AN EXPERIMENTAL MEDIUM-TERM MODEL FOR GREECE

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Introduction

The scope of this study is a real experiment in medium - term model - building for the Greek economy. Models of this kind have been developed for the Netherlands ( ).

As far as the Greek Economy is concerned econometric studies of short - term character (annual forecasting models) have been published (2).

In the case of medium or long - term macro - models regarding the Greek economy some works have already appeared in print when this exercise in model - building was beginning (3).

The first medium - term plan was published in 1950 setting up the following objectives (4):

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1. Central Planning Bureau : The Netherlands economic growth potential explored 1950 — 70, Hague 1955.

J. Sandee : An experimental phased sector — model for the Netherlands, June 1965.

Central Planning Bureau : A medium — term macro — model for the Netherlands, June 1965.

2. P. Pavlopoulos : Econometric model for the Greek Economy, in Bulletin of Economic Information, July and August, 1962.

D.B. Suits : An Econometric model of the Greek Economy, Center of Economic Research, Athens, 1964.

3. A.G. Papandreou : Strategy of Economic Development of Greece, Center of Economic Research, Athens, 1962.

Greek Society of Programming : The general outline, of the first long — term (1960 — 70) program of Greece, Athens, 1959.

Ministry of Coordination : Five year plans of Greece, Athens, 1959.

4. A.G. Papandreou : op. cit. p. 19.

a. Re-establishment of fiscal, monetary and credit system of the country

b. The full utilization of natural resources

c. A high possible level of employment

d. The stability or the increase of living standard of people and

e. The balance of payment equilibrium.

Generally speaking the plans of Greece, apart from those of short-term character mentioned, were of medium or long-term.

In those plans a certain breakdown of the economic activity in sectors has been done. But this does not change the character of the planning in Greece, which is of aggregate-model character with no distinction in sectors and especially that of Harrod-Domar's model (5). The appoach of sector-model analysis has not been applied yet in the real sense of the word, because the needed detailed input-output tables and other data needed have not been published yet. Nor the more sophisticated approach of inter-industry models — the linear programming techniques — has been applied in planning.

1. The Present Model

1.1. Introductory

Building up, estimating and testing the model the reader must keep in mind the shortness of the time within which this model should be finished. This has to a large extent to do with the effort to make the model both simple and good enough for projection purposes. Therefore, I did neither test the model nor apply other more scientific advanced methods (except the O.L.S.) in estimating the parameters of some equations and testing the model again.

Briefly, I could say: having specified the reaction equations I applied in a number of alternatives the Ordinary Least Squares (O.L.S.) method throughout the model (6). I have chosen the most acceptable variables and equations and I completed the model by setting up the necessary definition equations. The model was in a non-linear form so, for making projection I should linearize it. Afterwards having the inverce of the matrix-coefficients and the projected values of the exogenous variables I got the outcome of the model. Finally I found some variations of the model, i.e. the influences of some changes in predetermined and / or exogenous variables on some endogenous variables.

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5. According to prof. Chever's distinction can be characterized as a capital — centred growth model.

6. This does not alter the fact, however, that in some cases values of coefficients had to be fixed a priori.

1.2. General outline of the model

The present model is one of the demand and supply - type. The whole model is characterized by a severe simplification. It should be constructed in a short time with limited data. It refers to 1967 — the year of projection — and takes 1962 as the base year. Developments between these two years are assumed to be characterized, in general, by constant rates of change.

The starting point was to leave out the government sector, i.e. to make a model of the private sector only.

The model is consisted by 29 equations with 29 endogenous variables as so many unknowns. The main exogenous variables are the volume of world trade, import prices and world trade prices. Only 11 of these equations are reaction equations; the remaining 18 equations represent relationships that, logically or «per definition», exist between the several variables. Of the reaction equations the first set refers to the demand side of the model, which is consisted by the following expenditure components :

a) consumption expenditure

b) investment expenditure and

c) exports of goods and services

The consumption has been distinguished in private and governmental; the latter has been taken as exogenous for the model. The second component of demand, distinguished in private and governmental as well as in agriculture and non - agriculture, has been taken in fixed assets only; the stock formation has been taken as exogenous variable. The value of investment in agricultural sector as well as the volumes of govermnent investments in both sectors have been taken as exogenously determined.

All the variables have been introduced as aggregates, without any breakdown in their main components.

The second set represents the supply side of the model which stands with the following components :

a) domestic production and

b) imports of goods and services

The first component has been distinguished in agricultural and non - agricultural production. The agricultural production was taken as exogenous.

Here also none breakdown has been made for simplicity's sake, though its great importance for some key - variables of the Greek economy. For instance, the imports as well as the exports play an important rôle for the economy concerned. So a breakdown of goods in consumption goods, investment goods and raw materials would be necessary, especially for imports, in order to arrive at a more reliable estimate of the price elasticities involved, if the partial import prices could be introduced in the price equations.

The absence of a satisfactory serie for employment was the cause of leaving out of the model the labour as exogenous. Thus the use of the existing bad serie of employment figures was eliminated in the determination of wage rate and labour productivity.

Building up the model the problem of equilibrating the model appears. There should be some mechanism to equilibrate the volumes of demand and supply. Therefore I can introduce a variable, called *dummy*, in one or some of the equations in order to play the rôle of *equilibrium-maker* in the model.

Such equations could be chosen either the price equations or import or export equations or, finally, could be used the government expenditures mechanism.

My first thought was to use the market mechanism, working through the price equations. But difficulties arose from the view point of having the precise capacity - variable with the appropriate variations for each equation.

Finally the decision has been made to use the import equation, introducing in it a policy variable, which can be called *refusal to import*. The refusal to import can take two main forms :

a) quantitative restrictions and

b) custom duties.

The latter was negligible for the direct application in the model, because of the unacceptable results in the regression analysis. Thus the *credits*, given for imports have been used as a quantitative policy variable for stabilizing the model (7).

The third set deals with the price - formation:

a) money wage rate

b) consumption prices

c) investment prices and

d) export prices

The consumption prices are assumed to be the same for the government

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7. This means that when the demand ($c_p + c_g + i^p_{na} + i^p_a + i^g_{na} + i^g_a + b + n$) exceeds the supply ($y + m$) the policy — makers remove the quantitative restrictions in favour of the importers, giving to them more credit — facilities and so increasing the imports and finally equilibrating the demand and supply; when the demand is lower than the supply the policy — makers work in a opposite direction than the first case. Here, in the mechanism of equilibrating the model through imports, appears again the necessity of breakingdown the imports and domestic production into their main components. That means the policy — makers could know for which goods should put (remove) the restrictions and at the same time for which goods remove (put) the restrictions. Stated in other words : to know the partial (particular) excess or surplus of the demand against the supply.

consumption expenditures as well as the investment prices are assumed to be the same for both private investment in agriculture and government investment expenditure (agriculture and non - agriculture).

The last reaction - equations represent the direct and indirect taxes.

Volumes and values have been used and the units used were absolute figures and indices. The coefficient of variables appear throughout the model are either marginal propensities or elasticities.

The above is the general line of thought underlying the model, which is given on the appendix I and II.

The meaning of symbols appear from the appendix III.

1.3. Individual equations

Many difficulties arise to the model - builder in the construction of a model and particularly in building up a model for an underdeveloped or developing country like Greece.

There are little prewar data and the severe disruption of Greece during the postwar period makes information for years as late as 1950 of questionable value. The serious restrictions in foreign trade that persisted till the devaluation of 1953 and in 1958 / 59 later on shorten many of the available series even further.

A second serious problem lies in the fact that, over the sample period the entire Greek economy was characterized by a rapid and well sustained rate of growth. The resulting inter - correlation among the various time series is even more severe than usually.

The difficulties described above give the time - series data the character of poorness. And the poorest of all were the figures of employment (8).

Under these circumstances it is especially of a great importance to examine here the results of some formulations of the most acceptable equations and those of the equations chosen from among a number of alternative results to form the final model.

In all of the equations has been applied the Ordinary Least Squares method (O.L.S.) of estimation of the parameters.

In some cases it was necessary to fix a priori one of the coefficients in order to arrive at the final form of the equation.

1.3.1. Private consumption expenditure

Several theoretical approaches have been formulate in order to study the causes and the nature of consumer demand, the factors which affect it etc. These approaches vary widely in scope and content and can be reached in, more of less, two ways:

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8. There was working population census for 1951 and 1961 only and a true — serie of employment in manufacturing sector (including electricity), of which combination has been made use.

a) Taking the consumer as individual unit and examining his behaviour both theoretically by the marginal utility theory and practically by the analysis of household surveys and

b) Taking the consumer units totally and examining the aggregate consumption and its role in the economy.

In the model, use and combination of most of the determinants of consumer behaviour has been made in a number of alternative equations for the explanation of private consumption expenditure.

A great effort has been done for a distinction of disposable income into the three main groups of earners i.e. farm, wages and salaries and non farm - non wages disposable income. But the possibility for any success was very limited.

Finally, use has been made of total disposable income.

Among of some equations the following one has been chosen as preferable to serve the model

$$C_p = \underset{(.026)}{.780\ Y_d} + \underset{(.048)}{12.245\ p_c} - 2.00 \quad R^2 = .999$$

It can be understood from the above equation that the total private consumption (C_p) is assumed to be a function of total disposable income (Y_d) and consumer price index number (p_c) (cost of living). The coefficients show significance beyond the 99 % level.

The income and price elasticities correspondent to these marginal quota were in 1962 $E_{Y_d} = .885$ and $E_{p_c} = .147$ respectively.

1.3.2. Private investment expenditure

Investment demand has long been recognized as one of the most important dynamic elements in the economic system. The strategic position given to this variable in the literature derives from its twin rôles:

a) a primarily capacity - generating factor and vehicle towards higher levels of output or income and

b) a potential source of short - run instability which magnified intensity on general economic activity.

Many theoretical approaches have been developed in studying the factors determining investment spending.

The most commonly used theories of investment demand are the:

a) acceleration principle

b) profit principle and the

c) flexible accelerator's principle.

Though partly governed by technical conditions, decisions to invest like those to consume, are essentially behaviourictic in character and are likely to be motivated by economic as well as extra - economic forces.

In the present model the «profit - principle» has been applied in the regression analysis for a good explanation of investment fluctuations. For, on the one hand, by regretting experimentarily the private investment expenditure with the rate of change in output (acceleration principle) the results obtained were not satisfactory and, on the other hand, it is caused by the fact that investment expenditure appears on the production function as an explanatory variable of the rate of change in output. So the following equation stands to serve the present model:

$$I^{p}_{na} = \underset{(.042)}{.656}\, Z - 2.774 \qquad R^2 = .950$$

Thus the private investment in fixed assets in non - agriculture (I^{p}_{na}) is assumed to depend upon the non - wages - non - farm income (Z). The marginal quota coefficient has significance beyond the 99 % level. The coefficient is acceptable for the Greek reality as satisfactory one.

The elasticity in the base year (1962) correspondent to the above marginal quota was

$$I^{p}_{na} = 1.30$$

1.3.3. Production equation

All production results from a combination of labour, capital and technology. The first decision to be made is whether the production function should cover the whole economy or should exclude some branches that are considered exogenous. Many research have adopted the first solution but a numerous production function have applied to only a part of the economy.

In a number of countries, the rate of increase of the G.D.P. is assumed rather than calculated through a production function. In the last ten years the use of production function as an analytical tool in growth economics have, however, been subjected to much critical examination. The origins of the new classical theory lie in a model of behaviour of an individual firm in a competitive economy with a stationary technology and fixed consumer's preferences.

For the present model the following equation has been selected:

$$\Delta y_{na} = \alpha \Sigma i^{t}_{na} + \beta \Delta a$$

That the increase in productive capacity in non - agriculture (Δy_{na}) is seen as a function of the increase in employment (Δa) in the period of projection and the accumulated investment Σi^{t}_{na} in the period (i.e. using the accumulation of changes in fixed assets).

The contribution of the labour to the growth of potential output is estimated on the basis of the assumption that the marginal productivity of labour will not be very much different from the level of real wages. The coefficient «a» is the reciprocal of the incremental capital - output radio, which has been calculated (graphically) to be «3.9» and after correction for the contribution of labour to the growth in productive capacity. The remaining growth in capacity was attributed fully to gross investment, without allowing for disembodied technical progress. Comparing the obtained incremental capital - output ratio (i.c.o.r.) with similar in other research works about the Greek economy (9) I can say it is an acceptable one for the Greek reality. Of course, in the long - run it should be re - estimated, because of the influence of the technological changes on the investors' behaviour.

The beta coefficient has been found as the mean of the value of wage rate in the base year and the year of projection. Thus, the production function holds as follows:

$$\Delta y_{na} = \frac{1}{3.9} \Sigma i^{t}_{na} + 44.9 .\ \Delta a$$

The complication in the production function is the fact that the sum total of investment in five years (the length of the period of projection) appears as explanatory variable. This difficulty can be overcome, if the assumption of a constant annual increase of investment is made. And this assumption seemed to be a reasonable one for the present model.

1.3.4. Export equation

A number of variables has been used by many countries in determininig the export function for medium or long - term projections.

In the present model among some equations choice has been made for the following equation to stand into the model

$$b = b_0 \cdot b_w{}^{1.36} \ (p_b \ / \ p_{bw})^{-1.0}$$

It is assumed that the volume of exports of goods and services (b) depends upon the volume of world trade (b_w) and the ratio between the Greek and the world trade price levels (p_b / p_{bw}). The price ratio elasticity has been fixed a priori and the elasticity of exports with respect to world trade has been found by graph. This was the preferable solution, because regression analysis had shown, on the one hand, wrong sign (positive) of the price / ratio elasticity coefficient and, on the other hand, high coefficient of the elasticity of export with respect to world

9. A.G. Papandreou : «The strategy of development of the Greek Economy», 1963.
Ministry of Coordination — National Accounts Division: «The evolution of investment in the post — war Greece», Athens, 1963.

trade either correlating alone or together with the prices. The other solution could be to leave the exports out of the model as exogenously determined.

In the case of exports I wanted to break it down in its main components and to weight them according to geographical distribution. But neither the first nor the second has been done despite of great importance. It is hoped to make some improvement on this field later on.

1.3.5. Import equation

As I mentioned in the general line of the model the import equation has been chosen to equilibrate the demand and supply; there should be some equilibrium-maker, who makes the volume of demand equal to potential supply.

This equality is brought about by the credits.

Thus in the present model among some results the following equation has been selected to stand into the model

$$m = .309\ y + 12.878\ C_r - 12.69$$

The volume of imports (m) is seen as a function both of the volume of production (y) and the value of credits (C_r) given for imports.

The marginal quota of C_r has been fixed a *priori* and the marginal quota of y has been found by graph.

This was necessary because regression analysis has shown, on the one hand, a very low marginal coefficient of C_r (no different significantly from zero) and, on the other hand, the coefficient of y was too high. This was because of high multicolinearity between the two explanatory variables, more than in the usual case.

The elasticities correspondent to the marginal quota .309 and 12,878 were in 1962 $E_y = 1.34$ and $E_{Cr} = .20$ respectively.

Here, also a certain breakdown of imported goods should be made at least in the most important components, i.e. consumption goods, investment goods and raw materials. This, of course, would be done if the import - prices for each component could be introduced into the price equations.

The advantage of the latter would be a more reliable estimate of the price - elasticities involved.

1.3.6. Wage rate equation

Since the inception of the theory of wages, four major theories have emerged. Of these, the «Subsistence theory» has long since been laid to rest, as has also the original conception of the «wages fund theory». Remaining on the scene will, therefore, be the «marginal productivity» and the «bargaining» theories.

The former is assumed to take care of the fundamental underlying forces in the long- run determination of wage levels, and the latter is relied upon to explain the mechanical aspects of short - run wage setting in labour markets of the industrial society.

In the present model the labour productivity only (for simplicity's sake) has been chosen among some results to determine the wage level in the private sector

The following equation holds:

$$l = l_0 \cdot h^{1.20(.339)} \quad R^2 = .974$$

The wage - productivity flexibility is significant beyond the 99 % level. The elasticity coefficient is not too far from the Greek reality.

I. 3. 7. Price equations

First of all I have to stress here that for simplicity's sake the prices of:

a) private consumption

b) private investment in fixed assets in non - agriculture

c) exports

have only been introduced operationally into the model. Thus both prices of government investment expenditure (in agriculture and non - agriculture) and private investment in agriculture as well as prices of government consumption are assumed to be the same as those of private investment in non - agriculture and private consumption respectively.

In the present model the main explanatory variables chosen among several alternatives to determine the price level of each component of demand were:

a) the labour cost (ratio of money wage rate to the labour productivity) and

b) import prices.

Here I have to stress that the import prices, apart from the labour cost, have a considerable influence on the inland price level. Looking at the development of prices and comparing with development of domestic general price level we can see a parallel trend over the sample period.

1.3.7.1. Consumption price equation

$$p_c = p_{co} \left\{ \frac{1}{l_0} / h \right\}^{.57} \cdot p_m^{.20}$$

The import elasticity has been fixed a *priori* and after correction of p_c for the contribution of import prices in the determination of the inland price level the elasticity of prices with respect to labour cost has been formed by graph. This should be done because regretting the consumer prices with the labour cost and import prices I got, on the one hand, wrong sign (negative) for the import price coefficient and, on the other hand, the coefficient was too low with a standard deviation no different significantly from zero. This was due to the high multicollinearity existed between the two explanatory variables.

1.3.7.2. Private investment price equation

$$p_i = p_{i0} \cdot \{ \frac{1}{l_0} / h \}^{.67(.153)} \cdot p_m^{.18(.140)} \quad R^2 = .972$$

Among of some results the above equation has been selected to serve the model. The elasticities with respect to labour cost and import prices are significant beyond the 99 % and 68 % level respectively.

Taking into account the great importance of the imported investment goods for the development of the Greek economy the import coefficient should be higher than that one in the consumption price equation.

1.3.7.3. Export price equation

$$p_b = p_{bo} \cdot \{ \frac{1}{l_0} / h \}^{.72} \cdot p_m^{.10}$$

After correction of the export prices for the contribution of import prices, the export elasticity with respect to labour cost was found by graph. This technique of fixing a priori the coefficient of one variable has been applied, because of both low export elasticity which has been found with respect to import price and a high standard deviation.

1.3.8. Institutional equations

In the present model use has been made of one equation for direct taxes and another one for indirect taxes.

A great effort has been done to split up the direct taxes into the three categories of income earners.

But, finally, the will broken down because of the difficulty arose from the view point of available data.

So, the value of total direct taxes is assumed to be a function of the value of national income. The following equation holds to serve the model

$$T_d = .114\, Y_n - 1.143 \qquad R^2 = .991$$
$$(.003)$$

The marginal quota is significant beyond the 99 % level.

The elasticity correspondent to that marginal quota was in 1962 : $E_{Y_n} = 1.05$.

On the other hand the value of total indirect taxes (minus the subsidies) is seen as a function of the value of total expenditure. The following equation holds to serve the model:

$$T_k = .109\ V - .567 \qquad R^2 = .992$$
$$(.003)$$

The marginal quota is significant beyond the 99 % level and elasticity correspondent to it was in 1962 : $E_v = .972$.

For simplicity's sake none breakdown has been made in both functions of the model.

2. Projecting the 1967

2.1. Linearization of the model

In the original set up of the system several equations are of a non - linear type. As an example serves the equation for the volume of exports of goods and services (b) which is assumed to depend upon the volume of world trade (b_w) and the ratio of internal to world trade price level (p_b / p_{bw}). The original shape of the exports equation is as follows:

$$b = b_0 \cdot b_w \cdot {}^{\alpha} \{ p_b / p_{bw} \}^{-\beta}$$

Obviously, the solution of a large system of equations a considerable number of which are non - linear, offers great mathematical difficulties. A linear approximation should, therefore, be used. Since, however, the period covered by medium term predictions is too long to justify the use of linear approximations throughout it was necessary first to make a guess of the values which the variables might have in the projection year, in this case 1967.

These pre - projected values of the variables could be found either by extrapolation of their trend or by taking the (compound) rate of growth of the last five years. I followed the former way which gives, obviously, more accurate guesses ([10]). These first guesses ought to have a certain consistency among them and not to be far from the model's outcomes. Thus the use of a table of resources and expenditures was helpfull in obtaining such a consistency.

It is around these expected values, indicated below by symbols with a bar, that the system is linearized via the application of Taylor's expansion, while neglecting second and higher order terms.

Along these lines the export equation mentioned above can be taken as an example and has changed as follows:

10. By using the latter, the guesses could be overestimated or underestimated because of the rate of expansion or dispersion of the last five years.

$$b = \bar{b} + a \cdot \bar{b} \cdot \bar{b}_w \cdot {}^{-1} (b_w - \bar{b}_w) + \beta \cdot \bar{b} \cdot \bar{p}_b {}^{-1} p_b - \bar{p}_b) - \beta \cdot \bar{b} \cdot$$
$$\cdot \bar{p}_{bw} \cdot {}^{-1} (p_{bw} - \bar{p}_{bw})$$

Since $a = 1.36$ and $\beta = -1.0$

while

$\bar{b}_w$	$= 1.50$	(1962 = 1.00)
$\bar{p}_b$	$= 1.05$	(»)
$\bar{p}_{bw}$	$= 1.10$	(»)
$\bar{b}$	$= 21.6566$	(1000 mln drs 1962)

The following numerical result is obtained

$$b = 19.55\, b_w - 20.54\, p_b + 19.69\, p_{bw} - 7.76$$

As another example could serve the production function because of the fact that the sum total of investment in five years appears as explanatory variable.

The original form of the production function can be stated as follows:

$$\Delta y_{na} = \alpha \Sigma i^t_{na} + \beta\, \Delta a$$

$$y^{'67}_{na} - y^{'62}_{na} = \alpha \sum_{'62}^{'66} i^t_{na} + \beta\, (a_{67} - a_{62})$$

Assumption was made that the investment is a linear function of time, i.e

$$i^t_{na} = a + b\, t\, .$$

Then

$$\sum_{'62}^{'66} i^t_{na} = \sum_{'62}^{'67} i^t_{na} - i^{t'67}_{na} \text{ and by the use}$$

$$\text{of the form}^{(*)}\ S_n = \frac{1}{2}\, n\, (t_1 + t_n)$$

$$= \frac{1}{2}\, 6 \left(i^{t\,'62}_{na} + i^{t\,'67}_{na} \right) - i^{t\,'67}_{na}$$

$$= 3\, i^{t\,'62}_{na} + 2\, i^{t\,'67}_{na}$$

(*) Sum of the arithmetic progression where
- n = number of years covering the period of projection
- t_1 = first term
- t_n = last term

Thus the production function takes the following shape

$$y^{'67}_{na} - y^{'62}_{na} = a \left\{ 2 \cdot i^{t\,'67}_{na} + 3 \cdot i^{t\,'62}_{na} \right\} + \beta \left\{ a^{'67} - a^{'62} \right\}$$

Since

$$a = 1/3.9$$

$$\beta = 44.9 \qquad \text{(in 1000 drs)}$$

while $y^{'62}_{na} = 77.00$ (in 1000mln drs)

$$i^{t'62}_{na} = 22.67 \qquad (\quad » \quad)$$

$$a^{'62} = 1.37 \qquad \text{(in mln drs)}$$

the following numerical result was obtained :

$$y^{'67}_{na} = 0.513\, i^{t\,'67}_{na} + 44.90\, a^{'67} + 32{\cdot}93$$

Other non-linear equations undergo similar changes. The resulting linear form of the system can easily be solved with the help of well known computor techniques. If the initial guesses were good, the model solution will deviate only little from them.

However in case of considerable deviations an iteration procedure may be required, linearizing the system once more around the model solution and solving again.

In practice it is usually possible to make the preliminary guesses sufficiently accurate to complete the procedure in one or two rounds.

2.2. Some model outcomes

After having obtained a set of estimates for the year of projection (1967) it is of interest to consider alternative projections on the basis of alternative (policy) assumptions. For purposes of policy decisions the effects of a sustained change of «shift» in the level of the exogenous or of the instrument variables, are no doubt the more important features of an econometric model.

Alternative policy assumptions can easily be introduced by inserting additional autonomous components; e.g. into the equations for taxes and prices.

Likewise, the effects of variations in government expenditure can be studied.

A similar procedure holds,of course, for the external data. A combination of alternatives is also possible. But, the variations should never be chosen too large, since the model in its linearized form may then loose its validity.

The following table indicates both some of the model outcomes and some variations.

It appears that one percent autonomous wage increase ultimately results more wage increase by 1.17 percent. This is explained by rising production and consequently by rising labour productivity. The increase of production can be explained by the rising private investment in non - agriculture and the latter by the rising profit - income. The rising productivity can be explained by a higher capital intensity of production. The effect is small but it may be larger in the longer run.

The rising wage level means rise in prices (more than half percent) and this affects exports negatively by 0.16 billions of drachmas. The imports are increasing and so the deficit of balance of payments becomes larger.

The volume of private consumption also increases because the disposable income, increases too. But the etfect is smaller that the increase of disposable income, resulting from the rising prices.

Higher government investment in non - agriculture results a condiderable increase in production and consequently in imports. The wage level is also increasing but higher than the increase of productivity; this affects a slight rise in prices. The deficit of balance of payments is increasing again.

Higher direct taxes have none influence in prices; it results a considerable decrease of imports and volume of private consumption. The latter is explained by the decrease of disposable income.

In the case of higher indirect taxes (combined with an autonomous increase in p_c by 0.8 %) the private consumption is decreasing considerably; this is mainly explained by the rising consumption prices and partly by the decrease of disposable income.

The decrease of demand results a decrease of imports.

In both cases of higher taxes the deficit of balance of payments is decreasing considerably.

The above given predictions of changes in some of the endogenous variables, resulting from a change of a predetermined variable, are remarkable for the policy-makers.

2.3. Concluding observations

The principal aim of the above model is to arrive at a consistent set of medium term projections as realistic as possible in terms of volumes, values and global policy instruments. The results obtained so far do not seem to be too bad.

This does not alter the obvious fact that the model is still l a r g e l y a n e x p e r i m e n t . This is true of individual equations, like the production function, export equation, wage rate and price equations which were difficult to construct. It also holds for the set up of the model which is a static one. Moreover, the assumption of constant rates of change of development over the period of projection requires careful interpretation.

The model presented here should be looked upon not as a finished product but as a first approximation whose real merit lies in its potential for improvement.

Variables	Unit	1962 at current prices	idex 1967 (1962=100)	1967 at price 1962	1% extra increase in the level of wages 1	1 billions of drachmas increase in i^g_{na}	T_d	T_k
y_{na}	billions of drs	77.00	157	120.85	0.13	0.61	0.02	—0.01
b	»	11.91	182	21.69	—0.16	—0.02	—	—
m	»	24.56	176	43.19	0.11	0.91	—0.69	—0.88
i^p_{na}	»	15.54	201	31.18	0.26	0.19	0.03	—0.03
c_p	»	85.60	145	123.76	0.17	0.35	—0.70	—0.87
l	1962 = 100		156		1.76	0.94	0.03	—0.22
p_c	»		104		0.60	0.10	—	0.80
p_i	»		105		0.70	0.10	—	—
p_b	»		105		0.80	—	—	—0.10
h	»		145		0.20	0.80	—	—
			Values 1967					
T_d	bill. of drs	10.61	154	16.38	0.14	0.07	1.01	—0.01
T_k	»	14.51	153	22.20	0.17	0.19	—0.08	1.01
C_r	»	0.38	163	0.58	0.01	0.06	—0.05	—0.07
Z	»	30.80	175	54.04	0.71	0.33	0.06	—0.04
Y_n	»	97.89	157	153.48	1.25	0.62	0.06	—0.05
Y_d	»	97.11	156	151.59	1.11	0.55	—0.94	—0.05

* The autonomous increase of 1 billions of drachmas extra increase in T_k has been combined with an autonomous increase in p_c by 0.8 %; it is assumed that the entrepreneurs will increase the consumption prices so much in order to avoid to see decreasing their income,

Clearly, continued effort will be necessary over a number of years in refining data, estimating parameters, revising equations and testing forecasts before the model can possess a good degree of accuracy.

Finally, any judgement should take into account the severe limitations under which the above given model was constructed.

APPENDIX I

Original form of the model

1. Reaction equations

1.1 expenditures (demand)

1.1.1 $C_p = .780\ Y_d + 12.245\ p_c - 2.00$

1.1.2 $I^p_{na} = .656\ Z - 2.774$

1.1.3 $b = b_0 \cdot b_w^{1.36} \cdot \{ p_b / p_{bw} \}^{-1.0}$

1.2 resources (supply)

1.2.4. $\Delta y_{na} = 1/3.9\ \Sigma i^t_{na} + 44.90\ \Delta a$

1.2.5 $m = .309\ y + 12.878\ C_r - 12.690$

1.3 wages and prices

1.3.6. $l = l_0 \cdot h^{1.20}$

1.3.7. $p_c = p_{co} \cdot \left[\frac{l}{l_0} / h \right]^{.57} \cdot p_m^{.20}$

1.3.8. $p_i = p_{io} \cdot \left[\frac{l}{l_0} / h \right]^{.67} \cdot p_m^{.18}$

1.3.9 $p_b = p_{bo} \cdot \left[\frac{l}{l_0} / h \right]^{.72} \cdot p_m^{.10}$

1.4 taxes

1.4.10 $T_d = .114\ Y_n - 1.143$

1.4.11 $T_k = .109\ V - .567$

2. Definition equations

2.1 relations between value and volume variables

2.1.12 $c_p = C_p / p_c$

2.1.13 $C_g = c_g \cdot p_c$

2.1.14 $i^p_{na} = I^p_{na} / p_i$

2.1.15 $i^p_a = I^p_a / p_i$

2.1.16 $I^g_{na} = i^g_{na} \cdot p_i$

2.1.17 $I^g_a = i^g_a \cdot p_i$

2.1.18 $B = b \cdot p_b$

2.1.19 $M = m \cdot p_m$

2.2 wages and productivity

2.2.20 $W_p = l \cdot a_d$

2.2.21 $h = \left[\frac{y_{na}}{y_{na0}} \Big/ \frac{a}{a_0} \right]$

2.3 domestic production and supply

2.3.22 $y = y_{na} + y_a$

2.3.23 $v = y + m$

2.4 expenditures (demand)

2.4.24 $v = c_p + c_g + i^p_{na} + i^p_a + i^g_{na} + i^g_a + b + n$

2.4.25 $V = C_p + C_g + I^p_{na} + I^p_a + I^g_{na} + I^g_a + B + N$

2.4.26 $i^t_{na} = i^p_{na} + i^g_{na}$

2.5 incomes (resources)

2.5.27 $Y_n = Z + F + W_p + W_g$

2.5.28 $Y_d = Y_n - T_d - Y_g + T_g + T_w$

2.5.29 $Z = V - W_p - F - M - D - T_k + Y_{abr}$

APPENDIX II

Linearized form of the model

1. Reaction equations

1.1 expenditures (demand)

1.1.1 $C_p = .780\ Y_d + 12.245\ p_c - 2.000$

1.1.2 $I^p_{na} = .656\ Z - 2.774$

1.1.3 $b = 19.554\ b_w + 19.688\ p_{bw} - 20.540\ p_b - 7.764$

1.2 resources (supply)

1.2.4 $y_{na} = .513\ i^t_{na} + 44.900\ a + 32.926$

1.2.5 $m = .309\ y + 12.878\ C_r - 12.690$

1.3 wages and prices

1.3.6 $l = 46.011\ h - 10.736$

1.3.7 $p_c = .011\ l - .423\ h + .208\ p_m + .832$

1.3.8 $p_i = .013\ l - .501\ h + .189\ p_m + .859$

1.3.9 $p_b = .014\ l - .541\ h + .105\ p_m + .944$

1.4 taxes

1.4.10 $T_d = .114\ Y_n - 1.143$

1.4.11 $T_k = .109\ V - .567$

2. Definition equations

2.1 relations between value and volume variables

2.1.12 $c_p = .952\ C_p - 116.571\ p_c + 122.400$

2.1.13 $C_g = 1.050\ c_g + 4.960\ p_c - 5.210$

2.1.14 $i^p_{na} = .952\ I^p_{na} - 25.161\ p_i + 26.420$

2.1.15 $i^p_a = .952\ I^p_a - 1.678\ p_i + 1.760$

APPENDIX II

$$2.1.16\quad I^{g}_{na} = 1.050\, i^{g}_{na} + 10.690\, p_i - 11.220$$

$$2.1.17\quad I^{g}_{a} = 1.050\, i^{g}_{a} + 2.300\, p_i - 2.420$$

$$2.1.18\quad B = 1.050\, b + 21.440\, p_b - 22.510$$

$$2.1.19\quad M = 1.000\, m + 42.980\, p_m - 42.980$$

2.2 wages and productivity

$$2.2.20\quad w_p = .865\, l + 53.87\, a_d - 46.600$$

$$2.2.21\quad h = .012\, y_{na} - .939\, a + 1.389$$

2.3 domestic production and supply

$$2.3.22\quad y = y_{na} + y_a$$

$$2.3.23\quad v = y + m$$

2.4 expenditures (demand)

$$2.4.24\quad v = c_p + c_g + i^{p}_{na} + i^{p}_{a} + i^{g}_{na} + i^{g}_{a} + b + n$$

$$2.4.25\quad V = C_p + C_g + I^{p}_{na} + I^{p}_{a} + I^{g}_{na} + I^{g}_{a} + B + N$$

$$2.4.26\quad i^{i}_{na} = i^{p}_{na} + i^{g}_{na}$$

2.5 incomes (resources)

$$2.5.27\quad Y_n = Z + F + W_p + W_g$$

$$2.5.23\quad Y_d = Y_n - T_d - Y_g + T_g + T_w$$

$$2.5.29\quad Z = V - W_p - F - M - D - T_k + Y_{abr}$$

APPENDIX III

LIST OF SYMBOLS

Small symbols refer to volumes or prices (1962 = 1.00) : capital symbols to values in billions of drachmas, unless otherwise stated. The subscript, o, refers to the base year 1962.

APPENDIX III

	a	number of the total employed in non-agriculture (mln)
	a_d	number of dependant employed in non-agriculture (mln)
B	b	exports of goods and services
	b_w	world trade of goods
C_p	c_p	private consumption expenditure
C_g	c_g	government consumption in goods
C_r		credits for imports
D		depreciation
F		farm income
	h	labour productivity (index)
I^p_a	i^p_a	gross private investment in fixed assets in agriculture
I^b_{na}	i^b_{na}	gross private investment in fixed assest in non-agriculture
I^g_a	i^g_a	gross government investment in fixed assets in agriculture
I^g_{na}	i^g_{na}	gross goverment investment in fixed assets in non-agriculture
	i^t_{na}	private and government investment in fixed assets in non-agriculture
	l	money wage rate (1000 drs)
M	m	imports of goods and services
N	n	changes in stocks
	p_c	price of private consumption
	p_b	price of export of goods and services
	p_{bw}	price of world trade

	p_i	price of private investment in fixed assets in non-agriculture
	p_m	price of import of goods
T_g		government's transfers to households
T_w		transfers to households from the rest of the world
T_k		total indirect taxes minus subsidies
T_d		total direct taxes
V	v	total expenditure
W_p		private wage income
W_g		government wage income
	y	total domestic production in industries
	y_a	domestic production in agriculture
	y_{na}	domestic production in non-agriculture
Y_n		national income
Y_d		net income from abroad
Y_{abr}		government income accruting from property and entrepreneurship
Z		non-farm - non wages income

APPENDIX IV

The endogenous variables of the system are :

Productions and productivity	y, y_{na}, h
Wages and prices	l, p_c, p_b, p_i
Expenditures	B, b, C_n, c_p, I^p_{na}, I^g_{na}, I^g_a, i^p_{na},
	i^p_a, i^t_{na}, V, v, C_g
Imports and credits	M, m, C_r
Incomes and taxes	Y_n, Y_d, W_p, Z, T_d, T_k

The total number of endogenous variables is 29, exactly equal to the number of equations

The exogenous variables are the following :

Production	y_a
Employment	a, a_d
Prices	P_m, P_b
World trade	b_w
Expenditures	I^p_a, i^g_a, i^g_{na}, c_g
Depreciation and stock formation	D, N, n
Incomes	F, W_g, Y_g, Y_{abr}, T_g, T_w

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