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A SIMULATION MODEL OF THE KENYA
NATIONAL ECONOMY AND ITS USE AS
A GUIDE TO ECONOMIC POLICY

By

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ABSTRACT

This paper describes a simulation model of the Kenya national economy. The aim is to present a novel way of identifying, discussing and analysing a fairly wide spectrum of development problems facing Kenya. The model consists of a nine-sector input/output production component linked to a consumption component composed of four rural and five urban income classes. One of the main features of this model is that it is demand driven. Thus, growth rates in the productive sectors are generated endogenously as a function of demand. The model also deals with questions of income distribution, rural-urban migration and inflation.

An overview is presented of the Kenyan economic and planning environment and the development and applications of the Kenya Simulation Model (KENSIM). The structure as well as the computational sequences of the model are described. A more detailed description of the model, including the overall structure (as reported in Slater and Walsham 1975), the set of economic assumptions and equations, the fortran computer programme, and the details of the data sources are reported in a forthcoming book by Slater, Walsham and Shah(1977).

The paper goes on to discuss the application of KENSIM as a forecasting tool and for the simulation of alternative policy options, giving the example of rural-urban migration. The scope for further application and development of KENSIM is wide, and some of the major areas of current interest are identified. Some lessons and experiences are also included concerning co-operation between decision-makers and 'model-builders', which is essential if simulation models are to be used effectively for development planning.

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BACKGROUND: KENYA'S DEVELOPMENT PROBLEMS

When Kenya achieved independence in 1963 the nation resolved to work towards the achievement of a number of social and economic objectives which included individual freedom, freedom from want, disease and exploitation, and the growth and equitable sharing of the nation's income. These were ambitious objectives considering the constraints which were facing the country at that time.

Several of the major constraints will be described. First, the national income was small: in 1964 Kenya's GDP was K&330 million, or approximately \$1,000 million for a nation of 8 million people at that time. Second, the population relied very heavily on agriculture for income and subsistence. Ninety per cent of the population of Kenya was and continues to be rural and dependent on subsistence farming characterised by low productivity. The third, major constraint was the limited arable land that could be used for crop and livestock farming. Although Kenya has a land area of about 500,000 sq.km., less than a third is arable, thus limiting the potential for agricultural development. Fourth, the absence of rich mineral resources, which could be exported as an important source of finance, was an impediment to development.

Against this background, Kenya has attempted to achieve its development objectives through three Development Plans, the first covering the period 1966-70 (Kenya 1966), the second covering the period 1970 - 74 (Kenya 1969) and the third covering the period 1974 - 78 (Kenya 1974).

The economic and social progress made in Kenya's thirteen years of independence has been quite considerable. GDP has grown at an annual average rate of 6.6 per cent in the period from 1964 to 1973. Population, on the other hand, grew at an average rate of approximately 3.3 per cent so that per capita income only increased at an annual rate of about 3.3 per cent. The living conditions of the people have been improved through the provision of such services as education, health, water supplies and housing infrastructure. Yet although progress towards development objectives has been realised, Kenya has a long way to go in fulfilling its development aims and ambitions. A description of the major development issues and problems facing Kenya can be found in Leys (1975) and Clark (1965).

The main policy problems having general and continuing significance

2. The population problem, and
3. The unfavourable terms of trade that have recently been aggravated by the 1974 - 76 world-wide stag-flation.

These major problems could be approached individually and strategies evaluated to attack each one; however, to deal with these broad and pervasive problems within the constraints of Kenya's resources, material and human, a complex set of multifaced strategies may merit consideration. As background for application of a general systems simulation model to development problems, it is useful to examine the character and estimate probable costs of the three independent problems as a 'package'. Traditional piecemeal evaluation of programmes often fails to assess the interactive effects on the system. Unless analytical tools are used to evaluate policies and strategies for integrated programmes within an overall development plan, the plans will continue to perform poorly.

Experience with Kenya's three development plans has indicated that by the time a plan has been formulated numerous new situations have arisen. Often the assumptions made during the plan formulation period are invalidated by unforeseen and changing circumstances during the plan implementation period. In view of this, there is a critical need for plan updating and review during the implementation period. This need has been clearly visible during the first part of the 1974 - 78 plan period when the international economic situation led to major repercussions on the national economy. In this context, the usefulness of simulation models to evaluate alternative policies in order to review and update development plans has been recognised.

Simulation models can also be used in the plan formulation period when it is necessary to consider the tradeoffs between individual programmes and sectoral development within the overall economy. Traditional planning has been based on a 'trickle down' theory which suggests that money and other assistance will enter the top of a dualistic economy and spread downward until all segments of the society are better off. Some of the key issues considered in the construction of the Kenya Simulation Model were income distribution, labour displacement and quantitative demonstration of the impact of a variety of development strategies and even of specific programmes. An illustrative list of policy options and strategies will contain:-

- 1) Rural-urban migration problems and urban income distributive strategies,

- 2) Investment to foster traditional small-farmer market opportunities,
- 3) Investment to foster labour opportunities in the rural areas,
- 4) Investment to foster modern agricultural development to provide an expansion of food production,
- 5) Land development schemes to limit erosion, other soil degradation and deforestation,
- 6) Protective measures to assure wildlife survival in order to maintain the natural heritage and at the same time expand tourist revenues, and
- 7) Industrial and commercial development.

The conclusions that emerge are that Kenya's development problems make careful planning urgent. The population pressures upon the limited land resources make planning essential, but the tradeoffs are politically sensitive and difficult to calculate. Thus it appears useful to have analytical tools designed to provide an informed basis for decision and policy making. However, such analytical tools can make a worthwhile contribution only if appropriate administrative structures exist within the government planning machinery to use them. Fortunately in Kenya the administrative set-up exists such that the use of simulation models in the development planning process is viable. It was in this setting and with the background described above that the development of the Kenya Simulation Model (KENSIM) was attempted.

The KENYAN PLANNING PROCESS

In this section the Kenyan economic planning process, particularly in the Ministry of Finance and Planning, is described in relation to the process of developing KENSIM. Figure 1 shows the overall structure of Kenya's planning and budgeting system (Masakhalia 1975). Planning in Kenya is shared by the operating ministries and field planning units, including the Provincial and District Development Committees. However, the final responsibility for drawing up the plan and for coordinating the implementation and revisions lies with the Ministry of Finance and Planning. Part of the mechanism for this is the annual budgeting process, where the operating ministries submit budget proposals, but the final annual estimates and trimming of the budget are carried out by the Ministry of Finance and Planning.

The Ministry is divided into three main departments: Finance,

is divided into divisions or units which are assigned specific functions. It is probably useful to describe briefly the Planning Department organisation and indicate the interactions with the Finance Department as well as the planning process that involves other ministries. In the Ministry of Finance and Planning the Macro-Economic Planning Unit is a small group concerned with analysing and monitoring the statistical indicators of the economy. This unit, under the technical leadership of Professor John Powelson, undertook to develop a macro-economic model of the Kenyan economy during the period 1972 through 1974. The model was used in the preparation of the 1974-78 Development Plan. It was a traditional Harrod-Domar growth model. The growth target of 7.4 per cent was put into the model, and the model predicted the necessary levels of government and private investment to achieve the targeted growth rate. In a later section of this paper the results of applying this model will be contrasted with the results from KENSIM.

Sector planning units provide a link between the planning units in the operating ministries and the Finance Officers in the Finance Department. Working groups for sector planning and estimates draw members from both departments for a review of levels of expenditures of operating ministries, parastatal organisations and other users of public funds. A Rural Planning Unit co-ordinates the rural development efforts of several concerned sector planning groups and works closely with the District Development Committees. A Project Planning and Evaluation Unit monitors progress on projects and keeps a record of all public sector projects.

Operating ministries maintain planning units and originate most project plans. The government's guidance of private sector development involves support services such as identifying opportunities and providing financial information, government participation in selected development efforts, and parastatal enterprises. Senior members of operating ministries and Finance and Planning, as well as officers of several development banks, serve as board members of the numerous marketing boards and other government agencies and parastatal institutions. Many of these agencies were established during the colonial era and have survived with their functions slightly altered. Through these institutions, Kenya's government budgeting system can potentially penetrate more deeply into the national economy than is at first apparent. The budgeting process was designed originally to assure that funds were used in accordance with the Constitution, but recently more emphasis has been placed on the task of forward planning. This new emphasis provides a potentially favourable environment for the use of planning models such as KENSIM.

An appraisal of the administrative environment in which the designers of KENSIM found themselves working in 1973 and 1974 would point up some differences between the actual planning process at that time and a modified process which could introduce some desirable changes. In 1972 the sector planning for the important agriculture sector, for example, was done with limited concern for some of the distributive consequences of development strategies. Overall, the development of the so called non-monetary sector and traditional agriculture did not receive significant attention, although the majority of the population is in this sector. There appears to be a need for simulation models which would permit the assessment of trade-offs involving income distribution changes that would result from various alternative development strategies.

A DESCRIPTION OF THE KENSIM MODEL

Figure 2 shows a condensed diagram of the overall system in a given year. The model consists of a nine-sector input/output production component linked to a consumption component by four sales sectors from which consumers make direct purchases. The throughput of traditional produce is consumed directly by subsistence farmers and does not pass through a commercial sector. The throughput of the commercial sector is split into goods and services, the latter including such activities as hotels and transport services. Lastly, the utilities sales sector includes electricity and water for which consumers pay directly.

The consumption component is disaggregated into nine income classes, four rural classes A to D and five urban classes E to I. Consumer income is generated by wages and rents from productive sectors, including income in kind from subsistence agriculture. There is also an internal money transfer activity from richer to poorer income classes. Each class is characterised by fixed parameters representing real income, average consumption and savings propensities, average taxation, and income transfer behaviour to other classes. Thus, the income and expenditure pattern within a given class remains constant over time, but the number of households within each class varies with time depending on total income changes, inflation, population increases and rural-urban migration rates.

The government component receives income in the form of taxes and loans which it uses to operate government services, to create investment, to service loans and thus to generate a surplus or deficit. A capital formation

foreign loans. Capital is then invested in the productive sectors and this creates demand, due to construction expenditures, increases productive capacity and alters input/output coefficients.

The remaining flows shown in Figure 2 concern imports to and exports from the nine productive sectors. Exports are a simple aggregate by sector, whereas imports are split into three types. Capital imports are related to the investment in each sector, and intermediate imports are a function of gross output. Consumption imports occur when demand exceeds the capacity of the sector.

A complete set of historical data including technical coefficients and propensities for the overall system is entered for the first year. These data are based on the government records for the year 1971. The model then advances in time units of one year and the computer simulation sequence, described below, is shown in Figure 3.

Consumer Demand

Given the number of households within each income class, the first component of the model calculates the total consumer demand for the output of the four sales sectors from which the consumers make direct purchases. Direct consumer demand on the four sales sectors is converted to demand on the nine productive sectors using a matrix giving the proportion of the throughput of the sales sectors originating in each productive sector. This aspect is in contrast to traditional input/output analysis where demand is expressed for each industry sector and not aggregated through sales sectors, nor in turn disaggregated to demographic subsets of consumers with different consumption propensities.

Government

Government income is calculated as the sum of indirect taxes, consumer taxes, duty on imports and loans to the government. These items are calculated endogenously within the model depending on the performance of the economy during the previous year, with the exception of loans to the government which are read in exogenously. Government policies on consumption expenditure, capital formation expenditure and subsidies are also read in exogenously, and their sum results in total government expenditure. Note that policy simulation exercises can be carried out by varying total government expenditure and also by varying the pattern of expenditure, both in terms of different amounts to the various sectors and also in type of expenditure within each sector.

Capital Formation and the Impact of the Capital Investment

Capital formation within each sector is calculated as the sum of consumer savings allocated to that sector, business savings, government capital expenditure and private capital imports. The impact of capital investment is then considered as a three-stage process. This is a novel feature of the model which needs more detailed explanation.

First, capital investment is assumed to have a construction effect. Total investment in any given sector is used partly for capital imports, but the remainder pays for such items as buildings, roads, land improvement and other internal productive outputs. Thus the construction effect of capital investment results in the creation of direct demand on the nine productive sectors of the economy, a considerable proportion being demand on the building and construction sector and the services sector.

The second impact of capital investment is to alter the capacity of the sector. Since this model is demand driven, it is assumed that capital investment does not directly result in increased output, but only increased capacity. The extra capacity is utilised if demand rises sufficiently to require it.

The third effect of capital investment is to alter the input/output technical coefficients within the model. For example, Tobin (1972) demonstrated in Kenya that the long-term impact of capital investment within the economy is to gradually reduce the number of jobs per unit of output. This reduction can be estimated as a function of total capital investment within any given productive sector. Similarly, capital investment affects other technical coefficients, such as the degree of dependence on intermediate imports for production and the pattern of rental income changes.

Final Demand and Production

Having determined final demand, the provisional gross output of each sector can be calculated using standard input/output analysis. If the provisional gross output exceeds the capacity of the sector, the balance of demand is met by consumption imports at world prices. This is particularly relevant in the agricultural sector where shortfalls in local production must be met by the importation of foodstuffs. The model includes a weather factor which has the effect of reducing the capacity of the agricultural sector in a bad weather year, thus simulating the impact of unfavourable climatic conditions.

wages, rents, depreciation, interest and taxes; a number of these are policy variables which can be regulated by government. Corresponding output price increases can be calculated using standard input/output analysis. When the final output of each of the productive sectors is known, together with levels of price inflation in each sector, a calculation is made of wages paid and rental incomes to each of the consumer classes.

Income Distribution

This is the final stage of the computational sequence which redistributes the total population amongst the nine income classes. It draws together the generated data on income increases and inflation changes, together with exogenous data on population increase and rural-urban migration rates. At the completion of the redistribution of the population amongst income classes, a calculation is made of those in wage employment in each class, dependent on the employment spectrum within each productive sector. This enables numbers not in wage employment to be calculated, which is an important political variable in urban areas where high unemployment rates threaten stability.

The component of income distribution completes the computational sequence of the model. The model is recursive and the sequence for the succeeding year starts with the component of consumer demand.

APPLICATIONS OF KENSIM

The model has been applied, in conjunction with personnel from the Ministry of Finance and Planning, to two categories of problems, namely, forecasting and simulation of alternative policy options.

Forecasting

The first operational runs of the model were designed to evaluate some features of the 1974-78 Development Plan. The plan presents a series of estimates of government developmental and recurrent expenditures, as well as partial estimates of the private domestic and foreign investments expected over a five-year period. These capital investment and government consumption estimates are used, together with estimates of population growth and migration to urban areas, as inputs to the model. Some of the important measures of economic performance as forecast by KENSIM are summarised below.

Growth Rate of the Economy

1974-78 Development Plan forecasts:	7.4%
KENSIM forecasts:	
Optimistic (weather cuts modern agriculture by 2%) (inflation rate is 8% over 1974 to 1978)	5.8%
Best Estimate (5% weather effect, 10% inflation)	3.5%
Pessimistic (10% weather effect, 15% inflation)	3.0%
<u>Economic Survey, 1976: growth rate for 1972/75</u>	3.5%

likely to Δ in Cuba
- 9 -

Income Distribution. The 1974-78 Development Plan suggested a more equitable distribution of income. However, KENSIM forecasts, which are in agreement with present observations, are:-

	1973	1978
% of total income held by lower 50% of the income strata	17%	15%
% of total income held by upper 2% of the income strata	30%	39%

Urban Unemployment. KENSIM results indicated that urban unemployment would likely grow by about 25 per cent a year from 1974 to 1978. The subsequent experience of the economy has tended to follow the forecasts of KENSIM on modern sector employment trends. This is shown in the 1976 Economic Survey:-

The most striking aspects of employment in 1975 were a reduction of 2% in the number of people in wage employment in modern establishments, the first such reduction in ten years; a further fall in real earnings, this time of nearly 3% compared with one of 6% in 1974; and for the first time earnings from employment in the public sector exceeded those from employment in the private sector. (Kenya 1976).

The above application of the model is an example of the forecasting role in which problem areas are uncovered and quantified, but no attempt is made to suggest remedies. From the viewpoint of the policy planner, evaluation and choice of alternative policy options may be preferable. It is not possible in policy planning at the macro-economic level to formulate an objective function which matches the political and economic beliefs of all the interested parties to the decision-making process. The approach taken with this model is to extract a number of different measures of economic performance forecast under alternative strategies. These are presented to decision-makers, who then exercise the necessary judgement concerning trade offs.

Policy Options: Rural-Urban Migration

As in many developing countries, rural to urban migration is increasing in Kenya, leading to a large number of urban workers without formal sector employment. This was clearly shown by the model simulation in that the growth of unemployed in the period 1974-78 was forecast on the order of 106 per cent. The rural to urban 'drift' which was forecast was discussed with the decision-makers and led to some thought on the case for labour-intensive building and construction in rural areas as an alternative to expanded urban employment.

In reviewing the options available to offset the impact of high urban drift and the consequent high level of urban unemployment, some simulations

of the agriculture and building and construction sectors in rural areas. The presumption was that the relationship of jobs to output as a function of investment would shift from a 1 per cent per annum decline to a 2 per cent per annum increase in agriculture and from a 2 per cent per annum decline to a 1 per cent per annum increase in building and construction. It was hypothesised that if the government followed a policy of fostering projects that were only slightly more labour-intensive in these two industries, there would be some reduction in the urban unemployed. The results of the simulated shift in performance resulting from the policy change for 1975 through 1978 would be to reduce expected growth in GNP from 5.82 per cent to 5.79 per cent but to reduce urban unemployment by 6.4 per cent, or from an expected level of 31.4 per cent in 1978 to about 25 per cent. This translates into a trade-off of a reduction of about K£300,000 per year in gross product to provide employment for 48,000 workers, or about K£6.5 per worker (\$45.00 per worker year). Of course the labour-intensive projects may have some other costs of administration, but the benefit/cost ratios appear very favourable.

Various other policy options have been investigated. For example, the model has been used to assess some rather specific strategies designed to cope with the impact of rising costs of chemical fertilisers. This simulation analysis has apparently been useful in the evaluation of a temporary subsidy for fertilisers, both in the decision to adopt the subsidy for the three-year period 1974-77, and the decision to remove it in June 1976. Details of this policy option, as well as others, such as tradeoffs between development investments in modern agriculture and traditional agriculture are given in Slater, Walsham and Shah (1977).

FURTHER APPLICATIONS AND DEVELOPMENT

The present status of KENSIM represents the first stage of a long-term process to enhance the application of simulation methods to socio-economic planning. To date only a small set of forecasting problems and simulation of alternative policy options has been considered. The range and variety of problems that can be investigated are very wide. Further work on the model can be split into three main activities, namely, updating, applications and development.

Updating

It is important to appreciate that the data needs of KENSIM are not extreme; much of what is needed for the model is available for most economies, developed and developing. These include:-

- An input/output model of the economy,

- Some estimates of capital/labour ratios,
- A wage income survey showing wage income by income class for each major sector, and
- Some data on prices of imports and consumption goods.

At the present time the model is initiated from difference equations assessing changes between two base years, 1971 and 1972. In many developing countries such as Kenya there is a general lack of historical data, so that it is not possible to use time series analysis methods to estimate the system parameters. Already the data for the years 1973-75 are available, and these will be used to update the parameters of the KENSIM model. In the future when sufficient data are available, time series methods will be used. However, from our experience the use of time difference methods has enabled an explicit consideration of the interdependence of economic factors in the functioning of the model.

Another major area of updating concerns sensitivity, validation and further development of the data base for KENSIM. The model uses deterministic estimates of parameters and the results are a function of the assumptions made in these estimates. It is important to carry out sensitivity and validation exercises to ensure that the model represents reality as closely as possible and to establish sensitive data areas which have a major impact on results. This will make it possible to focus attention on those areas where improved data sources would lead to more accurate model forecasting and thus where resources can best be applied to collect these data.

Applications and Development

There is a considerable amount of overlap between these two areas, since work on the applications will often highlight limitations in the current representation leading to development work to remedy this. Some of the current areas of interest include:-

1. Evaluation of the performance of the economy under the constraint that increasing proportions of government investments are directed to the rural areas where the majority of the population resides.) relevant
2. A major focus of the 1979-83 Development Plan will be the alleviation of poverty. There is a need to disaggregate the income classes so that poverty and specific target groups can be identified. This is essential if government policies and strategies to alleviate poverty,

3. The inflation of recent years has led to a rapid increase in the price index. Evaluation of the effect of government policies to limit the rise in the price index for small income groups.
4. Development of micro models of some sectors of the economy. The priority areas include modern and traditional agriculture, demographic employment opportunities and the educational system.
5. Analysis and quantification of the relationship between investment in capital construction and the relevant sectors: services, building and construction, and the particular industry affected by the investment. In KENSIM the treatment of the impact of capital, though crudely estimated at the present time, still represents a considerable departure from most economic planning using growth models, where investment is usually assumed to affect production directly.
6. Exports are assumed to be at domestic prices and the total value of exports from each sector is a policy decision. Future work on this feature should explore the consequences of differing (or shadow) prices on exports. For example, it would be useful to consider the situation where exports are subsidised to earn foreign exchange.
7. Imports are the difference between what is demanded and local production. This approach is necessary since KENSIM is largely a demand driven system. However considering the foreign exchange position of the country, it might be necessary to impose ceilings on the level of imports. Further work is necessary on this aspect.
8. Although price inflation for imports may be uncontrollable, wage changes, rent changes and interest rate changes are partially, but not completely, under the control of government policy makers. There is a need to investigate ways of separating the controllable and the uncontrollable elements and estimating the likely patterns of behaviour of the variables to enable stochastic procedures to be applied.

In order to ensure the continued use and development of the KENSIM model, it is proposed to produce two user manuals: first, a manual for economists, utilising the simulation to enable them to indicate the parameters they wish to vary in order to observe the simulated results of particular

policy options, and second, a manual explaining to computer centre personnel the ways to vary the instructions to the computer to reflect the policy instructions of the economists.

CO-OPERATION BETWEEN MODEL-BUILDERS AND DECISION-MAKERS

The introduction of simulation models and methods into the socio-economic development planning system is both a difficult and a challenging task. It is difficult since the introduction of modelling methods into the traditional planning machinery requires not only that the model-builders show a great deal of patience, but also that others involved in planning be convinced of the value of modelling. This difficulty is to be expected because the use of sophisticated mathematical modelling methods may be seen as an elegant academic exercise without practical contribution since many of the components of socio-economic systems are not amenable to analytical treatment. However, socio-economic systems are very complex and have many dimensions so that an integrated evaluation of various development policies and programmes is essential for the success of the system. Simulation models can provide a quantitative facility for analysing and evaluating the effects of various government policies and programmes for socio-economic development. Model-builders and decision-makers must realise and accept the fact that simulation models of socio-economic development systems produce results which only form a basis for decision-making. It should be stressed that the results are only guidelines for decision-making since often many of the socio-political aspects cannot be modelled. However this is not a serious drawback, since the decision-makers do take account of the socio-political aspects before making policy decisions.

From our experience in Kenya, we are convinced that simulation modelling can provide significant inputs to the analysis, formulation and implementation of development planning systems. In order to develop fruitful and worthwhile co-operation between decision-makers and model-builders, some of the main ingredients necessary for success are as follows:-

1. The formulation and construction of a simulation model should be a team project where decision-makers and model-builders are involved right from the start when the idea of a model is conceived. It is useful if some of the model-builders have the opportunity to observe and even participate in the decision-making process within the government, as was the case with KENSIM. The initial discussion and co-operation will ensure that all the important components of the system are being structured and modelled, and also that the model will be suitable for analysing problems which are of current

as a team will make project continuity possible even when some members of the team leave. This is crucial in situations where there may be a large turnover of staff.

2. Given the fact that analytical methods are not available to model social aspects of the system, and also that there is a general lack of historical data, it is often impractical to build complex models. The simplicity of the model is often a crucial element, necessary to ensure that those involved can understand and clearly follow all assumptions that are being made in a particular simulation result. The use of a simulation model is a long-term process and appropriate extensions and refinements of the model should be made as and when data become available. Here decision-makers can make an important contribution by facilitating the collection and availability of appropriate data.
3. Model-builders and decision-makers should have faith in the simulation model. If decision-makers are to have confidence in the model, they must be kept informed during all the major stages of model-building and the model-builders must clearly state not only the good points of the model but also the limitations and shortcomings. Model-builders should not expect decision-makers to have confidence in the model overnight. This is a process that takes a long time and a lot of patience in order to evolve mutual respect and faith.
4. The introduction of models in the traditional planning and decision-making machinery may be difficult but it is absolutely essential. Model-builders should convince the planners and decision-makers so that they begin to use and think of the model as their own. Also for the simulation model to make a worthwhile contribution, appropriate administrative structures must exist within the government planning machinery. In Kenya these administrative structures do exist, so that the use of simulation models is possible.
5. Documentation is necessary to enable decision-makers, planners, model-builders and computer-users to understand and use the simulation model. For example, the economists, the systems analysts the statisticians and other specialists all require different aspects of the simulation model, and efforts should be made to produce appropriate written material for each type of user. In Kenya

The literature is full of recent applications of modelling methods to social, economic and development systems, and apparently many of these applications have ended up as elegant mathematical and academic exercises. In our view, it is up to the model-builders to consider all the relevant factors necessary to ensure that their model makes a valuable contribution to the decision-making process. On the other hand, decision-makers should be receptive to new ideas, concepts and methodology. In conclusion, perhaps the model-builders need to take a systems approach to formulate strategies leading to optimum co-operation with the decision-makers.

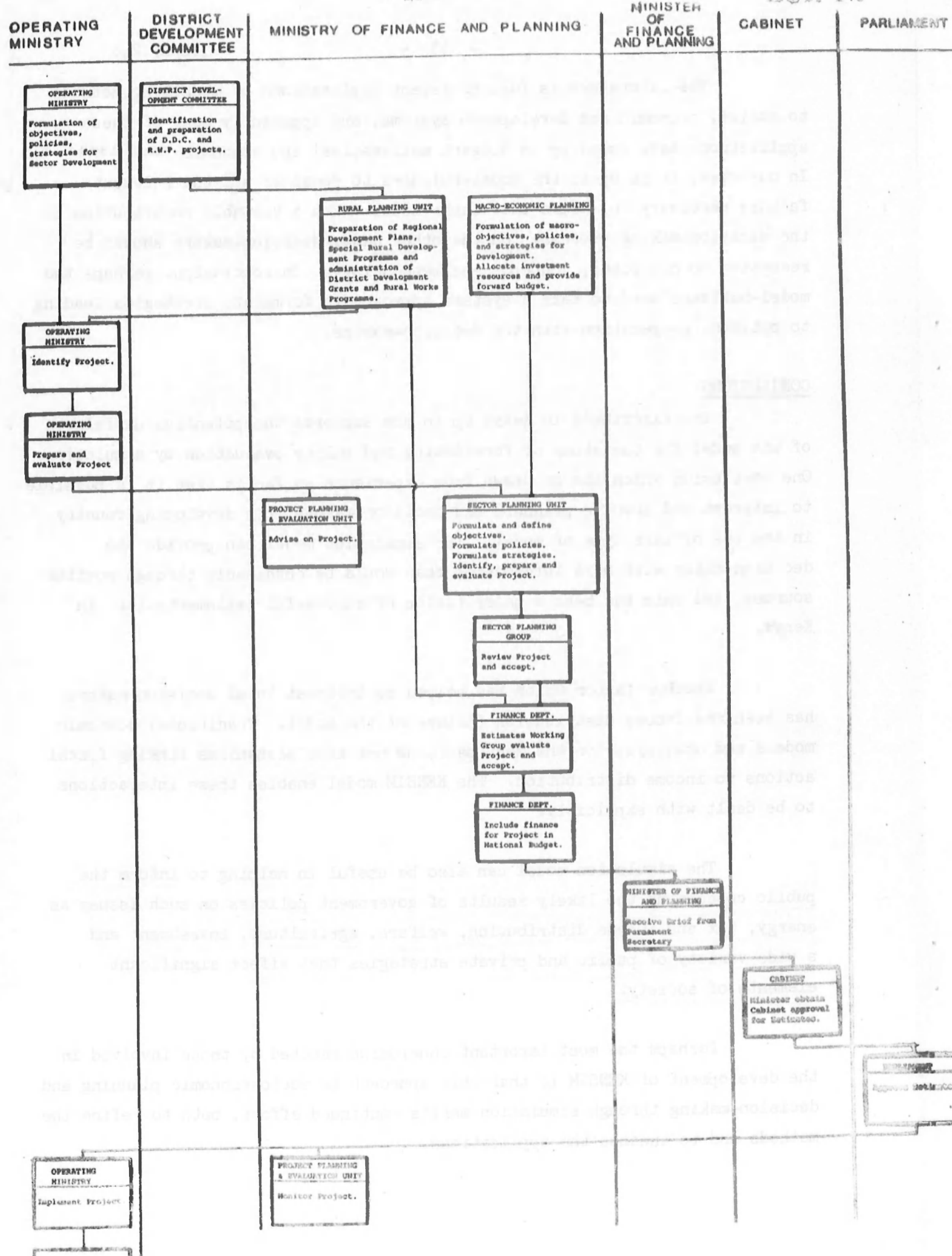
CONCLUSIONS

The experience in Kenya up to now supports the potential usefulness of the model for the study of forecasting and policy evaluation by simulation. One conclusion which can be drawn from experience so far is that it is possible to interest and involve planners and decision-makers in a developing country in the use of this type of model. The simulation model can provide the decision-maker with more information than would be obtainable through routine sources, and this has been a major factor of successful implementation in Kenya.

Another factor which has helped to interest local decision-makers has been the income distribution feature of the model. Traditional economic models and analysis, for the most part, do not have mechanisms linking fiscal actions to income distribution. The KENSIM model enables these interactions to be dealt with explicitly.

The simulation model can also be useful in helping to inform the public concerning the likely results of government policies on such issues as energy, tax and income distribution, welfare, agriculture, investment and a wide variety of public and private strategies that affect significant elements of society.

Perhaps the most important conclusion reached by those involved in the development of KENSIM is that this approach to socio-economic planning and decision-making through simulation merits continued effort, both to refine the methods and to enhance the applications.



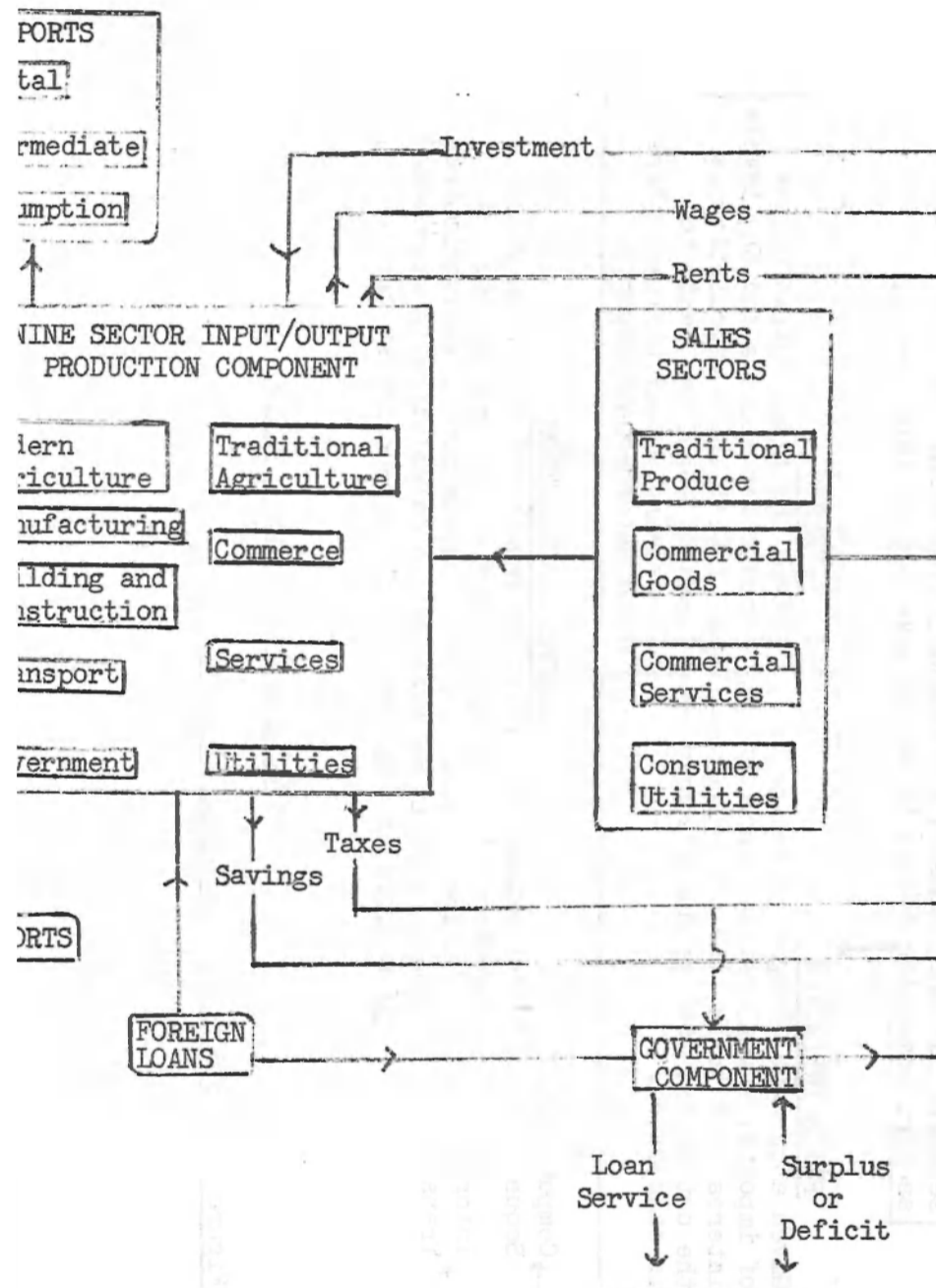
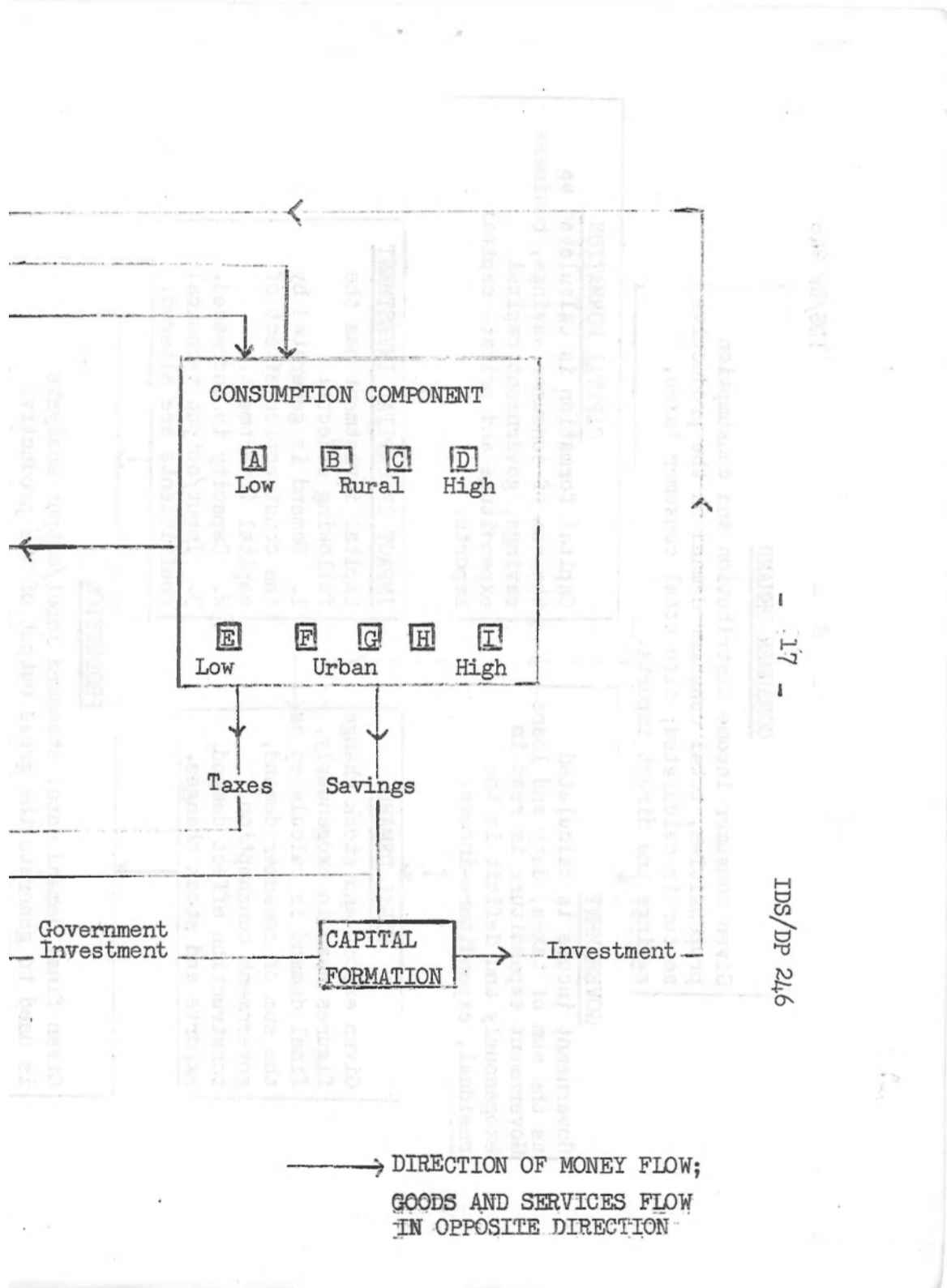


Figure 2. KENSIM model structure.



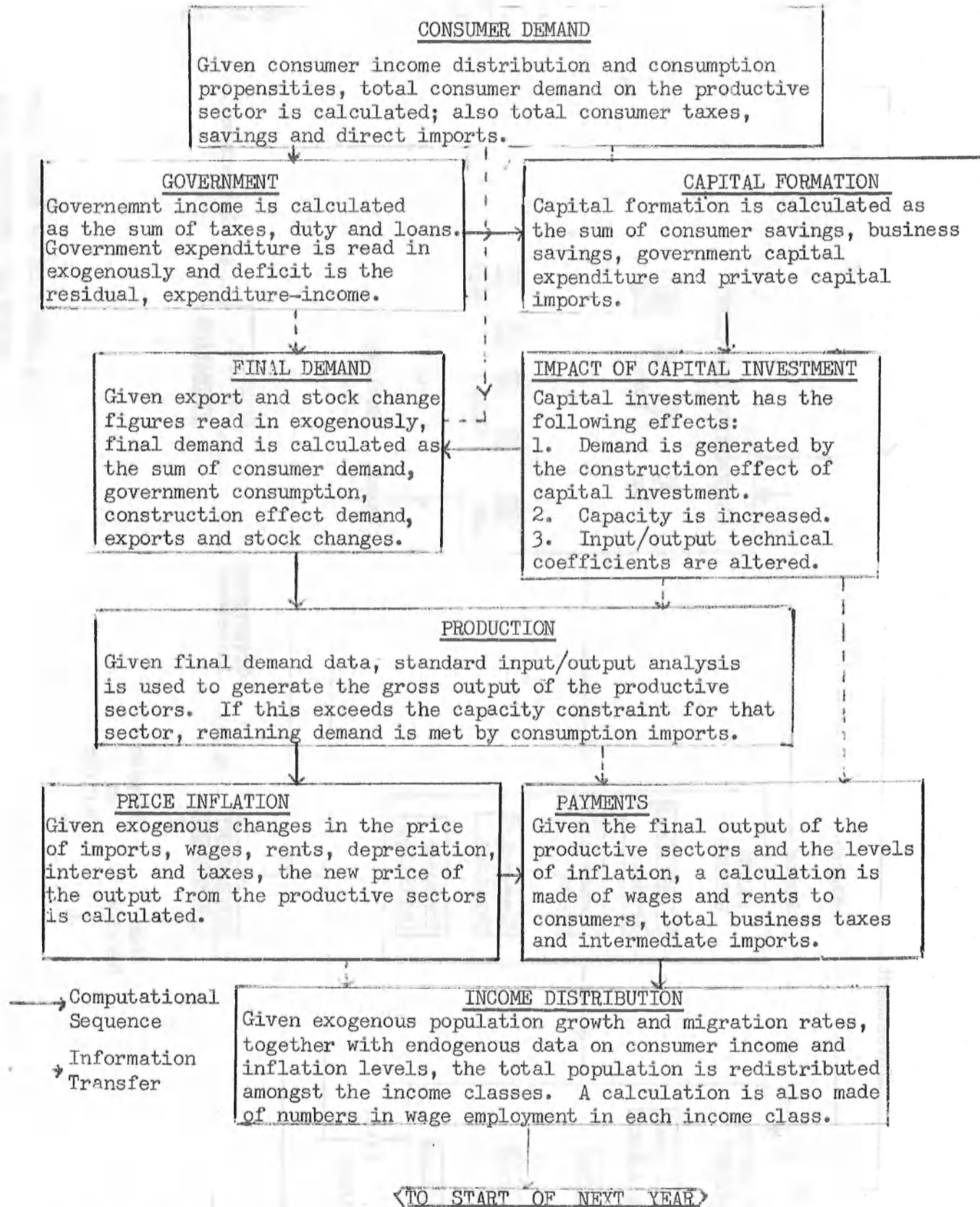


Figure 3. KENSIM Computational Sequence.

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