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, recognising 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 attain 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

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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 standardised 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 distinguishing 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 adjustible 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, intermediate goods, and construction materials, but not consumer vehicles,

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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 transac-
tions from the budgetary data. Then the figures for the fiscal year
beginning in any calendar year are used in conjunction with produc-
tion 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 relation-
ships 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, measu-
red 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. Manufactur-
ing 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

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* Since these data were prepared the Statistics Division has publi-
shed 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, reflect-
ing 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, respe-
ctively; 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 independent-
ly before the model is used in projection, in the course of specify-
ing 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 approxi-
mated, 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 sub-
stantially 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 expansion.

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 agricul-
tural 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 present-
ed 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, agricul-
tural 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 invest-
ment 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 - 3.5 and 4.3 for construc-
tion, 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

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* 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 alge-
braic 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 agricul-
tural and non-agricultural, have different effects on imports, invest-
ment requirements, and tax revenues; in which what happens domestic-
ally 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 pro-
duction, 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 invest-
ment coefficients, tax revenue coefficients, and the extent of import
substitution, but not other 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.*

C. Recent Economic Trends as seen in the Model

The principal variables of the model provide a rather illumina-
ting summary of recent trends in the Uganda economy. Two periods,
1954-58 and 1958-62, 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

* This picture of the economy seems fundamentally similar to that
in B. Van Arkadie, "Notes on a Model of the East African Economy",
EDRP 26, 7.4.64. Two differences are that the present model does
not consider explicitly the possible effect of relative prices in
any economic relationships or the possible differences in derived
demands from wages and other shares of gross product. For a pro-
jection model it seems preferable to neglect these theoretically
suggestive but unfortunately statistically less manageable relat-
tionships.

** I am indebted to Isaiah Kinyenye 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 1958, and doubled again by 1962.

Meanwhile the ratio of imports to GDP remained virtually con-
stant 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 coun-
try'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 18% 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.

D. 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

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* 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 pre-
sumption 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, c5, i2, and j2 - for vehi-
cles, fuel, and equipment - are presumed not to be subject to import
substitution, and as the observed parameters 1954-62 appear compati-
ble with this presumption, their future values are assumed to conti-
nue at the 1962 level. On the other hand, c1, c2, i1, and j1- 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 Sm is about £2.3 million at 1962 levels of GDP.

Turning to the four tax revenue parameters, r1 for direct
taxes 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, r3 and r4 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, r2 for export taxes 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 r2 parameter fell from
about 12% in 1958 to about 8% in 1962, and then jumped to about 16%
in 1963. The estimated future parameter starts from the 1963 level
of agricultural export prices and assumes an average annual fall of
1% between 1963 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

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may be especially interesting to examine the budgetary implications
of these "reasonable" tax decisions in a context of resumed expan-
sion 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 para-
meters unless the past rate of growth is expected to continue un-
changed. The author has not yet made any explicit projections of
the autonomous variables, so the process of estimating the invest-
ment 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 sub-
stitution 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 recognized 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 agri-
culture, 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 £1 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.* The multiplier for manufactured exports or import substitution is about the same as for agricultural export prices, because of two main offsetting effects; the larger import content of manufactured products tends to lower the multiplier while higher investment requirement tend to raise it.

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

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* 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, manufactured 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 manufactured 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.

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* 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
         1954-58 and 1958-62[a]

	1954-58	1958-62
Real gross domestic product (GDP*)	+ 20.3%	+ 11.0%
Gross domestic product (GDP)	+ 14.3%	+ 0.0%
Private income (Y)	+ 15.4%	+ 0.0%
Real agricultural exports (Ea*)	+ 9.9%	+ 1.0%
Manufactured exports (Em)	+ £2.9 mil[b]	+ £3.1 mil[b]
Imports: ratio to GDP (M/GDP)	.30-.32	.32-.32
Export surplus: ratio to imports (E-M/M)	.48-.51[c]	.51-.32
Investment: ratio to real GDP ($K + Q/GDP*$)	.23-18[d]	.18-.14
Gov. current expenditures (G)	+ 42.9%	+ 15.4%
Gov. revenue: ratio to GDP (R/GDP)	.21-20	.20-.20
Gov. saving: ratio to gov. revenue (R-G/R)	.33-.13	.13-(-.01)
Real gross product of agriculture (Pa*)	+ 7.9%	+ 10.1%
Urban gross product (U	+ 38.2%	+ 17.1%
Urban employment (L)	+ 9.5%	- 2.6%

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 inter-
    vening years except in a few cases (footnoted) in which
    a terminal year appears unrepresentative.

b. Manufactured exports were only £0.2 million in 1954,
    increased to £3.1 million in 1958, and doubled from
    from 1958 to 1962.

c. Initial year ratio is 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

	1954	1958	1962	Test Projection 1958-62	"Reasonable" Projection 1962-70
a1 (assumed)	1.0	1.0	1.0	1.0f	1.0
a3 (assumed)	.3	.3	.3	.3f	.3
$a2 = Pa^* - a1\ Ea^* - a3(Em+Sm)/Y$	.118	.0915	.131	.0915f	.131
$g = Pg/G$	.426	.541	.609	.541	.740[a]
m2 (assumed)	.5	.5	.5	.5f	.5f
$m1 = Pm - m2(Em+Sm)/Y$	.0829	.0715	.0649	.0715f	.0649
$s = Ps/Y$	.218	.240	.269	.262	.313[a]
$t = Pt/Pa^* + Pm$	.0957	.127	.132	.127	.132
$h = Pk/K$	.324	.364	.466	.364	.546[a]
$c1 = Ma/Y$	.0512	.0802	.0618	.0722	.0558[b]
$c2 = Im/Y$	.165	.145	.157	.131	.141[b]
$c3 = Mv/Y$	.0411	.0269[e]	.0331	.0338	.0331
i3 (assumed)	.2	.2	.2	.2f	.2
$i1 = Mi - i3(Em+Sm)/GDP^*$	.0187	.0193	.0246	.0180f	.0221[b]
$i2 = Mf/GDP^*$	.0210	.0241	.0217	.0241	.0217
$j1 = Mk/K$	.221	.225	.198	.205	.178[b]
$j2 = Mq/Q$	.585[e]	.702	.689	.702	.689
$k' = K/U$	.372	.256	.158	.180	.285[c]
$q' = Q/U$	.196	.180	.135	.170	.215[c]
$p1 = Kp/K$	.653	.496	.458	.496	.458
$p2 = Qp/Q$	.891	.926	.944	.926	.944
$r1 = Rd/Y$	.0398	.0496	.0467	.0496	.0467
$r2 = Re/Ea$	.133	.122	.0792	.0830	.139[d]
$r3 = Rn/M$	.146	.148	.228	.213	.308[a]
$r4 = Ri/Y$	.0784	.0787	.0841	.0787	.090[a]

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 8% in 1954-58 and 4% in 1958-62.

    d. Assumes 1963 parameter of .160 will decline at 1.5 times 1% per year price fall.

    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)[a]

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

Notes:
a. 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[a]

Increase in:	GDP	Government Revenue (R)	Imports (M)
Per unit increase in:			
Real agricultural exports (Ea*)	2.07	.53	.59
Agricultural export prices (T)[b]	1.80	.46	.54
Manufactured exports or import substitution (Em, Sm)	1.83	.44	.83
Gov. current expenditures (G)	1.60	.36	.60

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. Arithmetically 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.

	Government Revenue (R)	Imports (M)
Real agricultural exports (Ea*)[a]	.26	.29
Manufactured exports or import substitution (Em, Sm)[b]	.24	.45

Notes:

a. Requires an increase of .48 of Ea* to generate a unit of GDP.

b. Requires an increase of .55 of Em or Sm to generate a unit of GDP.

APPENDIX II

<u>A PROJECTION MODEL FOR UGANDA, ADAPTED TO AVAILABLE STATISTICS</u>

<u>A. Variables</u>

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 ser-
      vices (private), rents

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

M   = imports = net imports, interterritorial imports
U   = urban gross product = Pg + 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 organization

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

$$Pa + Pg + Pm + Ps + Pt + Pk = GDP$$
$$Pg + Pm + Ps + Pt = U$$
$$Ma + Mm + Mv + Mi + Mf + Mk + Mq = M$$

$$Ea + Em = E$$

$$Ea + T = Ea^*$$

$$Pa + T = Pa^*$$

$$GDP + T = GDP^*$$

$$Kg + Kp = K$$

$$Qg + Qp = Q$$

$$Rd + Re + Rm + Ri = R$$

$$GDP - R = Y$$

$$Ea^*, T, Em, Sm, G = given$$

$$Pa^* = a_1 Ea^* + a_2 Y + a_3(Em + Sm)$$

$$Pg = g\, G$$

$$Pm = m_1 Y + m_2(Em + Sm)$$

$$Ps = s\, Y$$

$$Pt = t\, (Pa^* + Pm)$$

$Pk = h \ K$

$Ma = c1 \ Y$

$Mm = c2 \ Y$

$Mv = c3 \ Y$

$Mi = i1 \ GDP^* + i3(Em + Sm)$

$Mf = i2 \ GDP^*$

$Mk = j1 \ K$

$Mq = j2 \ Q$

$K = k1 \ dU + k2U = k'U$

> Note: The symbol dU stands for increment in U etc.
> The parameter k' is derived as an approximation
> depending upon the capital coefficient $k1$, the retire-
> ment nefficient $k2$, and growth of U.

$Q = q1 \ dU + q2 \ U = q'U$

$Kp = p1 \ K$

$Qp = p2 \ Q$

$Rd = r1 \ Y$

$Re = r2 \ Ea$

$Rm = r3 \ M$

$Ri = r4 \ Y$

C. Parameters

Note: Parameters will be estimated from annual observa-
tions for the years 1954-62 and from incremental observa-
tions for the sub-periods 1954-58 and 1958-62.

$a1 = 1.0$

$a = \dfrac{Pa^* - a1 \ Ea^* - a3(Em + Sm)}{Y}$

$g = Pg/G$

$a3 = .30$

$m2 = .50$
$i3 = .20$

> Note: $a3$, $m2$, and $i3$ are estimated from the approximate
> proportion in 1961 value of output of all manufacturing
> in Kenya of (a) domestic agricultural inputs, (b) manufa-
> cturing value added plus domestic non-agricultural
> inputs, (c) imported inputs.

$m1 = \dfrac{Pm - m2(Em - m3 \ Sm)}{Y}$

$s = Ps/Y$

$t = Pt/(Pa^* + Pm)$

$h = Pk/K$

$c1 = Ma/Y$

$c_2 = Mn/Y$

$c_3 = Mv/Y$

$i_1 = \dfrac{Mi - i_3(En+Sn)}{GDP^*}$

$i_2 = Mf/GDP^*$

$j_1 = Mk/K$

$j_2 = Mq/Q$

$k_1 = (Sum\ K - Sum\ k_2\ U)/dU$

$q_1 = (Sum\ Q - Sum\ q_2\ U)/dU$

$k_2 = .04$ $\quad$ <u>Note:</u> k_2 and q_2 are stimated assuming approximately a
$\qquad\qquad\qquad\qquad$ 40-year life for construction and a 10-year life
$q_2 = .11$ $\qquad\qquad$ for equipment, with both stocks growing at an
$\qquad\qquad\qquad\qquad$ average annual rate of about 5%, and with the
$p_1 = Kp/K$ $\qquad\quad$ ratio of investment to gross product in the past
$\qquad\qquad\qquad\qquad$ about the same as in the 1950's.
$p_2 = Qp/Q$

$r_1 = Rd/Y$

$r_2 = Re/Ea$

$\qquad$ <u>Note:</u> r_2 for projection is adjusted separately for change in
$\qquad\qquad$ terms of trade adjustment (T)

$r_3 = Rn/M$

$r_4 = Ri/Y$

<u>Values of k' and q' for various annual rates of growth of urban</u>
$\qquad\qquad\qquad\qquad\qquad$ <u>gross product</u>

	3%	5%	7%	9%	11%
k'	.145	.215	.285	.355	.425
q'	.155	.185	.215	.245	.275

$\qquad$ Note: Assumes capital-output ratios $k = K/dU = 3.5$ and
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad q = Q/dU = 1.5$.
$\qquad\qquad$ Assumes retirement rates Ret $K = .04U$ and
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ Ret $Q = .11U$.

D. Some Key Relationships

$b_1 = a_1(1 + t + hk't)$

$b_2 = a_3 + (m_2 + ta_3 + tm_2)(1 + hk')$

$b_4 = g(1 + hk')$

$b_5 = a_2 + (m_1 + s + ta_2 + tm_1)(1 + hk')$

$b_6 = r_2 + r_3ta_1(j_1k' + j_2q')$

$b_7 = r_2 - r_3(i_1 + i_2)$

$b_8 = r_3i_3 + r_3(m_2 + ta_3 + tm_2)(j_1k' + j_2q')$

b10 = (r3) (g) (j1k' + j2q')

b11 = (r1 + r4) + r3(c1 + c2 + c3)+ r3(m1 + s + ta2 + tm1)(j1k'+j2q')
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ + r3(i1 + i2)

b12 = 1 + (r1 + r4) + r3 (c1 + c2 + c3)
$\qquad$ + r3 (m1 + s + ta2 + tm1)(j1k' + j2q')

b13 = ta1(j1k' + j2q')

b14 = i1 + i2

b15 = i3 + (m2 + ta3 + tm2)(j1k' + j2q')

b16 = g(j1k' + j2q')

b17 = (c1 + c2 + c3) + (m1 + s + ta2 + tm1)(j1k' + j2q') + (i1 + i2)

b18 = (c1 + c2 + c3) + (m1 + s + ta2 + tm1) (j1k' + j2q')

$$\text{GDP} = \left[\frac{1}{b12 - b5b12 + b5b11}\right] \left[(b12b1 - b5b6)\ Ea^* \right.$$
$$\left. -(b12 - b5b7)T + (b12b2 - b5b8)(Em + Sm) + (b12b4 - b5b10)G \right]$$

$$R = \left[\frac{1}{b12 - b5b12 + b5b11}\right] \left[(b11b1 + b6 - b5b6)Ea^* \right.$$
$$- (b11 + b7 - b5b7)T + (b11b2 + b8 - b5b8)(Em + Sm)$$
$$+ (b11b4 + b10 - b5b10)G$$

$$M = \left[\frac{1}{b12 - b5b12 + b5b11}\right]$$

$$\left(\left[b17(b12b1 - b5b6) - b18 (b11b1 + b6 - b5b6) \right.\right.$$
$$\left. + b13 (b12 - b5b12 + b5b11) \right] Ea^*$$
$$- \left[b17 (b12 - b5b7) - b18 (b11 + b7 - b5b7) \right.$$
$$\left. + b14 (b12 - b5b12 + b5b11) \right] T$$
$$+ \left[b17 (b12b2 - b5b8) - b18 (b11b2 + b8 - b5b8) \right.$$
$$\left. + b15 (b12 - b5b12 + b5b11) \right] (Em + Sm)$$
$$+ \left[b17 (b12b4 - b5b10) - b18 (b11b4 + b10 - b5b10) \right.$$
$$\left.\left. + b16 (b12 - b5b12 + b5b11) \right] G \right)$$