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# EXPERIENCE OF SOME AFRICAN AND MIDDLE EAST COUNTRIES IN THE PROJECTIONS OF DEMAND AND PRODUCTION 1/

by

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CONTENTS

## 1. INTRODUCTION.

Little could be described as sophisticated in the methodology of projecting demand and production actually used in African and Middle Eastern Countries. The main difficulties are those typical in the developing countries at large. First and foremost, there is the lack of statistical data needed to construct a time series of the variables to be incorporated in an appropriate mathematical model; and they are not only scarce but also inaccurate. The immediate result of this is that planners base their projections on very simple models which neglect the important characteristics particular to specific countries, and therefore do not reflect any realities. Second, most of the economies in Africa and the Middle East are mixed economies in which the application of econometric models is not as simple as it is in the market economies; the governments' measures being motivated by considerations which are not purely economic and which are in many instances unpredictable. Third, studies based on inter-country analysis are of limited use when applied to developing countries as long as the economic structure of the countries is not taken as an additional variable in the model. Another difficulty of considerable importance is the lack of qualified personnel engaged in this field.

The present note is more of a report than a paper on the actual experience of certain African and Middle Eastern countries in projecting demand and production of industrial goods. It concentrates on the methods

which have actually been used and does not attempt to develop any new methods or go into deep appraisal of the results obtained to judge the predictive power of the models and methods used.

Since only very little on official government reports is accessible to the author for the countries to be covered, the paper will depend mainly on studies undertaken by United Nations Organizations and by individuals. It will deal with the experience of forecasting by following a three-stage procedure: Macro-economic projections, then sectoral projections and finally projections on the commodity level. Use of mathematical models of the Harrod-Domar type will be considered, in connection with their application in African and Middle Eastern countries. The use of input-output analysis will also be considered. This will depend on an old paper on the problems and practices of African countries and on a paper by Elkish on the applicability and utilization of the input-output model in Egypt, and will also refer to the experience of Tunisia in this respect. Some other examples on commodity projections are given and a quick comparison between the various methods used in these studies will be presented.

## 2. The ECA Study on North Africa

The ECA study on North African industrial harmonization deals with the future economic development of the six Arab African countries, projected over the period 1970-1980.

The procedure here consists of 3 steps. The first concerns itself with forecasting macroeconomic indicators such as population,

gross domestic product, exports, imports, consumption, gross fixed capital formation, etc., by using a simple extended version of the Harrod-Domar model. These projections of macro indicators will then be used in making forecasts on the sectoral level, and these in turn are taken, together with the macro projections, as a basis on which commodity projections are made.

The macroeconomic development up to 1980 was estimated by simple projection models in which changes in the economic structure of the six countries (during the period of projections) were taken into consideration by modifying the parameters reflecting the economic structure over time. The macro projections were, however, made in three stages. In the first, provisional rough estimates for 1970, 1975 and 1980 on gross domestic product, its industrial origin, consumption and capital formation were made. This was to facilitate the work of the sector experts in their sector studies. These estimates were taken as a starting point in the second stage where the simple projection models referred to above were applied to provide a more detailed analysis for the possible future development. A consistent set of projections for gross domestic product, imports, categories of demand, savings and the balance of payments was then obtained. Given these projections, the future sectoral development by broad economic sectors was examined in the last stage, covering agriculture, construction, energy and services in order to determine which rate of growth of manufacturing would be compatible with the projected rate of growth for GDP.

The models used for projections varied between the countries. A simple model for an open economy was used for Morocco, Tunisia and Egypt, which assumed that capital was the only scarce factor of production. It consisted of a production function relating changes in capital formation to changes in gross domestic product. Commodity imports were subdivided by end use into consumption goods, investment goods and raw materials and semi-finished products, each depending on appropriate variables. Imported services, export of goods and services and government consumption were all assumed to grow autonomously. The rate of growth of gross domestic product is determined in this model by the initial level of capital formation, the capital-output ratio, the level and rate of expansion of exports and on the marginal import ratios, and may therefore differ from a planned rate of growth. Also, the inflow of foreign capital determined by the model might exceed what is to be expected. For these reasons, two slightly different versions of the model were formulated in order to allow for the rate of growth for GDP or the inflow of foreign capital to be determined in advance. The original model is given in appendix I.

For Algeria, an even simpler version of the Harrod-Domar model was used to allow for the nonavailability of historical data after 1958. For Libya, the model distinguished between three sectors: the petroleum sector, all national sectors together and all inter national industries. Production in the first sector was made to depend on foreign demand, in the second sector on production in the petroleum sector, and in the third sector production was determined exogenously.

A savings function, import functions and other definitional equations were also added.

For the Sudan, the model distinguished between the traditional sector and the modern sector, the first having a constant rate of growth determined exogenously, while growth of the second depends on the investments made in it. A consumption function, import functions and a relation expressing government revenue as a function of national income are also included in the model.

The second stage dealt with sectoral projections to determine the extent to which the main sectors of production contribute to the future development of gross domestic product. The development of agriculture was estimated by experts, and the development of the construction sector was explained by the variations in the volume of future investments. Energy and services were projected using the growth elasticity approach with respect to GDP. The growth of the services sector was assumed to be proportional to the growth of GDP, whereas for energy, elasticities based on past observations, which were found to be above one, were used. The future development of the manufacturing sector was then taken as the difference between the projected value of GDP and the sum of projected values of the other sectors.

On the basis of the provisional projections of macroeconomic indicators, sector experts made projections covering all the manufacturing industry subdivided according to the old two-digit ISIC classification with the addition of five mining sectors. Four items were

chosen to characterize sectoral developments: Value added, export, import and capital formation. The ECA report justifies having taken these items in particular in the following way. Value added measures the contribution of each industry in GDP, and for the manufacturing sectors it could be assumed that the ratio of value added to total production would be rather stable in the short run so that rates of growth in percentages derived for value added will provide good approximations to the corresponding growth rates for production. Exports were chosen because of the importance usually attached to its composition. On a commodity basis, the structure of exports becomes more diversified in the course of development, and therefore attention is also given to the projected share of manufactured goods in total exports and to the projected share in its composition.

Imports were included to study the import substitutions made by the experts for the various sectors. An analysis of the composition of imports of manufactured goods was considered less useful than in the case of exports, because such imports are usually less concentrated in a few sectors. New fixed capital formation was taken to demonstrate the extent to which the projected increases in production for the manufacturing industries would require the use of capital.

Confrontations were then made between macro and sectoral projections and experts' projections, and what were thought were appropriate corrections were carried out. Macro and sectoral indicators were then taken as explanatory variables in projections on the commodity level. Unfortunately, the ECA report does not say much about this

stage of work, but it is thought that simple regression models were taken with regressors chosen from the above indicators.

### 3. The UNESOB Study on Countries of the Middle East

The study by the UNESOB is concerned with long-term development perspectives, in an attempt to outline a development strategy for the Middle East with a time horizon extending to the year 2000. The study is based on the assumption that over a period of two or three decades, some of the conflicts between objectives tend to resolve themselves, and that certain problems connected with technological changes, demography, education, etc., can only be adequately dealt with over a long period of time.

The countries covered by this study are the Arab countries east of the Suez Canal. The methodology draws mainly on the work by Chenery & Taylor which consisted of estimating regression equations describing inter-country (cross-section) patterns of growth for major sectors and country groups; then comparing post-war changes in each group of countries with the inter-country regressions and with time-series patterns drawn for some advanced countries, and finally analyse some twelve sectors of the industry in order to provide a disaggregated view of production patterns. The dependent variables in the regression equations are the share of primary production, share of industry and share of services in the gross national product. The explanatory variables are per capita gross national product, population, share of gross fixed capital formation in GNP, share of primary exports in GNP and

share of manufactured exports in GNP. The sample taken by Chenery and Taylor covers 54 countries ranging from least to most developed, and different forms of relationships were tried on all the sample observations and also on subgroups of the sample with a view to isolate the effects of income level, size and patterns of trade. The distinction between large countries and small countries gave an idea on the effect of size, and the distinction according to the degree of industrialization measured the effect of trade patterns and the availability of natural resources in small countries.

The pattern of structural change depicted in the study of Chenery and Taylor and that developed in the study of Kuznets was used in the UNESOB study with variables of income, population and exports of the countries concerned in order to determine the normal structural change that could be expected in association with projected changes in the variables. This study also follows Chenery and Taylor's assertion that the projected industrial structure does not move to reach the normal cross-country structure, but the majority of countries tend to move parallel to that normal structure, thus maintaining a degree of allowance for the individual characteristics of the countries, reflecting differences in long-term comparative advantage.

The study set out growth targets which assume that the region concerned will tend in the long run towards more integration and less inequality in the stages of development. It also assumes that a long-term development strategy of the region should be based on some geographical and geological advantages. This would include:

1) The development of sea, air and land transportation services, especially that the region is expected to increase tremendously its exports of oil and nonprimary goods.
2) The development of fishing and marine resource industries.
3) The development of industrial complexes based on interdependence with strategic sectors.
4) The development of agricultural potential.
5) The development of capital goods industries.
6) The development of science-based industries and investment in research and development.

The study examines the changes connected with bridging the development gap between the region and the developed market economies, as reflected not only by the difference in per capita gross national product but also by agricultural and industrial productivity. This investigation was necessary in order to determine the rate of growth in GNP per capita which should be achieved so that the development gap is almost eliminated within a specified time horizon. It was considered reasonable for countries of the region as a group to try in the long run to achieve a rate of growth of GNP of 4 percent, but whether this should be feasible or not could not be judged since this should depend to a large extent on the historical trends of the economy, information on which is very meagre in the region under study. It could be said, however, that in Iraq, Lebanon, Syria and Jordan, the growth of GNP in the last few years was at a rate which was never below 5 per cent and sometimes as high as 8 per cent, but has been showing

[illegible] growth of [illegible] those countries will be [illegible] non-oil productive sector.

The study concluded that the region was at a turning point so that basing the future patterns on the past performance was not possible and therefore resorted to dealing with the question of feasibility by indicating the varying conditions under which alternative growth targets are feasible. The study went on to analyse savings ratios and capital-output ratios in the countries of the region and came out with a table giving average annual rates of growth for these countries based on the assumption of the stability of the investment ratios which prevailed in the recent past and also assuming alternative levels of the capital-output ratios, and it was argued that the rates given were the least attainable.

Three growth variants were put forward: the first is for the region to catch up with the USA within 100 years, the second is to reach in the year 2000 the present level of average European per capita GNP, and the third is to reach in the year 2000 the present level in the developed market economies. Assuming high and low limits of the capital-output ratios, it was found that from the standpoint of investment ratio the first variant was in general feasible for all countries in the region, but the second and third variants were only feasible for some countries. The first variant also appeared to be the most feasible from the standpoint of the savings ratio.

Chenery and Taylor's equations [illegible] were then used to estimate the relative shares in value added of the main sectors: agriculture and mining, manufacturing and construction, and all other sectors. These estimates were referred to as the normal pattern, and were then compared with the actual figures appearing in the national accounts of the countries for the base period (1969).

For Iraq, Lebanon, Syria and Jordan, the relative shares in total manufacturing of industrial branches, disaggregated up to two digits of ISIC, were also given both for base-year actual values and for estimated values derived from cross-section equations. The study of the industrial breakdown would then reveal those branches of the manufacturing industries which have larger values and those which have smaller values than the corresponding estimated values. Being above normal or below normal could then be ascribed to comparative advantages, and in certain cases could be ascribed to over-performance or under-performance. In the latter case, a correction could be sought by trying to get closer to the norm, whenever such deviation is identified. The projections are then based on the assumption that the deviations are due to the individual characteristics of the countries concerned, and will then make the economy move parallel to the normal pattern, maintaining a certain degree of relative deviation from the normal.

The projections for the manufacturing industry disaggregated into 12 subsectors were done using a procedure similar to that used in the sectoral projections, but were adjusted for consistency with the

projected manufacturing totals.

## 4. Planning in Tunisia

The projection studies undertaken in Tunisia deserve a special exposition. These were started by a global model prepared by Svennilson, and later continued by Yeganeh who prepared a table on inter-industrial relationships which was used for sectoral projections for 10 years. The Svennilson model had for objective to show the effects on the plan of investments, savings, balance of payments and of a policy of unemployment absorption. Svennilson starts from the active population as given by the 1956 census. Finding that the number of unemployed and of persons without profitable occupations was very large, he proposed a development strategy based mainly on the necessity of providing profitable jobs for the tunisian labour force. Consequently all the development strategy that he suggests is based on the necessity to achieve full-employment.

He first establishes a projection of the active population for 10 years, and starting from this projection he builds his strategy:

- Agriculture is to absorb the largest part of the increase in the labour force.
- Increase of industrial jobs is to be comparatively moderate; due to required expenditures.

He then studies the consequences of such a strategy on production, investment, savings and external aid. His projections of production

were based on some assumptions concerning the growth of productivity within the different sectors, and to estimate the necessary net investments, he relied on a capital coefficient (2.5) which was slightly lower than that observed in developed countries.

Planning was done in 2 phases: in the first one basic data needed for projections were elaborated; and in the second the projections themselves were done. These data helped to achieve the first relatively detailed projections for the tunisian economy. Projection was done for the period 1960-1970, using data for 1957, and computations were also done for the year 1971. For these projections, a very global model was used, then a sectoral model which allowed the disaggregation of results obtained from the first model.

The Global model: This model involved six aggregates:

- Gross domestic product (P)
- Deficit in goods and services (D)
- Household consumption ($C_m$)
- Government consumption ($C_a$)
- New fixed capital formation ($I_m$)
- depreciation (A)

These variables were linked by 3 relations, of which one is an equilibrium relation, while the other two are technical relations.

Equilibrium relationship:

$$P + D = C_m + C_a + I_m + A \qquad (1)$$

Technical relationships:

The first is the production function including labour and capital,

with the assumption that there is no possibility of substitution between them. Capital was the only restriction on production.

The production function used in this model was:

$$P = \rho K + \text{constant}$$

where K is the available stock of capital.

The function means that GDP in a given year is dependent linearly on capital existing at the beginning of the year. The coefficient ($\rho$) is a rate of global rentability of capital. It is supposed to be constant through time. The other constant of the equation can be eliminated by the introduction of quantities related to two different years:

$$P_{t+m} - P_t = \rho ( K_{t+m} - K_t )$$

If we consider two consecutive years (t+1)& t, we have:

$$P_{t+1} - P_t = \rho ( K_{t+1} - K_t ) = \rho I_t$$

The second technical equation gives the relationship between depreciation and the existing productive equipment:

$$A = \frac{1}{\theta} K + \text{constant.}$$

which gives

$$A_{t+1} - A_t = \frac{1}{\theta} (K_{t+1} - K_t) = \frac{1}{\theta} I_t \qquad (3)$$

$\frac{1}{\theta}$ being a parameter constant through time, and $\theta$ represents the average life of existing equipment. $\rho$ and $\theta$ are then estimated statistically and $P$, $C_a$ and $I_a$ determined exogenously. The model would then allow the computation of the investment (net and gross) necessary for the realisation of the planned growth in production and the deficit of

transactions in goods and services with foreign countries. This was done with data for the base year, according to the following formulas:

$$4)\quad I_t = \frac{t}{\delta} I_t - \frac{t-1}{\delta} I_t$$

$$= \frac{1}{p} ( P_{t+1} - P_t ) = \frac{r}{p} P_t$$

r : annual growth rate for $P_t$

$$5)\quad A_t = A^0 + a \frac{t-1}{\delta} I_t = A^0 + \frac{a}{p} ( P - P^0)$$

$$6)\quad D_t = C_{at} + C_{mt} + I_t - P_t$$

Sectoral Model: These projections were done for about 160 products grouped into 22 sectors. These sectors are:

1- Agriculture

2- Extractive industries and Manufacturing industries

3- Food industries

4- Beverages

5- Tobacco

6- Textiles

7- Clothing

8- Wooden products and furniture

9- Paper and paper products

10-Printing and Editing

11-Leather and shoes

12-Rubber products

13-Chemical products

14-Petroleum and coal extracts

15-Non metallic mineral products

16 -Metallurgical industries, machines, electric tools and transport material.

17- Different manufactures

18- Constructions

19- Electricity, gaz and water

20- Trade, banks and insurances

21- Transportation and communication

22- Services.

To pass from global projections to the stated sectoral projections, the method is as follows:

First stage: Projection of the final consumption of the 160 products for each of the consumers groups: Administration, European population, rural tunisian population and other tunisian. For each of these groups, the consumption of any product i was obtained by the formula:

$$C_{ni} = C_{oi} (1+p)^n (1+\alpha_i r)^n$$

where $C_{ni}$ = consumption of product i for the year r (i.e. for the final year of the projection.)

$C_{oi}$ = consumption of product i in the base year (1957)

$p$ = annual growth rate of population

$\alpha_i$ = coefficient of elasticity of consumption of product i related to total consumption.

$r$ = annual growth rate of total consumption.

This formula was proven as follows:

by definition: $\dfrac{\dfrac{\Delta C_i}{C_i}}{\dfrac{\Delta C}{C}} = \dfrac{\dfrac{\Delta C_i}{C_i}}{r}$

where $C_i$: consumption of i

C : total consumption.

For any year, consumption of (i) is equal to that of the previous year multiplied by population growth, and by growth due to increase in total consumption:

$$C1_i = C_{oi} \ (1+p) \ ( \ 1+ \frac{\Delta C_i}{C_i} \ ) = C^o1 \ (1+p)(1+\alpha_i \ r)$$

and for n years :

$$C_{ni} = C_{oi} \ (1+p)n(1+\alpha_i r)n$$

Constant elasticities were assumed for each of those sectors.

Second Stage: Evaluation of production, imports and exports of all final products. These projections were done by different approaches:

- Extrapolation of past trends
- Determination of the technical possibilities of increasing production by utilizing unused capacity, and by increasing this capacity.
- Results of previous approach were then compared with the projected final consumption. When production objective was found to be higher than this consumption, exportation opportunities were examined.

Third Stage: Exogenous projection of the products of the following sectors: Agriculture - extractive industries and of some services (education, health, etc.,) Assession of production of the extractive industries was started from known natural resources and main possible utilization.

Fourth Stage: Determination of what was called 'auto consumption' of each sector. i.e. consumption by each sector of its own products. By using the transformation coefficient in the base year, it was possible to determine this auto consumption product by product for all sectors.

Fifth Stage: Evaluation of the production of completely endegenous

sectors, such as 'electricity, gas and water', oil products, metallurgical industries. For each of the products of these sectors, intermediate consumptions of other sectors was estimated, since they constitute total production. The determination of the intermediate consumption of these sectors plus the final consumption allowed the determination of production and imports figures for different products.

Sixth Stage: This work was concluded by an estimation of needed investments. These were decomposed into 'Construction' and 'equipment'.

The methods used to project the tunisian economy by sector had the following characteristics:

1- It was not accepted to use automatically the technical coefficients of the inter-industry table of 1957, and was preferred to start from detailed projections by product, within the frame of what is called 'input-output' balances.

2- In the case where a new production is projected, technical coefficients of some foreign countries were used.

3- In the case of endogenous sectors, technical coefficients of the inter-industry exchanges table of 1957 were used.

So that the matrix of technical coefficients used for projection looks like the sum of three matrices:

- A matrix related to the autoconsumption of sectors, and of which the terms were computed from transformation coefficients product by product.
- A matrix related to new productions, and of which the elements are obtained from information concerning other countries.

- The matrix of technical coefficients of the Tunisian 'input-output' table for the sectors called endogenous.

Once the projection of the intermediate consumptions was made, it was possible to compute for 1971 the value added by sector as a difference between production and intermediate consumption. These projections had two types of imperfections:

- Imperfections due to the character of the model itself, which was very detailed for goods and services operations, but rather incomplete with regard to other operations.
- Imperfections due to missing statistics observations and to the lack of concrete information regarding future perspectives.

These imperfections have led to the more complete and more global model given in appendix 2.

## 5. Other Projections by Input-Output Tables

Some effort has been made in some African countries towards constructing input-output tables. Despite the fact that there are enormous difficulties in the compilation of data necessary for input-output tables in developing countries, some 20 African countries have embarked on this task either by the planning authorities or through United Nations Organizations and foreign agencies. In most cases, however, such tables are not adequate enough to be used for projection purposes. In the first place, the lack and inaccuracy of the data render those tables unreliable. Second, the structure of the developing economies in general provides us with technical coefficients which are hardly

interdependent, the structural relationships among the productive sectors in those countries being very weak. The tables prepared for the Gold Coast and Tanganyika are examples of this. Third, the technical coefficients could be extremely unstable due to changes in the technology, the scale of production and in relative prices. An input-output table normally takes years to compile, and by the time it is ready for use it is already out of date.

Perhaps Egypt's experience in the construction and use of input-output tables was the most useful among the other African and Middle Eastern countries. Despite the heavy reliance on imports at the time of constructing the table, it became apparent that considerable interdependency existed among the various productive sectors. It was also realized by the planners that the technical coefficients produced will not be very stable except in the short run, and that in order to use the input-output table in projecting the levels of production in a future year it would be necessary to introduce the necessary changes on those coefficients to take into account import substitutions and changes in the scale of production and in relative prices.

The Egyptian table of 1954 (83 X 83) and that of 1959 (33 X 33), were used in economic planning and forecasting. Along with the calculation of foreign currency requirements, testing the effect of an import substitution policy, the choice of investments, etc., input-output tables were repeatedly and successfully used in Egypt to calculate the requirements of investment programmes. This involved the calculation of the production required from each sector to meet the investment programmes.

## 6. Other Studies

In this section we present a quick summary of two projections on the commodity level. The first is a study of the development of the engineering industries in North Africa undertaken by ECA. It used two methods for projecting the demand for engineering goods. The first consisted of establishing a simple relationship between GDP per capita and total direct and indirect iron and steel consumption per capita. The relation was linear in the logarithms of the two variables. The second method consisted of estimating the capital formation, final consumption and intermediate consumption components of projected GDP, and then establishing their engineering goods content. The estimate of capital formation in each sector is obtained by applying suitable incremental capital-output ratios C to the given rates of growth of the various sectors according to the formula:

$$p = gC$$

where p is the proportion of GDP devoted to capital formation and g the rate of growth. The value figures were then converted into weights on the basis of the average prices for the main categories.

The other study is concerned with estimating the influence of increases in literacy on the consumption of cultural paper. It was undertaken by FAO as a part of a study on pulp and paper development in Africa and the Near East, and it drew upon another study which was undertaken by the Institute for International Economic Studies, Stockholm. The method of estimation is given below:

Let $y = f(x, z)$

be the demand function giving per capita consumption of cultural paper, y,

as dependent on per capita income $x$ and leteracy of adults, z. From this we can write

$$\text{Log } y = E_{y.x} \log x + E_{y.z} \log z$$

where $E_{y.x}$ and $E_{y.z}$ are the partial elasticities of y with respect to $x$ and z respectively. By a cross-sectional analysis of the world's consumption of cultural paper, y is shown to be a loguormal function of $x$ :

$$y = F(x)$$

If literacy could also be thought of as being correlated with income, then

$$y = f(x, z(x))$$

and the total elasticity of y with respect to $x$ could then be written as

$$E_{t.x} = \frac{d \log y}{d \log x} = \frac{x}{y} \frac{\partial y}{\partial x} + \frac{\partial y}{\partial z} \frac{dz}{dx}$$

$$= E_{y.x} + (E_{y.z})(E_{z.x})$$

If the rates of increase of y, $x$ and z during n years are a, b and c respectively, and if we could assume constant elasticities during those years, we then have

$$n \log (1+a) = n E_{y.x} \log (1+b) + n E_{y.z} \log(1+c)$$

Thus if we know the rate of growth of income and the rate of growth of literacy and the two partial elasticities, the rate of growth of consumption would be immediately obtained.

## 7. Concluding Remarks

In the previous sections we presented an outline of some of the actual experiences of projections in selected African and Middle

Eastern countries, which were considered by the author to be of the important studies undertaken in the field of projections. Another important study which was not reported here is now being undertaken by the Industrial Development Center for Arab States in collaboration with UNIDO, which runs more or less on the lines of the study by ECA on North African Industrial Harmonization, but makes use of cross-section inter-country elasticities both at the sectoral level and on the commodity level, whenever time-series data is lacking. Commodity balances are, however, compiled for some countries and some industrial commodities over a period of 10 to 12 years and projections based on such series are confronted with those derived from the cross-section analysis.

Projections based on input-output analysis could not be considered of much value in the countries of this region. The case of Egypt stands out, its experience in this respect was very useful and very encouraging, but its input-output table does not have, at the moment, more than a historical value. It certainly should be revised drastically, and more attention should be paid to the projections of the future values of the technical coefficients.

Much of the other projections made all over the African and Middle Eastern countries are rather naive, and are simple extrapolations of past trends. The ECA paper presented in section 2 is undoubtedly one of the best pieces of projection work done in this region, but its reliance on 5 observations only in the macro projections reduces to some extent the degree of reliability on the figures arrived.

However, it was the best that could have been obtained under the circumstances. The projections made by the UNESOB are, in the opinion of the author, rather daring. The long-term coverage and the assumptions of the variants of growth given in that study does not allow us to think of the projections given there but as being only tentative.

## Appendix 1.

### Projection Model for Morocco, Tunisia and Egypt.

( taken from the study by the Economic Commission for Africa on North African Industrial Harmonization).

**Variables:**

$Y$ : gross domestic product

$C$ : total consumption

$C^p$ : private consumption

$C^g$ : government consumption

$I$ : gross capital formation

$E$ : exports of goods and services

$E^h$ : exports of good/service h

$M$ : imports of goods and services

$M^c$ : imports of consumption goods

$M^I$ : imports of capital goods

$M^R$ : imports of raw materials and semi-finished products

$M^s$ : imports of services

$S$ : gross savings

$R$ : net factor income plus net current transfers

$D$ : deficit on current account

(Barred variables indicate absolute levels. Variables without a bar are changes over time with respect to the level of a variable in year t)

**Parameters:**

$\kappa$ : marginal capital-income ratio

$\mu$ : marginal import ratio

$\mu^c$ : marginal import ratio for consumption goods

$\mu^I$ : marginal import ratio for capital goods

$\mu^R$ : marginal import ratio for raw materials

$\mu^s$ : cumulative growth rate of imported services

$c$ : cumulative growth rate of exports

$c^h$ : cumulative growth rate of export of good/service h

$p$ : cumulative growth rate of new factor income plus net current transfers.

$z$ : cumulative growth rate of government consumption

$\sigma$ : marginal savings ratio

**The Model :**

(1) $\aleph Y_5 = \sum_{t=0}^{4} \bar{I}_t = 5\bar{I}_0 + 10\Delta I$

where

$$\Delta I = \bar{I}_{t+1} - \bar{I}_t , \qquad t = 0, \ldots, 4$$

(2) $I_5 = (\bar{I}_0 + 5\Delta I) - \bar{I}_0$

(3) $I = 0.5\aleph Y - 2.5\bar{I}$

(4) $S = \sigma Y$

(5) $M^C = \mu^C C$

(6) $M^I = \mu^I I$

(7) $M^R = \mu^R Y$

(8) $M^S = \mu^S \bar{M}^S$

(9) $M = M^C + M^I + M^R + M^S$

(10) $E = \bar{E}$ (from $\sum E^h = \sum c^h \bar{E}^h$)

(11) $I = S + D$

(12) $D = M - E - p^{\bar{R}}$

(13) $Y = C + I + E - M$

(14) $C^g = z\bar{C}^g$

(15) $C^p = C - C^g$

## Appendix 2.

## Tunisia's Complete Model.

This model consisted of the following sixteen unknowns:

$V$ = Sales

$D$ = Deficit

$A$ = Purchases

$C_p$ = Private consumption

$C_a$ = Government consumption

$W_e$ = Revenue paid by enterprises to households

$W_a$ = Wages

$H_e$ = Current transfers

$T_e$ = Taxes paid by enterprises

$T_p$ = Taxes paid by individuals

$E_e$ = Gross savings by enterprises

$E_p$ = Gross savings by individuals

$E_a$ = Gross savings by government

$H_K$ = Inflow of foreign capital

$I$ = Capital formation

$A_s$ = Increase of stocks.

These sixteen unknowns are linked by twelve equations forming the structure of the model. These equations include 5 equilibrium relations, 2 technico-economic relations, and 5 behavioural and structural relations.

Equilibrium relations:

$$V = A + W_e + T_e + E_e \quad (1)$$

$$W_e + W_a + H_e = C_p + T_p + E_p \quad (2)$$

$$T_e + T_p = C_a + W_a + E_a \quad (3)$$

$$D = H_e + H_K \quad (4)$$

$$E_a + E_p + E_a + H_K = I + A_s \quad (5)$$

- Technico-economic relations:

$$\frac{A}{V} = \frac{A^o}{V^o} \quad (6)$$

$$\frac{A_s}{V} = \frac{A_{so}}{V^o} \quad (7)$$

- Behavioural Relations:

$$\frac{W_e}{0.74} = \frac{T_e}{0.20} = \frac{E_e}{0.06} \quad (8 \& 9)$$

$$\frac{C_p}{0.86} = \frac{T_p}{0.01} = \frac{E_p}{0.13} \quad (10 \& 11)$$

$$\frac{C_a}{0.15} = \frac{W_a}{0.85} \quad (12)$$

N.B. Variable with the subscript e refer to 1957.

To these 12 relations are added the predetermined objectives, which are:

- Gross investment to be realised in Tunisia at the end of the period, and was assumed to be proportional to GDP

$$I = \lambda \left[(V-A) + T_e + T_p\right] \quad (13)$$

- Private consumption $C_p$, for which the growth rate accepted between 1957 and 1970 is 4% :

$$C_p = 1.67\ C_p^o$$

$C_p^o$ being consumption in 1957, and $C_p$ being consumption in 1970, and the numerical factor 1.67 representing the 4 % growth rate per year.

- Government expenditures $C_a + W_a$, for which also a 4 % annual growth rate was assumed:

$$C_a + W_a = 1{,}67 \; ( C_{ao} + W_{ao} )$$

The model then had 15 relations with 16 unknowns. the inflow of foreign capital was then determined exogenously in order for the model to be solvable.

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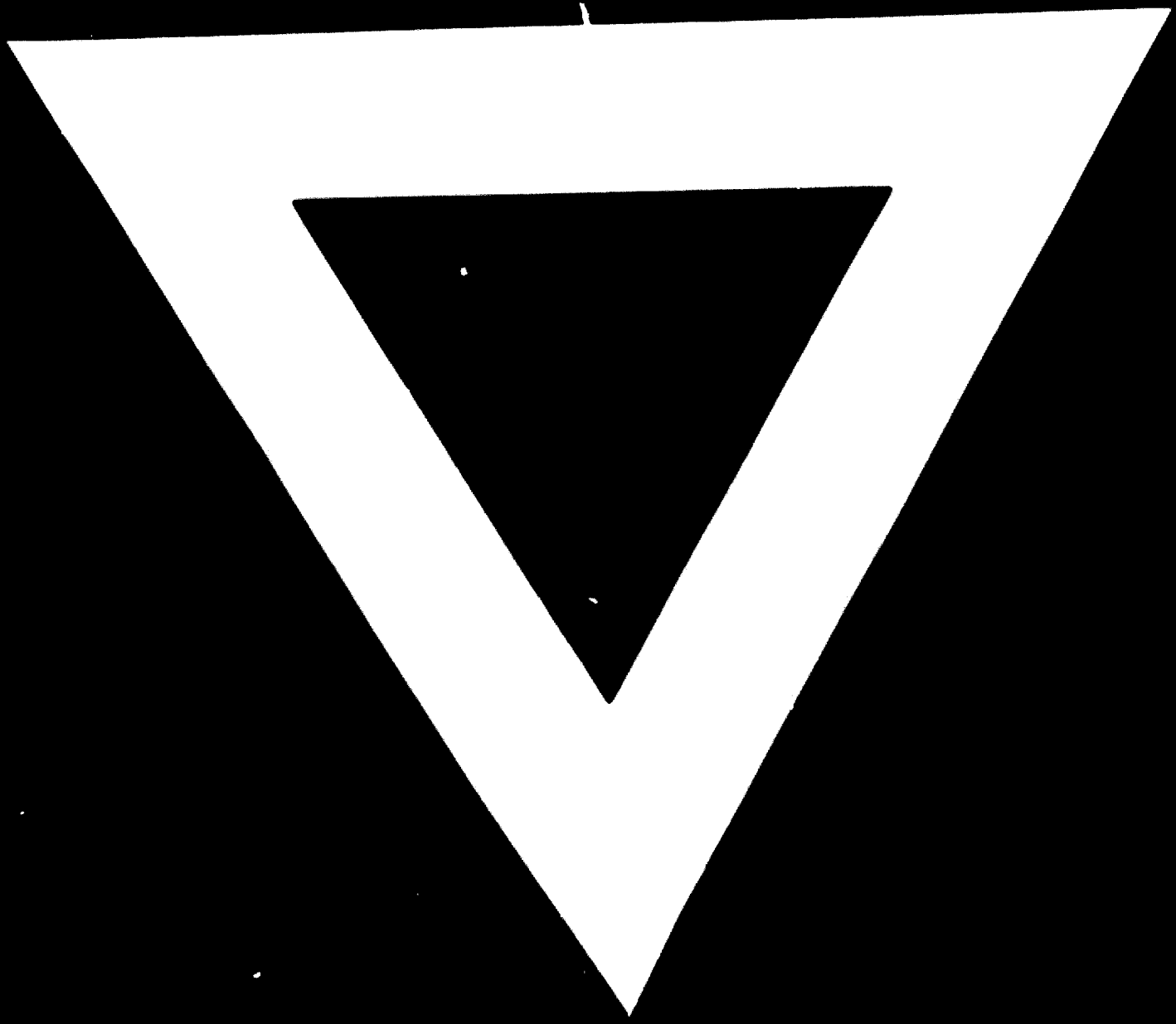

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