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التخطيط القومي

معهد التخطيط القومي

Memo. NO. 587

APPLICATION OF SOME MODELS FOR PLANNING

BY

The group of model building

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Preface

Since the beginning of the year 1965, a research group has been formed in the Operations Research Center of the INPC, with the aim of studing the problem of model-building for planning purposes. The final objective is to build up a series of models, each dealing with a specific number of development planning questions. For every model a full description will be provided, an analysis of its policy utilization made, and a system of programs prepared to enable direct running on the machines in each case.

The activity of model building has been in fact going on in the ORC for some time. Among the contributers is Prof. Frisch, with his highly elaborate models. Those experiments have indicated a lot of points envolved in the activity of mode-building:

1. The importance of the approach as a scientific way of answering fundemental questions in planning in a meaningful way.
2. The need for the collaboration of a large team, with a variety of back ground experience: economists, statisticians, mathematicians, technicians, etc.
3. The amount of effort and time usually envolved in building up asingle model.
4. The need for high speed machines to yield quantitive solutions relating to empirical situations.
5. The need for a large amount of data collected in a systematic way, which in many cases can be checked by the model itsefl, thus helping to improve the quality of the data itself.

This means that if we are to wait until a problem arises, before we start thinking about building a mode to solve it, some time would by necessity elapse before quantitative rsults would be available to the decision - taker. Therefore , a better "planning" of the activity would be to start thinking a head of the problems to prepare alternative systems of solution, so that the time lag accuring between raising a specific question and

obtaining an answer to it would be minimized to the period necessary to collect the relevant data, and running the already-set programs on the machines.

However, two major drawbacks have become already evident from past experience:

1. That the majority of decision-takers do not easily grasp the significance of such models, especially when, in an attempt to conform with reality, they are expressed in highly elaborate terms.

2. That if an attempt is made to start straightaway using such elaborate models, there is a possibility that alarge number of the members of the team would not fully grasp the essence of the operation, thus leading to the risk of decreasing the efficiency of their individual contributions.

One way of overcoming these difficulties is to introduce the approach through highly simplified models, then increasing their complexity step by step. Another way is to try to formalize the attempts already made by more familiar methods, and indicate the amount of gain to be obtained from the explicit way of stating formall models. The fundamental fact is that if a certain logic is used to determine a certain amount of quantitative results, it is always possible to express this logic in a mathematical way, hence testing its consistency(1). This would help to improve the logic and to suggest more efficient systems.

With this inmind, I have directed the group towards arather extensive discussion of models suggested by the ECAFE of the UN(2) for programming development in countries at an early stage of development. The following pages summarize attempts by

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(1) As an example see our memo. (No.255) on "models used in drafting the twenty-years plan 1959-1979.

(2) ECAFE: Programming Techniques for Economic Development.

members of the group to discuss the first model suggested in that work. Dr. M. Wahby has been helping in the preparation of these papers. Simple as it might be, the model has revealed certain interesting features of our annual plans, which are worth further study by means of more elaborate models. Attempts have been made to illustrate its uses by means of a brief discussion of a possible outline of a plan of doubling national income over the next 10 years. These attempts can be taken as an indication towards more elaborate approaches such as those suggested by Prof. Tinbergen and Prof. Frisch.

Although these attempts have been discussed by all members of the group; they are not yet in a finalized shape. The following pages are to be considered as a progress report, meant to keep on record the efforts of the group during the last few weeks. Series of these reports are to be expected in the near future, and they will be all written in English in order to facilitate reference to the various sources. In the final draft one might expect certain amendments and elaborations.

Dr. M. M. El-Imam

PART (I)

Model Building

(1-1) One of the important aspects of new techniques of planning for national development is the tendency to build up economic model. This is the usual way in which mathematical mode of reasoning is employed in economics.

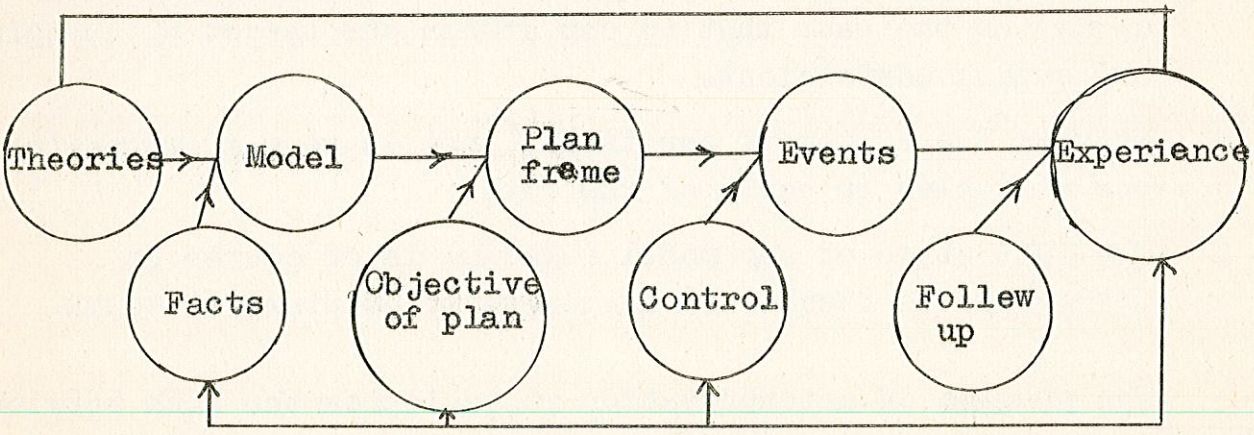
The economic (planning) model is an analytic mean which shows the inter-relationships between the economic variables as aspects involved in planning procedure. It is a mean to derive conclusions as projections based on certain assumptions we take.

The model is also a tool to check validity consistency and perhaps the optimality of our national objectives of planning. In other words the economic model is one of the important instruments which help us to prepare a plan frame.

(1-2) Economic models and planning:

Models are one of the main operations used in the preparation of a national plan frame. Hence it is very useful for planners to construct precise and elaborate models at any early stage before beginning to prepare the economic plan.

The following is a diagrametic form which illustrates how models are envolved in planning procedure



Theories of planning and development are combined together with the existing facts to set up a model. A model suplemented with the objective of the plan constitutes what is known by a plan frame. A plan frame supplied with a control produce events. Events with a follow up give experience.

(1-3) Stages used in building models

The usual stages involved in building up a model[1] are as follows:

1. Defining the variables of the model; classifying them into given and unknown variables. The given variables are called the data in our model. The unknown variables refer to certain economic phenomena which we seek to explain from within the model.
2. Indicating the level of abstraction on which the discussion is to be carried out by specifying the set of assumptions.
3. Shawing the quantitative relationships between the variables with the help of equations. In constructing such a system of equations there will be certain coefficients. These coefficients are assumed to be constant, but sometimes in certain problems, the change of these coefficients may be of great importance. For example, in many economic problems, it may be the case that we can attain our target by changing the saving coefficient.
4. Solving the system of equations, that is to say, expressing the variables in terms of the data.
5. The last stage of any model building is of course to interpret the results in economically meaningful terms.

The process of interpretation restablishes the link between the set of assumptions with which we started and the set of

implications that logically follows from it.

In order to understand what any model implies we must watch carefully the meaning of the various parameters and variables used in this model.

Classification of different models

Economic models can be classified according to different criteria. The following criteria [2] can be used in order to present in a systematic way the different types of models.

1. Formulation of a model

(1-1) Its approach

Determinestic models There are two main approaches:-

(i) Mathematical; where method of solution uses algebra and analysis. It can be subdivided into unsepecified and specified according to whether the explicit form of the functions is specified or not.

(ii) The analogue; where the method of solution uses engineering construction. It deals with more complex formulations and its merit lies in the fact that it can lead to quick solution of systems which are either insoliuble or prohibitive when treated by ordinary mathematical tools.

Stochastic Models: These allow for the unsystematic types of errors of differences between theory and practice. Instead of speaking about numerical determination of the characteristics of the model, we speak of statistical estimation. Econometrics has been especially designed in such a manner as to deal with problems of formulation and estimation of this type of models. Another new development in the field of model building is the use of analogue process in order to bring into existence models which would take care of the stochastic

nature of actual life.

Thus the approach aspects leads to the following subdivisions:

Deterministic:

a) Mathematical: (1) unspecified
(2) specified

b) Analogue numerical

Stochastic (1) Econometric
(2) Analogue.

(1-2) Form of equations that the models involve

In mathematical approach, there are some cases where the forms are specified and others are unspecified. In the specified forms, we may have linear or non-linear functions. In the unspecified forms, we have non-linear models. These contain one or more linear equations but at least one non-linear

2. Purposes

These fall into

(i) Exposition (ii) Description
(iii) Forecasting (iv) Projection & Policy-evaluation.

(v) Decisional

The first two types might be considered as analytical models while the last two can be considered as decisional in the broad sense.

3. Goverages

(3-1) Degree of Completeness: Complete models are those which give an interpretation of all magnitudes which can be considered

as variables in the system. Incomplete models give only a part of the picture.

(3-2) Scope or degree of generality: Here we are interested with the width of the market covered. There are three categories of partial models:-

(i) Those relating to individuals e.g. models of consumer's or producer's behairour.

(ii) Those relating to markets dealing with the interaction between both the supply and the demand.

(iii) Those relating to sectors, i.e., summarizing the total activity of groups of individuals belonging to a certain type.

Partial models need not be incomplete. On the other hand, we have the so-called general models which attempt to explain what they consider to be the key variables of the whole economy. Such models may vary in detail, they might be even incomplete.

(3-3) Range or degree of closeness: It expresses the degree of autonomy in the model. In closed models all the variables introduced are explained within the model itsefl. This is of an important interest in studying dynamic process. Usually analytical models started by being formulated in a general open manner but they are reduced to closed ones in the highest stages of analysis.

(3-4) Spatial Coverage:-

(i) Intra-regional type: models interested in tudying the relationships within a certain economy considered as one single entity.

(ii) Inter-regional types: models concerned with international trade problems.

(4) Type of interdependence

Physical, financial, degree of sector break down.

5. Time; which contains:-

(5-1) Continuity: In econometric models, the usual way of measuring variables is to consider them as discrete functions of time. This definition is implied in static models, since time does not appear explicity. For dynamic models we can still measure the variables discretely with difference equations as a tool of analysis. If the variables are assumed to be continuous differential equations take place. Frequently both discrete & Continuous approaches are mixed together leading to mixed models.

(5-2) Time specifications:- A model is said to represent a static picutre when its solution holds irrespective of time. On the other hand a dynamic model would lead to a solution which defines a time-path for each of its variables.

(5-3) Time duration: In dynamic problems one becomes concerned with the determination of the duration to which the analysis holds. Short run problems relate to deviations from equilibrium or fluctuations around what can be considered as a systematic time-path. Long run problems relate to the dynamic theory of growth.

(5-4) Time units: From econometric point of view, we differentiate between annual and sub-annual models where the main factor to be considered is seasonality. Aside from econometric problems, some authors define time unit as the period sufficient for one complete process of a specified type, e.g., production. In mechanical models, we have the non-seasonal type of units.

6. Variables

(6-1) Origin of measurements:- The lst possibility is to use variables in their absolute magnitudes i.e. the origin is their zero point. This leads to large variations which might render the linearity assumption untenable. To overcome this difficulty we have two alternatives.

(i) the variables might be measured as deviations from same equilibruim path or time trend

(ii) the variables might be measured as first differences.

(6-2) Degree of aggregation:- The passage frome micro-analysis to macro-analysis involves a process of aggregation. To construct a macro model we have either one of the following:-

(i) to build directly the model in an aggregated form

or(ii) to consult the bassic micro relations and derive from them the appropriate macro-ones

(6-3) Variable specification:- In economic theory it is usual to distinguish between flow-variables & stock-variables. The flow-variables are measured as flows per unit of time. The stock-variables are considered as magnitudes standing by at any point of time.

(6-4) term of measurements: Some fields of economic theory emphasize the monetary side of the economy. Others are occupied with the real side of the problems. In planning models, the concentration on real terms is obvious. But if we plan with the purpose of raising productivity, reducing costs, and improving the technological structure, we have to take account of these changes in our models. It follows that we have to use a more elaborate technique by introducing many non-linearities in the problems. The real-financial approach becomes the most suitable for the purpose.

PART (II)

Macro-economic model

By

Shinichi / Chimura

Model (1)

and its application to 1st five year plan.

(2-1) In planning the general rate of growth it is preferable to set a target of the economic development. This target is usually expressed in terms of Net national output or Real National income. So we must start by studying the general rate of economic development.

Use will be made of the Harrod-Domar model as presented by Prof Shinichi Ichimura. This is because of its simplicity and capability of being applied to the data now available about the Egyptian Economy. It also allows for government and foreign sectors.

(2-2) Symbols used in the model: Let

Y = National income at market price
Y' = National income at factor cost
Y^p = Disposable private income
Y^g = Disposable government income
C^p = Private consumption
I^p = Private investment
S^p = Private saving
C^g = Government Consumption
I^g = Government investment
S^g = Government saving
E = Total exports of goods and services
M = Imports of goods and services
B = Foreign loans and grants
T^i = Indirect tax-minus subsidies
T^d = Direct tax minus transfer payments.

(2-3) The parameters

$S = (Y^p - C^p)/ I^p$ = the average propensity to save in the private sector.

$\tau^d = T^d/Y$ = the ratio of direct tax to income

$\tau^i = T^i / Y$ = " " indirect " " "

$\mu = M / Y$ = average propensity to import

$\nu = (C^g + I^g)/Y^g$ = ratio of government expenditure to disposal government income.

$\gamma = I^g/(C^g+I^g)$ = ratio of government investment to government expenditure.

$S' = (Y^g-C^g)/Y^g$ = the average propensity to save in the government sector

$\frac{1}{\sigma} = \frac{I^p(t) + I^g(t)}{Y(t+1)-(Y(t)}$ = the marginal capital output ratio

$\tau = \tau^i + \tau^d$

(2-4) The basic balance equations

The following table represents an input-output table with 5 sectors in its simplest form. These sectors are given as

Business - Household - Government -
Rest of world - Capital information.

Receiving sectors / Delivery Sectors	Business	Household	Government	Rest of the World	Capital formation	Total
Business		C^p	C^g	E	$I^p + I^g$	$Y' + M$
Household	Y					Y
Government	T^i	T^d				Y^g
Rest of the world	M					M
Captial formation		S^p	S^g	B		$I^p + I^g$
Total	$Y'+M$	Y	Y^g	M	$I^p + I^g$	

From the 1st colunum we get

$$Y' = Y + T^i \quad (1)$$

From the 1st row we have

$$Y' = C^p + C^g + E + J^p + I^g - M \quad (2)$$

From the 2nd Column

$$Y^p = C^p + S^p \quad (3)$$

$$Y = Y^p + T^d \quad (4)$$

From the 3rd row

$$Y^g = T^i + T^d \quad (5)$$

From the 3rd column

$$S^g = Y^g - C^g \quad (6)$$

From the 4th Column

$$B = M - E \quad (7)$$

(2-5) The rate of growth "g"

By definition the rate of growth "g" is given as

$$g = \frac{\Delta y}{y} = \frac{y_{t+1} - Y_t}{Y_t} = \frac{(I^p + I^g)}{Y} \quad (8)$$

Substituting for $I^p + I^g$ from (2) we get

$$g = \frac{\sigma(Y' - C^p - C^g + M - E)}{Y}$$

$$= \frac{\sigma(Y' - C^p - C^g}{Y} + \frac{\sigma(M - E)}{Y} \quad (9)$$

From (1) $Y' = Y + T^i$ (10)

But we have $\gamma = I^g / (C^g + I^g)$

$$I^g = \frac{\gamma}{1-\gamma} C^g$$

Also $\nu = (C^g + I^g) / Y^g$

$$I^g = \nu Y^g - C^g$$

Consequently

$$\frac{\gamma}{1-\gamma} C^g = \nu Y^g - C^g$$

$$C^g = \nu(1-\gamma) Y^g \qquad (11)$$

Substrtuting from (5) for Y^g we get

$$C^g = \nu(1-\gamma)(T^d + T^i) \qquad (12)$$

By definition we have

$$S = \frac{Y^p - C^p}{Y_p}$$

$$C^p = (1-S) Y^p \qquad (13)$$

From (4) & (13) we get

$$C^p = (1-S)(Y - T^d) \qquad (14)$$

Now substituting from (10), (12), (13), (14) in (9) the rate of growth becomes

$$g = \sigma[1 + \tau^i - (1-S)(1-\tau^d) - (1-\gamma)\nu(\tau^d + \tau^i)] + \sigma(\mu - \frac{E}{Y})$$

$$= [\sigma S(1-\tau^d) + \sigma[1-(1-\gamma)\nu](\tau^d + \tau^i) + \sigma(\mu - \frac{E}{Y}) \qquad (15)$$

$$S' = \frac{Y^g - C^g}{Y^g}$$

$$= \frac{T^i + T^d - (1-\gamma)\nu(T^d + T^i)}{T^i + T^d}$$

$$= 1 - (1-\gamma)\nu \qquad (16)$$

Hence g can be rewritten in the form

$$g = \sigma S(1-\tau^d) + \sigma S'(\tau^d + \tau^i) + \sigma(\mu - \frac{E}{Y})$$

$$= \sigma S(1-\tau^d) + \sigma S' \tau + \sigma(\mu - \frac{E}{Y}) \qquad (17)$$

where

$\sigma S (1 - \tau^d)$ = the investment finaced by private saving

$\sigma S' \tau$ = the investment financed by government saving

$\& \sigma(\mu - \frac{E}{Y})$ = the investment financed by the foreign loans or grants

Equation (17) is the fundamental form for economic growth and can be reuritten as

$$g = \sigma S + \sigma[(S'-S)\tau^d + S'\tau^i] + \sigma(\mu - \frac{E}{Y}) \qquad (18)$$

(2-6) The following is a program for computing the general rate of Growth given by (17)

Let us start lst by giving the symbols used in the program corresponding th those given by the formula.

Symbols in the formula	Symbols in the program	
S	S	The average propensity to save in the private sector
S'	SP	The average propensity to save in the government sector
τ^d	T	The ratio of direct tax to income
τ^i	T1	The ratio of indirect tax to income
σ	B	The marginal capital output ratio
E	E	Exports
μ	U	Average propensity to import
Y	Y	National income at factor cost.

Program in Fortran:-

```
C       THIS IS A PROGRAM TO COMPUTE GENERAL RATE OF GROWTH OF THE FIRST
C       FIVE YEAR PLAN FROM59/60 TO 64/65
   10 READ1,S,SP,T,T1,U
    1 FORMAT(5F8.5)
      READ2,B,E,Y
    2 FORMAT(F6.3,2F8.2)
      READ3,
    3 FORMAT(80H
     X                                  )
      PRINT3,
      RATGR=B*(S*(1.-T)+SP*(T+T1)+(U-E/Y))
      PRINT5,
    5 FORMAT(63H    B         E         Y         S         SP        T
     X     T1/)
      PRINT6,B,E,Y,S,SP,T,T1
    6 FORMAT(F6.3,2F9.2,1X,4F10.5/)
      PRINT7,RATGR
    7 FORMAT(35X,6HRATGR=,F8.5)
      GOTO10
      END
TURN SW 1 ON FOR SYMBOL TABLE, PRESS START
```

RESULTS

THE FOLLOWING IS THE VALUE OF THE GENERAL RATE OF GROWTH

B	E	Y	S	SP	T	T1
.543	235.ØØ	1214.6Ø	.Ø81ØØ	.348ØØ	.134ØØ	.112ØØ

RATGR .Ø9Ø28

THE FOLLOWING IS THE VALUE OF THE GENERAL RATE OF GROWTH

B	E	Y	S	SP	T	T1
.6Ø2	241.5Ø	1324.9Ø	.133ØØ	.295ØØ	.134ØØ	.11ØØØ

RATGR .13658

THE FOLLOWING IS THE VALUE OF THE GENERAL RATE OF GROWTH

B	E	Y	S	SP	T	T1
.55Ø	291.8Ø	15Ø8.7Ø	.175ØØ	.255ØØ	.1Ø5ØØ	.138ØØ

RATGR .11999

THE FOLLOWING IS THE VALUE OF THE GENERAL RATE OF GROWTH

B	E	Y	S	SP	T	T1
.55Ø	3Ø2.ØØ	1698.6Ø	.144ØØ	.217ØØ	.126ØØ	.144ØØ

RATGR .Ø8285

FROM THE ABOVE RESULTS WE FIND THAT :-

FOR	YEAR	59/60	THE	RATE	OF	GROWTH	IS	0.09
"	"	60/61	"	"	"	"	"	0.13
"	"	61/62	"	"	"	"	"	0.12
"	"	64/65	"	"	"	"	"	0.08

PART III

Application to the-1st 5 year plan

(Some observationsConcerning the rate of growth of the Egyptian Economy)

(3-1) In this part, the study aims at investiagting the possibilities of growth of the Egyptian economy during the sixties of this century . Using the figures of "the frame of the general plan for economic and social development 1960-1965", light will be focussed upon the possible rat of growth of national income annually. Then a trial will be made to interpret the divergence between the result based on the figures of the frame and results which we can find in the follow-up reports. This leads to a very important section of this study, i.e. that concerning the possible rate of annual growth, based on a more reasonable values for the parameters of the system

(3-2) The following table gives the values of the economic variables based on the books of the 1st five year plan and the 1st and 2 rd years plan

Table (I)

	59/60	60/61	61/62	64/65	
C^p	991.0	1021.9	1073.4	1254.3	1302.0
S^p	87.1	157.2	227.7	211.5	101.1
Y^p	1078.1	1179.1	1301.1	1465.8	1403.1
C^g	195.2	227.7	273.8	250.3	~~371.0~~ 447.7
S^g	104.2	95.1	92.8	97.0	~~213.1~~ 137.0
Y^g	299.4	322.8	366.6	447.3	584.7
T^i	162.9	177.0	159.0	214.5	~~111.2~~ 280.3
T^d	136.5	145.8	207.6	232.8	~~473.5~~ 304.4
Y	1214.6	1324.9	1508.7	1698.6	~~1867.8~~ 1707.5
Y'	1377.5	1501.9	1667.7	1913.1	~~2044.0~~ 1987.8
I^p	28.5	49.3	67.2	137.0	38.6
I^g	175.4	256.1	295.7	214.2	430.6
I	203.9	305.4	362.9	351.2	469.2
E	235.0	241.5	249.4	302.0	367.0
M	247.6	294.6	291.8	244.7	410.8
B	12.6	53.1	42.4	-57.3	43.8
C^g+I^g	370.6	483.8	569.5	464.5	1749.7
	110.3	183.8	0.072(1508.7)	0.072(1698.6)	

1.849 1.662 108.6 122.3

.091 | 1.818 | 1223

From the values in table (I) we can calculate the parameters as given in table (II)

Table (II)

	59/60	60/61	61/62	64/65
τ^i	0.134	0.134	0.105	0.126
τ^d	0.112	0.110	0.138	0.143
μ	0.204	0.222	0.193	0.144
S	0.081	0.133	0.175	0.144
ν	1.283	1.499	1.553	0.038
S'	0.348	0.295	0.255	0.217
τ	0.246	0.244	0.243	0.269
σ	0.543	0.602	0.550	0.550
γ	0.423	0.519	0.519	0.451
E/Y	0.193	0.182	0.165	0.176
B/Y	0.011	0.040	0.028	-0.034

Now substituting in (17) and taking 6 = 0.55 we get the values of " " the rate of growth

Table (III)

	59/60	60/61	61/62	64/65
(1) $S(1-\tau^d)$	0.081(0.888) .0719	0.133(0.890) .1184	0.175(0.862) .1509	0.144(0.857) .1234
(2) $S'\tau$	0.348(0.246) .0856	0.295(0.244) .0720	0.253(.243) .0615	0.296(0.217) .0642
(3) μ - E/Y	0.010	0.040	0.028	0.034 -.1536
(1+2+3)	0.168554	0.230350	0.240329 .2404	0.153640
δ	0.0927	0.12669	0.13218	0.08450

From table II, it can easily be noted:-

(a) That the ratio of indirect taxes to income (τ^i) tends to decrease . The reason for this may be the declining rate of growth of imports. It is well-known that a great part of indirect taxes is originally import duties.

(b) With regard to the ratio of direct taxes to income (τ^d), it has shown a relative tendency to increase during the period, the 1960/61 being an exception. This is reasonable, so far as the carrying out of the plan will increase income.

(c) The most astonishing parameter is the average propensity to save in the private sector. It rises from 0.08 to 0.138 then to 0.175 in the years 1959/60, 1960/61 and 1961/62 respectively.

Here is an important question: What kinds of procedures have been implemented to raise the propensity to save in the private (houshold) sector, to such a high level, in such a short period? It is unlikely that this would be the result. If not, development in U. A. R. will be self-sustained and need not be aided from abroad. Moreover, the many procedures taken to redistribute income in the recent years will lead to less average propensity to save.

(d) The tendency for increased deficit financing of development is seen from the rising ratio of government expenditure to government income. It has risen from 1.238 to 1.499 to 1.553 to 1.638 in the years 59/60, 60/61, 61/62, 64/65 respectively.

(e) Among the distinguished rates also is the decline in the average propensity to save in the government sector.

A relation of great importance can be established as between the results stated in number c and e from these notes. A little thinking leads to the conclusion that it is difficult, if not impossible, to attain the required rate of growth of

income. The result will be an increasing inflationary tendency within the national economy.

(f) As for the capital-output ratio, it seems less than the values computed for other underdeveloped countries such as India. The more reasonable order of magnitude of this coefficient is 3 instead of 1.8. No country has attained such a low value for that coefficient except Mexico and India in 1955, where it was 1.5. There are many reasons to interpret this too low ratio:

(i) It may be due to increasing the number of shifts,

or (ii) It may be due to increased productivity,

or (iii) It can be related to good harvest in agriculture.

Whatever the reason may be, the value of 1.8 for capital-output ratio in U. A. R. is not reasonable, especially if we considered the investment structure of the last five-year plan. This structure gives a greater weight to investment in industry, electricity, housing and utilities. These investment channels are characterized by a high capital output ratio.

(g) Table III shows exceptional high rates of growth not less than 0.08 and not more than 0.13. The reason for this are that:

(i) the saving ratio is high

(ii) the capital coefficient is low

So, it is not strange that the follow-up reports showed a growth rate far less than 0.72. If we checked the figures of the frame and assumed a reasonable ratio for savings and captial-output, the result would be the other extreme. Assuming a capital-output ratio of 3 instead of 1.8, the possible rate of growth will decline to 0.05 - 0.07 annually. If the

exaggeration in estimating the saving ratio is eliminated, the rate of growth would rest at a level far below 0.072.

The final conclusion in this part of the study is that the rates of growth of national income, as computed from the frame figures are far away from fact. This leads us to inspect the possibility of doubling national income in the U. A. R. during the period 64/65 - 74/75 on the basis of a more reasonable values for capital-output ratio, and the savings ratio taking the growth of population into consideration.

PART IV

Drafiting a 10 Year plan

Using Model (I)

(4-1) In the Harrod-Domar model, we find that to set a target for economic growth, we may use the following two definitional equations

$$Y = \alpha P \qquad (1)$$

$$Y = \rho N \qquad (2)$$

where P = total population

α = National income per capital or the standard of living

N = Active labour force

ρ = Average productivity of labour

Now, if we estimate the future population (P_t) and the required standard of living in terms of real national income per capital (α_T), then the national income in year t is

$$Y_t = \alpha_t \; P_t$$

Comparing the with the national income in the base year i.e.

$$Y_o = \alpha_o \; P_o$$

we find that

$$\alpha_o \; P_o \; (1 + G_t) = \alpha_t \; P_t$$

where G_t is the growth rate over t years in real national income

If we put $1 + G_t = (1 + g)^t$

Where g is the average annual rate growth assumed to be constant over the t years, then

$$\alpha_o \; P_o \; (1 + g)^t = \alpha_t \; P_t \qquad (3)$$

Suppose that it is required to double our national income in 10 years i.e. for t = 10

$$Y_t = 2 Y_o$$

In other words

$$Y_o (1 + g)^{10} = 2 Y_o$$

Solving this equation we get

$$g = 0.072 = 7.2\%$$

This means that, in order to double our national income in 10 years, we must have an annual rate of growth 7.2%

(4-2) Consider the formula for (g) given in model (I) and assuming that there is a balance in the net creditor position i.e. imports are equal to exports, then equation (2-17) becomes

$$g = \alpha S (1 - \tau^d) + \alpha S' (\tau^i + \tau^d) \qquad (4)$$

In other words $\mu - \frac{E}{Y} = 0$.

From the data of the 1st five year plan, we can calculate the values of the parameters in the above formula. Taking 1964/65 as a base year, the values of the parameters for the 1st year in the plan are given as

$$S = 0.144$$
$$\tau^d = 0.143$$
$$S' = 0.217$$
$$\alpha = 1/3 = 0.333$$

Substituting in (4) we get

$$g = 6.1\ \%$$

This value is below that required for doubling the national income in 10 years

(4-3) In this section we are going to change one or more of the parameters as trials to raise the possible rate of growth to the required level (.072)

(i) Let us change the private saving (S), Keeping the government sarving (S'), τ^d, τ^i constant. Taking S' = 0.217, τ^i = 0.126, τ^d = 0.143 we get the following results

S	g
0.144	0.061
0.150	0.062
0.160	0.065
0.170	0.065
0.180	0.071
0.185	0.072

This means that S should be increased from 0.144 to 0.185 so that g increase from 0.061 to 0.72

(ii) Let us change the government saving (S') keeping the private saving (S), ^{d}, ^{i} constant Taking S = 0.144 , τ^i = 0.126, τ^d = 0.143 we get the following results

S'	g
0.217	0.061
0.220	0.061
0.230	0.062
0.250	0.064
0.270	0.065
0.300	0.068
0.320	0.070
0.340	0.072

This means that S' should be increased from 0.217 to 0.340 so that increases from 0.061 to 0.072

(iii) Let us change τ^i, the ratio of indirect tax to income) keeping S, S', τ^d constant. Taking S = 0.144 , τ^i= 0.126; τ^d= 143, we get the following results

i	g
0.126	0.061
0.140	0.062
0.160	0.063
0.190	0.065
0.220	0.067
0.250	0.070
0.270	0.071
0.280	0.072

From this table we find that τ^i should be increased from 0.126 to 0.280, so that g increase from 0.061 to 0.072

(IV) Let us change τ^d (the ratio of direct tax to income) Keeping S, S', τ^i constants Taking S = 0.144, S'=0.217, τ^i =0.126 we get the following results,

d	g
0.143	0.061
0.200	0.062
0.250	0.063
0.300	0.064
0.400	0.067
0.500	0.069
0.600	0.072

This means that τ^d should be increased from 0.143 to 0.600 so that g increase from 0.061 to 0.072

From the above analysis, we find that the parameter which can be changed least to attain to target is the private saving (S).

Of course there are an infinity of other ways which depend on changing more than one parameter at a time. The following two examples are given as illustration:-

Example(1) Suppose that the proportion of government c. investments will be increased gradually after the base year 1964/1965 by decreasing the expenditure on services and direct it to industrialization. Raising the rate of privat investments from 0.144 in the base year to 0.160 we get

S	S'	g
0.160	0.230	0.066
0.160	0.270	0.069
0.160	0.300	0.072

Where τ^d = 0.143 and τ^i = 0.126 . From the above table we find that the required rate of growth 7.2% can be realized by raising the parameter S' to the value 0.300.

Example (2) If the government's policy has been directed to encourage the private investment by different means in case of raising the rate of direct and indirect taxes from τ^d = 0.143 to τ^d = 0.200 and from τ^i = 0.126 to τ^i = 0.160, we get

i	d	S S	g
0.160	0.200	0.150	0.065
0.160	0.200	0.165	0.069
0.160	0.200	0.175	0.075

From the above table, the rate of growth would achieve the general target of doubling the national income if the parameter S reaches the value 0.175.

(4 - 4) From the analysis presented in the above section, the values of the parameters required to attain our target are

$S = 0.185$ $\qquad$ $S' = 0.217$

$\tau^i = 0.126$ $\qquad$ $\tau^d = 0.143$

In other words, using these values and taking into consideration that the annual rate of growth is 0.072, we are able to double the national income in 10 years starting from 1964/65. Accordingly the values of the economic variables are calculated and given in the following table.

	64 / 65	65 / 66	66 / 67	67 / 68	68 / 69	69 / 70
C^p	1254.3	1084.8	1181.0	1246.0	1336.4	1432.5
S^p	211.5	246.25	264.01	283.0	303.4	325.2
Y^p	1465.8	1331.1	1427.1	1529.6	1639.0	1757.8
C^g	250.3	383.5	411.2	440.7	472.5	506.5
S^g	97.0	106.9	113.9	122.1	130.9	140.4
Y^g	447.3	489.8	525.1	562.9	603.4	646.9
τ^i	214.5	229.4	245.9	263.7	282.6	303.0
τ	232.8	260.4	279.1	299.2	320.8	343.9
Y	1698.6	1820.9	1952.0	2092.5	2243.2	2404.7
Y^l	1913.1	2050.3	2197.9	2356.2	2525.8	2707.7
I^p	137.0	254.1	244.1	292.7	312.9	335.5
I^g	214.2	327.9	351.6	376.8	404.0	433.1
I	351.2	582.0	595.7	669.5	716.9	768.6
E	302.0	262.2	281.1	301.3	323.0	346.3
M	244.7	262.2	281.1	301.3	323.0	346.3
B	-57.3	0	0	0	0	0
C^g+I^g	464.5	711.4	762.8	817.5	876.5	939.6
Y_t	1698.6	1820.9	1952.0	2092.5	2243.2	2407.7

	70/71	71/72	72/73	73/74	74/75
C^p	1535.8	1646.5	1764.9	1891.8	2028.2
S^p	348.6	373.7	400.6	429.5	460.4
Y^p	1884.4	2020.2	2165.5	2165.5	2488.6
C^g	543.0	581.9	624.0	668.9	717.1
S^g	150.5	161.3	172.9	185.4	198.7
Y^g	693.5	743.2	796.9	854.3	915.8
T^i	324.8	348.2	373.3	400.1	428.9
T^d	368.6	395.2	423.6	454.1	496.8
Y	2577.9	2763.4	2962.4	3175.7	3404.4
Y'	2902.7	3111.6	3335.7	3575.8	3833.3
I^p	359.6	385.7	413.3	443.1	474.9
I^g	464.3	497.5	533.5	571.9	613.1
I	823.9	883.2	946.8	1015.0	1088.0
E	371.2	397.9	426.6	457.3	490.2
M	371.2	397.9	426.6	457.3	490.2
B	0	0	0	0	0
$C^g + I^g$	1007.3	1079.4	1157.5	1240.8	1330.2
Y_t	2577.9	2763.4	2962.4	3175.7	3404.4