AN ECONOMETRIC STUDY OF THE UGANDAN ECONOMY: 1954-1967

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Introduction

This study attempts at constructing an econometric model of the Uganda economy. The model, based on the period 1954-1967 aims at three related objectives. First, to analyze the evolution of the economy over the period and analyze the factors that have contributed to the economic changes that took place in the economy.

Secondly, the results of the econometric analysis of the economy are used to construct a model for projecting the growth of the economy during the 1970s and finally check the internal consistency of the planning targets embodied in the Second Five-Year Plan, 1966-1971 as well as the fifteen-year Perspective Plan of 1966-1981.

Increased participation of the public sector in the process of economic development necessitates better quantitative information on which to formulate development policies. In the past, important economic decisions were taken on an ad hoc basis; as development goals become more complex and comprehensive, however, the demand for information on which to base policies will increase. This study is an effort at meeting the lacunae in quantitative information for designing and analyzing economic policies.

Chapter II is a review of Uganda's economic performance over the period 1954-1967 and an attempt to highlight some of the strategic factors that are likely to be crucial in the evolution of the economy over the next decade. In addition, Chapter II

discusses developments in the agricultural, industrial and foreign trade sector in some detail. Structure of prices, terms of trade and balance of payments is reviewed briefly.

Chapter III outlines the reasoning behind what is referred to as macro-economic model building; planning and projection problems of constructing econometric models for developing countries are discussed and the usefulness of such models reviewed. The Chapter reviews some empirical work that has been undertaken in designing and using formal statistical models of the Uganda economy.

In Chapter IV the model is specified; it distinguishes six producing sectors, six external trade categories, and aggregate income and consumption relationships. Chapter III draws heavily from Chapters II and III and may be viewed as an integration of the economic structure and theory into a formal statistical framework.

Finally, Chapter V compares the actual working of the entire model and attempts to assess its applicability. In the process, the model results will be compared with the plan targets and examine the consistency or otherwise of the plan target.

Background

Uganda measures 91,000 square miles but a fifth of the area consists of open water and swamps, mostly formed by the rift valley system of Africa. The geography is characterized by considerable regional diversity; the Western region of the country is hilly and relatively densely populated. The Eastern region is dotted with

volcanic mountains dominated at its extremity towards Kenya by Mount Elgon. The region bordering the great lakes in the centre and Southern parts of the country is most fertile and consequently has the largest population..

Most of the country lies on a plateau whose altitude of 4000 feet above the sea level results in an equitable climate over most of the country with mean minimum temperature of 60°F and mean maximum temperature of 85°F. Except in parts of the northeast, the average annual rainfall generally exceeds 30 inches although it reaches 60 inches in the West. The uneven incidence of rainfall, while adequate for plant growth, is often damaging to crops. The heavy rainfall is concentrated in two distinct periods - the first in April-May and the second in September-October. In the north, the two seasons merge into one.

The 1969 census of population indicates a population approaching 9 million towards the end of the sixties. Much of the population is concentrated in the Eastern and Southern region of the country - the northeast bordering Kenya and Sudan being the least populated. The country's population is diverse, with three main ethnic groups of East African within its boundaries.

The Bantu people are concentrated in the South and engaged in self-employed settled agriculture with an evolved system of administration and land tenure. The Nilotic and Nilo-Hamitic people are concentrated in the North and are basically pastoral.

A considerable number of immigrants and refugees from other African countries also reside in Uganda. Just over 1 per cent of the population is estimated to be of non-African origin - a majority of them being Asians.

Uganda was one of the last countries to be opened up by Arabs and Europeans. The British, under an Anglo-German agreement concluded in 1890 obtained Uganda under their sphere of influence. Over the next 10 years, the British consolidated their influence and the constitutional framework of the country was settled by the Uganda Order-in-Council of 1902 and the entire area became a British Protectorate. Self-government was achieved in 1961 and full independence the following year.

As a result of strict control over land ownership by foreigners since the 1902 Order-in-Council, most of the agriculture in peasant-based and relying on two crops, coffee and cotton, for cash incomes and subsistence production for self consumption.

Since 1923, Uganda has been a member of a common market with Kenya and Tanzania (then Tanganyika). The common market, in addition to a common currency, had arrangements for free movement of factors of production. The development of a modern transportation system has linked the member states into a close, rather homogenous market. The differences that emerged between the three countries regarding equitable distribution of gains and benefits from the common market have, been recognized and a more formal arrangement

to meet some of the problems of unequal distribution of benefits, was instituted in an East African Treaty signed and ratified by the three governments in 1966.

Chapter II

Uganda Economy During 1954-1967

The Uganda economy during the period 1954-1967 recorded an annual average growth in total real output of 4.0 per cent per annum. This rate of output growth implies an average per capita income growth rate of just over 1.0 per cent per annum.[1/] The rate of total as well as per capita output growth places Uganda at the bottom quartile of growth performance among developing countries.[2/]

The period is characterized by considerable variation in performance; the period of fast growth in early fifties was followed by relative stagnation between 1954-1962 and the final period, 1962-1967, is characterized by a sustained recovery in production.

During the late fifties, savings and investment stagnated, the latter partly due to volatile expectations induced by political crisis. Production grew at rates only marginally higher than population and export performance was below that recorded in earlier or subsequent periods.

[1/] The 1969 Census of Population shows that the previously estimated growth of 2.5% has been a serious underestimate; revised figures, available in Background to the Budget, 1970-1971 (Statistics Division, Ministry of Planning and Economic Development), show that population growth has been 3.0 per cent.

[2/] Yearbook of National Accounts Statistics, Volume II, 1969, published by United Nations, 1970.

Following the disastrous crop failures in 1961 due to adverse weather conditions, a major recovery set in when the gross domestic product in the monetary sector grew at an annual average rate of 6.7 per cent between 1962 and 1967 and total output, including subsistence production, grew at 6.4 per cent (see Table 1). Per capita growth of 3.4 per cent was higher than previously recorded, resulting in an average per capita growth in consumption of 1.3 per cent per annum.

Secondary production, an important indicator of expectations in developing countries, grew at 7.4 per cent and output in the service sector recorded even higher growth rates (see Table I).

The growth was led by exports, which grew at the impressive rate of 8.3 per cent. It is characteristic of the Ugandan economy that periods of high export growth is accompanied by increased output in the non-agricultural sectors. The high level of demand originating from high export incomes in the agricultural sector is manifested in an expansion of output in the non-agricultural sector and a rapid growth in volume of imports. A particularly important source of export growth was the demand for Uganda's non-traditional exports in the East African Common Market (EACM) countries of Kenya and Tanzania; exports to EACM grew at an average rate of 12 per cent, contributing partially to a reduction in the dependence on traditional primary exports of coffee, cotton and tea to the rest of the world.

Table I

Real growth in output and related variables in Uganda - 1954-1967 and 1962-1967.

	Annual percentage change 1954-1967	1962-1967
Output and expenditure:		
Gross domestic product, market prices	4.0	6.4
Per capita GDP	1.0	3.4
Per capita consumption	.8	1.3
Primary production	4.0	5.1
Secondary production	1.4	7.4
Tertiary production	5.1	8.4
Subsistence output	4.0	4.5
External trade:		
Imports	3.5	9.9
Exports	6.2	8.3
Imports from East Africa	11.7	13.5
Exports to East Africa	7.2	12.3
Imports from rest of world	2.4	10.7
Exports to rest of world	5.6	8.2
Prices:		
Consumer goods	1.9	4.6
Agricultural goods	1.3	7.0
Imports	1.3	3.0
Exports	-1.8	1.5

Source: Based on Statistical Abstracts and Background to the Budget, various issues, Ministry of Planning and Economic Development, Entebbe.

Under the pressure of high demand, agricultural prices rose sharply at a rate of 7 per cent, compared to the period 1954-1960 when they actually declined. Consequently, overall price index increased at 3.5 per cent per annum between 1962-1967, compared to an average decline of 1.5 per cent during the fifties.

The emergence of Uganda to independent statehood ended the political uncertainty of the years preceding 1962. The First Five-year Plan, launched in 1961/62, brought about an increased efforts to mobilize resources - both foreign and domestic, and are reflected in an improved investment rate.

Important economic changes following independence have not however, materially affected the standard of living of the population; per capita income of $66 in 1967 indicates the magnitude of poverty and underdevelopment of the country.

II. Structure of production

While the rate of GDP change and per capita incomes are important and useful indicators of overall economic performance and stage of development, they do not fully reveal the structure characterizing production relationships in the economy. These underlying structural relationships are summarized in Table II. As is immediately evident, primary production dominates total production accounting for 60 per cent of gross domestic output.[1/]

[1/] The sector is defined to include mining since it embodies many of the characteristics of the agricultural products.

As may be inferred from Table II, the share of primary sector has declined, somewhat erratically, between 1954 and 1967. In 1954, the sector accounted for 63 per cent of the output and by 1967 59.8 per cent. An examination of monetary output in the primary sector reveals on the other hand, a slight increase of output during the period from 34.2 per cent to 34.8 per cent.

The subsistence sector consumes all of its output and is almost entirely agricultural; this sector has declined in relative importance over the period from 29 per cent to 25 per cent of GDP. The sector is considerably larger than secondary sector and almost as large as output in the tertiary sector. The dominating influence of the primary sector on the economy is not difficult to discern. A marginal decline in its output often tends to outweigh a compensating increase from the other sectors; the level of activity in this sector is rapidly manifested in the non-primary sectors.

The share of secondary sector in GDP is often regarded as a measure of the degree of modernization of the economy; the sector is generally regarded as the more dynamic characterized by high productivity of resources and fast pace of output growth, partly due to its low share in total output. As development process gathers momentum, resources are transferred from the traditional low productivity sectors to a more modern sector. In Uganda, such a trend is absent over the period 1954-1967. The share of this

Table II

Structure of the economy, 1954-1967 at 1960 prices
(Percentage)

	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
1. Primary (Incl. Mining)[a/]	63.1	60.24	59.4	60.4	60.5	61.6	62.8	61.6	63.1	62.3	62.3	60.4	59.6	59.8
2. Secondary[b/]	12.1	13.3	14.6	13.8	12.7	10.9	10.4	10.8	10.7	10.7	10.4	11.1	11.1	11.5
3. Tertiary[c/]	24.8	26.3	26.0	26.6	26.8	27.5	26.8	27.6	26.2	27.0	27.3	28.5	28.3	28.7
4. Total GDP, at Factor Cost	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Subsistence as % of Total GDP	28.9	27.6	27.3	26.9	27.3	26.8	27.1	25.9	28.9	26.7	26.1	25.4	25.0	25.02
5. Consumption/GDP ratio[d/]	81.8	83.1	83.6	83.7	81.6	82.9	82.5	82.5	84.5	95.8	80.3	80.7	80.6	75.3
6. Investment/GDP ratio[d/]	20.2	26.7	15.7	19.4	19.7	17.3	16.5	16.4	15.7	14.6	16.8	21.5	17.5	21.6
7. Export/GDP ratio[d/]	37.7	41.4	37.0	39.8	44.2	44.0	42.8	46.5	45.4	47.5	49.9	53.2	50.2	48.5
8. Import/GDP ratio[d/]	32.3	41.1	32.0	32.9	33.0	29.8	27.7	30.1	30.2	26.8	31.2	38.4	35.5	30.6

[a/] Includes agriculture, forestry, fishing, hunting and mining.

[b/] Includes cotton ginning, coffee curing, and sugar manufacture as well as manufacturing, electricity and construction.

[c/] Includes commerce, tourism, public and other services.

[d/] Refers to share in monetary GDP at constant market prices.

Source: Based on Statistical Abstracts and Background to the Budget, various issues, Ministry of Planning and Economic Development, Entebbe.

sector appears to have declined between mid-fifties and mid-sixties from an average of 13 per cent to 11 per cent. Such a trend is particularly disappointing given its already low share. The process experienced in Uganda is contrary to the development experience of a large number of countries, who are consciously attempting to modernize their structure of production.[1/] It must be noted, however, that in the sixties, manufacturing production, under the stimulus of an improved performance of the agricultural sector and higher investment rates, began to grow at over 8 per cent between 1960 and 1967.

Tertiary sector whose output consists of services, increased in relative importance from 24.8 per cent to 28.7 per cent between 1954 and 1967. As income rise, the proportion spent on services is expected to grow; however, part of the increase in this sector measures the effort undertaken by government to provide more social services - particularly in the field of medical care and education. Moreover, the increased independence, would also account for some of the increase in this sector.

Distribution of income from the production of goods and services would provide an index of the changes in welfare and production relationships in the economy. In Uganda, a detailed analysis

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[1/] See Table IV, World Economic Survey, 1969-1970, United Nations, New York, 1971 (Sales No. E.71.II.C.1).

of income distribution is not possible due to data limitations; however, an effort was made to assess the relative importance of wage versus non-wage income and it is found that some important changes, not reflected in the structure of production, have taken place in the course of the period 1954-1967. It is widely observed that in the process of economic development, a relative dimunition in the importance of earnings from self employment is accompanied by an increase in the proportion of income accruing in the form of wages and salaries. In Uganda, evidently, the share of wage to non-wage income has grown from 32 per cent in 1954 to 49 per cent by mid-sixties and 55 per cent in 1967. The share of non-African income which includes wages and salaries as well as profits and property income has doubled over the period whereas the African incomes (measured as agricultural and property incomes) have grown by 46 per cent over the period. This trend in the relative concentration of income in the urban and modern sector has important political and social implications. In an economic sense, however, the increased concentration of income in the modern sector is likely to have favourable impact on future savings and investment potential of the economy. The sector may be more amenable to planning and policy decisions and consequently may be an important source of modernizing impulses.

III. Performance in the agricultural sector: 1954-1967

Rates of growth of total and per capita production in the agricultural sector are the most important indicators of performance of the sector. During the period under study, output grew at an average annual rate of 4.0 per cent per annum, implying a per capita growth of 1.0 per cent per annum. The share of agricultural output, measured in 1960 prices at factor cost declined by 4 percentage points from 62.3 per cent in 1954 to 58.2 per cent by 1967.

In Uganda, over 90 per cent of the labour force is engaged in agricultural production; productivity of the sector is therefore lower than in the rest of the economy which employs less than 10 per cent of the population and produces about 30 per cent of the total output. However, there is some evidence to suggest that output per economically active population engaged in the agricultural sector is higher than many countries in Africa with a level of output per man of the order of $130 by 1967 at 1960 prices.[1/] Such an average conceals the differences between estate farming (which is mainly controlled by foreigners) and peasant farming; the former is estimated to hold about 1 per cent

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[1/] The average output per man in the East African sub-region in 1965 at 1960 prices of $96 - see Co-operation for Economic Development of East Africa - United Nations (Sales No. E.71.II.A.4).

of the total cultivated land and yet contributes to 5 per cent of total output. Some indexes of yield per acre for a number of important crops were calculated to determine the sources of productivity trends and it appears that for coffee and sugar productivity, measured as yield per acre, grew at a rate of 3.8 and 5.8 per cent per annum between 1954 and 1967. For cotton and tea production, however, the growth in output came mainly from expanding acreage - cotton production shifted to the dryer norther plains of the country and output of tea similarly grew by expansion of acreage in western and sourthern Uganda.

In future, scope for faster productivity growth cannot be ruled out but available evidence suggests that expansion of acreage and other inputs such as fertilizers, irrigation and better seeds would be a more important source of output growth. Additionally, diversification of output will be an important source of further growth.

The four crops cited in Table III are major source of cash incomes in Uganda; two of them, coffee and cotton, constitute 80 per cent of Uganda's exports on average, coffee being a somewhat larger source of cash incomes than cotton. The importance of tea has increased dramatically in the sixties when the volume of production grew by 120 per cent between 1961 and 1967 (See Table III). Production of sugar has also expanded at a rapid pace and has grown at a rate of 8 per cent per annum between 1961 and 1967.

Table III

Production and value of main agricultural commodities
1961-1968

Year	Coffee[a]		Cotton[a]		Tea		Sugar	
	Volume Tons '000	Value in $s	Volume No. of bales '000	Value in $s	Volume Lbs. Million	Value in $s	Volume Tons '000	Value in $s
1961	117	32.8	181	17.0	11.2	5.4	96.0	12.18
1962	156	47.9	358	34.7	13.4	6.67	104.0	13.1
1963	169	60.5	379	28.3	13.4	6.4	122.0	15.2
1964	150	42.3	438	41.4	16.8	7.8	123.6	14.5
1965	152	44.2	445	44.5	18.4	7.1	115.7	13.4
1966	161	44.2	427	28.5	24.7	8.5	125.8	14.3
1967	129	36.7	345	24.6	24.8	11.4	135.2	15.2
Percentage change 67/61	20.6[b]	11.5[b]	90	44	121	109	40	25

Source: Statistical Abstract, Statistics Division, Ministry of Planning and Economic Development, various issues.

[a] Refers to the crop year which runs from 1st October to 30th September.

[b] Refers to an average between 1961-1962 and 1967-1968.

As may be inferred from the table, overall growth in volume of production exhibit considerable variation between years. Production of coffee increased from 117,000 tons in 1961 to 169,000 tons by 1963 and fell to 129,000 tons by 1967. Corresponding to the variations in supply, value of output to growers also exhibit wide variations ranging from $60.5 million in 1963 to $36 million in 1967. The factors which contribute to such fluctuations in coffee supply is posted price of coffee to the growers and weather. Since coffee is a perennial crop, current output is determined by plantings at some point in the past. The decisions to plant are undertaken in response to prices and it is estimated that in response to high prices prevailing in early fifties, average output grew at a rate of 14 percent per annum during the second half of the fifties. An attempt has been made to derive a supply function of coffee in terms of the above two variables - namely, price and acreage planted. It is hypothesized that output of coffee (OCFF, measured as production of robusta coffee - in million tons is determined by current price, p_t, and acreage of coffee, lagged by five years, ACR_{t-5} as follows:

$$OCFF = (p_t, ACR_{t-5})$$

The regression fit of the above function is given below.

$$OCFF = \underset{(-2.16)}{-105.1} + \underset{(3.59)}{1.83\,P} + \underset{(7.42)}{0\text{-}40\,ACR_{t-5}} \qquad \bar{R}^2 = 0.835 \quad AW = 2.054$$

The regression fit yields a high correlation coefficient of .83 and the coefficient of the explanatory variables are of the correct sign

and statistically significant at 1 per cent level (the values in parentheses being the student 't' values). Also, the test for serial correlation yield a value of 2.03, indicating absence of any serial correlation.

The regression coefficient with respect to price is of some interest since it indicates considerable response on the part of growers to prices. It would seem that in the years when prices are low, farmers simply refrain from harvesting and respond immediately in periods when prices are high. It is also observed that elasticity of exports with respect to prices is greater than unity.[1/]

A similar effort to analyze the response of cotton producers to price and exogenous factors such as weather failed to yield any satisfactory results.[2/]

[1/] In an effort to determine the elasticity, a regression was made between the value of Uganda's coffee exports to USA (CF, USA) largest single market and the price of Uganda coffee in the N. Y. market, PCFNY and the results are as follows:

$$\log CF, US = -1.32 + \underset{(5.10)}{1.17} \log PCF, NY \qquad \bar{R}^2 = .65, \quad DW = 1.35$$

The results are statistically significant and the importance of price as an explanatory variable is strongly brought out by the equation.

[2/] The results were:

$$OCTN = \underset{(-1.211)}{-.718\, W_{-1}} + \underset{(1.540)}{.917\, PCTN_t} + 74.030 \qquad \bar{R}^2 = .20, \quad DW = 2.54$$

Where OCTN = output of cotton, PCTN = price of cotton and W_{t-1} = a weather index, measuring average rainfall, lagged one year. It will be noted that the coefficient with respect to price is significant at 10 percent level, however, the coefficient of overall determination is low and remains low when a number of alternative specifications are attempted.

It will be observed from Table II that during the period 1961-1967, there has been a considerable lag between production and value of the output. In case of each of the four crops, incomes have not kept pace with production, indicating that prices have changed proportionately less than output - the lowest gap being in case of tea, for which output has grown 120 per cent and value has increased 109 per cent between 1961 and 1967. The terms of trade, so construed, have moved against the producers suggesting a significant shift in incomes from agricultural to non-agricultural (particularly services) sectors. This trend may have an adverse effect on the growth of agricultural production in the future since it has been observed that farmers are responsive to prices, certainly in the long run and continuous price disincentives are likely affect marketable surpluses.

Domestic resource endowment suggests considerable potential for diversification of agricultural output and import substitution. In recent years, considerable quantity of dairy products continue to be imported from Kenya. Land resources in Uganda permit a rapid growth of dairy and ranching industry and the Second Five-Year Plan of Uganda recognizes the potential of a dairy industry in Uganda not only for diversifying domestic output and providing farmers and ranchers with additional sources of income but also to substitute imports from Kenya which enjoys a competitive industry.

The Southern region of Uganda has a nucleus of a dairy industry and its growth has been rapid in the past few years. However, expansion of output would necessitate considerable amount of extension work since in the past development was constrained by lack of high yield dairy cattle due to prevalence of tickbone diseases. As the stock of high-yielding cattle expands, the demonstration effect on the farmers is likely to be considerable and would make extension work easier and more productive as methods of animal husbandry begin to become widespread. Furthermore, as areas in the Northern and Western regions are cleared of tsetse fly, the ranching potential of these regions would expand - at present the prevalence of tsetse flies being a major obstacle to expansion of area that is potentially ideal for large scale ranching.

Apart from diversification, the other important strategy for expanding agricultural output has been the group farm and the tractor-hire scheme. The rationale behind the strategy seems to be that costs of large scale modern farming are prohibitive and consequently, if labour and land resources could be pooled in communal type of farming, unit costs of providing needed extension and other services would fall. Using mechanized services would be expected to raise the productivity of labour at a critical time of the year when, due to the seasonal nature of labour supply, bottlenecks develop and would be alleviated by a switching to a capital

intensive technique of farming. The tractor-hire service although operated separately, is designed to meet the problem of shortfalls in labour supply at planting time. By 1967, the service had a fleet of 900 tractors.

Evidence on the success of a relatively capital-intensive method of production in a labour surplus economy[1/] is not available, although, from the decision of the Government in 1967 to review its operation and suggest methods for increasing its efficiency and reduce losses suggest that the programmed has not been a success.

Marketing of agricultural output

In an economy where nearly a quarter of total output is not marketed, problems of monetizing the subsistence sector pose perhaps the most important objectives in raising the marketed surplus in the agricultural sector.

The most monetized agricultural output - tea, cotton, and coffee - is produced primarily for export markets although a small domestic market for cotton has been developing during recent years. In the post-war period, Lint and Coffee Marketing Boards were established to manage cotton and coffee exports and to stabilize incomes accruing to growers. In periods of high overseas prices,

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[1/] The 1963 census of agriculture reveals that a majority of owner farmers reported they were not fully employed throughout the year in farming.

the Board accumulated reserves which were subsequently used to subsidize prices when significant differentials between domestic and foreign prices emerged. The success of such a policy to stabilize incomes depend on the size of accumulated reserves; in the event they are exhausted, as has happened in recent years, the incomes could be stabilized only if additional incomes were transferred to the farmers through fiscal means. Such a possibility appears remote and consequently, the post-war policy would need to be abandoned in favour of the second objective for which the Boards were established - that is, seeking out and breaking into new traditional markets.

The lack of marketing facilities such as storage, transportation and regulating output, has been an important factor in limiting the size of domestic market for many food dairy and livestock products and the marketing functions in the future will have to evolve into a different role. A number of marketing Boards have been set up to provide this new type of service aimed at increasing the share of the monetary sector in total output. However, improved marketing arrangements have tended to be viewed as a panacea in the Second Plan; while the overall policy is correct, the emphasis on marketing and institutional arrangements may neglect the basic problem of expanding and diversifying production.

Extension of farmers cooperatives, which exists at the local level for both cotton and coffee into new crops is likely to provide

an increasingly important link between the farmers and the market. The services such cooperatives would provide would range from providing credit, extension facilities and wider distribution channels.

IV. Industry during 1954-1967

The industrial sector in Uganda has been of minor significance to the overall performance the economy during the period 1954-1967. Its contribution to total output, measured by its share in total value added has, on average, been 11 per cent.

During the period, the manufacturing sector has grown at an average annual rate of growth of 6.0 per cent per annum so that the share of manufacturing in total as well as industrial output has grown over the period. During the latter part of the period, there has been a sharp growth in the output of the sector - with an average annual growth rate of just 10 per cent per annum. Such a high growth rate could be explained in terms of the low stage of initial development of the sector in the economy which enables a faster output relatively easier to realize. The growth has undoubtedly been aided by an average nominal tariff rate of 30 per cent which reaches 100 per cent in case of low-cost textiles and over 65 per cent for luxury goods. There has, however, been no systematic effort to determine the cost and benefits to the economy of discriminatory tariff rates; in the absence of a well-coordinated tariff policy, it is difficult to analyze the impact of the tariff structure on local production. The distance of over 500 miles from the main trade entre port confers

a high degree of natural protection so that effective tariff rates would be expected to deviate from the nominal rate.

The main instrument of industrialization in Uganda has been the existence of a para statal sector which account for over half of the output in the industrial sector. Value added in the manufacturing has increased from 3 times that in agricultural processing in 1964 to over 4 times by 1967 (see Table IV). Processing of agricultural commodities is characterized by simple techniques of production whereby the agricultural produce is refined into a first stage of processing for export abroad. The importance of the manufacturing sector in both absolute and relatively terms is seen to be increasing in the industrial sector. Prospects for increasing the share of value added in gross output for the processing output are extremely limited due to the nature of demand for

Table IV

Gross output and value added by industry: 1963-1967

	1964		1965		1966		1967	
	Gross output	% value added	G. O.	% V. A.	G. O.	% V. A.	G. O.	% V. A.
Processing of Agr.	56.3	20.5	45.1	16.1	43.5	14.2	42.6	15.0
Manufacturing	46.0	66.1	51.2	70.5	52.6	70.8	53.0	67.8
Electricity	3.5	13.2	3.5	12.9	3.8	14.5	4.0	16.7
Quarrying	.2	0.1	.2	.5	.2	.4	.3	.4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on Statistical Abstracts and Background to the Budget, various issues, Ministry of Planning and Economic Development, Entebbe.

coffee, cotton and tea in overseas markets. Processing of these imports for final consumption is undertaken at the source of demand and for a country. With a very small share in total world supply, it would be very difficult to increase the share of processing. Higher domestic demand would enhance the share of local value added although this seems also a distant prospect given the size of the domestic market.

The evolution of Uganda's industrial structure will depend largely on the success of the trade arrangement between her, Kenya and Tanzania. The size of the domestic market, measured in terms of per capita income, and population cannot justify an industrial strategy based on domestic demand. Industrialization will have to be specialized, and based on comparative cost. Some evidence of Uganda's exports of manufactures (almost entirely to Kenya) indicates that even with a low initial base, exports in 1967 retain the level they realized in 1960. Admittedly, they grow by over 50 per cent between 1961 and 1964 but declined to the level of 1960 by 1967. This kind of instability in non-traditional exports is cause of concern and unless an external market are developed, the industrial growth will stagnate once the initial phase of import substitution is completed.

An important measure of performance of the manufacturing sector is its success in absorbing the rapidly growing population

of working age. In an economy where there are few incentives to remain in the rural occupations, given their low productivity and limited employment potential, the manufacturing sector is often viewed as a means of absorbing the growing work force converging to the urban areas in search of greater opportunities. While employment data are not very reliable, it emerges from an examination of available sources that in the manufacturing sector, employment grew at an average rate of 1.2 per cent per annum between 1954 and 1967; the low rate of employment growth suggests that the increases in output which took place in the sector, at an annual average rate of 8.0 per cent was realized mainly through increases in productivity of the labour force engaged in manufacturing industry. During the sixties, however, labour appear to have grown employment at an average of over 4.0 per cent per annum, considerably faster than during the fifties. The bulk of the employment increase would appear to have taken place in sectors other than manufacturing.

V. Foreign trade: 1954-1967

Apart from agriculture, the most important factor dominating the economic scene is the large external trade sector. The share of this sector in total GDP averages 50 per cent during the period 1954-1967 ranging from 60.0 per cent in 1954 to 50 per cent by 1967. Through the period, a favourable balance on commodity trade has developed in Uganda - increasing from $13.5 million in 1954 to $78.2 million by 1967.

Exports

Exports at fixed 1960 prices have grown at an average rate of 6.2 per cent per annum; the composition of exports; however, has gradually shifted from cotton to coffee and with it, the destination of the exports. Cotton, which formed half of the exports in 1954 has declined in importance and now constitutes 23 per cent of the total exports, compared to 45 per cent in the early fifties. Coffee exports on the other hand, have grown in importance and constitute the largest single foreign exchange earner for Uganda. The share of coffee has increased from 40 per cent of total exports in 1954/1955 to 53 per cent by 1966/1967.

The level of exports itself has been subject to considerable fluctuations; for example, it ranges from $113 million in 1956 to $105 million by 1960 rising to $180 million by 1970. The instability is typical of a country relying 80 per cent for its export receipts on two crops - cotton and coffee. The two crops, particularly cotton, one subject to vagaries both of prices and weather, so that small changes in supply bring about considerable fluctuations in income; moreover, Uganda's share in the world's supply of these commodities is so small that she is a price taker and the incomes are continuously subjected to exogenous influences.

More recently, an effort has been started to diversify the structure of the exports and this has met with some success; for example, the share of tea in total exports has increased from 3.4

per cent to 5.4 per cent between 1960 and 1967. Copper, the third largest earner of exchange, is a new export commodity, having been exported only since 1956. Both copper and tea are primary commodities and subject to vagaries of the external markets; production of copper is marginal and likely to grow only if prices continue to rise in world markets. The dependence on cotton and coffee will, in all likelihood, continue for sometime to come.

The changing commodity composition of exports is also reflected in their destination. The sterling area was the largest single destination of Uganda's exports in 1954; since then, its importance has declined considerably during the period with only 38 per cent in early to mid-fifties. The importance of trade with the dollar area has grown very rapidly over the period from 9 per cent in 1954 to 25 per cent of total exports by 1967. Also, trade with Socialist countries of Eastern Europe and Peoples Republic of China, among others, has grown very rapidly. Indeed, trade with areas other than sterling and European countries has grown from a more 5 per cent in 1954 to 23 per cent by 1967. A salient feature of the period has been the impressive value of export growth to the EACM countries. The growth has made EACM the fastest growing market for Uganda's exports, growing steadily from 11.2 per cent in 1954 to 16.3 per cent by 1967.

While the commodity composition of Uganda's exports has not altered to any significant extent, the destination of the exports

has undergone very significant changes. This diversification of markets must be viewed as a welcome development and if it is a 'second best' diversification, it is an improvement from a situation where over half of the export receipts originated from sterling area, primarily the United Kingdom and India.

The impact of export instability has been widely commented upon; since exports form, on average, 50 per cent of monetary GDP, its instability has an immediate impact on the rest of the economy. The share by itself does not indicate anything except the 'openness' of the economy. Its importance lies, however, in the fact that it also influences business expectations, public expenditures and level of investment activities. A decline in exports brings about a contraction in domestic real income. If the decline in exports is due to a fall in the volume of exports at given prices, the decline is reflected equally in both the GDP at fixed prices and real domestic incomes. If, however, the export shortfall is due to a fall in prices, only the volume of domestic income is affected. The incidence of the fall would be shared in varying proportion between the government and private sector. The next round of an export shortfall will be reflected in a reduction in private consumption and savings and public revenue also fall due to a decline in taxable income and taxable commodity exports.

Due to the structure of Uganda's exports, the fall in receipts affect consumption proportionately more than savings - the latter

are derived primarily from the private and government sector.

The initial fall in income will generate further contraction of income and expenditures through the familiar "multiplier" process - bringing about a final reduction in incomes considerably greater than the initial shortfall in income that brought it about. The impact of exports (X) on domestic production (GDP) in the monetary sector has been tested in a regression equation. Exports were lagged one year to take account of the dynamics of income adjustment and the following relationship, statistically significant, was observed.[1/]

$$GDP_t = 188.60 + \underset{(8.30)}{2.33}\, X_{-1} \qquad \bar{R}^2 = .813 \quad AW = 1.670$$

The 't' value of the coefficient in parenthesis is significant at 1 per cent level and the coefficient of overall determination "explains" 83 per cent of GDP variation in the monetary sector.

Import structure

Uganda depends on imports for a wide range of goods to meet domestic demand; between 1954 and 1967, they have grown an average annual rate of 3.5 per cent per annum, but accelerating sharply in the 1962-1967 period when they grew at almost 10 per cent per annum. The high growth in the latter half of the period can be attributed

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[1/] This equation is based on current prices whereas, for the projection model, it is based on fixed prices.

Table V

Structure of Uganda's imports- 1954-1967
(In percentages)

	1954	1958	1960	1962	1967
MCAP/M	14.9	16.2	13.5	15.2	25.3
MCONS/M	42.4	32.4	34.9	34.8	24.2
MEA/M	11.1	19.6	21.1	25.0	27.8
MPROD/M	28.0	31.8	30.0	25.4	22.5
M/GDP	28.9	29.0	27.7	27.1	28.3
MEA/GDP	3.2	5.6	5.8	6.8	7.9
MROW/GDP	25.7	23.4	21.9	20.3	20.4

Source: Uganda Statistical Abstract and the Background to the Budget, Ministry of Planning and Economic Development, Entebbe, Uganda, various issues.

TN = total imports

MCAP = capital imports

MCONS = consumer imports

MEA = imports from EACM

MPROD = imports of production foods

MROW = imports from non-EACM countries

to an increase in domestic income and the exigencies of the development effort initiated since the early sixties. The export grew at a somewhat lower rate - the first time during the period under examination - so that the balance of commodity trade began to decrease, although overall continuing to be favourable.

The above table reveal a distinct pattern in commodity composition of Uganda's imports. As may be inferred from the table, the import coefficient on the average propensity to import has remained fairly stable at an average of 28 per cent of GDP.

The stability of the average coefficient conceals, however, important changes in import structure that have taken place. First, the importance of capital good imports, particularly between 1960 and 1967 has increased sharply and now constitute the second largest single import category. The increase in the share of capital imports has been accompanied by a major decline in the consumer goods category whose share declines from 42 per cent to 24 per cent of total imports.

The largest change, however, is reflected in the import shares from East Africa - whose share has more than doubled during the period. While part of the increase may be accounted for the fact that goods in transit from abroad may get counted as EACM imports, this is not an important source of error. The largest increase in the East African imports took place during the fifties.

The relative decline in dependence of consumer goods from non-EACM members is reflected in the proportional increase in imports from Kenya which has emerged as an important supplier of the type of non-luxury goods in demand in Uganda. The decline in import co-efficients of consumer goods has been primarily due to import substitution in an EACM context rather than due to import substitution originating from Uganda.

The decline in share of producer inputs has been due to an increased domestic supply from the local construction industry.

During the period, the EACM has begun to increase its share in Uganda's imports at the expense of the rest of the world. The share of the former in GDP has more than doubled over the period. The EACM is likely to increase its share in the future, although probably at a lower rate.

VII. Planning in Uganda

There has been a history of planning in Uganda dating back to 1946 when a Uganda Development Plan was formulated. This was followed by a number of other plans consisting essentially of desirable targets of Central expenditure on public projects, thought to be of importance.

The first Five-Year Plan, initiated in 1961, was an important departure from the previous 'Plans' insofar it embodies as analysis of the economic prospects and sets certain targets in a loose framework of macro-economic aggregates. On the basis of the targets, a

number of policies necessary for implementing them were rendered explicit. The first five-year plan, based on a very detailed survey of the economy undertaken by a World Bank Mission in 1960,[1/] represented the first systematic attempt to assess the economy's growth prospects and set the planning targets accordingly. The plan was essentially a detailed profile of the public sector activities to be undertaken during the period 1961/62 - 1965/66. The plan aimed at an overall growth rate of 4 per cent in real terms; this target was realized although an upward revision of the targets mid-way through the plan was seen to be less realistic and the original targets were substantially met.

The First Plan's performance would have exceeded the set target rates but for a serious slump in agricultural supply caused by adverse weather. Cotton output was particularly affected during 1961/62 season although a major recovery followed through to 1965, when both investment and output picked up after 1962.

A considerably improved use of planning techniques and methods is reflected in the Second Five-Year Plan started in 1966[2/] and to be completed by 1971. This Plan embodied considerably more detailed sectoral output targets, and a detailed analysis of the growth

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[1/] Report of the World Bank Mission to Uganda, 1959 (John Hopkins University Press, Baltimore, 1960).

[2/] 'Work for Progress', Uganda's Second Five-Year Plan, 1966-1971, Ministry of Planning and Economic Development, Entebbe.

prospects of the economy over not only the first five years of the Plan, but up to 1981. The need for a perspective plan was rightly recognized; structural transformation in an economy at the stage of development of Uganda is difficult to bring about in a short period and consequently the process of bringing about a desirable transformation of the economy has to be cast in the context of a long range plan.

The second Plan was also more comprehensive; the plan incorporated the private sector in the aggregative framework of targets to be realized. The plan was based on a model of 10 sectors of the economy projected over a 15 year period. Once the desirable rate of GDP growth were set, the targets were distributed by sectors. These targets also embodied investment outlays to be undertaken between 1966 and 1971, and disaggregated between public, private and para statal sectors. A tentative phasing of investment was worked out so that the outlays would be relatively greater (over a third would be spent in the final two years, compared with less than a quarter in the first two).

The most crucial target - that of growth in the monetary sector - is considerably higher than that realized during the preceding 10 years. The plan called for a real growth in the monetary sector of 7.2 per cent per annum and is 3 percentage points higher than that which materialized during the period 1954-1964. The target growth of the plan was also considerably higher than that

realized by countries at a comparable stage of growth over a sustained period. Achievement of the targets depended on the attainment of the growth rates in the agricultural sector; growth in this sector, however, is predicated upon domestic supply conditions which are subject to the vagaries of weather and overseas prices.

An explicit assumption of the plan was that such adverse factors may be mitigated by a high rate of growth in the non-agricultural sector - of the order of 8.3 per cent - to realize the overall target growth rate of 7.2 per cent. Even higher growth rates in the manufacturing and construction sector are implied by the above target growth. Available evidence indicates that for the period 1966-1967, the target for the non-agricultural sector was ambitious - the average growth between 1965 and 1967 being 6 per cent in the monetary sector at 1960 prices.

The investment ratio and the projected growth imply an incremental capital output ratio of 2.7, a level considerably below that realized in the past of 3.3. The assumption of a decline in the ratio due to higher productivity gains and capacity utilization was optimistic; little attention appeared to have been given to gestation of investment and the lags involved in implementing development projects. Since an important share of capital formation was devoted to infrastructure, the expectation of an overall decline in the ratio appears to be misplaced. It must be pointed out, however, that during the period 1960-1967, the ratio increases

Table VI

Plan targets and perspective structure of Uganda economy, 1966-1981

Sector	Rate of GDP growth 1966-1971	Capital formation targets 1966-1971 (Mln. $s)	Perspective structure of the economy[a] 1966	1971	1981
Agriculture	5.1	58.8	37.8	34.3	27.2
Cotton, coffee and sugar processing	5.6	22.4	4.2	3.9	3.2
Forestry, fishing and hunting	6.0	2.8	1.6	1.5	1.3
Mining and quarrying	6.6	8.4	2.8	2.8	2.5
Manufacture of food	10.8	16.8	2.0	2.4	3.2
Misc. manufacturing	12.6	86.8	5.7	7.3	11.6
Electricity	9.8	64.4	1.9	2.1	2.6
Construction	11.3	22.4	2.8	3.4	4.3
Commerce	7.0	39.2	19.7	19.5	19.5
Transport and communications	8.5	112.0	3.5	3.7	4.0
Government administration	8.2)		1.5	1.5	1.4
Local government	7.0)	140.0	1.5	1.5	1.4
Miscellaneous services	9.3)		10.3	11.4	12.2
Rent	7.4	70.0	2.8	2.9	2.9
Total	7.2	644.0	100.0	100.0	100.0

Source: Work for Progress, op. cit.

[a] Refers to percentage share in total GDP.

Note: Target values are in 1964 constant prices and refer to the Monetary Sector only.

slightly from 2.45 in 1966 to 2.97 by 1971. A more realistic assessment of resources availability, based on historical capital output ratio would have indicated a growth rate somewhat less than 6 per cent in the monetary sector, implying an overall growth rate of less than 5 per cent. In Chapter III, some estimates of the capital output coefficient are provided under alternative assumptions of savings and investment.

The plan appeared to have no systematic manpower assessment over the period; lack of skilled manpower have been an important bottleneck in meeting the target growth of over 8 per cent in the non-agricultural sector. Secondly, the financing of the plan was based on an inflow of foreign capital of the order of 30 per cent of total capital formation. While this ratio is not as high as has been realized in some developing countries, it would be difficult to realize given the problems of utilizing capital due to an absorptive capacity that is fairly inelastic. Estimates of local financing also appear to have overestimated the contribution of the private sector which is expected to contributed over 37 per cent of total capital formation.

VIII. Price changes during 1954-1967

Price changes indicate indirectly the state of balance between supply of goods and services and demand for them. In an economy such as Uganda, price movements supplement information on production and supply but it needs to be interpreted with caution

for two reasons. First, production is dominated by agricultural sector so that overall GDP deflator is heavily weighted by vicissitudes of production in that sector. Secondly, imports form an important share of total supply of goods so that domestic prices at a retail level are closely influenced by import prices and fiscal structure. An examination of GDP, consumer and import prices reveal a rather close trend movement.

It is observed that, subject to minor variations, the GDP implicit price deflator has grown only moderately at 1.2 per cent per annum over the period. This is reflected in similar modest increase in consumer and import price indices. Inflationary pressures have not existed although during the latter part of the period, under the stimulus of increased government expenditure and overall growth, consumer prices began to grow at 4.0 per cent compared to an average decline of .6 per cent during the period 1954-1960. Similarly, GDP price deflator grew at 3.4 per cent between 1960-1967 compared to a trend rate of decline of 1.5 per cent between 1954-1960. Agricultural prices, it was noted earlier, also grew sharply during the sixties, directly influencing some of the retail prices.

Exports prices, following the Korean war reached a high plateau during the early fifties but have, with some exceptions, been declining moderately. Terms of trade - measured as the ratio of export price index to import price index - has remained generally favourable over the period indicating that change in export price has been greater than in the import prices.

Table VI summarized the trends in terms of commodity prices between 1960 and 1967, with 1960 = 100. A separate breakdown between EACM and rest of the world trade is available only since 1960. It is observed that with a few exceptions, the terms of trade have remained favourable to Uganda - particularly, non-EACM trade. It must be expected that in future, with the adjustments taking place in the international system of parities, unit price of goods from abroad will rise; and export prices, which were exceptionally favourable through much of the sixties will, not remain at the relatively high level experienced in the recent past. Adverse terms of trade will necessitate even greater pressures to diversify the structure of production in the future.

Table VII

External trade indices, 1960-1967

Year	External trade			East African Trade		
	Import price	Export price	Terms of trade	Import price	Export price	Terms of trade
1960	100	100	100	100	100	100
1961	93	102	104	101	103	103
1962	98	100	107	102	103	100
1963	109	106	98	103	102	99
1964	106	122	116	105	103	98
1965	111	119	108	109	109	100
1966	114	118	104	112	109	98
1967	109	115	106	108	104	96

Source: Based on Statistical Abstracts and Background to the Budget, various issues, Ministry of Planning and Economic Development, Entebbe.

Chapter III

Theoretical Background

Since the objective of this study is to develop a model for planning projecting future economic development of Uganda, the theoretical and empirical framework of the model may be expressed to indicate, first, the method with which various planning on policy objectives may be made explicit. To do this, simple mathematical models will be developed and their usefulness and limitations as planning devices examined. Secondly, a number of stochastic methods will be examined to see how the theoretical structure may be integrated with the empirical structure.

The construction and application of a model (by a model, we mean a set of equations in a number of variables obtained as postulates from economic theory) is justified on the grounds that economic relationships are complex and characterized by lags, numerous and continuous feedbacks, and interactions so that to trace the impact of a given policy on the rest of the economic structure necessitates a simultaneous examination of the economic system. Policy and development goals have to be consistent and be made explicit in the model so that all the ramifications of a policy can be traced in a logical fashion. This necessitates formulating planning and policy objectives in an operational context. They are operational in the sense that they can be

verified by available information, their internal consistency and feasibility is made explicit. Thirdly, on the basis of previously defined preferences, an "optimal" goal is selected where it is possible to conceive of a multiplicity of solutions.[1/]

The implications of a policy choice can be traced with reference to one of the most important development objectives - that of maximizing employment growth. The planners, let us postulate, wish to maximize employment (E) per unit of output (Y). The employment coefficient - that is, the elasticity of employment with respect to output growth, is defined as R_y/R_e, where R_y = output growth and R_e = employment growth. A given employment target, let us say y' per cent per annum, would require an output growth (R_y) of R_y/R_e x y' per cent per annum. It follows that in setting an employment target, the planners have also to fulfill an output target. The one-way causation, however, may be misleading since all the implications of the target are not made explicit. If we go back to our equation, it will be seen that since

$$\frac{R_y}{R_e} = \frac{\Delta Y/Y}{\Delta E/E}, \text{ it would follow that}$$

$$\frac{R_y}{R_e} = \frac{\Delta Y}{Y} \cdot \frac{\Delta E}{E}$$

and further

$$\frac{R_y}{R_e} = \frac{\Delta Y}{\Delta E} \cdot \frac{E}{Y}$$

[1/] See S. Chakvavarty in The Logic of Investment Planning, North-Holland Publishing Company, Amsterdam, 1959, Chapter 1.

It will be observed that the employment coefficient, varies directly with incremental output per man $(\frac{\Delta Y}{\Delta E})$ and (E/M); the latter may be construed as labour intensity of production. Labour absorption, at a given level of elasticity will depend on the rate of growth of output. However, if R_y rises due to growth in labour productivity $(\frac{\Delta Y}{\Delta E})$, even greater output growth than in the past would be called for. This means that savings ratio would have to rise and at given domestic savings rates, greater inflow of foreign capital would be required. If, in addition, the marginal capital output ratio rises, as is likely due to urbanization and greater infrastructure investment, the savings ratio would have to grow even more.

All the interactions implied by a seemingly straight-forward employment objective can be formalized and traced only if simultaneous character of economic relationships is recognized. In what follows, an attempt will be made to formalize some of the objectives in a rigorous fashion.

II. Production and investment relationship

Production of goods and services is predicated upon the willingness of society to mobilize and augment existing capacity for production. In the simplest terms, therefore, output (Y) is said to depend on a stock of capital (K) as follows: $Y = f(K)$. Alternatively, we may define K as investment or

augmentation of productive capacity and express it as follows:

$$I_t = k\,Y \text{ or } I_t = k\,(Y_{t+1} - Y_t) \qquad (1)$$

where

I_t = investment in time t

Y = output income at time t

Y = change in output

From the above, assuming k (which is incremental capital output ratio), is 3 and a target rate of growth of output of 5 per cent, the investment required in the base year, t is as follows:

$$I_t = 3(105 - 100) = 15$$

That is, to achieve an output growth of 5 per cent per annum, requires an investment share (I/Y) of 15 per cent, given a capital output ratio of 3. For the sake of simplicity, it was assumed that fixed coefficient of production prevail and that the amount of capital per unit of output, at given techniques is constant and does not depend on the amount of labour employed.

Savings and consumption functions

From above, we have ignored the impact of mobilizing resources on consumption, savings and balance of payments. This, we proceed to examine below. Y, now expressed as total income, can be stated to be composed of consumption C, (C^g being government consumption and C^p represents private consumption), I is investment, and trade balance is expressed as differences between exports (E) and imports (m), inclusive of factor income.

$$Y_t = C_t^p + C_t^g + I_t - M_t \qquad \text{(i)}$$

$$C_t^p = C_t^g = cY_t \qquad \text{(ii)}$$

Where C is the average propensity to save $\frac{C}{Y}$. Savings (S), is defined as:

$$S_t = Y_t - C_t^p + C_t^g \qquad \text{(iii)}$$

substituting $(C_t^g + C_t^p)$ from (ii), we obtain

$$S_t = (1 - c)Y_t = sY_t \qquad \text{(iv)}$$

where $s = (1 - c)$, and equals the average propensity to save, $\frac{S}{Y}$. Further, from (i) and (iii), we obtain:

$$I_t = S_t + M_t - E_t = S_t + s' \qquad \text{(v)}$$

The balance of payments deficit or surplus on trade account, $M_t - E_t$ is often referred to as foreign savings; equation (v), therefore, states that total capital formation must equal domestic(s) plus foreign (s') savings.

The above equations suggest that if part of consumption from domestic production is replaced with an equivalent volume of imported consumption goods, thereby reducing imported capital and producer goods equivalently, national income remains same as before. A fortiori, the curtailment of capital equipment imports is exactly compensated by the release of domestic resources for capital formation. By substituting in (v) for S_t from (iv) and for investment from (i) A above, we get:

$$k(Y_{t+1} - Y_t) = sY_t + S_t' \qquad \text{(vi)}$$

or

$$\frac{\Delta Y}{Y} = \frac{Y_{t+1} - Y_t}{Y_t} = \frac{s}{k} + \frac{1}{k} \frac{S't}{Y_t} \qquad \text{(vii)}$$

(viii) gives us the expression for the rate of increase in income in terms of saving/income ratio, capital/output ratio and the ratio of foreign savings to national income. The equation (vii) may be interpreted in one or more of the following ways: first, it suggests that at a given foreign savings income ratio, the rate of income increase is determined. Equivalently, a target rate of income tells us the volume of foreign savings that will be required. Furthermore, given the amount of foreign savings, the rate of increase in income may be increased if the savings/income ratio is increased and/or the dapital output ratio is lowered. It will be noted immediately that in the framework of an econometric model, the implications of such changes may be readily traced; secondly, the above analysis implies that a steady rate of growth of income requires a constant foreign savings to national income ratio $(\frac{S'}{Y})$, at a given savings propensity and incremental capital output ratio. If, for unforeseen reasons, $(\frac{S'}{Y})$ falls, the steady state growth of income will require a compensating increase in (S/Y) and or a fall in k. This requirement may be stated as follows; at a given constant rate of growth of income R_y.

$$R_y = \frac{S}{r} + \frac{1}{r} \frac{S'_t}{Y_t} \qquad \text{(viii)}$$

Given that R_y is constant, $(\frac{S'_t}{Y_t})$ must be constant. The rate of

increase in income is given by:

$R_y = \frac{1}{r}(s + s_f)$, where $s + s_f$ represents the total share of domestic and foreign savings in national income, or in terms of our example in (i) A above.

$$R_y = \frac{1}{3}(15) = 5 \text{ per cent per annum}$$

The two models of production and investment and consumption, savings and external trade may be integrated as follows:

$$Y_t = C_t^p + C_t^g + I_t + E_t - M_t \qquad \text{(i)}$$

$$I_t = r(Y_{t+1} - Y_t) \qquad \text{(ii)}$$

$$S_t = Y_t - (C_t^p + C_t^g) \qquad \text{(iii)}$$

$$S_t = sY_t \qquad \text{(iv)}$$

and

$$\frac{Y_{t+1} - Y_t}{Y_t} = R_y \qquad \text{(v)}$$

$$C_t^g = gY_t \qquad \text{(vi)}$$

$$M_t = nY_t \qquad \text{(vii)}$$

The above system of seven linear equations, at a given R_y and initial income Y_o, can be solved for seven unknowns. The equations are stated so that the policy implications of an export promotion or import substitution are made explicit. As is likely, a given increase in income, will bring forth an increase in imports which would have to be met through an increase in exports. In

absence of growing exports, a high rate of income growth can be maintained only if imports are kept lower, given the foreign savings requirement.

Within the framework of the above model, any number of refinements are possible; savings could be disaggregated into government and private component, imports could similarly be disaggregated and population and employment function readily introduced into the analysis. The final model we develop is based on the kind of reasoning implied above. Of course, empirical work does not present the same degrees of freedom available to a pure theorist and so much of the structure of a model is dictated by availability of data.

III. Projection Methods

A number of methods are available for formalizing development plans and projecting evolution as well as resource requirements of an economy in the future. Two methods that are commonly used as planning devices are critically examined below.

The first is the input-output method for estimating resource requirement in the future and the second is the 'patterns of growth' approach pioneered by Chenery.[1/]

1/ Hollis B. Chenery, "Patterns of Industrial Growth", American Economic Review, September 1960.

(a) Input-output system

The basic accounting framework of an input-output system is arranged in a matrix where sectoral output is divided into two portions of intermediate uses (X_{ij}), the addition of which leads to total intermediate uses (W_i) and final demand (Y_i), which consists of investment, consumption and exports. Each sector's supply (Z_i), in each column, consists of production (X_i) plus imports (M_i). Each column also shows the sectoral inputs whose addition leads to total produced inputs. Total production (X_i) minus total produced inputs (V_i) leads to total value added (V_i). For each row and column, the following hold:

$$\text{(i)} \quad Z_i = M_i + X_1 = \Sigma_j X_{ij} + Y_i = W_i + Y_i$$

$$\text{(ii)} \quad X_j = \Sigma_i X_{ij} + V_j = U_j + V_j$$

A number of assumptions are made to complete the theory (a) each commodity or group of commodities is supplied by a single industry on sector; (b) inputs depend on the level of production and finally (c) externalities do not prevail. This enables a demand for each industry to be expressed as a being dependent on its own level of output as follows:

$$\text{(iii)} \quad X_{ij} = \overline{X}_{ij} + a_{ij} X_j$$

Where a_{ij} is the marginal input coefficient and $\overline{X}_{ij}$ include costs that do not vary the level of output. When the latter is zero, the input function becomes:

$$\text{(iv)} \quad X_{ij} = a_{ij} \cdot X_j$$

By substituting equation (iv) into (i), and as arranging terms obtains a balance equation for each commodity or sector as follows:

$$X: - \Sigma_j a_{ij} X_j = Y_i - M$$

Such a system with n equations and n unknown, can be readily solved: n^2 parameters (a_{ij}) and two sets of n autonomous variables (Y_i and M_i). The method of solution consists of inverting the matrix as follows:

$$X = (1 - A)^{-1} \text{ or a system which includes imports}$$

$$X = (1 + M - A)^{-1} Y$$

It should be noted that the above system may be used for sectoral projections at varying levels of aggregation only when the components of final demand (consumption, exports, and investment) are determined outside the system. Once this is accomplished, the above system can be used to answer the following questions: a) how does the level of final demand influence production; b) what are the requirements of primary factors for each component of final demand (consumption, investment and export); c) what is the factor requirement per unit of demand?

Input-output system, because it is an interdependent system, provides mutually consistent values for the most important economic magnitudes such as total output, intermediate demand, final demand and value added. However, due to one of its central assumption - that of constancy of technical input-output coefficients - it

suffers from serious drawback. The assumption consequently does not permit a treatment of prices or consequence of technological change and change in composition of product mix. For projections purposes, the static nature of the system does not allow us to incorporate structual changes in the final projections. Analysis of an economy, as it transofrms from a traditional to a modern mode of production is likely to yield serious biased results in the static framework of input-output analysis. For short-term purposes, however, it can be an important tool for mobilizing and allocating resources in a consistent framework.

An interesting account of intersectoral approach to development planning has been developed by Dudley Seers.[1/] The system developed by Seers is a mixture of conventional national accounting and input-output flows. The design takes into account domestic conditions and emphasizes the role of government revenue. The model developed was operational since it integrated sectoral projections and the model provides measures of the desired effects of taxation and credit policy. Additionally, manpower requirements are indicated and the policies are laid bare.

[1/] See Dudley Seers, "The Use of a Modified Input-Output System for an Economic programme in Zambia" in Theory and Design of Development edited by Adelman and Thorbeeke (John Hopkins University Press, Baltimore, 1966).

'Normal' patterns of growth approach

An important empirical method for planning projecting sectoral production has been developed in a pioneering article by Chenery.[1/] The article attempts to incorporate changes in supply and demand conditions into a general explanation of the growth of individual sectors as well as observed patterns of growth. The model formulation assumes that in a simple closed economy with constant technology and population, the factors on demand side are relatively more important than on the supply side in determining the pattern of output. It is hypothesized that level of demand depend on the level of per capita income and size of domestic income market. As income rises, expenditure on 'luxuries' rises proportionately faster than on necessities. This, under technological conditions, determines demand for intermediate goods as well. The final determinants of sectoral output therefore is per capita income and size of market.

When the assumption of a close economy is realxed and allowance is made for differences in resource endowments, techniques of production, skills and national economic policies particularly as it pertains to trade, the strength of demand as a determinant

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[1/] "Patterns of Industrial Growth", op. cit.

of patterns of sectoral output is no longer important. Factors on supply side, taking into account comparative costs and choice of techniques in production assume greater importance in determining level and composition of sectoral output. Such variables are, however, difficult to quantify; however since relative factor prices, availability of skills and sophistication of technological know-how and its use depend on the stage of development, the level of per capita income can be taken as a proxy variable. Moreover, since level of demand of a particular sector is also additional dependent on the size of the population, the latter may be taken as a proxy for the size of the domestic market.

In actual empirical estimation, lack of qualitative information on variables such as resource endowment, efficacy of public policy and efficiency in use of resources warrant a less ambitious specification of the underlying causal relationships. If we assume an identical amount of natural resource endowment for countries, the model may be formalized as follows:

$$X_i = D_i + I_{mi} + E_i - M_i$$

where X_i = output of ith commodity

D_i = domestic final use of i

I_m = intermediate demand of i by other products

E_i = export of i

M_i = import of i

and $D_i = f_1 (Y)$

$I_{mi} = f_2 (Y)$

$E_i = f_3 (Y)$

$M_i = M_i' (D_i + I_{mi} + E_i)$

with

$M_i' = f_4 (Y, N)$

where

Y = income

N = population

M_i' = the proportion of total supply that originates from imports. Following the assumption of similar resource endowments for all countries, the above equations may be generalized as follows:

$$X_i = \overline{[1 - M_i' (Y, N)]} \; \overline{[I_{mi} (Y, N) + D_i (Y) + E_i (Y)]}$$

The above statement may be modified to take into account availability of capital (K), skills (S), national resources (NR), particular resources (NR') and normal output (X_i) for the country's size (N) and income (Y) level and ΔX_i is deviation from normal output.

$$X_i = \overline{[1 - M_i' (K, S, NR, NR', N)]} \; \overline{[I_{mi} (Y, N) + D_i (Y) + E_i (K, S, NR, NR') + \Delta I_{mi} (\Delta X_i, \Delta X_2 \ldots\ldots \Delta X_n)]}$$

For reasons stated earlier, data limitations preclude an analysis as thorough as implied above so that a surrogate hypothesis has to be developed to trace the pattern of growth. The model, now expressed with a stochastic variable U_i to indicate the random

error term can be recast as follows:

The model used is:

$$Y_i = \delta_o + \delta_1 \frac{GDP}{N} \delta_2 N + U_i$$

or in logarithmic form

$$\log Y_i = \delta_o + \delta_1 \log \frac{GDP}{N} + \delta_2 \log N + U_i$$

where

Y_i = value added in ith sector

$\frac{GDP}{N}$ = per capita income

N = size of population

U_i = random error form

δ_o = intercept of the function

δ_1 = growth elasticity

δ_2 = size elasticity

The growth and size elasticity approach has the important merit of simplicity - particularly in countries where there is a lacunae of qualifiable information. However, in using values of the regression coefficients, caution is warranted in assuming any kind of stability in the values of statistical coefficients. Finally, the likelihood of a high degree of correlation between size and growth variables results in biased values of regression coefficients in country time series studies.

IV. Types of models and principles of their construction

Two general types of macro-economic models may be usefully distinguished. The delineation is essentially based on the use to which the model is to be put; econometric model may be used for policy analysis, and or short-term forecasting or planning and long-term projections.[1/]

The first set of models, are primarily designed for analyzing impact of public policy on various macro variables in the economic system whereas the second is essentially designed for solving structural problems in the long run. The first class of models tend to be more suitable for advanced economic systems where the close integration between financial institutions, productive enterprises and public agencies enable the public authorities to influence the economic system. The objectives of such policy models is essentially to determine equilibrium level of prices, output and employment under alternative policies. Precisely because many of the goals of public policy are not simultaneously compatible, it is possible to examine the trade off between policy goals in a short-term forecasting-cum policy model. The basic mechanics of a policy model may be briefly outlined. Let us assume a model with (n+m) number

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[1/] This section has benefitted from Chapters 5, 6 and 10 of K. Fox, J. Sen Gupta and E. Thorbecke, The Theory of Quantitative Economic Policy with Applications to Economic Growth and Stabilization, North Holland Publishing Co., Armsterdam, 1966.

of variables - m refers to the number of exogenous variables and n endogenous variables. (A variable refers to the feature of the problem under study that will not change during a given period; the whole complex of features that do not change will be referred to as the economic structure. The endogenous variables are the set of variables which seek to "explain" or "influence" the system whereas the exogenous variables are determined outside the system and consequently, incapable of being influenced by the system. Among the exogenous variables which impinge on policy-making, are import prices, export prices, and climate conditions.)

The former set of variables, which purport to "explain" the dependent variables (which are, clearly, endogenous) are referred to as "explanatory" variables - these may be endogenous or exogenous. For our model with (n+m) variables, an analytical - that is n equations among n variables. The solution itself is obtained in terms of m exogenous variables. In terms of a policy model, the problem may be stated as follows:[1/]

X_i = endogenous variables that are not target variables called "irrelevant" variables, i in number

X_y = endogenous variables that are targets called "target" variables, j in number

Y_k = exogenous variables controlled by the policy-maker known as "instruments", k in number

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[1/] See N. V. A. Narasimhan, A Short Term Planning Model for India, North Holland Publishing House Co., Armsterdam, 1956.

Y_i = exogenous variables called "data" 1 in number

Q_u $(X_i^!, X_y, Y_k, Y_i^!) = 0$ $(n = 1, 2....n)$ when $n = (i+j)$

since n = no. of structural equations, and the number of endogenous variables equals the number of equations, the model may be said to be complete, i.e. $n = (i+j)$ which readily would explain the endogenous variables with the aid of exogenous ones.

Once it is decided whether the model is to be used for policy or analytical purposes, the best method of going about solving and estimating the model would be to specify all structural relationships before estimating them. A number of econometric estimating methods are available and they are:

1) Pure causal chain system (PCC or recursive systems);
2) Interdepednet (D) systems which are statis or dynamic;
3) Input-output system which are static; and
4) Conditional causal chain (CCC) system which is posed as an alternative to (2) above.

The specification of the model is reflected in a set of simultaneous[1/] linear independent equations with linear constraints. To the extent that some of the behavioural relationships are non-linear, they can be linearized by using logarithmic formulation

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[1/] J. S. Cramer, Empirical Econometrics, American Elsevier Publishing Co. Inc., New York, 1969.

without much loss in accuracy. The specification of a model should be, ideally, carried out before estimation; this implies that the model is not 'tailored to fit the data' and consequently, the theoretical integrity of a prior specification is not violated. The actual data used for estimation may be cross sectional or time series or alternatively, the two may be pooled. The magnitudes may be expressed in current or fixed prices, depending on the availability of reliable price deflators.

The model may be 'open ended' or fixed, depending on whether a planning or time horizon is specified. However, it is clear that as the probability of a change in the structure of the economy (structural break) increase as the planning horizon is extended, parametric values alter and therefore the usefulness of the model is reduced for planning purposes.

Thirdly, the model calls for prediction of exogenous variables. Such predictions may relate to behaviour of prices, particularly in foreign markets, trends in population (this may be treated endogenously in demographic models), and weather. In circumstances where there is no time series information to estimate an important endogenous variable, one of two procedures may be resorted to. In the first, parameters from cross-section data from other countries with a comparable structure of production may be used. In the latter, we noted that goals of policy objectives are those of ensuring equilibrium between domestic and external conditions and between provision of full employment under conditions of manageable prices.

Of course, additional objectives, such as income redistribution through fiscal or other means may be additional objectives and indeed long term planning may itself be an objective for regional development. However, this type of problems are better handled under the set of models which we classify as planning and projection models.

Essentially, such planning and projection models purport to explain the workings of an economic system in terms of a number of equations, derived as postulates from economic theory. The equations are essentially set up in a behavioural form to 'explain' movements in all the variables that are of chief interest. The models are operational in so far as their empirical content is subject to verification by available statistical means. In this sense, the ultimate test of such models is their predictive ability. In so far as they are policy models, the specification of behavioural relationships would include variables that can be subject to public policy. A part from behavioural equation, a model may contain identities or equations with numerical coefficients that are not estimated by inserted on the basis of a prior theorizing depending on the availability of data, the models may be disaggregated to suit the objectives of planners. The core of the planning model is an integration of growth and development models with that of a policy model.[1/]

[1/] Fox, et al., op. cit.

In constructing a model, the simultaneous character of economic relationships need to be made explicit. Once a number of equations have been specified, the question arises whether we need additional equations to explain what determines the independent variables themselves. This decision would depend on a number of considerations; first is to ensure and retain the simultaneous character of the system - that is, if any of the independent variables is itself influenced by a dependent variable, such interdependence need to be made explicit. This implies, in turn, that a model cannot be closed or that we may not stop adding new equations that already explain the determinants that occur unless these determinants are independent of all the dependent variables present and consequently, independent of the outcome of the economic process. The set of variables that meet the latter condition (i.e. that of independence from determination of the model solution) and called pre-determined variables as opposed to jointly dependent variables that are determined by the process under study.

Cramer[1/] observes that the "endogenous quality of variables is contagious, and in constructing a model we add relations and variables like beads on a chain."

A simple example of a simultaneous model and its construction may be briefly illustrated. Perhaps the most celebrated example

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1/ Op. cit.

of a simultaneous economic relationship is that of determination of supply and demand. Although the conventional simultaneous equation models may incorporate as many as 150 estimated equations, excluding definitions and identities, as in the case of the Brookings quarterly econometric model of the U.S. - the simple example of supply and demand may suffice. Assume that demand (Q_i) is determined by price and an exogenous variable, such as rainfall (W). By the assumption of market equilibrium, ($P_i Q_i$) must simultaneously satisfy two equations as follows, more formally.

$$Q_i = \delta_{10} + \delta_{11} P_i + \delta_{12} Y_i$$

$$Q_i = \delta_{20} + \delta_{21} P_i + \delta_{22} W_i$$

The 's are structural coefficient of structural relations. Solving the above, we obtain the reduced form of the system as follows:

$$P_i = \frac{\delta_1}{\delta_{11} - \delta_{22}} (\delta_{20} - \delta_{10} + \delta_{22} W_i - \delta_{12} Y)$$

and

$$Q_i = \frac{1}{\delta_{11} - \delta_{21}} (\delta_{11} \delta_{20} - \delta_{21} \delta_{10} + \delta_{11} \delta_{22} W_i - \delta_{21} \delta_{12} Y_i)$$

In a general model, with G linear equations and exactly G endogenous variables with K predetermined variables of any number, the following would hold for the above system:

$$\text{demand} \quad Q_i - \delta_{11} p_i - \delta_{12} y_i = 0$$

$$\text{and supply} \quad Q_i - \delta_{21} p_i - \delta_{22} W_i = 0$$

The G endogenous variables are now arranged in a column vector Y, the K predetermined variables in a column vector X, and the coefficients of the structural equations in a (G x G) matrix B and a (G x K) matrix. The model then reads:

$$B_y + \pi_x = 0$$

The system may be solved for any G variables we choose - if we select the G jointly dependent variable y, the reduced form obtained is:

$$Y = 1\, B^{-1} \Gamma_x$$

Expressing $- B^{-1}\Gamma$ as Π, the above equation may be further written as:

$$y = \Pi_x$$

It should be noted that so far, the discussion has assumed a deterministic model with no allowance for any error term. In a statistical or stochastic formulation as opposed to mathematical or deterministic formulation of the economic relationship, allowance is made for random disturbances. The properties of the random error ter are discussed in a later section dealing with teh assumptions of least square estimates. Suffice it to say at this point that in the basic equation derived above, an error term can be readily added to represent the formulation in a stochastic framework. There are G equations and in each of these equations except

the ones classified as definitional relations that are supposed to hold identically. Once equations with predetermined coefficients are eliminated, we are left with G structural equations, each with a random error term. The structural model outlined above would now read as:

$$B_y + \Gamma_x = v$$

Where v is a vector of random variables U_j. Solving the above for any G variables, with jointly dependent variables Y, the reduced form obtained is:

$$Y = - B^{-1} \Gamma_x + B^{-1} v$$

and rewriting

$$- B^{-1} \Gamma_x = \text{as before,}$$

$$Y = \Pi_x + v$$

Introduction of a random disturbance term in the model leads us to one of the fundamental assumptions of least square estimation; without this assumption, the whole structure of empirical estimation by least square techniques breaks down. In the simplest one equation model, we assume that the disturbance term is independent of the explanatory variable; it is dependent only on the dependent variable. In terms of single equation model, the covariance between the pair of random variables is zero. In the case of a simultaneous equation model, each structural equation is bound to contain more than one of the jointly dependent variables

with non-zero coefficients and any jointly dependent variable is related to all the variable since, it was noted above.

$$\Pi = - B^{-1} \Gamma \text{ and } v = B^{-1} u$$

It is this dependence of each of the jointly dependent Y_k that poses fundamental objection to the use of least square estimation of the structural coefficients in a simultaneous equation model. Least square estimates are neither biased nor consistent when the assumption of independence is indicated. However, in simpler models, it is generally possible to indicate the extent of the symptomatic bias of direct least squares estimates and at the same time there may be valid reasons to regard its effect as negligible.

A related problem in construction of least squares model is that of identifiability of a "structure" within a model of any equation (or equations),within a given equation (equations), within a given structure and of any coefficients within a given equation (or equations). The need for identification arises for three basic reasons: first, in dealing with non-experimental data (as in economics), the researcher has to know a priori whether one obtains a supply function or a demand function in a model that fits price equality data. Secondly, identification is necessary in consequence of changing economic structure as a result of policy implementation and thirdly, in a statistical sense, identification is necessary in order to preclude non-uniqueness and indeterminancy

of statistical parameters. The third condition may arise in a set of coefficients in an equation due to prevalence of multicolinearity.

Lack of identification in a model suggests that additional specification is required; in the simple supply and demand model, identification can be achieved by simply specifying two variables in addition to price. Supply can be properly regarded as also being determined, in addition to price also by per capita income. Often, in single equation estimation, identification may be achieved by specifying a priori restrictions on the stochastic variables. For example, if the demand curve is relatively stable, and the supply curve relative unstable, a restriction such as $\sigma^2_{ds} = 0$ can be imposed so that the estimate of the coefficient price may be identified as that of demand and not supply. Clearly, identification by a priori restriction on the specification is not a method which can be applied to in all cases. In much of economic research, we are compelled to rely on "weak" identification - that is to say, that the a priori specification would be of the form $\frac{\sigma_d^2}{\sigma_s^2} < \delta$ where δ is a constant less than unity and preferably as close to zero as possible.

In general, we may state that an equation is under identified if there are insufficient number of identifying restrictions; an equation may be said to be exactly identified if there are just as many restrictions as are necessary for identification. If there

are more restrictions than necessary for identification, an equation is said to be over-identified. This latter condition is more often the rule when there are a large number of variables to choose from. Models, similarly, are under identified, exactly identified or over identified, depending on the degree of identification of all equations in the model. Thus, a single under identified equation in a model renders the whole model under identified and in such cases, the estimating procedure is similarly compromised.

A rule of thumb method for identifying an equation in a model often provides necessary and sufficient conditions for identification. Let

V = number of variables in the system, excluding stochastic terms

V^* = number of variables in a particular equation

M = number of equations in the model system

Then the equation is exactly identfied if $V - V^* = M - 1$; it is under identified if $V - V^* < M - 1$ and it is over identified if $V - V^* > M - 1$. It should be noted that the degree of identification is not necessarily the same for all equations in a model - however, all the equations must be either over or exactly identified to obtain estimates of the parameters.

Projection models for Uganda

Use of quantitative methods for planning and projections is in a rudimentary state in Uganda. Pioneering work in this direction

to date has been that of Professor Paul Clarke.[1] In his analysis of planning problems in Uganda, Clarke argues that design and estimation of comprehensive plans (as opposed to public investment/protect plans) should be based first on "explicit quantitative analysis of desired objectives for the economy as above, from which the development activities of the immediate plan period are derived."[2] Secondly, the plan would be expected to integrate public as well as private investment expenditures and would also rely on private economic activity to accomplish the plan objectives. Thirdly, a comprehensive plan would place greater emphasis on implementation procedures and in particular would rely on policy instruments to induce private actions to fulfill the plans. In designing a plan, three main quantitative calculations are elaborated by Clarke. First, the planners have to determine how large a total programme of development activity the economy can support in the current plan period, what main lines of activity are to be undertaken and limits of progress, realistically attainable, has to be established. The core of the design therefore, is determination of the size of sustainable effort of total development programme -

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[1] Paul Clarke, Development Planning in East Africa, Makerere Institute of Social Research.

[2] Op. cit.

this, in turn determines the specifics of the plan's contents. This method of approach may be categorized as "planning from above" as opposed to determining the number and size of projects to be included in a given planning period and allocating their priority according to some form of social and public investment criteria.

Clarke views the main constraints of achieving the development targets in terms of total domestic saving plus foreign capital, total foreign exchange receipts, total government revenue and availability of educated manpower; given these constraints, the development strategy should be adjusted until the plan is at the limit simultaneously of all four constraints.

The second main function in Clarke's view, is to ensure consistency between development activities - particularly between plans and availability of resources. The function of sectoral coordination is thought to be one of the main advantages to be sought in planning so that inter-sectoral bottlenecks are avoided.

Finally, the third main function of a comprehensive plan is to select individual development activities and projects that maximize output and in turn attains the sectoral and other aggregative targets. This purpose of project selection, or planning from a micro level, involves choosing between projects within sectors, between sectors and in timing the implementation of projects and these activities can be called project analysis.

The above goals of comprehensive planning must, however, be

viewed as ideal and designable only with the existence of most sophisticated of planning institutions and statistical information. In practice, an aggregative plan is relatively easier to formulate and as statistical base widens, the degree of aggregation of the economic magnitudes may be relaxed. The Clarke model consists of producing sectors, seven categories of imports and four kinds of government taxes. The model's workings depend on a number of autonomous variables such as quantity of agricultural exports and import substitution in the manufacturing sector. With 37 variables, the model has 11 accounting identities, five autonomous variables and therefore 21 functional equations. The parameters of the model are obtained from observed ratios the period 1954-1962; their movements in the projection period is subject to policy or other analytical assumption. In addition, the parameters estimating the direct effects of the main difficulty in evaluating Clarke's model is that it provides no thorough-going statistical tests for determining whether the structural coefficients obtained exhibit the true relationships prevailing in the economy. Since they have been obtained as ratios from historical series, the probability of large errors must be high. With the benefit of hindsight, it is clear that a number of assumptions, particularly those pertaining to assumed rates of growth have proved to be quite unrealistic. However, the model and its working is a major pioneering effort at developing a quantitative fremwork for policy analysis for

an economy such as Uganda's.

A different type of model[1/] for the Uganda economy has been developed for the Secretariat of UNCTAD by the Chr. Michelson Institute of Norway. The objective of the model, and of the UNCTAD Secretariat's study which covered 30 developing countries was to estimate import and capital requirements of developing countries till the period 1975. However, the model developed for Uganda was applied to a wider purpose of analyzing the evolution of the economy during the period 1956-1965. The model provides projections for the period 1970 and 1975 at assumed growth rates and thus throws light on a number of important policy issues pertaining to mobilization of resources and the kind of savings effort required. The use of savings, investment, and balance of payments equilibrium conditions enable analysis of two gaps viz; the savings gap and the trade gap. The analytical framework of the model enables policy formulations regarding absorptive capacity to be made explicit. The model contains two variants - a lobal projection model that disaggregates visible trade by separating EACM trade from the rest of the world. The second variant has 33 endogenous variables and 33 equations. The projections obtained have been 'adjusted' by

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[1/] Trade Prospects and Capital Needs of Developing Countries (United Nations publication Sales No. E.68.II.D.13), part II, pp. 231-274.

taking into account estimation and projection biases, price changes and trend changes in external trade. The procedure is rather tendentious and its validity cannot be attested in the absence of very detailed information about price movements and changes abroad. Moreover, use of time series data without adjusting them for prices imparts serious bias to the projections. Correlation of various variables with GDP or GDP/N is essentially a correlation.between two variables related through time and does necessarily exhibit any significant theoretical interrelationship. The main weakness of the model, however, is that it does not attempt to explore in any meaning full detail the time structure of the relationships characteristic of the Ugandan economy. High statistical association is a necessary but not a sufficient criteria for evaluating the specification of the model relationships. By having an essentially unicausal model of analysis, the use of the model for serious policy analysis is impaired. Some of the conclusions of the model will be referred to and compared with our own model in a later section but the major findings of the UNCTAD model may be briefly summarized. First, a five per cent target growth rate will not create an overall resource gap in the years 1970 and 1975 although at both a moderate and a high rate of growth of GDP, there will be a shortfall in the export earnings to meet the import needs. At a higher rate of GDP growth, there will emerge a resource gap as well, necessitating an increase in domestic savings effort.

Applicability of economic models to developing countries

So far, we have assumed that the theoretical structure/framework for analyzing economic processes in the developing countries is no different from that prevailing in the advanced nations. To this assumptions, we now turn our attention and examine the extent to which such an effort does violence to reality. The question may be broken down in two distinct components. First, we may ask whether the underlying conditions in the developing countries warrant use of economic reasoning that were developed in the context of developed countries and reflects economic relationships prevailing there. Secondly, to what extent use of such models can be adapted to the developing countries bearing in mind the serious shortcomings of the methods?

Since the major part of the criticism of models for analyzing economic conditions in developing countries has to do with their scope, validity and relevance, we can concentrate on the first question and leave the second one for the next chapter where actual specification is analyzed.

Myrdal[1/] cites four main lines of criticisms: a) nature of the assumption made in constructing models; b) reliance on one factor analysis; c) misplaced aggregation and d) illigitimate isolation.

1/ Gunnar Myrdal, An Inquiry into the Poverty of Nations- Panther (Random House), New York, 1968, Volume III, Appendix 3.

Each of these may be dealt with briefly to illustrate the problems of applying economic reasoning developed elsewhere to the problems of less developed countries.

First, the analysis assumes that the "state of the arts" is constant and therefore, it is legitimate to separate "economic" from "non-economic" forces. Attitudes and institutions are either left out of any inquiry or simply assumed to be adaptable to new conditions. In the developing countries, it is suggested, the distinction between "economic" and "non-economic" factors cannot be as easily justified since the latter do influence "economic" factors. Attitudes to work, family planning, mobility of population, etc. affect "economic" factors. It has been observed, for exampled, that industrial managers prefer day shifts as opposed to night shift work for reasons other than economic - there is social opporbrium attached to night work with the result that many plants do not work fully capacity. Such underutilization is, however, discounted by entrepreneurs so that while economically the excess capacity represents a waste, it is not viewed so by investors who have already discounted for the preferences of the work force. The adaptability of workers as well as social institutions is sluggish to economic forces so that cause and effect traditional economic analysis postulates may at best be weak.

Secondly, much of the analysis is based on a single factor input and assumes away the importance of labour and technological

factors which play a vital role in the process of development. The emphasis is always placed on the need for more capital; while this is surely correct, it needs to be recognized that capital as an ingredient of growth process is a necessary but not a sufficient condition of development. The pattern of technological change plays a fundamental role in the development process;[1/] modern technology unlike liquid capital, is not readily malleable, particularly since it incorporates particular and general local characteristics which cannot be translated to developing countries. A transfer of technology cannot be expected to perform the same way as it does in a developed country and may even prove to be harmful. The role of capital and its relationship to technological progress is quite different in developing countries so that even without introducing other factors into analysis, the emphasis placed on capital alone provides misleading view of development process.

Thirdly, aggregation of what are essentially heterogenous elements of variables into single and presumably homogenous variables imparts bias to them. The factors of production do not respond rapidly to prices and their reliance as planning tools bring qualitatively different results.

[1/] Henry J. Bruton: "Growth Models and Underdeveloped Economies" The Journal of Political Economy, August 1955.

By and large, the type of criticism Myrdal makes is true of the developed countries, too. There, however, the level of abstraction assumed may deviate less from reality than in societies where "economic" and "non-economic" forces cannot be readily separated. To illustrate, a number of economic theories developed in the context of advanced societies will be presented below to clarify the limitations of some of the economic theories. Let us, to start with, examine the well-known Keynesian behavioural function between consumption (C) and income (Y). Formally, the function may be stated as:

$$C = f(Y)$$

or

$$C = \delta Y, \text{ where } 0 > \frac{\alpha c}{\alpha y} < 1 \qquad \text{(i)}$$

In developing countries, where a large share of the population is engaged in rural-based agricultural activities, the principal component of Y is C; indeed, for a large segment of the population, the relationship is:

$C = Y$, that is production is for self-consumption and surplus enters the market as barter between subsistence producers. Under such conditions, a Keynesian function which describes the income consumption relationship of a mature economy where savings may constitute as much as 20 is therefore misleading when applied to predominantly subsistence economies. A function relating savings to total income would also be misleading since

savings largely originate from the corporate and the public sector or is supplemented by aid from abroad in developing countries. Using the celebrated concept of marginal propensity to consume developed in the framework of Keynesian macro-economic analysis and applying it to developing countries illustrates the point.[1/]

The marginal propensity to consume determines the relationship between an increment of investment and the appropriate increment in income that will induce the increment in saving to ensure equality between investment and saving. The relationship between incremental income and investment is called the multiplier. The size of the multiplier is related to the marginal propensity to consume so that in less developed countries, given a high marginal propensity to consume, the size of the multiplier is large. Therefore, in LDC's a proportionately small increment in investment will bring about a larger increment in output than in developed countries and at the same time, due to the relatively lower share of investment in total output, the level of output and employment is less subject to fluctuations due to changes in investment than in developed countries. If, however, the role of investment, and multiplier in income determination are examined in greater detail, it is clear that the tools of Keynesian income analysis provide misleading picture

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[1/] See V.K.R.V. Rao "Investment, Income and the Multiplier in an Underdeveloped Economy", The Indian Economic Review, 1952.

of conditions in developing economies.

First, the Keynesian multiplier analysis assumes that with a first round of increase in income, the increase in income and employment in the next round come from secondary industries and after that from tertiary industries and so on. Assuming for the moment that secondary increase in income come from consumption goods industries, the question arises whether in LDC's these industries are in a position to increase output immediately to meet the demand induced by the first round of income generation. Clearly, the analysis assumes that output is elastic with respect to demand and ipso facto, supply is not a constraint. Similarly, the reasoning may be extended to impact of income generation in the tertiary sectors.

However, it is the case that in developing countries that capacity to meet the demand does not exist and the consequence of a bout of income generation is to put pressure on prices. The major consumption goods industry in LDC's is food and due to technical reasons its output is not able to expand immediately and offer employment. Due to the relatively low productivity of existing workers in the industry, partly due to institutional factors, such as family holdings of land and disguised unemployment, the employment effect of income generation are also extremely limited. The conclusion must follow that whereas in a developed economy the supply curve of output and factors of production is elastic, this

is not the case in less developed countries. For the analysis to work, the following must hold:

a) Involuntary employment;

b) Elastic supply function;

c) Excess capacity in the consumption goods industry; and

d) Comparatively elastic supply of working capital to sustain increased output.

Chapter IV

The Model

The model contains 29 endogenous variables that determine, together with eight exogenous and four lagged endogenous variables, a total of 29 equations. The model is linear, is solved simultaneously and can be described as dynamic since it takes into account numerous lagged relationships which influence current values. All the variables are expressed in constant 1960 values and cover the period 1954-1967. For sake of exposition and analytical convenience, the 19 structural equations are sub-classified as follows: there are three equations relating to income, consumption and investment; six equations describe sectoral production and demand; seven equations describe external trade relationships including balance-of-payments and the remaining are miscellaneous equations.

There are, as is discussed in Chapter IV, two alternative basic models. In the first one, GDP is treated as a function of capital stock which is treated as a basic determinant of GDP. In the second version, monetary gross domestic product is determined by lagged exports.

The production relationships at the aggregate as well as the sectoral level are determined either by supply considerations (as in the case of GDP, agriculture or on industrial production)

or demand consideration as in the case of transport, construction and output in the public services.

Although the construction, transport and public sector output are demand determined, they may be referred in line of Klein and Behrman's arguments,[1] as simple transformations of an input-output type of production process. This is done by expressing each sector's value added (which is assumed to be proportional to the value of gross output for that sector) as a linear function of the final demand component of the input-output matrix (i.e. consumption, investment, exports, government expenditures, etc.) and they are demanded by each sector. The linear relationship is approximated by replacing f_1, f_2 and f_3 (the elements of final demand) selectively in each equation by GNP components that are closely related to it. The regression of sector value added on GNP components (the three equations) are interpreted as input-output relationships. On the basis of the foregoing[2] it is suggested that these are not purely demand relationships but are based on production or supply processes. Admittedly, they do not go far enough in

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[1] See J. Behrman and L. R. Klein, "Econometric Growth Models for the Developing Economy", in M. F. G. Scott, et al, Induction, Growth and Trade (Clarendon Press, 1970).

[2] For a formal presentation of the arguments, see Behrman and Klein, op. cit., pages 176-177.

introducing supply factors - this is done in relatively greater detail for the two sectors considered crucial for the overall performance of the economy. The two sectors are manufacturing where a linear production is hypothesized and agriculture where prices are introduced.

External trade relationships are explained in essentially demand terms; however, prices are introduced and as will be seen later play an important role in import substitution. The external trade sector, due to its strategic importance in the future growth process, its sheer size, and availability of data is explored in somewhat greater detail.

A number of miscellaneous relationships ranging from tax equations to balance-of-payments equations give further insight into workings of the economy. The definitional identities aid in closing the model which is easily solved, both due to its medium size and linear specifications.

Since our objective is two-fold - that of "explaining" the evolution of the economy during the period 1954-1967 and projecting a profile of the economy by the year 1980 - it is necessary to cast the model in ways in which it is amenable to policy simulation. Future values are solved, essentially, by assigning initial values to the lagged endogenous variables and to exogenous variables. The former are datum and readily available; the

former are datum and readily available; the latter would have to be assigned values on the basis of either informed judgment, or a probabilistic expectation as to their course during the projection period.

In this context it may be relevant to distinguish between a projection and a forecast. Both forecasts and projections refer to future value of some variable and both may use identical techniques in arriving at the statements. Yet, whereas a forecast is based on the best judgement of the forecaster as to what conditions are most likely to prevail (i.e. as to the values of exogenous variables) the projections need not be so based but may be based instead on other hypothetical, assumptions about these conditions.

A projection, therefore, allows us the freedom of obtaining "desired" values of the variables - by some a priori targets. Policy variables, or instrument variables incorporated in the model therefore enable us to obtain maximum values of variables consistent with social welfare objectives.

The gaps between domestic savings and capital formation and between exports of goods and services are examined and used to obtain an estimate of resource requirements for the future.

The estimation of the parameters was carried out by two methods, the traditional single equation ordinary least squares methods (OLS) and two stage least squares (TSLS). Although

except otherwise indicated, the equations presented in the text are OLS. While OLS estimates in a mutually interdependent system of equations is known to give biased estimates, they possess the merit of having a smaller variance around their mean than other particular unbiased estimates.[1/] The TSLS methods, on the other hand, attempt to take into consideration the simultaneous character the estimates obtained possess. The merit of giving consistent estimates as compared to biased and inconsistent estimates of the single equation least squares method. However, in view of the smallness of the sample with which we have to work (often only 13 observations) the small sample properties of bias and efficiency has to be preferred to the asymptotic properties of consistency. The results obtained for the structural equations are evaluated in a number of ways. The most obvious first method has been to compare the estimates with a priori expectations of theory; in this sense, the statistical properties of the coefficients, such variance about their means and tests of significance, as well as signs of the coefficients are used. Secondly, since our purpose is to project certain values into the future, the model must be able to explain a large part of the variance in the dependent variables to render the stated relationships useful for forecasting

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[1/] See Pavlopoulos, op. cit., Chapter 3, pages 73-75.

purposes. This is done by checking the ability of the model to forecast for the sample period (see Chapter IV). The usual tests employed is the coefficient of multiple determinations, corrected for degrees of freedom. Secondly, variance analysis is employed for ascertaining from the sample data whether the observed association was real or spurious due to sampling variations. This is done by employing the F ratio which is the sum of sampling variance plus other variance as a proportion of sampling variance. A null hypothesis is set up that the variance of the two samples is equal; a value of F ratio greater than that given in the tests of significance (we adopt .5 per cent level) is sufficient to reflect the null hypothesis and accept the alternative - namely, the association is real and not spurious due to sampling variance. This ratio tests the entire regression relationship for significance and provides a useful complement to the coefficient of multiple correlation.

A crucial assumption of the estimates we derive is the serial independence of the disturbance terms, N, in the regression equation; the implied assumption $E(UU^1) = \sigma^2 I$ gives $E(U_t U_{t+s}) = 0$ for all t and for all $s \neq 0$. The assumption implies that in particular successive disturbances are drawn independently of previous values; in time - series estimation (and often in cross section as well), the assumption is not always justified - particularly as the period between the estimate years lengthen.

Moreover, we also assume that the residuals are uncorrelated with explanatory variables, that is,

$$E(X_i' U) = 0$$

Moreover, violation of the first assumption (heteroscedastic residuals) renders the formulas for sampling errors of regression coefficients meaningless. Also, the serial dependence of the residuals through time renders the F and t significance tests of limited value and finally, correlation of residuals with explanatory variables yields biased and inconsistent estimates or regression coefficients. A test for detecting auto-correlated disturbance has been devised by Durbin and Watson.[1/] A 'd' statistic is defined as follows:

$$d = \frac{\sum_{t=2}^{n} (U_t - U_{t-1})^2}{\sum_{t=1}^{n} U_t^2}$$

If the value of 'd' is greater than the upper bound value, d_u, in the Durbin-Watson table, we accept the null hypothesis of random disturbance.

In all the estimates that follow, the values in parenthesis are 't' values for the significance tests of the regression coefficient, corrected values of coefficient of multiple determination,

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[1/] See Johnston, Chapter 7, op. cit.

of F test and of the Durbin-Watson lest (DW) are given for each equation.

A number of shortcomings of the model may be stated; first, the degree and level of aggregation is high for a number of sectors and it would be desirable to attempt to disaggregate the relationships; in particular, exports ought to be viewed from supply side and a supply function for each of the major export crops of Uganda. Price relationships ought to be explained endogenously if a separate demand and supply estimate were available, instead of treating them exogenously (or as instrument variables), it would be useful to analyze them in an endogenous framework.

The model lacks any explicit monetary relationships, not only is data on money supply inadequate since Uganda was a member of the East African Currency Board which did not estimate separate money supply for each of its members, but also it may be questioned whether monetary policies would be effective in an economy at Uganda's stage of development.[1/]

[1/] Although in Uganda, process of control of money supply and credit creation is no different from an economy with a more sophisticated banking system, the balance of payments surplus on central bank lending determine the level of reserves and consequent credit creation. Since, however, monetary policy can do little to influence exports and imports, at least in the short run, the only crucial policy variable left at the governments disposal is central bank lending. (See Walter T. Newlyn, "What Monetary Policy can do to implement the Plan" in the Challenge of Uganda's Five-Year Plan, published by Milton Obote Foundation, Kampala, 1967).

However, as the economy develops, domestic demand for credit for both public and the private sector is likely to grow and therefore some integration of monetary variables with the real variables in the model would obtain a more comprehensive range of policy controls on the economy. The role assigned to price incentives, in particular, would need to be judged in the context of monetary policy objectives. This, unfortunately, has not been possible.

Despite the high level of aggregation and size of the sample, the projection model has been developed in the hope that it pinpoints certain strategic relationships in the economy which enable policy decisions to be undertaken with some certainty. In many ways, the structure of the economy renders the tasks of choosing policies somewhat easier. The economy is dominated by agriculture based exports and its overall dependence on agriculture and exports enables a relatively easier identification of policy objectives in the context of a medium run plant. It does not follow, however, that the need for detailed input-output information is less. Indeed, a statistical projection model could be ideally complemented by inter-industry information.

The model used for estimation and projections (including its variant) is summarized below:

Investment, consumption and GDP relationships:

(1a) $$GDPM_t = a_1 + b_1 \sum_{t=1}^{n=14} GFCF + U_1$$

(1b) $GDPM_t = a_1^1 + b_1^1 X_{t-1} + U_1$

(2) $GFCF_t = a_2 + b_2\ GDPM_{t-1} + c_2\ (PI/PY)_t + U_2$

(3) $CONSM_t = a_3 + b_3\ GDPM_t + U_3$

Sectoral production and supply relationships:

(4) $OAGRM = a_4 + b_4\ (PAGR/PY)_t + c_4\ OAGRM_{t-1} + U_4$

(5) $OMFG_t = a_5 + b_5 \sum_{t=1}^{n=14} CIM + c_5\ IL_t + U_5$

(6) $OPBS_t = a_6 + b_6\ GDPM_{t-1} + U_6$

(7) $OCSTR_t = a_7 + b_7\ GFCF_t + U_7$

(8) $OTRAN_t = a_8 + b_8\ GDP_{t-1} + U_8$

(9) $OSUBS_t = a_9 + b_9\ OSUBS_{t-1} - c_9\ (PAGR/PY)_t + U_9$

External trade sector:

(10) $MCAP_t = a_{10} + b_{10}\ GFCF + U_{10}$

(11) $MCONS_t = a_{11} + b_{11}\ CONS_t - c_{11}\ (PMC/PY)_t + U_{11}$

(12) $MPROD_t = a_{12} + b_{12}\ GFCF_t - c_{12}\ GDPM + U_{12}$

(13) $MEA_t = a_{13} + b_{13}\ DY_t + U_{13}$

(14a) $XROW_t = a_{14} + b_{14}\ XROW_{t-1} + U_{14}^1$

(15) $FY = a_{15} + b_{15}\ GDPM_{t-1} + U_{15}$

(16) $INVIS = a_{16} + b_{16}\ T + U_{16}$

Miscellaneous equations, identities and definitional relationships:

(17) $PR_t = a_{17} + b_{17}\ GDPM_t + U_{17}$

(18) PBCONS = $a_{18} + b_{18} PR_t + U_{18}$

(19) DTAX = $a_{19} + b_{19}$ GDPM + U_{19}

(20) GDPT = GDPM + OSUBS

(21) C = CONSM + OSUBS

(22) PR CONS = CONSM - PBCONS

(23) DY = GDPM - DTAV

(24) DS = GDPM - CONSM

(25) FS = GFCF - DS

(26) FM = X - M + (MS - XS) + FY

(27) CI_t = CI_{t-1} + GFCF

(28a) CIM_t = CIM_{t-1} + .28 GFCF

(28b) CIM_t = .28 CI_t

(29) M = MCAP + MPROD + MCONS + MEA

(30) X = XROW + XEA

(31) OSRV = GDPT - OAGR - OMFG - OSUBS - OSCTR - OPBS - OTRANS

Endogenous variables:

GDP - Total Gross Domestic Product at fixed market prices

GDPM - Monetary GDP

CONSM - Monetary consumption

C - Total consumption

CPR	-	Private consumption
PBCONS	-	Public consumption
DY	-	Disposable income
GFCF	-	Gross Fixed Capital Formation
OAGRAM	-	Monetary Agricultural Output
OMFG	-	Output in Manufacturing
OPBS	-	Output in Public Sector
OTRAN	-	Output in Transport Sector
OCSTR	-	Output in Construction Sector
OSUBS	-	Output in Subsistence Sector
M	-	Total imports
MCAP	-	Imports of Capital Goods
MCON	-	Imports of Consumer Goods
MPROD	-	Imports of Production Goods
MEACM	-	Imports from EACM
X	-	Total exports
XROW	-	Exports to Rest of World
XEA	-	Exports to East Africa
PR	-	Public revenue
S	-	Total savings
FS	-	Savings gap
FM	-	Trade gap
MS	-	Import of Services
XS	-	Export of Services
FY	-	Factor Income
INVIS	-	Invisibles

Exogenous Variables:

PI	-	Price deflator, Investment Goods, 1960 = 100
PY	-	Implicit price deflator, GDP, 1960 = 100
PAGR	-	Price deflator, Agricultural goods
K	-	Capital
ΣCIM	-	Cumulated Investment
ΣIMFG	-	Cumulated Investment in manufacturing
L	-	Labour input, million man-hours
WX	-	World Export Index
N	-	Population

I. Aggregate GDP determinants:

The structure and performance of the economy during the period 1954-1967 has been analyzed in Chapter I. It was noted that bulk of the production is based on a small scale agricultural sector, which depends on agricultural exports for cash incomes. The share of exports in monetary GDP is of the order of 40 per cent; its impact on the economy, such as output in government sector and revenue, capital formation and savings and capacity to import is so overwhelming, that it is the most important determinant of the pace of the activities in the rest of the economy. Due to its linkage with the modern sector of the economy, the export sector is, in a strategic sense, of even greater importance than the agricultural sector which is larger in absolute and relative size.

The performance of the economy in the past and its evolution in the future is closely linked with the vicissitudes in export performance. This hypothesis has been tested by regressing monetary GDP against exports (X) lagged one year to take into account dynamic aspects of the export multiplier. The results of the regression are reported below.[1/]

$$GDPM_t = \underset{(4.641)}{130.228} + \underset{(7.516)}{1.593}\ X_{t-1} \qquad (i)$$

$R^2 = .822$
$DW = 1.779$
$F = 56.501$

The statistical results suggest presence of a significant causal relationship between exports and monetary GDP; the former "explains" 82 per cent of the intertemporal variation in the dependent variable. Moreover, the export coefficient is "significant" at the 1 per cent level as evidenced by a 't' value of 7.516. Lack of serial auto-correlation is suggested by a Durbin-Watson value of 1.779.

On the basis of the above statistical findings and theoretical considerations, equation (i) is used in Model II (Chapter IV).

[1/] The regression of total GDP, GDPT, against lagged exports is also significant as reported below:

$$GDPT = \underset{(6.152)}{167.386} + \underset{(11.047)}{2.270}\ X_{t-1}$$

$R^2 = .909$
$DW = 1.477$
$F = 122.034$

The second basic relationship for determining GDP is the standard Harrod-Domar type of production function linking output to capital and savings. This model, whose variant we use in a highly abstracted form, recognizes capital to the limiting factor or production in the developing countries. In the developed countries, on the other hand, this constraint is less crucial - availability of manpower posing really greater difficulties for enhancing production. It is obvious, however, that complementary factors of production such as entrepreneurial and administrative capacity, skilled manpower and a host of other factors which are often collectively referred to as "absorptive" capacity are important limiting factors.

In the absence of sectoral investment data and aggregate capital stock estimates, the production function obtained is an aggregate one, and assumed a fixed technical relationship between cumulated gross capital formation (as a proxy for stock of capital) and monetary GDP. The relationship hypothesized is:

$$GDPM_t = f(K)_{t-1}$$

A number of additional underlying assumptions implied by the above specification may be made explicit; first, the production functions assumes full capacity. In the short run, production can be expanded by utilizing available capacity. The level of aggregation implied fails to take into consideration different responses of divergent sectors such as agriculture, manufacturing,

and services. Clearly, to have significant operational use, the inter-relationships between the sectors need to be spelled out.

The estimates of capital stock, is derived from gross domestic capital formation which includes residential construction; even if it were possible to exclude construction, important questions, relating not only to measurement of capital but also meaning of capital are raised and remained unanswered.[1/]

It is finally assumed that the average productivity of capital is constant and so, therefore, is the marginal productivity.

$$GDP = aK$$

where a is the constant output capital ratio. If we assumed that depreciation is a constant proportion of c of the total gross domestic fixed capital formation, I, the stock of capital, K, at time t will be

$$K(t) = K(0) + (1-c) \int_0^t I(\tau)\, d\tau$$

From the above equation it follows that output may be expressed as a function of cumulative gross fixed capital formation i.e.,

$$GDP\ (t) = aK(0) + a(1-c) \int_0^t I(\tau)\, d$$

The constant term aK(0) and the coefficient a(1-c) can be estimated by fitting least squares.

[1/] M. Ishaq-Nadiri: "Some Approaches to the Theory and Measurement of Total Factor Productivity - A Survey", The Journal of Economic Literature, December 1970, especially pages 1144-1146.

The least squares estimates of the relationship are given below.[1/]

$$GDPM_t = \underset{(20.486)}{239.913} + \underset{(9.243)}{.245}\ \Sigma GCF_{t-1} \qquad (ii)$$

$R^2 = .875$
$DW = 1.098$
$F = 85.448$

The results are statistically satisfactory. The marginal capital output ratio implied by equation (ii) above equals:

$$\frac{1}{\left(\frac{\partial GDPM_t}{\partial \Sigma GFCF_{t-1}}\right)}$$

that is, 4.081.

This estimate of marginal capital output ratio is considerably greater than the ratio (incremental) used for the second five-year plan.[2/] A marginal capital output ratio of 4 is greater than the average prevailing in developing countries at comparable stages of development.[3/] The investment effort implied to sustain the growth rates postulated in the Uganda Plan is therefore a gross under estimate. Alternative growth paths implied by different capital output ratio are examined in the next chapter.

[1/] The estimated relationship between total GDP and capital is reported below:

$$GDPT = \underset{(26.405)}{326.481} + \underset{(12.220)}{.341}\ \Sigma GFCF_{t-1} \qquad R^2 = .925,\ DW = .480$$

[2/] Work For Progress, op. cit.

[3/] See Table 32, World Economic Survey, 1969-1970, op. cit.

Consumption Relationships:

In a developing economy such as Uganda's, the consumption sector may be usefully decomposed into monetary consumption and subsistence consumption. The latter constitutes nearly 50 per cent of the former yet it is fundamentally different in behaviour. In the former, the behaviour postulated in the Keynesian consumption function is approximated in Uganda; that is, marginal propensity to consume is positive but less than unity. In the subsistence sector all production is consumed - and marginal propensity to consumer equals 1.

It is also the case, however, that a large part of the monetary sector consumes its output; developing countries typically have a dual economy in which the monetary agricultural sector behaves similarly to the subsistence (also agricultural) sector; savings comes mainly from the public sector or the urban-based "modern" secondary sector. This means that even in the monetary sector, consumption behaviour of a large part is similar to that in the subsistence sector.

A number of hypothesis were tested to examine the consumption propensities of different ethnic, income and occupational groups. An attempt was also made to estimate the short-run and long-run consumption propensities the functions fitted for verification were:

1. $CT_t = f_1 (GDPT_t, CT_{t-1})$

2. 2. $(CT/N)_t = f_2 (GDPT/N)_t$

3. $CM_t = f_3 (GDPM_t, CM_{t-1})$

4. $CM_t = f_4 (WY_t, N\text{-}WY_t)$

5. $CM_t = f_5 (PRY, NON\ PRY)$

6. $CPR = f_6 (CPR_{t-1}, DY_t)$

7. $CM_t = f_7 (GDPM_t)$

where

GDPT = Total Gross Domestic Product

GDPM = Monetary Gross Domestic Product

CT = Total Consumption

CM = Monetary Consumption

CPR = Private Monetary Consumption

N = Population

WY = Wage Income

N-WY = Non-Wage Income

PRY = Property Income

N-PRY = Non-Property Income

t = time subscript

Presnece of multi-collinearity between the various independent variables, as indicated by high 't' value and high coefficient of simple correlation compels us to confine the analysis to equation

7 whose estimates are presented below.[1/]

$$CM_t = -22.168 + .824\ GDPM_t \qquad \text{(iii)}$$
$$(-1.348)\quad (16.729)$$

$R^2 = .955$
$DW = 1.599$
$F = 279.888$

The marginal propensity to consume out of monetary income, $\frac{\partial CM}{\partial GDPM}$, equals .824 and is greater than the average propensity to consume. This suggests that strenuous effort on the part of the government would be required to contain consumption and even greater effort is implied in reducing it below the average propensity. Part of the reason for a marginal propensity to consume greater than the average is the rapid increase which took place in public consumption during the 1960s, following independence. A

[1/] An estimate of the short-run and long-run marginal propensity was made using the following equation based on current price data; the same equation, when deflated by fixed 1960 prices, yields results that exhibit a high degree of multi-collinearity. The results presented below are used simply to highlight the problem of obtaining reliable estimates from imperfect data.

$$PR\ CONS_t = -103.887 + .459\ PR\ CONS_{t-1} + .716\ DY$$
$$(-2.255)\quad (2.007)\qquad\qquad (2.905)$$

$R^2 = .929$
$DW = 1.422$
$F = 79.683$

The short-run MPC $\frac{PR\ CON}{DY}$ equals .716 whereas the long-run MPC, calculated as $\frac{\partial PR\ CON_t}{\partial DY_{t-1}} \cdot \frac{1}{(1 - \frac{\partial PR\ CON_t}{\partial DY})}$ equals 1.33.

strenuous effort is indicated in holding down public consumption if Uganda is to generate additional domestic resources for capital accumulation. The regression of public consumption (PBCONS) against public revenue suggests that the marginal propensity to consume out of total revenue is of the order of .9 as reported below.

$$\underset{}{PBCONS} = \underset{(6.926)}{.910\ PB\ REV} + \underset{(-1.438)}{-14.584} \qquad \text{(iv)}$$

$$R^2 = .783$$
$$DW = .599$$
$$F = 47.975$$

Prevalence of serial correlation in the residual, however, renders the above equation useful only for illustrative purposes. An alternative specification, that of regressing public consumption against monetary GDP also yields statistically unsatisfactory results.

Investment Behaviour:

Investment behaviour has been a controversial issue in economic research and its explanation in the context of the developing countries is a vexed one. What is clear, however, is that capital formation involves mobilizing additional real savings, to be channeled appropriately through the financial markets and finally translated into augmenting capital stock at an appropriate rate. The first requirement - that is of increasing the volume of real savings is of fundamental importance if a high rate of capital formation is to be sustained without inflationary pressures. In this sense, it

should be stressed that an increase in the supply of finance cannot be a substitute for real resources needed for capital formation.

While ex post domestic and foreign savings equal total fixed capital formation, ex ante they may diverge considerably and here expectations play an important note in determining the level of capital formation. Gross domestic product in the monetary sector, lagged one year is used as an explanatory variable that reflects the element of expectations; in a period of rapid growth, expectations are buoyant and stimulate savings, capital inflows and ultimately capital formation. An alternative casual relationship between capital formation and GDP is implied by the so-called investment accelerator. In the model we have tested, an element of expectations as well as the accelerator relationship is used to justify using GDP as an explanatory variable.

An additional variable thought to be of significance is the relative price of investment goods, PI/PY where PI refers to investment goods prices and PY refers to the GDP deflator.

Investment decisions, in addition to expectations, are also influenced by prices of investment activities or, in the Keynesian model by interest rate which influences the marginal effectiveness of capital (as indicated by the slope of the marginal efficiency schedule of investment). In the face of adverse prices, investment decisions are likely to be postponed; a switch to increased current consumption may be expected. On the other hand, if

incentives exist for undertaking investment decisions in the form of favourable relative prices, the response of entrepreneurs is likely to be positive: the incentives may range from discriminatory tariffs in favour of capital goods, fiscal concessions and concessional loans to stimulate investment. The level of capital formation in the absence of the above-mentioned incentives is likely to be lower.

The above two explanatory relationships were tested in a regression model and the following results strongly verify the underlying reasons.

$$GFCF_t = \underset{(3.072)}{82.121} + \underset{(6.692)}{.287}\ GDPM_{t-1} - \underset{(-3.796)}{122.493}\ (PI/PY)_t \qquad (iv)$$

$R^2 = .927$
$DW = 2.280$
$F = 64.800$

It will be observed that each of the regression coefficients is 'significant' at 1 per cent level and of the expected sign. The coefficient of multiple determination is quite high and is seen to "explain" over 90 per cent of the variation in the dependent variable. The 'd' value of the Durbin-Watson test suggests, moreover, the lack of serial correlation.

Production and Supply Relationships:

(a) Agriculturel Production:

Importance of the agricultural sector has already been noted in Chapter III. Due to its sheer size and a number of

other reasons noted below, it will be a major determinant of Uganda's economic performance in the future. Its behaviour in the past and its likely evolution in the future is therefore of considerable importance and needs to be examined with care.

The importance of the sector is based, first, on the need to furnish adequately demand for food from a rapidly growing population. The consequences of lagging food production on the foreign exchange resources and the domestic price structure are too well known and frequent to require elaboration.

Secondly, since the sector employs over 90 per cent of working force, its performance is widely felt. A fast rate of growth of production touches the whole sector and eventually the non-agricultural sectors as well since it is the prime determinant of demand. Agricultural performance also has salutory effect on export growth which enhances the economy's import and productive capacity.

In this study, an attempt was made to estimate production and supply behaviour of the sector with a view to obtain a relationship best able to project, subject to policy alternatives, future growth of the sector.

The following three basic relationships were selected for analysis from large number of alternative hypothesis tested.

$$OAGRM_t = f_1(W_t, ACR_{t-1}, Pagr_{t-1})$$

$$OAGRM_t = f_2(OAGRM_{t-1}, Pagr_{t-1})$$

$$OAGRM_t = f_3 (OAGRM_{t-1}, PAGR/PY)$$

where

OAGR = Value added, monetary agriculture

W_t = Index of weather (rainfall)

ACR = Index of acreage

PAGR = Price deflator, agriculture

PY = Price deflator, GDP

The first can be viewed, roughly, as a production function embodying physical factor inputs as explanatory variables whereas the last two can be viewed as supply relationships recognizing explicitly the role of prices rather than factors of production.

The results of the first regression equation are reported below:

$$OAGRM = \underset{(4.054)}{2.755} + \underset{(4.531)}{.011}\ ACR - \underset{(-2.094}{.740}\ PAGR \qquad (v)$$

$$- \underset{(-1.519)}{0.15}\ W \qquad R^2 = .609$$

The price variable in the equation is unexpectedly negative, but "significant" at 5 per cent level. The equation implies that high prices discourage output, either through reduced plantings or reduced effort to crop the plantings. There was no a priori hypothesis regarding the sign of the weather variable and therefore a negative sign must be to mean that an excess of rainfall is likely to adversely effect the current level of output. The acreage

variable is of some interest and its sign as expected and statistically significant. It is difficult to infer, given the regression specification, anything about the productivity of factor input since the acreage is an index whereas output is not. Due to the relatively weaker coefficient of overall determination and the poor 't' values of the regression coefficients, the above equation was rejected for the projection model.

The second equation is essentially similar to the third and its results[1/] are not statistically satisfactory and for that reason the third specification was chosen. This equations states that current monetary value added in agriculture at fixed prices is determined by two factors; the level of monetary output in the previous

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[1/] The results of this specification are:

$$OAGRM_t = \underset{(5.657)}{.859}\ OAGRM_{t-1} + \underset{(0.791)}{17.540}\ PAGR + \underset{(0.162)}{4.352}$$

$R^2 = .788$
DW = 3.051
F = 21.560

In an attempt to measure the Chenery type of "patterns" of "normal" development, a regression was made between agricultural production (OAGR) and per capita incomes (GDP/N) and size of population (N) (See Chapter II for a theoretical discussion of this specification). The following results were obtained and are worthy of note:

$$\log OAGR = \underset{(0.358)}{0.191} + \underset{(13.476)}{1.019}\ \log N - \underset{(-1.006)}{0.221}\ \log (GDP/N)$$

$R^2 = .983$

period. Lagged output determine the volume of seeds, fuels and fertilizers available for the next planting. A low level of output, due to natural phenomenon such as drought or floods, etc., has the effect of increasing consumption in previous periods and as the surplus of savings over investment is reduced, the level of current output is further affected. Secondly, it may be argued that the level of output realized in the past is the minimum that the growers aim to realize to keep up with the growth in demand.

In addition, conventions and habits perhaps play a role to the extent that growers have a certain targeted mix of crops which they would produce, other things being equal. Consequently, the level of output in the previous period serves as a gauge for undertaking decisions at the margin.

The second variable, that of relative price, is introduced into the analysis for two reasons. First, in order to complement the explanation of farmers behaviour offered earlier. That is, the decision to expand production, at the margin, is taken on perfectly national basis. If the relative price of agriculture is attractive and better than realized in the past, an inducement exists for farmers to expand output. The responsiveness of farmers to "modern" incentives in the form of higher returns is a controversial issue. In this study, it is argued that farmers are responsive to price incentives and react and plan production much as any other economic

unit does in consistent with the postulate of rationality.[1/]

The price variable suggests that if terms of trade are moving "against" the agricultural sector, the farmers are likely to respond by simply producing at the level in the past, at a minimu, and postpone decision at the margin to crop etc. in the face of adverse prices. By the same token, when the terms of trade are moving in favour of the agricultural sector, the growers respond in a positive fashion to take advantage of the incentives.

The introduction of prices as instrumental variables in the planning process enables an empirical assessment of different growth paths under alternative conditions. The view of planned prices is similar to that implied by Gunnar Myrdal[2/] who defines them as:

> "....prices that under all existing conditions, including the full range of government policies would give entrepreneur and more generall, producers, traders, consumers and savers incentives to act according to a particular development plan."

[1/] For an analysis of the issue in the context of Africa, see Marvin P. Miracle and Bruce Fetter in "Backward Slopping Labor-Supply functions and African Economic Behaviour" in Economic Development and Cultural Change, January 1970. Also see O. Jones, "Economic Man in Africa", Food Research Institute Studies 1 (May 1960). For a specific supply analysis, see Robert M. Stern, "The Determinants of Cocoa Supply in West Africa" in African Primary Products and International Trade, ed. I. S. Stewart and J. W. Ord (Edinburgh; Edinburgh University Press, 1965). For an interdisciplinary approach to the issue of economic decision making, see James E. Grunig in "Communication and Economic Peasants" in Economic Development and Cultural Change, July 1971.

[2/] See Myrdal, Asian Drama, op. cit., page 2037.

The results of the regression are highly satisfactory, with the signs of regression coefficient as expected a priori. The results are:

$$\underset{}{Oagvm} = \underset{(-1.327)}{-53.531} + \underset{(1.834)}{75.928}\frac{PAGR}{PY} + \underset{(8.972)}{.908}\ OAGR_{t-1} \qquad (vi)$$

$$R^2 = .927$$
$$DW = 2.280$$
$$F = 64.840$$

The coefficient of multiple correlation is high and the Durbin-Watson value of over 2 suggests lack of any auto-correlation in the equation. The coefficients of the variables are statistically "significant" at more than 1 per cent level for the lagged variable and 10 per cent for the relative price variable.

(b) Industry:

The industrial sector in Uganda is still in a stage of infancy; since an important part of its output is related to processing of agricultural commodities, its performance could be viewed as being dependent on the output in the agricultural sector. Moreover, the income generated in the latter provides impetus expansion of production in the sector. A simple relationship between manufacturing and agricultural growth is, in many ways, preferable to other relationships to "explain" the behaviour of the sector in terms of more sophisticated production functions.

The simple line of manufacturing production in Uganda could, therefore, be best described in terms of demand effect; income

growth generate demand which is partially met by increasing output of processed food and the modest range of consumer items produced within the country. Not only is the technology for producing this range of goods rather simple, but it will grow at a lower rate in future as consumer preferences shift towards "finished" goods of a different category, as import substituting strategy throws open opportunities for expansion of production into more sophisticated lines of production. The problems of increasing supply will assume greater importance. In particular, skilled labour, manpower and greater capital accumulation in the sector would call for a more comprehensive explanation of supply. Bearing this in mind, and the need for a specification that takes into consideration policy incentives for expanding output in the future, a proxy for capital stock is introduced into a simple linear production function linking output with labour input and capital stock.

In the absence of any data on the stock of capital in the industrial sector (which is defined to include mining and power), it was assumed that the share of capital formation in the industrial sector approximates levels attained in countries with a similar structure of production.[1/] This share also approximates the level

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[1/] See Table 31, World Economic Survey, 1969-1970, op. cit., (The average share assumed is 30 per cent).

of investment in plant and equipment. The assumptions pertaining to the use of capital and aggregation discussed earlier with reference to total capital stock are also applicable here.

Among the functions chosen for determining the pattern of manufacturing performances, the following yielded the best results from the statistical viewpoint, and may be of some interest:

$$\underset{}{\text{Indus}} = \underset{(-2.670)}{-26.649} + \underset{(10.686)}{.139}\ \Sigma IMFG + \underset{(4.950)}{.557}\ L \qquad \text{(vii)}$$

$$R^2 = .930$$
$$DW = 1.457$$
$$F = 32.400$$

The coefficient of multiple correlation is quite high and all the variables are statistically "significant" at 1 per cent level.

The capital output ratio $\frac{1}{\left(\frac{\partial OMFG}{\partial IMFG}\right)}$ of 7 appears to be quite high[1/] but it must be borne in mind that the definition includes capital formation in power as well and this has the effect of increasing the marginal output ratio.

The share of capital going to the industrial sector is to some extent subject to public policy and this enables an analysis during the projection period of the effect of shares of capital devoted to the sector.

[1/] Ibid., Table 32.

(c) Public Sector:

Public sector is likely to assume increasing importance in the future growth of the economy. First, its role in the overall development effort is likely to grow as it initiates and begins to implement development related activities such as provision of social services, transport and other infrastructural activities. Moreover, it is already the largest employer in the country and if para-statal institutions are considered as constituent parts of the public service, it is likely to become the most important producer as increasing number of economic activities come under its control.

In the absence of any direct estimates of value added in the sector, the data used is from factor income side. Although during the colonial rule the role of the sector was one of maintaining law and order, it is beginning to assume a development role. It is true that the capacity of the public sector to influence the rest of the economy is limited to a policy role. Its future importance, however, will depend on the rate at which the economy is growing and creating conditions for a greater participation of the sector in the overall economic activities. A number of fiscal relationships (see d below) should be viewed together with the sectors likely evolution. In the following equation it is hypothesized that 'output' in the sector will depend on the previous years monetary GDP as follows:

$$OPS = \underset{(7.207)}{.130}\ GDPM_{-1} + \underset{(.162)}{.958} \qquad (viii)$$

$R^2 = .809$
$DW = 2.451$
$F = 32.412$

The statistical fit is quite satisfactory and was adopted for projection in the model in preference to the one relating output in the sector to the level of public revenue.

(d) Construction:

Output in construction sector has been the most volatile component of the secondary sector output; from a high level recorded in the early 1950s, it has undergone a major decline through the later 1950s and into early 1960s, although it began to pick up appreciably after 1962-1963. Investment and planning decisions are reflected in this sector's behaviour. Due to a relatively greater skill component in the output of this sector, it is likely to be a bottleneck in future growth and expansion, in the absence of provision for training number of skilled manpower required for the sector. Growing level of economic activity demands increased construction services and as a proxy for the level of demand, current gross domestic product was chosen to explain the impact of overall demand on variation in the output of construction sector. The results were not very successful; the 't' value of the regression coefficient was found not to be significant at 5 per cent level. As an alternative, therefore, value added in the sector was regressed against gross fixed capital formation as follows:

$$\underset{}{OCSTR} = \underset{(1.931)}{5.021} + \underset{(2.904)}{.100}\ GFCF \qquad \text{(ix)}$$

$R^2 = .412$
$DW = 2.039$
$F = 11.631$

Transport Sector

This sector is examined separately since its importance will grow greatly in the future for two reasons: first, since Uganda is a landlocked country, transport provides important means of communications with the rest of the world and as Uganda's exports and imports structure begins to diversify, it will open up demand for greater transportation services from neighboring countries. Secondly, the internal demand for transport for commercial distribution will increase greatly. It, therefore, needs to be planned for accordingly to prevent bottlenecks appearing in the sector; however, for reasons noted below, the sector's growth is examined only from the demand side.

The demand for transportation services should distinguish between commercial transport and the non-commercial transport services and recognize the importance of substitution at different tariffs ranges between road transportation and rail transportation. Due to data limitations, however, it has not been possible to offer an analysis of demand which takes price, among other variables, into account.

A number of alternative specifications listed below, were attempted:

$$OTRP_t = f_1 \left(\frac{GDP}{N_t}, N_t\right)$$

$$OTRP_t = f_2 (OAGR_t)$$

$$OTRP_t = f_3 (GDPM_{t-1})$$

Of the three, the last was chosen although from a strictly statistical viewpoint, all three of them yielded equally good results. The statistical properties of the third equation are noted below:

$$OTRA = \underset{(-2.795)}{-5.507} + \underset{(11.063)}{.070}\ GDPM_{t-1} \qquad (x)$$

$$R^2 = .918$$
$$DW = 1.720$$
$$F = 32.600$$

Given the overall development objectives the question arises whether resources unproductivity employed in this sector should be given particular incentives to switch to more productive sectors. Or, alternatively, should the development objectives focus on the more dynamic sectors of the economy where returns to investment is higher and expect the resources to be pulled from the more backward non-monetary sector of the economy.

The case for the first type of strategy is based on the kind of arguments relevant to special measures in favour of regional or sectoral development. The essence of the argument is that structural rigidities make it difficult for the relatively backward sector to respond to incentives of the normal type and therefore proportionately greater effort is required to affect any significant changes in it.

Attentively, it may be argued that the sector, precisely because it is not identifiable and so little is known of its <u>modus</u>

operandi, is not readily amenable to policy incentives directly. The view is expressed that the sector embodies a type of economic activity that, although not marketed, has important repercursions on the agricultural sector. Moreover, the producer units in the market and non-market sectors of agriculture are identical and a distinction between them entirely spurious.

It may be argued that a decision regarding the proportion of total to be allocated between consumption and investment is based, assuming that supply is perfectly elastic and that institutional arrangements exist for products to be disposed on the market, on price incentives. An alternative view is that the behaviour of the sector is determined by what takes place elsewhere and that faster growth induces a movement out of the sector elsewhere.

It has been observed that output in the primary sector is responsive to market incentives and that such incentives must be stepped up substantially if the resources from the subsistence sector are to be released for development effort. The transfer will take place only when the rest of the economy is growing and thus generating higher demand for agricultural products via additional incomes. The overall strategy of development, particularly in agriculture, should be expected to provide a solution to the problem reducing the share of subsistence production, without any special measures in favour of the sector, provided the monetary sector is growing at a satisfactory pace.

An important qualification on the performance of the subsistence sector would be the level of capital formation that takes place and is not accounted for in the national account statistics. For example, improvements in dwellings, farms infra-structure (such as rural feeder roads and bridges) contributes to the overall capacity to enhance production. Yet this activity is not reflected in the available gross capital formation figures and to this extent, the share of subsistence sector may give misleading impression of a totally consumption-oriented production.

A number of hypotheses were formulated to clarify the role of subsistence output in the overall structure of the economy and following are some of the relationships tested:

$$OS_t = f_1 \left(N_t, \frac{GDP}{N}t\right)$$

$$OS_t = f_2 \left[\left(\frac{ONA}{OAGR}\right)t, t\right]$$

$$OS_t = f_3 \left[\overline{OS}_{t-1}, \frac{PAGR}{OY}\right]$$

where

OS = value added in the subsistence sector

ONA = value added in non-agricultural sector

GDP = gross domestic product

N = population

OA = value added in the agricultural sector

PAGR = price deflator, agriculture

PY = price deflator, GDP

Two equations, the first and third are discussed below. The first equation suggests that as the per capita incomes rise, the output of this sector will decline although the rate of decline will, to some extent, be offset by growing size of domestic market - that is, the subsistence production will continue to be related to population growth. The results of the equation, while statistically significant, showed only very general insight into its workings.

$$\log OBBS = \underset{(-1.412)}{.904} - \underset{(-1.517)}{0.400} \log \frac{GDP}{N} + \underset{(9.951)}{\log .904\ N} \quad (xi)$$

$$R^2 = .964$$
$$DW = 2.673$$
$$F = 178.000$$

The general inference that may be made from the equation is that while production in the sector will be positively associated with the growth in size of the market - that is, growth in population, it will decline through time in importance.

The third equation cited above suggests that if terms of trade in the agricultural sector are moving in favour of monetary agricultural output, subsistence output will decline - that is, the coefficient with respect to relative price variable is negative. Moreover, production in the subsistence sector can be viewed as a surrogate for consumption, and that the producers strive to at least maintain the level of overall consumption. These two variables are used explanatory variables and the results are as follows:

$$OSBS = \underset{(0.486)}{32.899} + \underset{(3.405)}{0.848}\ OSBS_{t-1} - \underset{(-0.118)}{8.318}\left(\frac{PAGR}{PY}\right) \qquad \text{(xii)}$$

$R^2 = .546$
$DW = 2.429$
$F = 7.616$

Although the price coefficient is not statistically significant, it is nevertheless of the correct sign. The equation was used for projection model since it is a reverse of the implied relationship for monetary agricultural output.

External Trade

(a) Exports:

Since Uganda's exports are entirely primary products, and her share in the total world exports of her major exports is low, its exports can be regarded as price taker in the world markets and changes in prices are unlikely to affect significantly the total volume of its exports. A detailed analysis of the destination of exports, taking into account preferences in each market and the market response to the exports from Uganda would be the only satisfactory way in which any significant pattern of exports could be inferred.

An alternative procedure, that of estimating an aggregate export function to non-EACM countries, is adopted here for the projection model; the problem of estimating export functions separately for the major export commodities was touched upon in Chapter I. The following regression fits were made and the

regression properties are briefly discussed:

$$XROW_t = f_1 (XROW_{t-1}, WX_t)$$

$$XROW_t = f_2 (XROW_{t-1}, PX_t)$$

$$XROW_t = f_3 (XROW_{t-1}, PX_{t-1})$$

$$XROW_t = f_4 (OAGRM)_t$$

where

XROW = value of exports to rate of world

PX = price of exports

WX = world exports index

OAGRM = monetary agricultural value added

The following estimates are of some interest and of the two, the first was chosen for the projection model since it forecasts somewhat better for the sample period.

$$XROW = \underset{(18.610)}{1.288\ OAGRM} - \underset{(-6.185)}{59.720} \qquad \text{(xiii)}$$

$R^2 = .964$
$DW = 2.150$
$F = 346.357$

$$XROW = \underset{(1.764)}{19.717} + \underset{(.255)}{.081\ XROW_{t-1}} + \underset{(3.104)}{.540} \qquad \text{(xiv)}$$

$R^2 = .926$
$DW = 1.881$
$F = 74.538$

The second equation exhibits a high degree of variance for the lagged export variable and is therefore rejected although it does bring out the demand effect in the world trade.

The equation (xiii) takes into consideration the supply side indirectly since it links export performance directly with production in the agricultural sector. It is expected that Uganda's export to the rest of the world will continue to be primary commodities and therefore, non-agricultural exports will assume greater relative importance but they will be destined for the EACM countries. Uganda is accorded preferential access to these markets and it is likely that the share of its exports to EACM will grow at a faster rate than to non-EACM.

An effort to estimate separate export functions by regressing exports against lagged monetary GDP in Kenya and Tanzania did not yield satisfactory results. It is observed from the following that variation in exports to Kenya and Uganda is largely attributed to a trend factor as follows:

$$XEACM = \underset{(2.234)}{3.582} + \underset{(9.645)}{1.816}\ T \qquad \text{(xiv)}$$

$R^2 = .876$
$DW = 1.297$
$F = 93.040$

For the projection model, a trend rate of growth of 6.5 per cent per annum was assumed for exports to EACM.

(b) Imports relationships:

Import data data is available in sufficient detail to classify them in two basic ways. First, imports from EACM are distinguished from the imports from the non-EACM countries. The latter are declining in importance relative to imports from the EACM and need to be distinguished since they are accorded preferential access to the markets of Uganda.

Imports from the rest of the world (i.e. non-EACM) are further classified according to end use. It is expected that in the future, the relative importance of various imports in this category is likely to alter considerably as industrialization gathers momentum and import substitution is extended to a wider range of goods. The analysis of imports is carried out with a view to tie it up as closely as possible with the evolution of other sectors; it is specified in the model as not only imposing constraints on the growth of the economy but also as reflecting the vital dependence on the rest of the economy.

A simple import function, relating imports to income, yields an elasticity that is lower though close to, 1 as follows:

$$\log M_t = \underset{(-0.765)}{-0.800} + \log \underset{(5.204)}{.941}\ GDPM_t \qquad \text{(xv)}$$

$R^2 = .667$
$DW = 1.677$
$F = 27.063$

(c) Capital goods imports:

Capital goods have been growing in importance over the years and currently constitute the biggest single category of imported goods in the economy. They depend essentially upon the level of capital formation taking place in the economy; since over a third of the capital formation is machinery and is entirely imported, it would be expected to exhibit a rather close relationship with the level of gross fixed capital formation in the economy. Equally plausibly, the level of capital goods would be expected to be determined by changes in the level of manufacturing activity. To "explain" the variation in capital goods imports during the period 1954-1967, the following regression was chosen for the model:[1/]

$$MCAP = \underset{(7.737)}{.454\ GFCF} - \underset{(-2.358)}{8.642} \qquad \text{(xvi)}$$

$R^2 = .819$
$DW = 2.115$
$F = 59.846$

As may be inferred from equation (xvi), the results are statistically significant and theoretically acceptable for projection purposes.

[1/] The regression of capital goods imports against value added in industry is as follows:

$$MCAP = \underset{(6.787)}{.909\ INDUS} - \underset{(-3.117)}{16.586}$$

$R^2 = .776$
$DW = .714$
$F = 46.068$

(d) Consumer goods imports:

It was noted in Chapter I that the share of consumer imports in Uganda is declining. This may be due to increased competition from EACM countries and/or due to greater domestic production of finished consumer goods. It would be instructive to determine whether, and to what extent, imports of consumer goods are complementary or competititve to imports from EACM. Moreover, the level of imports, being dependent on the level of consumption taking place in the economy, must be expected to reflect association between consumer spending and consumer imports. These considerations are reflected in a number of regression equations stated below in an attempt to obtain a fuller understanding of the pattern of consumer goods imports.

$$MCON_t = f_1 \left(MEA_{t-1}, \frac{Indus}{GDP}t\right) \qquad (i)$$

$$MCON_t = f_2 \left(\frac{PC_t}{PY_t}, CONS_t\right) \qquad (ii)$$

$$MCON_t = f_3 (DY)_{t-1} \qquad (iii)$$

where

MCONS = consumer goods imports

MEA = imports from East Africa

Indus = value added in industry

PC = price deflator, consumer goods

PY = price deflator, GDP

DY = disposable income

While all three yield quite satisfactory results, equation (ii) was chosen for reasons noted below.

As import substituting programme of industrialization is instituted, special measures in favour of the domestic industry have to be adopted; the most obvious first solution is to render imports of consumer goods prohibitive. This is done through tariffs or other fiscal means to render them relatively expensive. The existing arrangements accord domestically produced goods some advantage in any case; the level of effective tariffs is likely to be higher than the nominal tariffs and in consequence, relative prices would be expected to be important determinants of the consumer goods imports.

In addition, the level of total consumption would be an important determinant of imports; as incomes rise and consumption increases, it is spilled over into increased import demand. These two considerations are noted in the following regression that attempt to explain consumer imports in terms of relative import prices and the level of consumption spending as:

$$\frac{M\ CON}{P\ CONS} = 84.985 + \underset{(1.910)}{.056\ CONS} - \underset{(-2.145)}{73.614}\frac{PM}{PY} \quad \text{(xvii)}$$

$$R^2 = 2.43$$
$$DW = 1.920$$
$$F = 3.098$$

While the multiple correlation coefficient is low, the coefficients are statistically significant and of the correct sign.

Of particular interest is the relative price coefficient and the coefficient sign associated with it. The coefficient exhibits a high degree of sensitivity to changes in relative import prices.

(e) Producer goods imports:

This category of imports refers primarily to raw materials and construction goods which are among the more important intermediate goods. It was noted in Chapter I that this category of imports has been declining in relative importance due to a number of reasons. While there exists a wide range intermediate producer inputs whose demand would continue to expand, it is also the case that this category of goods are among the easiest to produce domestically; they range from building materials such as cement, asbestos, etc. to simple metal frames and boxes. Since producer goods are essentially intermediate construction inputs, we would expect demand for such imports to be closely determined by the level of capital formation. On the other hand, as industrial expansion takes place and due to the size of domestic demand, it becomes feasible to manufacture them domestically. As this process materializes, the level of producer imports would be expected to decline. These considerations lead to a regression equation that attempts to "explain" producer imports in terms of a positive association with the level of capital formation and a negative one with respect to lagged monetary GDP. The results of the regression are given below:

$$\underset{}{MPROD} = \underset{(5.684)}{41.792} + \underset{(4.079)}{.594}\ GFCF - \underset{(-3.425)}{.154}\ GDPM_{-1} \qquad \text{(xviii)}$$

$$R^2 = .585$$
$$DW = 1.654$$
$$F = 8.775$$

The regression coefficients remain significant at more than 1 per cent level and there is evidence of absence of any serial correlation in the equation. The equation is used for the projection model.

(f) Imports from EACM:

Imports from the EACM countries are likely to continue to increase their share in Uganda's total import bill, as industrialization proceeds in the EACM countries, many of the capital and consumer goods heretofore imported from non-EACM countries will be supplied by the trading partners.

It would be expected that if imports from EACM have been competitive rather than complementary, we would expect a positive association of EACM imports with non-EACM imports in the latter case and the reverse to be true in the opposite case, other things being equal. To determine whether and to what extent EACM imports were competing with non-EACM imports, regression between EACM imports and two independent variable - the level of non-EACM imports and the level of manufacturing output was attempted as follows:

$$\underset{}{MEA} = \underset{(11.802)}{.988\ OMFG} - \underset{(-1.373)}{0.103\ MROW} - \underset{(-2.476)}{11.437} \qquad \text{(xix)}$$

$$R^2 = .944$$
$$DW = 1.818$$
$$F = 110.687$$

The results suggest that imports from EACM (MEA) appear to be complementary with manufacturing output (OMFG) but compete with

imports from the rest of the world (MROW). The coefficient of multiple determination is high and the value of the Durbin-Watson test indicate lack of any special correlation; moreover, the signs of the coefficients are expected but statistically unsatisfactory in the case of the MROW coefficient as evidenced by a low 't' value.

The above specification was therefore rejected in favour of a simpler demand relationship that takes into consideration lags in determining current import levels. EACM imports are "explained" in terms of monetary GDP, lagged one year as follows:

$$MEA = \underset{(-4.775)}{-38.535} + \underset{(7.973)}{.198}\ GDPM_{t-1} \qquad (xx)$$

$R^2 = .839$
$DW = 1.398$
$F = 4.056$

The statistical properties of equation (xx) are quite satisfactory and is used for the projection period in preference to equation (xix).

The marginal import propensity $\partial MEA/\partial GDP_{t-1}$ of almost .20 is greater than other import categories and in all probability will increase through the projection period.

Miscellaneous relationships:

(a) Public revenue and expenditures:

The share of public revenue in total GDP has been growing at a rapid rate - between 1960 and 1967 the per capita tax revenue has nearly doubled. The exigencies of a growing development

budget has clearly necessitated greater domestic effort at mobilizing resources for development. During the period, the share of indirect taxes in total revenue appear to have increased, indicating that fiscal measures have in all probability have had some redistributive effects in favour of the relatively higher income groups in the economy. Instead of deriving separate explanatory relationships for different tax categories, an overall relationship was derived to obtain a measure of tax elasticity.

Tax elasticity is a measure of the government's efforts to channel growing resources for enhancing the public sector and overall development effort. Uganda's efforts in this direction have been noteworthy and its performance, in terms of tax effort, compares more than favourably with that of other developing countries.[1/] The following equation indicates an elasticity of the order of 1.4 at the margin.[2/]

$$\log PBREV = \underset{(-6.226)}{-4.064} + \underset{(12.785)}{\log 1.443\ GDP} \qquad \text{(xxi)}$$

$R^2 = .926$
DW = 1.578
F = 163.441

[1/] See "The Measurement of Development Effort" (United Nations publication, Sales No. E.71.II.D.4).

[2/] For the projection model, however, a linear relationship was used. This equation yields the following results:

$$PBREV = \underset{(14.564)}{.336\ GDPM} - \underset{(-4.684)}{36.132}$$

$R^2 = .942$
DW = 1.606
F = 212.193

(b) Miscellaneous relationships:

The relationships derived with respect to some of the external trade variables need to be completed to obtain a fuller idea of the likely trade pattern that would emerge by the end of the projection period; in particular, consideration would have to be taken of the trends in net factor income receipts and trade in services over the projection period. Both these would additionally enable an estimate of these two-gap hypothesis which is based on the necessary relationships between certain variables such as investment and imports with the rate of growth of output and on the other hand, the limits to the attainment of other variables such as domestic savings and exports. The difference between import requirements and export potential represent the "trade gap" and the difference between investment and savings represent "resource gap" - the two gaps are in national accounting terms equal ex post.

To estimate the trade gap, we have to include in the overall resource availability the earnings and expenditures from services and net from factor income earnings. Algebraically,

$$GNP = C + I + X - M \qquad (i)$$

$$GNP = C + S \qquad (ii)$$

$$FS = I - S \qquad (iii)$$

$$FS = M - X \qquad (iv)$$

where:

GNP = gross national product

C = consumption

I = investment

X = export of goods and services

M = import of goods and services

F = net foreign inflow

The presentation of the two "gaps" in the above brings out the importance of net foreign inflow in bridging the two gaps and making them equal in such models.

To obtain a further picture of the resource gap implied by different rates of growth, we have separated the factor income component of invisible earnings and attempted to obtain separate regressions for factor earnings and expenditures without success. Therefore, a simple trend relationship was fitted to the invisibles variable and the net factor was regressed against GDP. The results are given below:

$$FY = \underset{(-10.512)}{-24.269} + \underset{(14.042)}{.086}\ GDPM \qquad \text{(xxii)}$$

$R^2 = .937$
$DW = 2.643$
$F = 197.200$

$$INVIS = 7.513 + 3.388\ TIME$$

$R^2 = .938$
$DW = 2.643$
$F = 200.242$

where

FY = net factor income

INVIS = net invisibles

Chapter V

Application of the Model

The set of empirical relationships we have derived may be used in the context of an econometric model or on their own as describing structural characteristics of the Uganda economy during the period 1954-1967. The single equations, during the construction phase, serve as testing devices for the alternative components of the system. The system of relationships can be employed, if properly formulated, to project growth patterns of the economy and indicate the measure of the effort required to meet certain policy objectives. The model so developed can be put to a large number of uses depending on the predictive ability of the model, its logical ordering and suitability of a framework in which to integrate ramifications of various policy goals.

For example, if a certain growth rate of the economy is set as a desired policy goal, the impact of such a target on savings, consumption, sectoral production, external trade, net foreign capital inflows, fiscal measures, etc., would necessitate a solution of the entire system of relationships simultaneously. This is done, in practice, by substituting all lagged values of dependent variables for periods prior to the intital projection date. As the simulation proceeds, the computed values of the lagged endogenous variables become inputs for the projection period. In addition, values have to be assigned to exogenous

variables that are given as data; with given lagged endogenous variables and exogenous variables, it is a relatively straightforward matter to solve the model as a system of finite difference equations and a number of convenient computation methods are available to do so. Before we come to the actual solution of the model, and discuss its various properties, a number of general observations may be made about methodology.

In the reduced or projection form, each endogenous variable is expressed explicitly as a linear function of all the predetermined variables, (that is, lagged endogenous and exogenous variables). Symbolically, we may state:

$$Y_t = \sum_{i=1}^{n} \Pi i \; X_{jt} + V_t$$

Where Y_t represents endogenous variables, X_{jt} to the predetermined variables and Π_i to the reduced form coefficients and V_t for the reduced form residuals.

In our model, we are interested in determining future values of (Y_t), the endogenous variables. In the model the predetermined variables are those that determine economic change. In a policy model, elements of which were outlined in Chapter II, the predetermined variables can be classified into those variables are that are given (or data) and which the policymaker can do little to affect or variables which can be controlled by the

policymaker. In a strictly policy model, it is the relationship between controlled and endogenous variables that is important since they demonstrate the influence, if any, of the policymaker to affect and alter economic magnitudes. An important use of such a specification is to enable a comparative evaluation of various alternative policies.

The equation above may be generalized in a matrix form as $Y = \hat{\Pi} X$. Differentiating with respect to X, we obtain $\frac{\partial Y}{\partial X} = \frac{\partial \hat{\Pi} X}{\partial X} = \hat{\Pi}$. In terms of finite differences, the elements of the matrix express the ratios.

$$\frac{\Delta y_i}{\Delta x_j} = \Pi ij$$

and therefore, $\Delta y_i = \Pi ij . \Delta x_j$ which means that the Π's are multipliers of the predetermined variables. These multipliers are often referred to as impact multipliers since they show the effect on the endogenous variables which occur in the first year as a consequence of a unitary change in the predetermined variables.

Before the model is put to use for analysing either the consistency of the Second Plan targets or the growth patterns of the economy through to the year 1980, the predictive ability of the model has to be estiablished. Indeed, the entire exercise rests on the ability of the model to predict with an acceptable

degree of accuracy for the sample period 1954-1967. What degree of accuracy is acceptable depends on the type of model constructed, the use it is to be put to and the characteristics of the economy the model purports to describe. In a short-term forecasting models of the type used extensively in the United States, a high degree of forecasting ability is necessary and often realised whereas for projection purposes, only the broad pattern of the behaviour of the variables to be projected is of interest. Moreover, models of developing economies are likely to embody greater prediction errors due in part to the methodological difficulties discussed in Chapter II and the poor quality and range of statistical information available. In a relatively simple model with few aggregate varialbes to be predicted the level of predictive ability would have to be high, even when such models are developed for developing countries.

The structural estimates obtained from the statistical examination of the economy for the period 1954-1967, together with 't' values (in parenthesis), of the coefficients, values of multiple correlation coefficient adjusted for degrees of freedom and Durbin-Watson test (DW) and F values are presented below. The 29 equation model was simulated for the period 1954-1967, using actual exogenous variables and lagged endogenous to obtain

an indication of the predictive ability of the whole model for the sample period. The model is presented below:

Structural Equations	R^2	DW	F
1(a). $GDPM = \underset{(4.641)}{130.228} + \underset{(7.516)}{1.593}\ X_{t-1}$	.822	1.779	56.501
1(b). $GDPM = \underset{(20.486)}{239.913} + \underset{(9.243)}{.245}\ \Sigma CI_{t-1}$	.875	1.098	85.448
2. $CONSM = \underset{(-1.348)}{-22.168} + \underset{(16.729)}{.824}\ GDPM$	.955	1.599	279.888
3. $GFCF = \underset{(3.072)}{82.121} + \underset{(6.692)}{.287}\ GDPM_{t-1} - \underset{(3.796)}{122.492}\ (PI/PY)$	.927	2.280	64.800
4. $OAGRM = \underset{(-1.327)}{-53.531} + \underset{(1.834)}{75.928}\ \left(\frac{PAGR}{PY}\right) + \underset{(8.972)}{.968}\ OAGRM_{t-1}$	.927	2.280	64.840
5. $Oludus = \underset{(-2.670)}{-26.649} + \underset{(10.686)}{.139}\ \Sigma IMFG + \underset{(4.950)}{.557}\ L$	.930	1.457	32.400
6. $OPBS = \underset{(.162)}{.958} + \underset{(7.207)}{.130}\ GDPM_{t-1}$	.809	2.451	32.412
7. $OTRA = \underset{(-2.795)}{-5.507} + \underset{(11.634)}{.070}\ GDPM_{t-1}$	.918	1.720	32.600
8. $OCST = \underset{(1.931)}{5.021} + \underset{(2.904)}{.100}\ GFCF$	.412	2.039	11.631

	R^2	DW	F
9. $OSBS = \underset{(0.486)}{32.899} + \underset{(3.405)}{0.848}\ OSBS_{t-1} - \underset{}{8.318}\ (\frac{PAGR}{PY})$	.412	2.039	11.631
10. $XROW = \underset{(-6.185)}{-59.720} + \underset{(18.610)}{1.288}\ OAGRM$	.964	2.150	346.357
11. $XEA = \underset{(2.234)}{3.582} + \underset{(9.645)}{1.816}\ T$	.876	1.297	93.040
12. $MCAP = \underset{(7.737)}{.454}\ GFCF \underset{(-2.358)}{-8.642}$	.819	2.115	59.846
13. $MCONS = \underset{(1.361)}{84.985} + \underset{(2.321)}{.056}\ CONSM - \underset{(-2.145)}{73.614}\ (\frac{PM}{PY})$	.243	1.920	3.098
14. $MPROD = \underset{(5.684)}{41.792} + \underset{(4.079)}{.594}\ GFCF - \underset{(-3.425)}{.154}\ GDPM_{t-1}$	.585	1.654	8.775
15. $MEA = \underset{(-4.775)}{-38.535} + \underset{(7.973)}{.198}\ GDPM_{t-1}$	.839	1.398	4.056
16. $PBREV = \underset{(-4.684)}{-36.132} + \underset{(14.564)}{.336}\ GDPM$	.942	1.606	212.193
17. $INVIS = \underset{(2.614)}{7.513} + \underset{(5.313)}{3.388}\ T$	.938	.336	200.242
18. $FY = \underset{(-10.512)}{-24.269} + \underset{(14.042)}{.086}\ GDPM_{t-1}$	.934	2.643	197.200

Definitional Equations and Identities:

19. GDPT = GDPM + OSBS

20. CONSMT = CONSM + OSBS

21. MROW = MPROD + MCONS + MCAP

22. M = MROW + MEA

23. X = XROW + XEA

24. OSRV = GDPT - OSBS + OAGR + O INDUS + OPBS + OCSTR + O TRANS

25. DS = GDPM - CONS M

26. FS = GFCF - DS

27. FG = X - M + (MS - XS) + FY

28. $CI_t = \acute{\Sigma} CI_{t-1}$ + GFCF

The actual values of main variables, together with values of the variables predicted by model simulation are presented below.

It will be observed from Table 1 that the range of predictive ability varies considerably. For monetary GDP, the prediction error is just over -1 per cent for 1966 and +2 per cent for 1967, whereas for fixed capital formation, it is +22 per cent for 1966 and +2 per cent for 1967. The average range of error is considerably less than 10 per cent and much less than that for the important variables. Later on, in

Table I

A comparison of model with actual solutions
(million U.S. $)

Main variables	1966		1967	
	Actual	Model	Actual	Model
GDP, Monetary	429,830	425,331	439,100	448,587
Subsistence	149,800	149,839	154,300	153,975
Total GDP	579,640	575,170	598,770	602,562
Consumption Monetary	363,179	331,582	347.621	339,211
Gross Fixed Capital Formation	75,040	92,021	94,920	97,311
Value Added, Industry	49,470	51,639	52,950	57,780
Value Added, Public Sector	55,420	56,836	55,412	58,041
Value Added, Construction	10,320	14,223	11,180	14,752
Value Added, Transport	22,016	25,011	25,424	25,669
Exports, East Africa	24,770	27.190	34,920	29,006
Exports, Rest of World	156,460	171,443	179,190	176,935
Exports, Total	182,130	198,633	214,110	205,941
Imports, East Africa	43,178	42,699	37,534	46,399
Imports, Rest of World	105,042	101,580	101,678	102,957
Imports, Total	148,220	144,279	139,212	149,356

Table III, the projection values are compared with those realized since 1967 and on the basis of the two exercises, the results are believed to be acceptable for our purpose.

Elsewhere, we have already observed that Uganda's Five Year Plan is based on the assumption that an average incremental capital output ratio of 2.7 prevails through the period 1966-1971. Two implications of this assumption, not spelled out in the Plan, may be explicit before an effort is made to compare the plan projections with the model projections: the first of these assumptions relate to the savings effort; the plan implies an average investment/GDP ratio of 19.5 to sustain an average rate of growth of 7.2 per cent per annum. The marginal capital output ratio estimated by cumulating gross capital formation and regressing it with monetary GDP[1/] is 4.0 per cent. If we accept this ratio as the one that has prevailed in Uganda during the period 1954-1967 instead of the one assumed by the Plan, an unprecedented investment ratio of almost 29 per cent would be implied in sustaining a growth rate of 7.2 per cent per annum. While it is possible to identify conditions under which such a ratio may be attainable,[2/] it is by no means

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1/ See Chapter III.

2/ It is possible to assess the capital inflows required in meeting the resource gap, the difference between capital formation and domestic savings, in the so-called two gap model discussed in Chapter III.

easily attainable. Indeed, the information available suggests that during the period 1966-1969, the average has been 16.6 per cent. The actual growth rate during the period 1966-1970, on the other hand, has been 4.3 per cent at fixed prices - far below the rate targeted for in the Plan and closer to the histroical experience.

Using Variant 1 of the basic model - where GDP is determined by a production function with a stock of capital, K, as the only factor of production, the level of GDP that emerges through to 1980 is indicated in Table II below. At an unchanged marginal capital-output ratio of 4, the basic determinant of the capital stock is the rate of accumulation. We have incorporated the assumption that public authorities would undertake considerable efforts to render a high investment ratio possible through fiscal and other policy inventives. The rate of capital accumulation is determined by an exogenous price variable and a lagged endogenous variable, the level of gross domestic product in the monetary sector. Given the two predetermined variables - relative investment prices and lagged GDP - the following growth path of GDP is obtained.

A factor in this has been the stagnant growth of Uganda's export performance - their value remained constant between 1966 and

Table II

Year	GDPM[1/]	GFCF	GFCF/GDP	K[1/]
1968	471.305	96.952	0.206	948.682
1969	473.833	106.772	0.225	1055.453
1970	495.643	107.153	0.216	1162.606
1971	520.350	113.865	0.219	1276.471
1972	547.840	121.379	0.222	1397.850
1973	578.016	128.863	0.223	1526.712
1974	610.797	137.919	0.226	1664.631
1975	646.118	147.619	0.228	1812.250
1976	683.929	158.029	0.231	1970.279
1977	724.193	169.135	0.234	2139.414
1978	766.885	180.927	0.236	2320.341
1979	811.993	193.330	0.238	2513.671
1980	859.518	206.415	0.240	2720.085

1/ ΣGFCF. Values are in '000 U.S. dollars at 1960 prices.

and 1968 and increased by about 4 per cent between 1968 and 1969. While national accounts data is not available beyond 1969, it is clear that the growth path of the economy as projected by the model is closer to the realised path than that postulated by the Second Five Year Plan as the following table suggests.

Table III

Monetary Gross Domestic Product at Fixed Prices[a/]

Year	Actual[b/]	Model[c/]	Plan[d/]
1966	429,830	425,331	429,830
1967	439,100	439,100	460,777
1968	447,003	454,111	493,952
1969	505,113	483,177	529,516
1970	505,600	513,811	567,641
1971	n/a	547,076	608,511

a/ All values in '000 U.S. dollars at fixed 1960 prices.

b/ For 1969 and 1970, the values, respectively, are official estimates and forecasts.

c/ Based on Variant 1 of the basic model.

d/ The Second Plan, 1966-1971, values have been obtained by applying the planned growth rate to the actual 1966 value.

A detailed comparison of the structure of the economy as it emerges through the model's growth path and the path assumed in the Plan is rendered difficult since relatively little data is available in the Plan to indicate savings, capital formation and external trade relationships as they emerge by 1981. Indeed, apart from an assessment about the Perspective Plan little additional data is available to make any detailed comparison possible. If, however, the growth rate of 7.2 per cent assumed in the Plan is applied to our model, the structure that emerges as a result of such an assumption about growth is compared in Table IV below to the growth path that seems attainable in the context of the model developed in Chapter III and the path postulated by the Plan.

The wide divergence between the Plan targets and the model and the actual (realized) values raises serious questions about the feasibility of the Plan which from its inception is failing to meet its targets. The reason for this may be attributed to an unrealistic assessment of domestic production potential, optimistic assumptions about export and foreign aid availability and the failure to take into account administrative and manpower constraints. The structure of the economy as conceived in the Perspective Plan[1/] and as it emerges in the projection model is compared below in Table IV with a view to assess the overall consistency of the plan targets.

[1/] See Work for Progress, op. cit.

Table IV

Comparison of model solutions with actual and plan targets

Per cent of GDP	1966		1971		1981	
	Actual	Model	Model	Plan	Model[a/]	Plan
Agriculture	38.8	39.8	41.2	37.5	40.8	35.8
Industry	14.4	13.3	18.1	16.4	21.1	18.0
Public Sector	12.0	11.9	12.3	12.3	12.4	12.2
Subsistence	34.8	33.6	32.7	29.4	24.5	19.6
Transport	5.1	4.9	5.7	5.7	6.1	6.1
Exports	42.3	42.8	50.4	46.0	46.4	48.9
Imports	34.4	33.9	30.3	32.9	31.2	31.0
GFCF	17.5	18.9	21.9	21.4	24.0	24.3

Source: Statistical Abstracts, Ministry of Planning, Entebbe, various issues.

a/ Refers to 1980.

The rate of GDP growth implied between 1968 and 1980 is 5.1 per cent per annum - considerably below the optimistic Plan assumption of 7.2 per cent per annum between 1966 and 1981. The model solution and its underlying assumptions may be criticised on the basis that the implied marginal capital output ratio is greater than that prevailing in developing countries at Uganda's stage of development. While this is true, it, nevertheless has to be borne in mind that in Uganda, large overheads ranging from transport, electricity power and social services impart a major pressure on the productivity of capital in the short run. Moreover, considerable excess capacity is expected to emerge due to lags in gestation of investment projects with the consequence that capital output ratio may even increase through time; such an increase has been frequently noted for other developing countries in the past and therefore the assumption of a falling capital output ratio over a period as short as a decade seems unwarranted. It would be preferable, however, to examine the growth path of the economy in the context of a model that does not rely on a simple production function of the form $GDP_t = f(K)_{t-1}$.

Any assessment of the future growth of the economy has to take the basic structure of the economy into account and formulate future development strategies on the basis of that strucutre. This does

not mean that the projection is cast entirely on the basis of present characteristics of the economy and is a purely mechanical exercise. By allowing appropriate policy changes or alternative targets of growth, it is possible on the basis of our empirical investigations to examine the future performance of the economy and various alternatives to it. However, this necessitates a clear identification of the important characteristics of the economy; the specification strategic sectors, their effect on the rest of the economy and the model's ability to predict for the sample and projection period. In what follows we outline the projections of a model that is believed to capture the basic structure of the economy; that is able to forecase with acceptable accuracy during the sample period and the one that is specified in such a way that the implications of alternative policies can be examined.

From Chapter I and III, two salient features of the economy are brought out by our investigations. It is observed that the economy is predominately agricultural - with characteristics typical of the sector in other developing countries. Nearly half of the total output is consumed by producers, the rest being marketed in rural and urban areas and exported abroad. The commodities that are exported are not consumed domestically in any case and therefore

the largest component of marketed agricultural surplus is for export. It has also been noted that total export income constitute nearly half of the monetary gross domestic product. This income, the most important single source of income to the population and one of the major sources of revenue for the government, determines the pact of activity in the rest of the economy.

The link between agricultural performance and export performance is the most important single characteristic of the economy; exports translate domestic agricultural production into incomes; the peasant oriented mode of production ensures, through the export multiplier, that the effects of changes in production are rapidly transmitted to the rest of the economy. Admittedly, export price movements weaken to some extent the link between supply and incomes; the instability of export prices result in remuneration to growers that does not often reflect domestic efforts.

The basic ordering of the model is such that a number of key relationships determine directly or indirectly the growth trajectory of the economy. Agricultural production in the monetary sector is, as has been discussed in Chapter III, determined by two factors - relative agricultural prices and level of its own output in the preceding year. Agricultural production, in turn, determines the growth of exports to the rest of the world. These exports

consist almost entirely of primary commodities and therefore closely related to the performance of the agricultural sector. Export performance in the previous period in turn, determine the current level of output in monetary GDP.[1/] The latter in turn determines the level of capital formation, consumption and savings, and demand for services in the rest of the economy. The level of incomes is an important determinant of consumer imports and producer and capital goods inputs. The latter is related to the capital formation and the former is related positively to GDP and negatively to GDP, indicating some import substitution in this category of imports.

The propensity of consume and its reciprocal, the propensity to save indicate, given the level of capital formation, the foreign resources that would be required to close the resource gap. A number of miscellaneous relationships, pertaining to taxes, invisible trade and factor income payments, generally demand determined, close the model.

The simulation path depends on the assumptions we make pertaining to agricultural pricing policies. If a strategy of growth that relies on diversification and relatively greater emphasis on expansion of production in the non-agricultural sector is assumed,

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1/ The mechansim of the export multiplier has been noted in Chapter I.

a pricing policy that leaves the strucutre of existing prices unaffected may be the most obvious assumption to make.

Alternatively, a strategy of growth that relies on agriculture based export expansion would require effort to render agricultural production attractive through providing relatively attractive prices for agricultural production. Two paths may be assumed in the Second Strategy; first, a "moderate" effort of rewarding suppliers may be assumed or alternatively a vigorous effort at enhancing agricultural output may be assumed.

The solution of the model under the two alternative assumptions is compared below. The table indicates the growth path of the major macro variables and compares the structure of the economy as it emerges under the two alternative assumptions of model II.

From Table V, a number of clear patterns emerge; the structure of the economy, with one or two important exceptions, does not differ much between the two strategies as observed in the different share of non-monetary output, agricultural output, resource gap, and industrial share. A number of variables - share of public and service sector, the investment ratio, average import coefficient exhibit remarkable stability.

The share of the non-agricultural sector does not alter

Table V

Variable	Moderate growth	High growth
Rate of growth, 1969-1980		
GDP	4.5	6.7
Consumption	4.6	6.0
Agriculture	4.9	6.4
Public Sector	4.7	4.9
Industry	7.6	8.0
Subsistence	2.6	2.5
Transport	5.5	6.7
Exports	6.3	7.7
Imports	5.0	6.1
Structure of Economy, 1980 (Share of GDP)		
Agriculture	40.0	42.4
Capital Formation	24.0	24.0
Industry	22.3	20.1
Subsistence	28.3	23.3
Services	15.6	16.0
Exports	56.0	58.0
Imports	31.3	31.1
Public Sector	12.5	12.3
Tax Revenue	20.2	22.0
Resource Gap (Mln. $)	29.2	36.8

significantly and confirms our hypothesis that the agricultural sector will continue to play a dominant role in the future growth of the economy. To diversify the structure of production, an unprecedented increase in the output of the non-agricultural sector would be required - an effort that appears, based on our investigations, almost impossible to materialize. On the other hand, realization of an exceptionally fast growth in the non-agricultural sector is predicated on the performance of the agricultural sector. Output in the former is dependent on the level of income generation in the agricultural sector and a strategy of growth that fails to take this into consideration is likely to fail.

Under both assumptions, a resource gap emerges and implies a considerable inflow of foreign capital to bridge the gap. This finding differs from findings in UNCTAD secretariat's study[1/]. In the UNCTAD study, a resource gap does not emerge at growth rates of GDP of less than 7 per cent. Our own investigations show that a resource gap, based on the past savings performance, emerges after a growth rate of over 4.5 per cent per annum.

The visible trade balance continues, on the other hand, to remain in Uganda's favour through the period but is increasingly

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1/ Trade Prospects and Capital Needs of Developing Countries, op. cit., Table IX.2

offset by a growing invisibles imbalance.

The average import coefficient is fairly stable through to 1980 but a number of significant changes in its composition emerge. The share of producer goods in total imports decline as do consumer goods under both modest as well as high growth assumptions. This decline is offset by increases in the share of imports from East Africa and capital goods imports. Under the assumptions of high agricultural growth, the share of East African exports falls whereas the reverse takes place in the case of a moderate growth.

The fiscal structure as it emerges by 1980 is of some interest. While the average tax ratio declines somewhat from 23.8 to 21.7 between 1968 and 1980, the dependence on indirect taxes as a major source of revenue diminishes - the share of direct tax in total tax rising in both cases by 10 percentage points from 52 per cent to 62 per cent.

The share of capital formation remains at 24 per cent in both cases. This is due to the dependence of capital formation on relative investment goods prices, which are assumed to be instrument variables amenable to policy decisions. The second determinant of capital formation is level of lagged GDP and since a smooth growth trajectory is obtained in either case, capital formation continues to increase at a steady pace.

In the model, the industrial sector is assumed to grow independently of the overall growth although since it is based on a production function embodying a stock of capital, it is indirectly dependent on GDP. It is assumed that 28 per cent of total gross fixed capital formation is channeled to the industrial sector. This implies a sustained effort to attract resources, through tariff, fiscal and monetary incentive, to the industrial sector. In view of the strong possibilities for import substitution that we have observed, the sector is in a position to grow at fairly rapid rates and the growth assumed in the Plan is close to the model projection.

In considering the two versions of the model and its numerous variants, a number of 'robust' findings emerge. First, that the projections of the Perspective Plan are highly optimistic and nearly impossible to realise even under the optimistic assumptions of a sustained agricultural growth.

Secondly, the growth rate, under numerous alternative assumptions relating to key variables such as savings, capital inflows, export performance, agricultural growth and capital output ratios continues to remain stable between 4.0 and 6.7 per cent, with a likely rate given considerable development effort emerging somewhere in between - that is, somewhat higher than historical

rate. Given the most optimistic assumptions, per capita GDP barely rises from $51 in 1968 to $69 by 1980. The comparable levels if the Perspective Plan target is from $51 to $82. It is our contention that per capita GDP in the monetary sector will be a little over $60 at 1960 prices.

Thirdly, considerable import-substituting growth is feasible with imports from EACM countries replacing to a significant extent goods from non-EACM countries. Exports, on the other hand, are largely assumed to be constrained by domestic supply and likely to become important as greater domestic effort is directed to enhance agricultural output by making production and marketing more attractive.

Fourthly, the structure of the economy does not alter perceptibly. The kind of economic transformation envisaged in Work for Progress[1/] is not likely to materialize. It may be noted, on the other hand, that the economy continues to be monetized, with a significant decline in the subsistence sector's share of GDP.

Fifth, the average consumption share exhibits a tendency to increase through time, suggesting an increasing dependence on foreign capital inflows to supplement domestic resources.

1/ Op. cit.

Chapter VI

Summary and Conclusions

1. This study has threefold objectives; first, to examine the performance of the Uganda economy during the period 1954-1967. Secondly, to estimate the strucutral coefficients of the economy and based on such coefficient, construct a projection model for the economy. Finally, to test the model for its predictive ability; to carry out some policy simulations and to test the internal consistency of the 15 year Perspective Plan, the first phase of which is the Second Five Year Plan, 1966-1971.

2. The evolution of the economy during the period 1954-1967 may be summarised as follows:

(a) The growth of the economy has been uneven; the period of a high export led growth in the early 1950s was followed by relative stagnation during the mid-1950s and early 1960s. During this period, exports, imports, and capital formation stagnated; the vicissitudes of political changes and volatile expectations were contributing factors. Prices, too, stagnated further indicating deflationary tendencies following the upsurge in capital formation associated with railway and power dam construction in the mid-1950s. Rate of growth of employment has failed to keep up with the rapid growth in population. The latter has been growing at an exceptionally high rate, curtailing savings efforts and necessitating investments in social overheads. So far, there has

been a manageable urban labour force growth but it is anticipated that as output in the agricultural sector expands, the pressures on the growing labour force will increase. Public expenditure has increased sharply during the 1960s but is observed to be increasingly devoted to consumption.

(b) The external sector has been noted for its volatility; exports have grown at an uneven pace but throughout the period, Uganda has enjoyed a surplus on commodity account; with a substantial deficit emerging in the service account, it has necessitated a running down of reserves accumulated from the export booms of early 1950s. While imports have been growing at a modest rate, there is a clear tendency for them to fluctuate sharply with exports. The change in the composition of imports has been noteworthy; imports from East Africa, mainly consumer and producer inputs, have increased their share at the expense of producer goods from non-EACM countries. Capital imports have grown sharply over the period and now represent, as a group, the most significant single import category. Exports have been diversified by destination but not by commodities with the exception of exports to EACM which are essentially non-primary.

(c) Consumption in the monetary sector has grown but at a rate barely higher than population growth whereas production and therefore consumption in the primary sector has grown at a little less than growth in population. Change in per capita consumption, viewed as an indicator of change in welfare, has been rather modest.

(d) Since 1966, the government has embarked on a relatively comprehensive effort to alter the structure of production in the context of a long-term perspective plan aimed at doubling per capita monetary incomes. However, the available evidence suggest that many of the Plan targets are overly ambitious.

(e) During the same year, the government concluded a formal treaty with Kenya and Tanzania establishing qualified common market arrangements between them and formalizing previous arrangements which were vested in the East African Common Services Organization.

3. The statistical analysis of the economy confirm a number of hypothesis that were tested with a view to incorporate them in the framework of a projection model which could be used for policy analysis. Among the relationships tested and examined were:

(a) The determinants of GDP, consumption, investment, exports, imports and sectoral demand and supply.

(b) Impact of price changes on demand, production, investment and imports.

(c) The impact of alternative rates of export growth and accumulation on the structure of output.

(d) Resource requirements at different levels of demand.

(e) The significance of EACM trade on the future evolution of the economy.

4. The empirical analysis of the economy was carried out using methods of multiple regression, based on a sample of 14 years with variable measured in 1960 fixed prices. Our investigations support the view that prices have played an important role of determining the overall performance of the economy. Agricultural producers, investors and consumers exhibit substantial sensitivity to price changes and justify the use of prices as instrument variables in a projection model. It is also inferred that supply relationships are of greater interest and of policy significance than simple demand relationships. We have attempted to examine output of two strategic sectors, agriculture and industry, in a supply and production model and this effort has been successful. Investment decisions are viewed as being determined endogenously, although subject to policy incentives. External trade relationships have been formulated, on the one hand to take cognizance of the close association between exports and agricultural supply and on the other, to take into account import substituting growth as a result

of growing industrial sector.

5. The system of relationships have been solved and under alternative assumptions projected through to 1980. The important conclusions of the simulation exercises are:

(a) The growth potential of the economy is exaggerated in both the Second and the Perspective Plan.

(b) Under the most optimistic assumptions, a growth rate of 6.7 per cent is attainable provided numerous conditions pertaining to savings and investments, export performance and external finance are fulfilled. It is the conclusion of this study that such conditions are unlikely to materialize and therefore the best that can be hoped for, given sustained development effort, is a rate of GDP growht of about 1 percentage point above the historical rate of 4.0 per cent per annum. In any case, the structure of the economy does not alter appreciably, even assuming that the fast growth rate of the Plan materializes.

6. The projection model is aggregative and therefore of limited use for detailed economic planning. For this purpose, it would have to be supplemented by an inter-industry matrix and detailed sectoral analysis. It is, however, useful in tracing growth paths of the economy under alternative assumptions about the behaviour of invest

of strategic variables in the economy.

7. While the model does not predict with the degree of precision in short-term forecasting models of developed economies, its projections can be accepted, on the whole, with an acceptable level of error.

8. A number of limitations of the model may be outlined; first, it does not embody a monetary sector and fails to treat prices endogenously. In a model that depends on price relationships for a number of key conclusions, this weakness is obvious. Production relationships are too aggregative and the statistical findings may alter significantly if a disaggregated analysis was attempted - particularly for the major agricultural and export commodities. Production functions using cross section data from census of industry would improve the model considerably. A detailed analysis of the public sectors role would also seem to be an essential ingredient of a policy and planning model. Public savings and investment and consumption behaviour would be among the important relationships that would enhance applicability the model.

Selected Bibliography

1. Abraham, W.: "Growth and Composition of Malayas Capital Stock", Malaysian Economic Review, October 1966.

2. Adler, John: "The Budget and Public Expenditure Policy", in leading issues of Development Economics, ed., Gerald M. Meir (Oxford University Press, New York, 1964).

3. Ball, R.J.: "The Significance of Simultaneous Methods of Parameter Estimation in Econometric Models, Applied Statistics, March 1963.

4. Behrman, J. and Klein, L.R.: "Economic Growth Models for the Developing Economy", Induction, Growth and Trade, eds., W. Eltis, M. Scott and J. Wolfe (Clavender Press, London, 1970).

5. Belassa, Bela: Economic Development and Integration, (Centro de Estudios Monetarios Latinoamericanos, Mexico, 1965).

6. Bruton, H.J.: "Growth Models and Underdeveloped Economies", The Journal of Political Economy, August 1955.

7. Chakravarty, S.: The Logic of Investment Planning, (North Holland Publishing Company, Amsterdam, 1959).

8. Chenevy, H.B.: "Patterns of Industrial Growth", American Economic Review, September 1970).

9. Christ, C.: Econometric Methods and Models, (John Wiley and Sons, Inc., New York, 1961).

10. Clark, Paul, G.: Development Planning in East Africa, (East African Publishing House, Nairobi, 1965).

11. Cramer, J.S.: Empirical Econometrics, (American Elsevier Publishing Company, Inc., New York, 1969).

12. Desai, Padma: "Alternative Measures of Import Substitution", Oxford Economic Papers, November 1969.

13. Domar, E.D.: "A Theortical Analysis of Economic Growth", in Essays in the Theory of Economic Growth, (Oxford University Press, 1957).

14. Eckaus, R.S.: "The Factor Proportions Problem in Underdeveloped Areas", American Economic Review, September 1955.

15. Ferber, R. and Verdoorn, P.J.: Research Methods in Economics and Business, (The Macmillan Company, New York,).

16. Fox, K.: Econometric Analysis for Public Policy, (Iowa State College Press, 1958).

17. Fox, K., Sen Gupta, J. and Thorbecke, E.: The Theory of Quantitative Economic Policy with Applications to Economic Growth and Stabilization, (North Holland Publishing Company, Amsterdam, 1966).

18. Frank, Charles: Sugar Industry in Uganda, (East African Publishing House, Nairobi, 1966).

19. Ghai, Dharam: Taxation for Development - A case study of Uganda, (East African Publishing House, Nairobi, 1966).

20. Goldberger, A.S.: Econometric Theory, (John Wiley and Sons, Inc., New York, 1964).

21. Gray, C.S.: "Development Planning in East Africa - A Review Article", The East African Economic Review, December 1966.

22. Green, R.H.: "Cautious Growth Promotion and Cautious Structuralism: The Kenya and Uganda 1966 Development Plans", The East African Economic Review, December 1966.

23. ———— : "Planning in a Developing Economy", in The Challenge of Uganda's Second Five Year Plan, (Milton Obtole Foundation, Kampola, 1967).

24. Grunig, James: "Communications and Economic Peasants", in Economic Development and Cultural Change, July 1971.

25. Harrod, R.F.: Towards a Dynamic Economics, (Macmillan and Company, London, 1963).

26. Hirschman, A.O.: The Strategy of Economic Development, (Yale University Press, New Haven, 1958).

27. Howe, C.W. and Karani, H.: "A Projection Model for Kenya Economy - A study in Development Planning and Comparative Economic Structures", The East African Economic Review, June 1965.

28. Johansen, Lief: A Multi-sector Study of Economic Growth, (North Holland Publishing Company, Amsterdam, 1966).

29. Johnston, J.: Economic Methods, (McGraw Hill Book Company, Inc., New York, 1963).

30. King, T.: "Develop Strategy and Investment Criteria - Complementary or Competitive?", Quarterly Journal of Economics, February 1966.

31. Klein, L.: An Introduction to Econometrics, (Prentice Hall, Inc., Englewood Cliffs, 1962).

32. Krengel, R. and Mertens, D.: Fixed Capital Stock and Future Investment Requirements in Greek Manufacturing, (

33. Kyesimira, Y.: "The External Trade Prospects and the Plans", The East African Economic Review, December 1966.

34. Leser, C.E.V.: Econometric Techniques and Problems, (Hatner Publishing Company, 1966).

35. Linneman, Hans: An Econometric Study of International Trade Flows, (North Holland Publishing Company, Amsterdam, 1966).

36. Mahalanobis, P.C.: "Some Observations on the Process of Growth of National Income", Sankhya, September 1953.

37. Marwah, K.: "An Econometric Model of Colombia - A protype Devaluation view", Econometrica, April 1969.

38. Meir, G.: Leading Issues in Development Economics, (Oxford University Press, New York, 1964).

39. Miracle, and Fetten, B.: "Backward Sloping Labour and Supply functions and African Economic Behaviour", in Economic Development and Cultural Change, January 1970.

40. Murti, V.N. and Sastry, V.K.: "Production Functions for Indian Industry", Econometrica, 1957).

41. Myrdal, Gunnar: Asian Drama: An Inquiry into the Poverty of Nations, Volumes II and III, (Pantheon, New York, 1968).

42. Nadiri, I.: "Some Approaches to the Theory and Measurement of Total Factor Productivity - A Survey", The Journal of Economic Literature, December 1970.

43. Narasimham, N.V.A.: A Short-term Planning Model for India, (North Holland Publishing Company, Amsterdam,).

44. Ndegwa, P.: The Common Market and Development in East Africa, (East African Publishing House, 1965).

45. ——— and Van Arkadie, B.: "Future Trade, Balance of payments and Aid requirements in East Africa", The East African Economic Review, June 1965.

46. Newlyn, W.T.: "What Monetary Policy can do to Implent the Plan", in The Challenge of Uganda's Second Five Year Plan, (Milton Obtole Foundation, Kampola, 1967)

47. Pavlopoulos, P.: A statistical model for the Greek economy, 1949-1959, (North Holland Publishing Company, Amsterdam, 1966).

48. Prais, S.J.: Economic Research in International Trade: A Review, (Kyklos, 1962), Volume XV.

49. Rao, V.K.R.V.: "Investment, Income and the Multiplier in an Underdeveloped economy", The Indian Economic Review, 1952.

50. Seers, D.: "The Use of a Modified Input-Output System for an Economic Programme in Zambia", in Theory and Design of Development, ed., I Adelman and E. Thorbecke (John Hopkins University Press, Baltimore, 1966).

51. Sen, A.K.: Growth Economics, (Peguin, United Kingdom, 1970).

52. Theil, H.: "Specification Errors and Estimation of Economic Relationships", Review of International Statistical Institute, XXV, 1957.

53. Tinbergen, J.: Economic Policy: Principles and Design, (North Holland Publishing Company, Amsterdam,).

54. ——— and Bos, H.: Mathetical Models of Economic Growth, (McGraw Hill, New York, 1962).

55. Wold, H.: "Construction Principles of Simultaneous Equation Models in Econometrics", Bulletin of International Statistical Institute, XXXVIII, 1960.

56. Yamane, T.: Statistics: An Introductory Analysis, (Harper and Row, New York, 1967).

1. The following publications, published by the Statistics Division of the Ministry of Planning and Economic Development have been used as the basis for some of the statistical information.

(a) The Background to the Budget, various issues.

(b) The Statistical Abstract, various issues.

(c) Quarterly Statistical Digest, various issues.

(d) Real Growth in the Uganda Economy.

(e) Gross Domestic Product of Uganda, 1954-1962.

(f) Uganda's First Five Year Plan 1961-1962/1965-1966.

(g) Work for Progress: Uganda's Second Five Year Plan, 1966-1971. (Ministry of Planning and Economic Development, 1966).

(h) Uganda Census of Industry, various issues.