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SMEE 1: A SIMULATION MODEL OF THE EGYPTIAN ECONOMY WITH SPECIAL EMPHASIS ON ECONOMIC-DEMOGRAPHIC INTERACTIONS

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* The labour required for producing this paper was divided between the two authors as follows: El-Issawy was in charge of elaborating the theoretical framework, data preparation, parameter estimation, and designing the empirical work on model validation and policy simulation. El-Shafei was in charge of computer programming and execution of the simulation runs. The preparation of this document was the special responsibility of I. El-Issawy.

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I

INTRODUCTION

1.1 Background and Objectives:

The Food and Agriculture Organization of the United Nations(FAO) has embarked on a series of methodological studies, under the auspicies of the United Nations Fund for Population Activities(UNFPA), focussing on the interactions between population, employment and productivity with special emphasis on the agricultural sector in a multisectoral, long-term perspective study. A major objective of these studies is to assist underdeveloped countries in integrating more fully the population component and agricultural development programs into their development planning. Given this objective, the Policy Analysis Division of FAO has developed a simulation model, henceforth referred to as the Martos Model, under certain specific assumptions[1]. The model is essentially a prototype and its application in specific country case studies may therefore require a certain

1) Bela Martos, Long-term Employment Simulation Model, First Report, The Model, FAO long-term Employment Simulation Project PA 4/1 INT/73/P02 Working Paper Series No. 1, Rome: Policy Analysis Division, FAO, May 1974.

amount of adaptation and modification. It has been used in two experimental studies: one for Egypt[1], the other for Pakistan[2].

Given this background, and following a number of previous studies which were sponsored by FAO and carried out at the Institute of National Planning(INP), Cairo,[3] it appeared appropriate to choose Egypt for further adaptation and testing of the Martos Model. This document describes the modified version of the Martos model and presents the results of its use in an experimental study based on available data on the Egyptian economy[4]. The modifications were aimed at enabling the model to depict more accurately the

1) Wuu-Long Lin and M.C. Ottaviani-Carra, A systems Simulation Approach to integrated Population and Economic planning, FAO long-term Employment Simulation Project PA 4/T INT/73/P62 Working Paper Series No. 7, Rome: Policy Analysis Division, FAO, Aug. 1975.

2) A Systems Simulation Approach to Integrated Population and Economic Planning with Special Emphasis on Agricultural Development and Employment: An Experiemental Study of Pakistan, FAO/Pakistan Project on System Simulation Approach to Economic-Demogrephic Interaction, PA 4/1 INT/73/P02 Working Paper Series No. 11, Rome: Policy Analysis Division, FAO, March 1976.

3) See, for instance: INP, "Population, Employment and Productivity in Egyptian Agriculture", A Final Report on the FAO/INP research Project, Cairo, INP, Dec. 1974, and Perspective Study of Agricultural Development for the Arab Republic of Egypt, Central Policy Paper, ESP/P/73/2/CPS, FAO, Rome, 1973. =

specific features of the Egyptian economy, and to incorporate those policy choices which appear more relavant to the Egyptian situation. The general objective of the model is to provide planners and policy-makers with an effective tool for evaluating the economic-demographic implications of alternative development strategies. The model does not lead to an optimum solution, nor does it provide the policy-maker with an elaborate program of action. It is simply intended to serve as a useful basis or starting point for discussing relevant policy issues and exploring the consequences of alternative long-term policy options. The results of experimenting with a number of policy-packages should greatly facilitate the task of identifying a development strategy for the future.

1.2 Methodology: Simulation.

A systems simulation approach is adopted in this study for describing and analysing the system of econo-

4) Unfortinately, but for goods reasons to be given later, the experiments were confined to a simplified version of the model which did not fully consider the issue of economic-demographic interaction.

mic-demographic interactions in preference to an econometric or mathematical programming approach, for several reasons. First, Systems Simulation has a remarkable capacity in modelling processes involving recursive and feedback effects, which dominate the dynamic interactions between economic and demographic factors. Second, systems simulation affords considerable flexibility in model building, with the possibility of decomposing complex functional relationships into simple and hence more manageable components, on the one hand, and experimenting with various options relating to the inclusion or exclusion of certain variables and equations, or replacing them with others as the simulation experiments may suggest, on the other hand. Third given the recursive nature of the equations and the possibility of simplifying complex relationships, the task of estimating the parameters of the model is greatly simplified. Some parameters may be estimated by applying ordinary least squares to each equation when relevant data are available, others may be calibrated by means of sensitivity analysis when data are lacking or poor. Fourth, the systems simulation approach is particularly useful in testing alternative policy-packages corresponding to different sets of targets. This is especially important from the viewpoint of long-term planning, since what really interests the planner or the policy maker is an exploration of his area of options and the probable consequences of different combinations or sequences of policies, rather than a unique or optimum solution.

In short, systems simulation involves relaxation or elimination of many of the strict assumptions and constraints underlying the econometric or mathematical programming models, minimizes the data requirements and estimational problems characteristic of those models, and satisfies more adequately the needs of the planner or policy maker in the area of long-term planning.[1] All this is on the positive side. However,

[1] For instance, typical simultaneous equations problems of econometric models(e.g. identification, estimation,etc) are avoided. Lagged values of the endogenous variables are generated by the simulation model itself, whereas they are the actual observed or predetermined values in econometric models. A long time series is normally required for econometric estimation of the parameters, =

to be fair, mention should also be made of some negative aspects of the systems simulation approach. Simulation experiments consume a lot of time and a great deal of effort. Calibrating the unknown parameters and model validation may require a great deal of trial and error, patience, persistence and ingenuity. The task of arriving at realistic values of the parameters is made extremely difficult when the range of initial guesses is wide, on the one hand, and when too many unknown parameters appear in the same equation, on the other. The task of model validation is also made difficult by the fact that the reliability of the separate components of the model provides no

= whereas a short one may suffice for calibrating the unknown parameters in a simulation model. A complete input-output table is essential in mathematical programming models, whereas knowledge of a few cells may be sufficient in a simulation model such as the one used in this study. The treatement of multiple objectives is much easier in simulation models than in mathematical programming ones. Finally, neither the unique solution of an econometric model nor the optimal solution of a programming model is of great relevance to long-term planning. See: Wuu-Long Lin and M.C. Ottaviani-Carra, "A systems Simulation Approach ..." for an interesting, though brief, discussion on the justification of the methodology of Systems Simulation(Section II). For a detailed discussion see: T.N. Naylor, J.S. Balintfy, D.S. Burdick andkong Chu, Computer Simulation Techniques, John Wiley, New York, 1966, PP. 4-9.

guarantee of the reliability of the model as a whole. Finally, great care is required in indentifying a reasonable number of alternative policy variable combinations or policy packages. Meaningful selection should be guided by intuition, past experience and experince gained from previous simulation experiments. Otherwise, the number of possible alternatives may be too large requiring an enermous number of runs which wastes too much time and effort and causes a great deal of confusion.

II

THE MODEL

The purpose of this section is to describe, formally as well as informally(verbally) the modified version of the Martos model which we shall call SMEE 1: a Simulation Model of the Egyptian Economy-version 1.

2.1 Sectoral Breakdown

The following 11 production sectors are distinguished in SMEE 1:

i) Agriculture(AGR)

1. Old-land, food sector(OF)
2. Old-land, non-food sector($O\bar{F}$)
3. New-land, food sector(NF)
4. New-land, non-food sector($N\bar{F}$)

ii) Industry(IND)

5. Capital goods sector(CA)
6. Intermediate goods sector(IN)
7. Consumer goods sector(CG)

iii) Construction(CN)

8. Construction sector(CN)

iv) Services(SER)

9. Education sector(ED)

10. Health sector(HL)

11. Other services(OG)

sector totals and subtotals are calculated according to the following definitions:

1. Old-land agriculture: $O=OF+O\bar{F}$
2. New-land agriculture: $N=NF+N\bar{F}$
3. Food sectors : $F=OF+NF$
4. Non-food sectors : $\bar{F}=O\bar{F}+N\bar{F}$
5. Agriculture : $AG=O+N=F+\bar{F}$
6. Industry : IND=CA+ IN+ CG
7. Services : SER=ED+ HL+ OG
8. Economy : EC =AG+ IND+ CN+ SER.

In comparing this sectoral breakdown with that of the Ministry of Planning, the following points should be borne in mind: AGR corresponds to the total of agriculture, irrigation and drainage. IND corresponds to the total of industry, mining, petroleum and electricity. SER corresponds to the total of distribution and service sectors which include transportation and communications, suez-canal, commerce and finance, housing, public utilities, and other services.

2.2 Components of SMEE 1

SMEE 1 consists of six submodels, with each submodel further divided into a number of sections. The submodels and their sections are the following:

Submodel 1: Agriculture

- Land input : AGR 1
- Labour input : AGR 2
- Capital stock : AGR 3
- Production : AGR 4

Submodel 2: Industry and Construction

- Labour input : IND 1
- Capital stock : IND 2
- Production : IND 3

Submodel 3: Services

- Production : SER 1
- Employment : SER 2

Submodel 4: National Economy

Domestic product and income distribution	: ECN 1
Consumption	: ECN 2
Investment and saving	: ECN 3
Foreign transactions	: ECN 4

Submodel 5: Labour Market

Labour supply	: LAB 1
Employment and unemployment	: LAB 2
Labour productivity	: LAB 3

Submodel 6: Population

Education	: POP 1
Population profile	: POP 2
Births and survival	: POP 3
Migration	: POP 4

2.3. Variables and Parameters: Notational System.

A variable is generally denoted by 3 sets of characters*. The first set consists of 3 characters which refer to the name of the variable. The second set usually consists of 2 characters which specify

* This paragraph applies also to the parameters of the model, since they may change from one time period to another and hence may be regarded as variables.

the sector, subsector, population sex or age group, etc. to which the the variable belongs. In some cases the second set of characters is reduced to a single character or increased to 3 characters. The third set consists of a single character which refers do the point of time at which the value of the variable is measured. For example, LAN. AG.K stands for the total land area under cultivation(LAN) in the agricultural sector(AG) in the current time period(K). Note also that a * is used as a multiplication sign.

2.3.1 Policy Variables:

A development alternative or strategy is defined in terms of the values assigned to the following set of policy variables:

1. IAR: Investment allocation ratios

Allocation of investment among the sectors of which the economy is composed is expressed via the ratio of sectoral investment to total investment in a given year. These ratios may vary over time to express delibrate shifts in priorities during the planning period. Specific ratios are defined for all sub-sectors, except for agriculture where a single ratio is used for the sector as a whole. The allocation of agriculture's share is done at a later stage in the light of the land reclamation program.

2. LRN: Land reclamation program.

The opening up of new-land for cultivation is supposed to be determined by a policy decision. The annual program of land reclamation determines in turn the share of the new-land sector in total agricultural investment. The residual is the share of the old land sector.

3. EXR: Export targets.

These are expressed in terms of the ratio of production retained for export in the agricultural, industrial, and services sectors.

4. CPM: Growth of household consumption.

Growth of consumption per equivalent adult consumer(e.a.c.)is subject to policy control via a consumption to disposable income per e.a.c. growth rate multiplier. It is assumed that the rate of per e.a.c. consumption is always non-negative.

5. GVC: Growth of government consumption.

It is assumed that the rate of growth of public consumption is determined as a result of a policy decision.

6. TAX: Direct taxes.

The ratio of direct taxes to gross domestic product at factor cost is a policy variable, which determines the society's disposable income. This in turn affects consumption and domestic funds available for investment.

7. ITX: Indirect taxes and subsidies.

GDP at factor cost is converted into GDP at market prices using the ratio of net indirect taxes and subsidies to GDP at factor cost.

8. RGW: Growth of wage rates.

It is assumed that growth of the wage rate in new-land agriculture and industry is subject to policy control. Wage rates, together with marginal product of labour, determine employment in the non-service sectors.

9. PPI: Population Policy.

Population policy is incorporated in SMEE by means of a discrete variable which takes on the following values: 0 for slack or no policy, 1 for general policy with no specific commitments, 2 for partial policies programs, and 3 for well-defined national policy and commitment.

2.3.2. Exogenous Variables and Parameters:

These are the variables and parameters whose values are given from outside the model, and are not subject to policy control.

They are:

1. A.i, u_{h_j}, (i= OF, $O\bar{F}$, NF, $N\bar{F}$, h, j=1, 2, 3). Parameters of the agricultural production functions(equations (1)-(4) of AGR 4).

2. A.i, S_{hg}, (i=CA, IN, CG, CN, h=1, ...4, g=1, 2). Parameters of the industrial production functions and constructions(equations (1)-(4) of IND 3).

3. hij, (i=1, 2, 3, j=0, 1, 2): Parameters of the LAN. OF, LAN. NF and FPI. AG functions(equations (6), (8) and (10) of AGR 1 respectively).

4. BCA.i, (i=AG, CA, IN, CG, CN, ED, HL, OG): Input coefficients for capital goods when investing in sector i(equation (3) of ECN 4).

5. BCN.i, (i=AG, CA, IN, CG, CN, ED, HL, OG): Input coefficients for construction production when investing in sector i(equation (27) of ECN 3).

6. CO: Ratio of over-head labour to direct labour requirements in agriculture(equation (3) of AGR 2).

7. CID: Coefficient relating rate of growth of consumption per e.a.c. to income distribution(equation(4) of AGR 4).

8. CKR: Incremental ratio of educational capacity to investment in education(equation (1) of POP 1).

9. do: Ratio of overhead labour to direct labour requirements of the industrial sectors(equation (5) of IND 1).

10. DEP: Depreciation rates in capital stock equations (1)-(2) of AGR 3 and(1)-(4) of IND 2).

11. FGV: Ratio of government food consumption to total government consumption(equation (10) of ECN 2).

12. F̄PI: Price index for non-food agricultural commodities.

13. FRV: Net foreign revenue not connected with trade (e.g. aid, tourism, transfers of citizens working abroad).

14. gi; (i=0, 1, 2): Coefficients of the incremental capital-land ratio function(equation(24) of ECN 3).

15. HNA: Ratio of construction labour force to non-agricultural labour force(equation (12) of LAB 1).

16. IEF: Income elesticity of demand for food(equation(7) of ECN 2).

17. IMR: Ratio imports to gross production or consumption(equations(5)-(7) of ECN 4).

18. IRD: Interest rate on foreign debt(equation (13) of ECN 4).

19. ITS: Ratio of industrial to non-agricultural labour force(equation (11) of LAB 1).

20. JOF: Percentage of fertile women employmeht in total population of fertile women.

21. Ki, (i=0, 1, 2): Coefficients of the function of employment in the services sector(equation(1) of SER 2).

22. LCR: Ratio of land withdrawn from agriculture to construction gross production(equation(3) of AGR1).

23. LEB: Life expectancy at birth.

24. LPR: Labour force participation rates(equation(1) of LAB 1).

25. LSE: Labour switch elasticity with respect to wage differential growth rate multiplier(equation (6) of LAB 1).

26. MRB: Male ratio at birth(equation(2) of POP 2).

27. MTR: Maturation rates(equation(9)-(14) of POP 2).

28. NGR: Ratio of value added to gross production for each production sector.

29. OKR: Incremental output-capital ratio in service sectors(equations(1)-(3) of SER 1).

30. P1: Children's ratio of educational capacity (equation(2) of POP 1).

31. P3: Ratio of college graduates to adult educational capacity(equation(4) of POP 1).

32. PEF: Price elasticity of demand for food(equation (7) of ECN 2).

33. PES: Permissible rate of excess supply over demand for construction production(equation(29) of ECN 3).

34. PIN: Ratio of investment participation in current production in capital stock equations.

35. q_i; (i=0, 1, ... 4); Parameters of the fertility function(equation (4) of POP 3).

36. RIC: Ratio of investment oriented construction production to total construction production(equation(28) of ECN 3).

37. RGW: Ratio of growth of wage rates in the old land agriculture and construction sectors.

38. V_i: (i=CA, IN, CG, CN) coefficient of the industrial and construction employment functions(equation(1)-(4) of IND 1).

39. Wi, (i= O, N) Coefficients of the agricultural employment functions(equations(1)-(2) of AGR 2).

40. WIR: Ratio of wage income to total income of the services sector(equation(10) of ECN 1).

41. X: Ratio of additional new land cultivated to the stock of new land which has not reached the stage of economic production(equation(4) of AGR 1).

42. Yi, sg; (i=0, 1, 2, s=f, m, g= cf*, e, 0*) Coefficients of the survival functions(5)-(12) of POP 3).

43. ZDM.O: Coefficient to dampen the effect of decline in the old land area on the growth of labour force in that sector.

2.3.3. Endogenous Variables.

These are the variables whose values are determined within the model. The endogenous variables, arranged in alphabetical order, are presented below.

1. BTH: Number of births.
2. CAP: Capital stock.
3. CGR: Growth rate of consumption per e.a.c.
4. COS: Consumption of all goods and services.
5. COF: Food consumption.
6. COF̄: Non-food consumption.
7. DBT: Outstanding foreign debt.
8. DEK: Investment-induced demand for capital goods and construction.
9. DIN: Disposable income.
10. ECA: Educational capacity, expressed in terms of the total number of students in school, college, adult and other informal education.

11. EDC: Cumulated education, expressed in terms of the society's stock of educated adults.

12. EDL: Educational level, defined as the ratio of cumulated adult-age education to the adult population.

13. EGR: Growth rate of the educational level.

14. EMP: Employment.

15. EXP: Exports.

16. FER: Fertility rate.

17. FFI: Foreign financing of investment, expressed as the ratio of the excess of investment over saving to total investment.

18. FPI: Food price index.

19. GDP: Gross domestic product.

20. GPT: Gross production.

21. GPY: Gross labour productivity.

22. GRM: Gravity multiplier which is used in the labour force and population submodels and affects labour switching from agricultural to non-agricultural occupations in the former, and rural-urban

migration in the latter.

23. IMN: Net imports, i.e. the excess of imports over exports.

24. IMP: Imports.

25. INF: Investment(first allocation).

26. INR: Investment rate.

27. INS: Investment(second allocation).

28. INV: Investment.

29. KLR: Capital-land ratio in new-land sector.

30. LAB: Labour force.

31. LAN: Productive land area.

32. LAS: Switching labour force from agricultural to non-agricultural jobs.

33. LAW: Land withdrawn from cultivation.

34. MAT: Maturation from one population age-group to the next.

35. MIG: Migration from rural to urban areas.

36. MGR: Migration rate.

37. NCG: Number of graduates of technical schools and higher education institutions, which are eligible for placements for government and public sector jobs by the Ministry of Manpower.

38. NPT: Net product(value added).

39. NPY: Net labour productivity.

40. NWG: Total non-wage income.

41. OVL: Overhead labour input, i.e. labour requirements which cannot be assigned to the individual subsectors of a given sector.

42. PNL: New land brought into the orbit of economic production.

43. POP: Population.

44. POR: Rural population.

45. POU: Urban population.

46. RTP: Ratio of rural to total population.

47. SAR: Saving rate.

48. SAV: Total savings.

49. SEX: Excess supply of investment oriented construction output.

50. SVR: Survival rate.

51. TWG: Total wage income.

52. UEM: Total number of unemployed persons.

2.3.4. Other Symbols.

The following symbols are used in the population submodel.

1. Sex symbols

   S= Dummy index for sex groups

   m= Male

   f= Female.

2. Age symbols

   g= Dummy index for age groups

   c= Children(0-14 years)

   f^*= Fertile(15-49 years)

   e= Elderly(50-65 years)

   d^*= Old (65 years and over).

3. Totals and subtotal

$B = m + f =$ Both sexes

$W = f^{*} + e =$ Working age

$A = W + O^{*} =$ Adult

$T = A + c =$ Total.

The following symbols are also used:

$A\bar{A}$: Indicating movement from agricultural to non-agricultural jobs in the labour switch function.

EA: Equivalent adult consumer(e.a.c.).

FC: Factor cost.

HD: Household.

MP: Market prices.

RU: Indicating movement from rural to urban areas.

t: Dummy index for time.

O= Base year.

K= Current year.

J= Previous year.

2.4. The Equations:

As noted previously, SMEE consists of 6 submodels, namely agriculture, industry and construction, services, economy, labour market, and demography. Our presentation of the model will be as follows: we begin by stating the equations of each section in the model and describing how the key variables in each section are determined. This is followed by a brief description of the mechanism of economic and demographic determination and the interaction among the various submodels of which SMEE is composed.

2.4.1 Submodel 1: Agriculture:

AGR 1: Land input

1) LAN.AG.K= LAN.O.K + LAN.N.K

2) LAN.O.K = LAN.O.J - LAW.O.J

3) LAW.O.K = LCR.K * GPT.CN.K

4) $PNL.N.K = X * \left(\sum_{t=1960}^{J} LRN.N.t - LAN.N.J \right)$

5) LAN.N.K = LAN.N.J + PNL.N.K

6) $LAN.OF.K = b10 + b11 * \frac{LAN.OF.J}{LAN.O.J} + b12 * \frac{FPI.AG.J}{FPI.AG.J}$

$$7)\ LAN.O\bar{F}.K = LAN.O.K - LAN.OF.K$$

$$8)\ LAN.NF.K = b20 + b21 * \frac{LAN.NF.J}{LAN.N.J} + b22 * \frac{FPI.AG.J}{\bar{F}PI.AG.J}$$

$$9)\ LAN.N\bar{F}.K = LAN.N.K - LAN.NF.K$$

$$10)\ FPI.AG.K = b30 + b31 * \frac{COF.EC.J}{GPT.F.J} + b32 * TIM.K$$

The total area of land available for cultivation in the current year is the sum of the old-land and the new-land areas. The area of the old-land sector available for cultivation in the current year equals previous year's area minus the area withdrawn from agricultural production. Land withdrawal in a given year is assumed to be proportional to the gross production of the construction industry in that year, the factor of proportionality being LCR: the ratio of land withdrawn from old-land agriculture to construction gross production. The area of the new-land sector in the current year is calculated as the sum of previous year's area plus the additional new land which has reached the stage of economic production. The latter is assumed to be proportional to the area of land which has been reclaimed but has not reached the stage of economic production up to the previous year. This is defined as the difference between total area reclaimed since 1960, or a little earlier, and the area of productive new land in the previous year[1]. It is assumed that the new land sector is not subject to land withdrawal.

The area of each subsector is then allocated to food and non-food production. The share of food production is calculated by means of a simple linear function in which the explanatory variables are the proportion of each subsector's area devoted to food production and the ratio of the food to non-food price index, both lagged one year. The area allocated to non-food production is taken as the residual of total area and the food area in each subsector.

AGR 2: Labour input(employment)

1) $EMP.O.K = EMP.O.J * (1 + WO * \sqrt{\frac{VMP.OF.J}{WAG.O.J} * \frac{VMP.OF.J}{WAG.O.J}})$

2) $EMP.N.K = EMP.N.J * (1 + WN * \sqrt{\frac{VMP.NF.J}{WAG.N.J} * \frac{VMP.NF.J}{WAG.N.J}})$

3) $OVL.AG.K = CO * (\sum_{i=O,N} EMP.i.K)$

1) The year 1960 marks the beginning of large-scale land reclamation programs in Egypt.

4) $EMP.AG.K= \left(\sum_{i=O,N} EMP.i.K \right) + OVL.AG.K$

5) $WAG.O.K= WAG.O.J * (1+ RGW.O.K)$

6) $WAG.N.K= WAG.N.J * (1+ RGW.N.K)$

The labour input of the current year is calculated for each subsector by applying a rate of growth to the labour input of the previous year. The rate of growth applicable to each subsector is expressed as the geometric mean of the fraction of the ratio of labour marginal product to wage rate in the food and non-food sections of each subsector, lagged one year. It is assumed that labour is used according to the marginal productivity theory. The fractions wi(i=1, ..., 4)are included to allow for distrurbances and errors affecting farmer's responses. Since food and non-food products may be grown simultaneously, using available labour, it was considered risky to attempt to allocate labour to food and non-food production in the model. Total agricultural employment consists of labour employed in the two subsectors plus an overhead labour input which cannot be assigned to either of them. The latter is calculated as a fraction of the sum of employment in the two subsectors[1]. The current wage rate in new-land and old-land agriculture is endogenously determined, using a policy-determined growth rate for the former(RGW.N) and an exogenously-determined growth rate for the latter (RGW.O). The wage rates applicable to the food and non-food sections of each agricultural subsector are not distinguished in the model, since labour may be available to both at the same or at least similar wage rates.

AGR 3: Capital stock.

1) $CAP.OK= CAP.O.K-4 * (1-DEP.O)+ \sum_{t=K-4}^{K} INV.O.t * PIN.O.t$

2) $CAP.N.K=CAP.N.K-6 * (1-DEP.N)+ \sum_{t=K-6}^{K} INV.N.t * PIN.N.t$

Capital stock in the current year is equal to lagged capital stock after allowing for depreciation via the depreciation rate DEP, plus a weighted average of lagged investments. The weight of lagged investment PIN is the fraction of a given year's investment which effectively

1) The overhead labour input may also be interpreted to include persons appointed by the government, in view of the afficial commitment to employ all graduates of technical schools, collages and higher education institutions.

influences production in that year. In other words, PIN may be interpreted as the rate of participation of current investment in current production. Since the capital available in each subsector is available for use in all lines of production, no attempt is made to distinguish the relative shares of the food and non-food sections in each subsector.

AGR 4: Production.

1) $$\mathrm{GPT.OEK} = \mathrm{A.OF} \ast \mathrm{LAN.OF.K}^{u11} \ast \mathrm{EMP.O.K}^{u12} \ast \mathrm{CAP.O.K}^{u13}$$

2) $$\mathrm{GPT.O\bar{F}.K} = \mathrm{A.O\bar{F}} \ast \mathrm{LAN.O\bar{F}.K}^{u21} \ast \mathrm{EMP.O.K}^{u22} \ast \mathrm{CAP.O.K}^{u23}$$

3) $$\mathrm{GPT.NF.K} = \mathrm{A.NF} \ast \mathrm{LAN.NF.K}^{u31} \ast \mathrm{EMP.N.K}^{u32} \ast \mathrm{CAP.N.K}^{u33}$$

4) $$\mathrm{GPT.N\bar{F}.K} = \mathrm{A.N\bar{F}} \ast \mathrm{LAN.N\bar{F}.K}^{u41} \ast \mathrm{EMP.N.K}^{u42} \ast \mathrm{CAP.N.K}^{u43}$$

5) $$\mathrm{GPT.F.K} = \mathrm{GPT.OF.K} + \mathrm{GPT.NF.K}$$

6) $$\mathrm{GPT.\bar{F}.K} = \mathrm{GPT.O\bar{F}.K} + \mathrm{GPT.N\bar{F}.K}$$

7-8) $$\mathrm{NPT.i.K} = \mathrm{NGR.i.K} \ast \mathrm{GPT.i.K} \qquad i = F, \bar{F}$$

9) $$\mathrm{GPT.AG.K} = \mathrm{GPT.F.K} + \mathrm{GPT.\bar{F}.K}$$

10) $$\mathrm{NPT.AG.K} = \mathrm{NPT.F.K} + \mathrm{NPT.\bar{F}.K}$$

11) $$\mathrm{GPT.O.K} = \mathrm{GPT.OF.K} + \mathrm{GPT.O\bar{F}.K}$$

12) $GPT.N.K = GPT.NF.K + GPT.N\bar{F}.K$

13) $NPT.O.K = \left(NGR.F.K * \frac{NPT.F.K}{NPT.AG.K} + NGR.\bar{F}.N * \frac{NPT.\bar{F}.K}{NPT.AG.K}\right) * GPT.O.K$

14) $NPT.N.K = NPT.AG.K - NPT.O.K$

15) $VMP.OF.K = u12 * \frac{GPT.OF.K}{EMP.O.K}$

16) $VMP.O\bar{F}.K = u22 * \frac{GPT.O\bar{F}.K}{EMP.O.K}$

17) $VMP.NF.K = u32 * \frac{GPT.NF.K}{EMP.N.K}$

18) $VMP.N\bar{F}.K = u42 * \frac{GPT.N\bar{F}.K}{EMP.N.K}$

Given the land, labour and capital inputs from AGR 1, AGR 2 and AGR 3 respectively, the gross production of each section in the two agricultural subsectors is then determined from Cobb-Douglas production functions. Exogenously-determined ratios the NGR's are used to convert each sector's gross production into net product or value added. This section gives also the value of marginal product of labour in each section in the current year, which together with the wage rates obtained in AGR2, determine the labour inputs in the following year according to equations(1)-(2) of AGR2.

2.4.2 Submodel 2: Industry and Construction:

IND 1: Labour input.

$$1)-4)\quad EMP.i.K = EMP.i.J * \left(1 + v.i * \frac{VMP.i.J}{WAG.i.J}\right) \qquad i = CA, IN, CG, CN$$

$$5)\quad OVL.IND.K = d_0 * \sum_i EMP.i.K \qquad i = CA, IN, CG.$$

$$6)\quad EMP.IND.K = \sum_i EMP.i.K + OVL.IND.K \qquad i = CA, IN, CG.$$

$$7-10)\quad WAG.i.K = WAG.i.J * (1 + RGW.i.K) \qquad i = CA, IN, CG, CN.$$

Employment in each subsector in the current year is assumed to grow by a fraction of the marginal product-wage ratio in the previous year. Industry's overhead labour requirements are assumed to be proportional to the sum of the "specific" labour inputs of the industrial subsectors. Total employment in industry is then calculated as the sum of the overhead and specific labour inputs. Finally, the subsectoral wage rates in the current year are calculated using policy-determined rates of growth for the industrial subsectors, and an exogenous rate of growth for construction.

5-8) NPT.i.K=NGR.i.K* GPT.i.K i=CA,IN,CG,CN

9) GPT.IND.K= $\sum_i$ GPT.i.K i=CA,IN,CG

10) NPT.IND.K= $\sum_i$ NPT.i.K i=CA,IN,CG

11-14) VMP.i.K= s.i* $\frac{\text{GPT.i.K}}{\text{EMP.i.K}}$ i=CA,IN,CG,CN
s.CA=S11 S.IN=S21
S.CG=S21 S.CN=S41.

Cobb-Douglas production functions are used to determine the gross production of each industrial subsector and construction, on the basis of the values of labour and capital calculated in IND1 and IND2 respectively. Using appropriate net to gross product ratios, we arrive at the value added contributed by each industrial subsector and construction. Finally, we calculate the marginal products of labour in the current year, which together with the wage rates calculated in IND1, determine the labour inputs in the following year according to equations(1)-(4) of IND1.

2.4.3 Submodel 3: Services:

SER1: Production

1)-3) GPT.i.K=GPT.i.J+OKR.i.J* INV.i.J i=ED,HL,OG.

4) GPT.SER.K= $\sum_i$ GPT.i.K i=ED,HL,OG.

IND2: Capital stock.

1) $CAP.CR.K=CAP.CA.K-6*(1-DEP.CA)+\left(\sum_{t=K-6}^{K} INV.CA.t* PIN.CA.t.\right)$

2) $CAP.IN.K=CAP.IN.K-5*(1-DEP.IN)+\left(\sum_{t=K-5}^{K} INV.IN.t* PIN.IN.t.\right)$

3) $CAP.CG.K=CAP.CG.K-4*(1-DEP.CG)+\left(\sum_{t=K-4}^{K} INV.CG.t* PIN.CG.t.\right)$

4) $CAP.CN.K=CAP.CN.K-4*(1-DEP.CN)+\left(\sum_{t=K-4}^{K} INV.CN.t* PIN.CN.t.\right)$

Capital stock is calculated for the industrial sub-sectors and construction in the same manner used in AGR 3.

IND3: Production

1) $GPT.CA.K= A.CA* EMP.CA.K^{s11}* CAP.CA.K^{s12}$

2) $GPT.IN.K= A.IN* EMP.IN.K^{s21}* CAP.IN.K^{s22}$

3) $GPT.CG.K= A.CG* EMP.CG.K^{s31}* CAP.CG.K^{s32}$

4) $GPT.CN.K= A.CN* EMP.CN.K^{s41}* CAP.CN.K^{s42}$

5)-7) NPT.i.K=NGR.i.K* GPT.i.K i=ED,HL,OG.

8) NPT.SER.K= $\sum_i$ NPT.i.K i=ED,HL,OG.

Subsectoral incremental output-capital ratios are used together with the initial values of investment, to estimate the incremental gross production in each subsector. The gross and net products of the services sector are then calculated in an obvious manner.

<u>SER2: Employment:</u>

1) EMP.SER.K=KO+ K1* GPT.SER.K+ K2* NCG.ED.(K-2)

Total employment in the services sector is calculated from a linear function in which the explanatory variables are gross production of the services sector in the current year and the number of college graduates lagged two years. The latter is supposed to take account of the government's commitment to employ graduates of technical schools, colleges and higher education institutions. The fulfilment of this commitment is normally subject to a certain time-lag which is around 2 years.

2.4.4 Submodel 4: National Economy:

ECN1: GDP and Income Distribution

1) $GPT.\overline{AG}.K = \sum_{i} GPT.i.K \qquad i=IND,CN,SER.$

2) $NPT.\overline{AG}.K = \sum_{i} NPT.i.K \qquad i=IND,CN,SER.$

3) $NPT.\bar{F}.K = \sum_{i} NPT.i.K \qquad i=\bar{F},CG,SER.$

4) $GPT.EC.K = GPT.AG.K + GPT.\overline{AG}.K$

5) $GDP.FC.K = NPT.AG.K + NPT.\overline{AG}.K$

6) $GDP.MP.K = GDP.FC.K * (1 + ITX.EC.K)$

7) $TWG.AG.K = (1 + CO) * \sum_{i=O,N} (WAG.i.K * EMP.i.K)$

8) $TWG.IND.K = (1 + d\theta) * \sum_{i=CA,IN,CG} (WAG.i.K * EMP.i.K)$

9) $TWG.CN.K = WAG.CN.K * EMP.CN.K$

10) $TWG.SER.K = WIR.SER.K * NPT.SER.K$

11) $TWG.\overline{AG}.K = \sum_{i} TWG.i.K \qquad i = IND,CN,SER.$

12) $TWG.EC.K = TWG.AG.K + TWG.\overline{AG}.K$

13) $NWG.EC.K = GDP.FC.K - TWG.EC.K.$

The economy's gross production is calculated from the sectoral gross production obtained in the previous sub-models. GDP at factor cost(FC) is calculated as the sum of the sectoral NPT;S. This is converted into GDP at market prices(MP), using the policy-determined rate of(net)indirect taxes and subsidies(ITX). GDP at factor cost is split into wage and non-wage components, by calculating total wage income(TWG)from the sectoral employment and wage rates[1), and regarding the residual of GDP and TWG as non-wage income.

ECN2: Consumption:

1) $COS.EC.K= COS.HD.K+ COS.GV.K$

2) $COS.HD.K= COS.EA.K* POP.EA.K$

3) $COS.EA.K= COS.EA.J* (1+ CGR.EA.K)$

4) $$CGR.EA.K= \max \left\{0, \left[CPM.EA.K* \left(\frac{DIN.EC.K/POP.EA.K}{DIN.EC.J/POP.EA.J} -1\right) + CID* \frac{TWG.EC.K}{GDP.FC.K}\right]\right)$$

1) Overhead labour in a given sector is assumed to be paid the weighted average of the subsectoral wage rates, the weights being the relative shares of the subsectors in total "specific" employment.

$$5)\ DIN.EC.K = GDP.FC.K(1-TAX.EC.K)$$

$$6)\ COF.HD.K = COF.EA.K * POP.EA.K$$

$$7)\ COF.EA.K = COF.EA.J * \left[1+IEF.K * \left(\frac{DIN.EC.K/POP.EA.K}{DIN.EC.J/POP.EA.J} -1\right) + PEF.K * \left(\frac{FPI.AG.K}{FPI.AG.J} -1\right)\right]$$

$$8)\ \overline{\overline{COF}}.HD.K = COS.HD.K - COF.HD.K$$

$$9)\ COF.EC.K = COF.HD.K + COF.GV.K$$

$$10)\ COF.GV.K = FGV.K * COS.GV.K$$

$$11)\ COS.GV.K = COS.GV.J * (1+ GVC.K)$$

$$12)\ \overline{\overline{\overline{COF}}}.GV.K = COS.GV.K - COF.GV.K$$

$$13)\ \overline{\overline{COF}}.EC.K = \overline{\overline{COF}}.HD.K + \overline{\overline{COF}}.GV.K$$

Total consumption is the sum of household and government consumption. Household or private consumption is the product of consumption per e.a.c. and population expressed in e.a.c. units[1]. The growth of consumption per e.a.c. is endogenously determined, subject to the constraint that con-

1) Equivalent consumers is the weighted sum of age-and sex population groups, where the weights reflect differing relative consumption needs of the different age and sex groups. See equation(15) of POP2 below.

sumption per e.a.c. must never fall. The rate of growth in question depends on the growth of per e.a.c. disposable income and the share of total wage income in GDP as a proxy for income distribution. The response of consumption to the growth of DIN is policy-determined via the CPM coefficient, whareas the response to the distribution of income is exogenously-determined via the CID coefficient. The use of the concept of e.a.c. units enables us to allow for the effect of age and sex composition on private consumption. The use of the concept of DIN enables us to take into account the government's direct taxation policy(via the TAX coefficient), and to estimate the impact of different taxation policies on private consumption.[1]

Total private consumption is partitioned into food and non-food components. Food consumption per e.a.c. depends on the rate of growth of disposable income per e.a.c. and the rate of increase in food prices. Given the initial value of food consumption per e.a.c. and estimates of the income and price elasticities of demand for food, food consumption per e.a.c. is determined for the current year. The

1) Note that the calculation of DIN according to equation (5)above ignores net income transfers from abroad.

latter together with POP.EA.K give total food consumption. Private non-food consumption is calculated as a residual.

Total government consumption is assumed to increase according to a policy-determined rate of growth(GVC). It is divided into food and non-food components. Government food consumption is assumed to grow proportionally to total FGV. Government non food consumption is the residual of total and food government consumption.

<u>ECN3: Investment and saving:</u>

1) INV.EC.K= GDP.MP.K - COS.EC.K+ IMN.EC.K

2) INR.EC.K= INV.EC.K/ GDP.MP.K

3) SAV.EC.K= GDP.MP.K - COS.EC.K

4) SAR.EC.K= SAV.EC.K/ GDP.MP.K

5) FFI.EC.K= (INV.EC.K- SAV.EC.K)/ INV.EC.K

6-13) INV.j.K= { INF.j.K (first allocation) j=AG,CA,IN,CG,CN,ED,HL,OG.
INS.j.K (second allocation) }

14-21) INF.j.K= IAR.j.K* INV.EC.K   j=AG,CA,IN,CG,CN,ED,HL,OG.

22) INV.O.K= INV.AG.K - INV.N.K

23) INV.N.K= KLR.N.K* LRN.N.K

24) $KLR.N.K= g0+ g1 * \sum_{t=1960}^{K} LRN.N.t+ g2 *(TIM.K)^2$

If INV.N.K $\geq$ INV.AG.K, then reallocate agricultural investment as follows; INV.O.K= INV.O.J*(1+r)where r = minimum rate of growth of INV.O; INV.N.K=INV.AG.K- INV.O.K; the LRN target is adjusted accordingly: LRN.N.K=INV.N.K/KLR.N.K

25) $INV.IND.K= \sum_i INV.i.K \qquad i=CA,IN,CG.$

26) $INV.SER.K= \sum_i INV.i.K \qquad i=ED,HL,OG.$

27) $DEK.CN.K= \sum_i BCN.i* INV.i.K \qquad i=AG,CA,IN,CG,CN,ED,HL,OG.$

28) SEX.CN.K= RIC* GPT.CN.K - DEK.CN.K

If the following constraint

29) $0 \leq SEX.CN.K \leq PES.CN* DEK.CN.K$

is satisfied, then jump to ECN4. Otherwise reallocate previous period's investment fund as follows:

30) $INS.CN.J= \max\left\{0, \left[INF.CN.J+ \frac{PES.CN* DEK.CN.K+2(PES.CN-J)}{} * \frac{SEX.CN.K}{2* RIC* OXR.CN.J}\right]\right\}$

$$31\text{-}37)\quad INS.i.J = \frac{IAR.i.J}{\sum_{i} IAR.i.J} * (INV.EC.J - INV.CN.J) \quad i=AG,CA,IN,CG,ED,HL,OG.$$

Given the level of GDP from ECN1, total consumption from ECN2, and net import from ECN4, the level of investment in the current year is then determined as a residual[1]. The rates of investment, saving, and foreign financing of investment are then calculated in a straightforward manner. Policy determined investment allocation ratios are used to calculate sectoral investments. Agriculture's share in total investment is allocated to the new-land and old-land sectors in the following way: the share of the new-land sector depends upon the land reclamation program, and an endogenously-determined capital-land ratio.

Sectoral investments induce a demand for capital goods and construction output. An excess demand for capital goods over domestic production is assumed to be covered by importing capital goods. An excess demand for construction output

1) An IF statement should be incorporated in the computer program to ensure that total investment is positive. If this condition is not satisfied, adjust parameters or policy variables appropriately.

calls for a different treatement. Since construction output cannot be imported. To achieve equilibrium in the market for construction, investment must be reallocated. If the required growth of construction production does not greatly exceed or fall short of the expected demand for construction in time t+1 as induced by sectoral investments in time t, there will be need for changing the allocation of investment in time t.[1] Otherwise, we have to return to the previous year and augment or reduce investment into construction as the case requires. The shares of the other sectors in total investment should also be appropriately adjusted, and a further check in the equilibrium of the construction market is made, until equilibrium is attained.[2]

1) BCN.i is the input coefficient for construction output when investing in sector i; RIC is the ratio of investment oriented construction output to total construction output, PES is the permissible rate of excess supply over demand for construction output. Excess supply SEX.CN.K is the difference between investment-oriented construction output (RIC* GPT.CN.K) and investment-induced demand for construction output (DEK.CN.K).

2) This is the solution proposed for attaining equilibrium in the market for construction in the Martos Model. A mathematical proof is given which shows that, for all practical purposes, this reallocation procedure should only be done once and that no iteration is needed.

This is indeed the mechanism through which equilibrium is attained in the market for construction in the Martos Model. We accept it as a possible option, since it is not certain that it will work satisfactorily in our model. The reason is that it is based on the assumption that construction output is calculated from a Harrod-Domar production function, whereas a different functional form is adopted in the modified model. If this procedure does not lead to satisfactory results, our policy will be to regard the set of investment allocation ratios as infeasible, and to adjust the ratios informally until the equilibrium condition(29) is fulfilled.

<u>ECN4: Foreign Transactions:</u>

1) $IMN.EC.K = IMP.CA.J + IMP.NK.K - EXP.EC.K$

2) $IMP.CA.K = DEK.CA.K - GPT.CA.K$

3) $DEK.CA.K = \sum_{i} BCA.i * INV.i.K \qquad i = AG, CA, IN, CG, CN, ED, HL, OG.$

4) $IMP.NK.K = IMP.F.K + IMP.\bar{\bar{F}}.K + IMP.IN.K$

5) $IMP.F.K = IMP.F.K * COF.EC.K$

6) $IMP.\bar{\bar{F}}.K = IMR.\bar{\bar{F}}.K * COF.EC.K \qquad \bar{\bar{F}} = \bar{F} + CG + SER$

7) IMP.IN.K= $\sum_i$ IMP.i.K* GPT.i.K i=all production sectors.

8) IMP.EC.K= IMP.CA.J+ IMP.NK.K

9) EXP.EC.K= $\sum_i$ EXP.i.K i=F,$\bar{F}$,CA,IN,CG,OG.

10) EXP.i.K= EXP.i.K* GPT.i.K i=F,$\bar{F}$,CA,IN,CG.

11) DBT.EC.K=DBT.EC.J* (1+ IRD)+ IMN.EC.K-FRV.EC.K

Foreign trade is included in the model with the purpose of handling options regarding the openness of the economy. Imports of capital goods are defined as the difference between the investment induced demand less gross domestic production. Non-capital goods imports are the sum of food, non-food(consumer goods), and intermediate goods imports. The first 2 components are estimated as exogenously-determined fractions of consumption, the 3rd is related to sectoral gross production by means of appropriate import ratios. Agricultural and industrial exports are governed by policy-determined sectoral export ratios. This section ends with a calculation of foreign indebtedness. This is defined as the sum of the initial foreign debt, adjusted for interest payment, and net import, minus net foreign revenue not connected with trade.

2.4.5 Submodel 5: Labour market

LAB1: Labour Supply

1) $LAB.EC.K = \sum_{s} \sum_{g} LPR.sg.K * POP.sg.K \quad s=f,m; g=f*, e$

2) $LAB.AG.K = LAB.EC.K - LAB.\overline{AG}.K$

3) $LAB.\overline{AG}.K = LAB.\overline{AG}.J * \frac{POP.BW.K}{POP.BW.J} + LAS.\overline{AA}.J$

4) $LAS.A\overline{A}.K = LAS.A\overline{A}.J * \frac{LAB.AG.K}{LAB.AG.J} * \frac{GRM.A\overline{A}.K}{GRM.A\overline{A}.J} * WDM.A\overline{A}.K$

5) $GRM.A\overline{A}.K = \frac{LAB.AG.K * LAB.\overline{AG}.K}{(LAB.EC.K)^2}$

6) $WDM.A\overline{A}.K = 1 + LSE * \left(\frac{RGW.\overline{AG}.K}{RGW.AG.K} - 1 \right)$

7) $RGW.\overline{AG}.K = \frac{TWG.\overline{AG}.K / \sum_{i} EMP.i.K}{TWG.\overline{AG}.J / \sum_{i} EMP.i.J} \quad i=IND,CN,SER.$

8) $RGW.AG.K = \frac{TWG.AG.K/EMP.AG.K}{TWG.AG.J/EMP.AG.J}$

9) $LAB.O.K = LAB.O.J * ZDM.O * \frac{LAN.O.K}{LAN.O.J} * \frac{LAB.AG.K}{LAB.AG.J}$

10) $LAB.N.K = LAB.AG.K - LAB.O.K$

11) $LAB.IND.K = ITS.K * LAB.\overline{AG}.K$

12) $LAB.CN.K = HNA.K * LAB.\overline{AG}.K$

13) $LAB.SER.K = LAB.\overline{AG}.K - LAB.IND.K - LAB.CN.K.$

Total labour force is calculated from the sex-and-age specific population and the participation rates. The latter are assumed to be exogenous, but may vary over time as a result of increased job opportunities for women and enrollment of students. Only persons in the age group 15-64 are regarded as potential entrants to the labour market. The labour forces in the agricultural and non-agricultural sectors are distinguished. Given the labour force in the non-agricultural sector in the initial year, the non-agricultural labour force in the current year is determined depending on the rate of growth of the working population and the number of those who switch from the agricultural to non-agricultural sector. The extent of labour switch depends on the rate of growth of the agricultural labour force, the growth rate of a gravity multiplier reflecting the relative sizes of the source and recipient sectors, and a wage-differential multiplier reflecting the relative growth of wage rates in the agricultural and non-agricultural sectors. Agricultural labour force is divided between the old-land and the new-land sectors. Labour force in the old-land sector grows proportionately to the growth of cultivated land in this sector(subject to a dampering coefficient in view of the negative growth of land LAN.O.) and the growth of total agricultural labour force. The share of the new-land sector is then calculated as a residual. The distribution of the non-agricultural labour force is given by means of exogenously-determined ratios of subsectoral labour force. The assumption of independent labour markets may, however, be rather arbitrary. For practical purposes, the agricultural-nonagricultural distinction may be quite adequate.

LAB 2: Employment and Unemployment

1) $EMP.EC.K = EMP.AG.K + EMP.\overline{AG}.K$

2) $EMP.\overline{AG}.K = EMP.IND.K + EMP.CN.K + EMP.SER.K$

3-10) $UEM.i.K = LAB.i.K - EMP.i.K$ $i = EC, AG, \overline{AG}, O, N, IND, CN, SER.$

11-18) $UER.i.K = \dfrac{UEM.i.K}{LAB.i.K}$ $i = EC, AG, \overline{AG}, O, N, IND, CN, SER.$

This section provides estimates of total and sectoral employment and unemployment. The method of calculation is fairly conventional.

LAB 3: Labour Productivity:

1)-8) $GPY.i.K = \frac{GPT.i.K}{EMP.i.K}$ $i = AG, \overline{AG}, O, N, IND, CN, SER.$

9-16) $NPY.i.K = \frac{NPT.i.K}{EMP.i.K}$ $i = AG, \overline{AG}, O, N, IND, CN, SER.$

17) $NPY.EC.K = \frac{GDP.EC.K}{EMP.EC.K}$

Gross and net productivity of labour are calculated for the whole economy and selected sectors and subsectors. The equations are self-explanatory.

2.4.6 Submodel 6: Population:

POPI: Education.

1) $ECA.ED.K = ECA.ED.J + CMR.ED.J * INV.ED.J$

2) $ECA.BC.K = PI * ECA.ED.K$

3) $ECA.BA.K = ECA.ED.K - ECA.BC.K$

4) $NCG.ED.K = P3 * ECA.BA.K$

5) $EDC.BA.K = EDC.BA.J * SVR.BA.J + ECA.BA.K - ECA.BA.J$

6) $EDL.BA.K = \frac{EDC.BA.K}{POP.BA.K}$

7) $EGR.BA.K = \frac{EDL.BA.K}{EDL.BA.J} - 1$

A section on education is included in the population sub-model in order to generate an educational indicator which would be useful in tracing the effects of education on the fertility and survival rates. This indicator, EGR,is the growth rate of the adult education level. The latter(EDL) is defined as the accumulated adult students by the adult population for both sexes(EDC), where adult education includes high school and college education, as well as informal education. Cumulated adult-age education in the current year, equals cumulated adult-age education in the previous year, after making due allowance for the death rate, **plus** the increase in the capacity of adult education expressed in terms of the increase in the number of students in adult educational institutions(ECA.BA). Society's educational capacity, including both the children and adult education, is assumed to be influenced by investment in education, lagged one year. The number of college graduates elligible for jobs under the government's full employment(of graduates) policy is also estimated in this section(equation 4).

<u>POP 2: Population profile</u>

1-2) POP.sc.K=POP.sc.J*SVR.sc.K+BTH.sc.K-MAT.sc.K   s=f,m.

3 -4) $POP.sf^{*}.K=POP.sf^{*}.J*SVR.sf^{*}.K+MAT.sc.K-MAT.sf^{*}.K$ $s=f,m.$

5 -6) $POP.se.K=POP.se.J*SVR.se.K+MAT.sf^{*}.K-MAT.se.K$ $s=f,m.$

7 -8) $POP.so^{*}.K=POP.so^{*}.J*SVR.so^{*}.K+MAT.se.K$ $s=f,m.$

9-14) $MAT.sg.K=MTR.sg*POP.sg.J$ $s=f,m$; $g=c,f^{*},e.$

15) $POP.EA.K=0.6*POP.BC.K+0.9*POP.EA.K+POP.mA.K$

16) $POP.BC.K=\sum_{s} POP.sc.K$ $s=f,m.$

17-18) $POP.sA.K=\sum_{g} POP.sg.K$ $s=f,m;$ $g=f^{*},e,O^{*}$

19) $POP.BA.K=\sum_{s} POP.sA.K$ $s=f,m.$

20) $POP.BT.K=\sum_{g} POP.Bg.K$ $g=c,A$

21) $POP.BW.K=\sum_{s} POP.sf^{*}.K+\sum_{s} POP.se.K$ $s=f,m.$

Given the intial population with its age and sex compsition,births and the survival rates(from POP 3), and the outmaturation and immaturation which are calculated from age-and sex-specific maturation rates, the population profile by sex and age groups is constructed for each year during the projection period. This enables us to estimate the adult, working and total population.

POP 3: Births and survival:

1) $BTH.Bc.K = FER.ff^{*}.K * POP.ff^{*}.J$

2) $BTH.mc.K = MRB * BTH.Bc.K$

3) $BTH.fc.K = BTH.Bc.K - BTH.mc.K$

4) $FER.ff^{*}.K = q0 + q1 * EGR.BA.J + q2 * WLI.EA.J + q3 * JOF.ff^{*}.J$

$+ q4 * PPI.K$

5-12) $SVR.sg.K = y0.sg + y1.sg * LEB.sT.K + y2.sg * WLI.EA.J$

$s = f, m \; ; \qquad g = c, f^{*}, e, 0^{*}$

13) $$SVR.BA.K = \sum_{s} \sum_{g} \frac{POP.sg.J}{POP.BA.J} * SVR.sg.K$$

14) $$WLI.EA.K = \frac{(COF.EC.J + GPT.HL.J)/POP.EA.J}{[COF.EC.(J-1) + GPT.HL(J-1)]/POP.EA(J-1)} - 1$$

The number of births in the current year is the product of the initial population of fertile women and the fertility rate. The fertility rate is calculated from a simple linear equation in which the explanatory variables are (1) the growth of the educational level,(EGR); (2) improvements in welfare as expressed by an index (WLI) of food consumption and health services;(3) the extent of employment of fertile women(JOF); and (4) the population policy. The survival rates are assumed to depend on (1) the expectation of life at birth(LEB) and(2), improvements in welfare as reflected in the welfare index(WLI).

POP 4: Migration:

1) $POR.BT.K = POR.BT.J * \frac{POP.BT.K}{POP.BT.J} - MIG.RU.J$

2) $POU.BT.K = POP.BT.K - POR.BT.K$

3) $MIG.RU.K = MIG.RU.J * \frac{POR.BT.K}{POR.BT.J} * \frac{GRM.RU.K}{GRM.RU.J} * WDM.A\bar{A}.K$

4) $GRM.RU.K = \frac{POR.BT.K * POU.BT.K}{(POP.BT.K)^2}$

5) $RTP.BT.K = \frac{POR.BT.K}{POP.BT.K}$

6) $UTP.BT.K = 1 - RTP.BT.K$

7) $MGR.RU.K = \frac{MIG.RU.K}{POR.BT.K}$

Rural-urban migration is handled similarly to the labour switch from agricultural to non-agricultural activities in LAB.1. Equation(3) implies that the growth of migration is determined by(1) the growth of the rural population, (2)the growth rate of a gravity multiplier reflecting the relative rural-urban population pressure, and (3) the wage differential multiplier given in equation (6) of LAB 1.

The rural population is assumed to grow at the same rate as the total population. Its size in a given year equals its size in the previous year minus the rural-urban migration. The urban population is calculated as the difference between the total and rural population. These estimates enable us to calculate the relative size of the rural and urban population and the rate of rural-urban migration.

2.5. Model Mechanism and Interactions Among the Submodels:

Figure 1 gives a bird's eye view of the model mechanism and the interactions among the various components of the model. Figure 2 gives a condensed flow

Figure (1)

Schematic Presentation of the Interactions Among the Various Components of the Model.

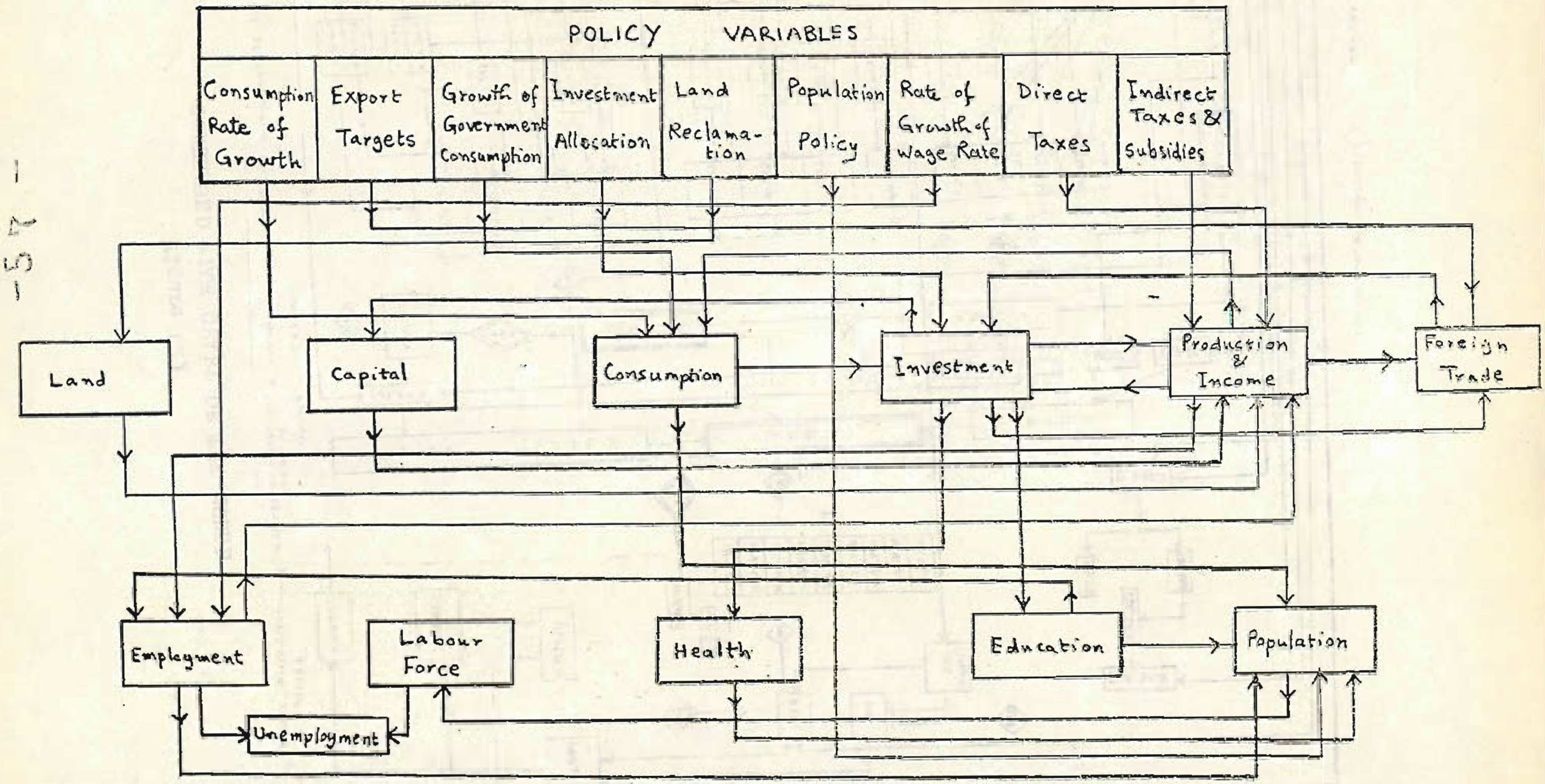
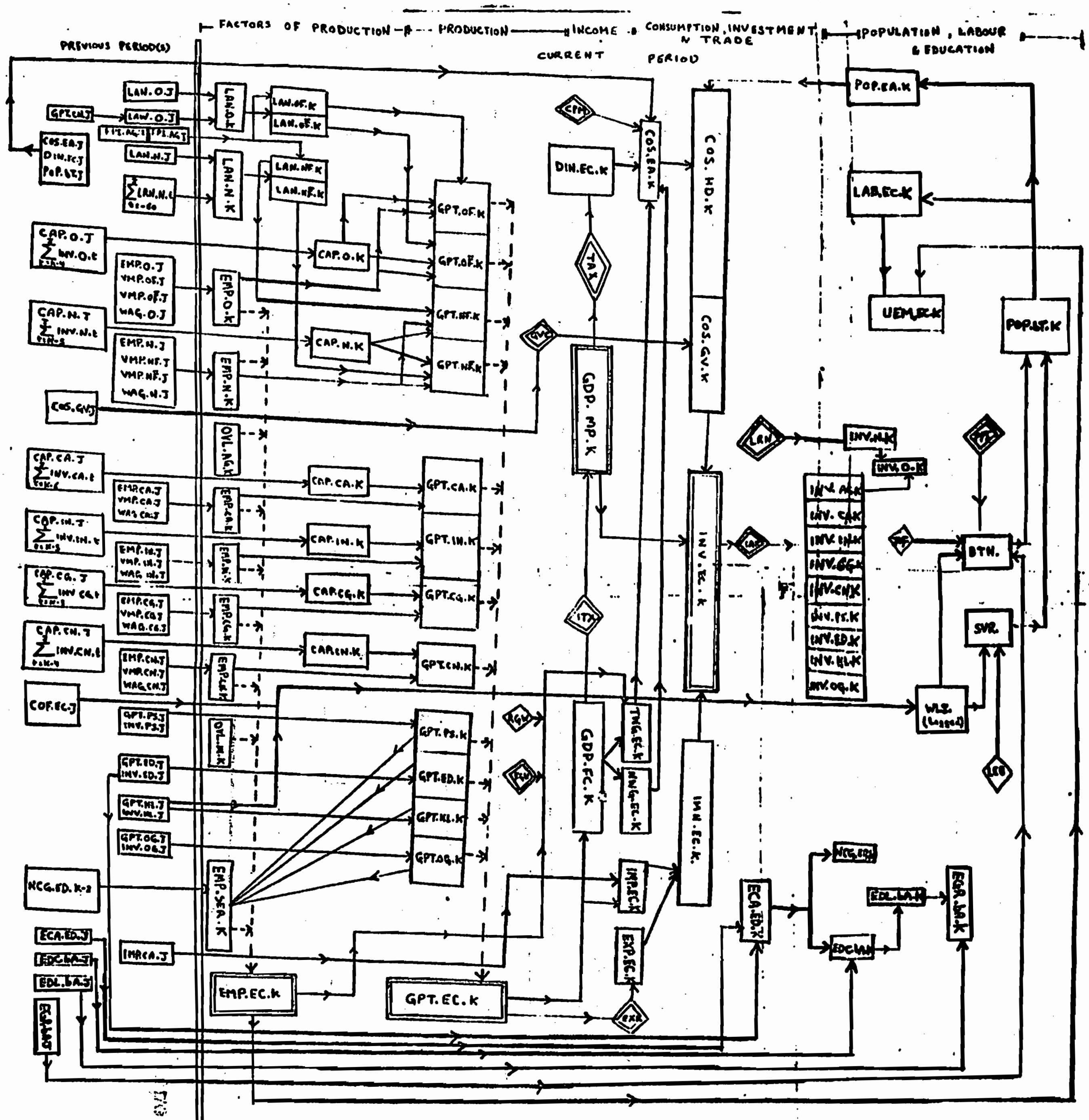


Figure (2)

CONDENSED FLOW CHART OF THE MODEL



◈ : EXOGENOUS POLICY VARIABLE   ◇ : EXOGENOUS NON-POLICY VARIABLE chart of the model, which shows the interrelationships between the economic and demographic variables. These two figures, together with the verbal presentation following the formal presentation of the model in the preceding pages and the brief sketch of the model given below, should provide an adequate description of the model's structure, logic and mechanism.

Our point of departure is the estimation of sectoral gross production for the first year's projection. Cobb-Douglas production functions are used for the determination of production in the agricultural, industrial and construction sectors, whereas. Harrod-Domar type production functions are used in the services sectors. To estimate production in the non-service sectors, one must calculate the values of labour input and capital stock, and in the case of agriculture, the land available for cultivation. All that is required for the estimation of production in the service sectors is the initial gross production and investment in each service subsector. Given the increase in the gross production of the services sector, and an estimate of the number of college graduates in the previous two years(which is generated in the population submodel for latter years in the projection period), an estimate is made of employment in the services sector in the current year. Sectoral gross production is converted to sectoral GDP or value added by means of appropriate ratios. The sum of the sectoral GDP's gives the economy's GDP at factor cost for the first year of the projection period. Using a policy-determined ratio of net indirect taxes and subsidies, GDP at factor cost is converted to GDP at market prices.

Now the economy's GDP at market prices consists of consumption, investment and foreign trade. Total consumption in the first year of the projection period is affected i.e. by policy decisions concerning the growth of consumption per e.a.c., the rate of direct taxation, the rate of growth of government consumption, as well as the size and composition of the population which is endogenously-determined in the population submodel. Foreign trade(net import)is determined partly by policy variables which influence exports and partly by exogenous variables which affect imports. This leaves us with the share of capital formation in the economy's GDP, which is calculated as a residual of GDP, consumption, and foreign trade.

The available investment for the current year is allocated to the various sectors by means of a set of policy variables designed to control the level of sectoral investments(investment allocation ratios). The sectoral shares in total investment thus determined for the current year influence capital stock in the different sectors and together with estimates of the labour and land inputs for the next year, they determine sectoral production and income, and hence the economy's GDP in that year. The process is similarly repeated for each year of the projection period.

As noted previously the age and sex structure of the population affects economic development through its effect on consumption which partly determines the resources available for capital formation. The latter may thus be increased in the model either by influencing the response of private consumption to the growth of disposable income, the rate of growth of government consumption or by controlling population growth via the population policy variable. Consumption can also be controlled through changing the rate of indirect taxes and subsidies, which is one of the model's policy variables. The age and sex structure of the population affects development also through its effect on the labour force. Given the population distribution by age-and sex groups, the size of the labour force is determined through exogenous labour participation rates. The size of labour force, together with the estimates of employment, provide estimates of the level and rate of unemployment.

The population profile by age-and sex groups is constructed for each year in the projection period. The crucial elements in this process are the fertility and servival rates. Fertility is influenced by the growth rate of the educational level which is endogenously generated in the model, improvements in welfare which are assumed to be approximated by the growth of per e.a.c. food consumption and gross production of health services, the percentage of fertile women, and the population policy. The survival rates are influenced by the expectation of life at birth and improvements in welfare. The changes in the economic variables are thus allowed to influence the major determinants of population growth. Labour switch from agricultural to non-agricultural activities and migration from rural to urban areas are also influenced by changes in the economic variables, through an endogenously determined wage differential multiplier.

III
MODEL VALIDATION

The object of this section is to test the theoretical model presented in the previous section empircially, i.e, to check its validity and ascertain the possibility of using it to explore the future paths of the Egyptian economy under alternative development strategies. To this end, we use Egyptian data to simulate the historical path of the economy during the period 1969/70-1975. Comparison of the simulated path with the actual path during that period will then indicate the extent to which the model approximates reality and enable us to assess the predictive power of the model.

3.1. Simplifying the Model

Given the time and resource limitations of the present research project, and in the light of our experience with validating a simple version of the model in which population was taken as an exogenous variable, it appeared wise to concentrate our efforts on establishing the workability and feasibility of this simplified version of the model. The implication of this decision is obvious, namely that it will not be possible to assess the capacity of the model developed in the previous section in investigating interrelations between economic development and population growth. In these circumstances, the issue of economic-demographic interaction will only be dealt with during the projection period (in Section IV) in the rather crude manner of producing and comparing projections of the economic variables under different assumptions relating to the rate of population growth. This procedure may lead to some useful insights into the interaction issue, but it is certainly no substitute for handling this issue in the manner specified in the theoretical model.[1)]

3.2. Data Collection and Parameter Estimation

One of the most challenging tasks in this study was the derivation from published and unpublished data of a set of values of the variables which figure in the model, and which can be used in estaimating or calibrating the parameters of the model. In most cases, available data did not conform to required data, and a process

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1) Moreover, the lenght of the projection period (10 years) may be too short to enable the economic - demographic interactions to manifest themselves.

of disaggregation had to be performed in the light of whatever fragments of evidence we were able to secure, or simply by pure guesswork. Our purpose in this subsection is to indicate the major difficulties we encountered in preparing the data required for the model.[1)]

Production and income data are available according to the sectoral definitions used by the Ministry of Planning. As already pointed out, these sectors are not the same as the ones used in the model. Additional information was therefore needed to disaggregate the Ministry's sectors into subsectors consistent with the model's sectoral breakdown. In the case of agriculture, we were able to obtain production and value added figures for the new land and the old land sectors, but not for the food and nonfood sectors within each of those two sectors. The food-nonfood classification was done by using the following scheme which was once adopted by CAPMAS. Food production includes 85% of beans production, 97.5% of maize production, 95% of millet production, 20% of barley production, plus crops unambiguously distined for human consumption

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1) The sources of data upon which the study relied are given in Appendix 1.

e.g. wheat, rice, onion, vegetables, etc. Nonfood production includes 15% of beans production, 2.5% of maize production, 5% of millet production, 80% of barley production, plus fodder and fibre crops (mainly cotton, linen, and clover).

Industrial production was available for the following sectors: mining and industry, petrol and petroleum products, and electricity. The model defines 3 sectors: consumer goods, intermediate goods and capital goods. No published figures were available according to this classification for the base and validation years 1968/69-1975. We were fortunate enough, however, to obtain such data for the period 1964/65 to 1970/71 from the Input-output Division of the Ministry of Planning, which were prepared on a rather tentative basis. We used the percentage distribution of industrial production thus classified, subject to some modifications, to calculate production and value added in the 3 industrial subsectors.

Needless to say, the sectoral classification of agricultural and industrial production and income is rather arbitrary. The element of judgement and guesswork is considerable in the case of industry. A large number of industrial products can be used for final or intermediate consumption and the line of demarcation between intermediate goods and capital goods was not always clear.

Production and value added in the services sectors defined in the model were calculated from the total service figures reported in Ministry of Planning documents and unpublished data obtained from the Ministry's Division regarding the education and health sectors.

Data on sectoral investment were obtained in a similar manner. The breakdown of investment in the industrial sector may suffice to illustrate the problem involved in this respect. In addition to the conceptual problem of which industries may be regarded as consumer, intermediate or capital goods industries, there is the problem of unallocable investment i.e., not assigned to aspecific project or subsector within the industrial sector, investment in research and training, and private sector investment. According to the Ministry of Planning tentative study, referred to above unallocable investments were divided equally between the intermediate and capital goods industries. Investment in research and training was regarded as intermediate investment if it is specific to a certain sector and as capital investment if it relates to the industrial sector as a whole. Private sector investments were allocated on a 50-50 basis to the consumer and intermediate goods industries.

Estimation of sectoral and subsectoral cpaital stock is another formidable problem. Actual data are nonexistent. The only practical solution was to use output data (part of which are mere estimated as indicated above) together with sectoral and subsectoral capital-output ratios (most of which are local or imported guesstimates) to derive the capital stock data required for applying the model.

Similar problems were also encountered in disaggregating employment figures (by sector and subsector), consumption data (e.g., food and nonfood consumption), and foreign trade aggregates (imports and exports by sector and subsector). A few examples will suffice to throw light on the nature of the problems involved.

Data exist on employment in the industrial sector as a whole as well as in its major branches or industries, but not in the three subsectors: Consumer, intermediate and capital goods. Conceptually, one may combine investment figures with data on the marginal capital/employment ratios to calculate the increments in employment in each subsector. But even such data were not available. As noted above subsectoral investments are mere estimates. Marginal capital/employment ratios exist for such sub-sectors as mining and industry, petrol and petroleum products, and electricity, but not for the three subsectors defined in the model. Available information was therefore used together with employment in the major branches of the industrial sector to arrive at estimates of subsectoral employment in that sector. Data gaps were filled by recourse to informed guesses, hypotheses and rough approximations.

Consumption is reported for the household and government sectors, as well as for principal consumer goods, but no division of aggregate consumption data is available according to the food-nonfood classification for the household and government sectors. Our procedure consisted in using the recently published 1974/75 family budget data to to calculate a weighted average ratio of food to nonfood consumption in the household sector and to apply the ratio thus calculated to total household consumption.[1] As regards the disaggregation of government consumption into food and nonfood components, the per capita food consumption derived from the 1964/66 family budget survey was used together with population data to calculate household food consumption. Government food consumption was then calculated as the residual of total food consumption (approximated by consumption of food products, beverages and tobacco) and household food consumption.

Finally, in dealing with the foreign trade statistics two serious problems were encountered. One is the problem of inconsistency and conflict of the figures to the extent that foreign trade figures do not always tally with the other components of the national income accounts. The second problem relates to the disaggregation of foreign trade figures. Whereas imports are classfied into consumer, intermediate and capital goods, exports are classified into agricultural and non-agricultural products. Problems of varying definitions

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1) The family budget survey results give details of consumption for urban and rural areas, but not for the country as a whole. Hence the need for a weighted average.

and concepts are always present. For instance, agricultural exports may include raw and ginned cotton, yarn and cotton fabrics, whereas, strictly speaking, the last two categories should be regarded as industrial products. We adopted the former definition in view of the lack of interrelationships in the present design of the model between the agricultural sectors and the industrial sectors. More will be said about this point in chapter V.

Data problems, of which the foregoing was only a small sample, lead to two sources of inaccuracy in the model. One, the estimates of the initial values of the variables may be subject to error. Secondly, the parameter estimates, based on available and "inferred" data, may be biased owing to the imperfections of the data as well as to the unavailability of sufficiently long series to make estimation by such method as regression analysis feasible and/or satisfactory.

The methods of estimating the parameters ranged from the use of simple arithmetic to calculate ratios or rates of change, to the use of multiple regression analysis to calculate response coefficients. On occasion, past estimates of certain parameters or initial guesses at their values were used. In no case were these estimates, however obtained, regarded as final or binding. In almost all cases, they were regarded as provisional estimates to be improved upon through model refinement and sensitivity analysis. In other words, we start by assigning to each parameter an apparently reasonable initial value, together with a set of values for the exogenous and policy varialbes based on the observed historical pattern. Parameter values are then varied in the light of comparing the values of the more important endogenous variables with their corresponding historical values. If the predicted path of those variables are sufficiently close to the historical paths, we then infer that our parameter estimates are reasonable.

Otherwise, the parameter estimates are adjusted until a sufficiently good fit is obtained. This bringsup the important question: What criteria should be used to judge the goodness of fit of the predicted path and the historical path? This issue is dealt with in the next subsection.

3.3. Criteria of Model Validity

Two criteria are used to assess the extent to which the simulated behaviour of the economy approximates its observed behaviour as reflected in the historical path of a number of variables which may be-garded as most important. They are:

i) A goodness of fit coefficient; also called coefficient of variation (CV). This is defined as follow:

$$CV = \frac{\sum_t |X_t - \dot{X}_t|}{\frac{1}{2} \sum_t (X_t + \dot{X}_t)}$$

Where X_t is the actual value of the variable X in year t, and $\dot{X}_t$ its predicted value in the same year. According to Chenery and Watanabe (1), if CV=2, the actual and predicted values are totally different and hence incomparable ; if CV=0, the actual and predicted values are identical. Thus the fit is considered "good" if $0 \leq CV \leq 2$. Since this range is too wide in the sense that it may permit rather absurd results, one may, following Lin (2), accept values of

1) See H.B. Chenery and T. Watanabe, "International Comparisons of the Structure of Production, "Econometrica, Vol.26, No,4, Oct. 1958.

2) Wuu - long Lin and M.G. Ottaviani - Carra, A Systems Simulation Approach ...., Op. Cit, P. 44.

CV in the interval CV 0.08 as indicators of reasonable goodness of fit. This is a mere "rule of thumb", which cannot be applied in a mechanical manner. Caution is warranted, because even with such a narrow range, the actual and predicted values may not be as close as the value of CV may suggest. That is why the following supplementary criterion will be used.

ii) Percentage projection error and graphical inspection. Here we concentrate on the distribution of the projection error. The latter is defined as:

$$\% \text{ Error} = \frac{\hat{X}_t - X_t}{X_t} \times 100$$

Unlike the CV test, both the sign and magnitude of the error are of significance. If, on the basis of error and graphical inspection, most of the errors are within reasonable limits e.g. less than 10 or 15 per cent, and if the errors change sign frequently, the fit may be considered "good". If, on the other hand, exceedingly large errors are observed and the errors tend to have the same sign indicating consistent over-or under-estimation, actual and predicted values are said to be incomparable, or even incompatible.

3.4. Model Performance.

Bearing in mind the data and estimation problems of which a brief account was given in 4.2, and employing the goodness of fit indicators presented in 4.3, we may now examine the performance of the model during the validation period 1969/70-1975,. Attention will be focussed on 10 variables, the behaviour of which may be regarded as summmarizing the behaviour of the economy as a whole. (1) They are gross production (GPT.EC), agricultural production (GPT.AG), industrial production (GPT.IND), service production (GPT.SER), gross domestic product at factor cost (GDP.FC), total consumption (COS.EC), private consumption (COS.HD), government consumption (COS.GV), and employment (EMP.EC) (2). Table (1) gives the

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(1) Projections of additional variables are reported in Appendix 2.

(2) Foreign trade variables are not included, because we were unable to obtain series of their values during the validation period which are consistent with the the remaining components of total expenditure. Simulated results are however shown in Appendix 2. Some reference will be made to those variables later in this subsection.

Table (1) Actual and Projected Values of Principal Variables, with Goodness of Fit Indicators

Variable/Indicator	Base 1968/69	1969/70	1970/71	1971/72	1973	1974	1975
Gross Production							
Actual	4715.60	5079.90	5391.20	5658.00	5979.50	6140.80	6633.10
Projected	-	5173.66	5340.00	5544.49	5774.28	6081.66	6422.36
% Error	-	1.85	-0.95	-2.01	-3.43	-0.96	-3.18
CV			Coefficient of Variation = 0.019				
AGR Production							
Actual	977.70	1033.80	1030.20	1074.40	1101.30	1107.20	1133.20
Projected	-	1035.06	10309.98	1031.88	1040.13	1078.65	1130.07
% Error	-	0.12	0.08	-3.96	-5.55	-2.58	-0.28
CV			Coefficient of Variation = 0.019				
IND. Production							
Actual	1985.50	2067.70	2254.80	2331.90	2454.40	2558.50	2792.30
Projected	-	2315.51	2344.06	2373.52	2407.48	2449.14	2497.11
% Error	-	11.98	3.96	1.78	-1.91	-4.27	-10.57
CV			Coefficient of Variation = 0.051				
SER Production							
Actual	1520.80	1645.80	1787.80	1916.00	2103.90	2213.20	2343.80
Projected	-	1579.37	1717.08	1890.13	2074.96	2293.34	2523.75
% Error	-	-4.04	-3.96	-1.35	-1.38	3.62	7.68
CV			Coefficient of Variation = .0.033				
GDP, Factor Cost							
Actual	2339.40	2604.10	2728.20	2871.00	3006.20	3101.30	3406.20
Projected	-	2522.82	2620.55	2743.65	2881.76	3069.24	3276.48
% Error	-	-3.12	-3.95	-4.44	-4.14	-1.03	-3.81
CV			Coefficient of Variation = 0.030				
Investment							
Actual	343.10	435.70	398.30	410.40	447.00	466.80	842.70
Projected	-	526.39	661.95	706.61	726.54	766.42	905.30
% Error	-	20.82	66.19	72.18	62.54	64.19	7.43
CV			Coefficient of Variation = 0.324				
Total Consumption							
Actual	2451.70	2630.10	2802.10	2933.80	3105.40	3181.90	3256.00
Projected	-	2571.90	2726.27	2862.11	3031.69	3210.31	3403.46
% Error	-	-2.21	-2.71	-2.44	-2.37	0.89	4.53
CV			Coefficient of Variation = 0.022				
Private Consumption							
Actual	1807.10	1934.90	2012.80	2052.70	2107.20	2154.40	2227.70
Projected	-	1874.44	1971.62	2045.56	2148.20	2254.38	2369.15
% Error	-	-3.12	-2.05	-0.35	1.95	4.64	6.35
CV			Coefficient of Variation = 0.027				
Public Consumption							
Actual	644.60	695.20	789.30	881.10	998.20	1027.50	1028.30
Projected	-	697.46	754.65	816.53	883.49	955.93	1034.32
% Error	-	0.32	-4.39	-7.33	-11.49	-6.97	0.59
CV			Coefficient of Variation = 0.050				
Employment							
Actual	8147.00	8529.80	8669.70	8864.50	9033.80	9078.00	9461.20
Projected	-	8374.87	8499.09	8659.13	8821.73	9018.56	9226.21
% Error	-	-1.82	-1.97	-2.36	-2.35	-0.65	-2.48
CV			Coefficient of Variation = . 0.017				

note: Monetary variables are in million £ E's at 1968/69 prices ; Employment in thousand persons.

actual and projected values of these variables, together with the percentage projection errors and the goodness of fit coefficient CV. Actual and projected values are also presented graphically in Figures (1) - (10).

GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF GPT_EC

* 4715.60 5079.90 5391.20 5658.00 5979.50 6140.80 6633.10
\+ 4715.61 5173.66 5340.00 5544.49 5774.28 6081.66 6422.36

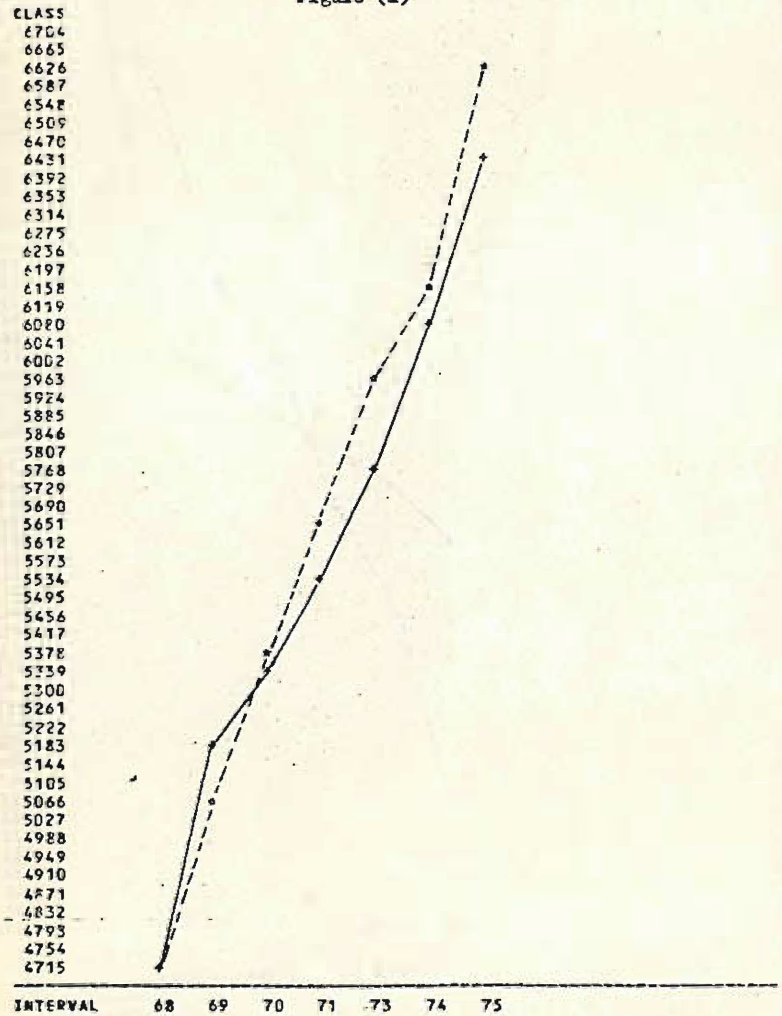
KEY FOR SYMBOLS

ACTUAL *
FORECAST +

SCALE

EACH * EQUALS 39 POINTS

Figure (1)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF GPT_AG

* 977.70 1033.80 1030.20 1074.40 1101.30 1107.20 1133.20
\+ 977.71 1035.06 1030.98 1031.88 1040.13 1078.65 1130.07

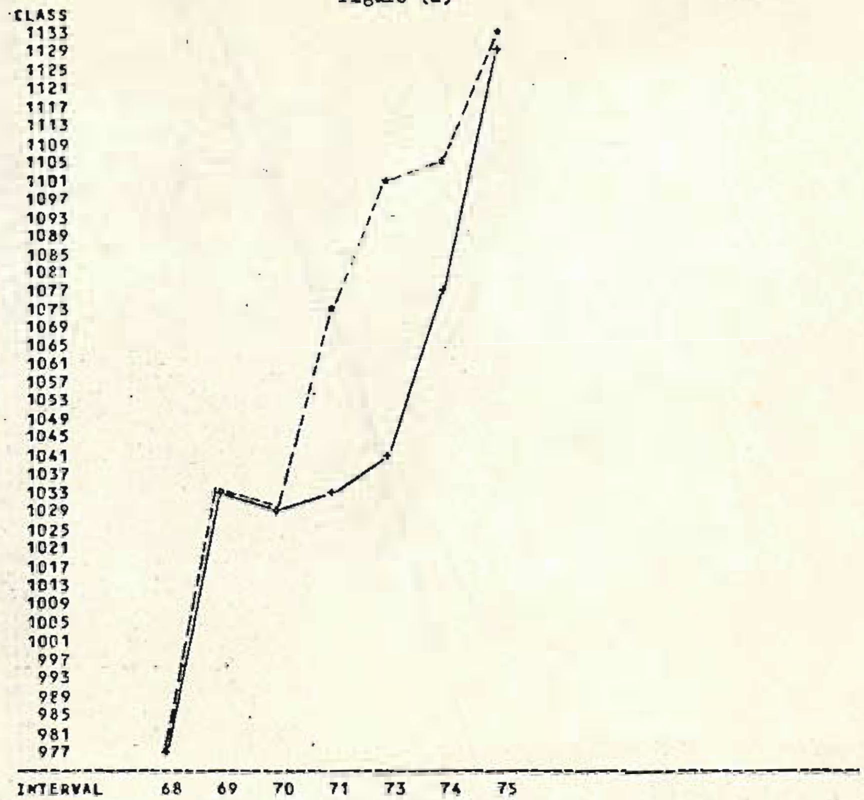
KEY FOR SYMBOLS

ACTUAL *
FORECAST +

SCALE

EACH * EQUALS 4 POINTS

Figure (2)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF GPT_IND

```
•   1985.50 2067.70 2254.20 2331.90 2454.40 2558.50 2793.30
+   1985.50 2315.51 2344.06 2373.52 2407.48 2449.14 2497.11
```

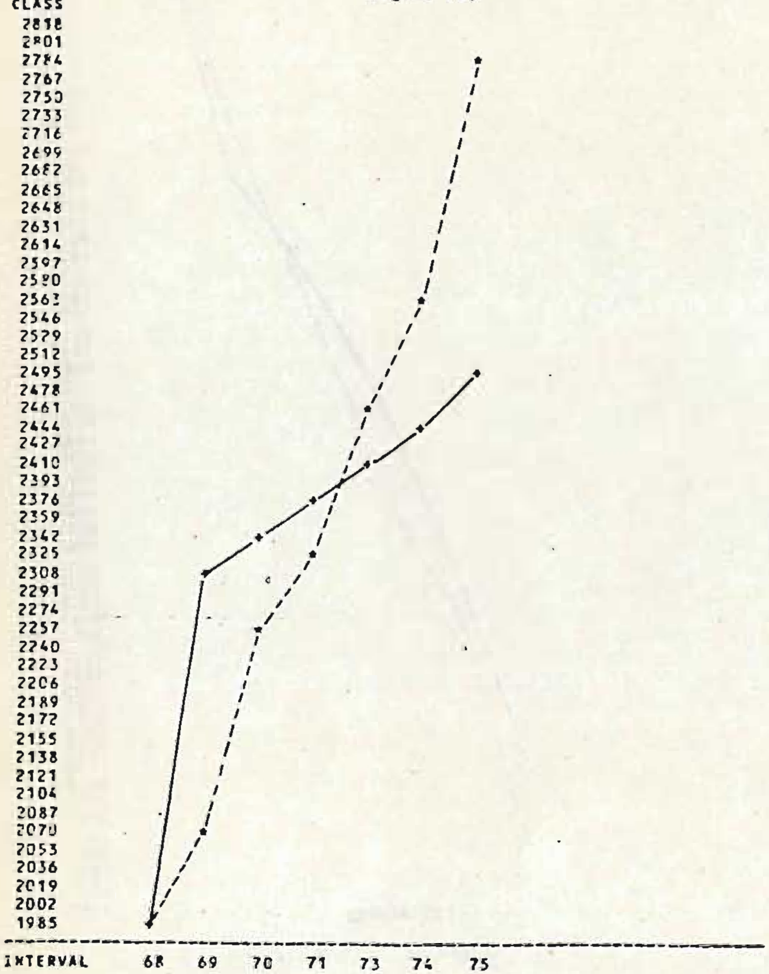
KEY FOR SYPBOLS

ACTUAL •
FORECAST +

SCALE

EACH * EQUALS 17 POINTS

Figure (3)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF GPT_SER

```
•   1520.80 1645.80 1787.80 1916.[illegible]0 2103.90 2213.20 2343.50
+   1520.80 1579.37 1717.08 1890.13 2074.96 2293.34 2523.75
```

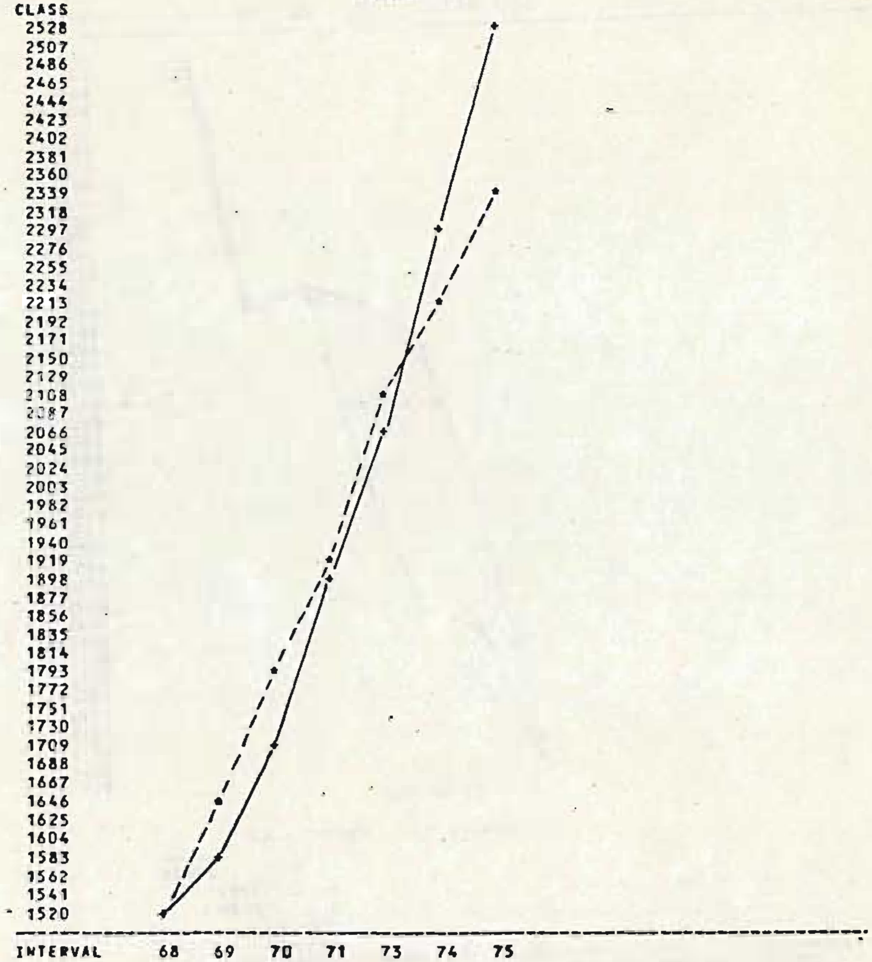
KEY FOR SYMBOLS

ACTUAL •
FORECAST +

SCALE

EACH * EQUALS 21 POINTS

Figure (4)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF GDP_FC

```
•   2339.40 2604.10 2728.20 2871.00 3006.20 3101.30 3406.20
+   2339.40 2522.82 2620.53 2743.65 2881.76 3069.24 3276.48
```

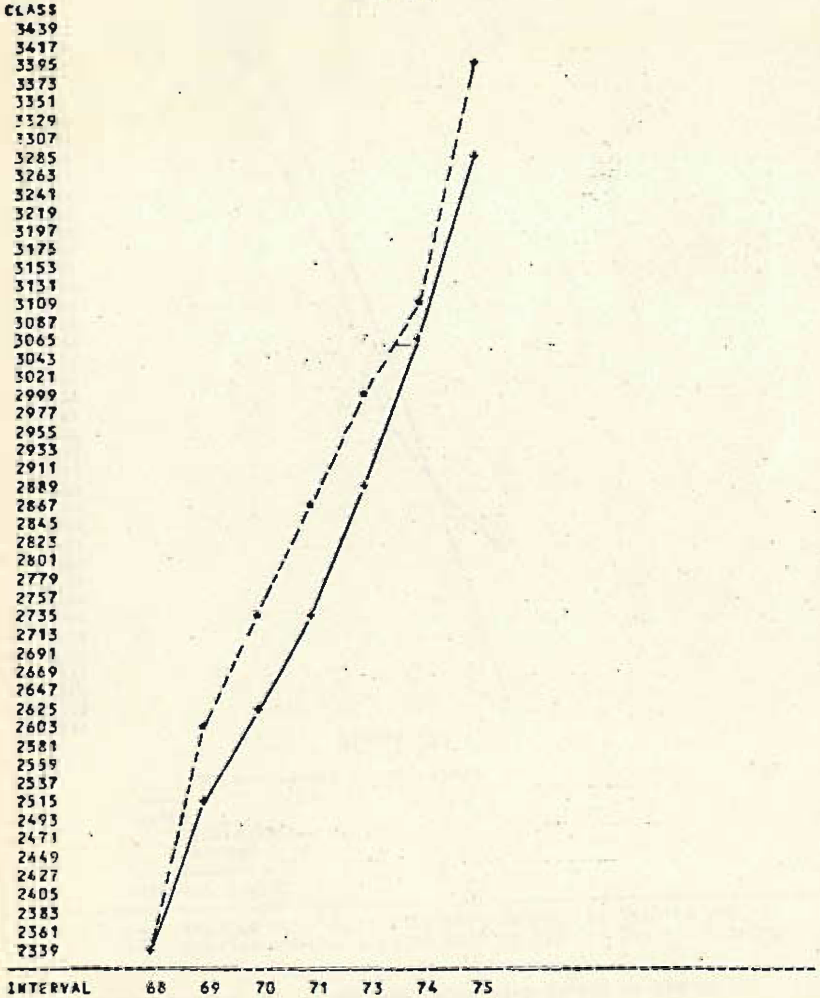
KEY FOR SYMBOLS

ACTUAL •
FORECAST +

SCALE

EACH • EQUALS 22 POINTS

Figure (5)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF INV_EC

```
•   343.10  435.70  398.30  410.40  447.00  466.80  842.70
+   343.10  526.39  661.95  706.61  726.54  766.42  905.30
```

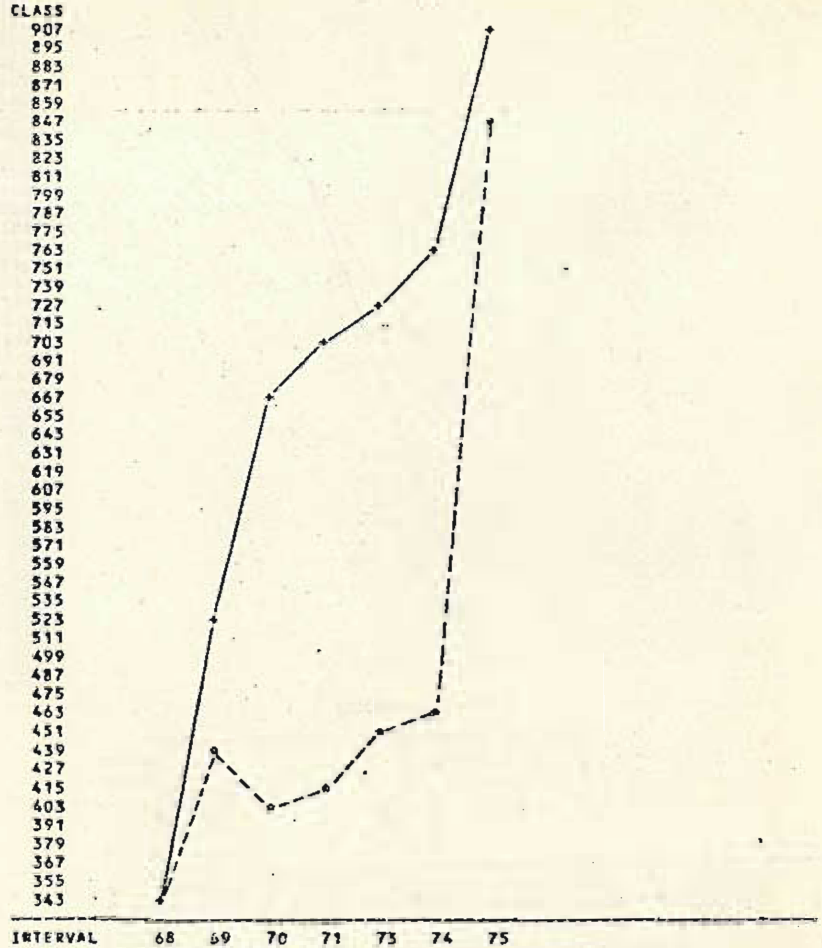
KEY FOR SYMBOLS

ACTUAL •
FORECAST +

SCALE

EACH • EQUALS 12 POINTS

Figure (6)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF COS.EC

```
*   2451.70 2630.10 2802.10 2933.80 3105.40 3181.90 3256.00
+   2451.70 2571.90 2726.27 2862.11 3031.69 3210.31 3403.46
```

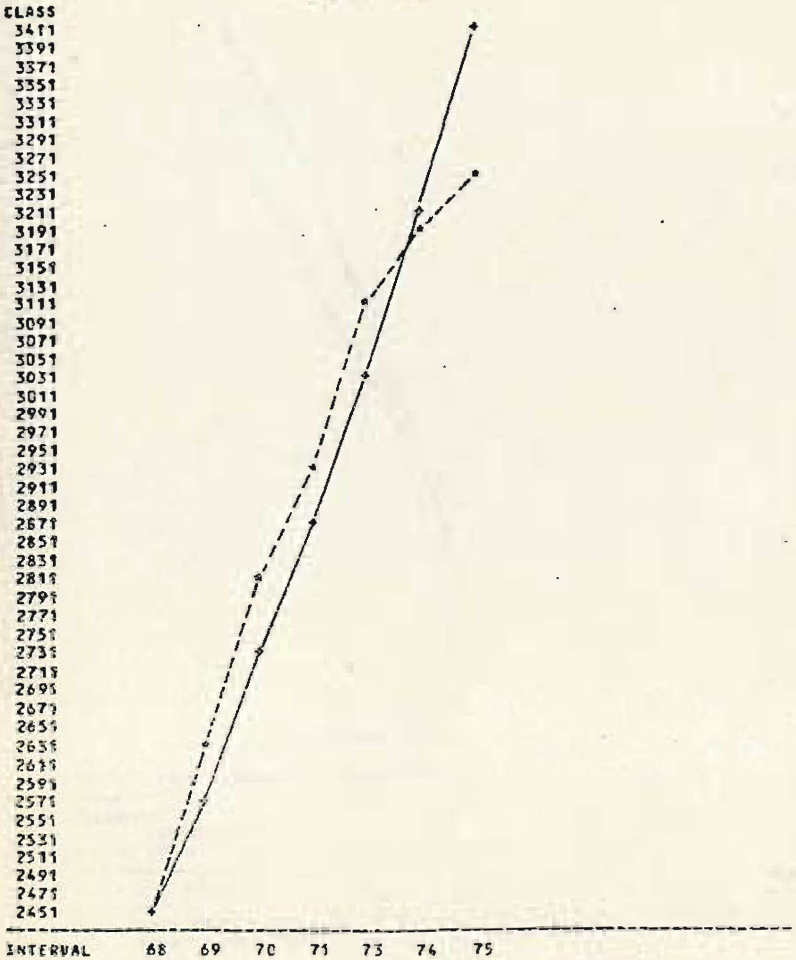
KEY FOR SYMBOLS

ACTUAL *
FORECAST +

SCALE

EACH * EQUALS 20 POINTS

Figure (7)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF COS.HD

```
*   1807.10 1934.90 2017.80 2052.70 2107.20 2154.60 2227.70
+   1807.10 1874.44 1971.62 2045.58 2148.20 2254.38 2369.15
```

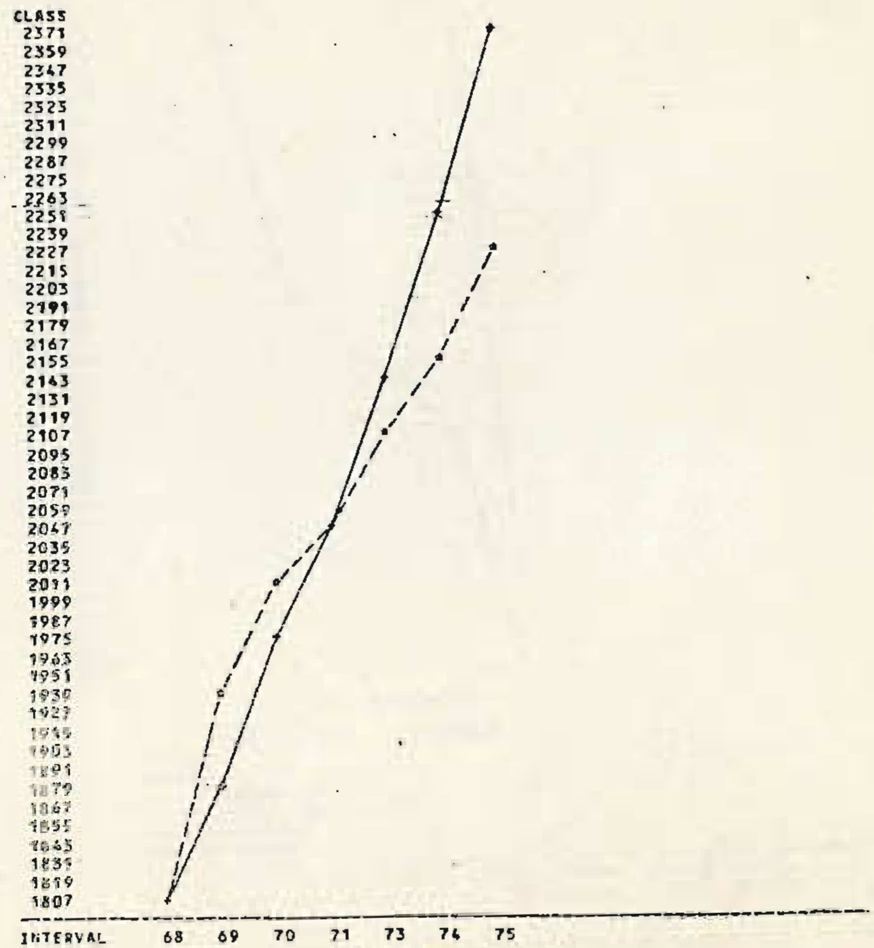
KEY FOR SYMBOLS

ACTUAL *
FORECAST +

SCALE

EACH * EQUALS 12 POINTS

Figure (8)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF COS_GV

*	644.60	695.20	789.30	881.10	993.20	1027.50	1028.30
+	644.60	697.46	754.65	816.53	883.49	955.93	1034.32

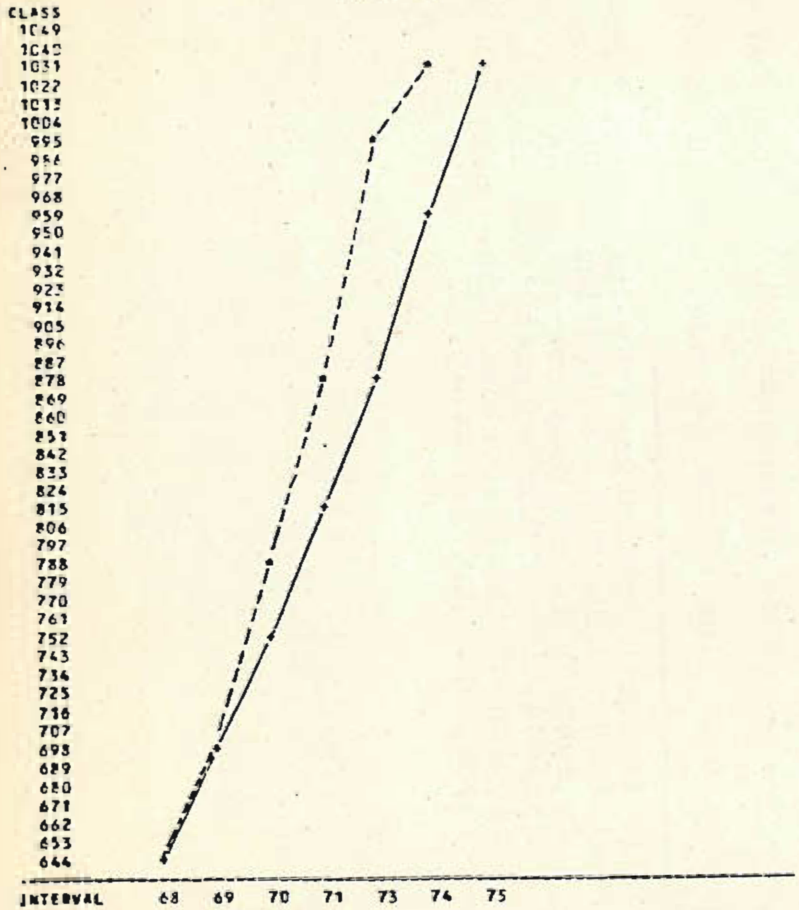
KEY FOR SYMBOLS

ACTUAL *
FORECAST +

SCALE

EACH * EQUALS 9 POINTS

Figure (9)



GRAPH PLOTTING FOR ACTUAL AND CALCULATED VALUES OF EXP_EC

*	8147.00	8529.80	8669.70	8864.50	9035.80	9078.00	9461.20
+	8147.00	8374.87	8499.09	8655.13	8821.73	9018.56	9226.21

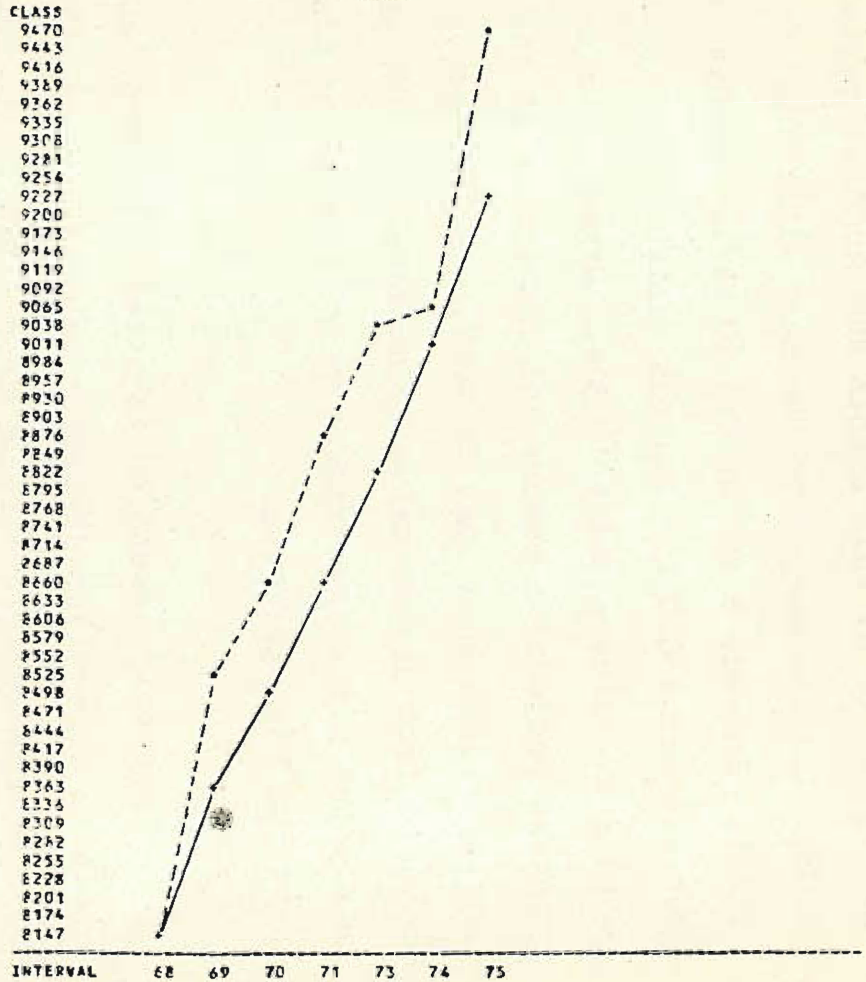
KEY FOR SYMBOLS

ACTUAL *
FORECAST +

SCALE

EACH * EQUALS 27 POINTS

Figure (10)



Actual and projected values of the 10 variables listed above are very close according to the CV criterion All values of CV fall within the critical region o CV 0.08. All are nearer to the zero limit than to the 0.08 limit. Indeed, 9 out of the 10 variables have a CV value not exceeding 0.051. The odd variable out is investment, with a CV value equal to 0.324. Examination of the percentage projection errors and inspection of the accompanying graphs show that in most cases projected values deviate from actual value by no more than 7%, and that the simulated paths approximate very closely the historical paths of the variables.

The only exception is total investment which exhibits a peculiar distribution of the projection errors. The percentage errors range from 7.43% to 72.18% implying systematic gross overestimation.(1) This may seem hard to explain in view of the impressive accuracy with which the

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1) It is worth mentioning that investment turned out to be illbehaved in Lin's applcation of the Martos model. Investment is not only overestimated but, which is more serious, the simulated path looks like an upside down version of the historical path. See, Lin and Ottaviani-carra, Op. Cit, PP. 44-45.

other key variables are predicted. But it should be noticed that we have left foreign trade variables out of consideration up to this stage. When the foreign trade sector is considered in the percentage distribution of GDP at market prices, and its actual share (calculated as a residual) is compared with its projected share, the source of discrepancy in investment behaviour is easily located. Referring to Table (2), it is clear that the systematic overestimation of investment goes hand in hand with a systematic overestimation of net imports. This is not surprising in view of the GDP identity and the absence of large errors in the projection of GDP, private consumption andpublic consumption. Some attempts were made to improve the investment and foreign trade projection through raising the export ratios, lowering the import ratios and increasing the productivity parameters of capital and/or labour, but satisfactury results proved difficult to attain from a small number of runs. On balance, we decided to accept the results reported earlier as they stand leaving this defect to be treated at another stage of modél refinement and development.

It should also be noted that the co-existence of large percentage errors in projected investment and fairly small percentage errors in the majority of the economic series projected may be explained by the fact that it is <u>capital stock</u> rather than <u>investment</u> which affects production of the non-service sectors in the model. In other

Table (2) Actual and Projected Distribution of GDP at 1968/69 Market Prices.

(%)

Item	Base 1969/70	1970/71	1971/72	1973	1974	1975
Private Consumption						
Actual	68.8	68.3	66.2	64.9	64.3	65.4
Projected	68.8	69.7	69.0	69.0	68.0	66.9
Public Consumption						
Actual	24.7	26.8	28.4	30.7	30.7	27.9
Projected	25.6	26.7	27.6	28.4	28.8	29.2
Investment						
Actual	15.5	13.5	13.2	13.8	13.9	22.9
Projected	19.3	23.4	23.8	23.3	23.1	25.6
Exports - Imports						
Actual*	-9.0	-8.6	-7.8	-9.4	-8.9	-16.2
Projected	-13.7	-19.8	-20.4	-20.7	-19.9	-21.7

* Calculated as a residual.

words, the volume of current investment, both total and sectoral, affects current production and hence the other variables whose behaviour depend on production, only marginally. The impact on current production is also further reduced due to the introduction of the PIN coefficients, whcih account for the rate of participation of current investment in current production.

In conclusion, given the remarkable degree of precision in the projection of the majority of the most important endogenous variables in the model at this stage of its development, we feel that the model is sufficiently valid to enable us to make a comparative analysis of predicted consequences of alternative development strategies. In other words, one should not attach much importance to the projected values emerging from a given scenario, and focuss attention on the relative changes of these values as we move from one scenario to another.

IV
POLICY EXPERIMENTS

The validation test conducted in the previous section has demonstrated the workability of the simplified version of SMEE, and the possibilityof using it as a tool of comparative analysis of the consequences of alternative development strategies. Three basic development strategies will be studied in this section. They include: i) a strategy which does not differ substantially from the one observed in the recent past, ii) a strategy focussing on the development of agriculture, and iii) a strategy focussing on industrial development. In addition to those basic alternatives which are in fact variants generated from the basic alternatives. They will enable us to examine the consequences of lowering the rate of population growth and the implications of terminating the present "war" conditions.

The projection period is limited to the 10 years from 1976 to 1985. Constant 1975 prices are used throughout.

4.1. The Development Alternatives

Different sets of values of the policy variables are used to define different development strategies. The main difference among the alternatives used lies in the policy of investment allocation among the various sectors of the economy. Two different sets of population variables were used to explore the implications of lowering the rate of growth of population on the path of the economy. Though one major assumption was the continuation of the war conditions until 1985, one alternative was constructed on the assumption that war conditions will disappear by the year 1978. With a few exceptions, the behavioural and technical parameters used are the same as those prevailing in the recent past (the validation period). In most cases too, those parameters were assumed to be constant over the 10 year period of the projections, though the model does not constrain us to constant parameters.

The salient features of the development alternatives may be breifly stated as follows:

1) Alternative 1A: This is the standard path in which a quasi continuation of past trends is assumed. Agricultural investment amounts to 10% of total investment. Land reclamation policy aims at bringing 5 thousand feddan under cultivation each year.(1) 39% of total investment goes to industry, 1.7% construction and 49.3% to the services sectors. Consumption policy including tax policy continues basically unchanged during the projection period. The recently recorded rate of population growth (in the 1976 population census) of 2.3 is assumed to pervail until 1985. War conditions are also assumed throughout the projection period.

(1) The land reclamation program has come to a near complete halt since the year 1970/71.

2) Alternative 1B: This is a variant of 1A in which we assume a termination of the war conditions by the year 1978. We assume that this will lead to a decline in the rate of increase of government consumption from 8.2% in the 1976-1978 period to 4% in the 1979-1982 period and to 3% in the last 3 years of the projection period. A slight change in the investment allocation policy is postulated. The shares of the relatively neglected sectors (agriculture, construction, education and health) are allowed to rise at the expense of some fall in the share of the other services sector, while the share of industry is kept unchanged. The land reclamation target is also raised from 5000 feddan in 1976-1978 to 12000 feddan annually in the 1979-1985 period. Indirect taxes and subsidies (net) are assumed to rise (e.g. as a result of lifting some subsidies or raising the rates of some indirect taxes) Agriculture and service exports are assumed to rise.

3) Alternative 2AA: Here the development strategy is agriculture-oriented. The share of agriculture in total investment is doubled to 20% at the expense of a fall in the shares of industry (from 30% 1A to 35%) and other ser-

vices (from 46.2% to 40.2%), other sectoral shares being kept constant at their 1A levels. An ambitions land reclamation program is assumed (50,000 feddan). Agricultural exports as a percentage of agricultural production are assumed to increase. Direct taxation is the same as in in 1A, but a rise in indirect taxes is assumed to provide additional funds for investment financing. War conditions and past rates of population growth rates are postulated.

4) <u>Alternative 2AB:</u> This a low population variant of 2AA. The rate of population growth is assumed to decline gradually by 0.1 percentage point from 2.3 in 1976 to 1.41 in 1985. The 1985 population is estimated at 44.924 million (the 1A estimate is 46.668 million).

5) <u>Alternative 3AA:</u> An industry-oriented development strategy is now assumed. The share of industry in total investment is increased from 39% in IA to 55%. Some increases are also assumed in the shares of agriculture (from 10 to 12%), construction (from 1.7 to 2%), education (from 2.3 to 4%) and health (from 0.8 to 2%). The other

services sectors share thus falls from 46.2% in IA to 36%. Industrial exports are assumed to rise as a percentage of industrial production. The land reclamation target remains at the same rate assumed in 1A (5000 feddan per year). War conditions and past population growth rates are assumed.

6) Alternative 3AB: This is a low population variant of 3AA, where population growth rates are assumed to decline gradually as in 2AB.

7) Alternative 4A: This is similar to 2AB in that an agricultureoriented development strategy and declining rates of population growth are assumed. The main difference between 4A and 2AB lies in attempting to contain consumption growth through various measures of demand management. The measures used include a lowering of the rate of increase of private consumption and government consumption, and the tax policy. Wages rates are however allowed to increase more rapidly than in 2AB in order to promote productivity. The investment shares of the construction, education and health sectors are raised at the expense of some fall in the share

of industry.

A summary of the projections is reported in Appendix 3. The rates of growth of the major variables are listed in Table (I) below. It should be re-emphasized that in view of the limitations of SMEEl which will be discussed in section V, our interest will be in comparing the consequences of the various development alternatives rather than in the correctness of the projections of any specific alternative. The exercise is not merely of an academic interest. Indeed the practical value of such exercise is considerable. Much is learnt about identifying meaningful (feasible) development alternatives. Very useful information is gained concerning the sensitivity of the system and its critical constraints. In most cases, we had to revise the development alternative so as to avoid unreasonable or non-feasible paths. Two constraints were frequently identified,namely the volume of investment and manpower requirements of development alternatives.

Table (1) Annual Average Rates of Growth of Major Variables

Variable	Development Alternative						
	1A	1B	2AA	2AB	3AA	3AB	4A
Gross Production:							
Agriculture	1.9	2.1	3.3	3.4	3.0	3.0	3.2
Industry	2.0	2.0	1.9	1.9	3.3	3.3	1.7
Construction	3.6	4.9	3.7	3.7	6.2	6.2	5.2
Services	7.7	7.9	7.4	7.6	7.6	7.7	7.9
Economy	4.3	4.5	4.3	4.5	4.9	5.0	4.7
GDP, Factor Cost	4.7	5.2	5.0	5.1	5.4	5.4	6.1
Employment	2.7	2.8	2.5	2.6	2.7	2.7	2.8
Consumption:							
Private	5.9	5.9	5.9	5.7	5.9	5.8	5.8
Public	8.2	5.1*	8.2	8.2	8.0	8.0	7.6
Total	6.4	5.4	6.3	6.2	6.3	6.2	6.1
Investment	Negative	1.9	Nagative	Negative	5.7	6.8	2.6
Exports	3.6	6.0	3.9	4.0	4.0	4.1	4.0
Imports	3.0	4.7	4.0	4.5	7.2	7.6	[illegible].1

Notes: The annual average rates of growth are calculated by applying the compound interest formula to the first and terminal values of the projections of the variables concerned.

* The rate of increase of government consumption is assumed to decline from 8.2% in the 1976 - 1978 period to 4% in the period 1979 - 1982 and [illegible] in the 1983 - 1985 period. The figure given above is and arithmatic average of those rates.

The discussion of the empirical findings is organized as follows: We begin by examining the effect of lowering the rate of population growth on the path of the economy during the projection period. The relevant alternatives are 2AA, 2AB, 3AA, 3AB. This will be followed by a comparison of the consequences of development alternatives with common population and defence assumptions. The relevant alternatives are 1A, 2AA, 3AA. Alternative 4A will also be examined in this part of the discussion. Finally, the impact of ending the war situation will be discussed in the light of comparing development alternatives 1A and 1B.

4.2. Impact of Reduced Rates of Population Growth

Reduced rates of population growth imply a smaller labour force as well as a smaller number of adult consumer equivalents. This is bound to reduce unemployment or at least its growth rate, and lower consumption. Additional funds will thus be released for investment. The rate of growth of production and income will therefore increase.

The results of the simulation experiments confirm these theoretical expectations, though the magnitude of the effects may not be as great as is often assumed in current controversy over the population question. The relevant alternatives are 2AA and 2AB, and 3AA and 3AB.

The annual reduction of the rate of population growth by 0.1 percentage points from 2.3%in 1976 to 1.41% in 1985 raises the annual average rate of growth of production by 0. 1 - 0.2 percentage points (from 4.3% in 2AA to 4.5% in 2AB and from 4.9% in 3AA to 5% in 3AB). A slight increase is also observed in the annual average rate of growth of GDP at factor cost as we move from 2AA to 2AB, but no significant increase is recorded as a result of moving from 3AA to 3AB. The rate of growth of household consumption decreases by 0.2 percentage points in the agriculture-oriented alternatives (2AA and 2AB) and by 0.1 percentage points in the industry - oriented alternatives (3AA and 3AB). This results in raising the average rate of savings by around 1.5-2.0 percentage points, which leads to higher investment rates, and lower rates of foreign financing of investment. The average rate of growth of exports is raised by 0.1 percentage points, and that of imports by 0.5 percentage points as a result of the higher rates of production and income growth. The rate of unemployment in the terminal year drops from 4.9% in 2AA to 1.8% in 2AB, and from 4.1% in 3AA to 1.2% in 3AB.

4.3. Consequences of Alternative Development Strategies

We will first examine those alternatives which assume continuation of past rates of population growth and war conditions, i.e. alternatives 1A, 2AA, and 3AA. The most promising alternative is 3AA which devotes a large proportion of total investment to the industrial sectors (55% in contrast to 39% in 1A and 35% in 2AA). The rate of growth of production in 3AA is 4.9% which is higher than in 1A and 2AA by 0.6 percentage points. GDP at factor cost grows faster in 3AA (5.4%) than in 2AA (5%) and 1A (4.7%). In this alternative agricultural production grows at 3% which is lower than in alternative 2AA (3.3%) but higher than in alternative 1A (1.9%). With the highest share in total investment devoted to industry, the highest growth rate of industrial production is of course attained in 3AA (3.3% in contrast with 1.9% in 2AA and 2% in 1A).

Employment grows somewhat faster in this industry - oriented alternative (2.7%) than in the agriculture-oriented alternative 2AA (2.5%). The rate of increase in employment is however the same as in 1A. Unemployment is reduced more rapidly in 3AA than in 2AA. The unemployment rates in the terminal year of the projection period are 3.5% in 1A, 4.9% in 2AA, and 4.1% in 3AA. The lower rate of unemployment in the standard path 1A is due to the higher share of the service sector in total investment in this alternative.(1)

The rate of growth of consumption is similar in the three alternatives under consideration. The share of household consumption in total expenditure is however lower in 3AA (64.8%) than in both 2AA (71%) and 1A (74.3%). This is obviously due to the higher rate of income growth in 3AA. The share of government consumption is also lower in 3AA (28.9%) than in 2AA (32.5%) and 1A (33.8%).

Investment grows more rapidly in 3AA. Indeed, the rate of growth of investment in both 2AA and 1A is negative. As a percent of the total expenditure in the terminal year, investment is 27.5% in 3AA, which contrasts sharply with

(1) Note that employment in the service sectors depends on production growth which is determined by investments and the output/ capital ratios.

10.8% in 2AA and 6.6% in 1A.

Exports and imports increase more rapidly in 3AA which is due to the higher rate of production and income growth. Growth of net imports is however greater in 3AA than in both 2AA and 1A. The highest level of foreign debt occurs in 3AA, as would be expected, though it requires a smaller rate of foreign financing of investment.

The structure of gross domestic product at factor cost becomes much more balanced in alternative 3AA than in the other two alternatives, towards the end of the projection period, as can be seen from table (2) of Appendix 3.

Let us now turn to alternative 4A. As noted previously, this alternative focusses on agricultural growth and assumes low rates of population increase. As would be expected, total consumption grows more slowly in this alternative than in the other alternatives discussed with the exception of 1B (no- war alternative).

The rate of growth of investment is higher than in both 2AB and 1A , but much lower than the industry - oriented alternative 3AB. The saving rate is higher than in 2AB, which leads to a lower rate of foreign financing of investment and generates the lowest volume of foreign debt in all alternatives. The structure of GDP in the terminal year is however similar to that obtained from alternative 2AB. This alternative produces the highest rate of GDP growth (6.1%). It is probable, however, that a higher rate of GDP growth could be obtained by incorporating similar demand management policies in the industry - oriented low population alternative 3AB.

4.4. Impact of Terminating the War Situation

It is of interest to compare the consequences of alternatives 1A (assuming war conditions) and 1B (assuming end of war condition). The annual average rate of growth of production is higher by 0.2 percentage points, and that of GDP by 0.5 percentage points. Though private consumption continues to grow at the same rate (5.9%), the assumed fall in the rate of increase of government consumption brings down the rate of total consumption growth from 6.4% to 5.4%.

This releases additional funds for investment, and causes investment to increase in 1B instead of declining in 1A. The higher rate of production and income growth leads to increased rates of growth of both exports. Both the volume of foreign debt and the rate of foreign financing of investment are smaller in 1B than in 1A in the terminal year of the projection period. This is due to the marked rise in the rates of saving and investment.

It sould be noted however that this simulation experiment does not reveal the full implications of a return to peace conditions. This is due to the assumption that the main parameter used to reflect the difference between the war and no-war conditions is the rate of increase of public consumption. Naturally, restoration of peace means much more than that. Moreover, even the lowering of the rate of increase of government consumption, with the additional funds that become available for investment, may lead to changes in other parameters such as productivity coefficients which would lead to higher rates of production and income growth. Finally, if a return to peace conditions is interpreted to mean a return to the pre-1967 development strategy, with a much greater share of total investment devoted to industrial growth, the positive effects of ending the war situation on the rate of economic growth would be much more appreciable than is suggested by the present exercise.

4.5. Policy Implications:

The foregoing discussion suggests three important conclusions:

i) An industry-oriented development strategy appears to be superior to an agriculture-oriented one, in terms of both income and employment growth. Needless to say, this is not a recommendation for neglecting agricultural growth.

ii) The rates of production and income growth are positively affected by policies aiming at curbing domestic consumption. These policies include population control, taxation and consumption rationalization. A significant rise in the rate of economic growth can be expected when such policies are combined with a development strategy focussing on industrial growth.

iii) Given the existing institutional framework of the economy there are definite limits to the growth of the Egyptian national income. Even the most drastic investment policy may not succeed in raising the rate of GDP growth over the conventional 5-6 per cent level, if no change occurs in the institional and production relations. (The highest rate obtained in the simulation experiments was 6.1%). This points to the need for efficiency-raising changes in the social framework of the economy including reform of the agrarian structure, reorganization of production relations in industry, administrative reform, and a firm commitment to comprehensive national planning. Improved incentives through income redistribution and broadly distributed economic growth are also of vital importance.

V
FURTHER WORK

The model presented and tested in this study is still preliminary . Much validation and refinement must be done if it is to be of adequate operational value in the development planning process. On the one hand, time and resource limitations permitted only a partial test of the model. On the other hand, even the part of the model which was verified needs further refinement, and some of its components may have to be reformulated. The object of this section is to point out the major gaps and shortcomings of the model, and to suggest some problem-areas which deserve further investigation. Three types of general problems can be identified, namely those relating to (a) data, (b) model structure, and (c) simulation "technology".

5.1. Data Problems.

There is an urgent need for further data refinement and improvement of the methods of estimating the technical and behavioural parameters. As previously noted in section III, disaggregation of sectoral data was done in a rather crude manner which may have led to certain inconsistencies and biases. This applies to such variables as production, investment and employment particularly in the industrial sector. The estimation of sectoral and subsectoral capital stock leaves much to be desired. Though for the most part the aggregate variables are predicted with an impressive degree of accuracy, we nevertheless feel that their components are not so accurately predicted. Indeed, they are subject to prediction errors whcih tend to cancel out upon aggregation. Similar reservations can be made concerning the estimates of such parameters as the elasticities of production and the response coefficients of the employment functions. The import requirements coefficients are also open to doubt. On the whole it is felt that a revision of the data base and the parameter estimates derived therefrom may immensly improve the performance of the model.

5.2. Model Structure.

i) Experimentation with the simple variant of the model showed that it does not provide for sufficient interaction among the economic variables. More precisely, production of a given sector is not related to production in the other sectors. For instance, there are no forward or backward linkages among the three industrial sectors, nor is there any input-output connection between those sectors and the agricultural sector. This defect could be remedied by incorporating some inter-sectoral input-output relations in the model. Needless to say, this will raise many difficult questions concerning data availability and quality.

ii) Another problem which merits further investigation and is related to the previous one is the lack of sectoral and subsectotal balance equations. The model provides no guarantee of the equality of each sector's production and imports on the one hand with that sector's consumption (intermediate and final), investment (including changes in stocks) and exports, on the other hand. The introduction of such balance equations would enhance the internal consistency of the model enormously. This may require reformulation of certain parts of the model, e.g. the foreign trade submodel. Exports or imports of some sectors or subsectors may be taken as residuals. Or, alternatively, exports of certain sectors may be treated as targets, in which case consumption may be treated differently, or the strategy of investment allocation may be appropriately adjusted.

iii) The investment allocation procedure may lead to certain inconsistencies, which probably remained concealed in the experimental runs owing to the lack of inter-sectoral relationships. Such inconsistencies may arise from the absence of upper limits on the absorptive capacity of the different sectors, or from the lack of a specification of minimm investment requirementsper sector. Of course, obvious inconsistencies are informally corrected as part of the policy simulation, but a formal procedure would be useful in spotting and dealing with the less obvious inconsistencies. This problem is clearly related to the problem of inter-sectoral balancing and consistency.

iv) It is felt that investment plays a vital role in the model. For instance, a decline in total investment in a given year, or even in two or three important sectors may be sufficient to initiate a downward trend in GDP in the following years, to the extent that investment may become negative (for the rate of consumption growth is constrained to non-negative values). This is obviously absurd. A corrective mechanism should be introduced in the model so as to avoid explosive trends. For example, if total or sectoral investment (or its rate growth) falls below a certain level for one or two years then import or export coefficients may be temporarily adjusted until investment restores its previous value. Or alternatively greater scope may be given for capital-labour substitution. Naturally, the solution of problems i) - iii) would contribute greatly to the solution of the present problem.

vi) Additional policy options need to be considered in view of the higher priority assigned to them in official statements. For instance, the slogan of "attaining self-sufficiency in food except for wheat" should be examined and the balance of payments implications and the trade - off between economic growth and food security determined. The "cotton-versus wheat" issue is also worth examining. In formulating "policy -sets" one should also take into account the implications of the open-door policy on the range and types of variables that are really subject to government control. For instance, to what extent may one legitimately treat private consumption or wage rates as policy variables in the open - door era?

V) The agricultural submodel may be reformulated so as to make possible an examination of the implications of a different crop-mix and the establishment of agro-industrial complexes. These are much talked-about issues which are awaiting serious investigation. Such reformulation may involve:

a) decomposing "food" into major components e.g. fruit and vegetables, fish, poultry, wheat, maize, etc.
b) distinguishing crop and non-crop production.
c) allowing for the introduction at appropriate point in time of new crops.

Furthermore, non-traditional factors should be included in the agricultural production functions in view of their critical role or their growing importance, e.g. fertilizers and water.

Finally, due attention should be given to the productivity effects of

a) such impediments to growth as water logging, salinity, natural or non-made, soil erosion, etc.

b) such growth promoters as changes in production techniques including mechanization structure of holdings, land distribution policy, cooperativization of production, etc.

vi) Though total employment is fairly accurately estimated by the model, we are somewhat unhappy about the estimates of sectotal employment. With the exception of the services employment function, sectoral and sub-sectoral employment shows insufficient response to the factors included in the employment functions (marginal products and wage rates). This may be explained by data imperfections, but we feel that alternative farmulations of the employment functions should also be tested.

5.3. Simulation Technology.

In view of the high cost and relatively long time involved in developing and validating models by means of the simulation approach, it is highly important that much attention should be given to the rationalization and optimization of the simulation methodology itself. Our experience in validating SMEE1 suggests that the work could be done more speeding and conveniently if it were possible to develop criteria for minimizing the time and cost involved in making corrections and frequent revisions in the parameter values. It is hoped that criteria will be developed for determining what the critical variables and parameters in the model and for determining the direction in which they should be changed once a deviation is spotted. True this is what we hope to achieve through sensitivity analysis. But what is hopefully sought is a formalization of the process and a set of formal guiding rules. It is understood that this connot be attempted in the abstract, or in general terms. Rather, this is a job which is specific to the model used, and can only be done, if at'all, in the light of a good understanding of the model and its mechasism.

Another important aspect of the simulation approach which ought to be integrated more fully in the empirical work on model validation and projections is the continuous consultation and dialogue with the planners and policy makers, or at least with those who are close enough to the centers of decision making. This would facilitate the revision of parameter values, the validation process, and the design of meaningful scenarios.

Appendix 1

Sources of Data Used in this Research

The major part of the data used in one form or another in this study was taken from two Ministry of Planning documents:

1. Indicators of Economic Growth in the Arab Republic of Egypt During the Period 1959/60 - 1971/72, Statistical and Analytical Tables, July 1975.

2. Proposals for the Five Year Plan 1976-1980, Memo. 28/1976, I June 1976.

Data in those two documents were supplemented by information reported in:

3. Ministry of Planning, Follow-up Reports.
4. ——————, The 1977 Plan, General Frame, October 1976.

and unpublished information from the Ministry's Input-Output Division, Services Division, Agricultural Division, Foreign Trade Division, and Commodity Balances Division.

Other data sources included:

5. CAPMAS, Statistical Handbook (Several issues)
6. ———, The 1966 Population Census (by semple survey).
7. ———, The 1976 Population Census, Preliminary Results, published in Al-Ahram El-Iktisadi, Cairo, May 1977.

8. ________, Population and Economic Development, June 1973.

9. ________, Statistical Indicators of the UAR, (Several issues).

10. ________, Births and Deaths Statistics, 1967, Dec. 1969.

11. ________, Cultivated Areas in the ARE, 1972, Dec. 1974.

12. ________, Summary Results of 1974/75 Family Budget Survey, published in Al-Ahram El-Iktisadi, Cairo, June 1976.

13. ________, The 1964/66 Family Budget Survey.

14. ________, Report of the Committee on the Estimation of Income Generated in the Agricultural Sector, July, 1966.

15. National Bank of Egypt, Economic Bulletin, (Several issues).

16. Central Bank of Egypt, Economic Review, (Several issues).

17. M.A. Mongi and M.N. Hanafi, Labour Absorption in the Egyptian Economy, INP, 1971.

18. ________________, Some Aspects of the Employment Problem in the ARE, INP, Memo. 1155 (external), July 1976.

19. A Mohie El-Din, Open Unemployment in the Egyptian Economy INP, Memo 1184 (external), Jan. 1977.

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21. INP, A Sectoral Model for Egyptian Agriculture, INP, 1972.

22. ________, Population, Employment and Productivity in Egyptian Agriculture, INP, 1974.

23. IBRD, The Egyptian Economy in 1974: its position and prospects, Report no. 491, July 1974.

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25. ________ , An Analytical Study of the Deficit in Egypt's Balance of Payments, 1959/60 - 1975, Price Planning Agency, Memo . No. 88, March, 1977.

26. IMF, International Financial Statistics, IMF., Jan 1977.

27. FAO, Demography for Agricultural Planners, FAO, May 1975.

28. S.A. Hussein, Evaluation of Land Reclamation Projects 1954-1974, INP, Diploma Paper, Nov. 1975.

29. A.M. Hashem, Evaluation of Horizontal Expansion Projects in the ARE, M.Sc. Dissertation, Faculty of Agriculture, Al-Azhar University, 1973.

30. G.T. Abdel-Malak, The Use of Input-Output Analysis in Preparing Medium-Term Plans in the ARE, State Minister of Planning Office, Memo. No. 855, Dec. 1973.

31. R.A. Hassan, The Use of Mathematical Relations in the Derivation of Price Elasticities for Food Products from Income Elasticity Estimates, Paper presented to a Seminar on Food Consumption , Bagded, March 1971.

32. H. Waschkau, Studies of Macroeconomic Demand Functions for Foodstuffs, with special reference to the ARE, INP, Memo. No. 1037 (external), June, 1973.

Appendix 2

Projections for the Validation Period 1969/70 - 1975

Table (1) Gross Production

(in LE million, at 1968/69 Prices)

Sector	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
AGRICULTURE	977.713	1035.058	1030.979	1031.881	1040.133	1078.647	1130.074
Old Land	958.000	1013.758	1007.658	1006.714	1013.519	1050.985	1101.843
Food	629.700	663.425	659.334	659.244	664.171	690.081	725.142
Nonfood	328.300	350.333	348.324	347.470	349.348	360.904	376.701
New Land	19.713	21.3	23.322	25.168	26.614	27.663	28.231
Food	10.290	12.419	13.404	14.411	15.186	15.741	16.019
Nonfood	9.423	8.881	9.918	10.757	11.428	11.922	12.212
INDUSTRY	1985.498	2315.507	2344.056	2373.512	2407.478	2449.140	2497.105
Capital goods	72.508	116.449	118.606	120.985	123.758	127.171	131.044
Intermed-goods	858.140	985.594	1007.049	1028.341	1051.004	1076.686	1105.660
Consumer goods	1054.850	1213.463	1218.401	1224.197	1232.717	1245.283	1260.402
CONSTRUCTION	231.600	243.719	247.883	248.953	251.711	260.529	271.430
SERVICES	1520.800	1579.373	1717.080	1890.130	2074.961	2293.341	2523.754
Education	107.500	112.188	121.656	133.554	146.262	165.864	186.546
Health	41.300	42.634	45.580	49.282	53.235	56.043	65.171
Others	1372.000	1424.551	1549.844	1707.295	1875.464	2068.435	2272.037
Total	4715.611	5173.656	5339.998	5544.487	5774.283	6081.657	6422.363

Table (2) Gross Domestic Product at Factor Cost

(in £E million, at 1968/69 Prices)

Sector	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
AGRICULTURE	689.370	730.262	727.455	728.039	733.811	760.773	796.774
Old Land	674.770	723.570	719.289	718.561	723.366	749.890	785.599
New Land	14.590	6.692	8.166	9.479	10.444	10.883	10.874
Food	416.720	439.298	437.279	437.876	441.582	458.784	481.755
Nonfood	272.650	290.963	290.176	290.164	292.228	301.989	315.019
INDUSTRY	539.600	638.671	646.804	655.226	664.919	676.793	690.444
Capital goods	35.529	57.060	58.117	59.283	60.641	62.314	64.211
Intermed goods	231.700	266.110	271.903	277.652	283.771	290.705	298.528
Consumer goods	272.370	315.500	316.784	318.291	320.506	323.773	327.705
CONSTRUCTION	110.300	116.010	117.992	118.502	119.814	124.012	129.201
SERVICES	1001.200	1037.881	1128.279	1241.879	1363.212	1507.658	1660.063
Education	93.520	97.603	105.840	116.192	127.248	144.301	162.295
Health	27.670	28.565	30.539	33.019	35.668	39.559	43.665
Others	880.010	911.713	991.900	1092.669	1200.297	1323.798	1454.104
Total	2339.400	2522.824	2620.531	2743.645	2881.756	3069.235	3276.482

Table (3) Structure of GDP at Factor Cost

Sector	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
Agriculture	29.468	28.946	27.760	26.535	25.464	24.787	24.318
Industry	23.066	25.316	24.682	23.881	23.073	22.051	21.073
Construction	4.715	4.598	4.503	4.319	4.158	4.040	3.943
Services	42.797	41.140	43.055	45.264	47.305	49.122	50.666
Total	100	100	100	100	100	100	100

Table (4) Consumption Indicators

(at 1968/69 prices)*

Type	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
Private	1807.100	1874.440	1971.618	2045.576	2148.204	2254.383	2369.146
Public	644.600	697.657	754.649	816.530	883.485	955.931	1034.317
Total Consump.	2451.700	2571.897	2726.266	2862.106	3031.690	3210.314	3403.464
Total per e.a.c.	71.101	72.072	73.420	75.081	77.077	79.071	81.233
Total Food	992.000	1115.618	1142.867	1158.692	1191.106	1224.731	1262.087
Food per e.a.c.	39.030	39.516	39.018	38.752	38.742	38.732	38.806

* In million LE's except food total consumption per equivalent adult consumer (e.a.c.) which are in LE's.

Table (5) Investment Allocation

(in £E million at 1968/69 prices)

Sector	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
AGRICULTURE	64.000	84.160	105.760	112.960	72.600	76.600	90.500
Old Land	13.944	68.352	103.513	110.646	70.190	74.063	87.806
New Land	50.156	15.808	2.247	2.314	2.410	2.537	2.694
INDUSTRY	136.200	210.4	264.4	282.4	290.4	306.4	362.0
Capital goods	27.297	36.820	46.420	49.420	50.820	53.620	63.350
Intermed goods	86.661	126.240	158.640	169.440	145.200	153.200	181.000
Consumer goods	22.242	47.340	59.490	63.540	94.380	99.580	117.650
CONSTRUCTION	2.600	8.416	10.576	11.296	12.342	13.022	15.385
SERVICES	140.300	223.024	280.264	299.244	350.658	369.978	437.115
Education	7.500	10.520	13.220	14.120	21.780	22.980	27.150
Health	2.400	3.682	4.627	4.942	7.260	7.660	9.050
Others	130.400	208.822	262.417	280.282	321.618	339.338	400.915
Total	343.100	526.391	661.950	706.608	726.545	766.418	905.301

Table (6) Functional Income Distribution

(in LE million at 1968/69 prices)

Item	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
Total Wages in : Agriculture	210.7	225.260	234.274	243.649	253.400	263.540	274.086
Industry	236.4	208.071	212.246	216.505	220.849	225.280	229.800
Construction	61.7	114.704	122.744	131.346	140.551	150.401	160.940
Services	661.1	885.312	962.422	1059.323	1162.820	1286.033	1416.034
Total Wage income	1169.9	1433.347	1531.686	1650.823	1777.619	1925.253	2080.859
Total non-Wage income	1169.5	1100.477	1088.845	1092.822	1104.137	1143.982	1195.623
Wage to Total Income	0.5001	0.5681	0.5845	0.6017	0.6168	0.6273	0.6351

Table (7) Structure of Expenditure

(Percentages, based on 1968/69 prices)

Item	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
1- Consumption:	92.643	94.394	96.329	96.590	97.410	96.849	96.181
- Private	68.285	68.796	69.664	69.034	69.023	68.010	66.952
- Public	24.358	25.598	26.664	27.556	28.387	28.339	29.230
2- Investment	12.965	19.320	23.389	23.847	23.344	23.121	25.584
3- Imports	19.612	28.607	34.335	36.797	36.882	35.894	35.368
4- Exports	13.989	14.894	14.618	16.360	16.127	15.924	13.603
5- Net Import	-5.623	-13.713	-19.717	-20.437	-20.755	-19.970	-21.765
Total (1+2-5)	100	100	100	100	100	100	100

Table (8) Labour Force, Employment and Unemployment.*

Sector	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
Agriculture							
LAB.	4319.700	4376.807	4432.774	4479.049	4491.810	4420.289	4409.115
EMP.	3964.900	4076.226	4076.299	4076.369	4076.436	4076.502	4076.567
UEM.	354.8	300.581	356.475	402.680	415.374	343.788	332.548
UER.	0.082	0.069	0.080	0.090	0.092	0.078	0.075
Non-Agriculture							
LAB.	4442.400	4489.183	4655.423	4836.429	5032.318	5316.679	5545.833
EMP.	4182.100	4298.646	4422.788	4578.765	4745.293	4942.054	5149.648
UEM.	260.3	190.537	232.636	257.664	287.025	374.625	396.185
UER.	0.58	0.042	0.050	0.053	0.057	0.070	0.071
Economy							
LAB.	8762.100	8865.990	9088.197	9315.478	9524.128	9736.968	9954.948
EMP.	8147.000	8374.872	8499.086	8655.134	8821.729	9018.555	9226.215
UEM.	615.1	491.118	589.111	660.344	702.399	718.413	728.733
UER.	0.070	0.055	0.065	0.071	0.074	0.074	0.073

* LAB= Labour force, EMP= Employment, UEM= Unemployment, UER= Unemployment ratio; all an 1000's except UER which is a percentage.

Table (9) Land Variables

(in 1000 Feddans)

Item	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
Old Land	5402.670	5392.670	5382.190	5371.531	5360.826	5350.003	5338.800
New Land	382.100	450.155	511.152	563.449	608.352	646.969	680.244
Food	2725.620	2712.598	2708.215	2717.67	2721.988	2727.459	2731.874
Non-Food	3059.150	3130.227	3185.127	3217.31	3247.191	3269.512	3287.169
Agriculture	5784.770	5842.825	5893.342	5934.980	5969.178	5996.971	6019.043
Land Withdrown	10.000	10.480	10.659	10.705	10.824	11.203	11.672

Table (10) Foreign Transactions

(in LE million at 1968/69 prices)

Item	1968/69	1969/70	1970/71	1971/72	1973	1974	1975
Imports	519.000	779.445	971.750	1090.354	1147.874	1189.795	1251.515
Exports	370.200	405.807	413.707	484.776	501.935	527.837	481.350
Net Import	148.800	373.638	558.043	605.578	645.938	661.958	770.165
External Debt	1000.000	1223.638	1642.863	2130.584	2683.051	3279.162	4013.284

Table (11) Rates of Growth of Major Indicators

(%)

Item	1969/70	1970/71	1971/72	1973	1974	1975
Gross Production	9.713	3.215	3.829	4.144	5.323	5.602
Agriculture	5.865	-0.394	0.087	0.800	3.703	4.768
Industry	16.621	1.233	1.257	1.431	1.731	1.958
Construction	5.233	1.709	0.432	1.108	3.503	4.184
Services	3.851	8.719	10.078	9.779	10.525	10.047
GDP, Factor Cost	7.841	3.873	4.698	5.034	6.506	6.752
Agriculture	5.932	-0.384	0.080	0.793	3.674	4.732
Industry	18.360	1.274	1.302	1.479	1.786	2.017
Construction	5.177	1.709	0.432	1.108	3.503	4.184
Services	3.664	8.710	10.068	9.770	10.596	10.109
Consumption	4.903	6.002	4.983	5.925	5.892	6.017
Private	3.726	5.184	3.751	5.017	4.943	5.091
Public	8.200	8.200	8.200	8.200	8.200	8.200
Investment	53.422	25.753	6.746	2.821	5.488	18.121
Exports	9.618	1.947	17.179	3.540	5.160	-8.087
Imports	50.182	24.672	12.205	5.275	3.652	5.187
Labour force	1.186	2.506	2.501	2.240	2.235	2.239
Employment	2.797	1.483	1.836	1.925	2.231	2.303

Table(1) GDP at Factor Cost and its Rates of Growth*

Strategy/Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1A	4769.526	5024.998	5311.993	5639.037	5997.134	6365.411	6731.152	7080.463	7395.	7653.655
((4.7))	(2.375)	(5.356)	(5.711)	(6.157)	(6.350)	(6.141)	(5.746)	(5.189)	(4.454)	(3.486)
1B	4769.516	5028.996	5323.041	5654.649	6005.127	6310.657	6685.987	7065.408	7443.511	7814.011
((5.2))	(2.374)	(5.440)	(5.847)	(6.[illegible]30)	(6.198)	(5.088)	(5.948)	(5.675)	(5.351)	(4.977)
2AA	4822.377	5057.336	5324.911	5634.938	6006.[illegible]65	6393.714	6781.755	7158.640	7512.161	7825.181
((5.0))	(3.509)	(4.872)	(5.291)	(5.822)	(6.600)	(6.440)	(6.069)	(5.557)	(4.938)	(4.167)
2AB	4822.377	5057.030	5324.829	5635.635	6009.170	6399.321	6794.132	7183.356	7557.807	7905.039
((5.1))	(3.509)	(4.866)	(5.296)	(5.937)	(6.626)	(6.493)	(6.170)	(5.729)	(5.213)	(4.594)
3AA	5098.490	5309.463	5562.726	5875.986	6274.561	6709.719	7168.834	7645.215	8135.440	8635.119
((5.4))	(9.435)	(4.138)	(4.770)	(5.631)	(6.783)	(6.935)	(6.843)	(6.645)	(6.412)	(6.142)
3AB	5098.490	5309.235	5562.658	5876.486	6276.269	6713.944	7178.202	7663.912	8169.905	8695.260
((5.4))	(9.435)	(4.133)	(4.773)	(5.642)	(6.805)	(6.973)	(6.915)	(6.766)	(6.602)	(6.430)
4A	4822.377	5067.150	5341.069	5655.647	6038.953	6440.715	6854.377	7274.036	7695.629	8112.234
((6.1))	(3.509)	(5.076)	(5.406)	(5.890)	(6.777)	(6.653)	(6.423)	(6.123)	(5.796)	(5.414)

* GDP is in £E million, at 1975 prices Figures in parentheses are growth rates.
Annual average growth rates for the 10 year period are given in double parentheses.

Appendix 3

Projections for the Period

1976 - 1985

Table (2) Structure of GDP at Factor Cost

Sector	Agriculture	Industry	Construction	Services
Base Year	30.930	22.621	4.948	41.501
Terminal Year				
Strategy				
1A	21.908	17.589	5.228	55.276
1B	21.880	17.286	5.779	55.054
2AA	25.467	17.001	5.166	52.366
2AB	25.299	16.859	5.123	52.719
3AA	21.642	23.160	5.972	49.226
3AB	21.538	23.052	5.944	49.465
4A	24.262	16.207	5.735	53.795

Table (3) Structure of Total Spending

	COS.HD	COS.GV	COS.EC	INV	EXP.	IMP
Base Year	66.729	25.005	91.734	28.303	19.542	39.579
Terminal Year						
Strategy						
1A	74.308	33.840	108.148	6.651	12.507	27.306
1B	72.010	23.940	95.950	17.998	16.830	30.779
2AA	71.055	32.468	103.523	10.806	14.568	28.896
2AB	69.452	32.140	101.592	14.047	14.520	30.159
3AA	64.827	28.883	93.710	27.544	16.703	37.957
3AB	63.484	28.683	92.167	30.287	16.667	39.121
4A	67.888	29.345	97.233	17.705	15.810	30.748

Table(4) Employment and its Rates of Growth*

Strategy/Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1A	9593.842	9884.381	10213.936	10564.971	10926.726	11291.188	11648.501	11985.041	1228.	12511.385
((2.7))	(1.392)	(3.028)	(3.334)	(3.437)	(3.424)	(3.336)	(3.165)	(2.889)	(2.474)	(1.871)
1B	9593.813	9889.557	10228.058	10591.090	10928.916	11200.584	11560.754	11897.112	12235.606	12576.448
((2.8))	(1.392)	(3.083)	(3.423)	(3.549)	(3.190)	(2.486)	(3.216)	(2.909)	(2.845)	(2.786)
2AA	9596.970	9860.005	10159.115	10476.771	10802.455	11132.399	11461.343	11780.830	12077.759	12333.464
((2.5))	(1.425)	(2.741)	(3.034)	(3.127)	(3.109)	(3.054)	(2.955)	(2.788)	(2.520)	(2.117)
2AB	9596.970	9859.610	10159.039	10477.715	10805.601	11139.398	11476.123	11809.676	12130.381	12424.268
((2.6))	(1.425)	(2.737)	(3.037)	(3.137)	(3.129)	(3.089)	(3.023)	(2.906)	(2.716)	(2.423)
3AA	9596.970	9815.274	10076.260	10363.899	10669.513	10992.459	11332.670	11688.967	12058.500	12436.665
((2.7))	(1.425)	(2.275)	(2.659)	(2.855)	(2.949)	(3.027)	(3.095)	(3.144)	(3.161)	(3.136)
3AB	9596.970	9814.991	10076.200	10364.574	10671.768	10997.462	11343.170	11709.342	12095.476	12500.150
((2.7))	(1.425)	(2.275)	(2.661)	(2.862)	(2.964)	(3.052)	(3.144)	(3.228)	(3.298)	(3.346)
4A	9596.970	9866.327	10167.491	10486.454	10815.941	11156.880	11509.944	11872.709	12239.803	12602.679
((2.8))	(1.425)	(2.807)	(3.052)	(3.137)	(3.142)	(3.152)	(3.165)	(3.152)	(3.092)	(2.965)

* Employment is in 1000'S, Figures in parentheses are growth rates.
Annual average growth rates are given in double parentheses.

Table(5) Unemployment and Unemployment Ratios*

Strategy \ Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1A	1220.135 (0.113)	1186.135 (0.107)	1079.516 (0.096)	952.096 (0.083)	820.154 (0.070)	690.890 (0.058)	573.557 (0.047)	481.747 (0.039)	435.07 (0.034)	457.369 (0.035)
1B	1220.164 (0.113)	1181.564 (0.107)	1065.394 (0.094)	925.977 (0.080)	817.964 (0.070)	781.494 (0.065)	661.304 (0.054)	569.676 (0.046)	481.026 (0.038)	392.306 (0.030)
2AA	1217.007 (0.113)	1211.116 (0.109)	1134.337 (0.100)	1040.296 (0.090)	944.425 (0.080)	849.679 (0.071)	760.715 (0.062)	685.958 (0.055)	638.873 (0.050)	635.290 (0.049)
2AB	1230.655 (0.114)	1200.932 (0.109)	1127.166 (0.100)	1028.889 (0.089)	961.097 (0.082)	784.054 (0.066)	645.746 (0.053)	497.169 (0.040)	348.794 (0.028)	228.308 (0.018)
3AA	1217.007 (0.113)	1255.847 (0.113)	1217.192 (0.108)	1153.168 (0.100)	1077.367 (0.092)	989.619 (0.083)	889.388 (0.073)	777.821 (0.062)	658.132 (0.052)	532.089 (0.041)
3AB	1230.655 (0.114)	1245.551 (0.113)	1210.005 (0.107)	1142.030 (0.099)	1094.930 (0.093)	925.990 (0.078)	776.699 (0.064)	597.503 (0.049)	383.699 (0.031)	152.426 (0.012)
4A	1230.655 (0.114)	1194.215 (0.108)	1118.714 (0.099)	1020.150 (0.089)	950.757 (0.081)	766.572 (0.064)	609.925 (0.050)	434.136 (0.035)	239.372 (0.019)	49.897 (0.004)

* Unemployment is in 1000's, Figures in parentheses are unemployment ratios.

Table(6) Household Consumption and Growth Rates of Consumption*

Strategy \ Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1A	3308.967	3525.539	3756.859	4012.869	4291.508	4586.916	9895.68	5214.379	5537.73	5857.919
((5.9))	(2.223)	(6.545)	(6.561)	(6.814)	(6.944)	(6.884)	(6.730)	(6.511)	(6.201)	(5.782)
1B	3308.967	3526.833	3760.470	4018.130	4294.281	4568.793	4880.162	5207.922	5550.977	5908.233
((5.9))	(2.223)	(6.584)	(6.625)	(6.852)	(6.873)	(6.393)	(6.815)	(6.716)	(6.587)	(6.436)
2AA	3308.967	3516.248	3738.033	3984.604	4262.566	4557.559	4865.779	5184.586	5510.458	5838.204
((5.9))	(2.223)	(6.264)	(6.307)	(6.596)	(6.976)	(6.921)	(6.763)	(6.552)	(6.285)	(5.948)
2AB	3311.024	3512.669	3733.767	3977.709	4253.396	4537.781	4835.699	5141.504	5452.535	5764.571
((5.7))	(2.287)	(6.090)	(6.294)	(6.533)	(6.931)	(6.686)	(6.565)	(6.324)	(6.049)	(5.726)
3AA	3308.967	3500.547	3708.225	3944.528	4217.485	4512785	4827.079	5159.659	5510.067	5877.772
((5.9))	(2.223)	(5.790)	(5.933)	(6.372)	(6.920)	(7.002)	(6.965)	(6.890)	(6.791)	(6.673)
3AB	3311.024	3497.000	3703.985	3937.621	4208.186	4492.717	4796.185	5114.631	5447.992	5796.092
((5.8))	(2.287)	(5.617)	(5.919)	(6.308)	(6.871)	(6.761)	(6.755)	(6.640)	(6.518)	(6.390)
4A	3311.024	3514.074	3735.610	3979.322	4256.197	4542.904	4847.091	5164.798	5495.504	5837.644
((5.8))	(2.287)	(6.133)	(6.304)	(6.524)	(6.958)	(6.736)	(6.696)	(6.555)	(6.403)	(6.226)

* Consumption is in £E million, at 1975 prices, Growth rates are given parentheses. Annual average rates of growth are given in double parentheses.

Table(7) Total Investment and Growth Rates of Investment*

Year / Strategy	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1A	1204.516 (-12.271)	1366.394 (13.439)	1455.494 (6.521)	1499.913 (3.052)	1511.030 (0.744)	1481.324 (-1.969)	1395.021 (-5.826)	1228.799 (-11.915)	951.961 (-22.529)	524.341 (-44.920)
1B	1226.117 (-10.698)	1403.522 (14.469)	1505.280 (7.250)	1499.691 (-0.371)	1532.508 (2.188)	1444.735 (-5.727)	1492.899 (3.334)	1502.267 (0.627)	1512.570 (0.686)	1476.674 (-2.373)
2AA	1238.331 (-9.808)	1408.326 (13.728)	1495.687 (6.203)	1533.454 (2.525)	1553.450 (1.304)	1548.638 (-0.310)	1503.958 (-2.885)	1397.514 (-7.078)	1203.074 (-13.913)	887.873 (-26.200)
2AB	1236.469 (-9.944)	1409.828 (14.021)	1500.496 (6.431)	1543.834 (2.888)	1571.608 (1.799)	1585.318 (0.872)	1570.254 (-0.950)	1509.580 (-3.864)	1383.043 (-8.382)	1165.907 (-15.700)
3AA	1434.011 (4.444)	1714.761 (19.578)	1890.042 (10.222)	2008.192 (6.251)	2122.082 (5.671)	2235.508 (5.345)	2341.155 (4.726)	2428.047 (3.711)	2484.629 (2.330)	2497.369 (0.513)
3AB	1432.147 (4.308)	1716.231 (19.836)	1894.874 (10.409)	2018.593 (6.529)	2140.158 (6.022)	2271.666 (6.145)	2406.129 (5.919)	2537.263 (5.450)	2659.025 (4.799)	2765.254 (3.995)
4A	1184.196 (-13.751)	1324.165 (11.820)	1402.470 (5.914)	1448.736 (3.299)	1499.066 (3.474)	1552.350 (3.555)	1594.951 (2.744)	1613.897 (1.188)	1595.218 (-1.157)	1522.447 (-4.562)

* Investment is in LE million at 1975 prices. Rates of growth are given in parentheses.

Table (8) Exports and Growth Rates of Exports[*]

Strategy / Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
IA	692.572	716.816	742.987	773.948	810.770	849.156	887.520	924.345	957.9	985.922
((3.6))	(-26.944)	(3.501)	(3.651)	(4.167)	(4.758)	(4.734)	(4.518)	(4.149)	(3.631)	(2.925)
IB	766.347	799.424	835.9[illegible]	995.263	1043.864	1086.765	1191.885	1247.473	1302.653	1380.891
((6.0))	(-19.162)	(4.316)	(4.567)	(19.060)	(4.883)	(4.110)	(9.673)	(4.664)	(4.423)	(6.006)
2AA	817.118	840.084	865.686	898.305	948.424	1001.647	1054.989	1106.298	1154.240	1196.949
((3.9))	(-13.806)	(2.811)	(3.048)	(3.768)	(5.579)	(5.612)	(5.325)	(4.864)	(4.333)	(3.700)
2AB	817.118	840.059	865.674	898.356	948.593	1002.148	1056.185	1108.774	1158.891	1205.239
((4.0))	(-13.806)	(2.807)	(3.049)	(3.775)	(5.592)	(5.646)	(5.392)	(4.979)	(4.520)	(3.999)
3AA	1021.016	1046.566	1077.631	1119.095	1175.993	1238.782	1304.951	1373.287	1443.312	1514.472
((4.0))	(7.702)	(2.502)	(2.968)	(3.848)	(5.084)	(5.339)	(5.341)	(5.237)	(5.099)	(4.930)
3AB	1021.016	1046.543	1077.621	1119.139	1176.161	1239.245	1306.024	1375.471	1447.388	1521.667
((4.1))	(7.702)	(2.500)	(2.970)	(3.853)	(5.095)	(5.364)	(5.389)	(5.317)	(5.229)	(5.132)
4A	923.036	950.282	980.019	1016.833	1070.960	1128.204	1186.669	1245.009	1302.864	1359.515
((4.0))	(-2.633)	(2.952)	(3.129)	(3.756)	(5.323)	(5.345)	(5.182)	(4.916)	(4.647)	(4.348)

[*] Exports are in LE Million, at 1975 prices. Rates of growth are given in parentheses

Figures in double parentheses are annual average growth rates.

Table (9) Imports and Growth Rates of Imports*

Strategy / Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
IA	1605.908	1853.090	2020.523	2141.053	2235.169	2307.389	2351.040	2353.302	2295.	2152.594
((3.0))	(-16.359)	(15.392)	(9.035)	(5.965)	(4.396)	(3.231)	(1.892)	(0.096)	(-2.461)	(-6.221)
IB	1605.905	1869.421	2049.024	2173.701	2227.187	2202.496	2342.189	2390.439	2457.511	2525.296
((4.7))	(-16.359)	(16.409)	(9.607)	(6.085)	(2.461)	(-1.109)	(6.342)	(2.060)	(2.806)	(2.758)
2AA	1613.386	1874.544	2044.784	2162.210	2256.091	2340.810	2409.850	2450.484	2445.509	2374.264
((4.0))	(-15.969)	(16.187)	(9.082)	(5.743)	(4.342)	(3.755)	(2.949)	(1.686)	(-0.203)	(-2.913)
2AB	1613.579	1872.763	2045.403	2165.017	2262.827	2352.325	2434.267	2495.991	2524.278	2503.284
((4.5))	(-15.959)	(16.063)	(9.218)	(5.848)	(4.518)	(3.955)	(3.483)	(2.536)	(1.133)	(-0.832)
3AA	1720.619	2101.781	2363.065	2552.305	2709.566	2866.749	3024.779	3178.696	3320.589	3441.514
((7.2))	(-10.384)	(22.153)	(12.432)	(8.008)	(6.162)	(5.801),	(5.513)	(5.089)	(4.464)	(3.642)
3AB	1720.813	2099.921	2363.720	2555.316	2716.718	2878.866	3050.095	3225.435	3400.797	3571.766
((7;6))	(-10.374)	(22.031)	(12.562)	(8.106)	(6.316)	(5.969)	(5.948)	(5.749)	(5.437)	(5.027)
4A	1611.724	1821.724	1967.681	2075.864	2174.466	2278.798	2388.640	2492.734	2581.373	2644.024
((5.1))	(-16.056)	(13.030)	(8.012)	(5.498)	(4.750)	(4.798)	(4.820)	(4.358)	(3.556)	(2.427)

* Imports are in LE million at 1975 prices . Rates of growth in Parentheses.
Figures in double parentheses are annual average growth rates.

Table (10) Investment, Saving and Foreign Debt

	Investment Rate (1)	Saving Rate (2)	Foreign Financing of Investment (3)	Outstanding Foreign Debt (4)
Base Year	28.303	8.266	85.000	4.5
Terminal Year				
Strategy				
1A	6.651	-8.148	222.503	18.4
1B	17.998	4.050	77.499	17.4
2AA	10.806	-3.523	132.599	17.3
2AB	14.047	-1.592	111.333	17.6
3AA	27.544	6.290	77.163	20.5
3AB	30.287	7.883	74.138	20.8
4A	17.705	2.767	84.371	15.7

(1) Ratio of investment to GDP at market prices

(2) Ratio of Savings to GDP at market prices

(3) Ratio of excess of investment over savings to total investmnet.

(4) Defined as debt interst + net import - net foreign revenue not connected with trade. Base year figure is a crude estimate, all figures in LE. billions, at 1975 prices.