably improved the equation and it was finally retained in the specification of the equation. The equation selected is:

$$(3.6)\quad PRINAC = \underset{(4.4)}{1615} - \underset{(-5.0)}{890}*WPAG(-1) + \underset{(7.30)}{0.128}*ABCC$$

$$R\text{-}SQ = 0.7758 \qquad D\text{-}W = 1.84$$

where WPAG is the wholesale price index of agricultural products for home consumption. Lagged investment and the agricultural income variable did not perform well and were dropped from the equation.

Services

Included in this category are investment in transportation, communications, electricity, public administration, and other services.

This sector of investment has traditionally been favoured with respect to bank credit extension, especially trade and tourism - unlike the manufacturing sector, where a small number of large firms absorb most of the credit. Credit availability, therefore, is also highly relevant in this category of investment. Other variables considered in the general specification include an income variable, the proxy for regional distribution-urbanization, and lagged investment. The reason for including the proxy for regional distribution-urbanization is that in this category of investment certain items constitute investment in public utilities. The general specification is:

$$PRINSC = a + b*BCTC + c*GDPC + d*GDPAC/GDPC + e*PRINSC(-1) + f*OTHER + u$$

where PRINSC is private investment in services at constant prices, BCTC is the volume of bank credit to trade at constant prices, and GDPC is the real gross domestic product. In "other" the variables cossidered are population

growth and the foreign investment proxy. The equation finally selected is:

$$(3.7)\quad \underset{}{PRINSC} = \underset{(2.5)}{22513} + \underset{(2.1)}{0.467}*BCTC - \underset{(-2.6)}{82567}*GDPAC/GDPC$$

$$R\text{-}SQ = 0.9327 \qquad D\text{-}W = 1.46$$

The output variable did not produce a significant effect, and the same was the case for the other variables considered. As a result, neither of these variables were included in the form of the equatiom finally retained.

It is worth noting that the coefficient on the regional income distribution-urbanization proxy indicates that this variable is of particular importance in the specification of this equation. This result is related to the urbanization process taking place during the sample period and to the fact that infrastructure investment constitutes a major part of this category of investment.

3.4 Import Demand Equations

The General Model

The disaggregation of import functions is into four SITC commodity groups, which are: 0+1 (food and agricultural products), 2+4 (raw materials), 3 (fuel and lubricants), and 5-9 (manufactured products).

The average relative import share of each group in total imports for the 1960-81 period is given below:

SITC	0	1	2	4	3	5	6	7	8	9
Share	11.1	0.2	9.3	0.3	17.9	10.0	17.4	30.2	3.4	0.05

Source: National Statistical Service of Greece, Statistical Yearbook, various issues.

where the different SITC categories refer to:

SITC 0: live animals, meat, fish, vegetables and fruits, and miscellaneous edible products

SITC 1: alcoholic and non-alcoholic beverages and tobacco;

SITC 2: inedible crude materials, excluding fuels;

SITC 3: fuels, lubricants, and related materials;

SITC 4: animal and vegetable oils and fats;

SITC 5: chemical products;

SITC 6: varicus manufactured goods;

SITC 7: machinery and transport equipment;

SITC 8: miscellaneous manufactures;

SITC 9: commodities not classified according to kind.

From the table above, and given the classification of

imports in 4 SITC commodity groups, the fourth group (SITC5-9) includes over 50% of all imported goods.

As in other applied international trade research (15), import demand for each group is in general taken to be a function of:

- a domestic activity variable (Q);

- relative import prices, adjusted for import duties ((1+dmi) * Pmi/Pdi);

- lagged imports (MCi(-1));

- other factors that may affect import demand, especially dummy variables (OTHER);

The general form of the import demand function for group i is of the following form:

MCi = m(Q, (1+dmi)*Pmi/Pdi, MCi(-1), OTHER)

with the first derivatives of imports with respect to Q and relative import prices being positive and negative, respectively. Here, MCi represents imports of SITC i goods, dmi is the import duty rate on SITC i goods, and Pmi and Pdi are the price index of imported goods and the relevant domestic price index for SITC i, respectively.

The relative import price variables are intended to account for the substitutability between domestic and foreign commodities.

The presence of lagged dependent (and lagged explanatory) variables characterizes a dynamic specification. Lagged variables should be included in the general form, on the grounds that dependent variables do not adjust instantaneously to a given exogenous change (16).

The domestic activity variable, to be used in the specification of the different import functions, depends on the nature of the commodities included in the particular group, and whether the import demand is for consumers' or producers' goods. In the experimentation, the variables used were disposable income, gross domestic product, and private consumer expenditure.

The relative import price variable is constructed as follows: first, we construct the ratio of the relevant import price index to the appropriate wholesale price index of domestic production; then, this ratio is adjusted by the duty rate, which is constructed as the ratio of overall import duties in the commodity group i in millions of current drachmas, to the value of imports in commodity group i in millions of current drachmas.

Experiments concerning the appropriate specification of import equations were based on two mathematical formulations, namely, the linear and the double-logarithmic forms. In previous sectoral studies concerning import and export equations for Greece, the double-logarithmic functional form has been the one most frequently used (17).

In our case, the two specifications resulted in insignificant differences in goodness of fit, and the linear specification was retained.

Import Demand in SITC 0+1

Imports of food and live animals (SITC 0) constituted the bulk of imports in this category.

Since the commodities under consideration are oriented towards direct consumption, the appropriate domestic activity variable should be disposable income or private consumer expenditure.

In the construction of the relative import price variable, the price index of imports in SITC 0 (since it accounts for 98% of total imports in this group) is divided by the wholesale price index of domestic production of foodstuffs for home consumption. The outcome is then adjusted for duties in this commodity group.

Regression results suggest that per-capita disposable income, performed slightly better than private consumption expenditure. The equation selected is the following:

$$(3.8)\quad M01C/N = \underset{(5.7)}{630.8} + \underset{(8.8)}{0.0220*YD/(PCE*N)} - \underset{(-3.7)}{438.8*DRP01}$$

$$R\text{-}SQ = 0.8962 \qquad D\text{-}W = 1.74$$

where PCE is the price index of private consumption expenditure and DRP01 is the relative import price variable.

Import Demand in SITC 2+4

This commodity group is dominated by SITC 2, which basically represents crude materials excluding fuels mainly used by the domestic manufacturing industry. Consequently, real GDP in manufacturing seems to be the appropriate domestic activity variable; the index of industrial production was also considered as an alternative.

In the construction of the relative import prices variable, the appropriate import price index (for SITC 2) was divided by the wholesale price index of domestic primary production for home consumption.

A dummy variable was also included to account for the abnormally high value of imports in the year 1973 (D2). The final form of the equation is:

$$(3.9)\quad M24C = \underset{(1.9)}{2627} + \underset{(9.2)}{0.0625}*GDPMC - \underset{(-1.2)}{830}*DRP24 + \underset{(3.4)}{967.8}*D2$$

$$R\text{-}SQ = 0.9787 \qquad D\text{-}W = 1.53 \qquad p = 0.40$$

This equation fits the data well, and all explanatory variables entered with the right sign.

Import Demand in SITC 3

Over the last two decades, this commodity group (fuels, lubricants, and related materials) accounted for an average of 18% of total imports, second only to SITC 7. Moreover, this share more than doubled during the 1973-1981 period

compared to the 1960-1972 period.

The items in this commodity group, just as in the one previously considered, are used primarily by the domestic manufacturing industry. Hence, the domestic activity variables examined are the same as in SITC 2+4.

The relative import price variable was derived by dividing the relevant import price index by the index of domestic industrial production for home consumption.

The impact of the oil crises is captured by a dummy variable (D3), taking unit value in the post-1973 period and zero elsewhere. The equation which performed best is given below:

$$\underset{(3.10)}{M3C} = \underset{(0.8)}{1128} + \underset{(1.9)}{0.050}*GDPMC + \underset{(1.4)}{1581}*D3$$

$$R\text{-}SQ = 0.8789 \qquad D\text{-}W = 1.40 \qquad p = 0.54$$

The inclusion of relative import prices did not result in a statistically significant coefficient (although it entered with the right sign), and did not affect the values of other coefficients or that of the coefficient of determination. Consequently, this variable was excluded from the final version of the equation. This empirical result suggests that imports of crude oil are not sensitive to relative import prices, given that crude oil is a necessity, and domestic production of oil during the period under consideration was practically nil.

Import Demand in SITC 5-9

SITC 7 (18), which consists mainly of capital goods and passenger cars for private use, is by far the most important item in this commodity group. SITC 5 and 6 are also important, but to a lesser degree. Given that nearly all capital goods and passenger cars are imported, the average imports to exports ratio for SITC 7 was as high as 19.5.

This commodity group consists of a wide variety of commodities, including capital goods as well as intermediate goods, which implies that the domestic activity variable should be a "catch all" variable, and real GNP may be considered as an appropriate regressor for this more aggregated import demand equation.

In constructing the relative import price variable (DRP59), the import price index for this commodity group has been estimated as a weighted average of the import price indices of SITC categories 5, 6, 7, 8, and 9. This was then divided by the wholesale price index of domestic industrial production for home consumption. The equation finally retained is:

$$(3.11)\quad M59C = \underset{(1.4)}{18895} + \underset{(20.7)}{0.135}*GNPC - \underset{(-2.1)}{22821}*DRP59$$

$$R\text{-}SQ = 0.9790 \qquad D\text{-}W = 1.98$$

In the above equation, the signs are correct (although the coefficient of relative prices is not significant at the 5% level), the fit is good and there is no indication of

serial correlation.

Domestic Activity and Price Elasticities of Imports

Average elasticities, with respect to the domestic activity and relative import price variables, were estimated for the four categories of imports.

For two import categories, the domestic activity elasticity is below one, varying from 0.63 (for M3C) to 0.66 (for M24C). On the other hand, imports of capital goods, manufactured goods and chemicals (SITC 5-9) assumed a value greater than one (1.21), and for imported foodstuffs, beverages and tobacco, a value of 1.10.

Estimates of the price elasticity of imports (given in the table below) suggest that imports are inelastic with respect to relative prices in all import categories. Price elasticity estimates range from the very low values of -0.10 and -0.20 (for M01C and M24C), to an estimate of -0.75 (for M59C).

TABLE 6

Import Elasticities

	Domestic Activity	Price
M01C	1.10	-0.10
M24C	0.66	-0.20
M3C	0.63	—
M5-9C	1.21	-0.75

With respect to the comparative values of elasticities, we may note the following: the ranking of activity elasticities (i.e., M5-9C > M01C> M24C > M3C) implies that the M01C activity elasticity is greater than the M24C and M3C elasticity. A sectoral study, by the Center of Planning (K. Prodromides and J. Anastasakou, 1983), involving one-digit SITC divisions produced similar results. For activity elasticities, the values that exceeded one in the above mentioned study were for SITC's 1, 3, 5, 6, 7, 8, and those that were falling below one were for 0, 2, and 4. In particular, for SITC 1 (beverages, tobacco), the value obtained from the above mentioned study is about three.

In relative price elasticities, the results are as expected. Based on the above mentioned study, relative price elasticity estimates suggest that the M59C elasticity is the highest, but still less than one.

3.5 Export Demand Equations

The General Model

The nature of disaggregation of the export demand equations is the same as the one for the import equations.

The average relative export share of each commodity group for the period 1960-1981 is as follows:

SITC	0	1	2	4	3	5	6	7	8	9
Share	23.3	12.3	11.9	1.5	6.5	4.8	27.9	3.3	8.5	0.03

Source: National Statistical Service of Greece, Statistical Yearbook, various issues.

The specification of the export demand equations should logically share the same characteristics as import demand equations (19). The main determinants of export demand are a "world" activity variable and the ratio of export prices to a "world" price index of exports. The relative export price variable is to account for the relative competitiveness of domestic exports in the world market.

Other variables which should be included in the general specification are a domestic supply variable, lagged exports (to capture habit formation effects by foreigners), and

other factors that may influence exports and can be captured by dummy variables. In light of the above, the general form of the equation is:

EXCi = EXCi(WY, Pxi/Pwi, Q, EXCi(-1), "other")

where, WY is the relevant world activity variable, Pxi/Pwi is the relative export price variable, and Q is the domestic supply variable.

Export Demand in SITC 0+1

Commodity groups 0 and 1 constitute the second and third largest export groups respectively.

In deciding on the appropriate foreign activity variable, two alternatives were considered: real gross domestic product (WY) and real private consumer expenditure (WC), both of them for all the OECD countries, which absorb over 75% of total Greek exports. The variable which performed slightly better, in this particular commodity group, was private consumption expenditure.

Unlike the relative price and the domestic supply variables, it was found that lagged exports significantly improved the equation indicating a habit formation on the part of foreign demand for foodstuffs, beverages, and tobacco. Finally, the specification was completed with the inclusion of a dummy variable (D5), taking unit value for years 1968 (negative impact of coup d'etat on export demand)

and 1973 (beginning of oil crisis) and zero elsewhere. The final form of the equation is:

$$(3.12)\quad \underset{}{EX01C} = \underset{(-1.4)}{-2308} + \underset{(2.8)}{0.000235*WC} + \underset{(1.3)}{0.272*EX01C(-1)} - \underset{(-2.3)}{1881*D5}$$

$$R\text{-}SQ = 0.9023 \qquad D\text{-}W = 1.97 \qquad h = 0.68$$

The equation performed well and captured most of the turning points. The coefficient of lagged exports however is significant only at the 10% level, and the h-statistic indicates the presence of serial correlation.

Export Demand in SITC 2+4

This commodity group is heavily dominated by crude materials excluding fuels (SITC 2), items used by foreigners as intermediate inputs in production. Two foreign activity variables considered relevant for this commodity group were examined, gross domestic production of the OECD countries and the index of industrial production (also referring to all the OECD countries). Both performed equally well. Experimentation revealed that the foreign activity variable was the only variable which entered with a significant coefficient. The dummy variable D5 was also used but it did not enter with a significant coefficient. As a result, the export demand equation for this commodity group is:

$$(3.13)\quad \underset{}{EX24C} = \underset{(0.3)}{95} + \underset{(9.3)}{0.000053*WY}$$

$$R\text{-}SQ = 0.6833 \qquad D\text{-}W = 1.55$$

The goodness of fit may be considered less than

satisfactory. Based on the value of the D-W statistic, we can't reject the hypothesis of no serial correlation.

Export Demand in SITC 3

An export equation for this commodity group was finally included in the model, basically for reasons of consistency with the rest of the import-export submodel. It should be noted, however, that this equation was exogenized when the model was used for simulation and policy analysis. The reason for proceeding in this way, besides the small share of this group in total exports, is the rather unusual developments in fuel (and related materials) exports. For the first years of the sample (1960-65), the value of exports (in constant prices) was close to zero. Between 1966 and 1972 the value of exports was ranged from 100 to 300 million drachmas. Then by 1973 (and as the domestic oil-refining industry developed), exports reached 2.5 billion and this picture continued for the rest of the period, with exports ranging between 1 and 2 billion drachmas. This complicated the effort to model this equation, if the entire sample was to be used.

Regression results suggested that the foreign activity variable which best fits, was the index of industrial production (WIIP). Furthermore, the only other variable which produced a significant coefficient was a dummy variable (D2), to account for the abnormally high value of exports in 1973. The relevant equation is:

(3.14) EX3C = -1527 + 21.5*WIIP + 1509*D2
(-4.2) (6.0) (3.5)

R-SQ = 0.7498 D-W = 1.20

The equation presented is not very satisfactory, especially in terms of residual errors which were high for a number of years. In addition, for the first years of the sample, values predicted from the equation turned out negative. Furthermore, there is also evidence of autocorrelation.

Export Demand in SITC 5-9

This commodity group includes SITC 6 (manufactured goods) which is the largest export group, comprising on average nearly 28% of total exports.

The real gross domestic product of all OECD countries was found to be the foreign activity variable which best fits the data in this commodity group. Furthermore, lagged exports proved to be a very powerful regressor which significantly improved the equation. The equation selected is:

(3.15) EX59C = -8929 + 0.000193*WY + 0.836*EX59C(-1)
(-2.6) (3.0) (10.3)

R-SQ = 0.9904 D-W = 1.84 h = 0.38

The equation fits the data well and there is no indication of serial correlation.

3.6 Production Equations

General

In the treatment of income generation that follows, three sectors will be treated endogenously, namely manufacturing, agriculture, and services. The remaining component of total GDP (mainly output generated by the public sector), is determined residually through an identity. In searching for the preferred specification of production equations, the level of real production was initially the dependent variable. Once the preferred specification had been determined, however, as a last step, the equations were reestimated with the share of each component of GDP in total GDP as the dependent variable. This was dictated by the choice of method to close the model, and in particular due to the necessity of linking the income-generating sector to the expenditure side of the model. Consider, for example, an increase in aggregate expenditure. GNP from the expenditure side will increase. In this model, production (GDP) will also increase according to the National Accounting identity linking GNP and GDP. The total change in GDP is then allocated to the three production sectors and the residual. The change in residual production will be such as to ensure that the sum of the changes in sectoral production equals the change in total GDP as given from the identity linking GDP and GNP.

The decision to proceed in this way was also based on the fact that this is a demand-determined model, with all "action" occurring on the demand side. The income-generating sector thus plays an auxiliary role in the overall functioning of the model.

Manufacturing

Manufacturing-mining can be singled out as the relatively modern sector (compared to agriculture) and be treated along the lines of the neoclassical approach, relating output in this sector to capital and labour inputs, which are taken to be homogeneous.

Before we proceed, we should note that labour in Greece has been the abundant factor in production, though this is not so for skilled labour and managerial expertise. Labour has been in a situation of excess supply for the whole period under consideration, and labour surpluses have traditionally been eased through emigration. Consequently, in the production function under consideration, labour is exogenous. Capital is the limiting factor which is combined with labour as the complementary factor. In this respect, the purpose of the resulting production function will not be to determine employment in this sector, but instead to predict sectoral output resulting from the combination of the two inputs, given the aggregate level of output, as determined by the demand side of the model.

We can now begin with the technological relationship suggested by the Cobb-Douglas empirical formulation (20). In double logarithmic form, and relating directly the output in this sector to the two factor inputs, labour and capital, the first set of equations examined was:

$$Log(GDPMC) = a + b*log(CUR*CSMC) + c*log(LMM) + u1$$

and the share of GDPMC in total GDPC:

$$Log(GDPMC/GDPC) = d + e*log(CUR*CSMC) + f*log(LMM) + u2$$

where, GDPMC is the gross domestic product in manufacturing and mining at constant prices, CUR*CSMC is the capital stock at constant prices adjusted for the capacity utilization rate (both provided by the OECD), and LMM is labour in manufacturing-mining measured in thousands of workers.

Data problems were encountered with the labour variable. Generally speaking, labour statistics are among the worst available for Greece. In particular, labour figures provided for manufacturing and mining refer to establishments with more than ten employees and, as mentioned in chapter II, a characteristic of the Greek manufacturing sector is the small scale of establishments. Consequently, a significant portion of labour in this sector is left out of these employment figures.

Experimentation with the equation presented above, provided the following results: first, the capital stock is

a very powerful explanatory variable for output in this sector; second, the coefficient of labour turned out not to be statistically significant at the 5% level, and even less significant in the case of the GDP share equation. In view of these findings, it was decided to drop labour from the equation and estimate the share of GDPMC as a function of capital stock adjusted for the capacity utilization rate. This last equation was estimated as:

$$\text{(3.16)}\quad \underset{}{\text{Log(GDPMC/GDPC)}} = \underset{(-12.7)}{-4.64} + \underset{(8.4)}{0.28}*\log(\text{CUR}*\text{CSMC})$$

$$\text{R-SQ} = 0.9819 \quad \text{D-W} = 1.80 \quad p = 0.70$$

The fit of this equation is good and the residual errors are small. The equation given above is the one reestimated after correcting for autocorrelation (using the Cochrane-Orcutt technique).

A variable in the form of a time trend to account for technological progress was also tried but, did not produce a significant coefficient and was thus excluded from the final form of the equation.

Agriculture

The major problem faced in the specification of this equation is the cyclical nature of output in agriculture. This is related to climatic conditions and other factors (i.e., the fact that olive trees do not bear fruit every year). This problem was circumvented by using an explanatory

variable which we will name "normal production" and is defined as an appropriate average of lagged agricultural production. This approach based on the capacity to produce has been used before by Vernardakis (21). Other forces such as expected agricultural prices (influencing production incentives) as well as exogenous factors, mainly weather conditions, will then determine whether production in a given year will be above or below "normal production". The variables used to account for these forces were lagged agricultural prices, and two weather cycle variables (i.e., a two-year and a four-year cycle) previously used by Pavlopoulos (1966) and Vernardakis (1978).

It was found that beyond "normal production", which was in the form of a four year-moving average of lagged agricultural production (SGDPA4), no other of the variables described above entered with a statistically significant coefficient. Thus, we are left with an equation which depends on one predetermined variable. Such an equation will not follow the cycles in agricultural production, in the sense that the value of agricultural production forecasted by the equation for each subsequent period is based on the moving average of the last four observed values. The equation for the level of GDP in agriculture was estimated as follows:

(3.17) GDPAC = 2790 + 0.980*SGDPA4
(0.8) (13.9)

R-SQ = 0.9150 D-W = 1.90

When this equation was estimated with the share of GDPAC as the dependent variable (GDPAC/GDPC), the independent variable was the four-year moving average of past shares (SGDPACR4), lagged one year. The estimated equation is:

$$(3.17') \quad \underset{}{GDPAC/GDPC} = \underset{(1.0)}{0.010} + \underset{(14.9)}{0.90}*SGDPACR4(-1)$$

$$R\text{-}SQ = 0.9094 \qquad D\text{-}W = 1.76$$

The fit of this equation is, nevertheless, fairly good and the absence of serial correlation is suggested by the value of the D-W statistic.

Services

This sector consists of output in transportation, communications, trade, housing, public administration, health, education, and miscellaneous services.

As mentioned earlier in this study, due to institutional and other characteristics of this sector - mainly its ability to attract a large portion of total investment - demand conditions are expected to be the major determinant of output in this sector, which by its nature cannot have inventories. It should be noted here that, in the estimation of this equation, the capital stock played no important role in explaining investment in this sector. This has also been suggested by Vernardakis (1978), who estimated a sectoral function for this category of output. An equation in which output is a function of final demand appears also in an

econometric model for the economy of Ireland, built by the Central Bank of Ireland (22). Real per capita disposable income is the main explanatory variable in this equation. Two other variables, namely, lagged output and the proxy for income distribution were tried. Experimentation indicated that lagged output is an important explanatory variable, while the distribution proxy did not produce a significant coefficient. Such an equation was estimated as:

$$\underset{(3.18)}{GDPSC/N} = \underset{(-1.6)}{-243.6} + \underset{(8.7)}{0.223}*YD/GDPSDE*N + \underset{(14.8)}{0.638}*GDPSC(-1)/N(-1)$$

R-SQ = 0.9995 D-W = 1.68 h = 0.62

A reason for concern, however, would be the fact that this equation and the equation for consumption in services (HTCROC) have very similar specifications (functions of disposable income and the lagged depended variable), and the coverage of HTCROC in GDPSC is in the order of 35-40%.

The final step of estimating the share of GDPSC in GDPC produced the following equation:

$$\underset{(3.18')}{GDPSC/GDPC} = \underset{(12.2)}{0.24} + \underset{(1.6)}{0.0000002}*YD/GDPSDE + \underset{(11.7)}{0.54}*GDPSC(-1)/GDPC(-1)$$

R-SQ = 0.9997 D-W = 1.40

The fit of this equation is very good and there is no indication of serial correlation.

3.7 Taxes and Depreciation

Direct Taxes

Direct taxation has been a relatively minor source of government revenue in Greece. While direct taxes in the EEC countries are close to 30% of national income, the relevant figure is as low as 12% in Greece (23). This is mainly due to the epidemic degree of tax evasion. Occasionally, government efforts to restrict tax evasion produce short-lived increases in tax revenue. This has introduced sharp shifts in the data series for direct taxes.

The most relevant income aggregate for the purpose of explaining the behaviour of direct taxation, is Net National Income (NNI), at current prices. Lagged taxes and the effect of a time trend were also examined but did not improve the equation. Consequently, the equation for direct taxes becomes:

$$(3.19)\quad DT = \underset{(-3.2)}{-3599} + \underset{(29.3)}{0.0469}*NNI$$

$$R\text{-}SQ = 0.9795 \qquad D\text{-}W = 1.50$$

The main weakness of this equation lies in the presence of rather large residual errors resulting from the inability of this equation to pick up the sharp swings in direct taxes over time.

Indirect Taxes

Indirect taxes mainly consist of sales taxes, tariffs and stamp duties. Close to 50% of total government revenue in Greece is generated by indirect taxes, compared to about 20% in the EEC. Furthermore, the ratio of direct to indirect taxes was 25.1% in 1960 and 35.4% in 1976, compared to an average of 57.8 and 90.1% respectively for the four large EEC countries (France, Germany, Italy, U.K.) (24).

Based on theoretical grounds, the indirect tax equation was estimated as a function of private consumption expenditure at current prices (PCE*CONC).

(3.20) NIT = 8568 + 0.143*(PCE*CONC)
(2.9) (32.8)

R-SQ = 0.9544 D-W = 1.80

As in the case of the direct tax equation, this equation did not prove very successful in following the sharp shifts in the data series. An alternative equation in which private consumption expenditure was disaggregated into the three categories of consumption was also examined. The predictive ability of this equation was considerably better, but a sign problem was evident involving a negative coefficient for the food-beverages-tocacco consumption group. As a result, this form of the equation was subsequently discarded.

Depreciation

Based on theoretical grounds, total depreciation is a function of the capital stock. Data on capital stock though, are available only for manufacturing (CSMC). An aggregate capital stock series was not constructed, in order to avoid the consequences of the reduced reliability of such constructed series. Instead, an equation for over-all depreciation was formulated by relating depreciation to its lagged value and lagged gross investment. This equation was estimated as:

$$(3.21)\quad DC = \underset{(0.8)}{126.9} + \underset{(81.3)}{0.98}*DC(-1) + \underset{(5.0)}{0.022}*TINVC(-1)$$

$$R\text{-}SQ = 0.9995 \qquad D\text{-}W = 1.79 \qquad h = 0.49$$

where, DC is depreciation at constant prices and TINVC is total investment at constant prices. Generally speaking, the equation performed very well, especially as a predictive equation.

3.8 Price and Wage Equations

Five price equations (one of which is an identity) and one wage equation have been estimated. Dependent variables are expressed in their rate of change rather than their levels. There is one equation explaining the developments in the GDP deflator, three sectoral price equations for

private consumer expenditures, one equation explaining wages in manufacturing, and one identity for the deflator of consumer expenditure expressed as a weighted average of the three sectoral consumption deflators.

Sources of the Inflationary Process, 1973-1981

The inflationary process which started in 1973-74 found its origin in the first world oil price shock, and immediately after brought an increase in all elements of cost which determine prices. A study by the Bank of Greece (25) suggests that the chain of influence in these elements of cost went from import prices to domestically produced agricultural goods, to entrepreneurial profits (non-labour costs per unit of product rose by 20.6% in 1973 compared to 1.5% in 1972), and finally to labour costs as an attempt to restore purchasing power from the workers' side. The same process characterized the second inflationary process (1979-81). This shows the particular sensitivity of domestic prices to international prices, mainly because of the dependence of the Greek economy on imports of oil, other materials and semi-finished goods.

The contribution of non-labour costs to the rate of inflation was very important, particularly at the starting point of the two inflationary processes. On the contrary, during the intervening period (1975-78), when the average inflation rate was significantly lower, labour costs were the main source of inflation.

Looking at the demand side, we can say that the influence of the above described developments in the elements of cost could have been weaker had it not been accompanied by increasing public sector deficits and relatively high rates of increase in money supply during most of the decade (26).

GDP Deflator

There are four main - not mutually exclusive - theories for the explanation of inflation that can provide the basis for empirical work. The first relates inflation to increases in the cost components (27); the second concentrates on the presence of excess demand as a determinant of inflation (28); the third suggests that a combination of both cost and excess demand determine the level of inflation (29); finally, according to the fourth, inflation is attributed to developments in monetary magnitudes (30). In our case, these suggestions of economic theory have been explored in relation to information available concerning the sources of the observed inflationary process during the 1970s and early 1980s.

As mentioned earlier, a large variety of factors was responsible for the inflationary process in Greece during the 1970s, including labour cost increases, import prices, and excess demand. Consequently, the general specification of the price equation of domestically produced goods and services combines both cost and excess demand components. Cost factors are included since they cause an autonomous

increase in prices, independently of the prevailing demand conditions. Furthermore, cost factors, mainly labour costs, influence prices through their effect on demand. Two alternative excess demand variables were tested: the first is a capacity utilization ratio and the second is an excess money supply variable. An estimate of the capacity utilization ratio has been derived as the gap between actual real GDP and the trend implied by two successive peaks of real GDP. The excess money supply variable is a measure of the growth rate of money supply, relative to the rate of growth of real output (31). The general specification of this equation is the following:

GDPDE = f(WM, GDPADE, PM, NIT/GDP, D)

where WM represents hourly wages in manufacturing, GDPADE is the deflator for agricultural production, PM is the price index of imported goods accounting for both the effects of imported raw materials and finished goods, NIT/GDP represents net indirect taxes per unit of output and, finally, D stands for excess demand. The deflator of agricultural production is used as an explanatory variable despite the fact that it is also a component of GDPDE. This is because developments in the prices of domestically produced agricultural goods were an important link in the inflationary process in Greece during the 1973-1981 period, as described earlier.

Experimentation with alternative equations showed that the two excess demand variables failed to produce a significant coefficient in all specification examined. The same was the case with indirect taxes. The other three variables, namely wages, agricultural prices, and import prices, were all shown to be very important determinants of domestic inflation. In the equation given below, variables are expressed as rates of change.

$$\begin{aligned}(22)\ DIF(GDPDE)/GDPDE(-1) = {} & -0.003 + 0.304*DIF(WM)/WM(-1) \\ & \quad (-0.3) \quad (5.3) \\ & + 0.236*DIF(PM)/PM(-1) \\ & \quad (7.6) \\ & + 0.257*DIF(GDPADE)/GDPADE(-1) \\ & \quad (6.4)\end{aligned}$$

$$R\text{-}SQ = 0.9997 \qquad D\text{-}W = 2.03$$

By interpreting the regression coefficients as partial derivatives, the results indicate that an increase in wages by 10% will result in a 3.0% increase in domestic prices while, for an equal increase in import prices and agricultural goods prices, the resulting increases in domestic prices would be 2.4% and 2.6%, respectively.

Sectoral Prices

The three sectoral price equations in the model are rather simplistic and taken to be determined primarily by cost mark-up considerations. In the food-beverages-tobacco (PFBT) and the clothing-footwear-household equipment (PCFRFH) equations, prices in manufacturing are the main

explanatory variable, with lagged prices entering the second. In the third sectoral equation, that for health-transportation-communicationsrecreation equation (PHTCRO), the GDP deflator for services is the only variable entering this equation. The three equations expressed in their rate of change are given below:

(3.23) DIF(PFBT)/PFBT(-1) = 0.019 + 0.96*DIF(GDPMDE)/GDPMDE(-1)
(2.8) (25.4)

R-SQ = 0.9995 D-W = 2.41

(3.24) DIF(PCFRFH)/PCFRFH(-1) = 0.001 + 0.293*DIF(GDPMDE)/GDPMDE(-1)
(0.1) (3.5)

+ 0.331*DIF2(PCFRFH)/PCFRFH(-2)
(6.8)

R-SQ = 0.9995 D-W = 2.41 h = -0.87

(3.25) DIF(PHTCRO)/PHTCRO(-1) = -0.02 + 1.14*DIF(GDPSDE)/GDPSDE(-1)
(-1.6) (19.1)

R-SQ = 0.9995 D-W = 1.61

Hourly Wages in Manufacturing

The approach employed in the specification of this equation was based on a bargaining theory of wage level determination. The decision to use this approach was enforced by the non-existence of reliable data on unemployment and productivity. Experiments with the use of an employment index in manufacturing and a proxy for productivity were unsuccessful.

The change in consumer prices is the most important

determinant of wage increases, due mainly to cost-of-living clauses, which virtually affect all wage earners. Of particular importance in the specification of this equation proved to be a dummy variable (DUMW), which accounts for the once and for all change in the relative trade union strength during the post-junta period 1975-78. This equation was estimated as follows:

$$(3.26)\quad DIF(WM)/WM(-1) = \underset{(3.2)}{0.06} + \underset{(11.2)}{0.93}*DIF(PCE)/PCE(-1) + 0.06*DUMW$$

$$R\text{-}SQ = 0.9996 \qquad D\text{-}W = 2.78$$

where, PCE is the deflator of consumer expenditure, and DUMW is the labour union strength dummy, taking unit value for the years 1975-78 and zero elsewhere.

Tests suggest that the coefficient on the rate of change of PCE is not statistically different from one, suggesting real wage determination.

3.9 The Identities

The identities section of the model (equations (3.27) to (3.39)), does not require detailed explanation:

(3.27) YD=NNI+GTR+TRFA+INPD-DT-SSC-PRTAX

(3.28) NNI=GNPDE*GNPC-DDE*DC-NIT

(3.29) GNPC=CONC+TPRINC+GC+EX09C-M09C+NESC+DSC+ERC

(3.30) CONC=FBTC+CFRFHC+HTCROC

(3.31) GDPC=GNPC-NIT/NITDE-NIFAC

(3.32) GDPRC/GDPC=1-GDPMC/GDPC-GDPAC/GDPC-GDPSC/GDPC

(3.33) TPRINC=PRINMC+PRINAC+PRINHC+PRINSC

(3.34) TINVC=TPRINC+PUINVC

(3.35) M09C=M01C+M24C+M3C+M5679C

(3.36) EX09C=EX01C+EX24C+EX3C+EX5679C

(3.37) TD=EX09C-M09C

(3.38) CSMC=CSMC(-1)+PRINMC-DMC

(3.39) PCE=FBTC/CONC*PFBT+CFRFHC/CONC*PCFRFH+HTCROC/CONC*PHTCRO

where, GTR: government transfer payments; TRFA: net transfers from abroad; INPD: interest on public debt; PRTAX: property taxes; DDE: deflator of depreciation; NESC: net export of services; DSC: change in stocks; ERC: errors and omissions; GDPRC: GDP in public utilities and general government; PUINVC: government investment; DMC: depreciation in manufacturing.

The first three identities are interrelated: identity (3.29) defining GNP at constant prices as a sum of components of aggregate demand enters identity (3.28) (NNI), which in turn enters the first identity (3.27), which is a definition of disposable income at current prices. Identity (3.32) defines

GDP at constant prices, given GNPC, net indirect taxes and factor income from abroad, while identity (3.33) defines the residual component of GDP (that generated by the public sector). Identities (3.30), (3.33), (3.35), and (3.36) determine total private consumption, total private investment, total imports and total exports, respectively, all of which enter as components in identity (3.29). Identity (3.39) defines the deflator of consumer expenditure as a weighted average of sectoral deflators. One identity (3.34) defines total investment as a summation of private and public investment. Another, (3.37), defines the trade deficit as the difference between total exports and total imports of commodities. Finally, identity (3.38) refers to the generation of the capital stock in manufacturing, given as a function of the previous period capital stock, new investment, and depreciation. Equation (3.31) simply transforms the logarithm of GDP in manufacturing and mining into their corresponding arithmetic levels.

3.10 The Structure of the Model

The medium-sized macroeconometric model proposed in this study attempts to describe the structure of the Greek economy over the period 1960-1981 (1960-1985 with the extended sample size). Data for the pre-1960 period exist for many of the variables used in this study, but there are

variables for which data series begin only in the early 1960s, and this was the reason for the exclusion of the pre-1960 period. The model consists of 39 equations, 26 of which are behavioural while 13 are identities. The model is linear in the parameters and nonlinear in variables since several variables appear as ratios or products.

It should be clear that this is an expenditure-determined model, with an auxiliary supply-side sector. In particular, the model implies an almost vertical aggregate demand curve and an almost horizontal aggregate supply curve.

The three consumption functions are generally similar to other estimated consumption functions (e.g., those estimated by Vernardakis 1978). Real per capita disposable income and lagged consumption are the main explanatory variables. Additional explanatory variables reflecting individual differences in consumption behavior are first, in clothing-footwear-household equipment, a proxy for income distribution or urbanization and a dummy variable; and second, in services, a variable capturing the wealth effect.

The four private investment equations differ among themselves. Investment in manufacturing-mining is a function of the capital stock, output, lagged investment and a profitability variable (total profits in manufacturing). In the other three investment equations, namely agriculture, housing and services, the central explanatory variable is the relevant bank credit variable to these sectors, which

basically provides the link between the real and monetary sectors of the economy, a role reserved for the interest rate in a Keynesian model. Other explanatory variables are:

1) in agriculture: lagged prices of agricultural products

2) in housing: the relevant mortgage rate, a three-year average of marriages, a dummy variable, and lagged investment in housing

3) in services: the distribution-urbanization proxy.

In the international sector, the classification of import and export equations is in four categories (32). Import equations are a function of: a domestic activity variable, relative import prices adjusted for import duties, and other factors that may affect imports captured by dummy variables. The relative import price variables are intended to account for the substitutability between domestic and foreign commodities.

Export equations are taken to be a function of: an activity variable for the rest of the world, lagged exports, and dummy variables.

In the income-generation blocks, the dependent variable is the share of each sector's GDP (manufacturing, agriculture, services) in total GDP. The remaining component of GDP (output by the public sector) is determined residually. In manufacturing-mining, the capital stock

adjusted for capacity utilization (the scarce factor) is the explanatory variable, and the equation is estimated in double-logarithmic form. The capital stock in manufacturing is estimated within the model by linking it to lagged capital stock, investment and depreciation. In agriculture, a capacity to produce variable is the main determinant. Finally, output in services is demand-determined.

The two institutional equations, direct and indirect taxes depend on national income and private consumption expenditure, respectively. Depreciation is a function of lagged investment and lagged depreciation.

Price equations and the wage equation are estimated in percentage changes. Sectoral prices (three consumption deflators) depend primarily on unit cost mark-up considerations. The GDP deflator depends on labour costs, import prices and the prices of agricultural products, while the deflator of private consumption is derived from an identity as a weighted average of sectoral deflators. Finally, in the wages in manufacturing equation, the explanatory variables are: the private consumption deflator and a dummy variable related to labour union strength.

As mentioned earlier, this is an expenditure-determined model in which both the demand and supply sides are independent of the price level, which is autonomous. To avoid inconsistencies (i.e., generating two different values for GDP, one from the expenditure side and another from the

supply side), the model was closed in the following way: on the supply side, the equations were specified in shares of each sector in total GDP, rather than in levels, while public sector output is residually determined. This way, an increase in aggregate expenditure (say) due to an increase in government spending will increase supply in manufacturing and services (because the capital stock and disposable income respectively have gone up). Agricultural output does not change since the values of no variables in the relevant equation have changed. Finally, the residual output (that of public sector) will adjust so that a result consistent with the expenditure side of the model is obtained. This accommodating behaviour of the residual output is a weak point of this model. However, as mentioned earlier, the supply side plays an auxiliary role in this model.

It would be useful, at this point, to comment on the relationship between the monetary and the real part of the model in the present study. In most models for countries in the process of development, when the monetary sector is not neglected altogether, it is added in a way that bears little relationship to the main body of the model (33). However, this should not be taken to mean that money is not essential in such models. In the case of the present model, the link of the monetary sector with the real part is through the bank credit to investment variables. This is because, with underdeveloped capital markets and rationing of funds, the interest rate ceases to represent the cost of borrowing. As

a result, the supply of funds would be the binding constraint and should appear in the investment functions.

NOTES

(1) Carter, R.A.L., "Least Squares as an Explanatory Estimator", Canadian Journal of Economics, vol. 6, no. 1, 1973, pp. 108-121.

(2) The fourteen consumption categories are: 1. food; 2. beverages; 3. tobacco; 4. clothing, footwear; 5. rent and water charges; 6. fuel and light; 7. furniture, furnishings and household equipment; 8. household operations; 9. personal care and health expenses; 10. transportation; 11. communications; 12. recreation and entertainment; 13. education; 14. miscellaneous services.

(3) See Brown, T.M, "Habit Persistence and Lags in Consumer Behaviour", Econometrica, vol. 20, 1952, pp. 355-371.

Friedman, M.A., A Theory of the Consumption Function, Princeton Univ. Press, Princeton, 1957.

Singh, B. and Ullah, A., "The Consumption Function: The Permanent Income versus the Habit Persistence Hypothesis", Review of Economics and Statistics, vol. 58, no. 1, 1976, pp. 96-103.

Ando, A. and Modigliani, F., "The Life Cycle Hypothesis of Saving: Aggregate Implications and Tests", American Economic Review, vol. 53, no. 1, 1963, pp. 55-84.

(4) Brown, T.M. (1952), op. cit., p. 355.

(5) Manassakis, N. "Investment and Financing in the Greek Manufacture", in The Greek Economy, edited by the Bank of Greece, Athens, 1982, p. 168.

(6) Hirshleifer, J., "On the Theory of Optimal Investment Decisions", Journal of Political Economy, vol. 66, no. 4, 1958, pp. 329-352.

(7) For the purpose of avoiding this situation, it has been ruled by the monetary authorities that 30% of investment expenditure by firms must be financed by own funds. This would simply reduce the demand for bank funds from 100% to 70% (see Manassakis 1982, op. cit., p. 169).

(8) See Stiglitz, J. and Weiss, A., "Credit Rationing in Markets with Imperfect Information", mimeo, Institute of Economics and Statistics, Oxford University, 1977.

(9) Manassakis, N. (1982), op. cit., p. 168.

(10) See Branson, W.H., Macroeconomic Theory and Policy, Harper and Row, New York, 1979, pp. 225-226.

(11) Vernardakis, N. (1978), op. cit., p. 87.

(12) The variable used is defined as "inflow of entrepreneurial capital", as provided by the Bank of Greece.

(13) A weighted average of marriages as an explanatory variable was first used by Pavlopoulos (1966).

(14) See Vernardakis, N. (1978), op. cit., p. 89.

(15) See Ball, R.J. (ed.), The International Linkage of National Economic Models, Amsterdam, North Holland Publ. Co., 1973, Chapters 6 and 8.

(16) This may be due to the influence of past habits (see Brown, T.M., 1952), or it may be related to the Koyck lag or the adaptive expectations hypothesis (see Goldberger, A.S., Econometric Theory, John Wiley and Sons, New York, 1964, pp. 274-278). By assuming habit persistence effects and non-autocorrelation of the error terms, we reduce the estimation difficulties related to the behaviour of the composite error term in the Koyck lag structure, and the cost involved in searching for the most appropriate lag structure when using Almon's technique (see Prodromides, K.P. and Anastassakou, J.N., The Determinants of Greece's Commodity Trade, Centre of Planning and Economic Research, Athens, 1983).

(17) See Prodromides, K. and Anastassakou, J. (1983) as well as Hittiris, T. and Petousis, E., Price and Tariff Effects in a Dynamic Specification, Applied Economics, vol. 16, no. 1, 1984, pp. 15-24.

(18) Imports of ships are excluded from this commodity group, since it is not certain whether they would remain under the Greek flag although owned by Greek companies, (see Prodromides, K.P. and Anastassakou, J.N. (1983), op. cit.).

(19) Ball, R.J. (ed.) (1973), op. cit., p. 234.

(20) Douglas, P.H., "A Theory of Production", supplement to the American Economic Review, vol. 18, no. 1, 1928, pp. 139-165.

(21) Vernardakis, N. (1978), op. cit., p. 100.

(22) See Bradley, J. and O'Raifeartaigh, C., "Optimal Control and Policy Analysis with a Model of a Small Open Economy: The Case of Ireland", in Dynamic Modelling and Control of National Economies, edited by J. Janssen, L. Pau and A. Straszak, Pergamon Press, Oxford, 1980, pp. 85-90.

(23) Gianaris, N.V., "Indirect Taxes: A Comparative Study of Greece and the EEC", European Economic Review, vol. 15, no. 1, 1981, p. 113.

(24) Gianaris, N.V. (1981), ibid.

(25) Bank of Greece, The Greek Economy, Athens, 1981, pp. 54-57.

(26) Bank of Greece (1981), ibid.

(27) Carrin, G. and Barten, A.P., "International Aspects of Cost-Push Inflation", in Inflation in Small Countries, edited by H. Frisch, Springer-Verlag, Berlin, 1976, pp. 243-271.

(28) Rushdy, F. and Lund, P.J., "The Effect of Demand on Prices in British Manufacturing Industry", Review of Economic Studies, vol. 34, 1967, pp. 361-373.

(29) Bodkin, R.G., "Wage and Price Formation in Econometric Models", in Inflation and the Canadian Experience, edited by N. Swan and D. Wilton, Industrial Relations Centre, Queen's Univ., Kingston, Ontario, 1971, pp. 87-120.

(30) Friedman, M., "Monetary Theory and Policy", American Economic Review, vol. 58, no. 1, 1968, pp. 1-17.

(31) This variable is defined as:

$$EMS = \left(\frac{M-M70}{M70}\right) - \left(\frac{X-X70}{X70} + \frac{v-v70}{v70}\right)$$

where EMS stands for excess money supply, M70, GDPC70 and v70 represent money supply, GDP at constant prices and the reciprocal of income velocity respectively, for the year 1970. This expression of excess money supply was used by K. Marwah in her econometric model for Colombia, see Marwah, K., "An Econometric Model of Colombia: A Prototype Devaluation View", Econometrica, vol. 37, 1969, pp. 228-251. as well as in Marwah, K., "An Econometric Model of India: Estimating Prices, their Roles and Sources of Change", The Indian Economic Review, vol. VII, 1972, pp. 53-91.

(32) As noted earlier, commodity imports and exports are

grouped into the following SITC classifications:

SITC 0+1 (food, live animals, beverages, tobacco).

SITC 2+4 (inedible crude materials, excluding fuels, animal and vegetable oils and fats).

SITC 3 (mineral fuels, lubricants and related materials).

SITC 5+6+7+8+9 (chemicals, manufactured goods, machinery and transport equipment, michellaneous manufactures).

(33) Vernardakis, N. (1978), op. cit., p. 9.

CHAPTER IV

THE MODEL

4.1 Introduction

The presentation of material in this chapter begins with a discussion of the estimation method, followed by the equation by equation presentation of the final model for the period 1960-1981. In the second part of this chapter, an updated model is estimated by using the additional observations available for the 1982-1985 period (which are also used, in the first instance, in testing the forecasting ability of the model outside the sample).

4.2 Method of Estimation

In my model, the number of predetermined variables (55) far exceeds the number of observations (22 or 26 for the updated model). A consequence of this is the inability to estimate the coefficients of the equations by standard methods. The practical solution employed was that of principal components, in which the set of predetermined variables is utilized to construct a small number of artificial orthogonal variables (principal components) which will represent the complete set of predetermined variables. In particular, to reduce the amount of computational work, the method used was the one which uses only one set of

principal components for the whole system, which is the method recommended by Kloek and Mennes (1).

It was observed that, when the number of components was less than 8, the results were not satisfactory. As this number was increased, the results improved up to a fairly high number of components, close to one half the number of observations. Further increases in the number of components did not significantly affect the quality of results. The final estimation of the model was with the use of 12 components.

From the estimated model it can be seen that the results are generally good and almost all coefficients are significant.

4.3 The Model Estimated by Non-Linear Two-Stage Least Squares Using Principal Components as Instruments

Consumption Equations

(4.1) FBTC/N = 851.2 + 0.045*YD/(PFBT*N) + 0.818*FBTC(-1)/N(-1)

(2.6) (2.0) (8.5)

R-SQ = 0.9954 D-W = 2.25 h = -0.64

(4.2) CFRFHC/N = 254.6 + 0.192*YD/(PCFRFH*N) - 3835*GDPAC/GDPC

(0.9) (6.2) (-1.3)

+ 342.1*DUMCFR

(2.4)

R-SQ = 0.9982 D-W = 1.68 p = 0.94

(4.3) HTCROC/N = 583 + 0.0464*YD/(PHTCRO*N) + 0.155*DEPTC

(2.0) (2.6) (3.3)

+ 0.488*HTCROC(-1)/N(-1) + 455*DUMW

(5.0) (5.2)

R-SQ = 0.9977 D-W = 1.51 h = 1.22

Private Investment Equations

(4.4) PRINMC = 866 - 0.082*CSMC(-1) + 0.084*GDPMC + 0.15*PROF

(1.1) (-1.6) (1.7) (2.4)

+ 0.677*PRINMC(-1)

(4.5)

R-SQ = 0.9534 D-W = 1.62 h = 1.20

(4.5) PRINHC = -20751 + 0.623*BCHC - 253.2*INTHR + 3354*LMRA

(-1.3) (4.2) (-2.6) (1.9)

+ 0.246*PRINHC(-1) - 12772*DUM74

(1.5) (-4.8)

R-SQ = 0.9193 D-W = 1.97 h = 0.10

(4.6) PRINAC = 1640 - 871*WPAG(-1) + 0.126*ABCC

(4.4)(-4.9) (7.2)

R-SQ = 0.7757 D-W = 1.84

(4.7) PRINSC = 27334 + 0.356*BCTC - 99356*GDPAC/GDPC

(2.5) (1.6) (-2.6)

R-SQ = 0.9316 D-W = 1.47

Import Equations

(4.8) M01C/N = 628.8 + 0.0220*YD/(PCE*N) - 437.4*DRP01

(5.7) (8.7) (-3.7)

R-SQ = 0.8962 D-W = 1.74

(4.9) M24C = 3043 + 0.061*GDPMC - 1107*DRP24 + 970.6*D2

(2.3) (9.7) (-1.3) (3.4)

R-SQ = 0.9787 D-W = 1.57 p = 0.41

(4.10) M3C = 1079 + 0.0513*GDPMC + 1520*D3

(0.8) (1.9) (1.4)

R-SQ = 0.8789 D-W = 1.39 p = 0.54

(4.11) M59C = 20346 + 0.135*GNPC - 23970*DRP59

(1.4) (20.5) (-2.2)

R-SQ = 0.9790 D-W = 1.99

Export Equations

(4.12) EX01C = -1994 + 0.000213*WC + 0.334*EX01C(-1) - 1925*D5

(-0.8) (2.5) (1.4) (-2.3)

R-SQ = 0.9018 D-W = 2.03 h = -0.22

(4.13) EX24C = 85 + 0.0000534*WY

(0.1) (5.8)

R-SQ = 0.6833 D-W = 1.55

(4.14) EX3C = -1782 + 23.7*WIIP + 1486*D2

(-4.0) (5.6) (3.3)

R-SQ = 0.7444 D-W = 1.36

(4.15) EX59C = -7654 + 0.000168*WY + 0.869*EX59C(-1)

(-2.2) (2.5) (10.3)

R-SQ = 0.9903 D-W = 1.90 h = 0.25

GDP Equations

(4.16) LOG(GDPMC/GDPC) = -4.61 + 0.278*LOG(CUR*CSMC)

(-12.5) (8.3)

R-SQ = 0.9819 D-W = 1.80 p = 0.70

(4.17) GDPAC/GDPC = 0.01 + 0.900*SGDPACR4(-1)

(1.0) (14.8)

R-SQ = 0.9094 D-W = 1.76

(4.18) GDPSC/GDPC = 0.24 + 0.00000022*YD/GDPSDE

(12.0) (1.6)

+ 0.54*GDPSC(-1)/GDPC(-1)

(11.2)

R-SQ = 0.9997 D-W = 1.40 h = -0.61

Direct Taxes

(4.19) DT = -3598 + 0.0469*NNI

(-3.2) (29.3)

R-SQ = 0.9795 D-W = 1.50

Net Indirect Taxes

(4.20) NIT = 8441 + 0.143*(PCE*CONC)

(2.9) (32.9)

R-SQ = 0.9544 D-W = 1.81 p = 0.50

Depreciation

(4.21) DC = 118.4 + 0.98*DC(-1) + 0.023*TINVC(-1)

(0.8) (80.7) (5.0)

R-SQ = 0.9995 D-W = 1.80 h = 0.46

GDP Deflator

(4.22) DIF(GDPDE)/GDPDE(-1) = -0.01 + 0.338*DIF(WM)/WM(-1)

(-0.7) (5.4)

+ 0.223*DIF(PM)/PM(-1)

(6.8)

+ 0.253*DIF(GDPADE)/GDPADE(-1)

(6.2)

R-SQ = 0.9997 D-W = 2.21

Consumption Deflators

(4.23) DIF(PFBT)/PFBT(-1) = 0.02 + 0.97*DIF(GDPMDE)/GDPMDE(-1)

(2.3) (25.4)

R-SQ = 0.9996 D-W = 2.56

(4.24) DIF(PCFRFH)/PCFRFH(-1) = 0.001 + 0.402*DIF(GDPMDE)/GDPMDE(-1)
(0.1) (4.0)
+ 0.271*DIF2(PCFRFH)/PCFRFH(-2)
(4.8)

R-SQ = 0.9994 D-W = 2.27 h = -0.87

(4.25) DIF(PHTCRO)/PHTCRO(-1) = -0.02 + 1.14*DIF(GDPSDE)/GDPSDE(-1)
(-1.7) (19.1)

R-SQ = 0.9995 D-W = 1.60

Hourly Wages in Manufacturing

(4.26) DIF(WM)/WM(-1) = 0.057 + 0.929*DIF(PCE)/PCE(-1) + 0.063*DUMW
(3.2) (11.0) (5.4)

R-SQ = 0.9997 D-W = 2.21

Identities

(4.27) YD=NNI+GTR+TRFA+INPD-DT-SSC-PRTAX

(4.28) NNI=GNPDE*GNPC-DDE*DC-NIT

(4.29) GNPC=CONC+TPRINC+GC+EX09C-M09C+NESC+DSC+ERC

(4.30) CONC=FBTC+CFRFHC+HTCROC

(4.31) GDPC=GNPC-NIT/NITDE-NIFAC

(4.32) GDPRC/GDPC=1-GDPMC/GDPC-GDPAC/GDPC-GDPSC/GDPC

(4.33) TPRINC=PRINMC+PRINAC+PRINHC+PRINSC

(4.34) TINVC=TPRINC+PUINVC

(4.35) M09C=M01C+M24C+M3C+M5679C

(4.36) EX09C=EX01C+EX24C+EX3C+EX5679C

(4.37) TD=M09C-EX09C

(4.38) CSMC=CSMC(-1)+PRINMC-DMC

(4.39) PCE=FBTC/CONC*PFBT+CFRFHC/CONC*PCFRFH+HTCROC/CONC*PHTCRO

LIST OF VARIABLES

ENDOGENOUS

CFRFHC: consumption of clothing-footwear-household equipment and operation (CFRFH), in millions of 1970 drachmas

CONC: private consumption, in millions of 1970 drachmas

CSMC: capital stock in manufacturing, in millions of 1970 drachmas

DC: depreciation, in millions of 1970 drachmas

DT: direct taxes, in millions of drachmas

EX01C: exports in SITC 0 and 1, in millions of 1970 drachmas

EX24C: exports in SITC 2 and 4, in millions of 1970 drachmas

EX3C: exports in SITC 3, in millions of 1970 drachmas

EX59C: exports in SITC 5 to 9, in millions of 1970 drachmas

EX09C: aggregate exports, in millions of 1970 drachmas

FBTC: consumption of food-beverages-tobacco, in millions of 1970 drachmas

GDPAC: GDP in agriculture, in millions of 1970 drachmas

GDPC: GDP, in millions of 1970 drachmas

GDPMC: GDP in manufacturing-mining, in millions of 1970 drachmas

GDPRC: GDP by public sector, in millions of 1970 drachmas

GDPSC: GDP in services, in millions of 1970 drachmas

GDPDE: GDP deflator, 1970 = 1

GNPC: GNP, in millions of 1970 drachmas

HTCROC: consumption of services (HTCRO), in millions of 1970 drachmas

M01C: imports in SITC 0 and 1, in millions of 1970 drachmas

M24C: imports in SITC 2 and 4, in millions of 1970 drachmas

M3C: imports in SITC 3, in millions of 1970 drachmas

M59C: imports in SITC 5 to 9, in millions of 1970 drachmas

M09C: aggregate imports, in millions of 1970 drachmas

NIT: net indirect taxes, in millions of drachmas

NNI: net national income, in millions of drachmas

PCFRFH: deflator of private consumption in CFRFH category

PFBT: deflator of private consumption in FBT category

PCE: deflator of private consumption

PHTCRO: deflator of private consumption in HTCRO category

PRINAC: private investment in agriculture, in millions of 1970 drachmas

PRINHC: private investment in housing, in millions of 1970

drachmas

PRINMC: private investment in manufacture-mining, in millions of 1970 drachmas

PRINSC: private investment in services, in millions of 1970 drachmas

TD: trade deficit, in millions of 1970 drachmas

TPRINC: total private investment, in millions of 1970 drachmas

TINVC: total investment, in millions of 1970 drachmas

WM: wages in manufacturing (index)

YD: disposable income, in millions of drachmas

EXOGENOUS

ABCC: agricultural Bank credit, in millions of 1970 drachmas

BCHC: bank credit to housing, in millions of 1970 drachmas

BCTC: bank credit to trade, in millions of 1970 drachmas

CUR: capacity utilization ratio in manufacturing

D2: dummy variable taking unit value in 1973 and 0 elsewhere

D3: dummy variable taking unit value for the years after 1973

D5: dummy variable taking unit value in 1968 and 1973 and 0 elsewhere

DDE: deflator of depreciation

DEPTC: savings deposits, in millions of 1970 drachmas

DMC: depreciation in manufacturing, in millions of 1970 drachmas

DRP01: relative prices of imports in SITC 0 and 1, adjusted for import duties

DRP24: relative prices of imports in SITC 2 and 4, adjusted for import duties

DRP59: relative prices of imports in SITC 5, 6, 7, 8, and 9, adjusted for import duties

DSC: change in stocks, in millions of 1970 drachmas

DUMCFR: dummy variable taking unit value from 1970 to 1972

and 0 elsewhere

DUM74: dummy variable,taking unit value in 1974 and 0 elsewhere

DUMW: dummy variable taking unit value from 1975 to 1978 and 0 elsewhere

ERC: erors and omissions, in millions of 1970 drachmas

GC: government consumption and investment expenditure, in millions 1970 drachmas

GDPADE: GDP deflator in agriculture

GDPMDE: GDP deflator in manufacturing

GDPSDE: GDP deflator in services

GNPDE: GNP deflator

GTR: government transfer payments, in millions of drachmas

INPD: interest on the public debt, in millions of drachmas

INTHR: real interest rate for housing

LMRA: three-year moving average of marriages

N: population in millions

NESC: net exports of other services, in millions of 1970 drachmas

NITDE: deflator of indirect taxes

NIFAC: net factor income from abroad, in millions of 1970 drachmas

PM: imports deflator

PRTAX: property taxes, in millions of drachmas

PROF: total profits in manufacturing, in millions of drachmas

PROFR: profit rate in manufacturing

PUINVC: government investment, in millions of 1970 drachmas

SGDPACR4: four-year moving average of the share of agriculture in GDP

SSC: social security contributions, in millions of drachmas

TRFA: net transfers from abroad, in millions of drachmas

WC: world (OECD) consumption expenditure of the private sector, in millions of 1970 drachmas

WIIP: world (OECD) index of industrial production, 1970=100

WPAG: wholesale price index of agricultural products

WY: world (OECD) GDP in millions of 1970 drachmas

4.4 Block Structure and Linkages of the Model

The system contains one simultaneous block, which involves 21 endogenous variables (GNPC, YD, NNI, GDPC, GDPMC, CSMC, PRINMC, PRINSC, TPRINC, FBTC, CFRFHC, HTCROC, CONC, M01C, M24C, M3C, M59C, M09C, DT, NIT, PCE). Once these variables are determined, variables WM, TINVC, TD, GDPDE, GDPAC, GDPSC, and GDPRC can be solved for. Finally, 11 endogenous variables depend only on predetermined variables, and equation (4.31) is a transformation equation.

4.5 A Re-estimation with an Enlarged Sample

The data series used in estimation extented until 1981, leaving the data available from 1982 to 1985 to be used in ex-post forecasting. It was considered useful, though, to re-estimate the model for the entire period 1960-1985, so that a comparison could be made relative to the stability of individual coefficients. It should be noted that, in the updated model, the profitability variable that performed best is the profit rate variable. The updated model is given below:

THE UPDATED MODEL

Consumption Equations

(4.1′) FBTC/N = 961.1 + 0.051*YD/(PFBT*N) + 0.788*FBTC(-1)/N(-1)

(4.4) (2.8) (11.4)

R-SQ = 0.9966 D-W = 1.95 h = 0.11

(4.2′) CFRFHC/N = 3036 + 0.193*YD/(PCFRFH*N) - 5927*GDPAC/GDPC

(2.3) (9.4) (-1.4)

+ 354.2*DUMCFR

(2.4)

R-SQ = 0.9978 D-W = 1.59 p = 0.88

(4.3′) HTCROC/N = 176.5 + 0.078*YD/(PHTCRO*N) + 0.155*DEPTC

(0.3) (2.7) (3.2)

+ 0.40*HTCROC(-1)/N(-1)+246.8*DUMW

(3.0) (2.1)

R-SQ = 0.9973 D-W = 1.92 p = 0.77

Private Investment Equations

(4.4′) PRINMC=-3635 - 0.059*CSMC(-1) + 0.11*GDPMC + 170.7*PROFR
(-2.2) (-2.0) (2.4) (2.6)
+ 0.670*PRINMC(-1)
(5.8)
R-SQ = 0.9612 D-W = 1.91 h = 0.25

(4.5′) PRINHC = -33326 + 0.530*BCHC - 226*INTHR + 4546*LMRA
(-2.3) (3.5) (-2.2) (2.8)
+ 0.443*PRINHC(-1) - 12750*DUM74
(2.7) (-4.3)
R-SQ = 0.8757 D-W = 1.71 h = 1.24

(4.6′) PRINAC = 2541 - 200.3*WPAG(-1) + 0.064*ABCC
(3.3) (-1.6) (2.3)
R-SQ = 0.5893 D-W = 1.97

(4.7′) PRINSC = 2474 + 0.936*BCTC - 13537*GDPSC/GDPC
(0.3) (4.7) (-1.0)
R-SQ = 0.9002 D-W = 1.42

Import Equations

(4.8′) M01C/N = 491 + 0.0385*YD/(PCE*N) - 668*DRP01

(1.0) (3.6) (-3.1)

R-SQ = 0.9124 D-W = 1.43 p = 0.82

(4.9′) M24C = 6410 + 0.0593*GDPMC - 3741*DRP24 + 778*D2

(2.9) (4.9) (-2.6) (1.4)

R-SQ = 0.9484 D-W = 1.65 p = 0.50

(4.10′) M3C = 891 + 0.0555*GDPMC + 1575.3*D3

(0.6) (2.1) (1.5)

R-SQ = 0.8796 D-W = 1.69 p = 0.58

(4.11′) M59C = 47482 + 0.143*GDPC - 48355*DRP59

(2.4) (9.2) (-3.5)

R-SQ = 0.9721 D-W = 1.41 p = 0.45

Export Equations

(4.12′) EX01C = -1570 + 0.000158*WC + 0.538*EX01C(-1) - 2134*D5

(-1.0) (2.0) (2.5) (-2.5)

R-SQ = 0.9201 D-W = 2.28 h = -3.6

(4.13′) EX24C = −711.8 + 0.000067*WY

(−1.0) (7.0)

R-SQ = 0.6888 D-W = 1.48

(4.14′) EX3C = −1554 + 21.8*WIIP + 1500*D2

(−4.6) (7.0) (3.4)

R-SQ = 0.7423 D-W = 1.20

(4.15′) EX59C = −8903 + 0.000192*WY + 0.839*EX59C(−1)

(−1.8) (2.1) (8.0)

R-SQ = 0.9854 D-W = 2.43 h = −1.23

GDP Equations

(4.16′) LOG(GDPMC/GDPC) = −5.75 + 0.343*LOG(CUR*CSMC)

(−5.2) (3.9)

R-SQ = 0.9768 D-W = 1.66 p = 0.91

(4.17′) GDPAC/GDPC = 0.012 + 0.889*SGDPCR4(-1)

(1.4) (17.0)

R-SQ = 0.9194 D-W = 1.87

(4.18′) GDPSC/GDPC = 0.21 + 0.000000048*YD/GDPSDE

(7.7) (1.7)

+ 0.596*GDPSC(-1)/GDPC(-1)

(9.0)

R-SQ = 0.9995 D-W = 1.50 p = 0.45

Direct Taxes

(4.19′) DT = -9028 + 0.0588*NNI

(-2.9) (28.7)

R-SQ = 0.9895 D-W = 2.25 p = 0.45

Net Indirect Taxes

(4.20′) NIT = -7712 + 0.178*(PCE*CONC)

(-0.4) (13.9)

R-SQ = 0.9904 D-W = 1.41 p = 0.79

Depreciation

(4.21′) DC = 80 + 0.97*DC(-1) + 0.027*TINVC(-1)

(0.5) (124.4) (7.1)

R-SQ = 0.9996 D-W = 2.00 h = 0.01

GDP Deflator

(4.22′) DIF(GDPDE)/GDPDE(-1) = 0.01 + 0.264*DIF(WM)/WM(-1)

(0.7) (3.9)

+ 0.235*DIF(PM)/PM(-1)

(5.7)

+ 0.315*DIF(GDPADE)/GDPADE(-1)

(4.4)

R-SQ = 0.9998 D-W = 1.60

Consumption Deflators

(4.23′) DIF(PFBT)/PFBT(-1) = 0.02 + 0.623*DIF(GDPMDE)/GDPMDE(-1)

(1.1) (7.5)

R-SQ = 0.9992 D-W = 1.51

(4.24′) DIF(PCFRFH)/PCFRFH(-1) = 0.002 + 0.324*DIF(GDPMDE)/GDPMDE(-1)

(0.3) (3.3)

+ 0.296*DIF2(PCFRFH)/PCFRFH(-2)

(6.5)

R-SQ = 0.9998 D-W = 2.12 h = -0.87

(4.25′) DIF(PHTCRO)/PHTCRO(-1)= -0.0003 + 1.01*DIF(GDPSDE)/GDPSDE(-1)

(0.0) (18.3)

R-SQ = 0.9997 D-W = 2.30 p = -0.60

Hourly Wages in Manufacturing

(4.26′) DIF(WM)/WM(-1) = -0.003 + 1.17*DIF(PCE)/PCE(-1) + 0.097*DUMW

(0.1) (4.0) (4.6)

R-SQ = 0.9989 D-W = 2.67

Parameter estimates and t-statistics for the two estimation periods are given below so that the stability of coefficients can be examined:

		1960-1981		1960-1985	
Equation	Variable	Estimate	t-Ratio	Estimate	t-Ratio
FBTC	YD/PFBT	0.045	2.0	0.051	2.8
	FBTC(-1)	0.818	8.5	0.788	11.4
CFRFHC	YD/PCFRFH	0.192	6.2	0.193	9.4
	GDPAC/GDPC	-3835	-1.3	-5927	-1.4
	DUMCFR	342.1	2.4	354.2	2.4
HTCROC	YD/PHTCRO	0.0464	2.6	0.078	2.7
	DEPT/PHTCRO	0.155	3.3	0.155	3.2
	HTCROC(-1)	0.488	5.0	0.40	3.0
	DUMW	455	5.2	246.8	2.1
PRINMC	CSMC(-1)	-0.082	-1.6	-0.059	-2.0
	GDPMC	0.084	1.7	0.11	2.4
	PROFR	263	4.6	170.7	2.6
	PRINMC(-1)	0.68	4.5	0.670	5.8
PRINHC	BCHC	0.623	4.2	0.530	3.5
	INTHR	-253.2	-2.6	-226	-2.2
	LMRA	3354	1.9	4546	2.8
	PRINHC(-1)	0.246	1.5	0.443	2.7
	DUM74	-12772	-4.8	-12750	-4.3
PRINAC	WPAG(-1)	-871	-4.9	-200.3	-1.6
	ABCC	0.126	7.2	0.064	2.3
PRINSC	BCTC	0.356	1.6	0.936	4.7
	GDPAC/GDPC	-99356	-2.6	-13537	-1.0
M01C	YD/PCE	0.022	8.7	0.0385	3.6

	DRP01	-437.4	-3.7	-668	-3.1
M24C	GDPMC	0.061	9.7	0.0593	4.9
	DRP24	-1107	-1.3	-3741	-2.6
	D2	970.6	3.4	778	1.4
M3C	GDPMC	0.0513	1.9	0.0555	2.1
	D3	1520	1.4	1575.3	1.5
M59C	GNPC	0.135	20.5	0.143	9.2
	DRP59	-23970	-2.2	-48355	-3.5
EX01C	WC	0.000213	2.5	0.000158	2.0
	EX01C(-1)	0.334	1.4	0.538	2.5
	D5	-1925	-2.3	-2134	-2.5
EX24C	WY	0.0000534	5.8	0.000067	7.0
EX3C	WIIP	23.7	5.6	21.8	7.0
	D2	1486	3.3	1500	3.4
EX59C	WY	0.00018	2.5	0.000192	2.1
	EX59C(-1)	0.869	10.3	0.839	8.0
LOG(GDPC/GDP)	LOG(CSMC)	0.278	3.3	0.343	3.9
GDPAC/GDPC	SGDPCR4	0.900	14.8	0.889	17.0
GDPSC/GDPC	YD/GDPSDE	0.00000022	1.6	0.0000005	1.7
	GDPSC(-1)	0.54	11.2	0.596	9.0
DT	NNI	0.0469	29.3	0.0588	28.7
NIT	PCE*CONC	0.143	32.9	0.178	13.9
DC	DC(-1)	0.98	80.7	0.97	124.4
	TINVC(-1)	0.023	5.0	0.027	7.1
% GDPDE	% WM	0.338	5.4	0.264	3.9
	% PM	0.223	6.8	0.235	5.7
	% GDPADE(-1)	0.253	6.2	0.315	4.4

% PFBT	% GDPMDE	0.97	25.4	0.623	7.5
% PCFRFH	% GDPMDE	0.402	4.0	0.324	3.3
	% PCFRFH(-1)	0.271	4.8	0.296	6.5
% PHTCRO	% GDPSDE	1.14	19.1	1.01	18.3
% WM	% PCE	0.929	11.0	1.17	4.0
	DUMW	0.063	5.4	0.097	4.6

A comparison of estimates and t-statistics of the initial and the enlarged sample suggests that coefficient estimates, generally speaking, are stable in the case of most equations. Changes in coefficient estimates, however, are evident in the case of the investment equations (especially manufacturing, agriculture, and services) and the price and wage equations. Concerning the PRINMC equation, changes in coefficients are due to developments in manufacturing investment in the post-1981 period, which can be linked to the 1981 political change (discussed further in chapter V). Changes are also observed in the coefficients of the relative price of imports (adjusted for import duties) variable. The reason seems to be that the enlarged sample contains some years (1982-1985) following the Greece-EEC association which brought about a substantial reduction in import restrictions.

Furthermore, for equations such as HTCROC, M01C, M59C, GDPSC, DT, and PHTCROC, changes in coefficient estimates may

be due to the autocorrelation correction which was necessary in the case of the 1060-1985 sample period, and not required for the 1960-1981 sample period.

NOTES

(1) See Kloek, T., and Mennes, L., "Simultaneous Equations Estimation Based on Principal Components of Predetermined Variables", Econometrica, vol. 28, no. 1, 1960, pp. 45-61.

CHAPTER V

MODEL VALIDATION

5.1 General

The purpose of constructing of an econometric model is for it to be used to serve specific objectives. Although the construction of such a model may be of interest in its own right (i.e., investigating the parameters of individual equations), the main reason for estimating such a model is to develop a tool that can be used for policy simulation and/or prediction. For the case of the model at hand, the main objective is the former (1). Prior to that, we will evaluate the model's performance as a predictive device. Applying an econometric model in forecasting or policy analysis requires that the model be tested to see how well it fits the known path of the economy. Inferences about the probable future performance of a model (assuming an unchanged structure) can be evaluated only on the record of its past performance.

The credibility of a model can be established through a variety of tests (2). A very common and rigorous one is to simulate the model over the sample period. Here the model is simulated using actual values of exogenous variables and actual initial values of lagged endogenous variables at the beginning of the test period and the model-user compares the

model's predictions for endogenous variables with actual values of endogenous variables. The most stringent type of this test is the examination of complete system dynamic simulations for the whole sample from fixed initial conditions (as opposed to static one-period forecasts, where the solution of the model is re-initialized every period).

A satisfactory performance of an econometric model when subjected to the test described above does not imply anything with respect to its performance beyond the estimation period. This is so because a model is built after extensive experimentation with alternative specifications against data that are available at the time and, as experience shows, models that fit well within the sample often do not perform as well outside the sample. An ex-post extrapolation beyond the sample period is performed with the use of actual values of exogenous variables for the post-sample period and actual initial values of lagged endogenous variables at the beginning of the post-sample period.

While the ability of an econometric model to perform well in historical and ex-post simulations is an important first test, it is not a sufficient means for establishing its validity. A further and important test is ex-ante forecasting, which incorporates the builder's ex-ante predictions of future values of the exogenous variables (3). In that respect, such a test will not only judge the accuracy of the model itself, but also the ability of the

builder to select future values of exogenous variables. Additional validation tests could take the form of multiplier and sensitivity analyses.

When we deal with multi-equation models, the selection of evaluation criteria becomes a complicated matter. In this case, even if the individual equations fit the data well, the model, when simulated as a whole, may not closely track the data series (or at least some of the equations may not do so) (4). Nontheless, the model-builder must make a judgement regarding the over-all statistical fit of the model. In a simulation context and when comparing the results of a historical simulation to actual data, it is desirable to have some quantitative measure of how closely individual variables track their corresponding data series. A number of such quantitative measures are widely used. One such measure is the mean absolute simulation error defined as:

$$MAE = (1/T)\sum_{t}|Pt- At|$$

where Pt is the simulated value of a given variable, At is its actual value and T is the number of simulation periods.

Another is the mean absolute percent simulation error, defined as:

$$MAE\% = (1/T)\sum_{t}(|Pt-At|/At)$$

The measures most frequently used in practice are the

root-mean-square-error, defined as:

$$RMSE = SQRT(1/T)\sum_{t}(Pt-At)^2$$

which is to be compared to the average size of the variable in question, and the root-mean-square-percent-error, defined as:

$$RMSE\% = SQRT(1/T)\sum_{t}(Pt-At/At)^2$$

RMSEs are used more often in practice because they penalize large individual errors more heavily (5).

The error statistics described above constitute only part of the desirable measures of evaluating a simulation fit. Another criterion of particular importance is how well the model is able to follow turning points in a historical simulation, where by turning points are understood to refer to sudden changes in the data.

Another useful simulation statistic, related to the RMSE usually applied in evaluating a historical simulation (or ex-post forecast) is Theil's inequality coefficient (6), defined as:

$$U = SQRT\left(\frac{1/T\sum_{t}(Pt-At)^2}{SQRT(1/T\sum_{t}At^2)}\right)$$

The numerator is the RMSE of the forecast, while the denominator is the RMSE assuming zero forecasted change, and

Pt and At are predicted and actual changes in the dependent variable. This statistic can take values between 0 and 1. When Pt = At for all t, then U = 0. On the other hand, if Pt = 0 for all t, then U = 1 and the model forecasts just like a "naive" zero-change prediction. The usefulness of Theil's inequality coefficient comes mainly as a result of its decomposition into three interesting statistics, which constitute the characteristic sources of simulation errors. These are the square of the bias, the variance, and the covariance, respectively:

$$Um = (\bar{P}-\bar{A})^2/(1/T)\sum_t(Pt-At)^2$$

$$Uv = (S_p-S_a)^2/(1/T)\sum_t(Pt-At)^2$$

$$Uc = 2(1-r)S_p S_a/(1/T)\sum_t(Pt-At)^2$$

where $\bar{P}$, $\bar{A}$, S_p , S_a , are the means and standard deviations of the predicted and actual series, and r is the correlation coefficient between $\bar{P}$ and $\bar{A}$.

The bias (Um) is an indication of systematic errors (errors in central tendency - i.e., $\bar{P}$ different from $\bar{A}$). Large values of bias would indicate a systematic error. The variance (Uv) is a measure of the model's ability to replicate the degree of variability in a given variable.

Finally, the covariance (Uc) measures what can be called unsystematic error or error due to incomplete covariation (i.e., the correlation coefficient is not equal to 1), and

is considered the least worrisome. The ideal distribution of U over its sources is Um = Uv = 0, and Uc = 1 (7).

5.2 Analysis of Within-Sample Prediction Errors: 1962-1981

In evaluating the model's predictive performance, simulation results for the 1962-1981 sample period will be first presented and discussed, followed by an evaluation of the model's out-of-sample predictive performance (years 1982 to 1985). Subsequently, simulation results for the updated model (1962-1985) will be presented and compared to the previous results.

This section is concerned with the most common tests of the forecasting performance of an econometric model, the ex-post, within-sample simulation. A number of within-sample simulations have been carried out, involving dynamic predictions. Since the period of estimation starts in 1960 and the system requires a number of one and two-year lagged observations for solution, 1962 is the first year for which the model can be solved.

The results given in Table 7 refer to a dynamic simulation for the entire sample period (1962-1981). This is done with the use of a procedure involving successive iterations, known as the Gauss-Seidel procedure. The simulation is a fully dynamic one in the sense that after using an initial set of lagged values for 1960 and 1961,

subsequent values of lagged endogenous variables are those computed from the previous period's solution. The model is the one given in chapter IV, which is now re-estimated with the equation for exports in SITC 3 omitted from the model, for reasons given in the previous chapter. Finally, I had to deal with the presence of a moderate simulation bias (reflected in the bias component of Theil's inequality coefficient) originating in the price and wage equations and, through them, transmitted to the rest of the model. After extensive experimentation, it was observed that tuning the model was the solution to this problem. A minor adjustment of the (statistically insignificant) constant terms of the relevant price equations was sufficient to eliminate the bias.

Generally speaking, it is apparent from the simulation results presented in Table 7 that prediction errors for most variables are relatively small. Furthermore, it can be seen that prediction errors for aggregate variables like GDPC, CONC, TPRINC, M09C and EX09C are smaller than those of their main components. This indicates a tendency for errors to cancel out.

In the consumption sector, simulation results are satisfactory with a low RMSE% for aggregate private consumption (2.2%), while for the three disaggregated consumption functions, the RMSE% ranges from 2.4% to 3.6%.

In addition the bias components is low (below 0.03), implying low errors of central tendency.

TABLE 7

DYNAMIC SIMULTANEOUS SIMULATION: 1962-1981

STATISTICS OF FIT

VARIABLE	R-SQ	MAE%	RMSE%	INEQ.COEF.(U)	SQ. OF BIAS
GNPC	0.9981	1.08	1.52	0.007	0.00
YD	0.9996	1.22	2.31	0.006	0.01
NNI	0.9997	1.16	2.86	0.006	0.02
GDPC	0.9964	1.55	2.39	0.009	0.03
GDPMC	0.9816	3.28	3.69	0.018	0.02
GDPAC	0.8846	4.33	5.16	0.026	0.02
GDPSC	0.9967	1.59	2.71	0.009	0.07
CONC	0.9956	1.78	2.17	0.010	0.01
FBTC	0.9904	1.79	2.37	0.011	0.03
CFRFHC	0.9868	3.29	3.56	0.019	0.00
HTCROC	0.9933	2.70	3.23	0.015	0.00
TINVC	0.9759	3.70	4.76	0.021	0.05
TPRINC	0.9610	5.10	6.76	0.029	0.05
PRINMC	0.9219	8.60	10.68	0.052	0.09

PRINHC	0.9208	7.21	8.97	0.042	0.00
PRINAC	0.7757	8.79	11.80	0.050	0.00
PRINSC	0.8952	9.99	12.96	0.055	0.03
M09C	0.9819	3.31	4.71	0.025	0.00
M01C	0.8927	7.25	8.48	0.040	0.00
M24C	0.9469	7.12	9.26	0.036	0.00
M3C	0.9434	7.91	11.54	0.098	0.00
M5-9C	0.9793	4.16	4.68	0.027	0.00
EX09C	0.9891	4.29	6.93	0.026	0.00
EX01C	0.9066	7.84	9.12	0.048	0.00
EX24C	0.6533	11.11	14.52	0.071	0.00
EX5-8C	0.9877	7.12	32.66	0.035	0.00
TD	0.7572	9.71	13.25	0.065	0.01
DT	0.9796	10.76	24.31	0.052	0.00
NIT	0.9505	11.07	18.04	0.071	0.00
DC	0.9994	0.87	1.30	0.005	0.01
CSMC	0.9932	2.91	3.38	0.017	0.04
GDPDE	0.9993	1.20	1.53	0.007	0.06
PCE	0.9986	1.05	1.43	0.005	0.12
PFBT	0.9990	1.56	2.01	0.009	0.13
PCFRFH	0.9969	2.23	2.32	0.013	0.06
PHTCRO	0.9847	4.13	3.85	0.030	0.00
WM	0.9994	1.70	2.20	0.009	0.18

Simulation results for the four sectoral investment equations are less tight than that for the consumption equations. However, the estimates track the data series reasonably well, and the RMSE% ranges from 8.9% to 12.9% (6.2% for total private investment and 4.8% for total investment). Overall, the magnitude of errors is acceptable, given the high volatility of investment, especially during the 1970s. Furthermore, turning-point prediction is very good, especially for the period after 1970. Finally, biases are close to zero for all investment equations except for PRINMC which has a bias of 0.09.

The simulation statistics for the international sector reveal that import equations performed better than export equations. The estimates of import equations track the historical trend well and capture the most important turning points, and in particular that of 1973, but miss the recession of 1979-80. Results for the export equations were inferior, especially for the last equation (EX59C). The rough performance of the trade deficit was to be expected, since it is estimated as a residual (EX09C-M09C).

RMSE% for the main income and production aggregates (GNPC, GDPC, YD) are very low ranging from 1.52% (for GNPC), to 2.3% (for YD) and 2.4% (for GDPC), while biases are below 0.03.

The relatively high simulation errors for the two tax equations (18.0% for NIT and 24.3% for DT) are due to sharp

changes in the data series, which are related to the frequently renewed efforts by the government to raise revenues and fight tax evasion.

Finally, for the price and wage equations, the performance is very satisfactory, with RMSE% ranging from 1.43% for PCE to 3.8% for WM.

FIGURE 1

TOTAL CONSUMPTION (CONC)

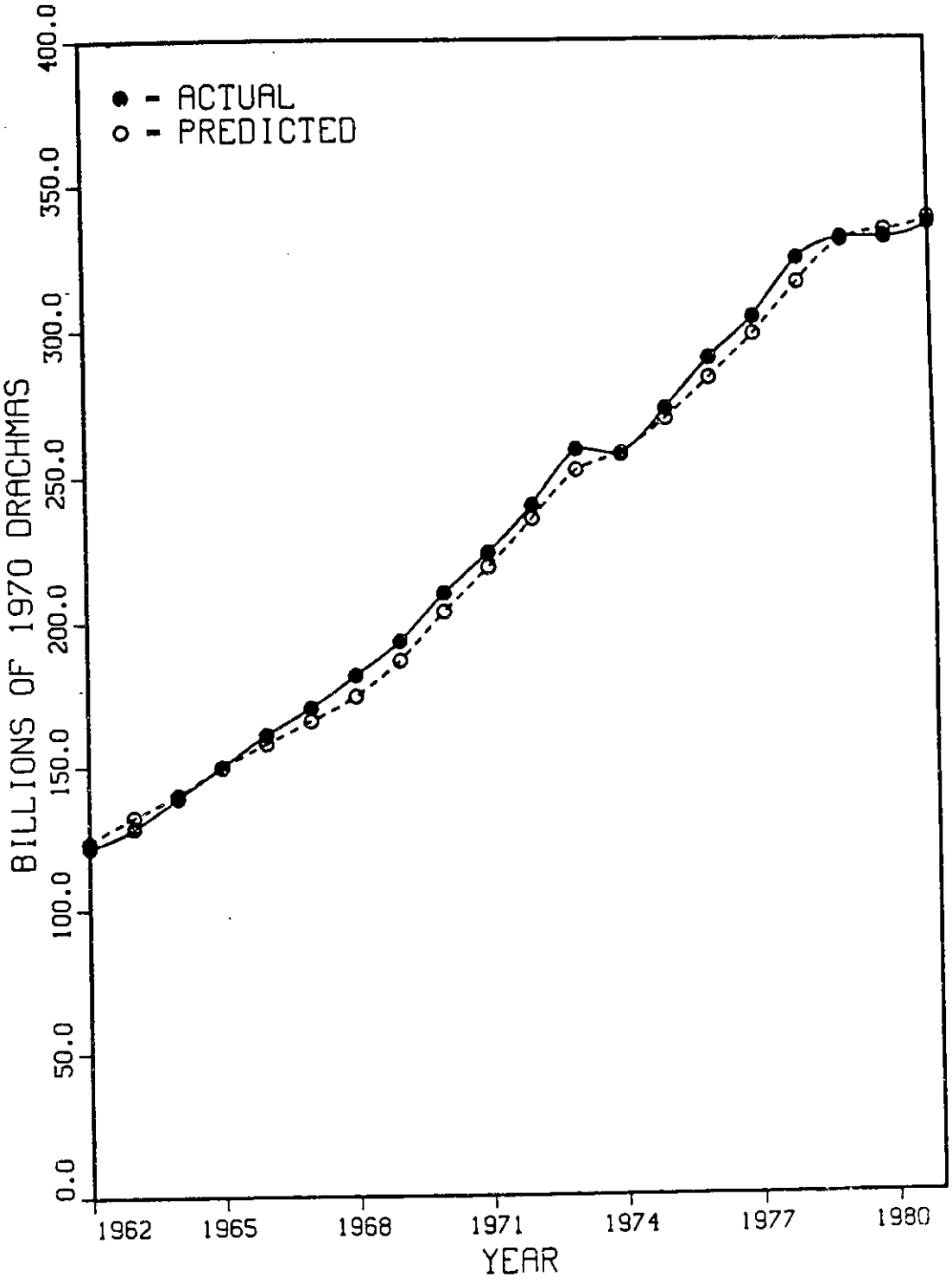


FIGURE 2

PRIVATE INVESTMENT IN MANUFACTURING (PRINMC)

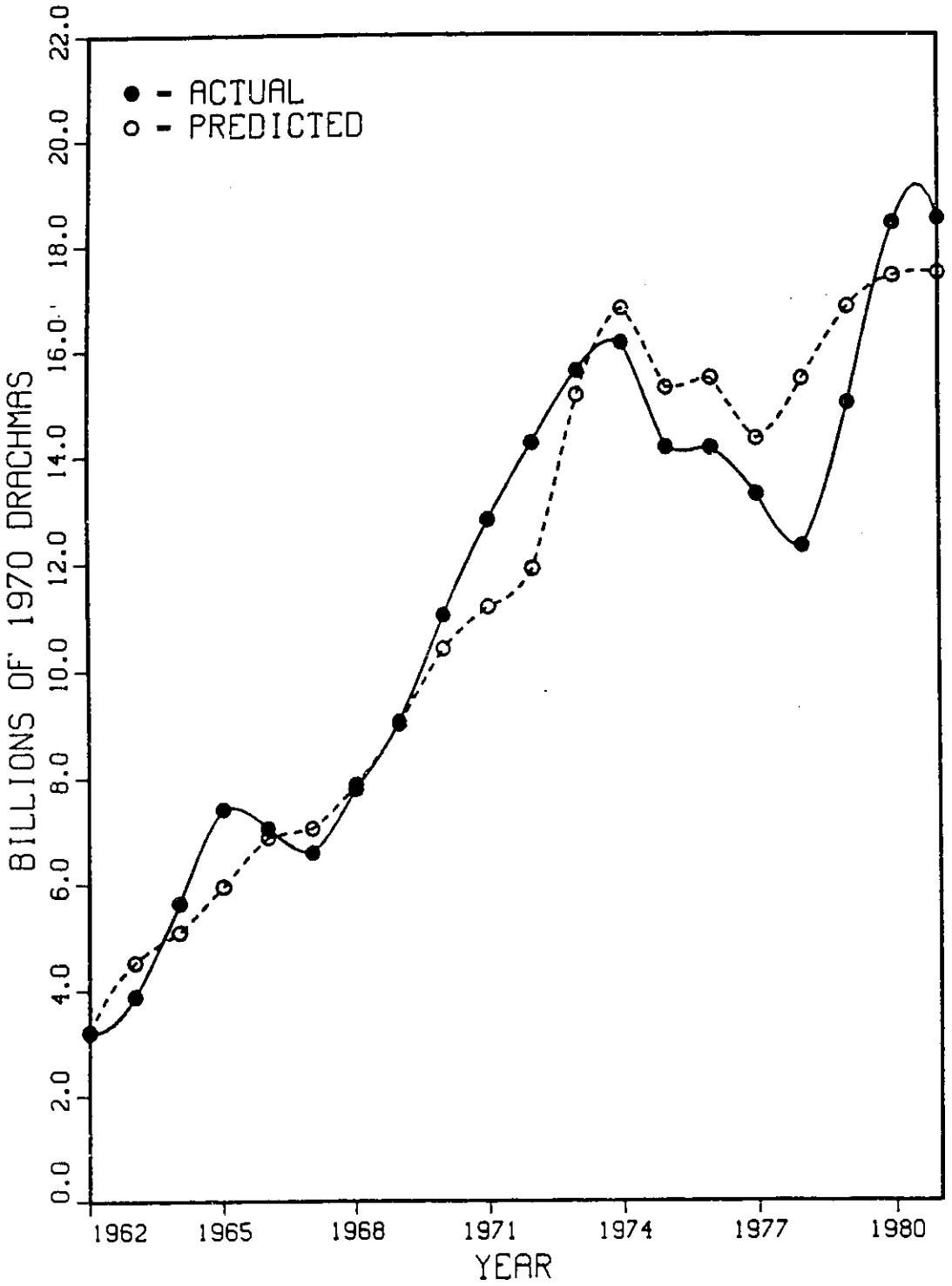


FIGURE 3

PRIVATE INVESTMENT IN HOUSING
(PRINHC)

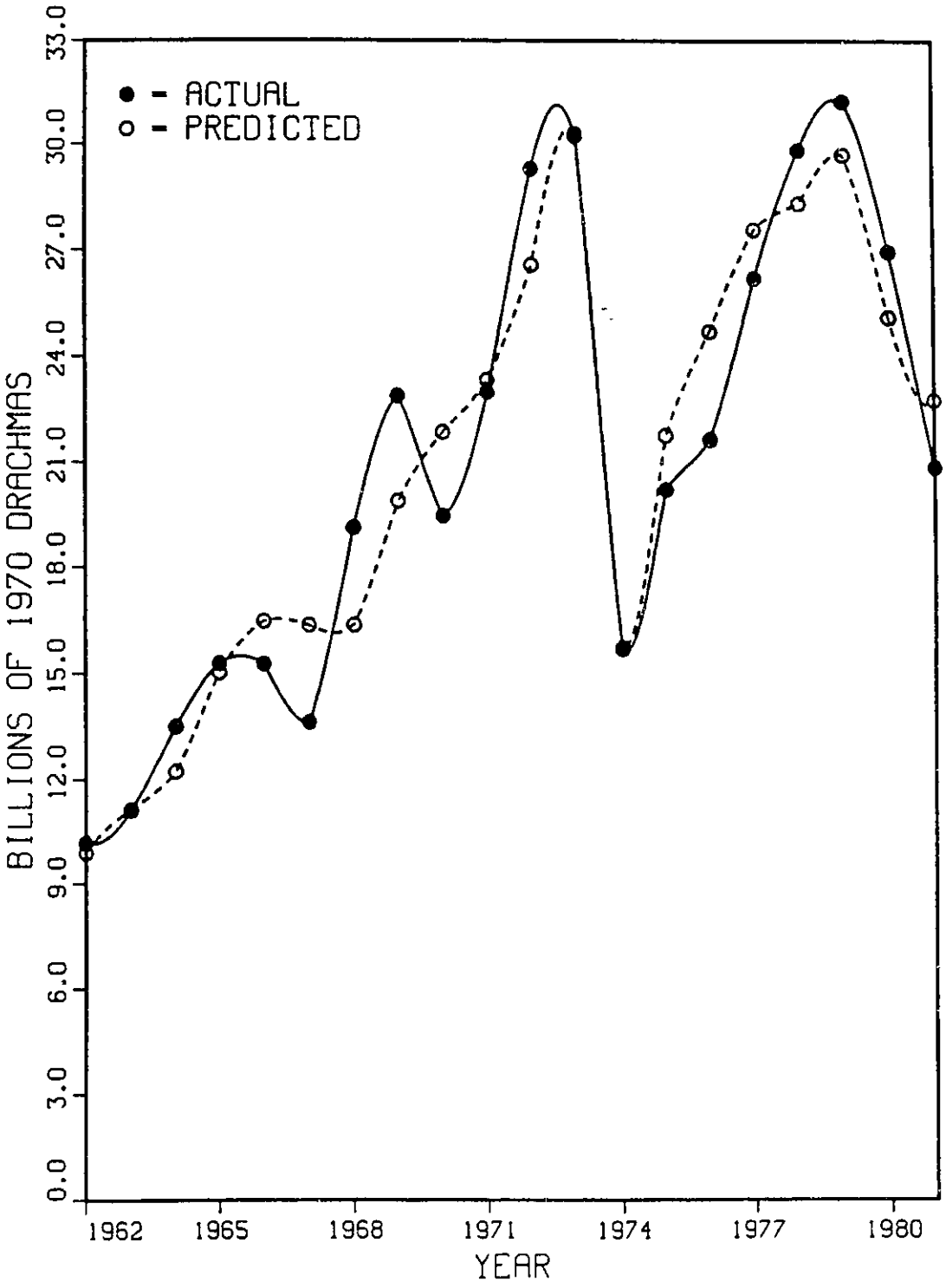


FIGURE 4

TOTAL PRIVATE INVESTMENT
(TPRINC)

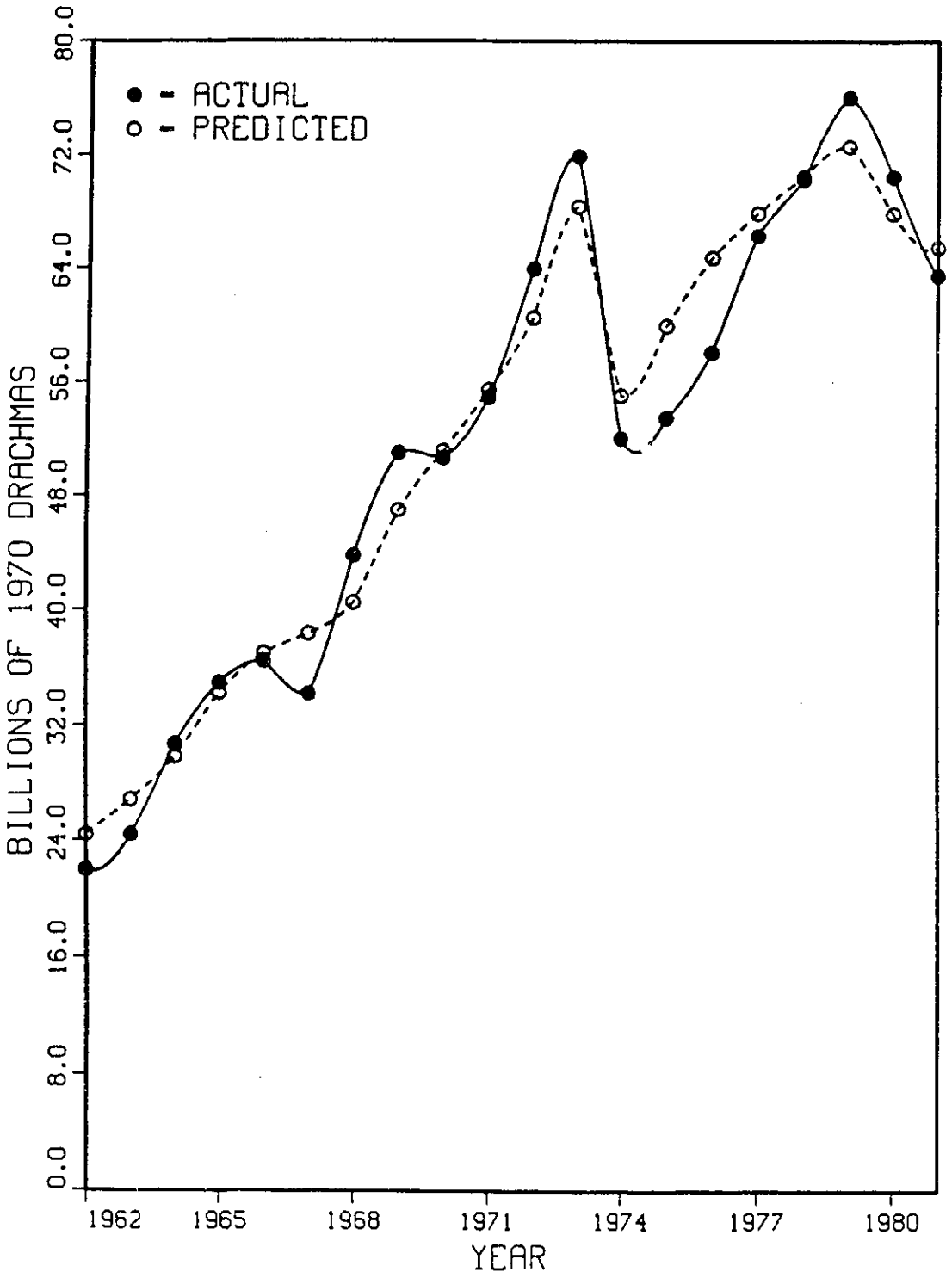


FIGURE 5

GDP IN MANUFACTURING (GDPMC)

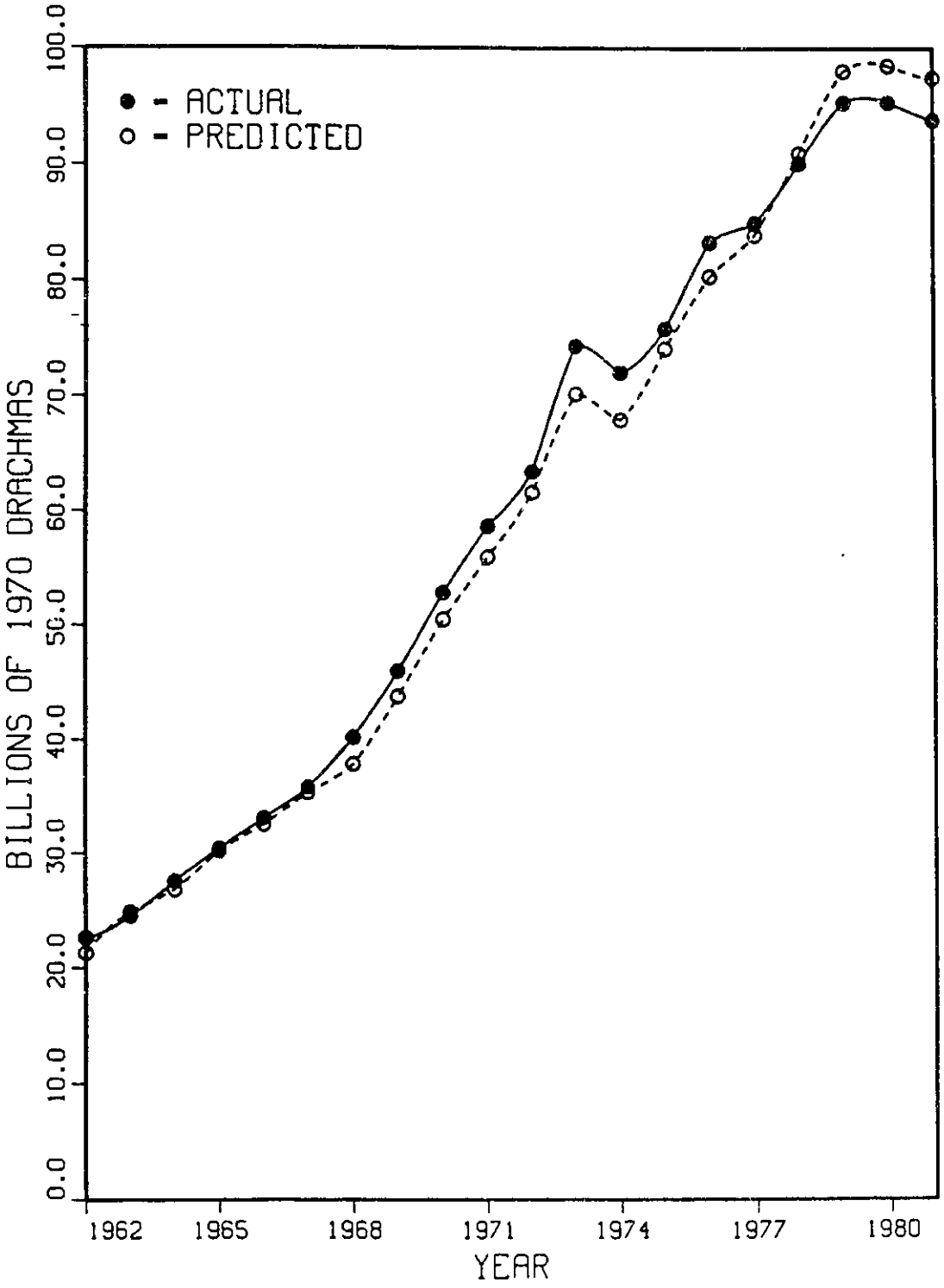


FIGURE 6

GROSS DOMESTIC PRODUCT GDPC

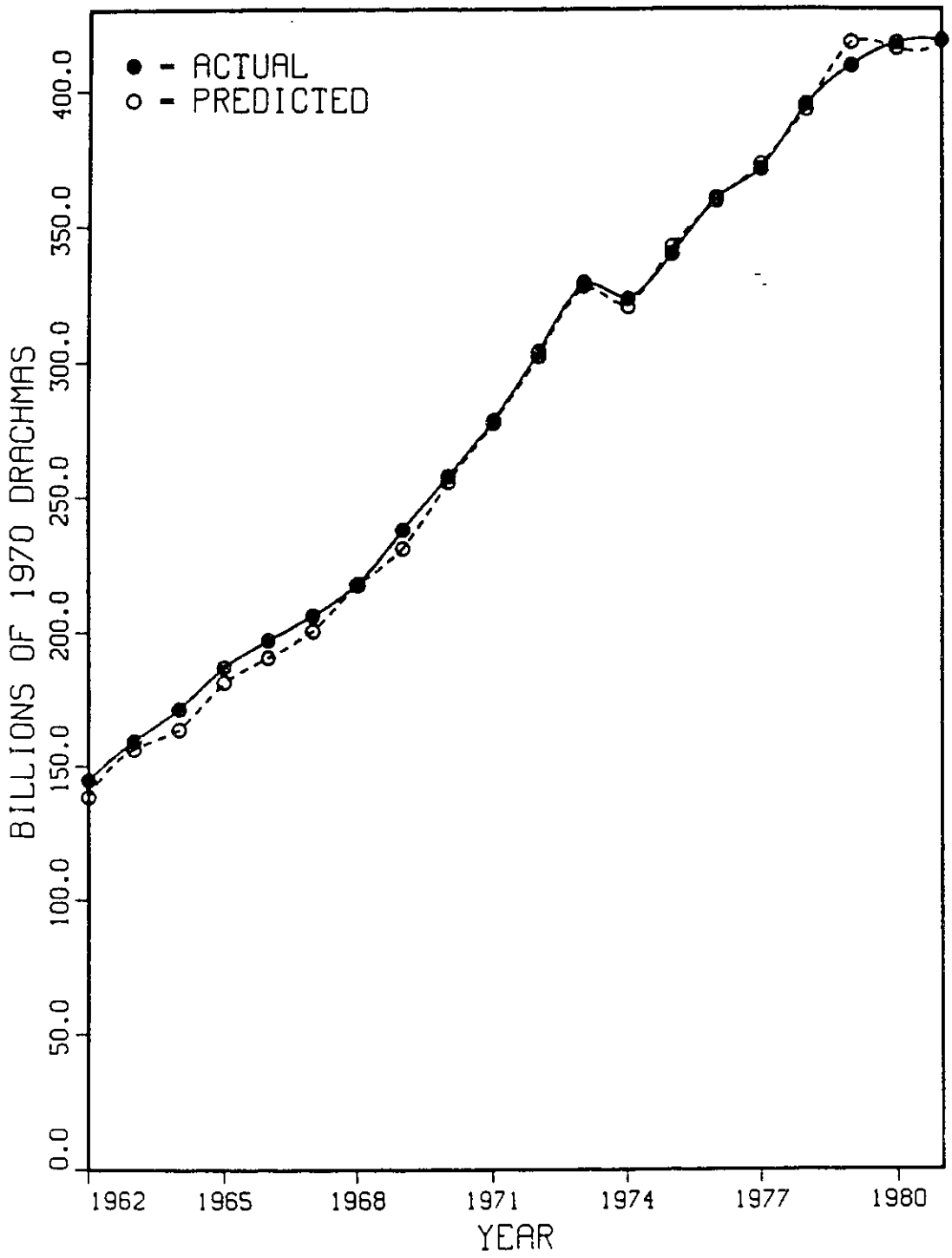


FIGURE 7

GROSS NATIONAL PRODUCT GNPC

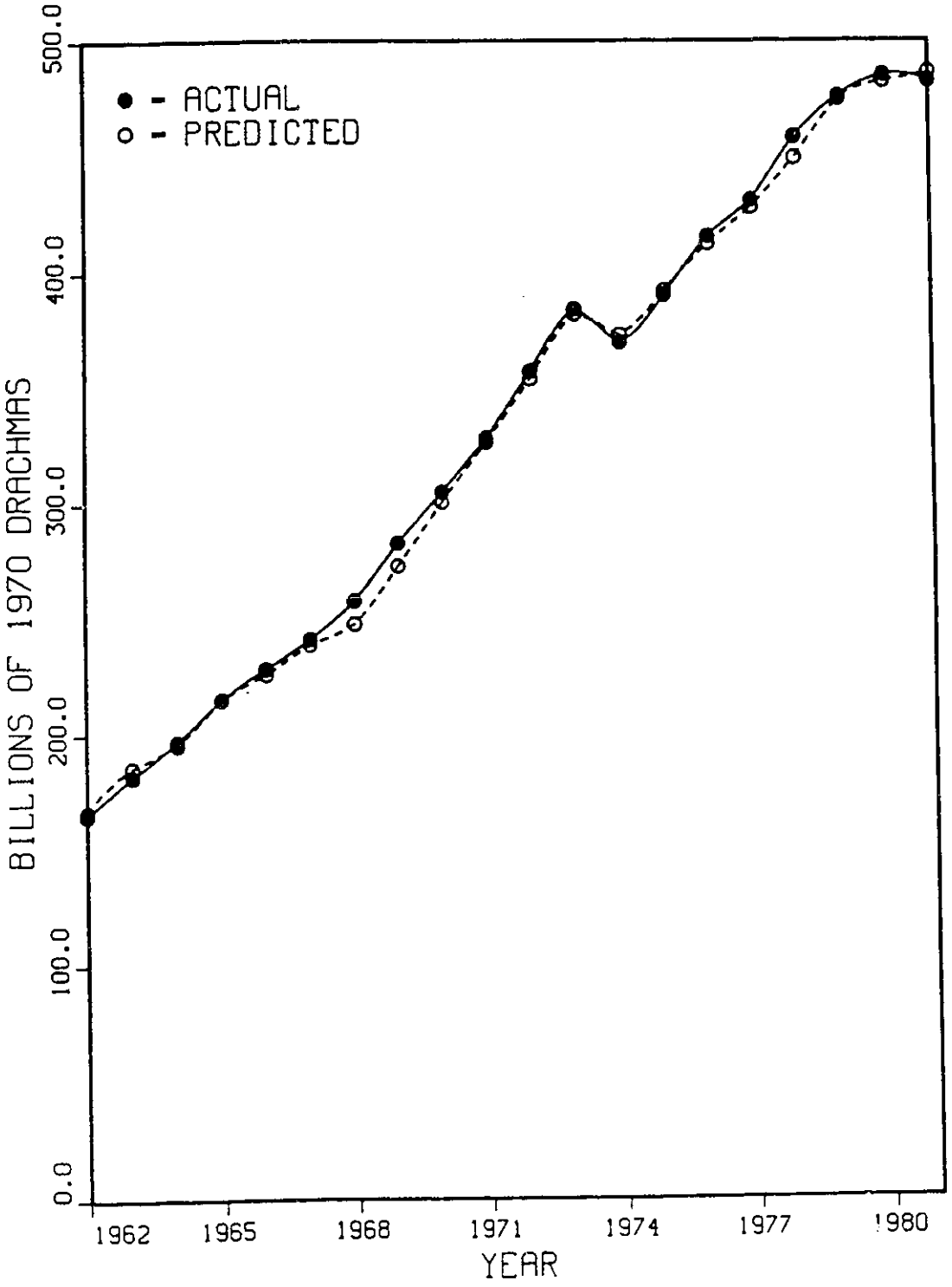


FIGURE 8

TOTAL IMPORTS M09C

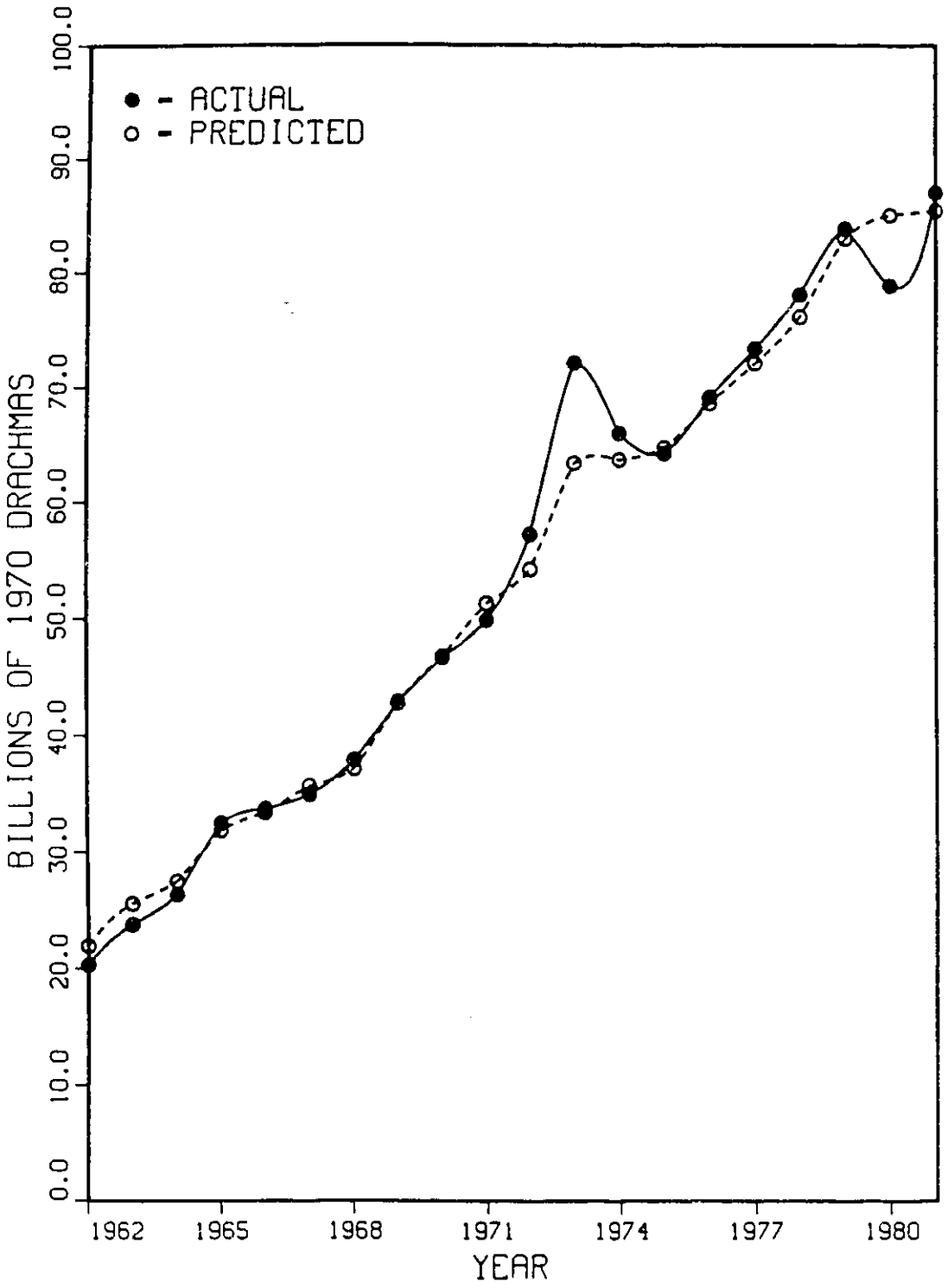


FIGURE 9

TOTAL EXPORTS EX09C

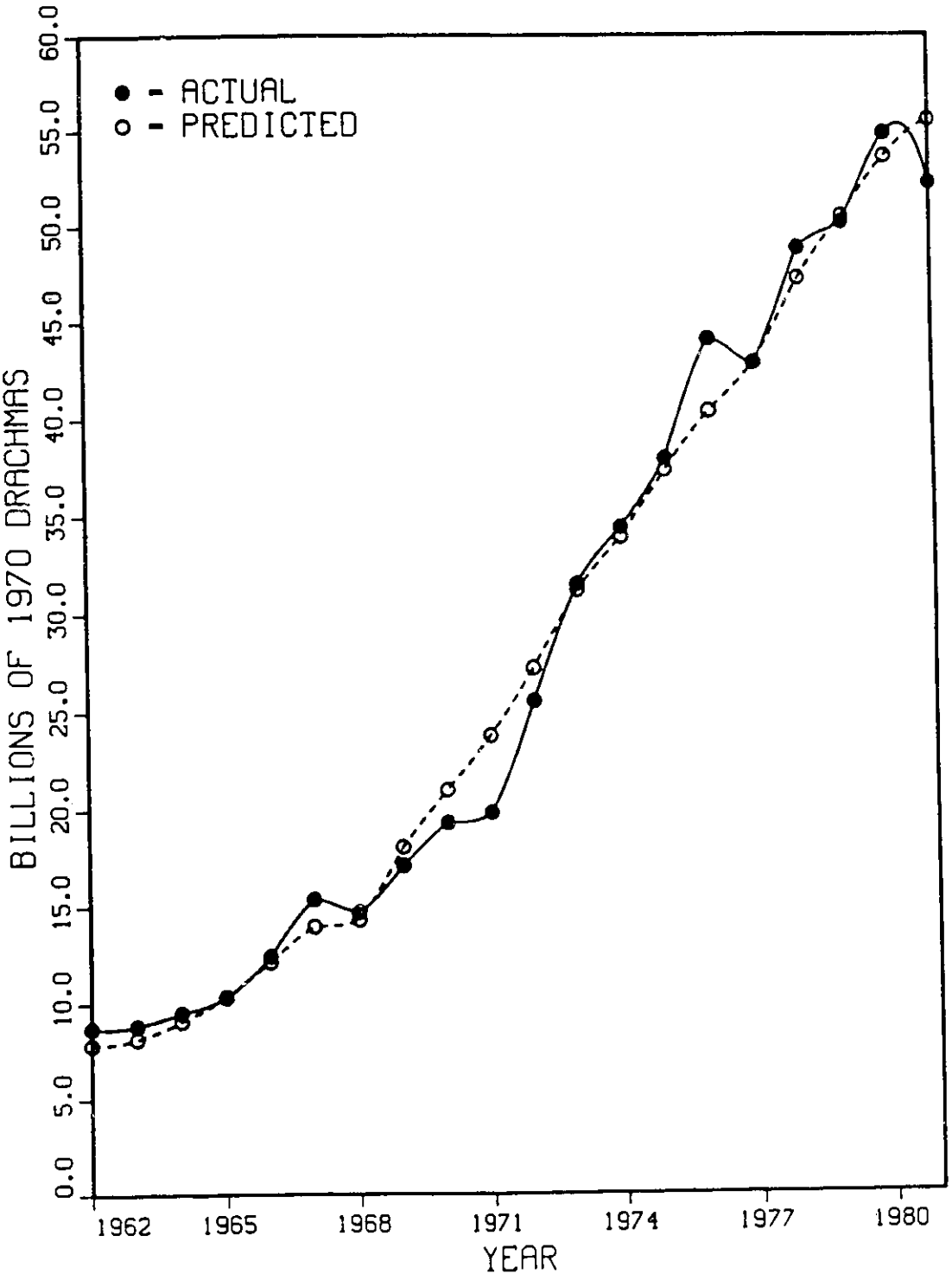


FIGURE 10

TRADE DEFICIT TD

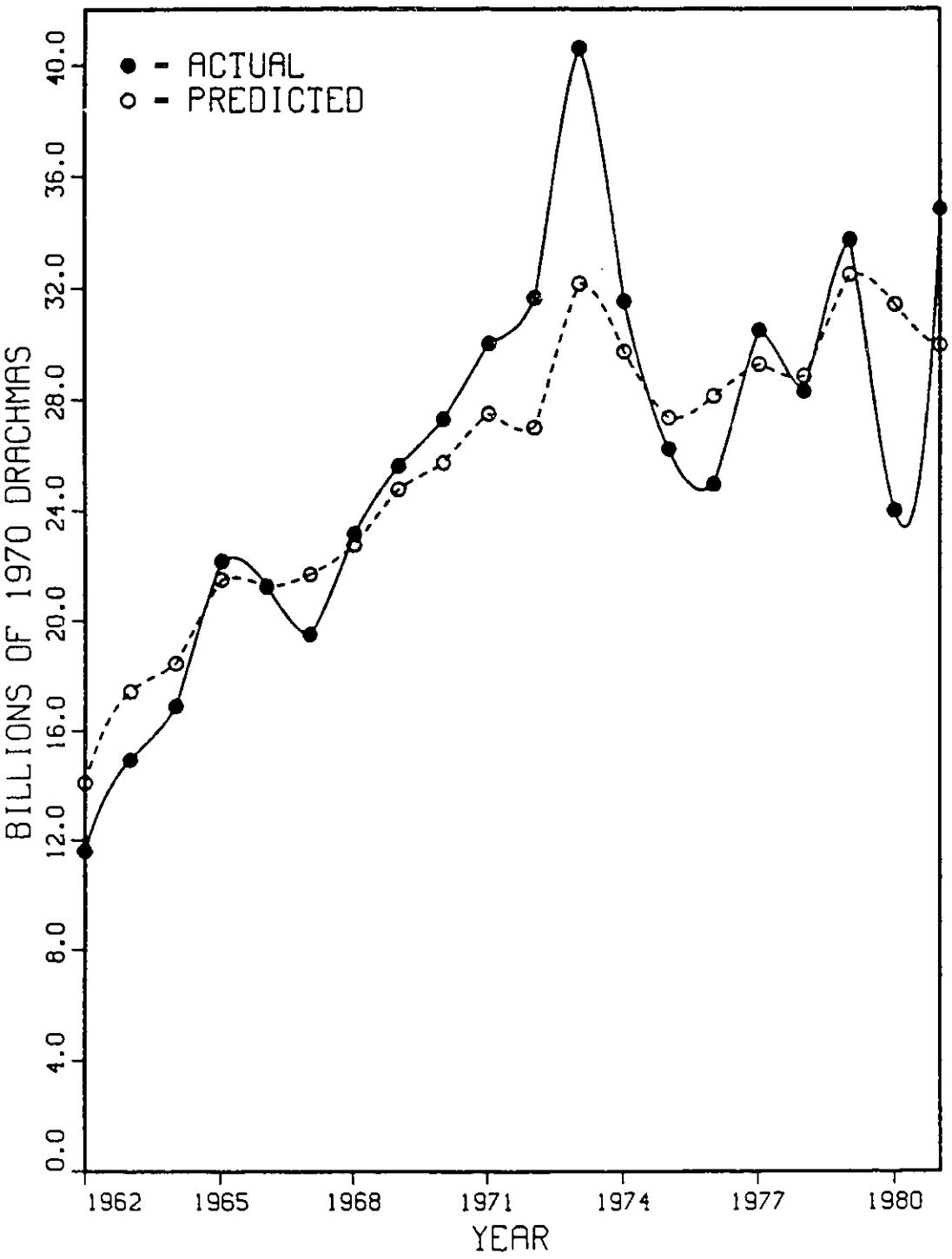
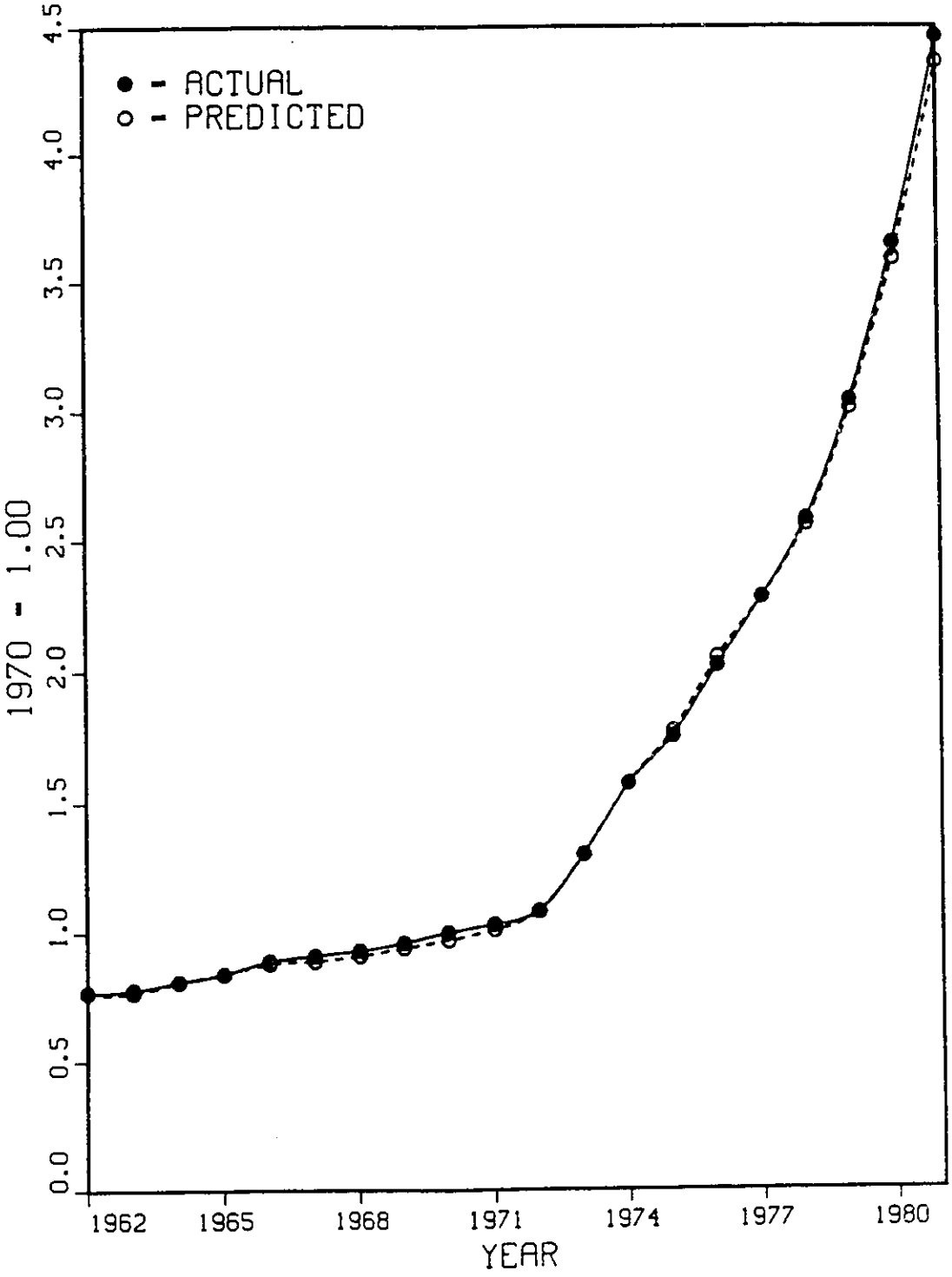


FIGURE 11

GDP DEFLATOR GDPDE



5.3 Analysis of Post-Sample Prediction Errors: 1982-1985

The post-sample simulations are considered more genuinely predictive tests, since they do not relate to data used in fitting the equations.

In testing the forecasting performance of the model beyond the sample period, a fully dynamic solution with fixed initial conditions was generated, using actual values of exogenous variables.

The first results proved particularly interesting; the equation for private investment in manufacturing-mining (PRINMC) produced significantly higher errors in the post-sample period 1982-85 which was in the order of 52% (RMSE%), despite the fact that the performance of the equation was acceptable during the sample period, picking up most of the turning points. This result is not strange or unexpected. In fact it can be seen as a strong evidence for something that has often been argued concerning the post-1981 further decline of private investment in manufacturing. The argument was that, while the declining tendency of PRINMC during the 1973-78 period was evidence of a recession (oil price shock), the further decline experienced after 1981 was directly related to the political change (in October 1981), from a Conservative to a Socialist Government (for the first time in modern Greek history), and the environment it created.

In Table 8, RMSE% are presented for 22 model variables for the year 1982. It should be noted that, in the case of the one-year prediction, the RMSE% and MAE% statistics are equal in value. In Table 9, simulation errors are given for a one, two and four-year ex-post forecast (1982, 1982-83 and 1982-85) for the same variables.

A comparison of the error statistics presented in Table 9 with the corresponding within-sample statistics in Table 7, shows that for most of the variables the post-sample prediction errors are higher, at least for the two and four year predictions. Exceptions to this rule are found in the case of GDPSC, FBTC, DT, and NIT. Table 9 also reveals that the error statistics generally increase with the length of the period forecasted. However, there are four exceptions, namely, variables EX09C, TD, DT, and NIT, for which errors decrease as the length of the forecast is extended.

TABLE 8

ONE YEAR EX-POST FORECAST: 1982

STATISTICS OF FIT

VARIABLE	1982 Actual	1982 Predicted	RMSE% (= MAE%)
GNPC	479407	498297	3.94
YD	2135563	2231204	3.99
NNI	2130702	2197379	3.13
GDPC	420641	428814	1.94
GDPAC	60940	58730	3.62
GDPMC	90076	99533	10.50
GDPSC	229313	230533	0.53
CONC	340400	349711	2.66
FBTC	128400	127700	0.54
CFRFHC	115457	119493	3.50
HTCROC	96873	102519	5.92
PRINMC	16100	18166	12.83
TPRINC	62104	64035	3.10
TINVC	85904	87835	2.25
M09C	94928	88914	6.33
EX09C	50500	58101	15.05
TD	-27350	-30813	30.64
DT	108300	99372	16.05
NIT	263964	293938	11.35
GDPDE	5.49	5.37	1.37
PCE	5.20	5.39	3.62
WM	173.9	176.3	1.39

TABLE 9

ONE, TWO, AND FOUR YEAR EX-POST FORECASTS

STATISTICS OF FIT

VARIABLE	1982 RMSE%	1982-83 MAE%	1982-83 RMSE%	1982-85 MAE%	1982-85 RMSE%
GNPC	3.94	4.56	4.57	6.57	6.96
YD	3.99	5.46	5.48	6.96	6.48
NNI	3.13	4.69	4.71	7.38	8.01
GDPC	1.94	3.24	3.25	5.77	6.44
GDPAC	3.62	2.85	6.19	4.79	6.64
GDPMC	10.50	13.85	14.02	19.43	20.39
GDPSC	0.53	0.53	0.79	1.46	1.90
CONC	2.66	3.92	3.93	4.36	4.47
FBTC	0.54	0.60	0.62	1.90	2.78
CFRFHC	3.50	6.82	6.86	5.11	5.50
HTCROC	5.92	6.51	6.52	6.76	6.87
PRINMC	12.83	17.49	17.96	38.75	51.70
TPRINC	3.10	7.27	8.41	14.42	16.43
TINVC	2.25	5.04	5.79	9.25	10.42
M09C	6.33	7.63	7.97	9.72	10.20
EX09C	15.05	7.27	10.65	1.38	8.27
TD	30.64	26.96	27.00	25.28	26.27
DT	16.05	14.94	14.94	14.36	14.52
NIT	11.35	6.57	8.01	2.42	5.50
GDPDE	1.37	2.08	2.09	2.84	2.97
PCE	3.62	3.44	3.76	5.67	6.12
WM	1.39	2.57	3.67	4.91	5.96

5.4 Within Sample Prediction Errors: 1962-1985

The updated version of the model covering the entire period for which data were available was also subjected to tests of within-sample predictive ability. Differences in the predictive performance of the two models can arise, among other things, from changes in coefficient estimates. Such changes in coefficient estimates were observed in the case of the PRINMC equation as well as the price equations (mainly PFBT and PCFRFH). It should be noted here that major events, which took place in 1981 (i.e., the political change of October 1981 and the integration of Greece into the EEC, which also occured in 1981), may have been the cause of a structural break in some equations (i.e., the PRINMC equation, as argued earlier in this chapter).

TABLE 10

DYNAMIC SIMULTANEOUS SIMULATION: 1962-1985

STATISTICS OF FIT

VARIABLE	R-SQ	MAE%	RMSE%	INEQ.COEF.(U)	SQ. OF BIAS
GNPC	0.9856	2.76	3.12	0.02	0.04
YD	0.9940	3.86	3.29	0.03	0.02
NNI	0.9936	3.92	3.35	0.03	0.02
GDPC	0.9852	2.64	3.12	0.02	0.02
GDPMC	0.9466	7.24	7.34	0.04	0.01
GDPAC	0.8724	4.37	5.07	0.02	0.03

GDPSC	0.9966	1.68	1.84	0.01	0.20
CONC	0.9837	3.45	3.62	0.02	0.08
FBTC	0.9833	2.70	3.12	0.01	0.20
CFRFHC	0.9652	5.10	5.50	0.03	0.02
HTCROC	0.9889	3.49	3.89	0.02	0.02
TINVC	0.9603	4.01	5.04	0.03	0.01
TPRINC	0.9337	5.61	7.50	0.04	0.01
PRINMC	0.8772	9.63	11.43	0.06	0.02
PRINHC	0.8446	9.27	13.30	0.05	0.00
PRINAC	0.5078	11.53	15.97	0.07	0.00
PRINSC	0.8959	8.63	10.82	0.05	0.00
M09C	0.9810	3.61	5.15	0.03	0.01
M01C	0.8754	10.25	12.58	0.06	0.00
M24C	0.9532	6.27	7.74	0.04	0.06
M3C	0.8234	14.72	18.21	0.08	0.00
M59C	0.9789	4.53	6.21	0.03	0.01
EX09C	0.9832	8.38	8.49	0.03	0.01
EX01C	0.9252	7.07	9.11	0.05	0.00
EX24C	0.6869	13.17	17.27	0.08	0.00
EX59C	0.9857	6.94	33.45	0.04	0.02
TD	0.7631	9.83	14.61	0.07	0.02
NIT	0.9910	6.21	9.96	0.04	0.00
DC	0.9993	0.95	1.22	0.01	0.00
CSMC	0.9607	6.35	6.21	0.04	0.20
GDPDE	0.9995	1.30	2.14	0.01	0.09
PCE	0.9976	3.24	4.27	0.02	0.03
PFBT	0.9957	4.13	5.14	0.02	0.09

PCFRFH	0.9987	2.49	4.82	0.01	0.20
PHTCRO	0.9972	2.82	3.47	0.02	0.09
WM	0.9954	6.47	11.10	0.03	0.20

A general observation from the comparison of simulation results for the two sample periods is that prediction errors for the 1962-1985 period are higher for most of the endogenous variables. Exceptions are found in the case of the M24C, NIT, DC, GDPAC, and PRINSC equations. Furthermore, the simulation experiments conducted indicated that the higher prediction errors for price equations PFBT and PCFRFH in the 1960-1985 period were, to a large extent, responsible for higher prediction errors for the consumption equations (i.e., FBTC, CFRFHC, and CONC), which resulted in higher errors in aggregates such as GNPC and GDPC, since consumption is the largest component of aggregate expenditure.

NOTES

(1) Concentrating on the objective of a forecasting model would not be of particular interest, mainly because national institutions such as the Bank of Greece and the Center of Planning have a comparative advantage in resources and information towards successfully completing this end. An example of such a model would be the Bank of Greece model, see Garganas (1983), op. cit.

(2) See Klein, L.R. "Use of Econometric Models in the Policy Process", in Economic Modelling, Current Issues and Problems in Macroeconomic Modelling in the U.K. and the U.S., edited by P. Ormerod, Heineman, London, 1979, pp. 309-329.

(3) Klein (1979), ibid.

(4) Pindyck, R.S., and Rubinfeld, D., Econometric Models and Economic Forecasts, New York, McGraw-Hill, 1976, p. 361.

(5) Pindyck and Rubinfeld (1976), op. cit., p. 363.

(6) Theil, H., Applied Economic Forecasting, North-Holland, Amsterdam, 1966, pp. 26-35.

(7) Pindyck and Rubinfeld (1976), op. cit, p. 366.

CHAPTER VI

POLICY EXPERIMENTS

6.1 General

The multiplier and elasticity calculations in this chapter can be divided into three parts: first, those involving changes in principal exogenous variables related to the international sector of the model; second, direct changes in government spending; and third, changes in monetary variables and, in particular changes, in the government controlled bank credit to housing (as well as other sectors of investment) and the mortgage rate.

6.2 Reducing Import Duties: Dynamic Tariff Elasticities

The extensive reliance of Greece on import duties has been justified on grounds of protecting the local industry and controlling the trade balance. Besides tariffs, other mechanisms to discourage imports and protect domestic production included other taxes on imports with an effect equivalent to tariffs and quantitative restrictions. Greece, however, became associated with the EEC (association agreement in 1961, full membership in 1981). Since January 1981, the process of eliminating import restrictions (with the exception of tariffs) has accelerated. With respect to

import tariffs the Greece-EEC membership agreement requires that all import duties be eliminated by 1986 (1). However, the EEC has allowed Greece to eliminate progressively any internal taxes on imported EEC goods which are in excess in comparison to taxes on domestic goods, by 1989.

In this section, an experiment is proposed, intended to simulate the effect of a gradual elimination of import duties (required by the Greece-EEC membership agreement), on Greek imports and domestic economic activity. In particular, the purpose of this experiment is the derivation of the dynamic response to a reduced duty rate series, by estimating the dynamic tariff elasticities for a period of 10 years. A dynamic elasticity would reflect the percentage change in a particular endogenous variable of the model, in response to a given percentage change of the duty rate in a particular year:

$$Ed(t) = -\frac{d(t)}{X(t)} * \frac{X(t)-X'(t)}{\Delta d(t)}$$

where, $\Delta d(t)$ is the change, over time, in the duty rate and $X(t)-X'(t)$ is the change in the value of the endogenous variable after a time t has elapsed; this way, it is explicitly recognized that the value of the elasticity depends on how much time is allowed to elapse after the change has taken place.

In deriving dynamic elasticities, two model solutions are obtained. One is the control solution (historical simulation), and the other is the model solution after the introduction of the shock (in this case the change in the import duty rate series). The changes in the values of endogenous variables from the two solutions and the elasticity formula are then used to calculate (and plot) dynamic elasticities.

In deriving the reduced series, for the post-1971 sample years, duty rates (the (1+d) component of (1+d).Pf/P), for all three equations that contain a relative price variable have been reduced by 10% for the post-1970 sample years. It is implicitly assumed that relative import prices (ratio of import prices to the GDP deflator) have the same effect on imports as tariffs (this does not mean that the two elasticities are equal in size, though). In particular, the hypothesis is that a 10% change in the relative price component of the variable (Pf/P) has the same effect on imports as a 10% change in the duty rate (d). This has been confirmed statistically by Hitiris and Petousis (2) as well as by Brisimis (3).

In estimating the import equations it has been assumed that the equations are homogeneous with respect to the prices of imported and domestic goods, so that relative prices can be used as explanatory variables. It should be mentioned, however, that: first, domestic and imported goods

generally differ with respect to other characteristics besides their price, so that different reactions of consumers to equal changes in prices are possible; second, domestic and import price indices refer to a basket of products. However, the weight of any particular good in the index is not necessarily the same in the two indices. As a result, an equal increase in the price of a product (home or abroad) would not correspond to equal percentage changes in the two indices. There may also be differences in the very construction of the two indices, i.e., in Greece, import price indices are based on the Paasche formula while domestic price indices (consumer or wholesale) are based on the Laspeyres formula so that these two indices would produce a different development in prices even though their composition does not change (4).

The estimated dynamic elasticities for six variables of the model are given in Table 11 below:

TABLE 11

TARIFF ELASTICITIES OF IMPORTS

10% sustained decrease in import duties

YR	M09C	TD	GNPC	GDPC	CONC	TPRINC	PRINMC	NIT
1	-0.58	-1.07	0.11	0.13	0.041	0.028	0.055	0.034
2	-0.57	-1.12	0.12	0.13	0.052	0.018	0.091	0.044
3	-0.47	-0.91	0.11	0.13	0.060	0.009	0.093	0.052
4	-0.42	-0.88	0.11	0.12	0.063	0.008	0.089	0.056
5	-0.42	-1.02	0.11	0.12	0.066	0.007	0.098	0.059
6	-0.41	-0.99	0.11	0.12	0.068	0.005	0.098	0.062
7	-0.38	-0.94	0.11	0.12	0.068	0.005	0.098	0.062
8	-0.36	-0.94	0.11	0.11	0.068	-0.005	0.084	0.062
9	-0.30	-0.78	0.10	0.11	0.067	-0.005	0.068	0.062
10	-0.29	-0.78	0.10	0.10	0.066	-0.006	0.053	0.062

where, M09C is total imports, TD is the trade deficit, GNPC is gross national product from the expenditure side, GDPC is gross domestic product, CONC is aggregate consumption, TPRINC is total private investment, PRINMC is private investment in manufacture, all at constant prices, and NIT is net indirect taxes at current prices.

A few observations seem in order:

First, the signs of the elasticities are all correct. In particular, M09C and TD increase as import duties are decreased, implying a negative sign for elasticities. GNPC decreases as import duties decrease (due to the increase in imports). CONC decreases due to its dependence on disposable income. Finally, indirect taxes decrease, because they depend on consumption expenditure.

Second, as to the size of total import elasticities, the results suggest rather low values in absolute terms, in support of other estimates of short and long-run elasticities, (i.e., Magee (5), Brisimis (1984), as well as those by Hitiris and Petousis) (1984). These studies, however, dealt with the estimation of elasticities based on a single-equation model, rather than from a complete econometric model. On the other hand, estimates of tariff elasticities of well above 1 (in absolute terms) were obtained by Kreinin (6) for the U.K., West Germany, and the United States. Finally, elasticity estimates for other variables of the model (besides the trade deficit) are naturally even smaller, i.e. income elasticities of around 0.13.

Third, the time interval before an elasticity peaks varies across the endogenous variables presented above. It takes 1 or 2 years for M09C, TD, GNPC and TPRINC to peak, while CONC and NIT take over 6 years to reach their maximum

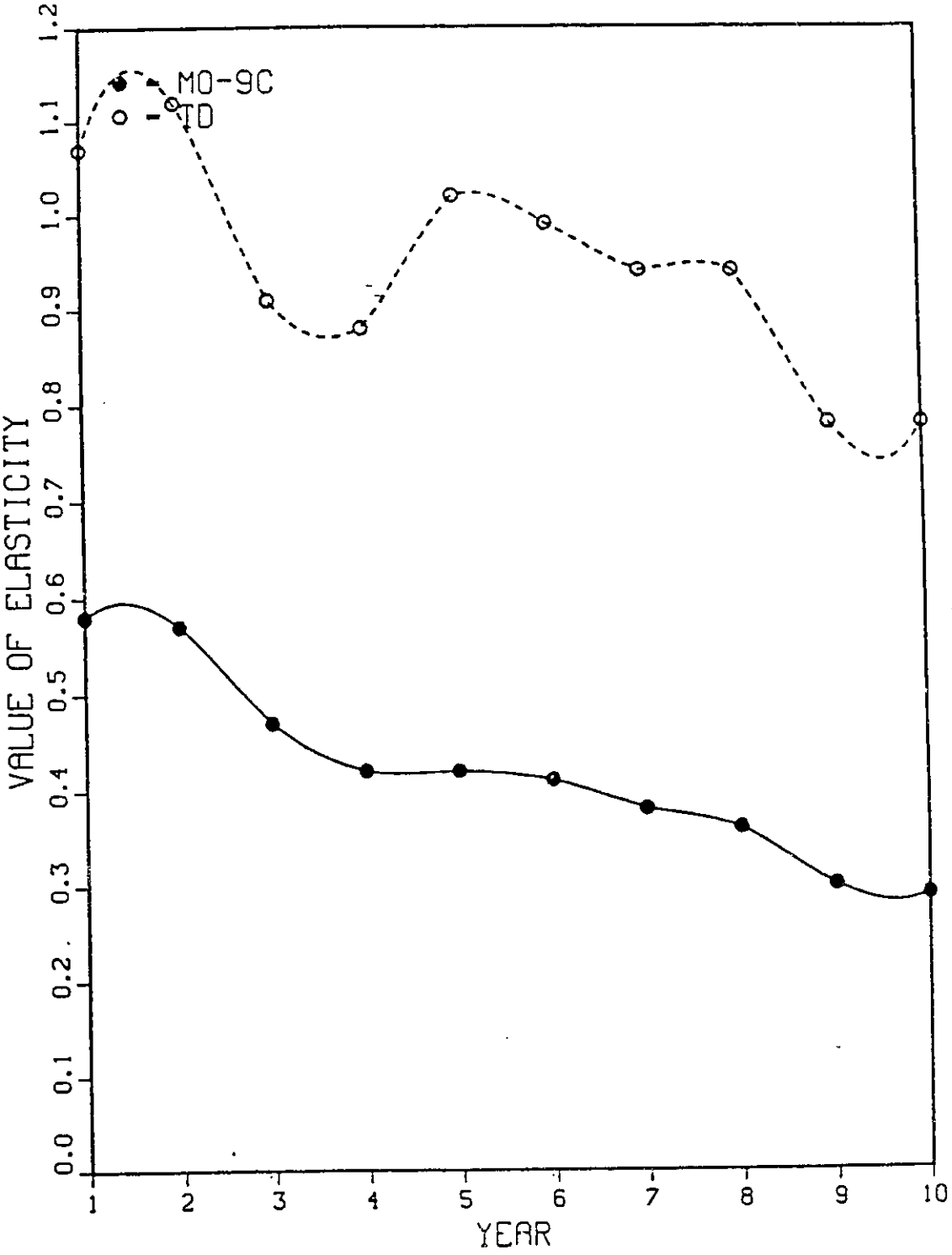
values.

In section 6.8 of this chapter, tariff elasticity results from the 1960-1981 model (as well as results for other experiments) are compared to those from the 1960-1985 model.

The time path of the import tariff elasticities for total imports and the trade deficit is depicted in the figure below:

FIGURE 12

IMPORT TARIFF ELASTICITIES



6.3 Foreign Activity Elasticities

The Greek economy closely approximates a small (in the sense that it provides only a small fraction of any traded good in relation to world availability) and open (the tradeable sector plays an important role) economy. Consequently, growing interdependence between nations and membership in the EEC makes the economy vulnerable to changes in external economic circumstances. Such a development could take the form of a recession abroad.

The experiment performed in this section refers to the derivation of the dynamic effects on a number of endogenous variables of a 1% sustained increase in the "world" activity variable entering the export equations for the post-1971 sample years. These effects allow domestic absorption of output to maintain a higher level, while the direct effect is to raise exports.

The dynamic effects are in the form of dynamic elasticities for total and disaggregated exports as well as for a number of other variables, and are given in Table 12 below.

TABLE 12

WORLD ACTIVITY ELASTICITIES

1% sustained increase in foreign activity

YR	EX09C	EX01C	EX24C	EX59C	GNPC	CONC	TPRINC	PRINMC	TD	M09C
1	0.95	0.91	0.99	1.00	0.08	0.03	0.007	0.036	-0.66	0.09
2	1.33	1.17	0.97	1.57	0.12	0.05	0.015	0.084	-1.06	0.14
3	1.51	1.51	0.96	1.89	0.15	0.07	0.023	0.11	-1.14	0.16
4	1.65	1.34	0.96	2.09	0.19	0.10	0.038	0.13	-1.45	0.20
5	1.70	1.29	0.96	2.22	0.21	0.11	0.043	0.17	-1.78	0.23
6	1.76	1.26	0.97	2.28	0.23	0.13	0.046	0.19	-1.92	0.25
7	1.82	1.24	0.98	2.30	0.24	0.14	0.049	0.23	-2.01	0.27
8	1.80	1.23	0.99	2.29	0.26	0.15	0.051	0.23	-2.20	0.28
9	1.80	1.22	0.98	2.27	0.27	0.17	0.052	0.23	-2.28	0.28
10	1.80	1.22	0.99	2.25	0.28	0.18	0.056	0.22	-2.28	0.29

where, EX09C are total exports, EX01C are exports in SITC 0 and 1, EX24C are exports in SITC 2 and 4, EX59C are exports in SITC 5, 6, 7, 8, and 9, GNPC is gross national product from the expenditure side, CONC is aggregate consumption, TPRINC is total private consumption, PRINMC is private investment in manufacture, TD is trade deficit, and M09C is total imports, all at constant prices.

In the first place, all commodity exports taken together were found to be unit elastic in the impact period with

respect to world activity (an elasticity of 0.95). However, they were found to be elastic in the long term, with a seventh-period elasticity of 1.82.

Looking at the various categories of exports, EX01C (food, beverages, tobacco) provided lower elasticities than the other categories, with an impact elasticity of 0.91 and a peak elasticity of 1.51. EX24C (raw materials excluding fuel) provided an elasticity which is stable over time at about unity. Finally, EX59C (manufactured goods), proved to be more elastic compared to the other two categories, with impact and long-run elasticities of 1.00 and 2.30, respectively.

With respect to the size of "world" activity elasticities, the results are in agreement with those obtained in the earlier mentioned study by Prodromides and Anastassakou (1983). Their results suggest that exports are elastic (long-run elasticity >1) with respect to "world" activity for all the one-digit categories (as well as total exports) except SITC 2.

Table 12 reveals that income and consumption elasticities increase over time, approaching a long-run value of 0.28 and 0.18 respectively. On the other hand, part of the income increase is diverted to imports. This is reflected in a long-run total imports elasticity of approximately 0.30. The trade deficit elasticity increases over time, approaching a value of approximately -2.3.

The time path of elasticities, depicted in Table 12 as well as the figures below, indicates that elasticities (with the exception of EX01C) peak, generally, after the sixth or seventh period.

FIGURE 13

WORLD ACTIVITY ELASTICITIES

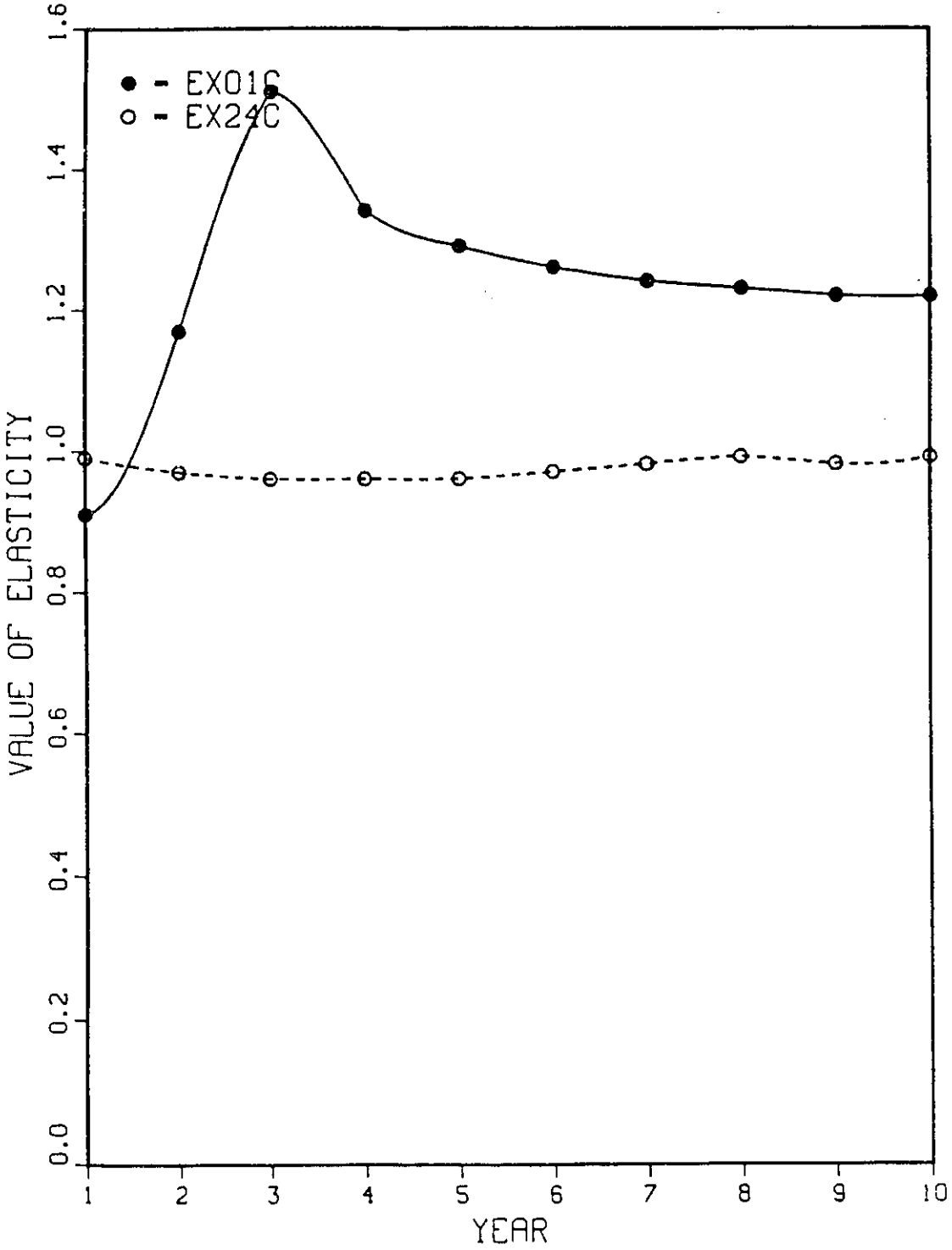
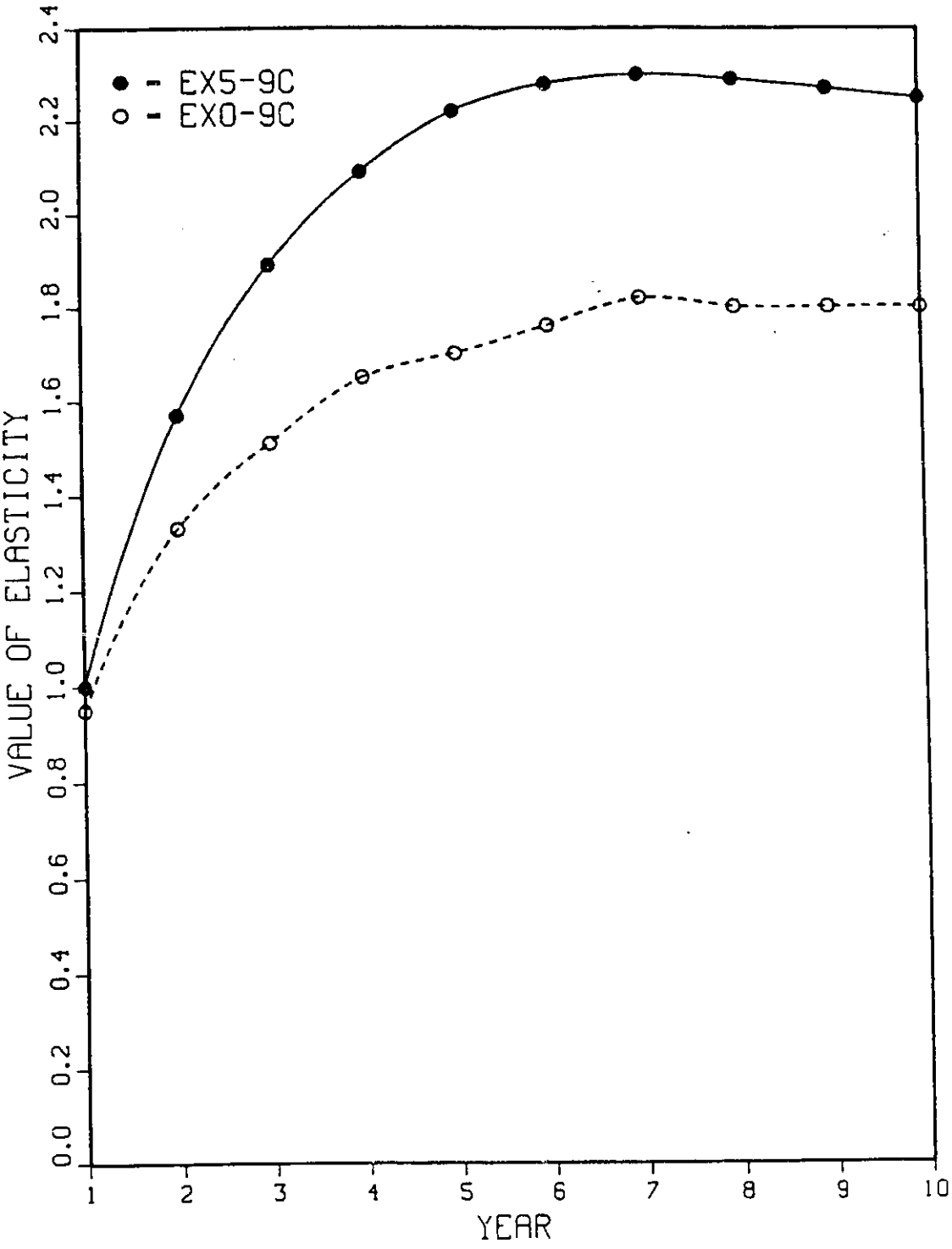


FIGURE 14

WORLD ACTIVITY ELASTICITIES



6.4 Multiplier Analysis: Government Expenditure Multipliers

Government expenditure multipliers have been receiving special attention in most econometric models. For the model presented in this study, impact and long-run government expenditure multipliers are derived and their growth over time is examined. They will also be compared to values obtained from other models of the Greek economy. The dynamic multipliers given below refer to both the consumption and investment budgets. The nature of the shock was the following: a one billion real drachmas sustained increase in government expenditures was introduced for the post-1971 sample years (i.e., government expenditures have been increased by one billion compared to actual data for the post-1970 period). The values of the endogenous variables resulting from the "shock" solution were subtracted from the corresponding values of the control solution. The resulting values of dynamic multipliers are given in Table 13.

An inspection of Table 13 shows that there is no qualitative difference between the impact and long-run multipliers as far as signs are concerned. This was also true concerning the rest of the experiments performed in this chapter. However, because of the lag structure of the model, a variety of feedback patterns over time is generated for the different endogenous variables.

TABLE 13

GOVERNMENT EXPENDITURE MULTIPLIERS

1 bill. drachma sustained increase in gov't expenditure

YR	GNPC	YD	YDC	GDPC	CONC	TPRINC	M09C&TD	DT	NIT
1	1.11	1.05	1.02	1.07	0.30	0.020	0.20	0.052	0.047
2	1.20	1.17	1.10	1.14	0.37	0.031	0.21	0.057	0.061
3	1.28	1.48	1.21	1.20	0.46	0.041	0.23	0.073	0.086
4	1.33	1.88	1.24	1.25	0.52	0.045	0.24	0.093	0.12
5	1.38	2.15	1.26	1.28	0.55	0.046	0.25	0.11	0.14
6	1.42	2.52	1.30	1.30	0.59	0.046	0.25	0.12	0.17
7	1.47	2.88	1.32	1.32	0.62	0.042	0.26	0.14	0.20
8	1.51	3.31	1.36	1.34	0.65	0.039	0.26	0.16	0.24
9	1.54	3.99	1.40	1.36	0.69	0.035	0.27	0.20	0.29
10	1.55	4.72	1.37	1.35	0.70	0.030	0.27	0.23	0.36
11	1.55	5.64	1.32	1.32	0.70	0.024	0.27	0.28	0.44

where, GNPC is gross national product from the expenditure side, YDC is disposable income, GDPC is gross domestic product, CONC is aggregate consumption, TPRINC is total private investment, PRINMC is private investment in manufacture, M09C is total imports, TD is trade deficit, all at constant prices, YD is disposable income, DT is direct taxes, and NIT net is indirect taxes all at current prices.

With respect to the magnitude of multipliers, the long-run multiplier relevant to GNPC is equal to 1.55, which seems to be in agreement with the value of 1.66 obtained by Vernardakis (1978, p. 117). However, a value multiplier for YDC (multiplier for disposable income at constant prices) than that of GNPC which has been obtained from this study seems more plausible than that of 1.96 derived by Vernardakis (1978, p. 117), given that government expenditures enter directly the GNPC accounting identity, and that YD contains the endogenously determined direct taxes. The total imports multiplier, on the other hand, has a long-run value of 0.27, which is between the values of 0.56 obtained by Vernardakis (1978, p. 118), and the earlier estimate of 0.19 by Pavlopoulos (1966). Finally, the low impact multiplier for total private consumption is a consequence of the low current marginal propensity to consume out of disposable income.

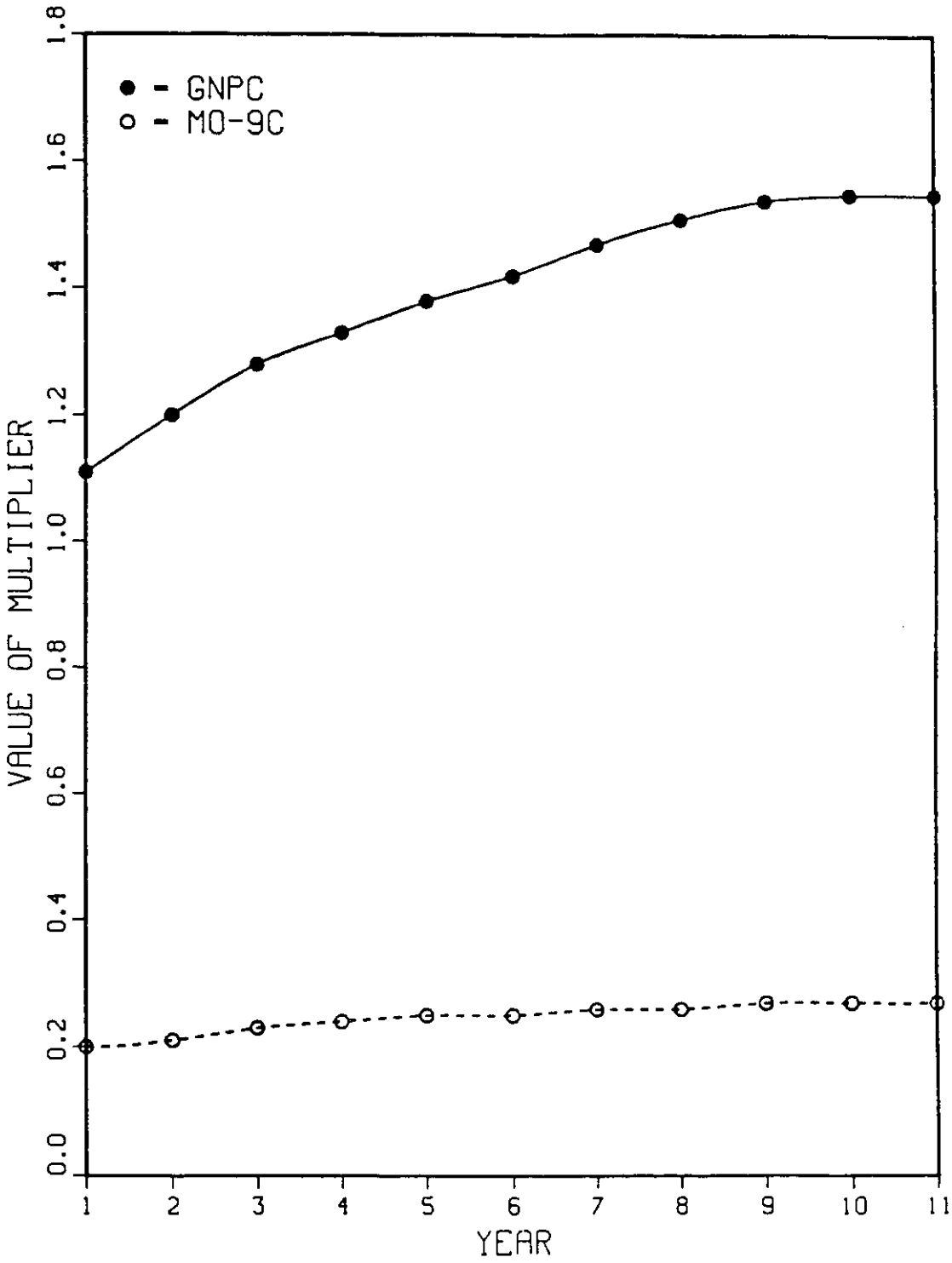
Dynamic multipliers level off generally after the sixth period, and this is in agreement with the findings of the two previously mentioned models. Most models for developed economies imply a considerably shorter period of time for reaching the leveling-off point (4-5 years for the Klein-Goldberger model) (7). A comparison of four Canadian macroeconomic models (8), namely Candide, QFM, TRACE and RDX2 showed that the time period before the GNP multiplier for a sustained increase in government expenditure levels off is rather short, varying from 2.5 years (for RDX2) to 4

years (for QFM), while the same time period for the Candide model was approximately 3 years. Vernardakis (1978, p. 116) argues that there is an indirect link implied between the time required for multipliers to level-off and the efficiency of an economy's stabilizers. This relationship, he argues, is related to the fact that less developed economies tend to have a more simplified system (i.e., taxation, social security, transfers) than developed economies.

The Figure below depicts the dynamic government expenditure multipliers for GNPC and M09C.

FIGURE 15

GOVERNMENT EXPENDITURE MULTIPLIERS



6.5 Bank Credit to Housing Multipliers

The housing sector (and the construction sector in general) have been an exception to the unfavourable developments in investment after 1973 (especially manufacturing investment), becoming one of the most important sectors contributing to economic growth in Greece. This sector has been frequently used by policymakers as a means of countercyclical economic policy. Important instruments in the hands of policy makers for this purpose are the volume of bank credit for housing and the mortgage rate.

A quote from the 1979 publication of the Center of Planning on the five-year plan for economic development (1978-1982) can provide an idea of the role reserved for the construction sector:

> If the developments in the international economy and especially in the EEC are unfavorable, demand and as a result exports of manufactures as well as production in manufacturing will not be growing at high rates. Consequently, the improvement in the structure of production coming from manufacturing will be restricted. In this case, to secure a rate of growth not far below 5%, priority will be given to other sectors with the least unfavorable effects on the structure of production (i.e. construction) (9).

The role of housing investment and construction in general in Greek economic growth has been the centre of controversy, with two opposing views. One, as put forward by J. Petras (10) and others (i.e., X. Zolotas, 1977 (11))

argues that the exceptional magnitude of investment in real property during the post-World-War II period is the main cause of the industrial underdevelopment that characterizes the Greek economy.

According to Petras (1984, p. 51), rentier capital (which includes mainly, investment in housing, hotels, stores and land), (a) "drains capital from productive areas and limits investment in industry and agriculture"; (b) emphasizes income generation through "the non-productive amassing of wealth", and thus lowers productivity; (c) results in the subsumption of industrial and agricultural activity under rentier activity, which means that the financing of these productive sectors will leak into rentier activity. He, therefore, proposed the initiation of "bold new policies that can direct financial resources away from building and toward industrial and productive investment", as a necessary precondition for any sustained effort at industrialization.

The Petras thesis has been attacked by A. Skouras (12), who, by redefining rentier capital to include construction activity only, rejected the implication that investment in housing and construction is directly competitive to investment in industry. He considers more probable that higher investment in housing and construction promotes more investment in industry. His argument is that the high level of housing investment in the post-war Greek economy had a positive effect on the levels of profit in investment

realized by the other sectors of the economy, that is, the high levels of investment in housing promoted rather than retarded industrial investment (see Skouras 1985, p. 11).

The Petras-Skouras argument, therefore, questions the possibility that the high post-World-War II levels of investment in real property have drained capital from productive investment (industry) or, alternatively, has promoted industrial investment. In the present study, however, the issue is of a different nature. Here, I examine the potential of the housing sector in stimulating domestic economic activity. In particular, the purpose of the experiment is to evaluate the effectiveness of policy instruments (such as the volume of the bank credit to housing and the mortgage rate) to meet the government's goals in expanding aggregate expenditure. In this section, dynamic multipliers were derived for a one billion drachma sustained increase in bank credit in housing (BCHC).

The bank credit in housing variable proved to be the policy variable with the second largest effect in both the impact and the long-run (peak value of multiplier) periods, with long-run and impact multipliers for GNPC of 1.21 and 0.70, respectively. This was 78% as effective as government expenditure in the long run, while the impact multiplier was 63% of that of government expenditure.

TABLE 14

BANK CREDIT TO HOUSING MULTIPLIERS

1 bill. drachmas increase in bank credit to housing

YR	PRINHC	GNPC	YD	YDC	GDPC	CONC	TPRINC	PRINMC	M09C&TD	DT	NIT
1	0.62	0.70	0.65	0.63	0.66	0.18	0.63	0.011	0.12	0.032	0.029
2	0.77	0.91	0.89	0.84	0.87	0.28	0.80	0.022	0.16	0.044	0.045
3	0.81	1.02	1.19	0.97	0.96	0.36	0.84	0.031	0.18	0.058	0.067
4	0.82	1.08	1.53	1.01	1.01	0.41	0.86	0.036	0.19	0.075	0.093
5	0.82	1.10	1.75	1.03	1.04	0.44	0.86	0.038	0.20	0.086	0.11
6	0.82	1.13	2.07	1.06	1.06	0.48	0.86	0.037	0.21	0.10	0.14
7	0.82	1.16	2.37	1.09	1.08	0.50	0.86	0.027	0.21	0.12	0.17
8	0.82	1.19	2.72	1.11	1.10	0.53	0.86	0.033	0.22	0.13	0.19
9	0.82	1.20	3.29	1.14	1.12	0.56	0.85	0.030	0.22	0.15	0.24
10	0.82	1.21	3.89	1.11	1.11	0.57	0.85	0.026	0.22	0.19	0.30
11	0.82	1.21	4.64	1.04	1.08	0.56	0.84	0.021	0.22	0.23	0.36

Where, PRINHC is private investment in housing, GNPC is gross national product from the expenditure side, YDC is disposable income, GDPC is gross domestic product, CONC is aggregate consumption, TPRINC is total private investment, PRINMC is private investment in manufacture, M09C is total imports, TD is the trade deficit, all at constant prices, YD is disposable income, DT is direct taxes, and NIT is

indirect taxes, all at current prices.

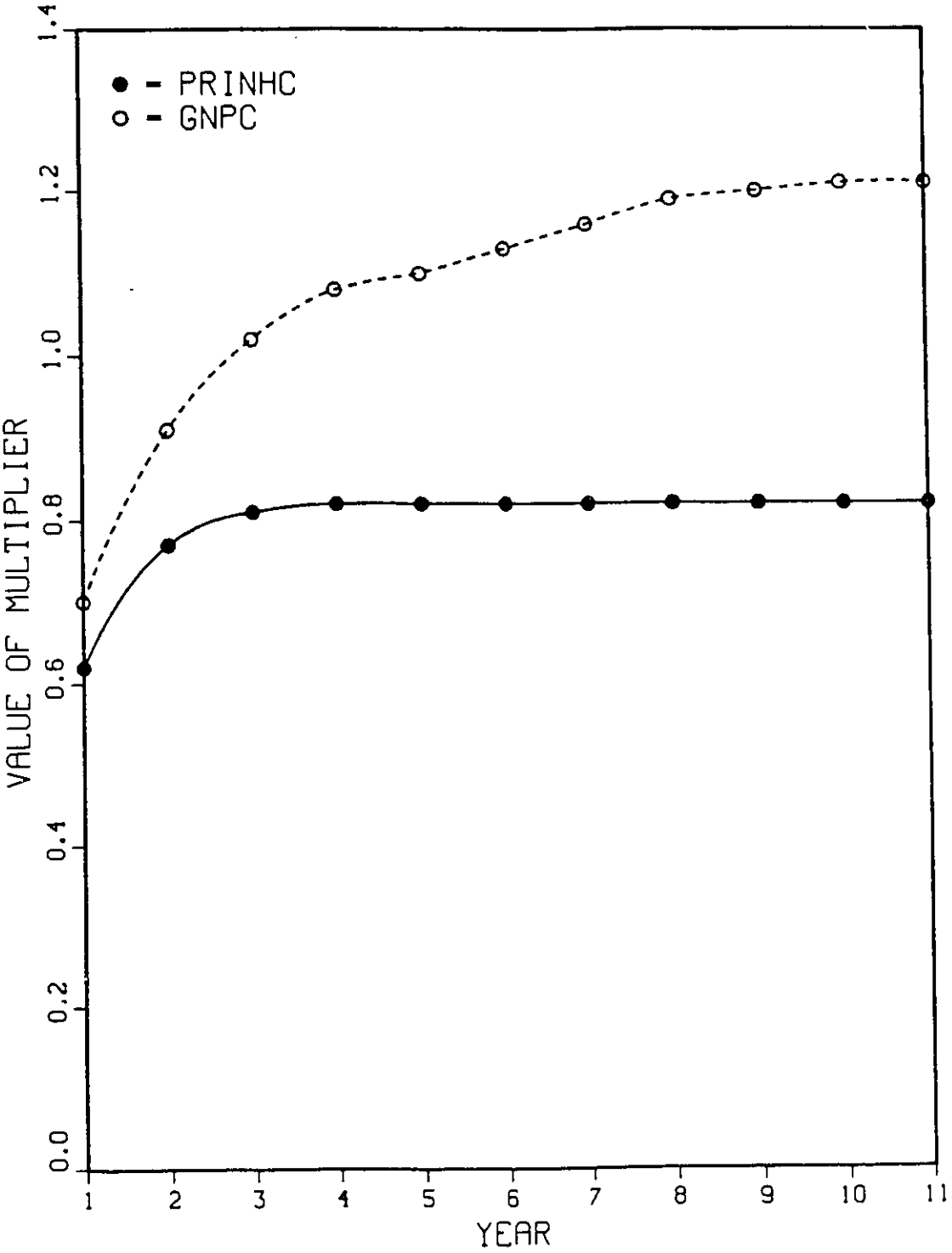
The private investment in housing multiplier reaches its highest value after the fifth period (0.82) and it remains approximately stable thereafter.

The rather large value of BCHC multipliers obtained from this model suggests that this variable is highly effective in stimulating investment and economic activity.

Finally, the pattern of convergence of multipliers before reaching their long-run value is depicted in the Figure below, for two of the model variables (PRINHC and GNPC).

FIGURE 16

CREDIT TO HOUSING MULTIPLIERS



6.6 A Combination of Two Instruments: Bank Credit to Housing and the Mortgage Rate

Stimulating activity in the housing sector has been a frequent policy which has led to fluctuations in the level of investment in this sector (13). It would be interesting to simulate the effect of a policy which is intended to influence housing investment by means of more than one policy instrument. This would suggest a further experiment in which both the bank credit and the mortgage rate are combined to increase the effectiveness of the policy intervention.

The nature of the shock in the experiment performed in this section involves a one billion drachma sustained increase in bank credit to this sector combined with a one percentage point sustained decrease in the mortgage rate for the post-1970 period. Experiment results in the form of dynamic multipliers are given in the table below:

TABLE 15

A COMBINATION OF TWO INSTRUMENTS (BCHC, INTHR)

1 bill. drachma increase in bank credit, combined with a 1% decrease in the mortgage rate

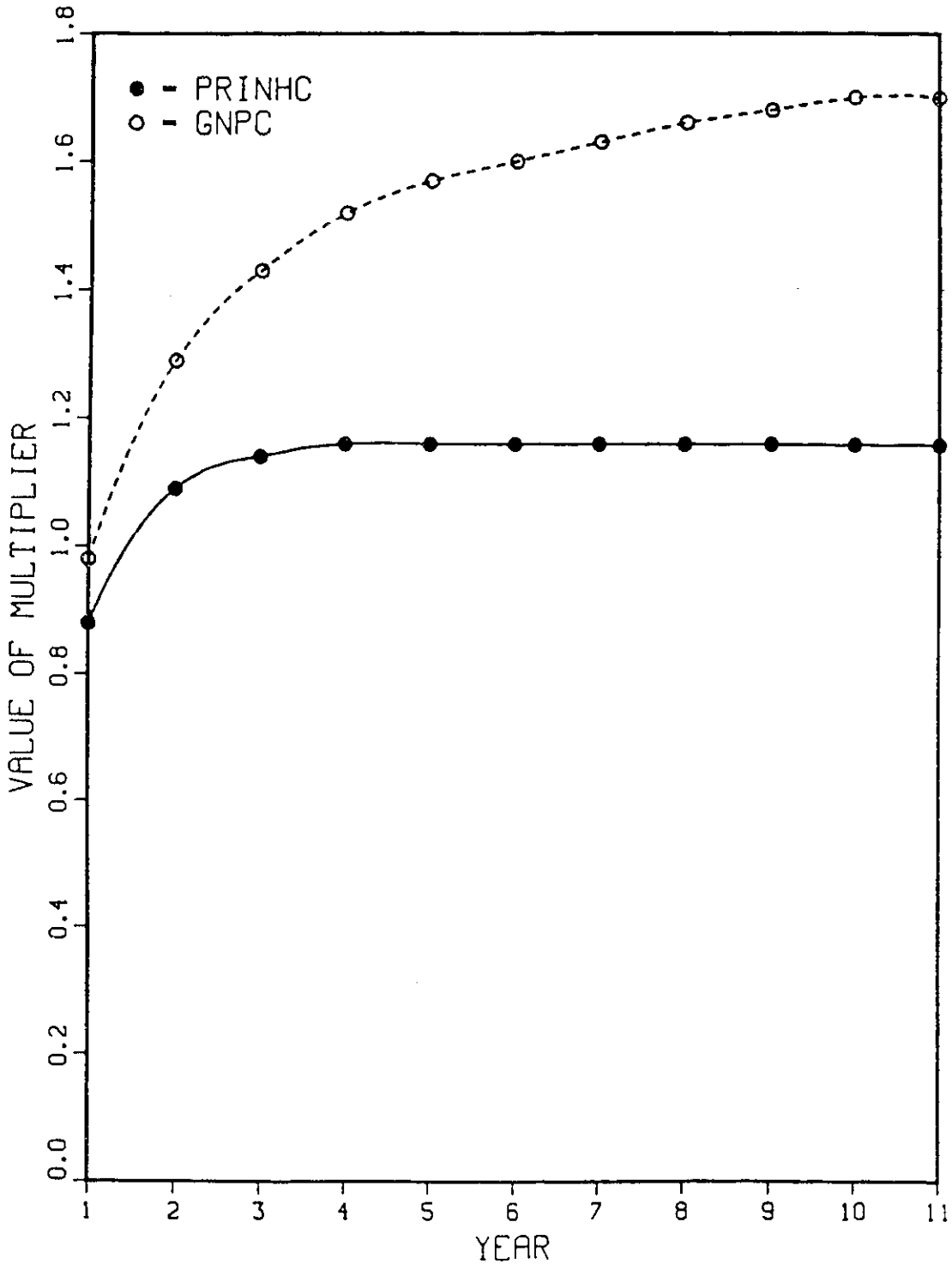
YR	PRINHC	GNPC	GDPC	CONC	TPRINC	PRINMC	M09C&TD	NIT	DT
1	0.88	0.98	0.93	0.25	0.89	0.015	0.17	0.04	0.05
2	1.09	1.29	1.23	0.39	1.12	0.032	0.23	0.06	0.06
3	1.14	1.43	1.36	0.50	1.19	0.044	0.26	0.09	0.08
4	1.16	1.52	1.43	0.58	1.21	0.051	0.27	0.13	0.11
5	1.16	1.57	1.47	0.63	1.21	0.053	0.28	0.16	0.12
6	1.16	1.60	1.50	0.67	1.21	0.053	0.29	0.20	0.14
7	1.16	1.63	1.52	0.71	1.21	0.050	0.30	0.23	0.16
8	1.16	1.66	1.55	0.75	1.21	0.047	0.31	0.27	0.19
9	1.16	1.68	1.58	0.79	1.21	0.043	0.32	0.34	0.23
10	1.16	1.70	1.57	0.80	1.21	0.037	0.31	0.42	0.27
11	1.16	1.70	1.54	0.80	1.21	0.031	0.31	0.51	0.32

All variables have been defined in section 6.5.

The magnitude of multipliers indicates that such a policy would be highly effective in stimulating activity in the housing sector and domestic activity in general, with a long-run PRINHC and GNPC multiplier of 1.16 and 1.7 respectively. The development over time and leveling off pattern of multipliers on the other hand, is similar to that of the previous two experiments.

FIGURE 17

A COMBINATION OF TWO INSTRUMENTS



6.7 Other Bank Credit Multipliers

For purposes of comparison with the bank credit to housing multipliers, two more multipliers were derived. One involves bank credit to the services sector, and the other Agricultural Bank credit. In deriving these two multipliers, the volume of bank credit to each sector was subjected to a one billion drachma sustained increase for the post-1970 period. The multiplier effect on two endogenous variables, the relevant investment vatiable, and GNPC, is given in Table 16 below:

TABLE 16

BANK CREDIT TO SERVICES AND AGRICULTURE MULTIPLIERS

	BCTC		ABCC	
YR	PRINSC	GNPC	PRINAC	GNPC
1	0.36	0.40	0.13	0.14
2	0.36	0.43	0.13	0.15
3	0.36	0.46	0.13	0.16
4	0.36	0.48	0.13	0.17
5	0.36	0.49	0.13	0.17
6	0.35	0.50	0.13	0.17
7	0.35	0.51	0.13	0.18
8	0.35	0.51	0.13	0.18
9	0.35	0.52	0.13	0.18
10	0.35	0.52	0.13	0.18
11	0.35	0.52	0.13	0.18

Where, PRINSC is private investment in serviced, and PRINAC is private investment in agriculture, both at constant prices.

As can be seen, multipliers are much lower than the BCHC multipliers, with long-run values for GNPC of around 0.52 and 0.18 for BCTC and ABCC, respectively, compared to 1.21 for the housing sector.

The policy experiment results thus seem to indicate that: first, looking at the import tariff elasticity results of section 6.2 in association with those from the updated model (following section), a considerable increase in imports should be expected from the gradual elimination of import duties. This gradual elimination should be combined with policies designed to improve the competitiveness of domestic products in the medium term; second, the large foreign activity elasticities (especially those for EX59C and EX09C) indicate that a small open economy such as Greece is vulnerable to changes in world economic activity, such as a world recession; finally, the use of the housing (and construction in general) sector by policy makers as a means of counter-cyclical economic policy seems to be based on the assumed existence of more than one policy instruments at their disposal, and on the strong multiplier effects of expansionary policies directed at this sector.

6.8 Policy Experiment Results Using the Updated Model

All simulations related to the policy experiments described in this chapter were repeated, this time using the updated version of the model (1960-1985). The purpose was to evaluate the stability of results. The new set of results is given in Tables 17 to 21.

A general observation from comparing the two sets of results is that, in the four experiments (tariff elasticities, world activity elasticities, government expenditure multipliers and bank credit to housing multipliers), the results are very similar with one exception, that of tariff elacticities. The change in the coefficients of the relative import price variables in the 1960-1985 model has resulted in higher import tariff elasticities. This is because the updated model includes years both before and after Greece entered the EEC. Years after 1981 are characterized by a significant relaxation of import restrictions (including import tariffs). This policy change has resulted in a change in structural coefficients, and consequently, in different (higher) import tariff elasticities. The values for import tariff elasticities from the 1960-1985 model are -1.04 and -2.09 for M09C and TD respectively (compared to -0.58 and -1.12 of the 1960-1981 model). These, rather high, values of tariff elasticities for total imports and trade deficit indicate that policy makers should be expecting a considerable increase in

imports from the gradual elimination of import duties.

World activity elasticity results are quite similar in the two versions of the model. Here, the largest difference in long-run elasticities is that of EX01C (1.28 compared to 1.51). The peak value of the world activity elasticity of total exports (EX09C) is actually slightly higher than the one which resulted from the 1960-1981 modeld (1.93 compared to 1.82), reinforcing the author's conviction that Greece, being a small open economy, is highly dependent on swings in foreign economic activity.

In the case of government expenditures and bank credit to housing multipliers, the results did not change qualitatively. Some quantitative differences, however, are present in the case of bank credit to housing multipliers (peak values of 0.95 compared to 0.82 for PRINHC and 1.38 compared to 1.21 for GNPC), which are again higher than those from the model estimated over the 1960-1981 sample period. Government expenditure multipliers for GNPC are very similar (1.50 compared to 1.55 for GNPC), which are in turn close to the value of 1.66 obtained by Vernardakis (1978, p. 117).

Finally, multiplier results from the updated model for a policy combination of a one billion drachma increase in the bank credit to housing combined with a one percentage point decrease in the mortgage rate produced a peak multiplier value of almost two (compared to 1.70 in the 1960-1981

sample period). This is a remarkably high value, significantly higher than the peak government expenditure multiplier value of 1.50.

TABLE 17

TARIFF ELASTICITIES OF IMPORTS (1960-1985 MODEL)

effect of a 10% sustained decrease in import duties

YR	M09C	TD	GNPC	GDPC	CONC	TPRINC	PRINMC	NIT
1	-1.04	-1.91	0.24	0.26	0.10	0.030	0.12	0.10
2	-1.03	-2.09	0.25	0.27	0.13	0.048	0.21	0.13
3	-0.84	-1.65	0.25	0.27	0.14	0.057	0.25	0.15
4	-0.72	-1.50	0.25	0.27	0.15	0.083	0.30	0.15
5	-0.77	-1.80	0.26	0.27	0.16	0.080	0.35	0.16
6	-0.72	-1.77	0.25	0.27	0.16	0.076	0.38	0.17
7	-0.66	-1.60	0.24	0.26	0.16	0.069	0.39	0.16
8	-0.63	-1.62	0.23	0.25	0.16	0.064	0.33	0.16
9	-0.53	-1.29	0.22	0.23	0.16	0.058	0.28	0.16
10	-0.48	-1.20	0.21	0.22	0.15	0.057	0.24	0.15

For a definition of these variables, see Table 11.

TABLE 18

WORLD ACTIVITY ELASTICITIES (1960-1985 MODEL)

effect of a 1% sustained increase in foreign activity

YR	EX09C	EX01C	EX24C	EX59C	TD	GNPC	M09C	CONC	TPRINC	PRINMC
1	0.94	0.55	1.21	1.19	-0.56	0.07	0.12	0.03	0.01	0.04
2	1.36	0.85	1.19	1.83	-1.11	0.13	0.14	0.06	0.02	0.09
3	1.61	1.28	1.18	2.14	-1.17	0.17	0.20	0.09	0.03	0.14
4	1.79	1.26	1.18	2.32	-1.35	0.21	0.27	0.11	0.06	0.20
5	1.84	1.25	1.17	2.45	-1.90	0.24	0.28	0.14	0.07	0.30
6	1.89	1.23	1.17	2.48	-1.96	0.26	0.31	0.16	0.07	0.37
7	1.93	1.23	1.16	2.47	-2.00	0.27	0.32	0.17	0.07	0.43
8	1.89	1.22	1.16	2.44	-2.10	0.29	0.33	0.18	0.08	0.41
9	1.88	1.21	1.14	2.39	-1.92	0.30	0.33	0.20	0.08	0.40
10	1.86	1.20	1.14	2.35	-1.97	0.31	0.33	0.21	0.09	0.39

For a definition of these variables, see Table 12.

TABLE 19

GOVERNMENT EXPENDITURE MULTIPLIERS (1960-1985 MODEL)

1 billion drachma sustained increase in gov't expenditure

YR	GNPC	YD	YDC	GDPC	CONC	TPRINC	M09C&TD	DT	NIT
1	1.10	1.00	0.97	1.04	0.30	0.02	0.23	0.06	0.06
2	1.21	1.16	1.09	1.14	0.40	0.04	0.23	0.07	0.08
3	1.28	1.46	1.19	1.20	0.49	0.05	0.26	0.09	0.11
4	1.31	1.81	1.23	1.24	0.54	0.06	0.29	0.11	0.14
5	1.41	2.18	1.27	1.31	0.60	0.06	0.29	0.13	0.18
6	1.43	2.53	1.30	1.32	0.65	0.07	0.29	0.16	0.21
7	1.45	2.88	1.32	1.34	0.68	0.07	0.30	0.18	0.25
8	1.47	3.31	1.35	1.36	0.70	0.06	0.31	0.21	0.29
9	1.49	4.00	1.39	1.38	0.74	0.06	0.31	0.25	0.35
10	1.50	4.76	1.36	1.37	0.76	0.06	0.32	0.30	0.42
11	1.50	5.72	1.33	1.35	0.76	0.05	0.32	0.36	0.52

For a definition of these variables, see Table 13.

TABLE 20

BANK CREDIT TO HOUSING MULTIPLIERS (1960-1985 MODEL)

1 billion drachma sustained increase in bank credit to housing

YR	PRINHC	GNPC	YD	YDC	GDPC	CONC	TPRINC	PRINMC	M09C&TD	DT	NIT
1	0.54	0.58	0.53	0.52	0.55	0.16	0.55	0.01	0.13	0.03	0.03
2	0.77	0.92	0.88	0.82	0.86	0.29	0.80	0.03	0.17	0.05	0.06
3	0.87	1.09	1.24	1.01	1.02	0.32	0.91	0.04	0.22	0.08	0.09
4	0.91	1.16	1.62	1.07	1.08	0.46	0.96	0.05	0.22	0.10	0.12
5	0.93	1.28	2.00	1.17	1.20	0.53	0.99	0.06	0.24	0.12	0.16
6	0.94	1.31	2.34	1.21	1.22	0.58	1.00	0.06	0.27	0.15	0.19
7	0.94	1.33	2.69	1.23	1.24	0.62	1.01	0.06	0.28	0.17	0.23
8	0.95	1.35	3.11	1.26	1.27	0.65	1.01	0.06	0.29	0.19	0.27
9	0.95	1.37	3.76	1.30	1.30	0.69	1.01	0.06	0.29	0.23	0.32
10	0.95	1.38	4.49	1.29	1.29	0.71	1.00	0.06	0.30	0.28	0.40
11	0.95	1.38	5.40	1.25	1.27	0.71	1.00	0.05	0.30	0.34	0.48

For a definition of these variables, see Table 14.

TABLE 21

A COMBINATION OF TWO INSTRUMENTS IN HOUSING (1960-1985)

1 billion drachma increase in bank credit combined with a 1% decrease in the mortgage rate

YR	PRINHC	GNPC	GDPC	CONC	TPRINC	PRINMC	M09C&TD	NIT	DT
1	0.77	0.83	0.79	0.23	0.79	0.02	0.18	0.04	0.05
2	1.10	1.30	1.23	0.41	1.14	0.04	0.25	0.08	0.08
3	1.25	1.55	1.45	0.56	1.30	0.06	0.31	0.11	0.12
4	1.31	1.67	1.56	0.67	1.38	0.07	0.34	0.17	0.14
5	1.33	1.82	1.70	0.76	1.41	0.08	0.36	0.18	0.22
6	1.34	1.87	1.74	0.83	1.43	0.09	0.38	0.21	0.27
7	1.35	1.91	1.78	0.89	1.44	0.09	0.40	0.24	0.33
8	1.35	1.95	1.81	0.93	1.44	0.09	0.41	0.27	0.38
9	1.35	1.96	1.84	0.98	1.44	0.09	0.42	0.33	0.46
10	1.35	1.97	1.85	1.01	1.44	0.08	0.42	0.40	0.57
11	1.35	1.97	1.84	1.02	1.43	0.08	0.43	0.48	0.69

For a definition of these variables, see Table 15.

NOTES

(1) According to the association agreement (1961), the pre-association tariff on all those industrial products which were imported in considerable quantities was to be eliminated over a 22-year period, before Greece became a full member of the community.

(2) See Hitiris, T. and E. Petousis, "Price and Tariff Effects in a Dynamic Specification", Applied Economics, vol. 16, no. 1, 1984, pp. 15-24.

(3) Brisimis, S., "Mechanisms to Discourage Imports and Their Effectiveness in Greece: 1975-1983", in The Greek Economy, vol. 2, edited by the Bank of Greece, Athens, 1984, pp. 110-133.

(4) Brisimis, S., ibid, p. 123.

(5) Magee, S.P., "Prices, Incomes and Foreign Trade", in International Trade and Finance, P. Kenen (ed.), Cambridge University Press, New York, 1975, pp. 175-252.

(6) Kreinin, M.E., "Price vs Tariff Elasticities in International Trade", American Economic Review vol. 57, no. 4, 1967, pp. 891-894.

(7) See Goldberger, A.S., Impact Multipliers and Dynamic Properties of the Klein-Goldberger Model, North Holland, Amsterdam, 1959, pp. 87-96.

(8) See Helliwell, J.F. et al. "Dynamic Properties of four Canadian Macroeconomic Models: A Collaborative Research Project", Canadian Journal of Economics, vol. 12, no. 2, 1979, pp. 133-181.

(9) Program for Economic and Social Development, 1978-82 (a preliminary version), Ministry of Coordination and the Center of Planning and Economic Research (government document), Athens, May 1979, p. 51.

(10) Petras, J., "Greek Rentier Capital: Dynamic Growth and Industrial Underdevelopment", Journal of Hellenic Diaspora, vol. XI, no. 2, 1984, pp. 47-58.

(11) Zolotas, X., Consumption, Investments and Monetary Equilibrium, edited by the Bank of Greece, Athens, 1977 (in Greek).

(12) Skouras, A., "Rentier Capital, Industrial Development, and the Growth of Greek Economy in the Postwar Period: A Response to J. Petras", Journal of Hellenic

Diaspora, vol. XII, no. 1, Spring 1985, pp. 5-15.

(13) Program for Economic and Social Development (1979), op. cit., p. 91.

CHAPTER VII

CONCLUSIONS

The present study dealt with the construction and application of an econometric model for the Greek economy. The economy of Greece is a "less mature" economy in the sense that, although it has made considerable steps in the development process, it is still faced with problems of a long-term, structural nature; and these structural problems and characteristics have to be taken explicitly into consideration when constructing such a model.

The approach followed is a "pragmatic and institutionalized" one, by taking into account the country specific institutional factors and the internal rigidities of the economy.

The model intends to serve specific objectives. Besides the objective of incorporating the structural characteristics and problems of the economic and social life, it: a) pays special attention to sectors which were not adequatly treated in previous models of the Greek economy (including the international and the price sectors); b) emphasizes the relationship between credit availability and private investment, and; c) is geared to specific policy analysis experiments with the use of variables central to the model.

It is a 39-equation model (26 structural and 13 identities), covering the period 1960 to 1981. It is linear in parameters and non-linear in variables and has been estimated by the two-stage least square method using principal components of predetermined variables.

The three consumption equations generally resemble other consumption equations, with consumption depending on disposable income and lagged consumption (representing the "habit persistence" effect). Furthermore, a rural/urban income distribution proxy proved important in the specification of the second equation (CFRFHC), and savings deposits entered the specification of the third equation (HTCROC).

The investment equations differ among themselves, with investment in manufacturing being a function of the capital stock, supply of output, profitability and lagged investment. In the other three investment equations, the central explanatory variable is the relevant bank credit variable, which basically provides the link between the real and the monetary variables in the economy, a role reserved for the interest rate in a Keynesian model.

In the international sector, import equations are a function of a domestic activity variable, relative import prices adjusted for import duties, lagged imports and other factors captured by dummy variables. Export equations are taken to be a function of a "world" activity variable,

lagged exports and dummy variables.

Production equations play an auxiliary role and are estimated with the share of each sector in total production as dependent variable.

The two institutional equations, direct and indirect taxes, depend on national income and private consumption expenditure respectively.

There are 5 price equations and one wage equation (hourly wages in manufacturing). The GDP deflator depends on labour costs, import prices and the prices of agricultural products. Sectoral prices (3 consumption deflators) depend primarily on unit cost mark-up considerations. The deflator for private consumption (PCE) is derived from an identity, as a weighted average of sectoral deflators. Finally, the wages in manufacturing equation is based on a bargaining theory of wage level determination and depends on the private consumption deflator and a dummy variable related to labour union strength.

Model validation took the form of a historical simulation within the estimation period, as well as an ex-post forecast for the years 1982 and 1983. In the historical simulation, the most stringent type of test was employed, that of a complete system dynamic simulation for the complete sample from fixed initial conditions. Prediction errors turned out relatively small and the turning point predictions were

satisfactory.

The post-sample performance of the model was satisfactory, with prediction errors generally increasing with the length of prediction period. Furthermore, as a byproduct of the post-sample simulation results, there is a strong indication that the inability of the manufacturing investment equation to follow the further decline in investment predicted for the period after 1981 related to the political change (in October 1981) and the environment it created.

Policy experiments were conducted, in relation to the international sector of the model, as well as to the importance of the bank credit to investment. In the international sector, one experiment deals with the derivation of dynamic tariff elasticities for a scenario of reducing import duty rates. The results of tariff elasticities suggest that, when the updated model was used (which includes the EEC membership years, 1981 to 1985), the import tariff elasticity for total imports exceeded unity (here the impact elasticity is the peak value of dynamic elasticities). Furthermore, the second period (peak) value of elasticity for the trade deficit was equal to 2.09. These findings semm to be in agreement with other studies for Greece (i.e., Hitiris and Petousis (1984); and Brisimis (1984)).

The other experiment related to the international sector took the form of the estimation of foreign activity elasticities for a 1% sustained increase in the "world" activity variable. Total exports were found to be elastic with respect to the foreign activity variable (peak value 1.93), while the highest elasticity value was for manufactured goods (EX59C, with a peak value of 2.48).

The rest of the experiments took the form of the estimation of dynamic multipliers. Starting with government expenditure, the updated model results suggest long-run values of 1.50 and 1.39 for GNPC and YDC respectively, which close to the values obtained by Vernardakis. This was not the case, though, for total imports for which a long-run value of 0.32 lies between the values obtained by Vernardakis (0.56) and Pavlopoulos (0.19).

The next experiment dealt with the derivation of multipliers for the bank credit to housing variable. The choice of this variable is due to the importance assigned to it by policy makers and its utilization as a means of exercising counter-cyclical economic policy. It was confirmed that the bank credit to housing variable is the policy variable with the second largest effect in both the immediate and the long run, with a long-run multiplier of 1.38 and 1.30 (updated model), for GNPC and YDC respectively. This was 92% as effective as government expenditure. A combination of both policy-controlled

variables in the housing sector (bank credit to housing and the mortgage rate) was found to result in values of multipliers higher than those of government expenditures.

Finally, for purposes of comparison, multipliers for the other two bank credit to investment variables (BCTC and ABC) were obtained. Their magnitude turned out much lower than that of BCHC, with values for GNPC of 0.52 and 0.18 respectively, compared to 1.38 for BCHC.

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APPENDIX I

THE DATA SET

It is a fact that reliable and abundant data are critical to an econometric model. In many studies concerning less developed economies the data series used are of uncertain quality and of limited accessibility. The model builder, though, usually argues that using the available data is the best that can be done. In the case of the model at hand, data problems are less severe despite weaknesses in the availability of data (especially concerning labor series). Kenneth Arrow, in his 1965 study on the statistical requirements for Greek economic planning (Centre of Planning and Economic Research), notes:

> Greece indeed, appears (to this very casual observer's eye) to be unusually capable of handling an increased collection of data. The Statistical Service appears, from its product, to have adequate statistically trained personnel to move further in the direction of thorough coverage of economic intelligence.

In our specific case, data series were obtained from a variety of sources. Most of them have been taken from the appendix to the Bank of Greece publication: The Greek Economy, Research Papers and Data Series. The original source for most of these series is the National Accounts of Greece. In particular, these are the variables related to Consumption, Investment and GDP, as well as GNP, NNI, Direct

and Indirect Taxes, Depreciation, Government expenditure, gov. transfers, and Net Income from abroad.

The data source for Imports and Exports series is the National Statistical Service publication: Statistical Yearbook of Greece. These and related data are also given in the appendix of the Centre of Planning publication: The Determinants of Greece's Commodity Trade.

Variables DRP01, DRP24, DRP59 and DRP09 were constructed with the use of data on Import duties, which were taken from the Statistical Yearbook of Public Finance, as well as the Quarterly Bulletin of Public Finance Statistics.

The foreign economic activity series, WC and WY, were obtained from the OECD Publications: National Accounts of OECD countries, and Economic Outlook, while the OECD publication: Main Economic Indicators, was the source for the variable WIIP.

Finally, the capital stock, capacity utilization ratio and depreciation in manufacturing series (CSMC, CUR and DMC respectively), were obtained from the OECD publication: OECD Surveys, Annual Review of Greece, various issues.

A more complete description of all these data series can be found in pages 113 to 118 above.

YR	CFRFHC	CONC	CSMC	DC	DT	EX01C
1960	31149	108744	22567	7527	2682	4130
1961	33376	116529	24096	7947	3129	4997
1962	35988	121826	26058	8515	3095	4819
1963	39106	128463	27909	9185	3361	5434
1964	42413	138954	30718	10014	3914	5804
1965	46764	149849	34554	10940	3814	6509
1966	48458	160958	37711	11905	4883	7463
1967	51975	170287	40628	12920	5727	8317
1968	57045	181475	44384	13998	6543	6915
1969	61855	193291	48919	15429	7672	7383
1970	71312	210036	54598	16860	8930	7789
1971	77625	223890	60978	18440	10840	8216
1972	84567	240027	68807	20200	10509	10010
1973	92734	259064	77234	22378	13507	8079
1974	92256	257298	85461	23889	19528	9107
1975	98662	272947	91347	25195	18261	10863
1976	105253	289995	96843	26700	22860	12823
1977	109177	304122	101103	28270	30940	12294
1978	113660	323977	104923	29990	38748	14266
1979	118314	331016	109335	31976	52770	14000
1980	115996	330995	114250	33717	74162	14500
1981	116760	335700	117850	35000	74820	16000
1982	115457	340660	118146	36752	118400	17000
1983	114000	341200	118002	37896	138170	15364
1984	115219	350150	117500	38780	181850	17292
1985	118910	361100	117000	39795	202500	16300

DT is in millions of current drachmas.
All other variables are in millions of 1970 drachmas.

YR	EX24C	EX3C	EX59C	EX09C	FBTC	GDPAC	GDPMC
1960	2031	1	619	6781	54245	29863	20001
1961	2112	1	791	7901	58628	37836	21554
1962	2885	22	979	8705	59735	32888	22633
1963	2481	23	891	8829	62099	39594	24538
1964	2490	17	1165	9476	65352	39446	27566
1965	2235	4	1526	10274	70242	43377	30424
1966	2636	111	2177	12387	74676	43687	33085
1967	3561	154	3312	15344	78502	44311	35760
1968	3483	183	4079	14660	81195	40484	40140
1969	3060	163	6465	17071	84612	43085	45964
1970	3406	192	7889	19276	87322	47058	52807
1971	3626	160	7794	19796	89801	48662	58617
1972	3407	296	11800	25513	93596	51543	63387
1973	4078	2536	16787	31480	99494	51204	74310
1974	3701	1227	20349	34384	100733	53672	72040
1975	3695	1863	21496	37917	103980	56733	75829
1976	4140	1500	25536	44079	108022	55971	83271
1977	3672	776	26063	42805	110200	51830	84940
1978	5193	1137	28191	48787	118100	57214	90064
1979	5600	1500	29000	50100	119770	53616	95327
1980	5300	1700	32000	54800	121713	60499	95340
1981	3350	819	36106	52193	125180	59516	93791
1982	4131	1149	32504	50500	128400	60940	90076
1983	6875	912	38386	61537	130459	55518	88987
1984	6860	1639	43517	69308	132193	59394	90916
1985	5630	2200	45950	70080	132210	60133	92120

All variables are in millions of 1970 drachmas.

YR	GDPSC	GDPC	GDPDE	GNPC	HTCROC	M01C
1960	65932	129201	0.72155	145458	23350	3120
1961	70078	143772	0.72977	161802	24525	3588
1962	74220	144612	0.76693	164674	26103	3347
1963	79199	159171	0.77569	181534	27258	4108
1964	85584	171177	0.81010	196586	31189	4173
1965	92585	187009	0.84464	214922	32843	5375
1966	99453	197011	0.88731	228040	37824	5566
1967	105031	206176	0.91386	240791	39810	5850
1968	111972	217895	0.92995	257226	43235	5934
1969	120177	238201	0.96135	282168	46824	6571
1970	129966	258000	1.00000	304420	51402	5747
1971	139087	278551	1.03185	327723	56464	6592
1972	150475	303973	1.08555	356886	61864	5748
1973	163698	329269	1.30051	383916	66836	7646
1974	167927	323307	1.56918	369325	64309	7406
1975	175528	339833	1.74551	390000	70305	6646
1976	186828	360399	2.02202	415491	76720	6969
1977	195968	371022	2.27649	431164	84745	7140
1978	206618	394803	2.57523	458675	92217	8404
1979	216612	409099	3.04419	476072	92932	10400
1980	221374	417510	3.64955	485108	93286	8230
1981	225378	418271	4.45781	482503	93760	8011
1982	229313	420641	5.49040	479407	96783	10799
1983	236218	422351	6.51708	476704	96740	11318
1984	243088	434726	7.70000	486495	102918	12267
1985	251259	448710	9.15000	492700	109980	14400

Variables GDPSC, GDPC, GNPC, HTCROC, and M01C are in millions of 1970 drachmas, while GDPDE is a price index.

YR	M24C	M3C	M59C	M09C	NIT	NNI
1960	1924	1412	11986	16564	11942	89853
1961	2069	1465	13701	18928	13716	101560
1962	2068	1554	13782	20305	15098	106784
1963	2621	1968	15697	23767	17247	119089
1964	2603	1716	18576	26363	19328	133887
1965	3615	2712	21767	32432	21809	152457
1966	3824	2696	22132	33639	25178	168224
1967	3650	2995	23320	34846	27681	181051
1968	4196	2913	26120	37823	31876	194773
1969	4985	3415	29247	42683	37465	219677
1970	5341	4040	31455	46582	40917	246643
1971	5670	4195	33317	49832	42878	275664
1972	6127	5629	39577	57186	47749	315816
1973	7558	7964	48797	72076	55935	410735
1974	6287	7425	44313	65930	56877	485912
1975	6608	7589	43182	64152	78977	564911
1976	7062	7442	47388	69035	96197	694477
1977	7253	5933	52248	73311	119100	802477
1978	7353	7755	53099	77096	144683	959680
1979	7300	8800	56550	83850	183570	1176297
1980	7500	6880	56200	78800	187210	1438261
1981	7415	5076	66500	87038	190086	1740251
1982	9003	6471	68650	94552	263964	2130702
1983	9595	6737	71350	98263	345934	2463910
1984	8755	7131	76000	104119	452058	2990382
1985	9884	8500	82000	115000	551500	3589187

Variables NIT and NNI are in millions of current drachmas, while all other variables are in millions of 1970 drachmas.

YR	PFBT	PCFRFH	PHTCRO	PCE	PRINAC	PRINHC
1960	0.75749	0.87399	0.72934	0.78482	2758	8259
1961	0.76392	0.87898	0.74744	0.79341	2534	8929
1962	0.77216	0.87999	0.76934	0.80341	2089	10173
1963	0.81006	0.88899	0.78792	0.82939	2462	11105
1964	0.83367	0.89800	0.80974	0.84794	3386	13503
1965	0.88767	0.90801	0.85294	0.88641	4029	15277
1966	0.92639	0.94199	0.86667	0.91705	3312	15255
1967	0.95071	0.96500	0.86164	0.93425	4172	13615
1968	0.94086	0.97600	0.89657	0.94135	4861	19109
1969	0.97785	0.98700	0.93059	0.96933	4571	22839
1970	1.00000	1.00000	1.00000	1.00000	4055	19443
1971	1.05204	1.00858	1.02063	1.02905	4504	22943
1972	1.09321	1.03387	1.06671	1.06547	4816	29290
1973	1.31346	1.15019	1.20028	1.22582	5691	30228
1974	1.61786	1.38034	1.54907	1.51550	4362	15679
1975	1.83227	1.52434	1.79657	1.71176	5024	20182
1976	2.10333	1.70497	2.05168	1.94508	4938	21597
1977	2.34417	1.90685	2.31105	2.17795	5657	26160
1978	2.63005	2.15750	2.58874	2.45251	4785	29834
1979	3.14371	2.51441	3.01229	2.88188	5237	31248
1980	3.89153	2.97346	3.59909	3.48738	4112	26929
1981	4.86913	3.63482	4.41580	4.31265	3730	20824
1982	5.80279	4.43627	5.32744	5.20401	3562	19613
1983	6.71260	5.26022	6.33044	6.14825	3590	20524
1984	7.96564	6.27469	7.44559	7.26000	4988	15605
1985	9.43401	7.56632	8.86534	8.61000	4845	16502

Variables PRINAC and PRINHC are in millions of 1970 drachmas, while all other variables are price indices.

YR	PRINMC	PRINSC	TD	TPRINC	TINVC	WM	YD
1960	2524	5369	-9783	18910	28767	7.0	89806
1961	2595	5499	-11027	19557	31330	7.5	100437
1962	3222	6527	-11600	22011	33923	8.0	105819
1963	3878	6995	-14938	24440	35879	8.4	118758
1964	5638	8129	-16887	30656	43275	9.3	133291
1965	7398	8188	-22158	34892	48823	10.1	153727
1966	7042	10810	-21252	36419	50376	11.4	168411
1967	6583	9768	-19502	34138	49593	12.7	181596
1968	7787	11995	-23163	43752	60286	13.7	194669
1969	9040	14529	-25612	50979	71541	15.1	217825
1970	11083	16059	-27306	50640	70566	16.0	244773
1971	12810	14654	-30036	54911	80357	17.4	274019
1972	14254	15591	-31673	63951	92806	18.9	314320
1973	15601	20362	-40596	71882	99788	22.0	408018
1974	16134	15836	-31546	52011	74300	27.9	481960
1975	14160	14113	-26235	53479	74437	34.7	565163
1976	14152	17413	-24956	58100	79470	44.7	681833
1977	13279	21231	-30506	66327	85527	54.0	798396
1978	12312	23311	-28309	70242	90742	66.7	952613
1979	15000	24575	-33750	76060	98794	80.5	1169233
1980	18420	21004	-24000	70465	92705	102.4	1423418
1981	18503	20448	-34845	63505	85760	130.2	1726135
1982	16100	22829	-44052	62104	85904	173.9	2133128
1983	14831	18830	-36726	57775	84475	207.6	2447912
1984	14900	14585	-34811	50078	79808	262.2	2983037
1985	14000	16226	-44920	51573	82933	310.7	3631887

Variables PRINMC, PRINSC, TPRINC, TINVC, and TD are in millions of 1970 drachmas, while YD is in millions of current drachmas and WM is an index.

YR	ABCC	BCHC	BCTC	CURL	DDE	DEPT
1960	13126.8	1981.0	5779.2	0.760	0.70692	10835
1961	14228.8	2262.7	6033.4	0.769	0.72291	12863
1962	13259.6	2463.0	7609.7	0.746	0.78967	15526
1963	15100.1	2868.7	9131.5	0.755	0.79695	19824
1964	18044.2	3616.1	9983.8	0.775	0.81226	22768
1965	21577.8	4140.0	9978.3	0.758	0.83446	25320
1966	22168.0	4872.6	10602.9	0.756	0.88064	31904
1967	23174.1	6846.8	11078.6	0.764	0.90402	35140
1968	23682.2	11077.6	11995.0	0.783	0.92163	46646
1969	26225.9	15461.7	13999.7	0.815	0.93007	56012
1970	27603.0	17581.0	14890.0	0.850	1.00000	69609
1971	31837.5	21737.1	16860.7	0.842	1.06480	87532
1972	35657.1	25261.6	17416.2	0.801	1.17515	106694
1973	36380.4	23427.4	18298.9	0.844	1.36590	116481
1974	36254.8	18921.3	16847.6	0.728	1.64444	141518
1975	38782.5	19950.7	18617.7	0.718	1.88359	188984
1976	41494.0	20056.6	21183.3	0.748	2.21723	239661
1977	47596.1	20597.0	23354.9	0.725	2.56208	302742
1978	48505.8	21069.1	24276.8	0.746	2.98333	380421
1979	47046.3	20290.1	22638.7	0.740	3.51157	446316
1980	45716.1	20080.0	21040.7	0.740	4.20826	541231
1981	50467.0	21521.0	21707.6	0.740	4.94543	747642
1982	55438.0	22800.0	21648.0	0.730	5.86088	968630
1983	56848.0	23000.0	18461.0	0.720	7.19372	1167315
1984	56888.0	22500.0	18152.0	0.710	8.4903	1542619
1985	56000.0	24000.0	17500.0	0.700	10.1156	1928000

Variables CURL and DDE are indices, variable DEPT is in millions of current drachmas, while all other variables are in millions of 1970 drachmas.

YR	DMC	DRP01	DRP24	DRP58	DRPM	DSC
1960	.	1.14	1.60	1.12	1.59	-814
1961	1066	1.16	1.59	1.12	1.54	3072
1962	1260	1.15	1.50	1.23	1.46	769
1963	2027	1.13	1.41	1.22	1.42	3354
1964	2829	1.25	1.37	1.20	1.39	7103
1965	3562	1.15	1.33	1.18	1.33	8837
1966	3885	1.14	1.32	1.20	1.31	2615
1967	3666	1.17	1.23	1.20	1.28	4572
1968	4031	1.18	1.17	1.21	1.25	-243
1969	4505	1.09	1.11	1.18	1.20	3742
1970	5404	1.22	1.15	1.20	1.19	13346
1971	6430	1.27	1.02	1.21	1.18	8715
1972	6425	1.47	1.06	1.25	1.22	6487
1973	7174	1.56	1.08	1.21	1.19	26510
1974	7907	1.56	1.30	1.06	1.39	22550
1975	8274	1.65	1.24	1.15	1.50	21100
1976	8656	1.56	1.12	1.17	1.44	18030
1977	9019	1.47	1.10	1.16	1.34	12930
1978	8492	1.38	0.96	1.19	1.33	15740
1979	10588	1.28	1.01	1.13	1.34	18200
1980	13505	1.46	1.03	1.04	1.50	19280
1981	14903	1.70	0.88	1.00	1.42	10305
1982	15804	1.64	0.76	0.99	1.43	9420
1983	14975	1.71	0.80	0.98	1.46	3420
1984	15402	1.67	0.88	1.00	1.50	9150
1985	14500	1.48	0.90	0.91	1.50	6700

Variables DMC and DSC are in millions of 1970 drachmas, while all other variables are import price indices.

YR	ERC	GC	GDPADE	GDPMDE	GDPSDE	GDPRC
1960	-4997	30359	0.71292	0.81526	0.72714	13405
1961	-2643	33177	0.70840	0.81331	0.74458	14304
1962	-5942	34744	0.79862	0.82442	0.76248	14871
1963	1721	35224	0.77444	0.83593	0.78247	15840
1964	-4133	38624	0.84607	0.85566	0.80905	18581
1965	-1359	42267	0.89073	0.88397	0.84007	20623
1966	-1499	44068	0.94632	0.91812	0.87258	20786
1967	-1200	48116	0.95895	0.93308	0.90737	21074
1968	1233	49634	0.97737	0.93176	0.92633	25299
1969	882	56201	1.00070	0.95903	0.96281	28975
1970	-3714	57668	1.00000	1.00000	1.00000	28169
1971	-270	65053	1.07546	1.02003	1.03094	32185
1972	2095	70706	1.19254	1.05468	1.07532	38568
1973	-7693	72604	1.70516	1.24072	1.21479	40057
1974	-12043	72385	1.86997	1.51798	1.49932	29668
1975	-9125	77033	1.95602	1.66873	1.72821	31743
1976	-7453	80323	2.43347	1.88695	1.97915	34329
1977	-5420	82000	2.73091	2.09581	2.24186	38284
1978	-8667	85500	3.09494	2.28204	2.54929	40907
1979	-10019	91534	3.69602	2.70369	2.98113	43544
1980	-7921	91180	4.46384	3.36495	3.51331	40301
1981	-5057	95895	5.53271	4.16173	4.29035	38849
1982	-1179	99130	6.96447	5.03991	5.27781	37722
1983	1391	104400	8.33550	6.12641	6.12342	39487
1984	-14792	110120	9.99130	7.39040	7.25797	39719
1985	-9313	113560	11.64480	8.72015	8.59392	41718

Variables GDPADE, GDPMDE, and GDPSDE are price deflators.
All other variables are in millions of 1970 drachmas.

YR	GNPDE	GTR	INPD	INTHR	LMM	LMRA
1960	0.74	5964	200	8.5	206000	8.00
1961	0.75	6399	229	8.0	211000	8.00
1962	0.78	7609	331	1.5	216000	8.12
1963	0.79	8964	450	8.0	223368	8.85
1964	0.82	10448	663	6.5	228677	8.83
1965	0.85	12631	1242	2.5	239877	9.19
1966	0.89	14772	1226	-2.5	248196	8.90
1967	0.91	17373	1289	6.0	244692	9.04
1968	0.93	19712	1583	7.5	239887	8.37
1969	0.96	21379	1852	4.0	246716	8.34
1970	1.00	23816	2345	-2.5	270750	7.77
1971	1.03	26437	2616	7.5	286783	8.06
1972	1.08	28634	3216	-1.5	301408	7.58
1973	1.29	32911	3739	-15.0	325307	7.78
1974	1.58	40325	5041	-18.5	354222	7.54
1975	1.77	49935	6882	4.0	359333	8.10
1976	2.04	63697	9773	- 7.0	380923	7.68
1977	2.30	82060	11277	-11.5	386107	7.89
1978	2.60	106864	16285	-13.5	391625	7.66
1979	3.09	125930	26747	-14.5	396731	8.10
1980	3.66	158358	34033	-4.5	404849	7.53
1981	4.40	207500	41561	3.5	411000	7.38
1982	5.41	317674	47201	3.9	418000	7.30
1983	6.47	389740	70575	0.2	425000	8.10
1984	7.75	502000	113239	1.1	426000	7.30
1985	9.12	645000	162000	-0.4	427000	7.40

GNPDE is the deflator of GNP, GTR and INPD are in millions of current drachmas, INTHR is the mortgage rate, LM is the mumber of workers in manufacture, and LMRA is the lagged moving average of marriages.

YR	N	NESC	NIFAC	PM	PRTAX	PROF	PROFR
1960	8.39	1382	2071	0.93	865	7580	23.7
1961	8.42	2419	2428	0.91	1047	8597	21.8
1962	8.45	2562	2856	0.91	1232	8482	24.6
1963	8.48	3635	3314	0.90	1337	8195	25.4
1964	8.51	792	3648	0.93	1605	8619	26.0
1965	8.55	1418	3862	0.95	1719	11109	26.6
1966	8.61	6739	4107	0.96	2115	13288	26.6
1967	8.72	6063	4584	0.95	2389	13117	26.9
1968	8.74	3220	5277	0.96	3333	13993	28.9
1969	8.77	1804	5277	0.96	3879	18401	33.1
1970	8.79	2298	5503	1.00	3974	21297	34.6
1971	8.83	4383	7525	1.04	4779	19907	35.1
1972	8.89	4985	8255	1.13	5534	20591	32.3
1973	8.93	1092	9756	1.35	6802	36956	35.4
1974	8.96	5322	8778	1.95	9800	38969	29.1
1975	9.05	22229	7638	2.33	10512	23163	24.2
1976	9.17	3573	8812	2.60	24142	31328	24.1
1977	9.31	2361	10542	2.72	16117	24681	23.6
1978	9.43	3078	9882	3.02	23292	36305	32.5
1979	9.55	7824	10693	3.85	26788	40101	33.8
1980	9.64	12981	11598	4.94	32346	41031	33.8
1981	9.70	17000	10488	6.47	38605	41442	32.2
1982	9.76	13700	8238	7.47	54836	40500	30.6
1983	9.81	6000	3747	9.06	63551	40000	30.1
1984	9.90	16600	185	11.23	70602	39500	29.6
1985	9.94	14000	-3753	13.85	78000	39000	29.1

PRTAX and PROF are in millions of current drachmas, NESC and NIFAC is in millions of 1970 drachmas, N is the population of Greece, in millions, PM is the deflator of imports, and PROFR is the rate of profit in manufacturing.

YR	SGDPCR4	SSC	TRFA	WC	WIIP	WPAG
1960	0.250	4613	3000	23500000	58.2	0.67
1961	0.250	5959	3240	24730500	60.6	0.66
1962	0.245	7179	5250	25993800	64.1	0.76
1963	0.243	7989	5430	27266400	67.6	0.74
1964	0.242	9538	5520	28737980	72.3	0.81
1965	0.235	10700	6210	30216900	77.0	0.86
1966	0.233	12711	7050	31686000	83.1	0.91
1967	0.225	14316	6960	32903400	85.1	0.94
1968	0.214	16565	7170	34598100	91.2	0.94
1969	0.200	18564	8250	36258300	97.3	1.01
1970	0.191	20630	10337	37614900	100.0	1.00
1971	0.181	22956	14070	39293700	102.0	1.00
1972	0.177	26880	17160	41650800	108.0	1.09
1973	0.171	32143	21960	43814700	119.0	1.41
1974	0.167	37858	19260	44077500	120.0	1.94
1975	0.165	46999	23676	45115800	110.0	2.03
1976	0.161	64054	29264	47228100	120.0	2.46
1977	0.157	80640	34003	48750000	124.4	2.90
1978	0.152	100617	35796	50550000	129.9	3.27
1979	0.143	123898	42826	52209743	135.4	3.85
1980	0.140	158313	45841	52715057	135.4	4.63
1981	0.141	208350	60317	53292558	136.5	5.27
1982	0.141	247000	70153	54358400	137.0	6.42
1983	0.143	305000	82428	55445600	138.0	7.41
1984	0.142	372000	103890	56554500	139.0	8.91
1985	0.142	450000	110299	56600000	140.0	10.49

WIIP and WPAG are indices, SSC and TRFA are in millions of current drachmas, WC is in millions of 1970 drachmas, and SGDPCR4 is the four-year moving average of gross national product in agriculture.

	WY
1960	39000000
1961	40723200
1962	42900300
1963	44924700
1964	47631600
1965	50182800
1966	52909500
1967	54867000
1968	57849600
1969	60546000
1970	62370600
1971	64737000
1972	68312100
1973	72465600
1974	72633000
1975	72262200
1976	76042200
1977	78780000
1978	81690000
1979	84222000
1980	85233000
1981	86597000
1982	88502000
1983	90449000
1984	92258000
1985	93200000

WY is in millions of 1970 drachmas.