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A DESIGN FOR AN ECONOMETRIC MODEL OF  
THE KENYANI ECONOMY

By

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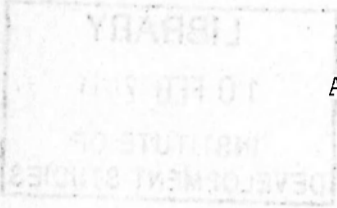
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ABSTRACT

This paper describes the structure, equations and data sources for a medium-sized econometric model of the Kenyan Economy to be estimated from annual data for the period 1947-1972.

A DESIGN FOR AN ECONOMETRIC MODEL OF  
THE KENYAN ECONOMY

This paper outlines the structure of an econometric model for Kenya whose main features are that it incorporates five producing sectors, takes exports to be determined by supply relationships in response to world prices and considers imports to be determined by the gap between supply and demand for the output of the producing sectors. Price formation is a simplified version of a formulation that assumes that producers adjust output prices in an effort to keep gross profit rates constant.

The treatments of consumption, investment, employment and earnings follow fairly conventional formulations.

Considerable complications are introduced by the import-output relationships involved with five producing sectors, and simplifying assumptions are made to make the model manageable in this respect.

The model involves about 33 structural equations.

The main purposes of the model are to test alternative hypotheses about the causal relations determining the main endogenous variables, to allow simulation of the implications of various plan proposals and to act as a guide for a more disaggregated version relying on fewer simplifying assumptions.

An offshoot of the model is that it involves the estimation of a considerable number of annual data series on a consistent basis back to 1947. For each sector a brief account of the method of estimation of the series is given, and also the data source when this is not the Kenya Statistical Abstract.

AGGREGATE DOMESTIC SUPPLY: THE PRODUCING SECTORS

Five sectors are considered - the traditional (i.e. non-monetary) sector, Agriculture (agriculture, forestry and fishing), Industry (mining and quarrying; manufacturing and repairs; electricity and water; building and construction), services (transport, storage and communications; wholesale and retail trade; banking insurance and real estate; ownership of dwellings; other services: domestic services and Government (the 'general government' sector)).

The approach is to estimate Cobb-Dougllass production functions for each of these sectors with the exception of the Government sector, which is taken to be exogenous.

(a) Traditional Sector

Form of production function taken to be:

$$VT = Ae^{rt} NT^{\alpha} R^{\gamma} \quad (1)$$

Where VT is constant price value-added in the traditional sector; A is a constant; r is the rate of exogenous technical improvement in the traditional sector; t is a time trend; NT is rural population, used as a proxy for labour input; R is a weather variable.

Data: VT - value - added in the non-monetary economy deflated by maize prices; NT - annual population of Kenya less the population of the main towns; R- deviations from mean rainfall for stations in six provinces weighted by high potential land in 1971 in these provinces.

(b) Agriculture

Form of production function taken to be:

$$VA = Ae^{rt} LA^{\alpha} KA^{\beta} R^{\gamma} \quad (2)$$

Where the variables are similar to those in the traditional sector, with KA being the constant price stock of capital in monetary agriculture monetary agriculture.

Data: VA - value-added in monetary agriculture, forestry and fishing deflated by an index of agricultural prices compiled from wheat, maize, coffee, pyrethrum, sisal, tea, dairy and cattle price series; LA - employment in agricultural sector; KA - constant price capital stock figure for agriculture compiled from separate series for structures and equipment (deflated by a building and construction price index and an index of the prices

of imported capital goods respectively) using the perpetual inventory method and benchmark figures culled from capital assets [1], Powell [6] and Tobin [7] with depreciation rates taken from Powell [6], and a series for livestock capital from figures of numbers of dairy cattle and breeding stock; R - weather variable as in the traditional sector.

(c) Industry

Form of production function:

$$VI = Ae^{rt} LI^{\alpha} KI^{\beta}$$

Data: VI - value - added in mining and quarrying, manufacturing and repairs, building and construction, electricity and water, each series deflated by its own price index and the series aggregated; LI - employment in industry; KI - constant price capital stock in industry compiled as for agricultural capital.

(d) Services

$$VS = Ae^{rt} LS^{\alpha} KS^{\beta}$$

Data: VS - value - added series for transport, storage and communications, wholesale and retail trade, banking, insurance and real estate, ownership of dwellings, other services, and domestic services, these six series separately deflated by appropriate price indices and aggregated; LS - employment in services; KS - constant price capital stock in services compiled as for agricultural capital.

(e) Government

The method of estimating the output of the General Government sector by valuing output at the cost of inputs does not lead to a Cobb-Douglas formulation which implies diminishing returns to factors - there is a linear relationship between inputs and outputs. Rather than estimate this accounting relationship

from the inputs and outputs series, value - added for this sector was left exogeneous.

Data: VG - value added in general government deflated by an index of earnings of public sector employees; LG - employment in general government; KG - constant price capital stock estimated as for agricultural capital.

AGGREGATE DEMAND

This is split into five components, Private Consumption, Investment, Stocks, Public Consumption and Exports.

(a) Private Consumption

The intention is to test two propositions here. Previous work showed (for 1964-71) private consumption to be related to GDP and the wage-share in the monetary sector, Hodd /3/. This would give a consumption function of the form:

$$C = a + bV - c(W/(V - VT)) \quad (5)$$

where C is private consumption in constant prices, V is G.D.P. in constant prices, W is wage income in monetary sector in constant prices.

It is hoped to test this formulation with longer series compiled from 1947.

However, it may be that the inverse relationship between consumption and the wage-share is observed because non-wage income is more readily taxed than wage income, and that really the formulation should be in terms of disposable income rather than G.D.P., i.e.

$$C = a + b(V-T) + c(W/(V-VT)) \quad (6)$$

where T is income tax in constant prices. If the coefficient of the wage-share variable in the above formulation is insignificant, the influence of distribution can be taken to be

solely through the greater taxability of non-wage income rather than via differing marginal propensities to consume out of disposable income.

It is intended to explore lags in the consumption function

Data:  $\bar{C}$  - estimated as a residual (1947-63) from other constant price series (i.e. G.D.P. - indirect taxes and + subsidies + imports - exports - stock changes - gross capital formation - public consumption = private consumption);  $W$  - product of employment and average earnings in each sector, aggregated and deflated by the implicit GDP price index;  $T$  - income tax deflated by implicit GDP price index.

(b) Investment

As the capital stock figures employed in the production functions are built up from separate series for structures and equipment (and livestock), for consistency separate investment functions for each of these types of capital formation are required, making seven equations for Agriculture, Industry and Services. In addition an equation is required for investment in dwellings in the traditional sector so that estimates of this can be made for the period 1947-63 for use in the identity used to find private consumption as a residual.

Taking this latter first, investment in traditional dwellings is related to rural population via a stock adjustment model.

If the stock of traditional sector housing is kept proportional to rural population, we have:

$$DT = cNT \tag{7}$$

where  $DT$  is the stock of traditional sector dwellings.

Then if dwellings depreciate at rate  $\delta$ , we have

the stock, investment, depreciation identity:

$$DT_t = IT_t + (1 - \delta)DT_{t-1} \tag{8}$$



where IT is investment in traditional sector dwellings  
Equations (7) and (8) yield two possible estimating  
equations:

$$IT_t = a \overline{NT}_t - (1 - \delta) \overline{NT}_{t-1} \quad (10)$$

Equation (10) will be a better proposition, using an  
extraneous estimate of  $\delta$ , as  $N_t$  and  $N_{t-1}$  will be highly correlated,  
bearing in mind that there is a large element of interpolation in  
their estimation.

An alternative formulation might involve rainfall as  
a factor hastening depreciation, such as

$$\delta = a + b.RN \quad (11)$$

or 
$$\delta = b.RN \quad (12)$$

where RN is a rainfall index, and a and b constants.  
These formulations could be used to substitute for  $\delta$  in equation  
(8), giving estimating equations

$$IT_t = aNT_t + bNT_{t-1} + CRN.N_{t-1} \quad (13)$$

or 
$$IT_t = a(NT_t - NT_{t-1}) + bRN.NT_{t-1} \quad (14)$$

Again, equation (14) is less likely to be smitten with collinearity  
than equation (13)

For the seven equations for investment in structures  
equipment and livestock in Agriculture, Industry and Services, it  
is planned to test three types of model: a capital-stock adjustment  
model, an expected profits model and a neoclassical model (see  
Jorgenson [4]). It is intended that experiments be made with  
these basic models with regard to lags and cost of finance.

(i) Capital Stock Adjustment Model

Desired capital stock given by

$$K_t^* = bV_t^* \quad (15)$$

Expected income determined by

$$V_t^* - V_{t-1} = V_{t-1} - V_{t-2} \quad (16)$$

Adjustment mechanism

$$K_t - K_{t-1} = \lambda(K_t^* - K_{t-1}) \quad (17)$$

Investment, capital stock, depreciation identity

$$K_t = I_t - (1 - \delta) K_{t-1} \quad (18)$$

Where K is capital stock, V value added, I investment, \* indicates an expected value of the variable, b is the desired capital - output ratio,  $\lambda$  the adjustment coefficient,  $\delta$  the rate of depreciation, and the letters denoting the sectors have been omitted.

The above model yields an estimating equation of the form

$$I_t = a(2Y_{t-1} - Y_{t-2}) + cK_{t-1} \quad (19)$$

In the context of this model it is hoped to test whether there is any trend to the desired capital - output ratio by regressing

$K/V = \alpha + \beta t = b^*$ , where t is time trend, and using estimates from this equation for b in equation (15).

It is also planned to test for the effect of political instability by experimenting with alternative dummy variables in the expected income relation for the years 1960-63 (first Constitutional Conference to Independence) and 1958 to 1963 (first African elected to Legco to Independence).

It is hoped to test the effect of external finance by relating  $\lambda$ , the adjustment coefficient, to the rate of interest (i) - say  $\lambda = \alpha + \beta i$  or  $\lambda = \beta i$  - and the effect of internal finance by relating  $\lambda$  to the profit rate,  $\rho$  in the sector.

(ii) Expected Profits Model

This will have the same form as the capital - stock adjustment model, except desired capital-stock is related to expected profits rather than value added. The formulation hinges on the idea that businessmen adjust capital stock until a normal

gross profit rate is achieved.

(iii) Neoclassical Model

A profit - maximising firm will equate the value of the marginal product with the price of the factor. In the context of Cobb-Douglas production functions and capital, the value of the marginal product is

$$dV/dK = \beta V/K \quad (20)$$

In current value terms, and equating the value of the marginal product to the rate of interest  $i$ , where  $P$  is the implicit price index of the value added and  $PK$  is the price of capital goods, we have

$$\beta P.V/PK.K = i$$

Thus, in a formulation which relates desired capital stock to the expected value of value-added, we have

$$K^* = \beta P.V^*/PK.i \quad (21)$$

and this takes the place of equation (15) in the capital stock adjustment model.

Investment in the Government sector is treated as exogenous.

Data: (apart from variables already described)  $\rho$  - estimated as non-wage income by subtracting the product of employment and money earnings from current price value added, deflating by the G.D.P. implicit price index, and dividing by constant price capital stock;  
 $i$  - Treasury Bill rate adjusted for price inflation, Kenya rate 1969-72, EACB rate 1966-69, UK rate 1947-65.

(c) Investment in Stocks

A simple relation of the level of stocks with the level of G.D.P. leads to a stock change equation with change in G.D.P. as

the independent variable

$$\Delta S = \delta(V_t - V_{t-1}) \quad (22)$$

Where  $\Delta S$  is investment in stocks, and  $V$  is G.D.P. Equation (22) will be explored for possible non-linearity before estimation.

Data:  $\Delta S$  only available from 1964-72.

(d) Public Consumption

This is taken to be exogeneous.

Data: Recurrent government expenditure used as a proxy (1947-63) deflated by general government implicit price index (i.e. index of earnings in public sector).

(e) Exports

It has always seemed to me that the usual demand equations for exports in econometric models are quite unsatisfactory for countries like Kenya which are mostly primary producers, exporting small proportions of the total world output of each crop, and, on the whole, taking the world price without having any control over it.

It is therefore planned to determine exports by supply relationships with the world price exogenous.

Seven export sectors are considered, based on the size of export earnings over the post-war-period. They are Coffee, Tea, Sisal and other Exports - all considered to be products of the Agriculture sector and Petrol, Soda and other Manufactures, considered products of the Industry sector.

The formulation chosen is to consider that the proportion of the gross output of a producing sector devoted to exports is a function of the price to producers for the export crop relative to the average price of the output of the producing sector. So for the coffee sector, say, we have

$$XC_t^*/XA = \alpha + b (PC/PA) \quad (23)$$

Where  $X_C$  is constant price exports of coffee,  $XA$  is gross output of the Agriculture sector,  $PC$  is the price to producers for coffee and  $PA$  is the implicit price deflator for the Agriculture sector.

Now if we assume (see below for Imports) that  $XA = r_a.VA$ , where  $r_a$ , a constant, is the number of units of agricultural value added required to make one unit of gross output of the agriculture sector, and we assume a Koyck distributed lag, we obtain as an estimating equation.

$$XL_t = aVA + b(PC/PA) + cXC_{t-1} \quad (24)$$

It is planned to explore the relation between prices to producers and the unit value price indexes of exports. If there is little relation, prices to producers will be taken as exogenous. Export prices will be considered exogenous.

#### IMPORTS: THE EQUATING OF SUPPLY AND DEMAND

In brief, it is considered that imports are determined the gap between supply and demand for the goods of the producing sectors.

A complication arises in that Private Consumption and stock changes are aggregates and not broken down into goods which can be associated with the five producing sectors. This problem is tackled by assuming that the proportions in which the goods are drawn from each sector are fixed. These proportions are taken from the final demand vector for consumption and stocks in the 1962 Input-output Table /1/ Investment, Public Expenditure and Exports are readily identified with producing sectors.

A second complication arises in that our sector outputs are expressed in value added, and demands will be in terms of final goods - we need to use a consolidated (5 x 5) version of the 1967 Input-Output Table to obtain domestic supplies of final goods.

The formal procedure is to split Private Consumption and Stock Changes into demand for output of the Traditional Sector (32.9%), Agriculture (5.4%), Industry (28.7%), Services (26.7%) and Government (6.2%), Agricultural livestock investment is allocated to the Agriculture sector, all equipment and structures investment to the Industry Sector, public consumption to the Government Sector, exports of Coffee, Tea, Sisal and Other Exports we allocate to the Agriculture sector, exports of Petrol, Soda and other Manufactures we allocate to the Industry sector.

We now have a vector of final demands (d) broken down by producing sector.

On the supply side we have value added by sector from the four production functions and the exogenous Government sector. Then if we make the usual production assumptions employed in input-output table manipulations, i.e. that

$$x_{ij}/x_j = a_{ij} = \text{constant} \quad (25)$$

$$\text{and} \quad V_j/x_j = r_j = \text{constant} \quad (26)$$

Where  $x_{ij}$  is total sales (including imports) of the  $i$ th good to the  $j$ th sector,  $x_j$  is the gross output of the  $j$ th sector,  $a_{ij}$  is the input of the  $i$ th good (including imports) required to make one unit of the  $j$ th good, and  $r_j$  is the value-added required to make one unit of good  $j$ .

Then we can obtain the vector of gross output ( $x$ ) from (26), via

$$x_j = r_j V_j \quad (27)$$

And the vector of goods available as supply to final users(s) will be gross output less interindustry demands, i.e.

$$s = x - Ax = \underline{\underline{I-A}}/x \quad (28)$$

where  $A$  is the matrix of the  $a_{ij}$ .

We now assume that the vector of imports (m) fills the gap between supply and demand, i.e.

$$m = d - s \quad (29)$$

Equation (29) assumes that the price elasticity of demand for imports is zero. A more flexible formulation would be to consider, for a sector i

$$m_i = f \left[ (d_i - s_i), \frac{PM_i(1 + MD_i)}{P_i} \right] \quad (30)$$

where  $PM_i$  is import price of sector i goods,  $P_i$  the implicit price deflator of sector i. and  $MD_i$  is the rate of import duty on goods of sector i.

Data: m - imports classified to appropriate producing sectors and deflated by unit price indices,  $PM$  - unit price indices of imports,  $MD$  - import duty as a fraction of current price value of imports.

#### EMPLOYMENT

It is planned to handle employment by sector by experimenting with a model based on a desired labour/output ratio and a neoclassical model. The models will thus be very similar to the equivalent models in the investment sector with an income expectation hypothesis and an adjustment relation (there is no equivalent of the investment/capital stock/depreciation identity). The years of the tripartite agreements may have to be excluded from the observations used for making the estimates.

Data: Earnings per man from total earnings divided by employment, only available for Agriculture, Industry and Services together and Government.

#### PRICE FORMATION

There is a strong body of opinion that the money supply is completely passive in Kenya (see King /5/). Testing the relationship between the general price level and the supply of money on a quantity theory basis is bedevilled by the East Africa Currency Board and its co-existence with the Central Banks of the three East

African Territories from 1966. Any testing of a quantity theory formulation would need to relate the general price level in East Africa to the levels of GDP in East Africa. Statistics of GDP for the three territories are available from 1956. However, if testing based lags of the price level behind changes in the money supply were consistent with the quantity theory, there would still remain the problem of obtaining the Kenyan price level from the general East African price level - this would presumably depend on supply and demand relationships for the particular mixes of goods produced by the three E.A. countries. Rather than bother to test a quantity theory relationship in the face of the arguments in King /5/, it was decided to formulate an explanation of prices in Kenya based on cost factors, and to assume that the supply of money was passive.

We must now square up to the problem that the price of gross output in a sector will not be the same as the price of the value added in that sector.

If  $P_j$  is the price index of the output of sector  $i$  and  $PV_j$  is the price index of its value added,  $h_{ij}$  is the input of domestically produced goods used to produce one unit of gross output of sector  $i$ ,  $m_{ij}$  is the input of imported goods used to produce one unit of gross output of sector  $i$ , ( $h_{ij} + m_{ij} = a_{ij}$ ) and  $r_j = V_i/x_i$ , then, for a particular year,

$$P_j = \sum_i P_i h_{ij} + \sum_i P M_i (1 + M P_i) m_{ij} + P V_j r_j \quad (31)$$

giving

$$P V_j = P_j / r_j - \sum_i P_i h_{ij} / r_j - \sum_i P M_i (1 + M D_i) m_{ij} / r_j \quad (32)$$

This should enable us to solve for the  $PV_j$ , taking the  $r_j$  from the input - output table, providing we could lay our hands on estimates of  $h_{ij}$  and  $m_{ij}$ . It would be possible to assume the  $h_{ij}$  and  $m_{ij}$  remained constant at the 1967 values, but this would be inconsistent with the hypothesis of the model that imports (and presumably imports of intermediates) depend on the supply/demand gaps for the sectors. A better procedure would be to make proportionality assumptions to estimate the  $m_{ij}$  from figure of imports analysed by end use 1964-72 and from import figures before then.



The various coefficient matrices of the consolidated input-output matrix for 1967 are shown below as Tables I, II & III.

TABLE I

100x aij Matrix (1967)

SALES TO SALES BY	TRAD	AGRIC	INDY	SERVS	GOVT
TRAD	2.52	0	0	0	0
AGRIC	0.52	1.01	18.35	0.28	0.44
INDY	2.17	10.29	33.00	15.40	11.66
SERVS	0.47	7.03	11.33	18.99	12.03
GOVT	0	0.24	0.02	0.27	0
V.A.	94.31	81.43	37.30	65.07	75.87

N.B. Table I includes imported inputs, but excludes import duty.

TABLE II

100 x hij Matrix (1967)

SALES TO SALES BY	TRAD	AGRIC	INDY	SERVS	GOVT
TRAD	2.52	0	0	0	0
AGRIC	0.52	0.93	16.68	0.24	0.39
INDY	1.81	4.33	16.57	8.80	9.14
SERVS	0.47	7.03	11.33	16.59	12.03
GOVT	0	0.24	0.02	0.27	0

TABLE III  
100 x mij Matrix (1967)

INPUT TO INPUTS OF	TRAD	AGRIC	INDY	SERVS	GOVT
TRAD	0	0	0	0	0
AGRIC	0	0.08	1.67	0.04	0.05
INDY	0.36	5.96	16.43	6.60	2.52
SERVS	0	0	0	2.42	0
GOVT	0	0	0	0	0

N.B. Import duties removed by assuming the same rate on all goods classified to a particular sector (e.g. assumes that all imported agricultural goods used as inputs by Agriculture, Industry Services & Government Sectors carry duty at the same rate).

If we look at the hij and mij in these consolidated tables, we see that they are on the whole, small compared with the rij. The one exception would appear to be the Industry sector, and here the input of Industry sector inputs (having the same price as the gross output) is fairly large at 16.57%.

Furthermore it is to be expected that the various Pi and PMi will be highly correlated. The assumption is made, for this formulation of the model, that Pj = PVj, and at this level of aggregation the error in doing so is probably not great.

We turn now to the determination of the Pj. The formation of prices is taken as a mark-up relationship to keep profit rates constant in the face of increases in costs.

Gross profit ( $\pi$ ) of sector j will be given, as a residual, by

$$\pi_j = P_j X_j - \sum_i X_{jih} P_i - \sum_i X_{jim} P_{Mi} (1 + MD_i) - E_j L_j \quad (33)$$

Where E is money earnings per worker, and L is employment.

Then the gross profit rate,  $\rho$ , will be given by

$$\pi_j/K_j = \rho = P_j X_j/K_j - (X_j/K_j) \sum_{hij} P_i - (X_j/K_j) \sum_{mij} P_{mi}(1+MD_i) + E_j \cdot L_j/K_j$$

Now if we assume that  $X_j/K_j$  and  $L_j/K_j$  remain constant, and that producers aim to preserve a constant profit rate, we have

$$P_j = a_p + b \sum_{hij} P_i + b \sum_{mij} P_{mi}(1+MD_i) + \rho E_j \quad (34)$$

A simplification seems to be called for with regard to the  $\Sigma$  terms. Looking at the tables of the  $h_{ij}$  and  $m_{ij}$  for 1967, it would seem, for imported inputs, that industry sector goods are the only significantly large category, and so the price element in the second  $\Sigma$  term could be taken to be the import price of manufactures. For domestically produced inputs, the general GDP price deflator could be used as there is no one predominant category of inputs.

Equation (34) then becomes

$$P_j = a + bP + cPMI(1+MDI) + dE_j \quad (35)$$

Where  $P$  is the general GDP price deflator,  $PMI$  is the unit price index for imports of manufactures and  $MDI$  is the rate of import duty on imports of manufactures. As the model argues that changes in the percentages of inputs that are imported will occur depending on the gap between supply and demand for the sectors, we could perhaps experiment with imports in equation (35) on the following lines

$$P_j = a + bP/M + cMI \cdot PMI(1+MDI) + dE_j \quad (36)$$

Where  $M$  is the constant price value of total imports, and  $MI$  is the constant price value of manufactures imports. It is planned to experiment with lags in the price equations. It is expected that equation (36) will serve for the Agriculture, Industry & Services sectors. The price index used to deflate the output of the Government sector is an index of earnings, and this will be determined by the appropriate earnings equation.

For the Traditional sector, output in any one year will be fixed and more or less equal to  $V_T$  as there are only small inputs of intermediates from other sectors. If demand depends on rural population,  $NT$ , and price,  $PT$ , we obtain an estimating

equation for the price of the Traditional sector output.

$$PT = a + bNT + cVT \quad (37)$$

Data:  $P_j$  - implicit price deflators of producing sectors.

#### EARNINGS

The formulation here (omitting the letters devoting particular sectors) is essentially a Phillip's curve relationship stating that the rate of change of money earnings,  $(E_t - E_{t-1})/E_{t-1}$ , depends on the rate of change of consumer prices,  $(PC_t - PC_{t-1})/PC_{t-1}$ , the rate of profit in the sector in the previous period,  $(V_{t-1}P_{t-1} - (L_{t-1}E_{t-1})/K_{t-1}$ , indicating the case with which demands can be met, trade union strength as indicated by the proportion of the employees in the sector unionised,  $TUM/L$ , trade union militancy as indicated by days lost in strikes per worker,  $STR/L$ , and a demand for jobs variable as indicated by the ratio of population (used as a proxy for the labour force) to jobs (ratio of rural population to Agricultural employment,  $NT/LA$ , for the Agriculture sector, ratio of urban population to non-agricultural employment  $NU/(L-LA)$  for Industry, Services and Government).

The years of the tripartite agreements will have to be excluded from the observations used to estimate the relationships.

Experiments will be made with various functional forms, and with lags.

Data: Earnings only available for Agriculture, Industry and Services together, and Government:  $PC$  - consumer price index; Union membership taken from Annual Reports of the Labour Department and the Ministry of labour. Days lost in strikes from statistical Abstract;  $NU$  - the population of the main towns obtained, between census years, by interpolation.

#### DISTRIBUTION OF POPULATION

It would be possible to make  $NT$ , (the rural population and proxy for the Traditional sector labour force) an endogenous

variable with an equation to explain urban population, NU, (using, say, modern sector employment, relative incomes etc as explanatory variables) and obtaining rural population as a residual from the total population. Thus just the overall level of population would be exogenous.

However, as the urban population figures, apart from three census enumerations, are interpolations there will be negligible effective degrees of freedom with which to test hypotheses about the effect of employment and incomes on urban population. Thus it would seem sensible to take rural and urban population as exogenous.

#### INCOME DISTRIBUTION

This will fall out of the model via the production function, price formation, earnings and employment relationships. Wage income for each producing sector will be given by the product of employment,  $L_j$ , and earnings  $E_j$  and gross non-wage income (gross profits) as a residual from  $P_j V_j - L_j E_j$ . Net profits can be obtained via the capital stock estimates and the depreciation relationships.

#### SUMMARY

The main causal relations in the model are presented in Diagram I. The system really divides into supply on the left of the diagram, and supply on the right, supply squaring up with demand via imports. Adjuncts to the system are earnings, prices and employment in the loop at the bottom left and income distribution at top left.

It is anticipated that there will be around twelve exogenous influences (some may not be significant), and it is expected that those will comprise income taxes, the rate of interest, export prices, import prices, import duties, public consumption, climate, technical progress (via time trend), population (as proxy for labour force) and union bargaining variables. In addition the Government producing sector is taken as exogenous (i.e. Government investment; employment and output).

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