This work is licensed under a Creative Commons Attribution – NonCommercial - NoDerivs 3.0 Licence.

To view a copy of the licence please see: http://creativecommons.org/licenses/by-nc-nd/3.0/
THE RATIONALE AND USE OF A PROJECTION MODEL FOR UGANDA

A. Introduction

The object of this paper is to present a model of the Uganda economy which can be used in making intermediate-term projections for development planning, which can be calculated with available statistical series, and which can be applied in comparisons with the Tanganyika and Kenya economies.

Intermediate-term projections of five to ten years are an integral feature of comprehensive development planning. They provide the link between the desired objectives for the economy as a whole and the development expenditures and policies subject to government decision, recognizing that many aspects of the economy have a continuity and life of their own. A projection model can be used to estimate, from given objectives, the "required" development expenditures and policies to obtain them, or from given development actions, the "expected" attainment of objectives. In practice such a model is commonly used in a process of successive approximation to arrive at a final judgment that the actions and the objectives are consistent and feasible. Of course this final judgment is bound to include an admixture of hunch and hope. The projection model, however, should make explicit those structural aspects of the economy which are believed to have a continuity of their own, and which therefore impose the tests of consistency and feasibility.

A practical projection model must be adapted to available statistical series. In the three East African countries the main bodies of statistical information available for a model are gross domestic product estimates built up from the product side for various sectors, merchandise export and import data derived from customs operations, rather rough estimates of gross capital formation with little detail, central government revenue and expenditure accounts using budgetary definitions for fiscal years, and reported employment figures for various sectors. Two major pieces of statistical information which are frequently used in development models for higher-stage underdeveloped countries, as in Latin America, are lacking here: independent gross domestic product estimates built up from the expenditure side for all final demands including household consumption, and input-output estimates linking final demands, intermediate demands, and gross product in the various sectors. However, for the present stage of development in East Africa it may be possible to design a projection model which leaps over the missing pieces and yet is quite useful for analysis with the observations we have.

In view of the present extensive economic cooperation among the East African countries, and the interest in further coordination.
of development efforts, it may be especially interesting to have a
general projection model which can be applied with a limited number
of adaptations to all three countries. This would permit standardi-
sed comparisons of economic structures, of past growth, and of future
plans. Thus though the present paper deals specifically with the
model for Uganda, some work has already been done in extending it to
Tanganyika and Kenya.

B. Rationale of the Model

The model is presented systematically in algebraic form in
Appendix II. Before examining it in detail, however, let us note
certain general characteristics. First, it is a sector model dis-
tinguishing six producing sectors of the economy, seven kinds of
imports, two classes of exports, four forms of capital formation,
four kinds of government taxes, and certain other variables. Thus
it embodies substantially more specific information than a purely
aggregative model but still much less detail than is involved in
planning development actions within ministries. Second, it portrays
an economy in which everything depends, by way of the structural
relationships among its parts, upon five autonomous factors: the real
quantity of agricultural exports, the prices of those exports, the
value of manufactured exports, import substitution in manufactured
products, and central government current expenditures. In particular,
it specifies that required capital formation is derived within the
model from implied increases in domestic production. Third, the
parameters describing the structural relationships among parts of
economy must each be projected into the future. Some are assumed to
remain unchanged or to follow a time-trend, while others are assumed
to be adjustable by government policy. Fourth, it is a linear model;
capital formation, though in principle non-linear, is represented by
a linear approximation depending on a tentative initial estimate of
rate of growth. Thus though the algebra is somewhat laborious, it is
mathematically simple. Finally, the model is designed to emphasize
three potential constraints on development expenditures and policies:
the balance of trade, which depends mainly on the various import
parameters; the government budget surplus or deficit, which depends
mainly on the tax revenue parameters; and the required saving, which
depends mainly on the capital formation parameters.

The 37 variables of the model are defined in the first section
of Appendix II, and only a few points of definition need comment here.
Both imports and exports include interterritorial trade, and many
transfers have been made among the SITC classes of imports to arrive
at somewhat more homogeneous import categories. It is assumed that
import substitution can affect food, consumer manufactures, inter-
mediate goods, and construction materials, but not consumer vehicles,
fuel, and equipment. Agricultural exports, agricultural product, and GDP are adjusted for changes in prices of agricultural exports, which clearly are a key phenomenon in the Uganda economy; given the ambiguity of information on import and domestic prices and the lack of any pronounced general price trend 1954-62, however, no other price adjustments seemed justified. Government expenditures and revenue are first adjusted to exclude capital and transfer transactions from the budgetary data. Then the figures for the fiscal year beginning in any calendar year are used in conjunction with production and trade figures for the calendar year, to reflect crudely the lag of cash expenditures behind use of resources and of revenues behind tax obligations. A variable which appears in many relationships is private income, defined as the current value of gross domestic product less government revenue.

The model itself is presented in the second section of Appendix II; there are 11 accounting identities and 5 autonomous variables, leaving 21 functional equations. Let us examine the rationale of these functional equations with some care.

The six gross product variables for the various producing sectors are treated either as functions of particular final demands, or of private income and hence implicitly of consumer spending, or of gross product in other sectors and hence implicitly of intermediate demands. Thus government product and construction product are treated simply as proportions of government current expenditures and construction investment, respectively. Agricultural product, measured in real terms, is assumed to be a function primarily of real agricultural exports, but also of manufactured exports and import substitution, reflecting agricultural inputs into manufacturing, and of private income, reflecting domestic consumer demands. Manufacturing product is of course partly a function of manufactured exports and import substitution, but mainly of private income and hence domestic consumer demands. Services product is treated as entirely dependent on private income. Transport product, on the other hand, is assumed to depend on intermediate demands stemming from real agricultural product and manufacturing product. From the standpoint

* Since these data were prepared the Statistics Division has published The Real Growth of the Economy of Uganda 1954-62, which is a major contribution in providing for the first time deflated domestic product estimates. The figures for real GDP used here follow a time-pattern 1954-62 similar to the figures in Real Growth, but at a somewhat higher level — a 34% increase over the eight years compared to a 26% one. The main discrepancy appears to be in services and government. However, the conceptual problem in measuring real product in services is thorny, and the implicit assumption that prices in services haven't risen (used here), seems quite as justifiable as the implicit assumption that productivity per employee in services has remained unchanged (used in Real Growth).
of methodology, a fundamental question about the model is whether these simplified relationships for the various producing sectors adequately represent the more complex interconnections with final demands and intermediate demands which actually exist.

The seven import variables are also treated in a variety of ways. The three kinds of consumer imports - food, manufactures, and vehicles - are assumed to be functions simply of private income; the reason for distinguishing the three kinds rather than combining them is to permit different degrees of import substitution in projecting the import parameters. Intermediate imports are treated partly as a function of manufactured exports and import substitution, reflecting imported inputs directly into manufacturing but mainly of real gross domestic product. Fuel imports are related only to real GDP. Construction material imports and equipment imports are assumed to depend upon construction investment and equipment investment, respectively; since these import parameters are comparatively high and since the volume of investment in the model varies substantially with the rate of growth of GDP, construction and equipment imports are comparatively variable elements of the overall import bill. It may be noted that import substitution must be estimated independently before the model is used in projection, in the course of specifying the future import parameters; the changes in these parameters then define the import substitution variable, which as we have seen affects manufacturing product, agricultural product, and intermediate imports.

Construction investment and equipment investment, with the breakdown between public and private investment handled separately, are in principle functions of marginal capital-output ratios tied to increases in gross product and of retirement coefficients tied to the level of gross product. These non-linear functions are approximated, however, by linear functions. Thus construction investment and equipment investment are actually projected in assumed ratios to gross product, the ratios being raised or lowered according to the rate of growth of gross product which is expected to result from the projection; if the expected rate of growth should prove to be substantially in error, the investment parameters must be adjusted in a second approximation. The model specifies that investment depends, not on GDP for the entire economy, but on a variable called urban gross product, the sum of gross product in government, manufacturing, services, and transport. Thus a small amount of capital formation in agriculture is ignored - Tanganyika figures suggest not more than ten per cent of the total - but the model properly emphasizes that required investment depends mainly on non-agricultural investment.

The four forms of government tax revenue are derived in the model from revenue coefficients, in principle set in the tax laws,
and appropriate tax base variables appearing in the model. Export tax revenue is treated as a function of the current value of agricultural exports; revenue thus varies proportionately with changes in quantity, but the revenue coefficient must be adjusted independently for changes in agricultural export prices. Customs revenue is treated simply as a proportion of the value of imports. Direct tax revenue and indirect (i.e. excises and all other) tax revenue are related to private income, representing the tax base for the former and the presumed influence of consumer demands for the latter; in a projection the two coefficients can be adjusted separately for tax policy changes.

Employment is not explicitly treated in the model as presented here, but could be readily added as a supplementary variable or variables related to sector gross products, after allowance for trends in productivity per employee.

The third section of Appendix II lists the parameters of the model. In general they can be calculated from observed ratios in the years 1954-62; in a projection they are either assumed to carry over unchanged, or to follow a simple time-trend, or to be adjusted as a result of some specific influence like import substitution.

Two further points about certain of the parameters may be noted. The parameters representing the direct effect of manufactured exports and import substitution on manufacturing product, agricultural product, and intermediate imports are estimated roughly from proportions which appear to prevail for all manufacturing in the 1961 Kenya Census of Manufacturing. The retirement coefficients for construction and equipment are estimated on the basis of assumed useful lives, past rates of growth, and past investment rates. These retirement coefficients are then used with actual gross investment and actual increases in gross product during the two four-year periods 1954-58 and 1958-62 to calculate marginal capital-output ratios; it was some comfort to find that the results were not strikingly dissimilar in the two periods - 8.5 and 4.3 for construction, 1.4 and 1.0 for equipment, 4.9 and 5.3 for both together - even though the rate of investment and rate of growth were much lower in 1958-62. Finally, the retirement coefficients and the

---

A technical national accounting point may be noted here. Customs and indirect tax revenue are not included conceptually in GDP at factor cost, but constitute part of the margin between GDP at factor cost and at market prices. Thus in principle one should deduct all taxes from GDP at market prices to arrive at the variable called private income, but only direct and export taxes from GDP at factor cost. Since the East African statistics do not include an independent estimate of GDP at market prices on which to base the model, however, and since it is believed that changes in customs duties and indirect tax rates probably would affect consumer demands out of a given GDP at factor cost, it seemed preferable in the model to subtract all taxes to obtain the private income variable. I am indebted to Brian Van Arkadie for clarifying discussion on this point.
marginal capital-output ratios for 1954-58 were used to calculate the implied investment parameters actually employed in the model.

The last section of Appendix II sets forth some of the algebraic relationships to be used in calculations with the model. The algebra is somewhat laborious but mathematically quite simple. In the end all of the parts of the model depend on the five autonomous variables and certain linear combinations of the parameters.

It is not easy to summarize the conception of the Uganda economy which is embodied in the model, but one may try. The model portrays an economy in which various sectors, particularly agricultural and non-agricultural, have different effects on imports, investment requirements, and tax revenues; in which what happens domestically is influenced largely though not entirely by agricultural export quantities and prices; in which required capital formation both public and private is induced by the rate of growth of domestic production, and the import bill is quite sensitive to variations in capital formation; in which import substitution in manufactures and a modest amount of manufactured exports are a prime potential source of structural change; in which government development actions can affect significantly government current expenditures, public investment coefficients, tax revenue coefficients, and the extent of import substitution, but not the structural parameters of the economy; and in which development is limited by one of three potential constraints - the balance of trade, the government budget surplus or deficit, and the saving implied by required capital formation. 

2. Recent Economic Trends as seen in the Model

The principal variables of the model provide a rather illuminating summary of recent trends in the Uganda economy. Two periods, 1954-58 and 1958-59, can be conveniently distinguished, and the various indicators for these periods are set forth in Table I.

During the earlier period real GDP expanded by a little over 20%, or at the respectable average rate of 4.7% per year. During the later period, on the other hand, real GDP expanded by only 11%, or at an average annual rate of only 2.6%, approximately the same as the probable rate of growth of population. This slowing down of real

---

*I am indebted to Jassie Kindle for valuable assistance in these and many other laborious calculations involved in the model.
growth from 1958 to 1962 was a major setback to material progress in Uganda.

These real trends were substantially worsened by the decline in agricultural export prices, moderately from 1954 to 1958, and more sharply thereafter. These price declines reduced the growth of private income to about 15% in the earlier period, and eliminated any growth at all in the later period. The complete stagnation of private income from 1958 to 1962 of course had repercussions on the real product of all sectors of the economy dependent on consumer demands.

The slowing down was not entirely due to unfortunate export price trends, however. The real quantity of agricultural exports, which expanded by about 10% 1954-58, was only 1% higher in 1962 than in 1958. The year 1962 was clearly abnormal climatically, and in 1963 there was a tremendous increase, raising the expansion of real agricultural exports over the five-year period 1958-63 to fully 36%. However, during the 1958-62 period with which we are concerned at the moment, this slowing down in real agricultural exports was a major cause of slowing down in the economy as a whole. Manufactured exports, on the other hand, rose from virtually nothing in 1954 to about £3 million in 1965, and doubled again by 1962.

Meanwhile the ratio of imports to GDP remained virtually constant during both the earlier and later periods; overall there appeared to be no significant import substitution. This stability in overall import content obscured two opposing trends, however - a fall in the share of construction materials and equipment, in line with the falling rate of investment noted below, and a rise in the share of intermediate goods imports. With virtually stable imports, the adverse trend in export prices reduced substantially the country's export surplus during the period 1958-62.

Perhaps the most disturbing trend during the entire eight years was the continuing decline in the rate of investment - from 23% of real GDP in 1954 (and even higher in 1955) to 12% in 1958 to 14% in 1962. The decline in the rate of investment was probably more the effect of slowing real growth due to unfavourable export trends than the cause of the slowdown, though obviously the two factors interact. At the same time raising the rate of investment seems essential in the course of accelerating the real growth of the economy to a more satisfactory rate.

Government current expenditure was expanded substantially more rapidly than GDP in both the earlier and later periods, but presumably as a result of limited revenue, also slowed down from 1958 to 1962. Government revenue, on the other hand, remained in virtually the same ratio to GDP; the falling share of export taxes was mainly offset by the rising share of customs duties. As a con-
sequence government saving, the excess of revenue over current expenditure, fell from about a third of total revenue in 1954 to 13% in 1958 and to minus 1% in 1962. Thus by 1962 the government budget was contributing nothing to the saving needed to permit capital formation, and all government investment as well as private investment had to be financed by private saving or foreign borrowing.

Real agricultural product and urban gross product grew at quite different rates during the two periods — urban product in both cases more rapidly, though less so during the slowdown of 1958-62. The effects on employment, however, were quite disappointing. Even the 38% increase in urban gross product in 1954-58 led to only a 10% increase in urban employment, while the 17% increase in 1958-62 was accomplished with a 3% decline in urban employment. Without some change in these output-employment patterns, it is difficult to see how even much accelerated economic growth can have a meaningful effect on employment opportunities in the near future.

Estimating Parameters and Autonomous Variables for Projection

Using the model to make intermediate-term projections for development planning involves two sets of operations — estimating the 25 future parameters and projecting independently the 5 autonomous variables. In some parts of the model the two operations also interact.

Estimating the future parameters should in principle stick closely to the observed past parameters, since these are conceived to represent those structural aspects of the economy which have a continuity of their own. Adjustments of some past parameters may be needed, however, to reflect three kinds of predictable structural change — simple time trends which are compatible with our understanding of the economy, changes due to government policy, and expected alterations in the growth of those autonomous variables which interact with a few of the parameters. Table 2 presents the observed parameters for the three years 1954, 1958, and 1962, and in the last column the assumed parameters suggested for a "reasonable" projection from 1962 to 1970. The column for the test projection 1958-62 will be referred to later. Let us examine the logic suggested in Table 2 for estimating the future parameters.

To begin with, the parameters a1, reflecting the relation between real agricultural exports and real agricultural product, and a3, m2, and i3, reflecting the direct impacts of manufactured exports and import substitution, are simply assumed from independent evidence, leaving certain residuals to be explained by the calculated parameters. Among the six gross product parameters, a2, m1, and t - for

* Parameters for intervening years were also examined, but are not reproduced here.
agriculture, manufacturing, and transport show some variation over the years 1954-62, of course, but this seems compatible with a presumption of constancy, so the future parameters are assumed the same as in 1962. The other gross product parameters, \( g, s, \) and \( h \) - for government, services, and construction - show a reasonably clear upward time-trend 1954-62, and this is understandable as a rise in wages and profits relative to material inputs in these sectors, so the future parameters are projected with a continuing trend.

Among the seven import parameters, the coefficients for vehicles, fuel, and equipment - are presumed not to be subject to import substitution, and as the observed parameters 1954-62 appear compatible with this presumption, their future values are assumed to continue at the 1962 level. On the other hand, the coefficients for food, consumer manufactures, intermediate goods, and construction materials are presumed to be subject to import substitution, and even though this was not reflected in the observations for 1954-62, a ten per cent fall in these coefficients is assumed for 1970. Such a change would of course depend on appropriate development policies promoting import substitution in manufactures, and a more refined assumption ought to take account of the specific policies which the government expects to pursue. The implied value for the import substitution variable \( S_m \) is about £2.3 million at 1962 levels of GDP.

Turning to the four tax revenue parameters, the direct tax parameter is simply projected at the 1962 figure; despite the progressive structure of the personal income tax rates, its narrow tax base, and its modest yield relative to business income and graduated personal taxes, do not seem to imply any significant change in the direct tax parameter. On the other hand, the parameters for customs duties and indirect taxes are assumed to continue to rise in line with the trends observed in the calculated parameters 1958-62. This of course implies continuing changes in tax rates; it represents a judgment that raising additional revenue from these sources is politically and economically attractive, and that future Finance Ministers are likely to continue the pattern of behavior of the recent past. Finally, the export tax parameter is estimated on the basis of assumed export prices with present tax rates, which make yields highly elastic with respect to prices. Thus largely due to the fluctuation in coffee prices, the observed parameter fell from about 10% in 1968 to about 8% in 1962, and then jumped to about 16% in 1965. The estimated future parameter starts from the 1963 level of agricultural export prices and assumes an average annual fall of 1% between 1965 and 1970, which still is much more favourable than in the last four years. From the standpoint of methodology one could make almost any assumption about future tax revenue parameters, as they are clearly subject to government policy decision. But it
may be especially interesting to examine the budgetary implications of these "reasonable" tax decisions in a context of resumed expansion of both government expenditure and GDP.

The investment parameters $k'$ and $q'$—for construction and equipment, respectively—depend on the rate of growth of $U$, urban gross product, and hence in a projection on a tentative initial estimate of this rate of growth derived from the five autonomous variables. They cannot be estimated simply from past observed parameters unless the past rate of growth is expected to continue unchanged. The author has not yet made any explicit projections of the autonomous variables, so the process of estimating the investment parameters is simply illustrated in Table 2 on the assumption that $U$ recovers to a rate of growth a little below that of 1954-58, but nearly double that of 1958-62. In an actual projection it would doubtless be most interesting to make some alternative estimates for alternative programmes of development expenditures and policies.

In the course of constructing the model a test projection to 1962 was prepared, using in principle only the 1954-58 information bearing on the parameters, but the actual autonomous variables for 1962. The parameters employed are shown in Table 2, and the results in Table 3. Since these calculations were performed, two general changes have been made in the initial version of the model, so the test is not exactly apposite. First, on theoretical grounds the formulation of the effects of manufactured exports and import substitution has been made more elaborate and hopefully more realistic—particularly in recognising its effect on agriculture—than in the initial version. Second, on the basis of the observed parameters 1958-62, rising trends in the gross product parameters for government, services, and construction have been recognised whereas they were not assumed in the test projection based on 1954-58 observations.

Despite these subsequent changes, the test projection is perhaps of some interest. Broadly speaking it reproduced the pattern of economic trends described in Section C above—a marked slowing down of real growth, a rise in urban gross product relative to agriculture, no significant overall import substitution and a fall in the export surplus, a decline in investment both absolutely and relative to real GDP, a virtually stable proportion of tax revenue in GDP and correspondingly the elimination of government saving. The test projection understated the modest growth of real GDP which actually occurred, however, and hence understated the absolute value of most of the variables in the model. Though the test has not been repeated since the two revisions pointed out above, it is clear that the revised model would have generated smaller absolute errors.
E. Some Conclusions about the Structure of the Uganda Economy

The model presented here is designed for making intermediate-term projections, but if it is accepted as a meaningful representation of the economy, it can also be used to clarify some significant structural characteristics of the economic system as a whole. For this purpose we use the estimated parameters for a 1962-70 projection discussed in the previous section, and refer to Tables 4 and 5.

First, it is of some interest to estimate the size of the GDP multipliers for the various autonomous factors, that is, the amount of GDP which is generated directly and indirectly by, say, $1 million of real agricultural exports. These implied multipliers are listed in the first column of Table 4. The multiplier of 2.07 for real agricultural exports asserts that a rise of $1 million in the quantity of agricultural exports will lead directly to a rise of $2.07 million in agricultural product and indirectly to a further rise of a little more than $1 million in all sectors of the economy (except government) to increase the volume of transportation, to satisfy the demands arising from increased private income, to provide the capital formation needed to expand domestic production, and so on. It may be worth noting that real agricultural exports have the highest multiplier of any of the five autonomous variables. The multiplier for agricultural export prices is somewhat lower, essentially because it has no immediate link with increased transport, and operates only through increased private income and capital formation.

Second, the magnitude of direct and indirect import requirements stemming from the various autonomous variables may have considerable policy significance. In particular, in foreign aid negotiations the amount of indirect imports generated by a particular project may be an important point at issue. The import "multipliers" shown in Table 4 are strikingly high - over 50% for agricultural export prices, about 60% for real agricultural exports and government current expenditures, and as high as 83% for manufactured exports and import substitution. This last figure includes 20% for direct imports, but the remaining 63% and the other import "multipliers" are essentially indirect requirements stemming from expanded

A technical point to note here is that the multiplier for agricultural export prices in Table 4 refers to the current value of GDP. The multiplier with respect to real GDP would be only .80, since the initial unit increase in prices would not affect real GDP. This distinction does not matter for the other autonomous variables.
private income and induced investment. In analysing a particular
development project, one might estimate direct imports from the
project design, and then indirect imports from "multipliers" such as
these applied to the domestic costs.

Third, the amount of government tax revenue resulting directly
and indirectly from the various autonomous variables is a quite
relevant question from the standpoint of financial planning. The
revenue "multipliers" shown in Table 4 are also strikingly high -
36% in the case of government current expenditures and from 44% to
53% for the other three autonomous variables. Real agricultural
exports have the greatest revenue effects, due to both the operation
of export taxes and the revenue yield from expanding private income.
Agricultural export prices rank next. Perhaps surprisingly, manufac-
tured exports and import substitution have almost the same revenue
effects as agricultural export prices; in essence additional revenue
from customs duties offsets lack of revenue from export taxes.
Doubtless the most dramatic implication of these revenue "multipliers"
is that additional government current expenditures (provided the
required investment can be financed by borrowing) ultimately "pay
for themselves" to the extent of over a third.

Finally, an interesting comparison between the revenue and
import effects of expanding GDP via agricultural exports or manufac-
tured import substitution can be derived, as shown in Table 5. The
revenue content of a unit of GDP via either approach is much the
same, for reasons noted above. The import content of a unit of GDP
generated by manufacturing expansion, however, is about half again
as great as for agricultural expansion - 45% compared to 29%. To the
extent that agricultural exports and manufactured import substitution
are truly alternatives, and considering only the balance of trade
constraint on development, this result reveals a notable advantage
of the approach via agricultural exports. If, on the other hand, an
operational development strategy is to expand both at the maximum
rate permitted by a variety of constraints, which are not the same
in both sectors, this result emphasizes that import substitution
itself generates substantial import demands, and will continue to
do so in the intermediate-term future.

* Table 5 restates the relationships in Table 4 in terms
of a unit increase in GDP, thus eliminating the effect
of different GDP multipliers. I am indebted to Richard
Jolly for suggesting this alternative presentation.
APPENDIX I: TABLES

Table I  Indicators of Trends in the Uganda Economy  
1954-55 and 1955-56

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1954-55</th>
<th>1955-56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real gross domestic product</td>
<td>+20.3%</td>
<td>+11.0%</td>
</tr>
<tr>
<td>(GDP&lt;sup&gt;a&lt;/sup&gt;)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross domestic product</td>
<td>+14.8%</td>
<td>+0.0%</td>
</tr>
<tr>
<td>(GDP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private income (X)</td>
<td>+15.4%</td>
<td>+0.0%</td>
</tr>
<tr>
<td>Real agricultural exports (&lt;p&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Em)</td>
<td>+6.9%</td>
<td>+1.0%</td>
</tr>
<tr>
<td>Manufactured exports (Em)</td>
<td>+.22.9 mil&lt;sup&gt;b&lt;/sup&gt;</td>
<td>+.31.1 mil&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Imports: ratio to GEP (H/GDP)</td>
<td>.50-.52</td>
<td>.35-.32</td>
</tr>
<tr>
<td>Export surplus: ratio to imports (E-W/H)</td>
<td>.48-.51&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.51-.53</td>
</tr>
<tr>
<td>Investment: ratio to real GDP (X + G/GDP&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>.23-.19&lt;sup&gt;d&lt;/sup&gt;</td>
<td>.18-.14</td>
</tr>
<tr>
<td>Gov. current expenditures (G)</td>
<td>+42.0%</td>
<td>+15.4%</td>
</tr>
<tr>
<td>Gov. revenue: ratio to GDP (R/GDP)</td>
<td>.21-.20</td>
<td>.20-.20</td>
</tr>
<tr>
<td>Gov. saving: ratio to gov. revenue (R-G/R)</td>
<td>.33-.13</td>
<td>.13-.01</td>
</tr>
<tr>
<td>Real gross product of agriculture (&lt;p&gt;)</td>
<td>+7.9%</td>
<td>+10.1%</td>
</tr>
<tr>
<td>Urban gross product (U)</td>
<td>+38.3%</td>
<td>+17.1%</td>
</tr>
<tr>
<td>Urban employment (L)</td>
<td>+9.5%</td>
<td>-2.6%</td>
</tr>
</tbody>
</table>

Notes:

a. Indicators are shown either as percentage changes between the initial year and final year of the period, or as ratios in both initial and final year, neglecting intervening years except in a few cases (footnoted) in which a terminal year appears unrepresentative.

b. Manufactured exports were only 20.2 million in 1954, increased to 33.1 million in 1955, and doubled from 1955 to 1956.

c. Initial year ratios calculated for 1954 and 1955 combined.

d. Ratio rose to maximum of .28 in 1955.
| TABLE 2. | COMPARISON OF ACTUAL PARAMETERS 1954-62 AND ASSUMED PARAMETERS FOR PROJECTION |
|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| a1 (assumed) | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| a3 (assumed) | | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| a2 = Fc - a1 Ea | | 0.118 | 0.0918 | 0.131 | 0.0918f | 0.151 |
| s = Fc/c | | 0.056 | 0.054 | 0.054 | 0.541 | 0.746 |
| w2 (assumed) | | 0.5 | 0.5 | 0.5 | 0.5f | 0.5f |
| m1 = Pm - sa(Em+8m)/y | | 0.0829 | 0.0713 | 0.0649 | 0.0713f | 0.0649 |
| s = Pm/y | | 0.218 | 0.240 | 0.269 | 0.262 | 0.313 |
| t = Pm/Pm | | 0.0977 | 0.137 | 0.152 | 0.137 | 0.133 |
| h = Fh/8 | | 0.354 | 0.364 | 0.466 | 0.364 | 0.564 |
| c1 = Ha/y | | 0.0123 | 0.0202 | 0.018 | 0.022 | 0.052 |
| c2 = 8m/y | | 0.105 | 0.145 | 0.137 | 0.131 | 0.141 |
| c3 = 8v/y | | 0.0411 | 0.0269 | 0.0381 | 0.0388 | 0.0382 |
| f5 (assumed) | | 0.2 | 0.2 | 0.2 | 0.2f | 0.3 |
| /1 = 8m - f5(Em+8m)/GDP | | 0.0187 | 0.0193 | 0.0246 | 0.0180f | 0.0221 |
| /2 = 8r/GDP | | 0.0210 | 0.0261 | 0.0217 | 0.0241 | 0.0217 |
| /1 = 8m/8 | | 0.31 | 0.225 | 0.196 | 0.205 | 0.173 |
| /2 = 8m/8 | | 0.495 | 0.702 | 0.689 | 0.708 | 0.689 |
| k' = 8k/8 | | 0.402 | 0.366 | 0.158 | 0.180 | 0.285 |
| q' = 8q/8 | | 0.396 | 0.180 | 0.136 | 0.170 | 0.215 |
| p1 = 8p/8 | | 0.653 | 0.436 | 0.458 | 0.486 | 0.458 |
| p2 = 8p/8 | | 0.951 | 0.926 | 0.944 | 0.926 | 0.944 |
| r1 = 8d/8 | | 0.0395 | 0.0496 | 0.0485 | 0.0495 | 0.0467 |
| r2 = 8E/8 | | 0.135 | 0.192 | 0.0792 | 0.0830 | 0.139 |
| r3 = 8m/8 | | 0.145 | 0.148 | 0.228 | 0.213 | 0.308 |
| r4 = 8x/8 | | 0.0734 | 0.0737 | 0.0841 | 0.0787 | 0.090 |

**Notes:**

a. Assumes trend continues
b. Assumes ten per cent import substitution
c. Assumes as first approximation a 7% average annual rate of growth of urban gross product, compared to about 3% in 1952-53 and 4% in 1956-57.
d. Assumes 1963 parameter of 1.85 will decline at 1.5 times 1% per year price rate.
e. Considered unrepresentative in relation to preceding or following years.
f. The test projection used on early version of the model for which these parameters were defined somewhat differently, but the values in the table represent the logic of the test projection.
TABLE 3. COMPARISON OF ACTUAL AND CALCULATED ECONOMIC VARIABLES IN TEST PROJECTIONS 1958-62. (VALUES IN £ MILLION)

<table>
<thead>
<tr>
<th></th>
<th>Actual 1958</th>
<th>Actual 1962</th>
<th>Calculated 1962</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real gross domestic product (GDP)</td>
<td>95.1</td>
<td>105.6</td>
<td>98.3</td>
</tr>
<tr>
<td>Gross domestic product (GDP)</td>
<td>106.3</td>
<td>106.4</td>
<td>99.1</td>
</tr>
<tr>
<td>Private income (Y)</td>
<td>84.5</td>
<td>84.5</td>
<td>79.0</td>
</tr>
<tr>
<td>Real gross product of agriculture (P_a*)</td>
<td>46.0</td>
<td>50.6</td>
<td>46.4</td>
</tr>
<tr>
<td>Urban gross product (U)</td>
<td>44.9</td>
<td>52.6</td>
<td>48.7</td>
</tr>
<tr>
<td>Imports (M)</td>
<td>34.3</td>
<td>33.9</td>
<td>31.7</td>
</tr>
<tr>
<td>Imports ratio to GDP (M/GDP)</td>
<td>(.32)</td>
<td>(.32)</td>
<td>(.32)</td>
</tr>
<tr>
<td>Export surplus : ratio to imports (E - M/A)</td>
<td>(.51)</td>
<td>(.32)</td>
<td>(.42)</td>
</tr>
<tr>
<td>Investment (K + Q)</td>
<td>19.6</td>
<td>15.4</td>
<td>17.0</td>
</tr>
<tr>
<td>Investment : ratio to real GDP (K + Q/GDP )</td>
<td>(.18)</td>
<td>(.14)</td>
<td>(.17)</td>
</tr>
<tr>
<td>Gov. revenue (R)</td>
<td>21.8</td>
<td>21.8</td>
<td>20.1</td>
</tr>
<tr>
<td>Gov. revenue : ratio to GDP (R/GDP)</td>
<td>(.20)</td>
<td>(.20)</td>
<td>(.20)</td>
</tr>
<tr>
<td>Gov. saving : ratio to gov. revenue (R-G/R)</td>
<td>(.13)</td>
<td>(-.01)</td>
<td>(-.02)</td>
</tr>
</tbody>
</table>

Notes:
1. The model used in the test projection was an earlier version with slightly different treatment of agricultural gross product and of manufactured exports and import substitution. See the text for discussion of the parameters used in the test projection.
Table 4. Some Significant Multipliers in the Structure of the Uganda Economy

<table>
<thead>
<tr>
<th>Increase in:</th>
<th>GDP</th>
<th>Government Revenue (R)</th>
<th>Imports (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural exports ($E^*$)</td>
<td>2.07</td>
<td>0.53</td>
<td>0.29</td>
</tr>
<tr>
<td>Agricultural export prices ($T$)</td>
<td>1.30</td>
<td>0.46</td>
<td>0.54</td>
</tr>
<tr>
<td>Manufactured exports or import substitution ($E_m, S_m$)</td>
<td>1.83</td>
<td>0.44</td>
<td>0.83</td>
</tr>
<tr>
<td>Government current expenditures ($G$)</td>
<td>1.60</td>
<td>0.36</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Notes:

a. Assumes that the parameters have the values indicated in Table 3 for a "reasonable" projection 1962-70.

b. Represents an increase in agricultural export prices sufficient for a unit increase in value of agricultural exports, with quantity constant. An increase in the model, a positive change in prices actually appears as a negative change in $T$.

Table 5. Comparison of Revenue and Import Content of a Unit of GDP Generated by Agricultural and Manufacturing Expansion

<table>
<thead>
<tr>
<th></th>
<th>Government Revenue (R)</th>
<th>Imports (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural exports ($E^*$)</td>
<td>0.26</td>
<td>0.29</td>
</tr>
<tr>
<td>Manufactured exports or import substitution ($E_m, S_m$)</td>
<td>0.24</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Notes:

a. Requires an increase of 0.46 of $E^*$ to generate a unit of GDP.

b. Requires an increase of 0.55 of $E_m$ or $S_m$ to generate a unit of GDP.
APPENDIX II
A PROJECTION MODEL FOR UGANDA, ADAPTED TO AVAILABLE STATISTICS

A. Variables

GDP = gross domestic product = monetary GDP at factor cost

Pa = gross product of agriculture = agriculture, cotton ginning, coffee curing, sugar manufacture, forestry, fishing, hunting

Pm = gross product of manufacturing = mining, manufacture of food products, miscellaneous manufacturing

Pk = gross product of construction = construction

Pt = gross product of transport = transport, communication, electricity

Ps = gross product of services = commerce, miscellaneous services (private), rents

Pg = gross product of government = government administration, miscellaneous services (public), local government

M = imports = net imports, interterritorial imports

U = urban gross product = Pa + Pm + Ps + Pt

Ma = imports of food = SITC 0, 1, 4

Mm = imports of consumer manufactures = SITC 5 (part), 6 (part), 7 (part), 8 (part), 9 (part)

Mv = imports of consumer vehicles = SITC 6 (part), 7 (part)

Mi = imports of intermediate goods = SITC 2 (part), 5 (part), 6 (part), 8 (part), 9 (part)

Mf = imports of fuel = SITC 3

Mk = imports of construction materials = SITC 2 (part), 6 (part), 7 (part), 8 (part)

Mq = imports of equipment = SITC 7 (part), 8 (part)

E = exports = domestic exports, inter-territorial exports

Ea = agricultural exports = SITC 0, 1, 2, 4

Em = manufactured exports = SITC 3, 5, 6, 7, 8, 9

T = terms of trade adjustment = Ea (1960-62 prices) less Ea

Ea* = real agricultural exports = Ea + T

Pa* = real gross product of agriculture = Pa + T

GDP* = real gross domestic product = GDP + T

K = construction investment = gross capital formation: government construction plus private construction

Kg = government construction = central government buildings, local government, common services organisation

Kp = private construction = remainder: urban building, rural industrial building and construction

Q = equipment investment = gross capital formation: government equipment plus private equipment
Qg = government equipment = central government: plant, equipment, and vehicles
Qp = private equipment = remainder: plant, equipment, and vehicles
G = government current expenditures = actual recurrent expenditures, less public debt transactions, pensions and gratuities, overseas addition, for fiscal year beginning in any calendar year
R = government revenue = actual recurrent and non-recurrent revenue, less public debt transactions, reimbursements, and grants from abroad, for fiscal year beginning in any calendar year
Rd = revenue from direct taxes
Re = revenue from export taxes
Rm = revenue from customs
Ri = revenue from indirect taxes = excises, licences and fees, rents and interest, miscellaneous, contributions from local funds
Y = private income = gross domestic product less government revenue
Sm = import substitution in manufactures = decrease in imports of food, consumer manufactures, intermediate goods, and construction materials compared to what imports would be with unchanged import coefficients

B. The Model

\[ Pa + Pg + Pm + Ps + Pt + Pk = GDP \]
\[ Pg + Pm + Ps + Pt = U \]
\[ Ma + Mm + Mv + Mi + Mf + Mk + Mq = M \]
\[ Ea + Em = E \]
\[ Ba + T = Ea^* \]
\[ Pa + T = Pa^* \]
\[ GDP + T = GDP^* \]
\[ Kp = K \]
\[ Gg + Qp = Q \]
\[ Rd + Re + Rm + Ri = R \]
\[ GDP - R = Y \]
\[ Ea^*, T, Em, Sm, G = \text{given} \]
\[ Pa^* = a_1 Ea^* + a_2 Y + a_3 (Em + Sm) \]
\[ Pg = g G \]
\[ Pm = m_1 Y + m_2 (Em + Sm) \]
\[ Ps = s Y \]
\[ Pt = t (Pa^* + Pm) \]
\[ P_k = h K \]
\[ M_a = c_1 Y \]
\[ M_m = c_2 Y \]
\[ M_v = c_3 Y \]
\[ M_1 = 11 \text{ GDP} + 18(\text{Em} + \text{Sm}) \]
\[ M_f = 12 \text{ GDP} \]
\[ M_k = j_1 K \]
\[ M_q = j_2 q \]
\[ K = k_1 dU + k_2 u = k'U \]

Note: The symbol \( dU \) stands for increment in \( U \) etc. The parameter \( k' \) is derived as an approximation depending upon the capital coefficient \( k_1 \), the retirement coefficient \( k_2 \), and growth of \( U \).

\[ q = q_1 dU + q_2 U = q'U \]
\[ X_p = p_1 X \]
\[ Q_p = p_2 Q \]
\[ R_d = r_1 Y \]
\[ R_e = r_2 E \]
\[ R_m = r_3 M \]
\[ R_i = r_4 Y \]

\( \alpha \) Parameters

Note: Parameters will be estimated from annual observations for the years 1954-58 and from incremental observations for the sub-periods 1954-56 and 1956-58.

\[ a = \frac{P_m - q_1 E_m - q_2 (\text{Em} + \text{Sm})}{Y} \]
\[ g = \frac{P_a}{G} \]
\[ c_8 = .30 \]
\[ m_2 = .50 \]
\[ t_3 = .30 \]

Note: \( c_8 \), \( m_2 \), and \( t_3 \) are estimated from the approximate proportion in 1961 value of output of all manufacturing in terms of (a) domestic agricultural inputs, (b) manufacturing value added plus domestic non-agricultural inputs, (c) imposed inputs.

\[ m_1 = \frac{P_m - m_2 (\text{Em} - m_3 \text{Sm})}{Y} \]
\[ s = P_a/Y \]
\[ t = P_t/(P_a + P_m) \]
\[ h = P_k/K \]
\[ c_1 = M_a/Y \]
\( c_3 = \ln Y \)
\( c_3 = \ln Y \)
\( i_1 = \frac{[1.13(Fn+Sn)]}{\text{GMV}} \)
\( i_3 = \ln Y/\text{GMV} \)
\( j_1 = \ln Y \)
\( j_2 = \ln Q \)
\( k_1 = \left( \text{Sun} K - \text{Sun} k_2 U \right)/\text{AU} \)
\( q_1 = \left( \text{Sun} Q - \text{Sun} q_2 U \right)/\text{AU} \)
\( k_2 = .06 \quad \text{Note: } k_2 \text{ and } q_2 \text{ are estimated assuming approximately a} \)
\( g_2 = .11 \quad \text{40-year life for construction and a 10-year life} \)
\( p_1 = Kp/K \quad \text{for equipment, with both stocks growing at an} \)
\( p_2 = \frac{Kp}{Q} \quad \text{average annual rate of about 9%, and with the} \)
\( r_1 = R_1/Y \quad \text{ratio of investment to gross product in the past} \)
\( r_2 = R_2/Y \quad \text{about the same as in the 1950's.} \)
\( r_3 = R_3/Y \quad \text{Note: } r_3 \text{ for projection is adjusted separately for change in} \)
\( r_4 = R_4/Y \quad \text{terms of trade adjustment (T).} \)

Values of \( k' \text{ and } q' \text{ for various annual rates of growth of urban} \)
gross product:

| \( k' \) | \(.145 \) | \(.215 \) | \(.265 \) | \(.355 \) | \(.485 \) |
| \( q' \) | \(.155 \) | \(.135 \) | \(.215 \) | \(.245 \) | \(.275 \) |

Note: Assumes capital-output ratios \( k = K/\text{AU} = .5 \text{ and} \)
\( q = Q/\text{AU} = 1.5 \text{.} \)

Assumes retirement rates \( \text{Ret } K = .04 \text{ and} \)
\( \text{Ret } Q = .11 \text{.} \)

D. Some Key Relationships

\( b_1 = a_1(1 + t + hk') \)
\( b_2 = a_3 + (m_2 + ta_3 + tm_2)(1 + hk') \)
\( b_4 = g(1 + hk') \)
\( b_5 = a_2 + (m_1 + s + ta_2 + tm_1)(1 + hk') \)
\( b_6 = r_2 + r_3a_1(jk' + j2q') \)
\( b_7 = r_2 - r_3(11 + 12) \)
\( b_8 = r_3a_3 + r_3(m_2 + ta_3 + tm_2)(jk' + j2q') \)
\( b_{10} = (r_3) (r_4) (j_{ik}' + j_{pq}') \)

\( b_{11} = (r_1 + r_4) + r_5(c_1 + c_2 + c_3) + r_5(m_1 + s + t_{a2} + t_{m2})(j_{ik}' + j_{pq}') + r_3(i_1 + i_2) \)

\( b_{12} = 1 + (r_1 + r_4) + r_5 (c_1 + c_2 + c_3) + r_5 (m_1 + s + t_{a2} + t_{m2})(j_{ik}' + j_{pq}') \)

\( b_{13} = t_{a1}(j_{ik}' + j_{pq}') \)

\( b_{14} = i_1 + i_2 \)

\( b_{15} = i_3 + (c_3 + t_{a3} + t_{m3})(j_{ik}' + j_{pq}') \)

\( b_{16} = s(j_{ik}' + j_{pq}') \)

\( b_{17} = (c_1 + c_2 + c_3) + (m_1 + s + t_{a2} + t_{m2})(j_{ik}' + j_{pq}') + (i_1 + i_2) \)

\( b_{18} = (c_1 + c_2 + c_3) + (m_1 + s + t_{a2} + t_{m2})(j_{ik}' + j_{pq}') \)

\[ \text{GDF} = \frac{1}{b_{12} - b_{5b10} - b_{5b11}} \left[ (b_{12} - b_{5b6}) E_m \right] \]

\[ - (b_{12} - b_{5b7}) T + (b_{12} - b_{5b8})(E_m + S_m) + (b_{12} - b_{5b10}) G \]

\[ R = \frac{1}{b_{12} - b_{5b12} - b_{5b11}} \left[ \frac{b_{12} - b_{5b6}}{E_m} \right] \]

\[ = (b_{11} + b_{7} - b_{5b7}) T + (b_{12} - b_{5b8})(E_m + S_m) + (b_{12} - b_{5b10}) G \]

\[ M = \frac{1}{b_{12} - b_{5b12} - b_{5b11}} \]

\[ \left[ \begin{array}{c}
\text{b}_{17} (b_{12} - b_{5b6}) - \text{b}_{18} (b_{11} b_{1} + b_{6} - b_{5b6}) \\
\text{b}_{17} (b_{12} - b_{5b7}) - \text{b}_{18} (b_{11} + b_{7} - b_{5b7}) \\
\text{b}_{17} (b_{12} + b_{5b6}) - \text{b}_{13} (b_{11} b_{2} + b_{6} - b_{5b6}) \\
\text{b}_{17} (b_{12} - b_{5b10}) - \text{b}_{18} (b_{11} b_{4} + b_{10} - b_{5b10}) \\
\text{b}_{18} (b_{12} - b_{5b12} + b_{5b11}) \end{array} \right] \]

\[ \left[ \begin{array}{c}
\text{b}_{17} (b_{12} - b_{5b6}) - \text{b}_{18} (b_{11} b_{1} + b_{6} - b_{5b6}) \\
\text{b}_{17} (b_{12} - b_{5b7}) - \text{b}_{18} (b_{11} + b_{7} - b_{5b7}) \\
\text{b}_{17} (b_{12} + b_{5b6}) - \text{b}_{13} (b_{11} b_{2} + b_{6} - b_{5b6}) \\
\text{b}_{17} (b_{12} - b_{5b10}) - \text{b}_{18} (b_{11} b_{4} + b_{10} - b_{5b10}) \\
\text{b}_{18} (b_{12} - b_{5b12} + b_{5b11}) \end{array} \right] \]

\[ \text{T} \]