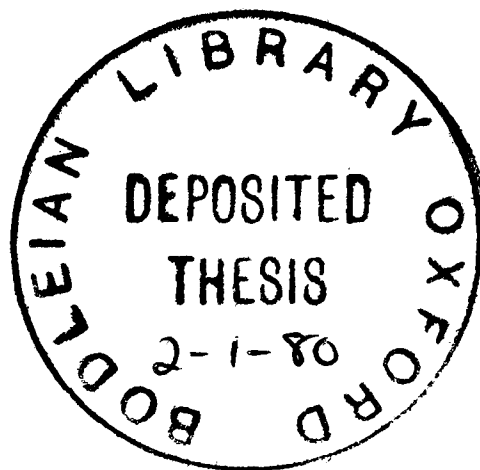


INCOME DISTRIBUTION IN MODELS FOR
DEVELOPING COUNTRIES : KENYA AND TANZANIA

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LIST OF ABBREVIATIONS

EAC	East African Community
ILO	International Labour Office
IRS	Integrated Rural Survey
K£	notional unit used only in Kenya national accounts and trade statistics; equal to 20 Ksh.
Ksh	Kenyan shilling
M	million
NFS	non factor services
Tsh	Tanzanian shilling

I INCOME DISTRIBUTION IN MODELS FOR DEVELOPING COUNTRIES

1.1. Introduction

With some exaggeration the 1970s may be described as the decade in which development economists rediscovered the problems of poverty and inequality of the distribution of income, after fifteen years or more of preoccupation with economic growth. Three groups of income distribution studies can be distinguished in the literature: (a) statistical investigations of the relationship between economic growth and income inequality, (b) partial equilibrium analyses of the distributional consequences of market imperfections and (c) analyses of the causes and effects of changes in income distribution using economy-wide models.

The first group of studies are inspired by Kuznets' (1955,1963) observation that initially inequality may increase as the economy grows. Cross-country regressions have been used to establish the existence of such a Kuznets curve.¹ The latest - and perhaps the last - study of this kind is that of Ahluwalia (1976). By now disillusionment with the approach has set in.

First, the cross-country approach has become suspect as the profession has become more aware of inter-country differences in the determinants of the distribution of income, including the diversity of institutional arrangements. Secondly, such studies do not contribute anything to an explanation of changes in inequality. Finally, if one accepts the Kuznets curve then there are no policy implications: increasing inequality is inevitable during the early stages of development; one would have to believe that it is impossible to affect income distribution through policy measures.

1. Adelman and Morris (1973) went one step further and claimed that as developing countries grow not only relative but also absolute poverty increases. For severe criticism of their analysis, cf. Little (1976), Lal (1976).

The second group of studies, in contrast, is concerned about causality. They belong to an old tradition of development economics in which standard neo-classical theory is amended by incorporating those market imperfections which are typical of developing countries. In neo-classical theory income distribution is determined by the data of general equilibrium analysis: technology (factor-substitution possibilities), preferences and endowments (including the distribution of assets). This is at most a useful point of departure. Developing countries are characterised by price rigidities and other market imperfections in both goods and factor markets and these have significant implications for the distribution of income. A major part of this literature focusses on wage rigidities and on their implications in terms of migration, labour market segmentation and rationing of jobs. We return to this subject in section 1.3.

The third approach is that of the modelers. Initial effort concentrated on the effects rather than the causes of distributional changes. This emphasis may have been motivated by a concern for the effects of such changes on the economy's savings rate and on the composition of consumption. Such questions could easily be studied using existing input-output planning models.¹ Such models are not based on a theory of income distribution. More recent models - for a review see section 1.5 - are more firmly based on theory. These models usually however adopt conveniently extreme assumptions about the way in

1. Cf. Cline (1975), Chenery et al. (1973, pp. 191-194). In as recent a survey of economy-wide models as that of Blitzer et al. (1975) the discussion of income distribution is very short (pp. 138-147) and it presupposes a model in which the distribution of income is determined by 'a set of accounting relationships, most of which are definitions without much behavioural significance' (Clark (1975), p. 139): the emphasis is still on the effects on consumption and savings.

which equilibrium in the markets for goods and factors is reached. Often, prices are either entirely rigid (so that all adjustments are quantity adjustments) or they are treated as entirely flexible. In the early tradition of input-output models changes in demand and supply did not affect prices. The pendulum has now swung the other way: some modelers, in their enthusiasm for models based on general equilibrium analysis¹, have constructed models in which prices (including wages) are so flexible that some of the processes which in the second part of the literature have been identified as crucial in determining distributional change, are ignored.

Such processes - largely the result of imperfections in the labour market - play an important role in the models we have constructed for Tanzania and Kenya. While the former model describes an economy in which prices are in fact very rigid that is not true for the Kenya model. We consider that model as a modest step in the direction of an integration of the approaches of partial and general equilibrium analysis. While the former approach may be misleading because of its partial nature,² models in the latter tradition suffer from their excessive emphasis on price adjustment processes. At least for the two countries which we consider that emphasis is misplaced.

The rest of this chapter is theoretical. In section 1.2 we present a very simple one-sector model and consider how the responsiveness of output,

1. cf. Robinson (1976).

2. in chapter 5 we give an example of an effect of wage increases on rural-to-urban migration which would be counter-intuitive in the Harris-Todaro model.

employment and income distribution in that model differs depending on the assumptions made on the way in which the economy reaches an equilibrium position. The next section is devoted to a discussion of labour market imperfections and their implications. In section 1.4 we discuss the relation between the distribution of income between individual earners and the household income distribution. Finally, section 1.5 is devoted to a review of six existing models.

In chapter 2 we discuss the main specifications of the models for Kenya and Tanzania, their place in the literature and some of the results. The rest of the thesis consists of a detailed description of those models and their results: chapters 3-5 for Tanzania, chapters 6-8 for Kenya.

1.2 Models of Models

Models of income distribution and growth which are applied to real economies^{1.} are usually complex, large-scale, multi-sector models. This detail and complexity often makes it difficult to understand the basic mechanisms responsible for the model's results. It is therefore useful to construct models of models: simple, one-sector, analytically tractable models which capture the basic mechanisms of the large simulation models which they represent. Regarding income distribution, the one-sector models which we will consider in this section generate only the functional distribution, but in addition they can be used to determine the effects of policy changes on prices and investment and these we will find important for understanding the changes in the size distribution which are generated by simulation models.

Understanding the behaviour of these larger models is not our only concern in this section. In addition, we will consider the suggestion in the literature^{2.} (a) that in these models distributional change occurs largely as a result of changes in prices, (b) that if these models are closed^{3.} in a realistic way, price effects will be very small and, hence, (c) that the distribution of income will be very insensitive to changes in policy.

The basic model (table 1.2.1) of this section is a one-sector model stripped down to its bare essentials. There are no intermediate goods, exports or

-
1. cf. the models of chapters 4 and 7 and those discussed in section 1.5.
 2. Taylor and Lysy (1977), especially pp. 19-22.
 3. a model's closure is defined by its list of exogenous variables.

direct taxes. Substitution possibilities are described by a CES production function (1.2.1) in capital and labour; the next two equations give the usual marginality conditions; (1.2.4) determines private consumption and allows for the possibility of a difference between savings rates for wage and for capital income (if $c_L \neq c_K$); the next equation gives the material balance where G stands for autonomous expenditure and M for imports, which are constrained to equal (given) foreign savings by (1.2.6)¹. Finally, in two variants we will also use the import equation (1.2.7).

Table 1.2.1.: Basic Model and Main Closures

(1.2.1)	$Y^{-\rho} = a K^{-\rho} + b L^{-\rho}$	$\sigma = 1/(1+\rho), 0 < \sigma < 1$
(1.2.2)	$K/Y = (ap/p_K)^{\sigma}$	
(1.2.3)	$L/Y = (bp/p_L)^{\sigma}$	
(1.2.4)	$pC = c_L p_L L + c_K p_K K$	$0 < c_L < c_K < 1$
(1.2.5)	$Y = C + I + G - M$	
(1.2.6)	$F = p_W M$	$e = p_W = 1$

models B and D only:

(1.2.7)	$M = \mu_C C + \mu_I I$	$0 < \mu_C < \mu_I < 1$
---------	-------------------------	-------------------------

model endogenous (in addition to Y, C, I, M and p_K)

exogenous (in addition to K, G and F)

A	L	p, p_L
B	L, p	p_L
C	p_L	L, p
D	p, p_L	L

The model is rewritten - in growth rate² rather than level form - in table 1.2.2.³

1. p_W is the world price (in foreign currency), hence F is given in foreign currency and in current prices. The exchange rate is fixed in nominal terms and, by choice of units, (e in, say, rupees per dollar) $e = p_W = 1$.
2. x' denotes the growth rate of x .
3. note that (1.2.9) corresponds to the cost function rather than the production function. The cost function implied by the model's first three equations is:

$$(1.2.8) \quad p^{1-\sigma} = a^{\sigma} p_K^{1-\sigma} + b^{\sigma} p_L^{1-\sigma}$$

There are a large number of possible ways of closing this model; here we consider four closures. For the goods market we assume in models A and C that the domestic price level (p) is given. This would be true e.g. if there were no controls on foreign trade and tariffs remained constant in nominal terms, so that the domestic price is predetermined by the world price ($p' = p_W' = 0$)¹.

Table 1.2.2: Basic Model (Growth Rates)

$$\begin{aligned}
 (1.2.9) \quad p' &= \zeta_K p_K' + \zeta_L p_L' & \zeta_K + \zeta_L &= 1 \\
 (1.2.10) \quad K' - Y' &= \sigma(p' - p_K') \\
 (1.2.11) \quad L' - Y' &= \sigma(p' - p_L') \\
 (1.2.12) \quad CC' &= Y [c_L \zeta_L (p_L' + L' - p') & \zeta_L &= p_L L/pY \\
 &+ c_K \zeta_K (p_K' + K' - p')] & \zeta_K &= p_K K/pY \\
 (1.2.13) \quad YY' &= CC' + II' + GG' - MM' \\
 (1.2.14) \quad FF' &= MM'
 \end{aligned}$$

Models B and D only:

$$(1.2.15) \quad MM' = \mu_C CC' + \mu_I II'$$

Alternatively, in models B and D we use equation (1.2.7), which can either be seen as a way of allowing in an aggregate model for limited import substitutability or as a representation of a system of import controls.² Corresponding to this physical constraint, the domestic

1. this is probably why Taylor and Lysy (1977) call this specification neo-classical. That, however, is not the only possible interpretation. In a planned economy in which domestic prices are determined by a mark-up system of price control - as in the Tanzanian model of chapter 4- the price level would also (through its link to wages) be predetermined. What matters in model A is that the real wage (p_L/p) is predetermined and that would be true in either case.

2. in multi-sector models equations such as (1.2.7) are used to restrict imports of non tradeables to zero, e.g. in Adelman Robinson (1978) and in the Kenya model of chapter 7.

price level is endogenous under this alternative.^{1.}

We also consider two alternative specifications for the labour market.

In models ^A~~C~~ and ^B~~D~~ the (nominal) wage rate (p_L) is given and employment is endogenous. There is no guarantee that the labour market will clear. In models ^A~~C~~ and ^B~~D~~ however a full employment condition is imposed: employment thereby becomes exogenous and the model has to be solved for a market clearing wage rate.

We will compare the effects in the models of changes in the wage rate (when applicable, i.e. in models A and B); in autonomous expenditure; in foreign savings; and in the capital stock. Since in this model the only dynamic element is investment, this last experiment complements the other three which are static.^{2.}

Solving the model - expressed in growth rates - for the elasticities of the endogenous variables with respect to p_L , G , F , and K involves no complications but a lot of laborious algebra. The main results appear in table 1.2.3.

Consider first the effect of changes in autonomous expenditures (G) or foreign savings (F). In spite of the differences in specification, the effects are identical for models A and C: investment is reduced (increased) by the full amount in the former (latter) case and all other variables

-
1. note that changes in the (implicit) tariff rate do not affect private agents. Such changes increase the government deficit ($= pG - (p - ep_W)M$) and thereby reduce domestic savings.
 2. the comparison is limited to models A, B and C. Since the basic model is ~~linear~~ homogenous in prices (p, p_K, p_L) and none of these are predetermined in model D, that variant cannot be solved unless a normalisation is introduced.

Table 1.2.3 : Elasticities in the Basic Model

	wage (p_L)		aut.expen- diture (G)		foreign savings (F)		capital (K)		
model: vari- sym- able bol	A	B	A,C	B	A,C	B	A	B	C
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
wage p_L	1	1	-	-	-	-	-	-	ζ_K/σ
price p	-	1	-	$\zeta_K \epsilon_1$	-	$\zeta_K \epsilon_2$	-	$\zeta_K \epsilon_3$	-
real wage p_L/p	1	-	-	$-\zeta_K \epsilon_1$	-	$-\zeta_K \epsilon_2$	-	$-\zeta_K \epsilon_3$	ζ_K/σ
employ- ment L	$-\sigma/\zeta_K$	-	-	$\sigma \epsilon_1$	-	$\sigma \epsilon_2$	1	$1+\sigma \epsilon_3$	-
out- Y put	$-\sigma \zeta_L/\zeta_K$	-	-	$\sigma \zeta_L \epsilon_1$	-	$\sigma \zeta_L \epsilon_2$	1	$1+\sigma \zeta_L \epsilon_3$	ζ_K
wage ζ_L share	$1-\sigma$	-	-	$(\sigma-1)\zeta_K \epsilon_1$	-	$(\sigma-1)\zeta_K \epsilon_2$	-	$(\sigma-1)\zeta_K \epsilon_3$	$\zeta_K(1/\sigma-1)$
invest- ment I	δ_1	δ_2	$-G/I$	δ_3	F/I	δ_4	δ_5	δ_6	δ_7

elasticities of investment are:

(1.2.16) $\delta_1 = (Y/I)(\sigma(c_L-1)\zeta_L/\zeta_K - (c_L - c_K)\zeta_L)$

(1.2.17) $\delta_2 = 0$

(1.2.18) $\delta_3 = (Y/I)(-\lambda(\mu_C/\mu_I)\epsilon_1)$

(1.2.19) $\delta_4 = (Y/I)(-\lambda(\mu_C/\mu_I)\epsilon_2) + (F/I)(1/\mu_I)$

(1.2.20) $\delta_5 = (Y/I)(1-c_L\zeta_L - c_K\zeta_K)$

(1.2.21) $\delta_6 = (Y/I) [(1-c_L\zeta_L - c_K\zeta_K) + (\sigma\zeta_L - \lambda)\epsilon_3]$

(1.2.22) $\delta_7 = (Y/I)(\zeta_K(1-c_K) - \zeta_K\zeta_L(c_L-c_K)/\sigma)$

, while the substitutions used are defined by:

(1.2.23) $\lambda = \zeta_L(c_L\sigma - \zeta_K(c_L-c_K))$

(1.2.24) $1/\gamma = \sigma\zeta_L - (1-\mu_C/\mu_I)\lambda$

(1.2.25) $\epsilon_1 = \gamma G/Y$

(1.2.26) $\epsilon_2 = -\gamma(1-1/\mu_I) F/Y$

(1.2.27) $\epsilon_3 = [(\mu_I-\mu_C)(c_L\zeta_L + c_K\zeta_K) - \mu_I] / [(\mu_C-\mu_I)\lambda + \sigma\zeta_L\mu_I]$

, where ϵ denotes the elasticity of p_K .

remain unchanged. In model A this is the result of the fact that - with both the price and the wage predetermined - the real wage remains constant. Hence no factor substitution is involved, output and employment remain the same (since the capital stock is unaffected) and hence adjustment occurs entirely through changes in investment. Since in model C full employment has to be maintained, the nominal wage - which in that model is endogenous - will not change; hence the real wage remains constant and the model's response is the same as that of model A.

In these models then, such shocks (changes in G or F) have no instantaneous effects on output, employment or factor prices, nor does the (functional) distribution of income change. The effects that do occur are dynamic: the adjustment mechanism being the level of investment, the solution for the next period is affected by a change in the size of the capital stock. The table's seventh column shows the elasticities of output and employment with respect to the capital stock to be equal to one for model A.¹ Hence the growth rate generated by that model - if subjected to no other shocks than in G or F - is one of constant prices, factor proportions and factor income shares.² Since factor

1. that growth path is feasible because it is implicitly assumed that (a) labour supply is infinitely elastic at the wage rate p_L and that (b) there are no limits on import substitution: all imports are competitive.
2. this does not imply that the economy-wide income distribution does not change: it does if the increase in employment is achieved through the transfer of labour out of activities with opportunity costs lower than p_L . Thus interpreted, model A is easily recognised as having very old antecedents: it describes the first phase in the surplus labour model of Lewis (1954) and Ranis and Fei (1961), with labour transfer taking the form of rural-to-urban migration.

prices do not change anyway it is irrelevant whether the model allows for factor substitution possibilities or not.

While models A and C are identical in static effects, the dynamic effects differ. In model C factor proportions can not remain constant when the capital stock changes, because labour supply is predetermined and the labour market has to clear (column (9) of the table). The nominal (and hence the real) wage rises,¹ output rises and ($\sigma < 1$) the wage share goes up as well. Hence there are profound differences in models A and C in their dynamic effects.

The effects of a wage increase in model A (first column of the table) are the usual neoclassical ones.² The wage share rises, output and employment fall, investment is reduced and the value of the substitution elasticity determines how much of the final effects occur instantaneously and how much over time, through the effect of the wage change on capital accumulation. The limiting case ($\sigma=0$) is that of the early, linear income distribution models; the one remaining term in the investment elasticity - equation (1.2.16) - is that in $(c_L - c_K)$; naturally, such analyses focussed on the effects of differences in savings propensities between groups of income recipients.

-
1. Taylor and Lysy (1977) compare model closures only for differences in static effects, apparently considering the elasticity of investment (i.e. δ in table 1.2.3) a sufficient measure of dynamic effects. The present example illustrates that this is inadequate.
 2. Model A is in fact identical to the neo-classical closure in Taylor and Lysy (1977).

So far we have only considered models in which the price level is predetermined. In model B the price level (p) becomes endogenous.

Corresponding to that, it incorporates the additional equation (1.2.7).

As noted above the import equation may describe a policy of import controls; or limits on import substitution (imports are at least partly non-competitive); or (more extremely) non tradeability. This physical constraint on trade (and the resulting variability of the ratio of domestic and world prices, p/p_W) makes model B thoroughly different from model A.^{1.}

Let us, again, first consider the effects of changes in G or F (columns 4 and 6 in the table). Investment is now no longer the only adjustment mechanism: price changes are induced and therefore all other variables^{2.} change as well.^{3.} From (1.2.25) and (1.2.26) the sign of ϵ_1 and ϵ_2 is that of γ (since $\mu_I < 1$); from (1.2.23) and (1.2.24) the derivative of $1/\gamma$ with respect to σ is positive (since $0 < \mu_C < \mu_I < 1$). For $\sigma=0$ we find:

$$(1.2.28) \quad 1/\gamma = (\mu_I - \mu_C) \zeta_L \zeta_K (c_L - c_K) / \mu_I$$

, which is positive since $\mu_I > \mu_C$ and $c_L > c_K$. Hence ϵ_1 and ϵ_2 are positive for all values of the substitution elasticity; hence the effect of increases in G or F is to raise the price level, thereby to lower the real wage and therefore (if $\sigma > 0$) to raise output and employment. The distributional

1. whether exogeneity of investment (which differentiates the Keynesian closures of Taylor and Lysy (1977) from the neo-classical model) or the presence of trade constraints (as in model B) represents the more significant departure from the neo-classical tradition is mainly of semantic interest. For our present taxonomic purpose the latter is the more useful distinction. Very few models - the model for Brazil of Lysy and Taylor (1977) is an exception - make investment exogenous (so that it determines savings - and, in Kaldorian fashion, income distribution - rather than vice versa). Cf. Cline (1975) for a critique of the use of the Kaldorian approach in models for LDCs.

2. with the exception, of course, of the (nominal) wage, which remains fixed.

3. in the case of a change in F , the exception would be the extreme case ($\mu_I = 1$) when all capital goods are imported; from (1.2.26) and (1.2.19) one finds $\epsilon_2 = 0$ and $\delta_4 = F/I$: columns (5) and (6) would be identical. The case is excluded by the assumption $0 < \mu_C < \mu_I < 1$.

effect is a fall in the share of labour (ζ_L).

The effect on investment is given by the elasticities δ_3 and δ_4 . Except for very low values of σ ,^{1.} λ is positive. Hence δ_3 is negative and, in general,^{2.} δ_4 is positive: while an increase in F reduces investment through its effect on expenditure, this is more than offset by its direct effect on the supply of savings.

The first two columns of the table allow a comparison of the effects of a nominal wage increase in models A and B. From (1.2.9) - (1.2.15) one easily finds the solution $p'=p_K'=p_L'$ and $I'=L'=Y'=K'=0$ for model B. Hence while in model A all real variables change, in model B all are unaffected by a wage change. This is trivial, given the model's ~~linear~~ homogeneity, in prices.

of degree zero

The wage policy amounts to a change in the value of the numéraire and hence has no real effect.

We will now modify model B by introducing one other price (which is predetermined so that the wage level now does affect relative prices). The modification is obtained by dropping the assumption that there is no intermediate good. We now assume that of gross output X a fraction v represents value added ($Y=vX$) and a fraction m ($v+m=1$) demand for the intermediate goods, which is imported.^{3.} The price p of the basic model is now replaced

1. e.g. for $\zeta_L = 0.6$, $\zeta_K = 0.4$, $c_L = 0.8$, $c_K = 0.5$ the critical value of $\sigma = 0.15$.

2. e.g. using the parameters of the previous footnote and $\sigma=0.566\dots$, $\mu_C=0.3$, $\mu_I=0.6$, one finds $\lambda = 0.2$, $1/\gamma=0.24$ and $\delta_4 = (F/I)1.11\dots$ 382

3. substitution in (1.2.5) then gives $X-mX=Y=C+I+G-(M+mX)$, mX denoting intermediate demand and M (net) imports of final goods.

by p_Y , the price of gross output (p) now being given as the weighted average $vp_Y + mp_W$.¹ Foreign savings now finance imports of both final and intermediate goods, hence $F = p_W (M + (m/v)Y)$. In growth rate form the model (E) now is:

(1.2.30)
$$p'_Y = \zeta_K p'_K + \zeta_L p'_L$$

(1.2.31)
$$K' - Y' = \sigma(p'_Y - p'_K)$$

(1.2.32)
$$L' - Y' = \sigma(p'_Y - p'_L)$$

(1.2.33)
$$CC' = Y [c_L \zeta_L (p'_L + L' - p') + c_K \zeta_K (p'_K + K' - p')] (p_Y/p)$$

(1.2.34)
$$YY' = CC' + II' + GG' - FF'$$

(1.2.35)
$$FF' = MM' + (m/v) YY'$$

(1.2.36)
$$MM' = \mu_C CC' + \mu_I II'$$

(1.2.37)
$$p' = vp_Y' \uparrow_{(p_Y/p)} (v+m=1)$$

, the extra equation corresponding to the additional endogenous price variable. Clearly, for $m \neq 0$ (i.e. $v \neq 1$) the model is no longer ~~linear~~ homogenous in domestic prices p, p_Y, p_L, p_K .²

of degree zero

The nominal wage level now does affect real variables (table 1.2.4).³

Wage earners' real income falls, but the real wage to producers

- note that we maintain the assumption that the nominal exchange rate remains constant at unity.
- It is ~~linear~~ homogenous^{*of degree zero*} in price p, p_Y, p_L, p_K and p_W , but $p_W = 1$ (hence $p'_W = 0$, which is why the world price appears neither in (1.2.35) nor in (1.2.37)) and this provides the anchor of the relative price vector. Hence changes in nominal wages must affect relative prices. This would of course be true for any other modification of model B involving the fixing of a nominal price e.g. the response of the models of chapters 4 and 7 to wage policies is similar to that in model E, not only because of the presence of imported intermediate goods, but also because producer prices in agriculture are fixed in nominal terms.
- for $v < 1$; for $v = 1$, $\epsilon_5 = 1$ and $\delta_8 = 0 = \delta_2$: one re-obtains the results of model B (column 2, table 1.2.3). If one assumes $p_Y = p$, $\mu_I = 0.6, \mu_C = 0.3, \zeta_L = 0.6, \zeta_K = 0.4, Y = 5$ I then the values of $(\epsilon_5 - 1)$ and δ_8 at different values of σ and v are:

v	σ	$(\epsilon_5 - 1)$			δ_8		
		0.0	0.5	1.0	0.0	0.5	1.0
1.0		-	-	-	-	-	-
0.9		.28	.10	.06	-	-.20	-.24
0.8		.63	.16	.09	-	-.44	-.51

to simplify the algebra we have assumed that there is no saving out of wage income ($c_L = 1$) and that there is no consumption out of capital income ($c_K = 0$); this is reflected in the expressions in table 1.2.4.

Table 1.2.4: Elasticities in the Modified Model (E)

<u>variable</u>	<u>effect of p_L</u>	<u>effect of K</u>
p	$v+v\zeta_K(\epsilon_5-1)$	$v\zeta_K\epsilon_6$
p_Y	$1+\zeta_K(\epsilon_5-1)$	$\zeta_K\epsilon_6$
p_K	ϵ_5	ϵ_6
p_L	1	-
Y	$\sigma\zeta_L(\epsilon_5-1)$	$1+\sigma\zeta_L\epsilon_6$
L	$\sigma(\epsilon_5-1)$	$1+\sigma\epsilon_6$
I	δ_8	δ_9

substitutions:

$$\delta_8 = (Y/I)\zeta_L \left[(\epsilon_5-1) (\sigma-(p_Y/p) (\sigma-v\zeta_K)) - (p_Y/p) (1-v) \right]$$

$$\delta_9 = (Y/I) \left[(1 + \sigma\zeta_L\epsilon_6) - (p_Y/p)\zeta_L (1 + (\sigma-v\zeta_K)\epsilon_6) \right]$$

$$\epsilon_5-1 = \left[(p_Y/p) (1-v) (\mu_I-\mu_C) \right] / \left[(\mu_I + m/v)\sigma - (p_Y/p) (\sigma- v\zeta_K) (\mu_I-\mu_C) \right]$$

$$\epsilon_6 = \left[(\mu_I-\mu_C) (p_Y/p)\zeta_L - (\mu_I + m/v) \right] / \left[(\mu_I + m/v)\sigma\zeta_L - (\mu_I-\mu_C)(p_Y/p) \zeta_L (\sigma-v\zeta_K) \right]$$

increases.^{1.} Either effect is likely to be very weak however, so - while the wage increase may lead to slightly higher output and employment - the main adjustment mechanism is, again, a fall in the level of investment.^{2.} This effect is, as one would expect, strongest if there is little room for factor substitution and if the price level is to a large extent exogenous (thereby reducing the possibility of adjustment through erosion of real wages), i.e. for low values of σ and of v . Note that the model is more general than the interpretation of $m=1-v$ as the share of imported intermediate goods in gross output suggests. If model E is thought of as describing only part of an economy then m may denote the share of any inputs of which the price is predetermined. In a multi-sector model its specification might apply to some of the sectors; m then denotes both imported intermediate inputs and inputs from other sectors, in which the price is predetermined.^{3.} Having noted that the effect of wage policies on the level of investment is likely to be strong, it is useful to compare the closures we have discussed so far with those considered in a paper

1. the elasticity of (p_L/p) with respect to p_L is positive, but that of (p_L/p_Y) is negative since $(\epsilon_5 > 1)$ p_K rises more than p_L .
2. note, from the values in footnote 3, that a 10% nominal wage increase will (for $\sigma=0.5$ and $v=0.8$) raise real wages (p_L/p) by only $1\frac{1}{2}\%$, the real wage to producers (p_L/p_Y) by only -0.6% , output by 0.5% while investment falls by 4.4% in real terms.
3. Either because it is controlled (e.g. agricultural prices in the Kenya model) or because it is - as in model A - linked (through fixed nominal tariff rates) to world prices (e.g. in the Kenya model the price of manufactures in the open economy version, cf. section 7.4). Such a combination of model A and model E specifications in a multi-sector model is typical of the Kenyan model of chapter 7 and the Korea model of Adelman and Robinson (1978). In the latter case the correspondence with the closures here discussed is less perfect, since investment is pre-determined in nominal terms.

by Taylor and Lysy.^{1.}

Their objective is to explain why in a number of large-scale models the distribution of income is very insensitive to changes in policy variables.^{2.} To this end they compare a neo-classical and a 'Keynesian' way of closing the model. The neo-classical version is virtually identical to our model A.^{3.} In the 'Keynesian' version the price level (p) becomes endogenous but, while we close the model with the import equation, Taylor and Lysy make investment (I) exogenous.

That difference is crucial. Taylor and Lysy can conclude that wage policies strongly affect output, employment and income distribution in the neo-classical model - both instantaneously and through their effects on capital accumulation, over time - but that the instantaneous effects in the Keynesian model are very weak. The story stops there, because - investment being exogenous - the possibility that insignificant static effects might only be the prelude to significant dynamic effects does not arise. Hence, to the extent that the 'Keynesian' closure adequately captures the structure of

1. Taylor and Lysy (1977).

2. they note this insensitivity in the results of the models of Lysy and Taylor (1977) and of Adelman and Robinson (1978). Adelman et al. (1977) - in a paper presented at the same conference - note the same feature for the latter model and for that of Rodgers et al. (1974). They however explicitly dismiss the possibility that it is due to model structure rather than being true in the real world.

3. the only difference is that they introduce an imported intermediate good, the same difference which distinguishes our models B and E. In the neo-classical version, however, this detail is irrelevant: with world prices given ($p_W'=0$) one obviously gets $p'=p_Y'=0$.

large-scale income distribution simulation models,¹ it is explained why not even a redistributive policy as direct as a change in wages changes the distribution of income: because price rises offset the effect on the real wage, income redistributions - as the title of their paper suggests - vanish.

In model E, the effects discussed for period 1 are reinforced for period 2,^{2,3}. The importance of the fall in the growth rate for the distribution of income, becomes obvious as soon as one sees the model as one which describes only a part of the economy, say the formal sector. One then has to consider the effect of changes in the formal sector on employment and incomes in the rest of the economy. That is the subject of the next section.

-
1. which they do not. In most models savings determine investment rather than vice versa. Exogenous investment is a specification which apparently appeals mainly to Taylor; it is used in Lysy and Taylor (1977) and Bacha and Taylor (1976). It does not even apply in one of the two models of which Taylor and Lysy attempt to explain the behaviour: in Adelman and Robinson (1978) it is not real but nominal investment which is predetermined.
 2. basically because with a capital stock smaller than it would have been without a change in the wage rate, p_K continues to rise. Note that p_K is the product of the price of capital and the rate of return.
 3. the solution in period 2 is affected by the lower investment of period 1; since the value of the elasticity δ_g in the second column of table 1.2.4. is negative (except for very high values of σ or very low values of v), investment is likely to be cumulatively reduced. For $\sigma = 0.5$ and $v = 0.8$ the value of $\delta_g = -0.89$. (assuming again: $p_Y = p, \mu_I = 0.6, \mu_C = 0.3, \zeta_L = 0.6, \zeta_K = 0.4$ and $Y/I = 5$).

but small

1.3. Disequilibrium in the Labour Market: Migration and

Urban Job Search.

So far we have said little about the labour market. For models C and D this is justified, because a full employment condition is imposed. The size of the labour force is predetermined and these models are solved for a wage rate which clears the market. For many LDCs such wage flexibility is not a realistic description.

The fixed wage assumption of models A and B (or E) requires further comment. These models can not cover the whole economy. They implicitly assume the existence of a reserve army from which labour can be drawn or into which it can be pushed back as the demand for labour in that part of the economy which is covered by the model - which may be called the formal or modern sector - changes. In an economy-wide model one must be explicit about the relationship between these two parts of the economy.

One approach is to identify the second part of the economy with the rural subsistence sector. Per capita income in this sector is constant and rural-to-urban migration ensures both that urban wages will not rise above rural income¹, and that urban labour supply always equals labour demand. This approach - which goes back to Lewis' (1954) surplus labour theory - requires two assumptions. First, that the modern sector labour market is competitive so that when demand or supply change equilibrium is maintained through wage

1. except for a premium to offset the cost of migration and the difference in rural and urban cost of living.

changes. Secondly, that migration is very sensitive to the urban-rural income differential so that any deviation of wages from migrants' reservation price is virtually instantaneously eliminated through migration (or return migration).

A second approach is illustrated by the model of Harris and Todaro (1970). Here wages are rigid and unsuccessful applicants become unemployed (maintaining urban residence)¹ in the hope of finding employment later. The equality ensured by migration in this model is that between rural income and expected urban income, with (in the simplest formulations) the ratio of employment and the urban labour force serving as the probability variable in the calculation of the latter.

Our own models are in this tradition but with two modifications: in addition to unemployment we consider informal sector employment and (in the case of Kenya) employers use educational qualifications as a rationing device.

Observed unemployment rates are far lower than what would be predicted by the Harris-Todaro model. One reason for this is² that the model recognises only one alternative to employment in the modern sector: unemployment. In principle one could distinguish any number of free-entry activities.³

1. this is a crucial assumption: the equilibrium rate of unemployment would be much lower if applicants would remain in the rural sector, migrating only when they have found a job.
2. for a discussion cf. Fields (1975).
3. as opposed to wage employment, entry into which is restricted by wage rigidity.

By definition there are no restrictions on labour mobility between such activities and hence expected incomes will be equalized. The activities may however differ in the efficiency of continued job search. If we treat the number of vacancies (V), the wage rate (W), the labour force net of modern sector employment (L) and total income in activity i (Y_i) as given, one may solve for employment (E_i) and per capita income (W_i) in activity i , unemployment (U) and probability (p) from:

$$(1.3.1) \quad p (U + \sum_i n_i E_i) = V$$

$$(1.3.2) \quad (1-n_i p) W_i + n_i p W = p W$$

$$(1.3.3) \quad W_i E_i = Y_i$$

$$(1.3.4) \quad L = U + \sum_i E_i$$

Here the efficiency parameters n_i ($0 < n_i < 1$) determine the allocation of L over U and E_i . The equilibrium condition (1.3.2) reveals the trade off: in activity i one has an actual income but that advantage is offset by the fact that the probability of employment is lower than for the unemployed. The Harris-Todaro model is the special case of $Y_i = 0$ or $n_i = 0$.

The second modification relaxes the assumption that employers in the rationing of jobs to which excess labour supply gives rise do not take any of the applicants' characteristics into account: all applicants¹ have an equal probability of employment. Dropping this assumption creates, after having introduced wage rigidity, a second difference from the neo-classical wage competition model.²

1. measured in 'efficiency units': as in (1.3.1) people employed in the informal sector count as n_i applicants.

2. on wages vs. job competition cf. Cline (1975).

In the neo-classical wage competition model labour demand is skill specific and wage flexibility ensures the equality of demand and supply for each skill category. In contrast, in the job competition model the wage is a characteristic of the job and (at least in the short run) independent of labour market conditions. In addition, relevant job skills do not exist prior to employment but are acquired on the job through training and experience. Excess supply can only be eliminated through rationing and for this purpose employers use screening criteria, usually related to education. This leads to 'bumping'. With job seekers ranked in order of descending educational qualifications, employers go down the job queue until their demand is met. If (as is of course the case in practice) the variable measuring applicants' qualifications is discrete, this implies that there is uncertainty about one's chances of employment for at most one group. People with higher (lower) qualifications have a probability of getting a job of 1 (0).¹

Formally:

$$(1.3.5) \quad n_k^c = \sum_{\kappa=1}^k n_{\kappa}$$

$$(1.3.6) \quad \pi_k = \begin{cases} 1 & \text{if } n_k^c \leq n^D \\ (n^D - n_{k-1}^c) / n_k & \text{if } n_{k-1}^c < n^D < n_k^c \quad (k = k^*) \\ 0 & \text{if } n_{k-1}^c \geq n^D \end{cases}$$

where n^D is labour demand

n_k labour supply (with qualifications k descending for $k=1,2,\dots$)

π_k employment probability for qualification k .

1. this is in fact the only redeeming feature of the use of screening criteria; provided the critical value k^* is known, the efficiency loss compared to a free-for-all lottery system is reduced because people with qualifications $k > k^*$ will not engage in job search.

The extension to the case of multiple markets is straightforward; if job types are denoted by i (with wages declining for $i = 1, 2, \dots$) people first compete for the high wage jobs ($i = 1$); if unsuccessful they then turn to the next market ($i = 2$) and so on.

$$(1.3.7) \quad n_{ik} = \begin{cases} n_k & \text{if } i = 1 \\ n_k - \sum_{l=1}^{i-1} \pi_{lk} n_{lk} & \text{if } i > 1 \end{cases}$$

$$(1.3.8) \quad n_{ik}^c = \sum_{\kappa=1}^k n_{i\kappa}$$

$$(1.3.9) \quad \pi_{ik} = \begin{cases} 1 & \text{if } n_{ik}^c \leq n_i^D \\ (n_i^D - n_{ik-1}^c) / n_{ik} & \text{if } n_{ik-1}^c < n_i^D < n_{ik}^c \quad (k=k^*(i)) \\ 0 & \text{if } n_{ik-1}^c \geq n_i^D \end{cases}$$

The bumping model is clearly extreme. In practice, one finds employment probabilities (π) below one for all groups (i.e. including those with $k < k^*$). To allow for this, we assume the existence of a vector of probabilities p : if $k < k^*$ $\pi = p$ rather than $\pi = 1$. One then allows for the fact that education may be the most important, but not the only criterion used; one would then expect $p_k < p_{k-1} < 1$ (higher education raises one's probability of employment but not to unity). In the one market case the model would then be:

$$(1.3.10) \quad n_k^c = \sum_{\kappa=1}^{k-1} \pi_{\kappa} n_{\kappa} + p_k n_k$$

$$(1.3.11) \quad \pi_k = \begin{cases} p_k & \text{if } n_k^c \leq n^D \\ (n^D - n_{k-1}^c) / n_k & \text{if } n_{k-1}^c < n^D < n_k^c \quad (k=k^*) \\ 0 & \text{if } n_{k-1}^c \geq n^D \end{cases}$$

which implies $\pi_k = p_k$ for $k < k^*$, and $\pi_k = 0$ for $k > k^*$. The extension to the multiple market case is analogous to the one used for (1.3.7)-(1.3.9):

$$(1.3.12) \quad n_{ik} = \begin{cases} n_k & \text{if } i = 1 \\ n_k - \sum_{l=1}^{i-1} \pi_{lk} n_{lk} & \text{if } i > 1 \end{cases}$$

$$(1.3.13) \quad n_{ik}^c = \sum_{\kappa=1}^{k-1} \pi_{i\kappa} n_{i\kappa}^c + p_{ik} n_{ik}$$

$$(1.3.14) \quad \pi_{ik} = \begin{cases} p_{ik} & \text{if } n_{ik}^c \leq n_i^D \\ (n_i^D - n_{ik-1}^c) / n_{ik} & \text{if } n_{ik-1}^c < n_i^D < n_{ik}^c \\ 0 & \text{if } n_{ik-1}^c \geq n_i^D \end{cases}$$

This version of the bumping model is used in the Kenya model (chapter 7).¹

1. time-series will usually not be available; one then has to assume that for the year for which one does ~~not~~ have data $\pi_{ik} = p_{ik}$.

Then if actual employment n_{ik}^* is observed: $n_{ik}^{c*} = n_k - \sum_{l=1}^{i-1} n_{lk}^*$, $\pi_{ik} =$

$p_{ik} = n_{ik}^* / n_{ik}^c$. The equality of π and p holds of course only for the year of the observations (1974 in the case of the Kenya model); during the projection period π is determined by (1.3.12)-(1.3.14) and hence will, in general, differ from p . The matrix p does remain constant.

Its main purpose there is to capture in the specification that bumping affects different households differently, depending on their educational endowment, i.e. the number of people in the household by level of education. An important implication of the model is that changes in employment will not be distributionally neutral: if e.g. the number of high wage jobs (say n_1^D) increases then the newly employed will be disproportionately drawn from those who already had high (expected and actual) incomes.^{1.}

The treatment of the informal sector and the introduction of bumping distinguishes our models from those in the literature^{2.} which do consider labour market imperfections (in the form of wage rigidities). The one model in which an attempt is made to capture the labour absorbing characteristic of the informal sector^{3.} throws the baby away with the bathwater by imposing constancy of the ratio of wages and informal sector incomes. Non constancy of that ratio is the very essence of the dualism in the labour market: rigidity of wages in one sector implies shifts of labour between the two sectors and hence flexibility of incomes in the other sector.

1. there is, of course, a 'trickle down' effect: jobs are vacated by those who move to the new jobs and the employment probabilities of others therefore increase.

2. cf. section 1.5.

3. note that (1.3.3) defines a unit-elastic demand curve for employment in the informal sector.

1.4. The Transition to the Distribution of Income over Households

What models of income distribution generate are the number of people and their mean income for various groups of income earners: capitalists, smallholders, share croppers, self employed, skilled and unskilled wage employed etc. Labour supply is either exogenous or treated as an individual decision. Employment and income are determined in factor markets and the models can be solved for the distribution of income over its individual recipients, without considering how these individuals have grouped themselves into households.

To the extent, however, that household formation reflects a community of interests and that some economic decision (notably those regarding consumption) are taken at the level of households, the analysis can not stop short of deriving the distribution of income over households.

The mapping from the distribution over individuals to that over households is trivial only if (a) the number of members of the household who are in the labour force is the same for all households and if (b) the distribution of that number over the activities distinguished in the model does not differ between households. Survey data indicate that in practice neither condition is satisfied.^{1.}

Hence the inequality of the two distributions may differ; in fact our data for Kenya and Tanzania indicate that by mapping to the household distribution one captures a significant redistribution of income. The

1. cf. Kuznets (1978).

poor are not confined to poor households. Some of them can in fact afford to be poor - i.e. to search for higher income jobs while unemployed or engaged in low income activities - only because they are members of relatively rich households. This raises doubts about the procedure of treating labour supply independent of household formation: individuals may react differently to changing labour market conditions depending on the sort of household of which they are a member. Very little work has been done in this field and the approach we use in chapters 4 and 7 is only a very small step towards a model which incorporates such considerations.

In this section we restrict ourselves to the existing literature. We first consider how the mapping from the one distribution to the other is handled and next the way in which discrete distributions generated by the model are sometimes approximated by a continuous curve.

A very curious model of 'household formation' is used by Adelman and Robinson (1978, pp 215-217) to determine the mapping from the size to the household distribution of income.

Household types are defined by the activity in which the head of household is engaged. Define:

- n_i mean number of non heads in households of type i
- D_{ij} proportion of non heads in households of type i who are engaged in activity j ($\sum_j D_{ij} = 1$ for all i ; note that since there are as many household types as activities the matrix D is square).
- h_i number of households of type i (and hence the number of heads of households in activity i)

l_i	employment in activity i
y_i^I	mean income (per individual) in activity i
y_i^H	mean income (per household) for households of type i
N	diagonal matrix with $N_{ii} = n_i$
I	identity matrix

The vectors h , l , y^I and y^H are column vectors and we will use primes to denote transposition. Clearly, two identities must be satisfied.

$$(1.4.1) \quad l_i = h_i + \sum_j h_j n_j D_{ji}$$

$$(1.4.2) \quad y_i^H = y_i^I + n_i \sum_j y_j^I D_{ij}$$

or, in matrix form:

$$(1.4.3) \quad l' = h' (I + ND)$$

$$(1.4.4) \quad y^{H'} = (I + ND)y^{I'}$$

The matrices N and D are assumed to remain constant. Once the model has generated employment by activity (i.e. the vector l), one solves for the number of households of each type from (1.4.3):

$$(1.4.5) \quad h' = l' (I + ND)^{-1}$$

and for the vector of household mean incomes from (1.4.4). What makes this method attractive is obviously its simplicity. But that is the only thing to be said in its favour. First, while one would expect the total number of households and the total population to be predetermined by demographic factors (population growth and migration), here these variables are endogenous. Regarding the latter, the survey data from which one derives that households of type i have $1 + n_i$ members of the labour force, must also have defined the household size (including children and other members not in the labour force) s_i . Since there is no constraint on $\sum_i s_i h_i$

the procedure implicitly makes the population an endogenous variable.

Secondly, there is no direct link with labour supply.

Consider two possible cases. In the first one there are no wage rigidities: all labour markets clear and there is neither unemployment nor absorption of a residual of the labour force in a 'traditional' or 'informal' sector. The natural approach would then be to make the vector h exogenous. Equation (1.4.3) is then used to calculate the vector of labour supply. The model of the labour market ensures that this will equal the vector of employment and generates a vector of market clearing wages y^I , which is, again, used in (1.4.4) to calculate household incomes. In this case there is no need for the matrix inversion of (1.4.5). So far the two approaches are formally equivalent: it is irrelevant whether one treats h or labour supply l as predetermined. For policy analysis however, the former method is to be preferred. This may be illustrated with a numerical example. Suppose that there are only two activities, of which the first one is skilled employment. Initially:

$$N = \begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}, \quad D = \begin{pmatrix} \frac{1}{2} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \end{pmatrix}, \quad h = \begin{pmatrix} 3 \\ 7 \end{pmatrix}, \quad l = \begin{pmatrix} 13 \\ 24 \end{pmatrix}$$

Suppose one would want to use the model to evaluate the effect of a training programme, whereby 10% of the unskilled workers become skilled. In the Adelman and Robinson approach the new vector l' would equal (15.4, 21.6) and, keeping everything else constant, this gives in (1.4.5) $h' = (4.92, 5.56)$. The training programme results in remarkable social change: 1.44 type 2 households are broken up and their members regroup themselves instantaneously into 1.92 new type 1 households. Under the alternative approach h would be determined by demographic change alone; there is no need to change it. The matrices I and D however must change. This forces one to be quite

explicit about how the programme affects the household distribution of assets, i.e. in this case of skills. Let us suppose that all type 2 workers have an equal probability of being enrolled in the programme.

Then the new matrices would be:

$$\tilde{I} = \begin{pmatrix} 1.0 & 0.0 \\ 0.1 & 0.9 \end{pmatrix}, \tilde{I} + \tilde{ND} = \begin{pmatrix} 2.1 & 0.9 \\ 1.3 & 2.7 \end{pmatrix}$$

, which, using (1.4.3), implies the same employment vector: $l' = (15.4, 21.6)$.¹ Obviously, the two approaches will lead to different estimates of the effect of the upgrading of the labour force on measures of inequality. This is illustrated in table 1.4.1, where we have assumed (a) that in the absence of the programme $y^{I'} = (2, 1)$ (b) that the wage bill remains constant and (c) that substitution possibilities between skilled and unskilled labour are given by a Cobb-Douglas function.²

Table 1.4.1 : Inequality and Household Composition Specification

	without change				with training programme							
type					I,D changed				h changed			
	h	y ^H	h'y ^H	Gini	h	y ^H	h'y ^H	Gini	h	y ^H	h'y ^H	Gini
1	3	5	15		3	4.545	13.63		4.92	4.487	22.08	
2	7	5	35		7	5.194	36.36		5.56	5.021	27.92	
Total	10		50	0.000	10		50	0.027	10.48		50	0.028

1. note that one of the implications of this approach is that I ceases to be the identity matrix: the correspondence between the occupation of the head of household and the household type applies only in the base year. This feature is characteristic of the household composition models of chapters 4 and 7.
2. hence the wage bill is $13 \times 2 + 24 \times 1 = 50$ and the share of skilled labour in the wage bill remains constant at 52%. Under these assumptions the new wages are given by $y^{I'} = (1.688, 1.111)$.

In this example - which by using the Cobb-Douglas assumption is biased against showing a difference - the difference in the Gini coefficient is already 1.7%, a difference which Adelman and Robinson (who find it difficult to generate changes in the Gini coefficient of more than 5% with their model) should consider as substantial.

Note that with the vector h endogenous, y^H is lower for both household types, a difference which would affect the level and composition of private consumption.

In the second case there are wage rigidities. The wage may be fixed for type 1 labour (say formal sector employment) while employment of type 2 (say in the informal sector) is residually determined. Then, clearly, the procedure (by taking 1 to be predetermined) is simply inconsistent. If the formal sector wage were to be raised then unsuccessful type 1 applicants would turn to the informal sector. The vector h calculated from (1.4.5) would be inconsistent with this since it is based on an unchanged employment vector.

The characteristic feature of the approach is that labour force members of different types can form households only in certain combinations, as if they are atoms forming molecules. Hence, we will refer to the model in which I and D remain constant as the chemical model.

Our objection to this chemical model may be summarised: (1) the number of households of different types should be predetermined by demographic factors (population growth and migration) (2) the model leads to inconsistencies

if there are imperfections in the labour market (3) even if there would be no such imperfections the model will, in general, generate the wrong household income distribution which may lead to spurious general equilibrium effects and which has potentially serious implications for the validity of the inequality measures derived from it (4) it can not handle changes in the distribution of assets over households explicitly.

Most models derive a discrete distribution, defined by the vectors y^H and h . Some authors^{1.} find it convenient to approximate this distribution by a log normal distribution. Given the mean (m) and variance (s^2) of the original distribution - which are calculated from the vectors y^H and h - the log mean (μ) and log variance (σ^2) are defined by

$$(1.4.6) \quad \ln m = \mu + \frac{1}{2} \sigma^2$$

$$(1.4.7) \quad \ln (m^2 + s^2) = 2 (\mu + \sigma^2)$$

With the two parameters thus determined the log normal distribution is used to derive frequencies and corresponding income shares, i.e. points on the Lorenz curve. In fact one obtains a new pair of vectors $\hat{y}^H$, $\hat{h}$ which will be different from the original pair unless that one happened to satisfy log normality.

This procedure is unnecessary^{2.} and may result in large errors.

1. this procedure is adopted by Rodgers et al. (1978) and by Adelman and Robinson (1978); cf. section 1.5.

2. since if one needs to interpolate (e.g. to derive a decile) one may do so as well between the points of the Lorenz curve given by the discrete distribution.

Consider a numerical example. Suppose there are three types of households, representing 40%, 40% and 20% of the total and receiving mean incomes of 0.50, 0.75 and 2.50 respectively. At $t = 1$, 10% of total income is redistributed from the richest to the poorest group, leaving total income unchanged at 1. Table 1.4.2 shows that the values of the vector of income shares ($\zeta_i = h_i y_i^H$) changes from (0.2, 0.3, 0.5) to (0.3, 0.3, 0.4) and that the redistribution is reflected in a fall of the Gini coefficient (γ) from .34 to .20. If the continuous approximation were used one finds from (1.4.6) and (1.4.7) - using $m=1$ and $s^2 = .250$ for $t=1$ - that the distribution's parameters change from $(\mu, \sigma^2) = (-.2869, .5738)$ for $t = 0$ to $(-.1116, +.2231)$ for $t=1$. In this case the approximation is already a very bad one for the initial period (y^H and $\hat{y}^H$ show considerable differences and $\hat{\gamma}$ is much higher than γ for $t=0$); more importantly, the relative fall in the Gini coefficient is very much underestimated (24% vs. 41%)

Table 1.4.2 : Effect of a Log Normal Approximation

(hatted symbols denote approximation)

i	h_i	t=0						t=1					
		y_i^H	$\hat{y}_i^H$	ζ_i	$\hat{\zeta}_i$	γ	$\hat{\gamma}$	y_i^H	$\hat{y}_i^H$	ζ_i	$\hat{\zeta}_i$	γ	$\hat{\gamma}$
1	.4	0.50	0.16	0.2	0.0655			0.75	0.28	0.3	0.1120		
2	.4	0.75	1.17	0.3	0.4681			0.75	1.33	0.3	0.5321		
3	.2	2.50	2.32	0.5	0.4644			2.00	1.78	0.4	0.3559		
total													
	1.0	1.00	1.00	1.0	1.0	.340	.428	1.00	1.00	1.0	1.0	.200	.324

The danger involved in the procedure's use is obvious: even if log normality is a reasonable approximation in the base year, there is no guarantee that that property will be preserved over time. Whether this leads to a substantial bias in the results of the models which use such approximations

is impossible to check. But that possibility makes us suspicious of the conclusion of e.g. Rodgers et al. (1978) that the household income distribution is very insensitive to policy changes: that might well be so because redistributive changes are diluted - as in our example- by the requirement to preserve log normality which implies that the incomes even of groups who are unaffected are adjusted.

1.5. Some Recent Models

This section is devoted to a - by no means exhaustive - review of economy-wide models for L.D.Cs which focus on income distribution. We consider six models: by Taylor and Bacha for 'Belindia', by Gupta for Korea, by Rodgers et al. for the Philippines, by Lysy and Taylor for Brazil and by Adelman and Robinson for Korea.^{1.}

In our discussion of these models we will emphasise:

(a) the models closure. How is equilibrium in the goods market, in the labour market and of the balance of payments ensured; which variables are exogenous? Here we will frequently compare the models with the simple one-sector models of section 1.2.

(b) dualism. What is the distinction, if any, between the modern and the informal sector in the model? How are incomes outside the modern sector determined? Is unemployment a residual?

(c) terms of trade. What determines the relative price of agricultural goods? How important are changes in the terms of trade in determining the model's results? What determines agricultural output and employment?

(d) household composition. Is there an explicit mapping from the functional to the household distribution of income? If so, is the 'chemical model' used?

(e) migration. What determines rural-to-urban migration and to what extent does that process dominate the results? Do imperfections in the urban labour market introduce expectational considerations in the migration decision?

(f) asset distributions. Which assets play a role in the model? Is their distribution over households explicitly considered?

1. much of the applied work in this field is supported by international organisations. Of the five applied models (i.e. excluding the 'Belindia' model which is theoretical), the model for the Philippines was constructed by staff members of the ILO, the other four by staff members or consultants of the World Bank.

We conclude this section with a short summary. A discussion of the differences between the six models reviewed here and our own models for Kenya and Tanzania is left for the next chapter.

The first model is that of Taylor and Bacha (1976) for the hypothetical country of 'Belindia', an economy which is dualistic and combines characteristics of Belgium and India.

In the modern part of the economy there are three sectors, producing wage goods, luxury goods and capital goods. The technology is linear; in each sector capital and labour use are given by fixed coefficients. There is a rural subsistence sector which à la Lewis (1954) plays the dual role of setting the real wage and providing a labour reservoir. Employers can choose to upgrade some or all of their employees. The productivity (and hence the wage) of skilled workers is a fixed multiple of that for the unskilled. In efficiency units the two types of labour are perfect substitutes in production. They differ, however, in their consumption behaviour: skilled workers spent most of their wages on luxuries while the unskilled consume only wage goods. There is no consumption out of capital income. Finally, there is no restriction on inter-sectoral mobility of capital (only the total capital stock is predetermined) and investment (and hence the output level of the capital goods sector) is exogenous.

How does such a model respond to changes in autonomous expenditures, e.g. in investment? First, there will be no change in the prices of goods or factors: with a Leontief technology all prices are predetermined à la Marx

by technical coefficients alone. Secondly, ignoring for the time being the existence of two types of labour and two different consumer goods, investments determine savings rather than vice versa: the difference in savings propensities determines the change in employment (and hence in income distribution) which ensures continued equality of savings and investment. Finally, considering the extension of the model to include two consumer goods and two types of labour, changes in the skill composition of employment are determined by the difference in consumption preferences of the two types of workers and the need to satisfy demand for both types of consumption goods. Whenever such a model is subjected to a shock three adjustment processes occur simultaneously: the capital stock moves between sectors, total employment changes and there will in general, be a change in the proportion of workers who receive the higher wage.

There are several objections to this approach.^{1.} First, inter-sector capital mobility is a rather questionable basis for a short run adjustment process. Secondly, twenty five years after the appearance of the seminal² article by Lewis (1954) there can be few people who still accept the surplus labour theory's relevance for developing countries: LDCs have abundantly demonstrated their ability to maintain for decades modern sector wages at levels far above rural subsistence incomes. Thirdly, even if investment could be treated as exogenous,^{2.} it is not credible that any investment plan can be realized^{3.}

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1. at least one of the authors seems to have developed reservations since the model's publication: in Taylor and Lysy (1977, p. 22) the theory is called extremely crude.
 2. a position which we do not accept; for a criticism cf. Cline (1975). Since this model is clearly Kaldorian, the usual objection applies: it only works for two types of labour. To see this, note that if there are I sectors and K labour types then there are $I + 1$ balance equations (two for factor use: one for total employment and one for capital; $I - 1$ for goods since output of the capital goods sector is predetermined by the exogenous level of investment) in $I - 1 + K$ unknowns (employment of K types and output levels, except for the capital goods sector). Hence the model breaks down except for $K = 2$.
 3. as long as it is feasible in the sense of not violating non-negativity constraints.

without a change in prices. Finally, it is not clear how the equilibrium would be reached except in a planned economy. Even if one allowed for price changes in the out-of-equilibrium phase, employers never have an incentive to upgrade their labour force: in efficiency units the two labour types are perfect substitutes.

The model is used to demonstrate the possibility of an 'unequalizing spiral'. Investment may increase skilled but reduce total employment and if the 'animal spirits' guiding entrepreneurs' investment decisions are inspired by the growth of demand for luxuries then the economy moves along the spiral.

Of the applied models which we will consider the first one is that of Gupta (1977) for Korea. His is a 17 sector input-output model in which output is determined by past investment. The main difference from the structure of the models discussed in section 1.2 is that there are no production functions: in each sector output is linked by a fixed coefficient to the (predetermined) capital stock. Foreign trade is treated as in models A and C of section 1.2: for each sector exports are exogenous and imports are determined residually from the material balance equation.¹ With internal equilibrium thus

1. Gupta does however (unlike most modelers who use that specification) not ignore limits on tradeability and import substitutability. Tradeability is taken into account by adjusting the allocation of investment over sectors (outside the model) until imports of non tradeables are close to zero. Limited import substitutability is taken into account by comparing (for manufacturing) the actual level of imports - as derived from the balance equation - with the level as it would have been if the ratio of imports and consumption plus investment demand would not have changed. The exchange rate is related by a constant elasticity to the ratio of these two import levels. Hence the won is devalued as import substitution proceeds. This raises the price (in domestic currency) of imported intermediate goods and hence (through the Leontief pricing system) affects absolute and relative prices.

guaranteed, changes in the level of investment is the main mechanism by which the economy adjusts to external equilibrium: the model solves for a level of investment at which total net imports equal predetermined foreign savings. Prices are endogenous but are based on costs (Leontief pricing): they play no equilibrating role.¹

Since imports are determined residually and since prices are calculated on a cost-plus basis, the rural-urban terms of trade do not play the dominating role which they have in the models for Korea and for the Philippines which we discuss below: a low income elasticity for food crops is reflected in import substitution in this model rather than in a fall in farmers' real income as it is in those models.

For each sector, employment and self employment are related by fixed elasticities to output levels. The self employed receive what is left of value added after subtraction of the wage bill. Wages are a function of labour productivity and hence largely exogenous. There is a second term in the wage equation which involves the unemployment rate, but this effect is apparently very weak: the rate of unemployment (and hence the distribution of income) is very sensitive to small changes in the rate of growth. Apparently nominal wages are very unresponsive to changes in excess labour supply.

There is no explicit mapping to the household distribution of income: each household has only one earner (but dependency ratios differ between types of

1. the return of capital is exogenous, cf. Gupta (1977), p. 9, p. 102.

earners and unemployment - which is calculated as a residual - is allocated between household types thereby raising dependency ratios, especially those of rural households).

Given sectoral wage differentials, the key equations in the model as far as distributional changes are concerned, are those defining employment and unemployment. With the wage structure and level fairly rigid, distributional change occurs mainly because of quantity changes: intersectoral shifts of employment and shifts of the labour force out of unemployment into either wage employment or self employment. Because of the price and wage rigidities in this model, distributional change is much more pronounced than in the Adelman and Robinson (1978) model for the same economy.

There is no trade-off between growth and equity: any policy which raises the growth rate improves income distribution since it reduces unemployment and increases the share of wage earners in value added. Migration in this model is a function not of income levels but only of the growth of the non-agricultural sectors. A curiosum in the model's results is that if wages are raised exogenously growth accelerates. Apparently this is so because the change leaves corporate savings unaffected but redistributes personal income: the total income of the self employed is reduced by the same amount as the increase in the wage bill. Since savings rates are higher for wage employees this results in an increase in savings and investment.

We have three criticisms of this model, two of which concern its applicability to Korea: (a) an economy in which exports are growing at 16.6% per year - as they are in Gupta's base run - is likely to be considered by lenders so credit worthy that it faces a highly elastic supply of foreign savings. Modelers usually assume either perfectly elastic or perfectly inelastic supply; for Korea the former assumption seems to be the more realistic one,

hence it is inappropriate to impose a/ foreign savings constraint
 (b) demand and supply have no effect on prices and wages (c) even if
 wages were perfectly rigid, one would not expect incomes of the self
 employed to be totally immune to changes in excess labour supply: the
 residual specification of unemployment is extreme.

The Bachue model for the Philippines^{1.} is designed as a tool for the analysis
 of interactions between economic and demographic phenomena. We will concentrate
 on its treatment of output, employment and income distribution, ignoring its
 demographic part.

Amongst the models discussed in this section, Bachue is unique in staying
 very close to the tradition of demand driven input-output simulation models.
 With two exceptions, the model does not recognise supply constraints.

Investment, exports and public consumption are exogenous and imports are
 given by import substitution parameters^{2.} (which change exogenously over
 time). Since private consumption is related to lagged incomes it is pre-
 determined and output levels can be found by applying the Leontief inverse.
 There is no foreign exchange constraint: external borrowing is assumed to
 finance any excess of imports over exports. The first exception is that a
 constraint on aggregate output is imposed; if this is exceeded all variables

1. Rodgers et al. (1978). Also: Wéry et al. (1974, 1977) and Adelman et al. (1977).

2. with the final demand vector F defined by $F = C + I + G + E$ (and hence M by $M = F - (I - A)X$), it is assumed that $X_i = \alpha_i Z_i + (1-\alpha_i) E_i$ where α is the import substitution parameter and $Z = (I - A)^{-1}F$.

(including the exogenous ones) are adjusted proportionately downwards. The second supply constraint applies only to agriculture. The relative price of agricultural and non-agricultural goods determines a maximum growth rate of agricultural output. If actual output is higher the relative price rises in the next period.¹

Employment is disaggregated by location (rural and urban), by types of employment (self employment, skilled and unskilled wage employment) and by sector (modern or traditional). Given labour supply (by location and type of employment), employment and income distribution are determined by:

(a) making the traditional sectors labour absorbing and (b) making the shares of the different labour types in value added a function of the 'level of development' and of the relative supply of unskilled labour.

Distinguishing sectors not only on the basis of product homogeneity but also on whether or not they can be considered as 'absorbing' labour is a very useful device.² In the traditional sectors mean income is simply the ratio of total income and labour supply.

Bachue's specification of shares in value added is more controversial. The non-wage share is a linear function of the 'level of development' for which

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1. since actual output is equal to demand even if there is excess demand this is a rather indirect way of modeling a supply constraint: output is constrained only because the relative price change reduces demand in subsequent periods.
 2. its drawback is that it requires a very detailed input-output table and, in addition, the table should fully cover the traditional sectors. Neither condition is satisfied for countries such as Kenya and Tanzania.

the share of urban modern sectors in total output is used as a proxy. Except for the observation that this share differs between developing and developed countries, no economic rationale for this specification is offered.¹ The share of unskilled labour in the remainder of value added is determined as a linear function of the proportion of unskilled labour in total labour supply. A theoretical or empirical² justification for this is not given.

The allocation of unskilled labour between the modern and traditional sectors is determined by keeping the ratio of incomes in the two activities constant. Given the capital stock and unskilled employment, educated employment is then derived (for each of the modern sectors) by inverting a Cobb-Douglas production function.³

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1. the function is determined by data for the Philippines in 1965 and Japan in 1960. The same linear form is used to generate corporate savings. Subtracting these and corporate taxes gives the income of the self employed.
 2. the parameters of the function are obtained by forcing it through the origin and through the point observed for 1965.
 3. the exponents of this function are adjusted each year to preserve consistency with the value added shares. The use of a Cobb-Douglas function is very curious. As in most demand-driven input-output models the sectoral allocation of investment is determined by fixed ICORs and the interpretation of those coefficients is very ambiguous because they have to be adjusted proportionately to ensure that investment sums to the exogenous total: this is one of those models in which capital costs rise by 10% if total investment does. An economist's patience is severely taxed if that error is compounded by simultaneously using a Cobb-Douglas function to generate employment.

Educated labour not employed in the modern sector is absorbed in the traditional sectors.

Note that wages are not rigid and that employers do not maximise profits. Why they would want to employ as much skilled or unskilled labour as the model says they will remains unclear. The number of self employed grows with population.

This is - with some simplifications - the structure as determined by what the authors call 'basic demand'. It is subsequently modified by (iso-elastic) functions relating shifts of labour supply from one type to another (e.g. from self employment to skilled employment) to income differentials.

In its treatment of the urban income distribution,¹ Bachue differs radically from our models of chapters four and seven. As an example, it is instructive to see why the sort of urban poverty problem which we will discuss below for Tanzania can not arise in the Philippines model. There are two reasons for this. First, rapid growth of urban employment does not attract migrants: expectations do not enter the migration function.² Secondly, an increase in the supply of unskilled labour does not drive down incomes in the traditional sectors as much as would be the case if wages for the unskilled were fixed: in Bachue such an income fall leads - in a mysterious way³ -

1. the treatment of rural employment and income distribution is very similar, with food crop production being the main labour absorbing sector.

2. migration is related to the ratio of actual urban and rural incomes, Rodgers et al. (1978), p. 225.

3. mysterious because one would expect modern sector wages either to be fixed (in which case unskilled employment in the sector would not increase) or flexible (with employment determined by marginal productivity conditions). Since neither is true the modern sectors are - as far as unskilled labour is concerned - in fact undistinguishable from the traditional sector. Both absorb labour, the allocation being given by a fixed income differential (which also governs the allocation of unskilled labour between traditional sectors).

to an increase in unskilled employment in the modern sector; inequality - within the group of unskilled - is, by definition unaffected. It will not come as a surprise that the authors conclude from their results that the distribution of income is very stable.

Bachue derives the household income distribution ^{1.} by a modified version of what we called the chemical model in section 1.4. Labour force participation rates are predetermined for heads of households.^{2.} Total employment for non-heads of households is then derived residually and all elements of the vector n ^{3.} are multiplied by a scalar which ensures consistency with this total. The RAS method of input-output analysis is then used to update matrix D, subject to the constraints that rows must continue to sum to one and that (1.4.3) must be satisfied.^{4.} This procedure is entirely mechanistic. There is no economic reason why changes in the labour market should induce such shifts in labour supply that the assumption of the RAS method (multiplicative row-and column effects) would be satisfied.

1. before inequality measures are calculated the discrete rural, urban and total distribution are approximated by log normal curves; cf. our comments on this procedure in the previous section.

2. the sectoral distribution of heads of households (the matrix $\tilde{I}$ of section 1.4) does not change.

3. where - as in section 1.4. - n_i denotes the number of active labour force members (other than the head) in households of type i .

4. i.e. one finds diagonal matrices R and S such that $l_i = \sum_j r_{ij} s_{jj} D_{ij}^0 n_i h_i$ and $\sum_j r_{ij} s_{jj} D_{ij}^0 = 1$; the updated matrix is given by:
 $D_{ij} = r_{ij} s_{jj} D_{ij}^0$.

Bachue is a very large and detailed model; its development represents one of the most ambitious efforts in applied modeling in recent years. However, we do not find it convincing either as a model for the Philippines or as a prototype for other models.^{1.} There are several reason for this. First, output and investment are exogenous. Secondly, there is no limit on foreign borrowing. While that may be a reasonable specification (at least in the medium term) for fast growing middle-income developing countries such as Korea or Brazil,^{2.} it certainly is not for the poorer LDCs. Thirdly, prices play no role in this model except for the internal terms of trade. That relative price plays a central role in the results.^{3.} It does so because of the rigidity which the model's structure imposes on external trade: both imports and exports are virtually exogenous. When agricultural productivity increases the effect is not a reduction in food imports but a deterioration of the terms of trade. Since a very large proportion of the population^{4.} is engaged in food production this curious specification strongly affects the results. Finally, the results for income distribution depend heavily on the curious equations for shares in value added. Exaggerating only slightly, the model proceeds by (a) generating total income in various

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1. the ILO intends it to be the first in a series of similar models.
 2. such countries have indeed relied heavily on foreign capital in adjusting to the oil price increases and OECD recession of 1973-75.
 3. cf. Wéry et al. (1977), Adelman et al. (1977).
 4. In 1965 the sector accounted for 32% of total employment, Wéry et al. (1974), p. 45. One's confidence is not increased if one finds that the estimated equation for the consumption of food crops gives a prediction for the base year which is already 42% off (idem, p. 30). When the model is used to experiment with different growth rates, the dice are loaded: with a lower growth rate farmers lose because of reduced demand for food, while with a higher growth rate they do not gain because the specification is changed: food imports are increased to meet the extra demand. Wéry et al. (1977), p.6.

categories by applying these functions - straight lines forced through data for the Philippines and for Japan - to output (which is largely exogenous) and (b) generating personal incomes by dividing labour supply over these categories in a way which preserves income differentials.

While the authors admit that Bachue is crude as a macro-economic model it really does not have very much to say about income distribution and employment either.

By far the simplest applied model is that of Blitzler (1978) for Zambia. It is best understood as a modified and extended version of model A of section 1.2. The modification concerns the treatment of investment and foreign savings. Private investment is determined by private savings,¹ but public investment is exogenous; to ensure equilibrium foreign savings - which are exogenous in model A - are determined residually: it is implicitly assumed that any government deficit can be financed by external borrowing.²

The model is extended to cover three goods. Output (and hence ³ investment, employment and exports) of the mining sector is exogenous. Commercial agriculture and the urban sector are treated as in model A: with output, prices and wages given and the capital stock predetermined, the model is solved for profit maximizing output and employment levels in the two sectors.⁴

1. which consist entirely of household savings; it is not explained why there are no retained earnings in the model.
2. this implies that changes in the world price of copper - a variable which would be recognised as crucial by anyone familiar with the Zambian economy - affects no variables other than the level of foreign savings.
3. since factor use is given by fixed coefficients and all output is exported.
4. changes in pricing policies have very strong effects on output and employment since the production functions are Cobb-Douglas (cf. table 1.2.3.).

Given the urban labour force, employment in the mining sector and in the urban sector, urban unemployment is derived as a residual.

The agricultural good is also produced by smallholders and these do not maximise profits. Two groups of smallholders are distinguished. 'Traditional' farmers become - as their incomes (and hence savings) rise and as the income differential between the two groups rises - 'emergent' farmers. The two groups operate along the same (Cobb-Douglas) production function but since emergent farmers have more capital their per capita production is higher. The transformation of traditional into emergent farmers is essentially a process whereby smallholders accumulate the savings necessary to finance capital intensive techniques. With the number of emergent farmers predetermined by this process (and employment in commercial agriculture already determined) the number of traditional farmers is derived residually.

Of the six issues which we singled out in the beginning of this section, three do not arise in the Zambia model: (a) the rural-urban terms of trade are exogenous, since all prices are ¹. (b) household composition is ignored: private consumption and savings depend on individual, not on household incomes (c) there is no urban informal sector and unemployment is (therefore) a residual.

There are several features which undermine the model's credibility.

1. in fact, the pricing policy assumed in the base run is one which keeps the terms of trade constant.

The first is its treatment of foreign trade. We have already noted one curious implication: the fact that the copper price does not affect the domestic economy. To this must be added the absence of any economic or institutional constraint on imports: there is no equation such as (1.2.7). This means that both the agricultural and the urban good are considered fully tradeable and that all imports are competitive: there are no limits on import substitutability. Non tradeability can certainly not be ignored in an economy in which services account for about two thirds¹ of GDP in the urban sector. The treatment of all imports as competitive is particularly unrealistic for Zambia: imports of intermediate goods account for about half of the total² and of the remainder a large part consists of capital goods which Zambia can not produce domestically, except in the very long run. The absence of a constraint on imports also means that no account is taken of Zambia's stringent import licensing system: the model could never explain why imports fell from 162 (1965 = 100) in 1972 to 88 in 1976 (in real terms).³

The second feature is the way output and employment are determined in the urban sector. Profit maximization and a Cobb-Douglas production function are unlikely to describe adequately a sector which includes (in addition to manufacturing) construction, transportation, public administration and

1. in 1976, cf. World Bank (1977b), table 2.02, p. 184.

2. this limitation of the model does not appear explicitly since there are no intermediate goods in the model. Note that this implies that the price of e.g. oil is irrelevant for Zambia.

3. World Bank (1977b), pp. 104-105. The restrictions had serious implications for production, especially in 1976.

services. Services (including public administration) accounted in 1976 for 65% of value added in this sector and in 1974 for more than half of employment.¹ While the Cobb-Douglas function implies the constancy of labour's share in value added,² that share fell by 1% for manufacturing between 1965 and 1974, but rose by 110% over that period for construction, by 102% for transport and communications and by 134% for services.³

Thirdly, the treatment of the urban income distribution is very crude: the informal sector is assumed away and - with the functional distribution very stable because of the Cobb-Douglas specification - the main endogenous distributional change is due to changes in unemployment, which is derived as a residual.⁴

Finally, the treatment of smallholders. Output growth is not just a matter of accumulating savings to finance capital-intensive production - presumably oxen or tractor technologies - but also of switches to non-traditional crops,⁵ use of hired labour and the adoption of improved seeds, fertilizers and insecticides, but the model recognises only capital accumulation. That

1. World Bank (1977b), table 2.02, p. 184 and table 5.01, p.202.

2. technical progress is assumed to be Harrod-neutral, Blitzer (1978), p.A-2.

3. World Bank (1977b), table 5.03, p.204.

4. in classical Harris-Todaro fashion, all jobs are assumed to turn over every year. This makes expected urban incomes (and hence migration) rather insensitive to the rate of unemployment, which may account for the strange specification of the migration function: migration is linear in $(y_U/y_R)^{\epsilon_1} (1/u)^{\epsilon_2}$ (where y_U is expected urban income, y_R rural income, u the unemployment rate and $\epsilon_1 = 1$; the value of the elasticity ϵ_2 is not given). No rationale for the second term is provided.

5. that, in fact, is seen in the World Bank report as one of the most important differences between 'traditional' and 'emergent' farmers. World Bank (1977), p. 38.

smallholders do not maximise profits is by now a highly unorthodox position. One has to make extreme assumptions about land availability, about the preference for leisure and about the opportunity cost of labour to justify the assumption (implicit in the model) that agricultural producer prices have no effect on output, other than an indirect effect through capital accumulation. It is also very questionable whether smallholders derive their income entirely from farming.^{1.}

The distribution of assets plays only a very limited role in this model. The only distribution that matters is that of capital in the smallholder sector. Outside that sector there is only one class of Zambian capitalists so that the distribution of capital is irrelevant.^{2.} The distribution of land does not matter either, since land is not recognised as a factor of production. Finally, there is no inequality of the distribution of assets amongst wage employe^es: labour demand is not disaggregated by skill,^{3.} nor is there a rationing device which would make the probability of employment depend on e.g. the applicant's educational qualifications;^{4.} the rationing in the labour market is entirely random.

1. non-farm income (including urban-to-rural remittances) is a major source of smallholder income (and of income inequality) in Tanzania and Kenya, cf. chapters 4 and 7 below.

2. savings of wage earners are implicitly treated as a gift to capitalists (including the government and foreign owners).

3. in models such as Lysy and Taylor (1977) and Adelman and Robinson (1978) various (pre-existing) skills which are imperfect substitutes in production are recognised so that the distribution of income depends on that of skills (i.e. assets).

4. that is the way in which assets matter in the Kenya model, cf. section 7.6 and appendix 3.

The next two models are far more sophisticated.

The Brazil model of Lysy and Taylor (1977) is a very detailed general equilibrium model: there are 25 sectors, 11 types of labour and 6 types of capital goods. Its results may however be understood by considering it as a one-sector model of the type of model D in section 1.2: domestic prices are endogenous and so are wages¹; since a full employment condition is imposed. There are however four differences. First, as in our model E, there is an imported intermediate good so that a fixed proportion of the domestic price level is predetermined.² Secondly, there are no competitive imports. Hence the final demand components (C,I,G) represent demand for domestically produced goods only. The balance equation then becomes $X = C + I + G$ and foreign savings are given by $F = mX + \mu_C C + \mu_I I$. Thirdly, the model is closed in a slightly different way: I is exogenous and F is endogenous. Finally, in addition to workers and capitalists a third group is introduced, the self employed. Their number (S) is proportional to gross output³. ($S = sX$) and their per capita income (p_S) is fixed at unity.

This last specification is crucial, but strangely enough its importance seems to have escaped the authors. They also discuss their model in terms of a one-sector analogue. That simplified model however has all the characteristics which we have listed above with one exception: the imported intermediate input is ignored. With world prices thus eliminated they

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1. at least in the variant discussed here: in another version of the model nominal wages are exogenous.
 2. cf. equation (1.2.37) which in its general form reads $p' = vp'_Y + mp'_W$; we dropped the last term because world prices were assumed to be constant.
 3. hence $p = vp_Y + mp_W + sp_S$, with $v + m + s = 1$.

naturally find - as we did for model D - that the model is ~~linear~~ homogenous ^{of degree zero} in prices (p , p_Y , p_K , p_L and p_S). They find it convenient (p. 7-8) to treat p_S (p_E in their notation) as the numéraire and of course this choice (or any other choice) is innocuous. By the time the full model (including imported intermediate inputs) is discussed, Lysy and Taylor seem - in the maze of the detail of their disaggregation - to have lost sight of the fact that the model is no longer ~~linear~~ ^{of degree zero} homogenous¹ in prices: for this full version they state again that 'it is convenient to normalize on proprietors' remunerations' (i.e. on p_S in our notation, p. 8-11). Obviously, this no longer amounts to a choice of numéraire but to the fixing of the income of the self employed in nominal terms. No justification is provided for this specification.² Nor is a rationale provided for the proportionality of output levels and the number of self employed or for the fact that - while for wage earners the market has to clear - labour supply is not defined for the self employed: it is not clear where they are recruited from when the economy grows.³

Since investment is exogenous, it is instructive to derive the elasticities of the endogenous variables with respect to investment. One then finds that (a) the elasticities are the same for p_Y , p_K and p_L hence no substitution

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1. the model would of course continue to be homogenous of degree zero in prices if the exchange rate would adjust (so that in domestic currency import prices would inflate at the same rate as domestic prices). However, the exchange rate is kept exogenous (p.8-11, footnote 2; p. 8-24). Again, it is astonishing that the authors do not seem to realise that this fixes a relative price: to make the exchange rate exogenous is simply called 'convenient'.
 2. the point would be trivial if the self employed were a minor group in the economy, but according to Lysy and Taylor 'they play a large role in the economy' (p. 8-11).
 3. cf. p. 8-28 and footnote 3.

between capital and labour occurs and output remains constant (b) the price level p rises¹. thereby eroding the real income of the self employed: to maintain equilibrium, income has to be redistributed to groups with high savings rates and this is achieved through forced saving of the group with the highest propensity to consume, the self employed.

It is easily seen why the main adjustment mechanism is such a process of inflation (or deflation), even if some variable other than investment changes: the model is excessively rigid since investment is exogenous and competitive imports are ruled out. With these two routes blocked adjustment must necessarily rely on changes in the price level.

Price changes in this model are enormous: the price level falls e.g. by 43% if investment is reduced by 10%.² This makes the treatment of foreign trade highly dubious: if the ratio of domestic to world prices can change by as much as that, the assumption that the ratio of imports in final demand is constant becomes untenable.

Given the rigidity of foreign trade, the rural-urban terms of trade are of course very volatile: an increase in agricultural productivity harms the rural poor because agricultural prices are forced down.

The migration equation is not given and household composition is not an

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1. $p' = v p_Y' = v \epsilon I'$ where $I = -Y(p_Y/p) [(c_L \zeta_L + c_K \zeta_K)(1-v) - c_S]$ Since in the Brazil model c_S is much larger than c_L and c_K , the elasticity ϵ is positive.
 2. changes in relative prices are also incredibly large. The reason is that private consumption of domestic goods (representing less than 30% of final demand) is the only demand component which is price elastic.

issue: the model only generates the functional distribution of income. Note that to the extent that the self employed can be identified with the informal sector, the link between the modern and the informal sector is an unusually direct one:^{1.} the production of the self employed is treated as an intermediate input.

The second model for Korea, that of Adelman and Robinson (1978), is the only one of the six models which can not be analysed in terms of a one-sector analogue: one of its more important characteristics is that the model is closed in different ways for different sectors.^{2,3.} For some sectors the domestic price is predetermined (by world prices, nominal tariff rates being fixed); in these cases the adjustments consist of changes in (net) imports, which are treated as fully competitive. For other sectors, external trade does not play such a market clearing role: imports are constrained by an equation like (1.2.7);^{4.} for those sectors equilibrium is achieved through changes in the domestic price level.^{5.} Since Adelman and Robinson assume full employment, this implies that their specification combines those of our models C and D of section 1.2. There is however one difference: instead

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1. in the Philippines model the traditional sectors produce a different good, largely for final demand, hence they have their own balance equation. In the Adelman and Robinson model for Korea the self employed produce the same good as the modern sector. Hence here the link between the two is the fact that they face the same price.
 2. the statement applies to the closure of the goods market; in most models the treatment of the labour market differs between sectors.
 3. in this respect it is similar to our Kenya model of chapter 7.
 4. the equation may of course - in the case of non tradeables - be used to constrain imports to zero.
 5. in this case the (implicit) tariff rate is of course endogenous.

of foreign savings, investment is exogenous, but not in real terms (as in the Belindia, Philippines and Brazil models) but in nominal terms. The model is in the temporary equilibrium tradition in the sense that firms are constrained (by lack of perfect foresight) to optimise in two stages. In the first stage they decide on the basis of expected prices on their optimal capital stock and hence their desired investment. In the second stage they recalculate their maximisation problem using actual prices, but they do not adjust their nominal investment plan. Hence, if inflation is incorrectly anticipated, ex ante and ex post real investment will differ.^{1.}

This model is less rigid than that for Brazil; it generates less extreme changes in prices because the adjustment mechanism can rely to a much larger extent on changes in imports and exports.^{2,3.}

In agriculture the distribution of land is taken into account; there is a

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1. the stage one model - in which an ambitious attempt is made to model the financial system - can not be considered convincing; in the second period of the projection period (1972) fixed investment is already 11% too low, while the projected value for the change in inventories is more than four times higher than the actual, an error of more than 2% of GDP (table 10, p.66). In spite of this, the authors call the 'degree of agreement' between the results and the actual data 'quite remarkable' (p.71).
 2. relative prices may be more volatile because some prices are predetermined. This we consider realistic. In the real world some prices are isolated from changes in domestic demand or supply (either because they are controlled or because they are linked to world prices), while import controls, non-tradeability or limited import substitutability make other prices much more sensitive to such changes.
 3. it may be noted that we criticise some modelers for making foreign savings endogenous and others for treating them as exogenous. There is no contradiction: either specification may be appropriate, depending on the country's credit-worthiness. For Korea we think it realistic to assume endogeneity.

disaggregation by farm size. Family labour is immobile and rural wages are flexible: they are adjusted until all landless labour is hired.^{1.} There are two agricultural sectors: cereals (maize, rice and wheat) and 'other agriculture'. Apparently, land, capital and family labour do not move between these two sectors: changes in relative prices do not induce inter-crop substitution.^{2.}

Changes in the rural-urban terms of trade are the central phenomenon in virtually all the simulation experiments.^{3.} In the base run the terms of trade turn against agriculture for three reasons: (a) income and price elasticities for food crops are very low (b) the distribution of income becomes more unequal over time, so that incomes grow most for groups with low propensities to consume food crops^{4.} (c) food crops are treated as if non tradeable: any increase in supply (e.g. as a result of a rural development programme which succeeds in raising productivity in agriculture) drives down the price of food crops rather than reducing imports. Given this specification it comes as no surprise that policies intended to help the rural poor usually have the opposite effect. The authors seem to think that these results^{5.} are not

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1. apparently there are imperfections in this market: for each farm size there are minimum and maximum constraints on hiring (p.30). The justification for these constraints is not discussed, nor is the exact specification given: the equations for the agricultural labour market are nowhere given (cf.pp.209-212).
 2. the point is worth stressing, since the model's results for the rural income distribution are dominated by changes in the terms of trade. These would be much less important if farmers could switch to non-food crops when food prices fell.
 3. this paragraph draws on Gunning (1978).
 4. rural-to-urban migration has the same effect.
 5. in listing the causes (p. 182) they conveniently omit (c). That specification is certainly not generally applicable, even if it would be relevant for Korea.

specific to the Korean economy. The generality of the result may however be questioned. First, because it is unrealistic to assume that increased domestic production can not substitute for imports of food crops. It is much more typical to find agricultural producer prices controlled, the market being cleared through quantity adjustments.¹ Secondly, because the model does not allow inter-crop substitution, but in many LDCs substitution of, say, cotton for maize would be an important stabilizing factor. Thirdly, the results would not apply (as the authors admit) if a significant proportion of agricultural production was not marketed.² Fourthly, in many countries rural incomes are to a significant extent derived from non-agricultural activities (in which case both the direct impact of a fall in the terms of trade on rural incomes and the feedback effect is reduced). Fifthly, the empirical basis is not clear: the estimation results for the demand functions are not reported and regression estimates of the production functions were rejected in favour of point estimates.³ Finally, in many countries migration would be sensitive to the drastic falls in real rural incomes generated by the Korea model, but in the model that adjustment mechanism is apparently very weak.⁴

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1. when such a policy is followed (p. 134) it is indeed successful, in spite of an extraordinarily high growth rate of production (9.3%). That growth rate alone should have made the authors very hesitant to generalise the results of deteriorating terms of trade.
 2. this is typically the case in the poorer LDCs, such as Kenya and Tanzania.
 3. this also applies to the production functions for the non-agricultural sectors. If the regression results were 'not successful' (p.58) one would expect some justification for nevertheless using the CES and Cobb-Douglas specifications.
 4. probably partly because migration is subject to an arbitrary maximum.

In the non-agricultural sectors there are wage-employed (disaggregated by skills) and self employed. For the wage employed, labour supply is given and the model solves for market clearing wages for each skill category.

In the production functions a labour aggregate is used: a Cobb-Douglas function is used to aggregate over skills. Hence, for any skill the share in the wage bill is fixed.^{1.} This may go some way in explaining the insensitivity of the distribution of income, one of the authors' main conclusions. The supply of self employed is also fixed and they do not compete for wage employment.^{2.} The model does not explain why members of the labour force participate only in certain labour markets.^{3.}

One of the most important dynamic processes in this model is migration, but the reader searches in vain for the migration equation and its empirical foundation. There is "a migration elasticity with respect to the differential between rural income and the average wage of the three urban categories' to which migrants are assigned (p. 255). For mysterious reasons not more than 2% of the three groups of potential migrants - landless labourers and farmers in the first two farm size groups - can migrate in any year. This means that the maximum migration flow is 1.3% of the rural labour force and also 1.3% of the urban labour force^{4.} Such low percentages are very untypical of most LDCs.

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1. again, no empirical or theoretical justification for this crucial specification is given.
 2. astonishingly for a book of almost 350 pages, some of the really important details of the labour market models are never spelled out. In chapter 2 one reads that there is some mobility between self employment and wage employment (p.32); that migrants are assigned (but how) to the three lowest skill categories of wage employment (p.35); and that there 'is also some relative reshuffling of labour among urban categories as a function of wage differentials that is concomitant with migration'. In the appendices in which the model is described in detail, no further explanation is given (cf. p.255 where the quoted passage is repeated verbatim). The labour supply equation (13) of p.211 is not used 'in most experiments' so that does not explain endogenous labour mobility either.
 3. spillover effects between labour markets are ignored in most models. Bachue is an exception, but there - as we noted above - they are treated rather crudely.
 4. data for the base year (1968) from table 16, p. 72.

Adelman and Robinson use the 'chemical model' in its pure form to derive the distribution of income over households. There is no indication that the implications for household composition of exogenous changes in labour supply have been taken into account or that the authors are aware of the model's limitations; in fact they apparently consider this part of their work one of their major contributions. For each household type log normality is assumed. As we noted in the previous section this may well be a source of errors.¹ The authors consider most of their conclusions relevant for countries other than Korea as well. One of those conclusions is that

'... the economy adjusts to policy interventions mainly through changes in wages and prices. In view of the scope for substitution in both consumption and production in our model, it is surprising that wage and price effects are so dominant...In omitting what our experiments suggest are the most important mechanisms through which economies respond to policy interventions, such models [namely those in which the emphasis is on real quantities] thus seem inappropriate for the very problems they seek to address' (p.185).

Changes in the agricultural terms of trade are the most important price effects and we have already cast doubts on the relevance of the Korea model for LDCs in that respect. More generally, whether an economy adjusts through changes in prices or through changes in quantities is a question one would like to answer differently for different countries. In this respect our model for Tanzania represents the opposite extreme. In the Korea model a number of market imperfections which in many countries are important in determining

1. curiously, the variance used for household income is that of the mean income for the head of household's occupation. This may be convenient but is of course unjustified, unless the matrix D (cf. section 1.4) is diagonal, in which case the whole problem of household composition is trivial.

the distribution of income are simply assumed away. Obviously, changes in wages and prices in such a pure general equilibrium model are the main adjustment mechanism. For countries in which the rural sector is much larger,^{1.} in which a number of prices (typically food prices) are controlled and in which nominal wages are fairly rigid^{2.} changes in quantities (including external trade and wage employment) play a much more important role.

In summary, it will be clear that the six models which we have considered are very different, both in their treatment of income distribution and as macro-economic models. If we first consider the models' closures the first five models all represent extreme positions regarding the determination of domestic prices: they can be (and are) completely controlled in the Zambia model; they are determined by the economy's technology in the Belindia model; they are set on a cost-plus basis in Gupta's Korea model; they are ignored^{3.} in Bachue; finally, in the Brazil model (in which foreign trade plays virtually no role) they are determined by domestic demand and supply. None of these extremes we consider realistic.^{4.} Our own

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1. in Korea the urban population is about half of the total; for Kenya and Tanzania its share is not much more than 10%, so that changes in migration have much more dramatic consequences for the urban labour force.
 2. note that the full employment condition in the Korea model rules out expectational considerations in the migration decision: whatever its exact form, the migration equation will not be of the Harris-Todaro type.
 3. with the exception of the rural-urban relative price which is a function of excess demand for food crops.
 4. with the exception of Leontief pricing, which is a realistic specification for some socialist countries, including Tanzania; cf. section 4.5.

preference is for the simultaneous use of different specifications, as in the Adelman and Robinson model, adjustment being through changes in quantities (external trade) for some sectors (where prices are controlled or linked to world prices) and through changes in domestic prices in other sectors (where trade can not be considered the residual item). In three models (Belindia, Bachue and Brazil) investment is exogenous in real terms. As already noted in section 1.2, we consider this assumption that investment plans are always realised unrealistic; in our own models investment is determined by savings.

In most of the models, wage employment is treated in a rather simplistic way. Adelman and Robinson assume full employment, as do Lysy and Taylor. In the Belindia model wages are rigid but there is always just enough migration to meet labour demand. In the models of Gupta and Blitzler there is no such adjustment; excess labour supply in a situation of rigid wages is simply reflected in unemployment in those models. The market imperfection which those two models recognise does not result in spillover effects; unsuccessful job seekers have no alternative other than unemployment. In the Bachue model there is an alternative: the traditional sector is 'labour absorbing'. But the authors have thrown away the baby with the bath water: the ratio of income for the unskilled in the modern and the traditional sector is fixed. To accommodate that constraint, modern sector wages are made endogenous but that implies that the distinction between the two sectors disappears: with wages no longer rigid the very imperfection which gives rise to a traditional sector has been removed.

The agricultural terms of trade play a central role in the Brazil and Philippines model and in the second Korea model. In all three cases they

derive their importance from an unrealistic treatment of food imports. In general rural incomes are treated in a rather cavalier way: Adelman and Robinson are the only authors to emphasise the distribution of land; non farm income and inter-crop substitution are ignored in all models; in the Zambia model agricultural growth depends only on capital accumulation and in Bachue only on demand.

Household composition is ignored except by Rodgers et al. and by Adelman and Robinson. In both cases however the chemical model is used and the derivation of the distribution of income over households is also suspect because of the use of log normal aggregation.

None of the models (with the exception of Blitzer's) use the Harris-Todaro migration formulation: the probability of finding employment is either ignored in the migration equation or it is irrelevant because urban labour markets are assumed to clear.

Dualism we have already discussed under the heading of the models' closures. We may add that in Gupta's model the number of self employed is given by an elasticity with respect to output; that in the Brazil model their income is fixed in nominal terms while their production is treated as an intermediate input; and that Adelman and Robinson treat the self employed as a separate firm size so that an increase in the number of self employed affects the rest of the economy by forcing down prices. None of the models are suitable for explaining the dualism in the urban labour market which we shall discuss below for e.g. Tanzania.

Applied economy-wide models - and especially those which address income distribution questions - present readers with a formidable task of disentangling what is essential from a mass of forbidding detail.¹ We have suggested - and here we agree with Taylor and Lysy (1977) - that, in spite of this complexity, there usually are a few simple mechanisms in the model which dominate its results. Once those basic mechanisms are revealed one is usually not impressed by the model's realism.

Income distribution modelers have either thrown economic theory overboard² or adopted (analytically convenient) extreme assumptions: very often, prices (including wages) are either all flexible or all rigid; hence there is an extreme emphasis on either price or on quantity adjustments.

The tendency to use extreme specifications for the goods market has led to models in which distributional change (and government policies' effectiveness in bringing it about) is exaggerated - as e.g. in the model A type Zambia model - or to models (Taylor and Lysy's 'Keynesian closures') in which such change quickly vanishes through price effects. A perfect example in the latter category is the Brazil model in which economic change is largely a process of inflation (or deflation). Neither extreme is generally applicable. It is more typical to find that while some prices are predetermined - because they are controlled or linked to world prices -

1. the task is not made easier by those authors who do not seem to have understood themselves what the crucial equations in their model are, not spelling them out at all or banning them to the periphery of their presentation.

2. a description we would e.g. apply to the way shares in value added are determined in the Bachue model.

others are market clearing. When in addition we recognise that in many LDCs the level of investment is constrained by the availability of domestic savings (foreign savings being in inelastic supply) then one obtains a model combining elements of e.g. models A and E of section 1.2, in which both price and quantity changes play an important role. Both types of adjustment may be important mechanisms of distributional change; the former e.g. in a model in which there is a price rigidity for a large group of earners (e.g. farmers, when producer prices are controlled), the latter in a situation of wage rigidities where changes in the level of investment - and hence, through growth, in employment - may lead to a large labour transfer. The polar models can not handle such cases.

Extreme specifications imply for the labour market that either all incomes are determined by demand and supply or that wage rigidities are recognised but their implications ignored. Rigidity of wages in one part of the economy implies shifts of labour in and out of that sector and flexibility of incomes in other sectors. Such segmentation and its consequences in terms of migration, job rationing and the development of the informal sector is not handled well in existing models. One suspects (as for the goods market) that some of the more important processes of distributional change are thereby ignored.

What models are bad at then is in capturing dualism in the widest sense of the word, i.e. in describing the implications of the co-existence of goods or factor markets in which the market is cleared in different ways. For the goods market this is captured by Adelman and Robinson (1978), but for the labour market dualism is not treated satisfactorily in any of the models reviewed.

At several points in this chapter we have hinted that the stability of the distribution of income in the simulation results may say more about the model than about the real world. The use of log normal aggregation; of the 'chemical model' of household composition; of Cobb-Douglas aggregation over labour skills; the fixing of crucial income differentials; the treatment of investment as exogenous; all of these may contribute to insensitivity. Finally, one of the models on which the conclusion of instability has been based - that of Adelman and Robinson (1978) for Korea - applies to an economy which is so unlike most LDCs¹ that generalising the results seems inappropriate.

1. in the economy's openness, in the relative size of the rural sector, in already having a fairly equal income distribution and in the absence of a large urban-rural income gap.

II KENYA AND TANZANIA: THE MODELS AND RESULTS

The main part of this thesis (chapters 3-8) consists of a description of the specification and results of our two models, for Kenya and Tanzania.

These models are used under different assumptions about government policies and other exogenous variables to study the effects of such changes on macro-economic variables and on income distribution. Like other authors - cf. section 1.5 - we use computer simulation. Analytical solutions can be obtained for partial equilibrium analyses or for static, very simple, one-sector economy-wide models (such as those discussed in section 1.2); more realistic, dynamic, multi-sector models require computer simulation if realism is not to be sacrificed for analytical tractability.

We have chosen Kenya and Tanzania not just because we happen to be familiar with those two economies. First, they are countries at a much earlier stage of development than those previously studied¹. Secondly, these two countries are characterised by a very large gap between rural and urban incomes, a relatively very large smallholder population². and highly

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1. of the countries for which we discussed recent models in section 1.5, Brazil had a per capita income of \$1300 in 1976, Korea 700, Zambia 450 and the Philippines 420. Per capita incomes in Kenya and Tanzania were very much lower: 250 and 180 respectively. World Bank (1978).
 2. the relative size of the rural sector is especially important for its implications for migration. The effects of changes in migration on urban employment and income distribution are obviously much more pronounced in a model for e.g. Tanzania (where the rural population is about eight times as large as the urban one) than in a model for, say, Korea (where the two populations are of about equal size).

protective trade policies.^{1.} In that respect, they are more representative of most LDCs than most of the countries for which models exist. Thirdly, the labour market phenomena which have played a large role in partial equilibrium analyses in the literature^{2.} - sticky wages; rationing of jobs on the basis of educational qualifications and the resulting 'bumping'; the co-existence of a modern and informal sector in the urban labour market; and the effect of expected rather than actual incomes on migration - these phenomena have not been satisfactorily incorporated in any of the existing models, but they are highly relevant for the two countries we have selected.^{3.} Finally, income distribution in Kenya and Tanzania has been the focus of much attention and a conventional wisdom has developed which roughly holds that in Kenya the distribution of income becomes more and more unequal as government policies emphasise economic growth along capitalistic lines while Tanzania's socialist policies may not have done much for growth but are a showpiece in having succeeded in reducing income inequality. The interest in the two countries and the fact that our data do not support the conventional view^{4.} provide the final justification for our choice of countries.

A summary of the structure of the two models will be given in chapter 3 and chapter 6.^{5.} At this stage we will confine ourselves to a brief discussion

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1. it is ironic that the one model which treats import controls satisfactorily - that of Adelman and Robinson (1978) for Korea - applies to a country in which such controls are much less important than in most LDCs, pursuing inward-looking strategies.
 2. cf. section 1.3.
 3. not surprisingly, since the Kenyan and Tanzanian economies provided much of the inspiration for the theoretical work on these phenomena.
 4. cf. sections 3.1 and 6.1 and appendix 3.
 5. the models are described in detail in chapters 4 and 7.

of those aspects of the models which distinguish them from existing ones.^{1.}

(a) goods market. In both models investment is determined by savings and the difference between total imports and exports is given, hence we explicitly exclude the possibility of adjusting to changing circumstances by increasing the reliance on external borrowing. For Kenya and Tanzania - but by no means for all developing countries - it is realistic to assume that their access to foreign savings is strictly limited.

Both models capture the effects of import controls and of limits on the tradeability or import substitutability of goods in the import equations:^{2.} imports are not treated as fully competitive.

There the similarities end and the models illustrate in fact two radically different ways of ensuring equilibrium. In Tanzania prices are controlled and play no equilibrating role. Since the process of adjustment can not rely on changes in foreign savings or in domestic prices, the model describes - realistically, we think - a very rigid economy. Equilibrium is reached through changes in quantities: the level of investment, its allocation over sectors and import controls. In the Kenya model, however price control is much less important; it applies only to food prices. While changes in the level of investment are also important in this model, price changes play an important role in the adjustment process.

As far as income distribution is concerned, prices derive much of their importance from the fact that wages (in some of the simulations) and

1. the background to this discussion is provided by the review of the literature of section 1.5.

2. cf. the discussion of equation (1.2.7) in section 1.2.

agricultural producer prices (in all experiments) are fixed in nominal terms. One implication is that in the Kenya model trade policies - through their effect on the price level and hence on real income of smallholders, the largest group of Kenya's poor - have very strong distributional effects. Such effects are not captured by any of the existing models. Wage increases similarly erode the real incomes of farmers; in the Tanzania model because of cost-push and in the Kenya model because of demand-pull inflation.

The urban labour market is segmented. Wages in the modern sector are fixed and excess labour supply spills over into unemployment and informal sector employment. If the labour force grows faster than modern sector employment then dualism becomes more pronounced over time: the distribution of income becomes more and more unequal as a growing number of unsuccessful job applicants force down the incomes in the informal sector while wages remain unaffected. This possibility is implied by the structure of both models. Whether such a development actually occurs depends on the modern sector's growth rate and on migration. In these respects, the two countries differ and the models generate in fact very different results. For Tanzania - with massive rural-to-urban migration and a falling rate of investment - we do indeed project an increase in the relative size of the informal sector; increasing income inequality; and an appalling increase in the absolute number of the urban poor. In the case of Kenya the rate of migration is much lower and we even project wage employment to grow faster than the labour force: the model works in reverse and the urban distribution of income becomes somewhat less unequal.^{1.}

1. the overall distribution deteriorates however: the urban-rural income gap widens.

(b) agriculture. Data limitations ^{1.} forced us to make agricultural output in the model for Tanzania largely exogenous. The Kenya model, on the other hand, illustrates what can be done if good rural survey statistics are available. Compared to the models reviewed in section 1.5 the agricultural submodel is unusually detailed; we distinguish large farms and smallholdings and (for the latter group) disaggregate by size of holding and by province. Our results suggest that such detail is not superfluous: there are considerable differences between groups of farmers in the extent to which they are affected by policy changes.

This submodel for smallholders has four distinctive features. First, we assume -unlike e.g. Blitzer (1978) - that smallholders do maximize profits. Secondly, the model recognizes the distribution of land. Thirdly, we take into account that - at least in Kenya - peasants derive their income to a very large extent from sources other than the farming of their own holding. Hence - while in other models the crucial variables for the rural income distribution are agricultural prices and the demand for agricultural goods - the model emphasises in addition labour demand on other farms; employment opportunities outside agriculture; and remittances by urban residents. Finally, agricultural innovation (changes in product mix) is modeled as a function of smallholders' access to non-farm sources of income.

Since (in both models) agricultural goods are fully tradeable and producer prices are controlled, the results on rural incomes are not dominated by violent

1. cf. section 3.2.

changes in the agricultural terms of trade, as in some of the models of section 1.5.¹

(c) migration. Both models include a migration equation of the Harris-Todaro type. Hence migration may involve an efficiency loss - as the output forgone in agriculture is not offset as long as the migrant has not found an urban job² - and may lead to a deterioration of the distribution of income: migration lowers the migrant's actual income and (given the segmentation of the urban labour market) it increases intra-urban equality. This is, of course, fundamentally different from models in the surplus labour tradition in which (since urban full employment is assumed) migration is always beneficial: the move to the city increases the migrant's actual income and the overall distribution of income is likely to improve as the effect of migration on urban and rural wages reduces the rural-urban income differential.

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1. even if producer prices are not controlled and if agricultural goods would not be tradeable it remains to be seen what the effects of the resulting volatility of terms of trade are. The costs of purchased farm inputs (fertilizers, seeds, insecticides) in terms of producer prices would change but in Kenya such inputs represent such a small percentage of production costs that that effect may be ignored. The real cost of hired labour would not be affected in the Kenya model since the wage rate on smallholdings is fixed in terms of food prices (admittedly, a specification which may be too extreme). What remains then is the effect on consumer prices. This makes the mapping from gross output prices to consumer prices crucial. If - as we suspect is true for many models - this mapping is the same for rural and urban consumer prices, then, when agricultural prices fall relative to the price of manufactures, rural consumer prices may fall very little. In the Kenya model we recognize that it is realistic to assume that the consumer price of food items produced in rural areas follows the producer price. Given the composition of the rural consumption basket, this implies that smallholders may gain almost as much as consumers as they lose as producers from a fall in the terms of trade.
 2. the efficiency loss may persist if his marginal productivity in urban employment is lower than in agriculture. In the case of Tanzania (where overmanning in the modern sector has gone very far) that is a very real possibility. Such a case is best described by standing the surplus labour theory - Lewis (1954), Ranis and Fei (1961) - on its head, the urban rather than the rural sector being characterised by surplus labour.

The two models differ both in the magnitude and in the effects of migration. First, in Kenya it is easier than in Tanzania to engage in the search for an urban job without actually migrating. In the notation of section 1.3 this implies that the rural sector may be considered as one of the alternatives to unemployment, with a positive value for the efficiency parameter n_i . It is easily seen that this implies a smaller equilibrium size of the urban free entry sector. Secondly, in Kenya migrants maintain their rural ties to a much larger extent. This has four important consequences: (a) there is more return migration upon retirement (b) a fall in the urban-rural income differential reduces net migration not only by discouraging in-migration but also by inducing out-migration (c) urban labour turnover and hence the probability of employment is higher (d) rural areas benefit more from migration in the form of remittances. Thirdly, as noted above, the initial conditions are different: in the base year of the projections migration is much higher (relative to the size of the urban labour force) in Tanzania than in Kenya and later this is accentuated by a projected fall in the growth rate of the Tanzanian economy. To this may be added that in the period 1969-1975 real wages rose in Tanzania but fell substantially in Kenya, while rural smallholder incomes fell in the former but rose in the latter case.

Hence, while the models use a similar migration equation, the results are very different.

(d) Household composition. For neither country do we use the 'chemical model' (section 1.4) to derive the household distribution of income. Labour force members do not move between households but rather within households

between activities. Changing labour market conditions affect different households differently, in the Tanzania model largely because they differ in the number of earners, but in the case of Kenya largely because households have different educational endowments.

Tanzania is a planned economy and this is reflected in that model's structure. The Kenya model, however, is in the tradition of models in which market imperfections are introduced in a neo-classical framework. The most important departures from neo-classicism concern trade policies (import controls), wage employment (sticky wages), land (the distribution of which is given) and agricultural innovation (opportunities for which differ between small-holders).

The problems we want to emphasise have guided our choice of simulation experiments.¹ In the case of Tanzania the emphasis is on the economy's growth, on migration and on urban poverty. Investment - and hence growth - strongly depends on wage levels, on the availability of foreign capital, on the type of industrial strategy which is pursued and on the growth of public consumption. This provides us with one set of simulation runs. These runs, which focus on the economy's growth, are also relevant for migration. In addition, we reduce in one of the runs (the exogenous part of) the supply of migrants and in another run we change that supply indirectly by assuming higher output growth in agriculture. None of the experiments are explicitly designed to estimate the effects of policies on urban poverty, but, since that problem - as projected in our base run -

1. cf. tables 5.4.1 and 8.6.1.

depends on the rate of investment, migration and on wage levels all of our experiments have a bearing on it.

Our choice of simulation experiments is somewhat different for Kenya; partly because the results of our base run suggest that the Tanzanian problems are less important in Kenya, partly because the model's structure allows us to experiment with a wider set of policies. In three simulations we experiment (as for Tanzania) with the growth rate of public consumption and with wage policies. In another group of experiments we focus on policies which affect the rural poor. We change the base run assumptions on producer prices, on the control of food prices, on land redistribution and on the urban bias in the location of wage employment. Finally, there is a group of simulation runs concerned with trade policies.

For both countries, the policy changes which we simulate - changes compared to a base run in which present policies are maintained - are very modest in virtually all experiments. This is deliberate; we are more interested in small changes (e.g. a 10% increase in producer prices) than in radical measures which are unlikely to be adopted.

Our results for Tanzania are very grim. In the base run, the growth rate of GDP falls rapidly during the projection period. This is partly due to external factors - unfavourable world prices and a fall (in real terms) in the supply of foreign savings - but also to the high growth rate of public consumption, to the protection of real wages in the formal sector and to a number of highly inefficient activities included in the industrial investment programme. Migration continues to grow rapidly (at 9% p.a.) in this run, the result of (a) an enormous expansion in rural education (b) high urban wages and (c) the fact that the growth of urban wage employment - hence the probability of employment - does not fall substantially until the very end of the period. The period 1969-1975 saw

increasing income inequality and a growing number of people in absolute poverty in the urban sector. Our results suggest that these trends may continue in the near future. They are in fact quite dramatic:

- (a) over the period 1976-1985, the percentage of urban households in absolute poverty¹ rises from 23% to 39%.
- (b) the share of the poorest 40% of households falls from 19% of total income to 11%.
- (c) the urban Gini coefficient rises from 0.35 to 0.45.

The overall distribution of income improves but in a perverse way: the rural-urban income gap narrows because while rural incomes grow (but only very little), mean urban household income falls by about 15% (1976-1985).

The other experiments indicate that both income distribution and macro-economic developments are sensitive to policy changes. Regarding the latter, the level of investment is extremely sensitive² to even quite modest deviations from the assumptions underlying the base run. Since wages are rigid this sensitivity is mirrored in changes in income distribution.

The model's structure implies that adjustment to changes largely takes the form of changes in quantities. Unlike Adelman and Robinson, who apparently consider such adjustment inappropriate for income distribution modelling for any country³, we think that in the case of Tanzania this is entirely appropriate.

1. Using TSh 2000/year (1969 prices) as poverty line.

2. not surprisingly, because the economy's rigidity (reflected in the model's structure) rules out most other adjustment mechanisms.

3. cf. the quote given in section 1.5.

The most notable results are those for the urban labour market. These are very different from what would be projected with any of the existing models because in those models either (a) wages would fall because of excess labour supply or (b) since they would not recognize an alternative to unemployment, expected urban incomes would fall more quickly,¹ thereby reducing migration.

Our results for Kenya tell a rather different story. In the base run the economy's growth rate (1975-1985) is 4.5%², but the projections indicate a substantial difference between short term (1975-1978) and long term developments. The earlier period is one of very rapid growth, marking the recovery from the 1975 recession and drought and the impact of an enormous rise in coffee prices³ on agricultural production, on Kenya's balance of payments and on the level of investment. A sharp increase in consumption and investment demand leads to substantial price increases, a boom in the construction sector and increased growth and profitability of manufacturing. Urban households benefit from rapid growth of employment and rural households from the rise in coffee prices. Long term developments are very different. The terms of trade deteriorate as coffee prices fall, real wages recover from their 1978 low, inflationary pressures subside, the real value of foreign savings drops, import controls - relaxed during the boom years - have to be tightened again and, finally, investment falls and never reaches its 1978 level again.

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1. compared to the results of our model in which the alternative is informal sector employment.
 2. this is considerably below the historical (1964-1974) average of 6.3%.
 3. producer prices for coffee were almost four times as high in 1977 as in 1975.

The results for smallholders - which are of special interest because they constitute the vast majority of the country's poor - are encouraging. First, production grows rapidly (at 5%, 1975-85) as producer prices rise, population growth induces more intensive cultivation and smallholders continue to innovate¹ (by switching to coffee and livestock production). In terms of production, smallholdings do in fact much better than large farms, which are more affected by the fall in coffee prices and the rise in wages. Production growth is not the only reason for the projected improvement in rural per capita incomes: non farm income (especially in the form of wages) shows a very large increase, not only because smallholders increasingly participate in wage employment in the modern sector but also because the need for hired labour within the smallholder sector itself grows rapidly. This is encouraging since fears have been expressed that employment growth - both in agriculture and in the urban based sectors - would not be sufficient to absorb the growth of the rural population. Our results suggest that the recovery of employment growth in the modern sector² is not a temporary phenomenon and that there will be large increases in labour requirements on smallholdings as production grows and the product mix becomes more labour intensive. This implies some improvement in the rural income distribution as 'surplus' labour on the smaller holdings benefits when labour requirements on larger plots begin to exceed the supply of family labour.

These favourable developments should not detract from the fact that the rise in the rural standard of living is a very slow one. Real incomes per household grow at only slightly more than 1% per year; incomes of smallholders in two of the poorest provinces (Nyanza and Western) grow even less, while

1. these innovations represent a 'trickle-down' effect since they are to a large extent financed from remittances by urban households and from incomes earned in wage employment.

2. the pessimistic view relies heavily on data from the late 1960s when modern sector employment stagnated; it has grown quite rapidly since.

smallholders who in 1975 had already reached the highest income levels (those in Rift Valley province) grow most. The rural income distribution - which deteriorates during the first few years when smallholders who grow coffee increase their share of income - shows little change over the ten year period. However, there is a substantial reduction in the percentage of the smallholder population for which real incomes fall under the poverty line which we use. But this reduction is achieved very early in the projection period; the percentage remains constant thereafter; and, when population growth is taken into account, the absolute number of rural poor remains virtually identical (at about 2 million).

Our results on the urban labour market and income distribution also contradict some of the conventional pessimism. First, our analysis of the 1974 Nairobi Household Budget Survey - confirmed by provisional results of a 1977 survey of the informal sector - indicate that incomes in the informal sector are considerably higher (although still far below modern sector wages) and the sector's share of the urban labour force much smaller than was suggested in e.g. the 1972 ILO report. Secondly, estimates of demographic changes in the period 1969-1977 indicate a very large fall in rural-to-urban migration and hence a reduction in the growth of the urban labour force. For both reasons, the starting point in our projection is already a more favourable one. During the projection period there are four important developments. First, wage employment growth exceeds population growth by 2% per year, and this reduces both unemployment and the size of the informal sector. By 1985 the composition of the labour force is dramatically different: wage employment accounts for 76% (65% in 1975), high income self employment for 7% (6%), low income self employment for 4% (5%) and

unemployment for 13% (23% in 1975). Secondly, although migration rises again (by some 40% over the period) - as urban incomes rise more than those in rural areas - this growth takes place from such a low base that it has little effect on the size of the urban labour force. Thirdly, as more and more people succeed in getting wage employment, the gap between wages and incomes of the self employed in the informal sector narrows: the ratio between the two falls by 40%. Fourthly, employment grows fastest for jobs at high income levels. Finally, while in the past excess labour supply has reduced the probability of employment in high wage jobs of those with low educational qualifications, that 'bumping' process now seems likely to work in reverse: as more high wage jobs open up than can be filled by the educationally most highly qualified - whose labour supply is reduced anyway by switches into high income self employment - those who previously would not have got any job at all or only one at the bottom of the wage scale now move up the ladder.

These developments make the urban distribution of income somewhat more equal, but the change is small.¹ While both the intra-urban and intra-rural distribution show a slight change in the direction of greater equality, the national distribution changes in the opposite direction: incomes of urban households grow at about 2½% per year - more than twice the rural rate - so that the gap between urban incomes and those of smallholders widens.

1. both in terms of the Gini coefficient (which falls by 7%) and of the income share of the bottom 40% (which goes up by 1½ percentage points). There are substantial differences between various types of urban households, the increases in real income over the 10 year period ranging for 8% to 43%.

The results of the simulation experiments concerned with trade policy and balance of payments issues indicate:

- a) the growth of GDP depends strongly on Kenya's ability to borrow abroad and to attract foreign investment, but foreign financed growth benefits urban households much more than the rural population.
- b) a devaluation would benefit smallholders as producers of export crops but they would lose almost as much as consumers through price rises.
- c) if the protection of the manufacturing sector is removed employment expands, urban incomes go up and there is a substantial rise in the rate of investment.
- c) controls on the imports of consumer goods protect urban groups at the expense of the rural population, which would benefit enormously from the effect on inflation of their removal.
- e) trade policies need to be coordinated with policies affecting wages, food prices and agricultural producer prices if they are not to lead to unexpected and undesirable results.
- f) the effects of trade policies on smallholders - usually ignored by identifying smallholders with 'subsistence' production and consumption - need to be considered: this group is more vulnerable to the effect of trade policies on prices than the urban population, which is likely to be compensated by wage adjustments.

Our results on the effects of wage policies suggest:

- a) that the informal sector heavily relies on wage incomes earned in the rest of the economy.^{1.}

1. this is because in our model the sector produces for final demand; wage policies would not affect the informal sector directly in e.g. the Brazil model (section 1.5) in which the sector is treated as if producing intermediate goods.

- b) the effect of wages on prices is so strong that an extreme policy of keeping nominal wages constant results in a real wage level not much lower than that reached under a policy of keeping real wages constant.
- c) with the single exception of the removal of import controls, wage restraint is the policy which benefits the rural poor most.

Our final set of simulation runs concerns agricultural policies. From these experiments we conclude that:

- a) increasing producer prices is a very attractive policy. It leads to higher investment and higher rural incomes but, surprisingly, urban households do not lose under the policy, although food prices rise: as a result of higher investment non food prices are lower than they would have been otherwise.
- b) income changes for smallholders differ substantially between smallholders, largely because of differences in access to non-farm income.
- c) there is no reason to fear that land redistribution will reduce agricultural production.
- d) a locational policy, whereby the urban bias in the growth of wage employment is reduced, is one of the most effective ways of reducing the urban-rural income gap. As those who under the policy gain access to wage employment substitute off-farm work for farm work, the demand for hired labour on smallholdings increases and thus substantially reduces rural poverty.

A comparison of the results in different simulation runs for variables measuring economic growth, employment, real incomes and income distribution shows that policies do matter greatly. If, for example, we put the result of the base run for 1985 at 100, the results in other runs range from 99.8

to 109.2 for GDP; from 99 to 148 for the level of investment; from 88 to 103 for mean real urban household income, while for rural incomes the range is 97-130 in Central, 96-116 in Coast, 96-136 in Eastern, 97-139 in Nyanza, 95-138 in Rift Valley and 95-124 in Western province. Perhaps most importantly, the results for the urban-rural income ratio range from 69 to 102. Hence in Kenya both growth and distribution are sensitive to the policies pursued.^{1.}

We think the two models contain some improvements compared to those reviewed in section 1.5. There are however reasons for modesty. First, the treatment of the rural labour market in the Kenya model is crude:^{2.} the model ignores the landless. Secondly, personal incomes are not explicitly linked to the rents which arise under protection. Finally, and most importantly, the Kenya model does not explain changes over time in the two asset distributions (of land and of education) which it recognises. 'Unequalizing spirals' resulting from e.g. the urban rich buying up land or the rich being in a better position to finance the education of their children are important processes of distributional change,^{3.} but we have not been able (because of data limitations) to model them.

1. Adelman et al. (1977) have argued (on the basis of the results of models for Korea and the Philippines) that most policies do not succeed in bringing about lasting change and that only 'big-push' packages - of a much more drastic nature than we have considered - can result in significant distributional improvements. They conclude (p.44) that the overall distribution is 'exceedingly stable' because (even for 'substantial policy interventions') 'it is rare that there is more than a 5 per cent change in the Gini coefficient, even in the long term'. In the Kenya model the overall Gini coefficient in the final projection year is almost 15% lower than in the base run if import controls on consumer goods are relaxed (run 6, cf. section 8.3). This change is modest because it leaves those imports still 20% lower than what they would have been under the pre-1971 arrangements: in run 6 only about half of the reduction in imports resulting from the controls instituted in that year is eliminated. Many more examples could be given of distributional changes far larger than what Adelman et al. consider normal.

2. cf. appendix 8.

3. cf. Collier and Lal (1979).

III TANZANIA : INTRODUCTION

3.1. Introduction^{1.}

Tanzania^{2.} became independent in December 1961. In the early post-independence period - up to the 1967 Arusha declaration - the country's economic objectives and policies were thoroughly conventional. The paramount goal was rapid income growth. Import - substituting industrialization was seen as the engine of growth and was expected to be financed mainly by private and foreign capital: the economy still heavily relied on private enterprise. A low priority was attached to agricultural growth.

There were three developments during this period which worried the leadership and led to dramatic policy reversals in 1967 and subsequent years. First, the government's development effort - which in agriculture was dominated by a few highly capital intensive and unsuccessful settlement schemes which affected very few peasants - bypassed the majority of the population. Secondly, a beginning of class formation amongst peasants was noted: inequality in landholding, hiring of agricultural labour and the rise of 'progressive' farmers to dominating positions in cooperative organizations and local political bodies were interpreted as the beginning of capitalist farming and the emergence of a kulak class.^{3.} Thirdly, the gap between rural and urban incomes widened: while urban wage earners saw their real incomes rise by 60%, smallholders' incomes rose by only 5%.^{4.} The group of urban wage earners began

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1. this section draws heavily on the World Bank report, especially its main volume Acharya (1977). Other recent summaries of Tanzania's goals, performance and economic history include Pratt (1976) and Green (1974).
 2. the name Tanzania was adopted after the union with Zanzibar in April 1964; what used to be called Tanganyika is now referred to as the mainland. With the exception of trade data all statistical sources exclude Zanzibar. Our analysis is confined to mainland Tanzania.
 3. economic differentiation amongst smallholders was apparently quite limited. cf. Ruthenberg (1968) and Gottlieb (1973).
 4. Acharya (1977), p. 5. These data are for the period 1961-67.

to emerge as an elite, partly because the Africanisation of high and middle level jobs previously held by expatriates, partly because of very substantial real wage increases.

The Arusha declaration ¹. brought a restatement of goals. The declaration emphasized the need for state control over the major means of production, the need for economic growth, minimal reliance on foreign aid, redistribution of income and especially the narrowing of the rural-urban gap by a shift in favour of rural and agricultural development based on communal production. The government's control over the economy has vastly increased since 1967 through nationalization, import licensing, control of prices and wages and the very high share of the public sector in capital formation (almost 70% in 1973).

Economic growth has slowed down since 1969 (table 3.1.1). This was partly due to very slow agricultural growth (e.g. in 1967-73 the sector grew at only 2.7%, while accounting for some 40% of GDP) but also to a fall in the

Table 3.1.1 : Macro-economic Developments (1964-1975)

(in millions of Tsh, 1966 prices)

	1964	1969	1973	1975	growth rates (%) ²	
					1964-69	1970-75
GDP at factor cost	5619	7259	8803	9407	5.3	4.1
GDP at market prices	6057	8048	10034	10573	5.8	4.3
private consumption	4516	5780	7106	9032	5.1	4.8
public consumption	604	964	1531		9.8	
capital formation	807	1216	1908	2156	8.5	3.4
(of which: public)	(246)	(589)	(1300)	(1180)	19.1	1.6
exports	1488	2061	2202	1612	6.7	-5.7
imports	1358	1973	2713	2227	7.8	-2.7

1. the Arusha declaration and the other policy statements of 1967 are reprinted in Nyerere (1968).
2. 1969-70 is characterized by large jumps in investment and imports as a result of construction on the TAZARA (the railway from Tanzania to Zambia) project; cf. Acharya (1977) pp. 58-59.

efficiency of investment in other sectors: the gross incremental capital output ratio has steadily increased (from 3.7 in 1967/68 to 6.1 in 1973/74) thereby to a large extent offsetting the rise in the rate of investment (from 13.3% in 1964 to about 20% in the years just before the 1974-75 drought). Not only was the economy's rate of growth disappointing but also the Arusha aim of self reliance was frustrated: while there was still an export surplus in 1967, by 1970-72 (i.e. before the balance of payments crisis of 1974-1975) the resource deficit already accounted for 6% of GDP in current prices.

Until quite recently it was felt that while the macro-economic performance might be disappointing, government policies were at least succeeding in improving the distribution of income. Data for the period 1969-1975 indicate otherwise.¹ First, mean smallholder incomes fell by about 5% and intra-rural inequality increased. Secondly, the rural-urban income gap widened dramatically from 1969-1974, although this was reversed in 1974-75 when urban prices rose substantially while wages were frozen and producer prices were raised substantially. Taking this reversal into account, urban wage earners still saw their income rise by 5% in real terms over the 1969-75 period. The most dramatic development was the emergence of urban poverty and a very strong worsening of the intra-urban income distribution. As a result of rural-to-urban migration, the urban labour force increased by 9.3% per year, far outstripping the growth of employment in the formal sector (5.5%). This was accompanied by a sharp rise in unemployment (from 10% of the labour force in 1969 to 16% in 1975), a massive increase in the number of people in the informal sector (from 44 thousand to 106 thousand) and a fall in real incomes in that sector of 44% over the six year period (table 4.4.1 below). Intra-

1. cf. Collier (1977) and the summary in Acharya (1977).

urban inequality increased and the proportion of households living on less than Tsh 40/month (1969 prices) rose from 1% in 1969 to 10% in 1975.

The policies which were pursued to reduce intra-urban inequality (wage policies and changes in tax rates) affected mainly the regular wage earners, that is the urban elite.¹ Even for this subset the policies were unsuccessful: while the inequality of wage scales was indeed reduced, the effect was offset by promotions and seniority increases; in real terms the after-tax distribution of income even became slightly less equal. More importantly, the result of low producer prices, slow agricultural growth, rapid expansion of rural education (and thereby of the group most prone to migrate to the cities), the maintenance (and even rise) of very high² wages in the formal sector and, finally, the high rate of growth of wage employment led to a growth of the urban labour force with disastrous consequences for those who did not succeed in getting regular wage employment.³

Rural-to-urban migration and the growth of urban poverty are two of the issues which we want to explore with the model. The third one is Tanzania's industrialization policy.

After a long period in which industrial investment decisions were taken on an ad hoc, project-by-project basis, the government adopted in 1974, what was called the Basic Industry Strategy (BIS). The analytical content of this concept is not very clear.⁴ The strategy's main aim is to achieve a close

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1. even in 1969, i.e. before the massive fall in informal sector incomes, mean wages were already 2.3 times as high as incomes in that sector.
 2. relative, of course, to incomes elsewhere in the economy.
 3. in 1975 this group already accounted for 44% of the urban labour force.
 4. for a description of the strategy see Thomas (1972, 1974) Rweyemamu (1973), Helleiner (1976)'s review of the latter's book, Roemer et al. (1976, pp. 269-271) and Tidrick (1977).

correspondence between the composition of domestic production and that of domestic demand. This implies a shift from the production for exports of goods not locally demanded^{1.} to the production of mass consumption goods and to the basic goods,^{2.} which, through backward and forward linkages, would achieve a 'structural transformation'. While domestic demand would be one criterion, the second would be the domestic availability of raw materials.^{3.} The strategy has a clear anti-trade bias: exporting agricultural goods (in raw or processed form) to pay for imports of intermediate and capital goods is to be replaced by production for the domestic market using domestic materials. While the BIS aims at structural transformation and self-reliance,^{4.} we are primarily interested in its 'side' effects on growth and employment. We use the model to compare the BIS in those terms with a strategy which places more emphasis on efficiency and comparative advantage.

3.2. The model

The model is a dynamic simulation model; its most important endogenous variables relate to output, investment and income distribution. It is designed to address three problems: that of economic growth (levels and use of domestic and foreign savings); of rural-to-urban migration; and that of urban poverty.

1. in Tanzania's case e.g. the processing of sisal or cashew nuts.

2. these would include cement, glass, iron and steel, chemicals, plastic products, metal fabrication.

3. in the Tanzanian context this implies a high priority for sugar, textiles, and clothing (based on cotton), leather and footwear, fertilizer (phosphates) and tyres (using natural rubber).

4. the work of Roemer et al. (1976, p. 273) suggests that it may succeed in achieving the former but not the latter; under the BIS the manufacturing sector would still be a heavy net foreign exchange user; cf. also Tidrick (1977), ch. 3.

The model is highly aggregate in nature, except for investment in manufacturing and for the urban labour market. There are:

- 11 sectors : agriculture; mining; manufacturing; small scale industry; electricity and water supply; construction; trade; transport, storage and communication; ownership of dwellings; government; and other services. Within manufacturing, 30 subsectors are distinguished.
- 10 cash crops: coffee, cotton, tea, tobacco, sisal, cashew, pyrethrum, maize, rice and wheat.
- 15 groups of urban workers: regular wage earners (eleven skill/income levels), casuals, self employed (two income groups) and unemployed.
- 25 groups of urban households, defined by the occupation of the head of household.

The model has four distinctive features. First, it belongs to the family of input-output models in which the 'consumption loop' is closed: production affects incomes, incomes expenditures and expenditures output levels. The model solves for import and investment levels which satisfy both internal and external equilibrium conditions. Secondly, the model includes a migration equation of the Harris-Todaro type. Thirdly, the wage rate in the urban labour market is not market clearing, but nor is unemployment calculated as a residual: the allocation of excess supply to the market for wage employment between the informal sector and unemployment is determined as an equilibrium position. Finally, we model the relation between the distribution of income over earners and the distribution over households, taking into account the higher employment probability for heads of households and the inequality in the distribution of labour force members over households.

Output is largely exogenous for agriculture, but is determined by investment and demand in other sectors.^{1.} For each sector the four components of domestic demand are generated: intermediate demand (related to output levels by input-output coefficients), private consumption (related to the level and distribution of income by consumption function for rural and urban households), public consumption (which is exogenous) and investment demand. The market must clear for each of the eleven sectors (internal equilibrium), while simultaneously the difference between imports and exports must satisfy the foreign exchange constraint: foreign savings are predetermined in current prices (external equilibrium). In principle, the equilibrium conditions could be satisfied through a combination of price and quantity adjustments and this is the specification we shall use in the model for Kenya.^{2.} But in Tanzania prices play no such role and the adjustment in the model is therefore entirely one of quantity changes. The model solves for levels of imports and investment which ensure the two equilibria and satisfy the constraint - for the services sectors - that there can be no imports of non tradeables. The institutional justification for this specification lies in Tanzania's system of price control^{3.} and in the government's virtually complete control over imports and investment allocation. Domestic savings are derived as the difference between output (GDP at market prices) and consumption; foreign savings are added to arrive at total investment. Note that there is no excess demand or supply and that there is no foreign exchange gap to be financed: foreign exchange availability is already taken into account. The rate of investment is affected by the system of price control, which is of the mark-up type; one consequence of this is

1. output remains constant in the mining sector, which is very small.
 2. cf. section 7.4 below.
 3. cf. section 4.5 below.

that wage increases strongly affect the level of domestic savings.

Wages in the modern sector are fixed at levels which do not clear the market. Fixed (sector specific) coefficients link labour demand to output levels. With wages fixed, the size distribution of wage income is entirely determined by demand. It depends on wage levels, wage differentials (between skills), the sectoral composition of output and on the skill composition of each sector's demand. In addition to regular wage earners, there is a free-entry sector, consisting of casuals and (low income) self employed. Here incomes are determined at market clearing levels. Labour force members¹ who have not gained entry into the elite group of regular wage employees, compete for the job openings in that sector. They can do so either while unemployed or while working in the free entry sector. In the latter case the advantage of earning an income is offset by a much lower probability of finding wage employment. Total income in the free-entry sector is predetermined by demand factors; individual incomes depend on the number of people in the sector. The model solves for such a distribution of the labour force between the various activities that expected incomes are equal for those in the free entry sector and for the unemployed. This expected income enters the migration function.

This part of the model is similar to the partial models of Harris and Todaro (1970) and Fields (1975). Its inclusion in a more general model (in particular a model in which growth and hence wage employment is not exogenous), leads however to different results.²

1. with the exception of the small group of high income self employed, cf. section 4.4.1.

2. chapter 5.

In addition to the distribution of income between (and within) the groups which we distinguish in the urban labour force, the model generates the distribution of household income. The relationship between the two distributions takes into account heads of households' greater access to wage employment - and especially to jobs in the higher paid skill categories - and the differences between households in the number of labour force members.

Agriculture and the rural income distribution are treated in much cruder fashion. Subsistence production and production of export crops are exogenous,¹ while the output of food crops sold to urban centres is related to urban demand. In addition to this last part of income from crop sales, the remaining two components of rural cash incomes (wages and 'other' cash income) are ~~exogenous~~^{endo}. Given the estimated variance of a log normal distribution, the rural income distribution (which affects the level and composition of consumption) and, in particular, the number of households below a poverty line can be calculated.

This crude treatment of the rural sector (in which after all the vast majority of Tanzania's population is engaged) requires comment. The first reason for this is one of data limitations. Other than national totals for crop statistics² and for the distribution of cash incomes in 1975, there are no more recent data than those of the 1969 Household Budget Survey. Secondly, ever since Arusha the sector has been affected by continual institutional change which makes the use of data for any year hazardous. Finally, the

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1. except for the effect of migration on output.
 2. a more satisfactory model of the rural income distribution would have to include (at least) a disaggregation by regions. The regional data of the Agricultural Census are however completely unreliable.

crash villagization programme of 1974-75, whereby seven to nine million people (more than half the population) were moved into villages - so that the locational distribution of production changed radically and intensive cultivation replaced the pattern of shifting cultivation - makes any modeling exercise futile: even if there were reliable data, several years would have to go by before these could be used in a meaningful way.

While this limitation is serious, we believe that what can be modeled (especially the urban income distribution and the effects of migration) is important enough to justify the model's construction.

IV THE TANZANIA MODEL

4.1. Production, Trade and Investment

We distinguish eleven sectors: agriculture; mining; manufacturing; small scale industry; electricity and water supply; construction; trade; transport, storage and communication; ownership of dwellings; government; and other services.

The model solves for output, investment and import levels which satisfy internal and external equilibrium. External equilibrium requires that - at current, world prices - the difference between imports and exports equals foreign savings, which are exogenous. Internal equilibrium requires that there is no excess demand or supply; for each sector the material balance is satisfied:

$$(4.1.1) \quad X_i = \sum_j A_{ij} X_j + C_i + G_i + IS_i + E_i - MF_i$$

, where X is gross output

A the input-output matrix¹.

C private consumption

G public consumption

IS investment (by sector of source)

E exports

MF imports of final (consumer or capital) goods

and all variables are expressed in constant (1969) domestic market prices.²

1. the matrix is expressed in producer prices and obtained by aggregation from the 45 sector IO table for 1969, Tanzania (1973). We have adjusted the table for the significant changes which have occurred in the period 1969-1973 in the real rates of customs duties and of indirect taxes (Gunning (1977), pp. 6-7, and appendix B). As the composition of the manufacturing sector changes, the IO column for that sector changes over time (cf. section 4.2).

2. hence MF is valued at c.i.f. prices plus duties.

Imports of intermediate goods are given by fixed coefficients:

$$(4.1.2) \quad MI = \sum_i \sum_j MIM_{ij}$$

Investment by source (IS) is related to investment by destination:

$$(4.1.3) \quad IS_i = \sum_j B_{ij} ID_j$$

and total investment is IT:

$$(4.1.4) \quad IT = \sum_i IS_i = \sum_i ID_i$$

Public consumption is exogenous and so are non-agricultural exports, while for agriculture E_i is given by the output levels of the seven export crops which the model distinguishes.^{1.}

For agriculture, mining and manufacturing (4.1.1) is used to derive MF residually: excess demand is eliminated through imports. For the remaining eight sectors - which produce largely non tradeables - imports are exogenous and the material balance is used to determine production (X). Hence, output in these sectors is determined by demand; while for agriculture it is exogenous^{2.} and for manufacturing determined by investment.^{3,4.}

We use fixed incremental capital-output ratios (ICORs) and assume a one-year output lag, so that:

$$(4.1.6) \quad ID_{it} = \xi_i (Y_{it+1} - Y_{it})$$

$$(4.1.7) \quad Y_i = \gamma_i X_i$$

where, Y is value added (at factor cost)

ξ the ICOR

γ the value added ratio

-
1. coffee, cotton, tea, tobacco, sisal, cashew nuts and pyrethrum. Together these accounted in 1975 in current prices for 79% of agricultural exports and for 52% of merchandise exports.
 2. production of the seven crops listed above is exogenous and so is subsistence production. Agricultural production is however not entirely exogenous: the output of three food crops (maize, rice and wheat) is determined by urban demand.
 3. cf. section 4.2: the sector's growth does not only depend on total industrial investment but also on its allocation between (thirty) subsectors.
 4. mining plays a minor role in the model; there are no plans for expansion, hence output (and exports) remain constant. Investment is for replacement only.

Given total exports and projections of world prices, the foreign exchange constraint predetermines the level of imports. The model solves for output, imports and investment levels which satisfy both this constraint and equations (4.1.1)-(4.1.7). Since in Tanzania prices play no equilibrating role - in that sense our model is very different from that of chapter 7 for Kenya - the burden of the process of adjustment to internal and external equilibrium is thereby placed on the level and allocation of investment.

The nature of the solution may be illustrated with a simple example. Consider a two-sector economy, which does not export, in which there are no intermediate goods and no differences between domestic and world prices. All investment originates in sector one. Personal incomes stand in a fixed ratio (β) to total output, there are no personal savings and the shares of the two sectors in consumption are constant (α and $1-\alpha$). Then:

$$(4.1.8) \quad X_1 = C_1 + IT - MT$$

$$(4.1.9) \quad X_2 = C_2$$

$$(4.1.10) \quad IT = ID_1 + ID_2$$

$$(4.1.11) \quad ID_i = \xi_i (X_{it+1} - X_{it})$$

$$(4.1.12) \quad C_1 = \alpha\beta(X_1 + X_2)$$

$$(4.1.13) \quad C_2 = (1-\alpha)\beta (X_1 + X_2)$$

where MT is total imports which, in this case, is equal to foreign savings and hence exogenous. Equations (4.1.8) and (4.1.12) imply (4.1.14); equations (4.1.9) and (4.1.13), (4.1.15); and (4.1.10) and (4.1.11), (4.1.16):

$$(4.1.14) \quad X_2 = \frac{1-\alpha\beta}{\alpha\beta} X_1 + \frac{MT-IT}{\alpha\beta}$$

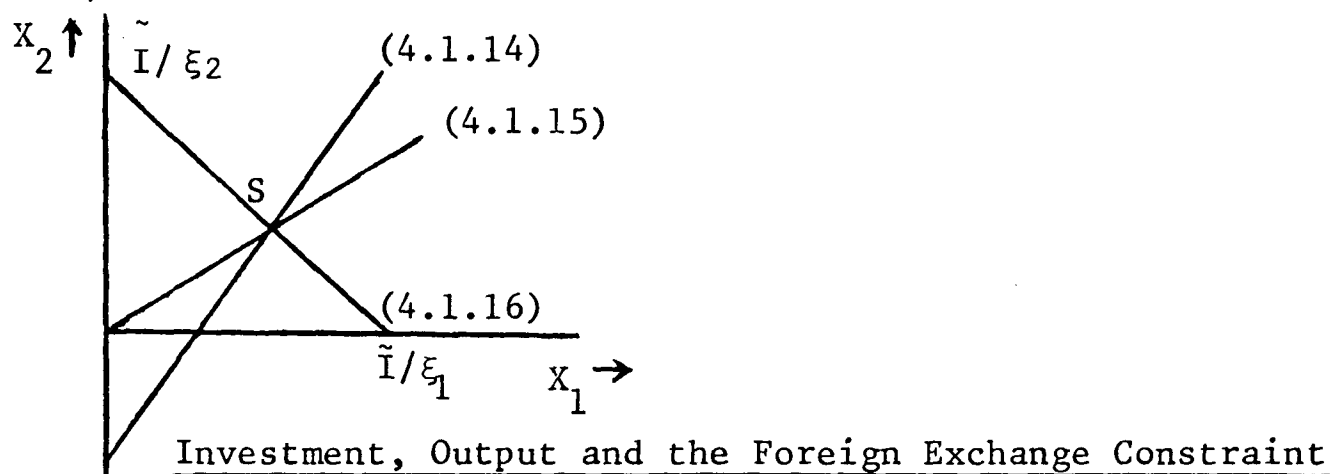
$$(4.1.15) \quad X_2 = \frac{(1-\alpha)\beta}{1-(1-\alpha)\beta} X_1$$

$$(4.1.16) \quad X_2 = -(\xi_1/\xi_2) X_1 + \tilde{I}/\xi_2$$

, where $\tilde{I} = IT_{t-1} + \xi_1 X_{1t-1} + \xi_2 X_{2t-1}$. The diagram shows that output

levels (X_1, X_2) are determined by the last two equations; the intersection

of these two lines at S determines the intercept of the line corresponding to (4.1.14) and hence the level of investment IT .



Hence (4.1.14)-(4.1.16) can be solved for X_1 , X_2 and IT given past output and investment (I) and present foreign savings (MT). This specification implies that the model is intertemporally simultaneous. The solution for period t determines $\tilde{I}_{t+1}$ and hence the position of the downward sloping line for the next period. But only when we have solved for $t+1$ can the allocation of IT_t between sectors (ID_{1t} , ID_{2t}) be determined (from (4.1.11)).¹ Note that domestic savings ($X_1 + X_2 - C_1 - C_2$) are independent of foreign savings; this is so because prices are controlled.² This implies that if foreign savings rise, investment rises by the full amount ($\frac{d IT}{d MT} = 1$).³

Our model differs from that of the diagram. First, because there are more sectors; secondly, because in two cases (agriculture and mining) output is largely exogenous; and finally because the level and composition of private consumption depend on the distribution of income. The principle, however,

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1. in the particular case of this model this does not lead to serious computational difficulties for two reasons. First, (unlike for Kenya) there are no data which allow one to estimate for each sector (of destination) the sectoral composition (by source) of investment: the columns in the matrix B of (4.1.3) are identical. Secondly, because the output lag of investment is only one year. This implies that the model can be solved completely for period t (except for ID_i , but not excepting IS_i), while the allocation of investment follows from the solution for $t+1$. If either condition were not satisfied, the model would of course have to be solved for all periods simultaneously. Cf. appendix 6 on computational methods.
 2. they are set on a cost-plus basis (section 4.5) irrespective of changes in demand or supply.
 3. with prices endogenous this is in general not true; cf. section 8.3.

remains the same. Hence, while it is convenient to discuss (4.1.1) in terms of imports being determined by net excess domestic demand in the case of manufacturing and output being determined by demand for the services sectors, this overstates the differences. As the simplified model of (4.1.8)-(4.1.13) shows - while it may be computationally convenient to use (4.1.8) to derive imports (output in sector 1 being predetermined by past investment) and (4.1.9) to derive output (imports being constrained to zero for non-tradeables) - there is no difference between the two sectors in the extent to which demand or supply factors determine output.¹ The only real difference is that - as in (4.1.9) - imports of goods are zero for sectors 4-11.²

It should be noted that our approach differs from that of the two-gap models.³ First, because foreign savings are exogenous rather than assumed to fill the larger of the two gaps; but this is a difference with the original formulation rather than with some of its later extensions. Secondly, because in this situation one would, if working in the two-gap tradition, derive private consumption (hence domestic savings) as a residual to ensure the ex post equality of the two gaps: the economy's assumed lack of flexibility⁴ is reflected in a disequilibrium solution, which does not lie on agents'

1. In particular the investment allocation is endogenous for all sectors, although for a given iteration we do not treat it as such. With the current iteration denoted by τ , the computation proceeds in four steps: (1) $X_{1t\tau}$ is solved from (4.1.11), using X_{1t-1} and $ID_{1t-1\tau-1}$ (2) the material balances are solved for $IT_{t\tau}$ and $X_{2t\tau}$ (3) $ID_{2t-1\tau}$ is calculated from (4.1.11) (4) a new estimate of ID_{1t-1} (on which the next iteration is based) is obtained residually as $ID_{1t-1\tau} = IT_{t-1} - ID_{2t-1\tau}$. After this procedure has converged the final solution for ID_{1t-1} (which would correspond to investment in manufacturing in the full model) can, of course, not be considered as a residual.
2. the exogenous values for MF, in those sectors are for imports of non factor services only: imports of (final) goods are positive only for sectors 1 and 3, agriculture and manufacturing.
3. Cf. Chenery and Strout (1966) and Fei and Ranis (1968).
4. Chenery and Strout (1966), p. 682.

consumption functions. Since investment is not exogenous there is no need for such a solution.¹

In Tanzania the government controls - directly through the development budget and indirectly through its complete control (at least in theory) over the use of parastatal surpluses - the bulk of capital formation. In addition, through the import licensing system, it can (and does) control the level of imports. What our specification implies is the assumption that import controls and investment policies are used in such a way that internal and external equilibrium is guaranteed. This is a strong assumption considering the prevalence of shortages, especially of consumer goods in rural areas. In this sense (since a descriptive model would have to be of the fixed-price equilibrium type, taking forced (dis)saving and spillover effects into account) our model is a planning model, normative in the sense that we assume the adoption of policies which avoid such effects.

4.2. Industrial Strategy: Investment Allocation in Manufacturing

Within manufacturing, we disaggregate output, investment and employment in order to be able to measure the effects of changes in the policy by which industrial investment is allocated between subsectors.

Roemer, Tidrick and Williams (1976) have analyzed investment possibilities for twenty eight manufacturing activities which could be started or expanded in the

1. Even though - since prices play no role in the adjustment process - the economy's flexibility is severely limited; cf. section 7.4. where prices do play such a role.

period 1975-1995. They defined a number of industrial strategies - rules for selecting activities from the list of possible projects - and compared their effects on growth, employment and foreign exchange requirements, given a capital constraint: the level of total investment in manufacturing for the twenty year period was specified exogenously. We use their data in the model, but since investment in manufacturing is determined endogenously in the model, we can consider the effect of the choice of industrial strategy on the level of investment, an issue which does not arise in the analysis of Roemer et al. because of their use of an exogenous capital constraint.

In analogy with (4.1.6) and (4.1.7) we have:

$$(4.2.1) \quad ID_{jt}^m = \xi_j^m (Y_{jt+1}^m - Y_{jt}^m)$$

$$(4.2.2) \quad ID_{3t} = \sum_j ID_{jt}^m$$

$$(4.2.3) \quad Y_{3t} = \sum_j Y_{jt}^m$$

$$(4.2.4) \quad Y_j^m = \gamma_j^m X_j^m$$

$$(4.2.5) \quad N_3 = \sum_j \lambda_j^m X_j^m$$

, where the superscript m denotes manufacturing and N_3 is wage employment in manufacturing.^{1.}

1. cf. equation (4.4.1) below. The data in Roemer et al. - and in their unpublished background papers - have been used to construct for each activity j an IO column. In the rest of the model we use the weighted average of these columns - weighted by gross output levels X_j^m - instead of the column for manufacturing of the 1969 IO table. Hence the matrices A and MIM in (4.1.1) and (4.1.2) are updated every year for changes in the composition of the manufacturing sector. Capital cost data have been adjusted for recent relative price change: our ICOR's (ξ_j^m) are considerably higher than those used by Roemer et al. For an example of the IO adjustments, cf. Gunning (1977), pp. 36-37.

Subsectors are assigned to four groups, in descending order of priority under a given industrial strategy. If sufficient investment funds are available, all (exogenously given) investment plans for group 1 are executed, otherwise they are scaled down proportionately. Whatever funds are left are similarly allocated within the next group, and so on. The strategy used in the baserun corresponds fairly closely to the priorities of the 'basic industries strategy' (BIS) to which the government has committed itself. Activities are assigned as follows:

group 1 : sugar processing, other food,¹ textiles,¹ leather, chemicals, fertilizer, metal fabrication, iron and steel.

group 2 : beer, cigarettes, clothing, footwear,¹ wood, paper, printing and publishing, petroleum refining, tin, plastic, glass and cement.

group 3 : cashew processing,¹ sisal spinning, textiles (for exports), pyrethrum.

Note that the BIS attaches a low priority to processing of agricultural commodities for exports and a high one to a number of heavy industries, especially to iron and steel (which would - depending on capital availability - absorb 15-20% of total investment over a 15 year period)².

4.3. Savings and Investment

Total investment is determined as the sum of domestic and foreign savings. Once output, private consumption³ and public consumption are known, domestic savings are of course already determined. But we are interested in the composition of this aggregate - in terms of savings by households, businesses and government -, even though changes in that distribution have no effects in the model, since it gives an indication of the extent

1. in these cases Roemer et al. identified two techniques; the one chosen under the BIS is the more capital intensive one.

2. Gunning (1977), pp. 56-57.

3. cf. section 4.5.

to which the government will be able to control the allocation of investment.

To this end government current revenues are calculated. Direct taxes are derived by applying income tax rates to individual incomes,^{1.} and, in the case of the corporate income tax, to corporate savings. Input-output coefficients are used to generate income from indirect taxes and from import tariffs and export duties.^{2.} Government saving is then derived as the difference between current revenue and public consumption. With household savings determined by the level and distribution of personal incomes,^{3.} this finally gives corporate savings as a residual.

An important feature of the Tanzania model is that the domestic savings rate is sensitive to the economy's growth rate. This reflects the country's socialism. In the formal, urban part of the economy the capital stock is increasingly publicly owned. Hence the non-wage part of value added is largely retained by the corporate sector or by the government, rather than being paid out as the personal income of a capitalist class. Even allowing for the informal sector (where returns to capital do of course form part of the personal income of the self employed) this implies that the ratio of personal incomes to value added is much lower for the urban sectors than for agriculture. This means that if the urban sectors grow faster than agriculture - as they do in our projection - the share of private consumption in GDP will fall. It further implies that if, for whatever reason, the growth rate of GDP increases, the effect will be reinforced by an increase in the savings rate.

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1. We assume, for urban areas, that casuals are not taxed and for rural areas, that only wage income is taxed.
 2. We assume that, for each sector, indirect tax rates remain constant in real terms.
 3. equation (4.5.3) below.

Data on the structure of existing external debt plus assumptions on the availability, terms and disbursement patterns of new loans and grants and assumptions on transfers and changes in reserves were used in a detailed accounting model to derive foreign savings.¹ Total foreign savings (in constant prices) includes a change in the terms of trade term which is calculated on the basis of projected export and import prices.

4.4. Employment and Income Distribution

4.4.1. Employment, the Urban Labour Market and the Urban Distribution of Income

Employment in the formal sector is related by fixed coefficients to output levels:²

$$(4.4.1) \quad N_{ilp} = \lambda_{ilp} X_i$$

where N is formal sector employment

X gross output

i subscript for sector (i=1,...,11)

l subscript for wage income group (l=1,...,11)

p subscript for location (p=1 : urban, p=2 : rural).

This simple, linear formulation implies two assumptions. First, that labour productivity does not grow but remains (in each sector) at its 1973 level. If anything, this assumption is an optimistic one since there is considerable evidence that labour productivity has fallen in recent years.³ Secondly, formal sector wages (which are exogenous in the model) do not affect labour intensity. This we consider realistic, considering Tanzania's system of price

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1. all these flows are exogenous with the exception of changes in reserves which are related to imports.
 2. our data are based on unpublished updates for 1973 of tables VIII and XIII of the Survey of Employment and Earnings, Tanzania (1974). These data appear in appendix C of Gunning (1977). The employment coefficients λ do not remain constant for manufacturing. In this case we use disaggregated information which gives the ratio of employment and output for thirty subsectors (cf. section 4.2). We do assume that the distribution of total employment in manufacturing over i and p remains constant.
 3. using 1973 data on the sectoral distribution of regular wage employment in conjunction with the data in appendix 3 of Tanzania (1974b) gives a weighted average of labour productivity growth of -1.0% p.a. for 1969-74. For manufacturing the rate was -3.4%.

control, which makes it quite easy to pass wage increases on to consumers in the form of higher prices, leaving employment unaffected. Note that, over time, aggregate labour intensity and the distribution of wage income will change ^{1.} with the sectoral composition of output, as sectors differ in labour intensity and in the skill composition of employment.^{2.}

Within the urban labour force, we distinguish five groups: regular wage earners in the formal sector, high income self employed, low income self employed, casuals and unemployed. Table 4.4.1 presents data on the size and incomes (in 1969)^{prices} of those groups.

Table 4.4.1.: The Urban Labour Force: Incomes and Employment, 1969 and 1975.

	number	(thousands)	growth	incomes	(Tsh/month)	growth
	1969	1975	rate	1969	1975	rate
			1969-75			1969-75
regular wage employment	141.1	195.4	5.5%	368	387	0.8%
high income self-employment	12.1	15.1	3.8	1218	625	-10.5
low income self-employment	26.9	78.0	19.4	163	85	-10.3
casuals	17.1	27.7	8.4	163	111	-6.2
unemployment	22.4	59.2	17.6	-	-	-
total labour force	219.6	375.4	9.3	336	252	-4.7

source: Collier (1977), appendix A, table 4.

Note that incomes, other than those in wage employment, fell quite dramatically. High income self employment is a sector in which capital and skill requirements pose barriers to entry. Its growth is probably

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1. even though we assume that wages grow at the same rate for all i.
 2. Cf. Gunning (1977), appendic C. Our disaggregation by income level is meant to give a proxy of the skill composition.

more determined by policies towards the Asian community than by economic factors. We do not pretend to be able to say anything about this sector's development and therefore keep the number of people in it (N_h) and their incomes, constant, taking comfort in the fact that by now the sector accounts for a tiny (4%) fraction of the urban labour force.

The total income of casuals and of low-income self employed is endogenous, but predetermined at the stage when we derive the distribution of the urban labour force over the five activities. For casuals (as for regulars) that income is given by output levels and wage policies.

$$(4.4.2) \quad N_c W_c / N_c^0 W_c^0 = \sum_i W_i^c \lambda_i^c (X_i / X_i^0)$$

where N_c is the number of casuals

W_c their mean incomes

λ^c sector specific employment coefficients

W_i^c index of wage rates for casuals, deflated by urban consumer prices

and the year 1973 is denoted by the superscript ^{0} . Note that while for regulars output determines employment, for casuals it determines only the total amount of work to be done: the number of people amongst whom this work is shared remains to be determined.

Demand for the services of the low income self employed is related to the growth of consumer demand. Assuming an unitary income elasticity:

$$(4.4.3) \quad N_s W_s / N_s^0 W_s^0 = (Y_u / Y_u^0)$$

where N_s is the number of low income self employed

W_s their mean income

Y_u total urban income (in constant prices).

Those who are not in (high income) self employment or who have already

gained access to regular wage employment, constitute the free entry sector. These have to choose between two job search strategies: seeking jobs in regular wage employment while employed as casuals or as (low income) self employed, or doing so while in open unemployment. We assume that labour supply adjusts quickly to changing conditions: in each year expected incomes for the two strategies are equalized. The trade-off which is reflected in this equilibrium condition is that the actual (rather than expected) income earned in self or casual employment is bought at the expense of a lower probability of finding wage employment.¹

The equilibrium position is determined from five equations. First, total income in the sector ($N_1 W_1$) is predetermined by demand:

$$(4.4.4) \quad N_1 W_1 = N_c W_c + N_s W_s$$

Secondly, the size of the sector is known:

$$(4.4.5) \quad N_1 + N_2 = L_f - N_r - N_h$$

, where N_2 is the number of unemployed, N_1 the number of casuals and low income self employed, L_f the labour force and $N_r (= \sum_{i=1}^3 N_{ilp})$ ³ regular wage employment. Thirdly, the ratio of employment probabilities remains constant

$$(4.4.6) \quad p_1 = \xi p_2$$

Fourthly, we take an extreme position on labour turnover, assuming that the number of vacancies is equal to the net increase in wage employment². so that p_2 is determined by:

1. cf. Fields (1975).

2. Data limitations force us to ignore vacancies arising from deaths or retirements. This implies a downward bias in our estimate of p_2 , hence we may under estimate the rate of unemployment.²

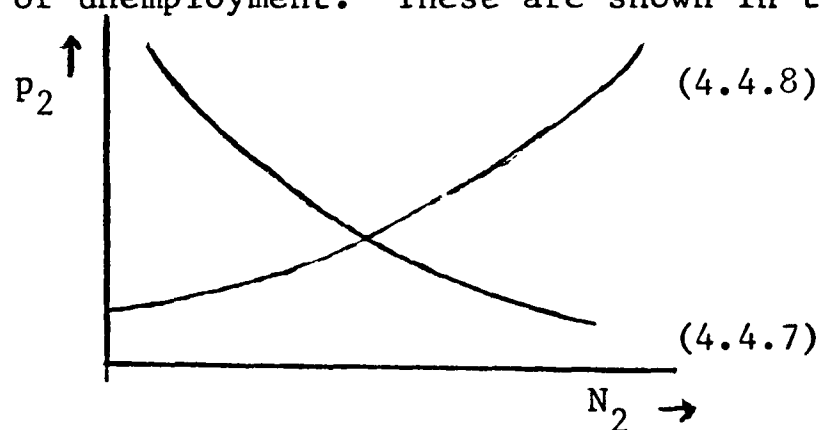
3. for $p = 1$.

$$(4.4.7) \quad p_2 (\xi N_1 + N_2) = N_{rt} - N_{rt-1}$$

Finally, expected incomes are equalized:¹.

$$(4.4.8) \quad Y_2^e(p_2, W_r) = Y^e(p_1, W_r, W_1)$$

If we substitute for p_1 , N_1 and W_1 - using the first three equations - the last two equations define two relations between the employment probability p_2 and unemployment N_2 : A quasi-demand and quasi-supply curve respectively of unemployment. These are shown in the diagram.



Demand and Supply for Unemployment

Given the size of the free-entry sector (which changes over time with the growth of wage employment and of the urban labour force) an increase in the number of vacancies shifts the demand curve up (thereby increasing expected

1. Assuming a four-year planning horizon:

$$\begin{aligned} Y_1^e(p_1, W_r, W_1) &= p_1 W_r (4 + 3(1-p_1) + 2(1-p_1)^2 + (1-p_1)^3) \\ &+ (1-p_1) W_1 (p_1 + 2p_1(1-p_1) + 3p_1(1-p_1)^2 + 4(1-p_1)^3) \\ Y_2^e(p_2, W_r) &= p_2 W_r (4 + 3(1-p_2) + 2(1-p_2)^2 + (1-p_2)^3). \end{aligned}$$

Note that this second function ignores gifts received while in (and contingent upon) unemployment. The omission is deliberate. The unemployed are mainly secondearners (children or other relatives rather than heads of households): unemployment of heads of households is very low (in 1969 only 7.2% reported to be 'not working' and of these more than 75% were over 40 years old so that unemployment would be considerably below the former percentage; Gunning (1977), appendix E, table 4). Hence one would expect unemployment to be financed mainly within the household. If job search strategies are guided by the effect on household rather than individual income, then gifts have to be omitted from the expected income function: the loss of this income upon leaving unemployment does not affect household income.

incomes - which are an increasing function of p_2 - but also raising unemployment as people leave casual and self employment) and an increase in demand ($N_1 W_1$) raises the supply price of the unemployed: the supply curve shifts up, p_2 rises and N_2 falls.¹

Our estimates of ξ and of the time-horizon used in the calculation of expected incomes are based on data for 1969 and for 1975.²

1. note that in the simple Harris-Todaro formulation the supply curve is horizontal in the long run: expected incomes are equal to the marginal product in agriculture which is constant. In the short run the supply curve is vertical: unemployment is predetermined as the difference between the labour force and wage employment.
2. For these years we have estimates of N_1 , N_2 , W_1 , W_r and of $(N_{rt} - N_{rt-1})$. For any time horizon we can of course solve for p_1 and p_2 for each year. For horizons shorter than four years ξ would have risen dramatically while the theory (Fields (1975)) implies its constancy. Over the period 1969-75 the size of the sector increased by 148%, real incomes (W_1) fell by 36% and employment probabilities (p_1, p_2) by about 40%. For 1975 we estimate $p_1 = .027$ and $p_2 = .145$. Hence the value for ξ used in the model (.18) is very low: casuals and low income selfemployed count for only about 1/5 in terms of unemployed equivalents (cf. equation (4.4.7)). The data on which these estimates are based can be found in the World Bank report, Collier (1977), appendix A, table 4. Our use of these data differs from Collier's own. In his one-period formulation gift income would have had to increase massively over the period to satisfy the equilibrium conditions, while wages (probably the most important source of gifts) per unemployed fell by 45% in real terms. Secondly, when he does consider a multi-period extension (appendix C, p. 22) his procedure is to solve the one-year equilibrium condition.

$$p_1 W_r^* + (1-p_1) W_1 = p_2 W_r^* + (1-p_2) Y_g$$

for W_r^* , using 1969 values for p_2 and W_1 , assuming that gift income of the unemployed is Tsh 40/month and that $\xi = 0.25$. He then finds that $W_r^* = 3.4 W_r$, concludes that the time horizon is four years and, since that seems reasonable, that the assumed value of ξ is acceptable. Apart from the inclusion of gift income - which we have questioned above - there are three objections to this approach. First, the time horizon estimated in this way is very insensitive to the value assumed for ξ ; e.g. W_r^* would fall by only 10% if $\xi = .15$ were used. Secondly, the multi period case can not be treated by simply using a multiple of W_r in the one period equilibrium condition. If one repeats Collier's calculation using the four-period equilibrium condition one finds a value of W_r which is 74% higher than what he takes to be the actual value, a huge error. Finally, and most importantly, the procedure makes no use of the one implication of the theory - the constancy over time of ξ - which makes it falsifiable.

Note that in the simple Harris-Todaro formulation (the $\xi = 0$ case) the supply curve would be vertical (unemployment is predetermined as the difference between the labour force and wage employment) and the demand curve is a rectangular hyperbola^a. The elasticity of our supply curve implies that employment probabilities (and hence expected incomes and migration) are less sensitive to shifts of the demand curve: shifts between N_1 and N_2 - i.e. in and out of unemployment as its attractiveness changes - cushion the effects of such shifts.

With incomes in, and the size of each of the five urban employment categories (regular wage, high income self, low income self, un- and casual employment) determined,¹ we know the distribution of income over earners but it remains to derive the distribution of household income. We distinguish 25 types of household (subscript h): households where the head is a wage employee - disaggregated by age (5 groups) and wage level (4 groups), self employed - disaggregated by income, one group for high income self employed and three for low income self employed and finally those where the head of household is not working. For the initial year we have estimated the distribution of the total number of households over these types. This distribution remains fixed - for each type the number of households (γ_i) grows at the same rate as the urban population - but we do not assume that the distribution of heads of households over the three activities remains constant : only for the base year does the typology reflect the occupation of the head. Thereafter, the number of labour force members remains constant for each household type

1. with N_1 and W_1 known we solve for the number and incomes of casuals and low income self employed from the pre-determined income totals ($N_c W_c$ and $N_s W_s$) using the condition $W_c / W_{ct-1} = W_s / W_{st-1}$. The reason for this condition is that in 1969 W_c and W_s (and hence the employment probabilities for the two groups) are equal. Consistency then requires that incomes grow at the same rate, but since total income in the two sub-sectors is determined by different factors, the distribution of N_1 over the two activities (hence the growth rates of N_c and N_s) may change over time.

but they (including the head) may change their occupation in response to changing labour market conditions.

First, jobs are divided between heads of households and other earners. We assume that (a) the share of heads of households in wage employment and in (total) self employment does not change, (b) that all high income self employed are heads of households and (c) that all casuals are other earners. Unemployment for the two groups then follows residually.^{1.}

For the two most important sources of income - wage employment and self employment - we take the variance of the size distribution into account.^{2.}

For low-income self employed we use a three-class distribution based on 1971 data and apply this both to heads and to others.^{3.} For wage income we make use of the strong correlation between age and wage levels to derive wage distributions separately for heads and for others: given the age distribution of heads of households we derive the distribution of wage income for heads (in four income groups) and then, residually, the corresponding distribution

1. these residuals are, of course, consistent with total unemployment, since in the derivation of that total we used the identity (4.4.5). In Gunning (1977) we assumed that the unemployment rate for heads would remain at its 1969 value (7.2%; p.15 and appendix E, p.5); that extreme position is not implied by the present formulation.

2. for casuals we only use the mean, i.e. W_c ; this also applies to the (small group of) high income self employed.

3. These data are from the NUMEIST survey, Bienefeld and Sabot (1972). They were taken from Bienefeld (1974), table 20, p.41; cf. Gunning (1977), table E.3. We cut the distribution off at incomes of Tsh 350/month: those earning more than this are considered to belong to the high income self employed. Since the distribution is kept constant, mean incomes in the three classes grow at the same rate as the overall mean, i.e. W_s .

for other earners.^{1.}

We distinguish seven activities for non-heads: wage employment (four income groups), low income self employment, casual employment and unemployment.

Given the number of households, the distribution of heads and non-heads of households over activities and the number of labour force members per household type, we derive the household income distribution:

$$(4.4.9) \quad \gamma_h = \sum_i \gamma_i f_{ih}^H$$

$$(4.4.10) \quad \gamma_{hk} = \gamma_h f_k^N$$

$$(4.4.11) \quad n_h = \sum_i \gamma_i f_{ih}^H n_i / \gamma_h$$

$$(4.4.12) \quad Y_{hk} = Y_h^H + n_h Y_k^N$$

, where:

Y_h^H is income^{2.} of heads of households in activity h (h = 1,..., 25)

Y_k^N income^{3.} of non-heads in activity k (k = 1,..., 7)

γ_i, n_i the number of households and the mean number of earners (excluding the head) for type i, i.e. for which the head was in activity i in the base year

γ_h, n_h idem, for which the head is at present in activity h.

f_{ih}^H distribution of heads of type i households; $\sum_h f_{ih}^H = 1$

and the matrix f^H would remain diagonal if the occupational distribution of heads did not change^{4.}

1. the age distribution of heads of households who are wage earners is derived from unpublished data from the 1969 Household Budget Survey; cf. Tanzania (1972) and Gunning (1977), table E.4 and E.5. The correlation between age and wage levels is based on NUMEIST data; cf. Bienefeld and Sabot (1972), Bienefeld (1972), table 31, p.76 and Gunning (1977), table E.1.

2. $Y_h^H = 0$ for h = 25, i.e. for unemployed.

3. $Y_k^N = 0$ for k = 7, i.e. for unemployed.

4. this could occur only if wage and self employment grew at the same rate as the labour force, a condition which is not satisfied in our projections. Given row - and column totals of the matrix, f^H is derived by (a) allocating the difference between ex post and ex ante self employment to the ex ante wage employed (b) allocating the remaining difference between ex ante and ex post wage employment to ex post unemployment.

f_k^N distribution of non heads; $\sum_k f_k^N = 1$

At this stage, incomes are net of income taxes, so that what we derive is the after tax income distribution $(\gamma_{hk})^1$. It should be noted that this way of mapping from the size distribution to the household distribution of income is crude in two senses. First, unemployment rates are highest for non-heads of households. One would expect the choice of job search strategy by other earners to be a function of household income: members of richer households can afford to remain longer unemployed. But our specification does not allow for this: the same distribution f_k^N (and hence implicitly the same unemployment rate for non-heads) is used for all household types (equation (4.4.10)).²

Secondly, in chapter 2 we argued that, rather than keeping the occupational distribution of labour force members within a household type fixed and solving for the number of households of each type, the household income distribution should be derived from given endowments by household type and the predetermined

1. this point is worth stressing, since the Tanzanian income tax structure is highly progressive. The present structure determines a 13-segment piecewise linear function T , where $T(x)$ gives the amount of income tax paid by someone with an income of x . We assume that the income tax covers all urban incomes except for casuals. In the projection the tax brackets are adjusted each year for the rate of inflation: in real terms rates are assumed to remain constant. Note that we apply the legal rates to individual rather than to household incomes. Huang (1976, p.83) used the latter method. Since the rate structure is progressive this would overestimate government revenues and underestimate the inequality of the after-tax income distribution.

2. this is due to data limitations. While for Kenya (appendix 3) we have recent (1974) and detailed household composition data, for Tanzania the most recent data (1975) give only the household income distribution but no information on household composition. The same applies to the published data of the 1969 survey Tanzania (1972), while the unpublished data of that survey which we use - see Gunning (1977), appendix G, pp.1-2 for a discussion of these data - give occupational information only for heads of households. Hence, while for Kenya we could derive distribution by household type for all labour force members, this is not possible in the case of Tanzania.

number of households of each type. The present specification fits that prescription only to a limited extent. The only endowment which it recognizes is the number of labour force members. In particular this implies that whatever rationing criteria are used in the allocation of modern sector jobs, those criteria do not affect the household income distribution. This is partly, again, a matter of data limitations;¹ the second reason is that in Tanzania the rationing system is much more that of a job lottery, while in Kenya it is much more (and increasingly rigidly) based on educational qualifications. Therefore while in the Kenya model we recognize a second endowment (the educational attainments of the household members) in the case of Tanzania we do not.

Equation (4.4.10) defines a discrete approximation to the household distribution with a large (7×25) number of intervals. Before using it to generate household saving and consumption we aggregate it to a distribution with eight income classes, the class limits corresponding (in real terms) to those of the 1969 Household Budget Survey. Inequality measures are however calculated on the basis of the disaggregated distribution.

4.4.2. Rural Income Distribution

As noted in chapter 3, the treatment of the rural distribution is very simple. For cash income, the model determines the mean but the distribution itself remains constant; this distribution is log normal and based on survey data

1. the procedure which we used in the case of Kenya to capture the effect of the use of educational qualifications as rationing devices (appendix 3) can not be used: first because we do not have the necessary data on household composition (cf. previous footnote) and secondly (and most importantly) because we would have to use data for 1969, i.e. predating the most serious phase of excess labour supply (in the period 1969-1975 the urban labour force grew at 9.3% p.a., regular wage employment at only 5.5%).

for 1975.¹ To generate the mean of this distribution we distinguish between four sources of rural cash income: income from extra rural crop sales (separately for export crops and food crops), wage income and all other cash income. The first component is already implied by our assumptions on export crop volumes and on producer prices and both these variables are exogenous.² The second component, which consists of sales of maize, rice and wheat, is endogenous, volumes growing at the same rate as urban consumption of these crops. Wage income is treated as it is for urban households: employment is related to output levels by sector-specific fixed coefficients and the growth of nominal wages is a policy variable. The final component includes income from private rural trading and from (intra-rural) sales of food crops.³ Assuming unitary elasticity of demand, the share of this component in total cash income remains constant.⁴

Given the distribution's mean, we use rural consumer prices and the estimated log variance to derive mean incomes and the number of households in eight income classes, the class limits corresponding again (in real terms) to those of the 1969 survey.⁵

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1. the actual distribution and the one estimated using the assumption of log normality appear in table D.1 of Gunning (1977). Ideally, one would like to disaggregate by province: rural income inequality is largely explained by inter- (rather than intra-) provincial differences. While the 1975 data are available at the level of provinces, such a disaggregation would require reliable agricultural data at the provincial level and these do not exist.
 2. the ratio of producer prices and world commodity prices has fallen as parastatals involved in marketing and transportation have claimed an increasing share of the proceeds. We assume that this will continue to be the case: producer prices grow at a rate one percentage point below that projected for world prices.
 3. note that we do not model urban-to-rural remittances which, in the case of Tanzania are very small (Tanzania (1972), p. 30 indicates that 'remittances and gifts' account for less than 4% of rural income and this includes intra-rural transfers). This is very different from the situation in Kenya (where the percentage is about three times as high) and indicates the extent to which migrants break their rural ties.
 4. in 1975 the three endogenous components account for 83% of cash income.
 5. we allow for the fact that the 1969 income concept is inclusive of subsistence consumption while the log normal distribution applies only to cash income.

4.5. Prices, Household Savings and Consumption

In the Tanzanian model - and in this respect it is very different from our model for Kenya - prices are completely isolated from supply and demand. All domestic prices are given by the Leontief equation (4.5.1), which reflects the policy followed by the National Price Commission (N.P.C.). Although the Regulations of Prices Act (1973) which established the NPC, charges it to consider a large number of (conflicting) objectives¹ in determining maximum prices, in practice a very simple mark-up system is followed.² The 'margin in relation to turnover and capital employed' of which the Act speaks is in practice a fixed percentage applied to all current costs, including losses and depreciation. If a commodity is produced by more than one firm, the price is based on the costs of the least efficient firm. Capacity underutilization is simply reflected in higher prices.³ This is probably one of the few real world situations in which the use of Leontief pricing in modeling is entirely appropriate.

Gross output prices are given by:

$$(4.5.1) \quad p_i^D = \sum_{j=2}^{11} (I-A^*)^{-1}_{i-1,j-1} \zeta_j \quad (i = 2, \dots, 11)$$

$$(4.5.2) \quad \zeta_j = p_{1j}^D A_{1j} + \alpha_{1j} p^{mi} + \alpha_{2j} \tau_j + \alpha_{3j} \omega_j + \alpha_{4j} p_j^D$$

, where p_i^D is the gross output price (sector i), index 1969=1

A^* the matrix obtained from the IO matrix A by eliminating

-
1. these include preservation of the competitive position of products in domestic and foreign markets; the maintenance of efficiency of domestic industries; incomes of peasants and workers are not to be eroded by unnecessary or unjustified price increases; the ability of the government to finance development and recurrent expenditure must be ensured; and fair relations among the incomes of different sectors of the community. There is no reference to excess demand or supply.
 2. understandably, since NPC has a very small staff and sets and enforces thousands of prices.
 3. Another curious feature of the system is that for a large number of consumer goods the maximum prices apply nationwide. The effect of this is that shortages are concentrated in rural areas: transporters have no incentive to deliver the goods up-country. Our specification (section 4.1) implies the assumption that this feature will be eliminated.

the row and column for agriculture

p_{1j}^D is the price index for agricultural goods delivered to sector j

p^{mi} an index of prices of imported intermediate goods

τ an index of indirect taxes

ω_j an index of wages^{1.}

α_{ij} the share in value of gross output of sector j of the cost of intermediate imports ($i=1$), indirect taxes ($i=2$), wages ($i=3$) and operating surplus including depreciation ($i=4$).^{2.}

$1-\zeta_j$ share (in current prices) of the cost of (non-agricultural, non-imported) intermediate inputs in the value of gross output of sector j .

Rural and urban consumer price indices are calculated as weighted averages of gross output prices, taking trade margins into account.^{3.}

Household saving and consumption are given by (piece-wise) linear functions

1. no adjustment for labour productivity growth is needed, since we assume that labour productivity remains constant.

2. $\sum_{i=1}^{11} A_{ij} + \sum_{i=1}^4 \alpha_{ij} = 1$. Clearly, $p_j^D = \sum_{i=2}^{11} p_i^D A_{i-1,j-1}^* + \zeta_j$ ($j=2, \dots, 11$)

from which (4.5.1) follows. Note that the use of p_j^D as price index for α_{4j} in (4.5.2) implies the constancy of the mark-up percentage.

The coefficients α_{ij} are derived from the 1969 IO tables, Tanzania (1972).

Indirect tax rates are assumed to remain constant in real terms, i.e. τ_j and p_j^D grow at the same rate.

3. In Gunning (1977) we compared rural and urban consumer prices (table F.2) for the period 1969-1975. In terms of the rural consumption basket, urban prices were about 4% higher in 1969, equal in 1973 and about 5½% higher in 1975 (table V.1; this excludes housing). The difference is surprisingly small (e.g. Scott (1976), pp. 177) found a difference of 69% for Kenya); we take it into account when comparing rural and urban incomes.

in income alone:

$$(4.5.3) \quad S^H = \sum_j (n_j^R s_j^R Y_j^R + n_j^U s_j^U Y_j^U)$$

$$(4.5.4) \quad C_i = \sum_j n_j^R (1-s_j^R) Y_j^R \tilde{C}_{ij}^R + \sum_j n_j^U (1-s_j^U) Y_j^U \tilde{C}_{ij}^U$$

, where rural and urban are denoted by the superscripts R and U and

S^H is total household saving

C_i private consumption, sector i

n_j, Y_j the number of households, mean income in income class j¹.

$\tilde{C}_{ij}$ share of sector i in consumption by households in income class j.²

4.6. Migration

Rural-to-urban migration is given by a Harris-Todaro (1970) type of equation, modified to allow (in the form of a shift of the supply curve) for the growth of the group of potential migrants: young, educated, rural males.

$$(4.6.1) \quad m = (Y_U^e / Y_R^a)^\eta S^{ed}$$

where m is an index of the number of migrants

Y_U^e an index of real urban expected income (i.e. of $Y_1^e = Y_2^e$ of equation (4.4.8)).

Y_R^a an index of mean real rural per capita income

η the elasticity of migration with respect to the ratio of expected urban and actual rural income

S^{ed} an index of the number of young, educated rural males.

1. Y is net of income taxes.

2. the data on the composition of consumption are from Tanzania (1972) but in the case of rural consumption the data are not published; cf. Gunning (1977), appendix G. The calculation is done separately for cash and subsistence consumption, a detail which we ignore in (4.5.4). The data in appendix G give consumption for 50 items. This detail is not used (except to generate urban demand for three food crops: maize, rice and wheat): the matrixes in (4.5.4) are obtained from those in appendix G by multiplying with a matrix (discussed in appendix H) which maps from the 50-commodity to the 11-sector classification.

Barnum and Sabot (1975) have estimated cross-section regression equations using survey data for 1971 and this provides a value for the elasticity η .^{1.} Their results also establish the importance of education in explaining migration flows.^{2.} This is captured by the variable S^{ed} in (4.6.1) which, during the projection period, grows at the same rate as rural school enrolment.

1. the data are from the NUMEIST survey, Bienefeld and Sabot (1972). Barnum and Sabot disaggregate the data by level of education (4 values), age (3), rural region (3) and urban centre (3) so that their regressions are based on 108 observations. We assume that their estimated elasticity can be used in equation (4.6.1) in spite of the fact that their expected urban income variable differs in two respects from Y_U^e . First, they divide the increase in wage employment by the number of unemployed rather than - cf. equation (4.4.7) - by the number of unemployed equivalents (i.e. taking into account that casuals and low income self employed compete with the unemployed for wage jobs). Secondly, and consistent with this, their income variable is simply the wage rate.
2. Barnum and Sabot allow for the possibility that education increases migration propensities, because (if job rationing is, at least partly, based on educational qualifications) it increases the employment probability and hence expected urban income. But they also find a separate effect of education, i.e. independent of the effect on expected income (pp. 23-29). The two influences are indistinguishable in our model, since - unlike in the Kenya model - employment probabilities do not differ between groups with different levels of education.

This shift of the supply curve of migrants implies that migration will continue to grow - in fact quite rapidly - even if the income ratio remains constant. Collier (1977) has estimated how well this specification -combining the Barnum and Sabot income elasticity with an education-related supply shift - explains migration for the period 1969-1975. He finds that using the equation Y_U^e gives a very close approximation to the actual value of expected urban income,¹ which is the more encouraging since the period 1969-1975 was one of very substantial change, migration increasing by more than 70% and expected urban incomes falling by more than 40%.

A priori one would expect equation (4.6.1) to lead to a worsening of the problem of urban poverty which developed over the period 1969-75 for three reasons. First, because by 1975 migration already represents a very high share of the urban labour force: in that year migration added 24.2 thousand people to an urban labour force of about 380 thousand. Hence, a very strong income effect is needed to reduce migration sufficiently to bring the growth of the labour force (about 9% p.a.) down to that of wage employment (about 5% p.a.). Secondly, because the elasticity of migration with respect to the urban-rural income differential

1. appendix C, pp. 19-22. In this period rural income fell by 4.6%, S^{ed} (using male standard seven enrolment as a proxy) increased by 95% and migration by 71%. In addition education reached poorer groups during this period, which would be reflected in a downward shift of the supply curve. Combining these estimates with the Barnum and Sabot value for η (.57) gives a predicted fall of expected urban income (Y_U^e over the period) of 43.1%. This is extremely close to the (estimated) actual fall of 41.0%.

is fairly low.¹ Thirdly, because to a large extent changes in migrations are determined by the spread of education and hence immune to changes in the income variable. All of this implies a very slow adjustment process: as high migration drives down the expected urban incomes, the negative feedback effect of these incomes on migration is too weak to prevent a further fall in urban incomes.

The growth of migration is a phenomenon crucial in determining changes in the urban income distribution, both for the historical period for which we have data (1969-1975) and for the projection period. Hence the empirical basis for a high estimate of migration in the earlier period is important. The estimate of the population of Dar es Salaam in 1975 is based on Ytterberg (1976) whose estimates are based on voter registrations. At the time when this population estimate was used in the World Bank report,² there were two supporting pieces of evidence: unpublished data from the Pilot 1975 Household Budget Survey and data on informal sector income from the Manzese survey.³ Since that time provisional data of the 1978

1. this reflects the long distances between the main urban centre, Dar es Salaam, and the regions from which migrants come and, in addition, the fact that migrants in Tanzania do not maintain rural ties. This is strikingly different from the situation in Kenya, where migrants into Nairobi come predominantly from Central province and continue to have strong rural ties (as evidenced by having access to land and by high urban-to-rural flows of remittances). The difference is reflected in a very large drop in migration propensities in the period 1969-1977 (see appendix 3). A fall in the urban-rural income ratio does not only reduce in-migration but it also leads to significant out-migration. In Tanzania, migrants - who have not maintained rural ties - are trapped in urban centres under such circumstances.

2. Collier (1977), Gunning (1977).

3. Blunt (1975). If population growth of Dar es Salaam had been lower than that implied by Ytterberg's data, incomes could not have fallen as much since 1969 as indicated by the two other sources. Cf. Collier (1977) Appendix A.

Census have become available which provide independent confirmation.^{1.}

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1. while we used an estimate of 586 thousand for the population of Dar es Salaam in 1975, the Census gives it as 870 thousand in 1978, which suggests that either Ytterberg's estimate - at the time by many observers dismissed as incredibly high - was too low or that migration has accelerated since 1975 (in which case the capital's population would have grown by 14% per year in 1975-78). Secondly, while estimated urban population growth (including, in addition to Dar es Salaam, nine other towns) was 9.3% for the 1969-75 period, the latest data imply growth at the rate of 10.5% for the inter-Census period 1967-78.

V SIMULATION RESULTS : TANZANIA

5.1. Introduction

The results of eight simulation experiments with the Tanzania model are presented in this chapter. The assumptions used for the base run, which is discussed in the next section, imply a continuation of present policies. This is true in particular for wage policies, investment in industry and for the growth of public consumption. The other seven runs are discussed in section 5.3. Here we assume a lower rate of rural-to-urban migration, lower wages in the formal sector, a different industrial investment strategy, higher foreign exchange availability, better agricultural performance and, finally, lower levels of public consumption.

The model is solved for each year in the projection period 1974-1985.^{1.}

The results are summarized in the last section.

5.2. Base run

There are ten key assumptions on which the first simulation run is based.

Regarding government policies we assume:

- that (nominal) wages of regular wage earners are increased at 8% p.a.

This implies that, in 1985, the real wage is only slightly higher than in 1969, representing an increase of about 10% over its 1975 value.^{2.}

-
1. a longer projection period (up to 1990) was used in an earlier version of the model, Gunning (1977). In this version, the longer period is used only when comparing industrial strategies (runs 3 and 5). Data sources are discussed, and unpublished data presented, in the appendices of the earlier version.
 2. this will be difficult to implement, since the 8% does not apply to wage scales but to the total effect of wage scale revisions, promotions and seniority increases. Collier (1977) estimates that in the 1969-1975 period the latter factors accounted for 6% p.a. growth of nominal wages.

- indirect taxes and customs duties remain constant in real terms
- public consumption grows at 8% per year in real terms
- investment in manufacturing is according to the priorities of the Basic Industries Strategy (section 4.2).

Regarding other exogenous variables we assume:

- the supply curve of migrants shifts to the right at the same rate as rural school enrolment.^{1.} Agricultural production growth rates take the effect of migration on the rural labour force into account.^{2.}
- foreign savings are derived from detailed projections of interest payments and receipts, amortization, transfers, commitments and disbursements of loans and changes in reserves. These projections imply that, although commitments and disbursements continue to grow, the net flow is in current prices virtually identical in 1975 and 1985. In real terms (especially since our world price projections imply a large terms of trade loss) foreign savings are reduced to zero at the end of the projection period.
- for world prices we use the most recent (October 1978) World Bank projections.^{3.}
- cash crop production grows at 5.5% until 1980. This largely reflects recovery from the drought affected output level of 1975, especially of coffee (coffee production fell sharply in 1975 and increased by over 75% in 1976). The long term

-
1. enrolment projections are taken from the World Bank report, Acharya, Bery and Edgerton (1977). The projections used are those for enrolment in standard VII. The 'hump' in those projections for the early 1980's - when enrolment would increase by 160% in two years - is smoothed out over the 1980-1990 period.
 2. migration at higher rates than those projected in the base run reduces output by the average product in agriculture. We assume that in Tanzania - where, except in some isolated high-yield areas such as Kilimanjaro Region, land scarcity is not a problem - this is an adequate proxy for the migrant's marginal product.
 3. for export crops, these are considerably lower than those of 1976 which were used in Gunning (1977). This accounts for most of the differences in the results between the two versions.

(after 1980) growth rates used for export crops are: 2% for coffee, 4% for cotton, 5% for tea, 10% for tobacco, 0% for sisal, 10% for cashew and 2% for pyrethrum.

- exports of manufactured goods grow at 3.7% p.a. and other (non-agricultural) exports at 3.3%
- subsistence production grows at 2.4% per year.

In the base run, the economy continues to grow rapidly: GDP at factor cost grows at about 5% p.a. over the projection period. Table 5.2.1 illustrates however three problems. First, the growth rate falls over time; by 1985 it is only just above 4%. At the beginning of the projection period the outlook is favourable; not only is the investment rate very high (almost one fifth of GDP) but its efficiency is higher than in the preceding period (1969-1975) in which a number of large infra-structure projects (with high capital output ratios and long gestation lags) claimed a large share of total investment. The main reason for the slow down in growth is a drastic fall in the savings rate. Domestic savings are affected by the rapid growth in public consumption which outpaces the growth of government revenues: by 1985 the government is projected to be a very significant dissaver. Almost as important is the fall in foreign savings, which initially still finance almost a quarter of total investment and by 1985 have dwindled to an insignificant (and negative) amount. There are two reasons for this. The projected prices for the agricultural commodities which form the bulk of Tanzania's exports grow much more slowly than import prices: there is a terms of trade loss which grows from Tsh 70 million in 1976 (a year in which Tanzania benefitted from high coffee prices) to about Tsh 500 million in 1985 (in 1969 prices).^{1.}

1. since the basis for our price indices is 1969, the terms of trade loss of course also reflects the rise in oil prices.

Table 5.2.1 : Production, Expenditure and Savings

(Base run)				
	share	share	growth rates	
	1976	1985	1976-80	1980-85
<u>production:</u>				
agriculture	36.0%	30.7%	3.2%	2.8%
manufacturing	8.2	11.7	11.6	7.0
government	10.7	14.0	8.0	8.0
other	45.1	43.6	4.5	4.3
total (GDP at factor cost)	100.0	100.0	5.1	4.6
<u>expenditure:</u>				
private consumption	66.5%	60.6%	2.7%	4.3%
public consumption	19.3	25.5	8.0	8.0
investment	18.6	13.8	3.9	-0.8
exports	15.6	14.3	4.5	2.9
imports	19.3	14.1	-1.0	2.8
total (GDP at market prices)	100.0	100.0	4.9	4.5
level (Tsh million, 1969 prices)				
<u>savings:</u>	<u>1976</u>	<u>1980</u>	<u>1985</u>	
household saving	564	618	861	
corporate saving	765	1570	2030	
government saving	358	304	-405	
domestic saving	1688	2492	2486	
foreign saving	516	80	-21	
total	2204	2572	2465	

The second reason is that while grants and aid disbursements continue to grow quite rapidly, once debt servicing is taken into account the resource deficit can grow at only 4.1% per year and once we allow for import price inflation, foreign savings (excluding the terms of trade loss) fall at 2.2% per year. Our assumptions imply that (at least within the period we consider) there is little expansion of non-traditional exports to offset the terms of trade loss on agricultural exports. Since Tanzania relies so heavily on foreign savings its virtual disappearance by 1980 strongly affects the

Table 5.2.2 : Urban Incomes and Employment

	1976	1980	1985	growth rate 1976-85	actual 1969
<u>composition of</u>					
<u>the labour force (1)</u>					
regular wage earners	232	294	388	5.9%	141
high income self employed	19	19	19	0.0	12
low income self employed	69	92	163	10.0	27
casuals	36	48	87	10.3	17
unemployed	65	125	203	13.5	22
total	419	577	858	8.3	220
<u>incomes (2)</u>					
regular wage earners (4)	335	343	371	1.1	368
high income self employed	435	387	348	-2.4	1218
low income self employed	80	65	51	-5.0	163
casuals	106	85	67	-5.0	163
mean	233	205	192	-2.1	372
<u>free entry sector (3)</u>					
number of people ($N_1 + N_2$) (1)	168	264	451	11.6	66
actual income (W_1)	77	72	57	-3.3	163
expected income ($\frac{1}{4}$ ye)	92	86	68	-3.3	179
employment probability ($p_2, 1976=100$)	100	90	64	-4.9	132

notes: (1) in thousands (2) in Tsh/month, after tax, 1969 prices
 (3) cf. section 4.4 for notation. (4) excluding non-citizens, whose
 mean wages are higher

Table 5.2.3 : Urban Household Distribution of Income*

	1976	projected 1980	1985	actual 1969
mean income (absolute)	4056	3662	3426	5436
mean income (1976=100)	100	90	84	
% of households with incomes below:				
- Tsh 1000	4.1	13.5	26.8	7.0
- Tsh 2000	23.0	32.1	38.8	20.0
income shares (%):				
- bottom 40%	19.0	15.4	11.0	
- next 40%	37.4	37.9	39.8	
- top 20%	43.6	46.7	49.2	
Gini coefficient	0.35	0.40	0.45	

* incomes in Tsh/year, after tax, in 1969 prices

economy's investment and growth rate and this is (in the period 1980-1985) compounded by the effect of public consumption on domestic savings.

Secondly, with slow agricultural growth and little expansion of non agricultural exports, the reduction in foreign savings is made worse by slow growth in exports: what we project is in fact an economy which becomes more and more closed. The implication is the continuation of a policy of import substitution: we project in fact a significant fall (from 19.3% of GDP in 1976 to 14.1% in 1985) of the import rate.^{1.}

Given the initial conditions: a high migration rate and a wage far above rural incomes and incomes in the informal sector; and given our assumptions which imply that the real wage does not fall and that there is a substantial shift to the right of the supply curve of migrants, the projected growth rate has disastrous consequences for urban incomes and employment (table 5.2.2).

While wage employment continues to grow rapidly (at about 6% per year), the growth rate of the labour force (8.3%)^{2.} is even higher than this. As a

1. Unlike for Kenya (for which we fixed minima for imports in each sector as fixed shares of consumption and capital formation; cf. equation (7.4.2.)) we have treated all final goods imports - but not imports of intermediate inputs - as competitive. It is therefore useful to calculate, as an indicator of feasibility, how much lower the imports which we project are than what they would have been if the import content of consumption and investment had remained the same as in 1969 (this calculation can only be made for the aggregate since the IO table - unlike the Kenyan one - does not give the sectoral breakdown of imports of final goods). In 1985 projected imports are 27% lower than that level (compared to 12% for 1975). This seems feasible, both because the manufacturing sector grows rapidly and because the demand for imported capital goods falls in relative terms.

2. note that this is lower than the average for the period 1969-1975: 9.3%.

result there is an enormous growth in the size of the free entry sector, accompanied by a substantial (26%) fall in incomes. Only at the end of the projection period - when the fall in the investment rate is reflected in lower growth of wage employment - does the probability of employment fall substantially.^{1.} Since real wages do not fall, this implies that expected urban income does not fall substantially either until late in the projection period. Hence the adjustment process - whereby the growth of the labour force is reduced as lower expected incomes induce lower migration - is a slow one. These developments are not distributionally neutral (table 5.2.3): the Gini coefficient rises from 0.35 to 0.45, the share in income of the poorest 40% of household falls from 19% to 11% and there is an enormous increase in the extent of absolute poverty.^{2.}

What are the implications for rural-to-urban migration ² and the fall in urban incomes?^{3.} Table 5.2.4 shows that rural incomes grow (although very slowly), that as a result there is a strong negative income effect on migration,^{4.}

-
1. by that time (1985) the free entry sector already constitutes more than half of the urban labour force.
 2. note that in 1985 27% of households earn less than Tsh 1000 (in 1969 prices) per year, while in 1976 this was true of only 4%. Our results would be even worse if we extended the projection period. After 1985, the stagnation of investment would leave a very large percentage of the labour force trapped in the free entry sector with very little chance of gaining wage employment. As a result, people would shift from unemployment to casual and low income self employment, thereby further reducing incomes in those activities. Cf. Gunning (1977), pp.46-50, where results for 1990 are given.
 3. note (tables 5.2.2 and 5.2.3) that while mean household incomes fall by 1.9% p.a., the mean income of labour force members falls at the rate of 2.1% and expected income - the variable relevant for the migration decision, cf. equation (4.6.1) - even more: 3.3%.
 4. in the absence of the shift of the supply curve migration would be 23% lower in 1985 than in 1976. The growth rate of migration over the period 1975-85 is lower than for 1976-85: in 1976 (and 1977) migration is lower than in 1975, reflecting the effect of high coffee prices on rural incomes.

but this is too weak to offset the very large projected increase in the number of potential migrants.^{1.}

Hence in the base run we project three remarkable developments

(a) a secular decline in the rate of investment, threatening an end to the economy's growth, (b) massive rural-to-urban migration, (c) increasing urban poverty^t and income inequality. From our discussion of the results it will be clear that the critical assumptions are those on--the availability of foreign capital - wage policies - the shift of the supply curve of migrants - the growth of agriculture - the level of public consumption. All of these assumptions - and in addition the one we made on the choice of industrial strategy - are relaxed in the seven simulation experiments discussed in the next section.

5.3. Other Runs

In the base run the supply curve of migrants shifts to the right at the same rate (12.3% on average over the projection period) as projected rural school enrolment. That rate is not high by historical standards;^{2.} but we want to explore the sensitivity of our results to this assumption. In run 2 we reduce the rate to 6% p.a. Of course, migration is not reduced by as much as the change in the supply shift alone would suggest; with a smaller

1. the income effect would have been stronger if producer prices were higher, but the terms of trade turn against agriculture: note that while cash crop production grows, the value of sales falls when deflated by consumer prices (table 5.2.4).

2. for 1969-1975 the use of this proxy (which grew at 11.8%) gave a very good prediction of the estimated increase in migration; cf. section 4.6.

Table 5.2.4: Rural Incomes and Migration

<u>Incomes(1)</u>	1976	1985	<u>growth rate</u>
subsistence income	2136	2619	2.3%
cash income:	2853	3950	3.7
- extra rural sales of crops	730	710	-0.3
- wage income	764	1358	6.6
- other cash income	1360	1882	3.7
total income	4989	6569	3.1
mean household income	1894	2054	0.9
<u>Migration(2)</u>			
expected urban income: Y_U^e	100	74	-3.3
actual rural income: Y_R^a	100	108	0.9
income effect: $(Y_U^e/Y_R^a)^\eta$	100	77	2.9
supply shift: S^{ed}	100	283	12.3
migration: m	100	217	9.0

notes: (1) in 1969 prices (incomes deflated by rural consumer prices); Tsh million, except for household income (Tsh/year)
 (2) indices, 1976=100; for notation cf. section 4.6.

urban labour force expected urban income falls less than in the base run so that the income effect is weaker (table 5.3.1). Even so, by 1985 migration is almost 40% lower; for the period 1976-1985 the growth rate of migration is now only 3.7% (vs. 9.0% in the base run). These differences are reflected in the size of the free entry sector (in 1985 12% lower than in run 1), in the income level of that sector (11% higher) and in a more equal distribution of urban incomes.

Most importantly, however, the deterioration of the urban income distribution is in this run - in spite of much lower migration - reduced but not eliminated. Hence, while our assumption on the shift of the supply curve may be questioned, our most important result - a very significant increase in both absolute and relative urban poverty¹ - is not very sensitive to it.

1. as measured by the percentage of urban households with incomes below Tsh 2000/year (1969 prices) and by the share in income of the bottom 40% respectively.

Table 5:3.1: Migration: Smaller Supply Shift*

	1985		1976
	Run 1	Run 2	Run 1
expected urban income: Y_U^e (1)	74	82	
actual rural income: Y_R^a (1)	108	108	
income effect $(Y_U^e/Y_R^a)^\eta$ (1)	77	82	
supply shift: S^{ed} (1)	283	169	
migration: m	132	82	
urban labour force	858	803	
free entry sector: $N_1 + N_2$	453	399	
free entry sector incomes: W_1	57	63	
% of urban households with incomes below Tsh 2000/year	38.8	34.6	23.0
share of bottom 40%	11.0	12.9	19.0
Gini coefficient	0.45	0.42	0.35

note (1) 1976= 100

* for notation, see sections 4.4, 4.6.

In the next run (run 3) we assume a different wage policy: nominal wages are now increased by 7% rather than 8% per year. This modest change - which reduces the 1985 real wage level by 7% - has three important consequences. First, it leads to a massive increase in domestic savings and investment (table 5.3.2); the investment rate falls much less than it does in the base run. Secondly, as a result, GDP grows at a higher rate.¹ Finally, since the probability of employment is now very much higher² (offsetting the effect of the fall in real wages) migration is higher than in the base run. This result is counter intuitive in the Harris-Todaro framework in which lower wages always induce lower migration. It

1. the effect is very strong if a longer period is considered: while table 5.3.2 shows a 3% increase in GDP in 1985 as a result of lower wages, a slightly different version of the model gives a 12% difference for 1990. Gunning (1977), table X.4, p.65.

2. the effect of changes in wage employment on the probability of employment would of course be weaker if we had made a less extreme assumption on labour turnover; cf. section 4.4.

Table 5.3.2: Effects of Lower Wages

	1985		
	Run 1	Run 3	Difference
total value added (1), (2)	16,035	16,475	+2.7%
domestic savings (1)	2,486	3,162	+27.2%
investment (1)	2,465	3,141	+27.4%
investment rate (1), (3)	0.138	0.171	0.033
urban incomes: (4)			
- wage earners (W_r)	371	345	-7.0%
- free entry sector (W)	57	60	+5.3%
wage employment: (5) ¹			
- absolute	388	401	+ 3.4%
- increase over preceding year	19.7	23.5	+19.3%
migration (5)	132	138	+ 4.5%

notes: (1) Tsh million, 1969 prices. (2) GDP at factor cost.
 (3) share in GDP at market prices. (4) cf. section 4.4
 for symbols. (5) thousands.

illustrates the limitations of the partial nature of that model, in which employment is an exogenous variable. The results of our model - which includes the effect of wages via savings and economic growth on wage employment - indicate that even the sign of the effect of changes in wages on migration predicted by the Harris-Todaro model may be wrong.

The effect of the change on the different components of domestic savings is shown in table 5.3.3. Savings by households fall but this effect is minor compared to the increase in corporate saving and to the reduction in public dissaving (which is virtually eliminated). The effect on the government budget is both direct (as the government wage bill is reduced) and indirect (as revenues from corporate income taxes increase).^{1.}

1. The magnitude of these effects might of course be quite different in an economy in which changes in wage rates would induce factor substitution. This case is ruled out by our specification (section 4.4). Note that our estimates of the effect on saving may be biased upwards to the extent that in practice lower wages might well lead to increased government expenditure and to increased parastatal inefficiency.

Table 5.3.3 : Effect of Lower Wages on Savings

1985			
	run 1	run 3	share in increase
corporate savings	2030	2351	47.5%
government savings	-405	-24	56.4
household savings	861	834	-4.0
gross domestic savings	2486	3162	100.0%

In run 4 a different industrial strategy is adopted.¹ The differences from the strategy described in section 4.2 are:

- for textile production and for 'other food' processing the labour intensive technique is chosen
- only the first (300,000 tons) phase of the iron and steel programme is implemented
- group 1 (projects with top priority, cf. section 4.2) now consists only of sugar processing, other food processing, leather and iron and steel; all other activities are assigned to group 2.

The rationale for these changes is provided by the cost benefit calculations of Roemer et al.². In the case of iron and steel there are strong economies of scale, but production from the second phase of the programme would not be absorbed for a very long time.³ Note that

1. We compare industrial strategies at a higher level of foreign savings than was assumed in the base run. Run 4 is therefore to be compared with run 5 (discussed below) in which the net inflow of foreign capital is 10% higher than in the base run.
2. for estimates of the efficiency of the 28 manufacturing activities cf. Roemer et al. (1976), p. 263.
3. Tidrick estimates that at 800,000 tons, there would be overcapacity until about 1995. This - although the second (500,000 tons) plant, if alone, would be marginally efficient at shadow prices - would make the industry a high cost one. As Tidrick points out 'if the high cost of steel is passed on to metal-using industries, the growth of these industries will be slowed; yet it is the metal-using industries, not steel production, which yield large potential external economies in the form of skill development, capacity to adapt technology, and productivity growth'. Tidrick (1977), p.90.

processing of agricultural commodities (sugar, cashew, sisal, pyrethrum), which under the Basic Industries Strategy (BIS) of run 5 receives a very low priority,¹ is ranked much higher in the strategy of run 4. In general, the strategy of run 4 is a more efficient one.²

The results are summarised in table 5.3.4. The difference in investment allocation has significant effects on aggregate manufacturing output and employment: although total investment in manufacturing is only 6% higher the increase in industrial employment and value added over the projection period is 28% and 14% higher respectively: the strategy of run 4 is substantially more labour - and less capital - intensive.

The strategy's greater efficiency has surprisingly strong macro-economic effects: in 1989 total investment of the economy is more than 18% higher than under the BIS. A large part of this increase is needed for expansion of the services sectors (which now have to satisfy a larger industrial demand) but this still leaves a strong feed-back effect on industrial investment itself. This effect was ignored in Roemer et al. (1976) and is all the more important since the availability of capital for industrial investment is likely to be very much lower than they assumed at the time.

A large part of the increase in total investment can be traced to the effect of one project alone: the second phase of the iron and steel programme³ (table 5.3.5). The price of this one large project is seen

1. cf. section 4.2; the exception is sugar.

2. we have not carried the use of this criterion to its extreme. In particular two activities (leather and the first phase of iron and steel) are kept in group 1 (in spite of their inefficiency, cf. Roemer et al. (1976)) because there no longer is an element of choice: the government has already committed itself to these projects.

3. these results were obtained with the earlier version of the model. They were not reported in Gunning (1977), but appeared in Tidrick (1977), table 27, p. 91.

Table 5.3.4 : Effects of a Different Industrial Strategy (1)

	run 5	run 4	increase (%)
<u>investment in manufacturing</u> (total for 1975-1988):			
processing of agricultural products (1)	1638	2267	
food (2), beer, cigarettes	757	1016	
textiles, clothing, leather, footwear	1446	851	
wood products, paper, printing and publishing	496	1468	
chemicals	763	539	
iron and steel	1214	575	
metal fabrication	1634	1189	
all other	692	1297	
total	8692	9202	5.9
<u>total manufacturing sector</u> (1989)			
value added	2474	2711	9.6
employment	117.3	134.4	14.6
increase in value added (3)	1706	1943	13.9
increase in employment (3)	61.2	78.3	27.9
ICOR (4)	5.1	4.7	-7.0
ILOR (5)	.036	.040	12.3
<u>national total (1989)</u>			
GDP at factor cost	19,353	19,700	1.8(6)
investment	2,365	2,796	18.2

notes: (1) processing of sugarcane, cashew nuts, sisal and pyrethrum. (2) excluding sugar production. (3) increase over 1975. (4) incremental capital output ratio, average for the period 1975-1989. (5) incremental labour output ratio, average for the period 1975-1989. (6) the effect is stronger under the assumptions made for the model's earlier version; cf. Gunning (1977), p.61, where the increase was 4.6%. (7) investment and value added in millions of Tsh, 1969 prices; employment in thousands.

to be very high: it reduces grossdomestic savings by 16%.

Interestingly, the more efficient strategy does not only increase output and investment but also performs much better in terms of distributional objectives (table 5.3.6). This is largely because of its direct and

Table 5.3.5 : Effect of the Second Phase of Iron and Steel Production

(millions of Tsh, 1969 prices)

	GDP at factor cost total	industrial	gross domestic savings
1976 all runs	10,524	865	1,823
1990 BIS (1)	20,846	2,859	2,891
AIS (2)	21,700	3,303	3,834
BIS* (3)	21,353	3,016	3,433

notes: (1) Basic Industrial Strategy, as in run 5.
(2) Alternative Industrial Strategy, as in run 4.
(3) BIS but without the second (500,000 tons) phase of the iron and steel investment programme.

Table 5.3.6 : Industrial Strategy, the Urban Labour Market and
Income Distribution (1989)

	run 4 (run 5 = 100)
urban labour force	100.8
wage employment	102.8
free entry sector ($N_1 + N_2$)	99.4
migration	103.8
% of urban households with incomes below Tsh 2000/year	97.7
share of bottom 40%	107.3
Gini coefficient	98.4
free entry sector incomes (W_1)	105.6

indirect (via a higher level of investment) effects on the growth of wage employment, effects which are only partly offset by higher migration.

In run 5 we consider the effect of higher foreign savings:^{1.} in each year the resource deficit is 10% higher (in current prices).^{2.} The

-
1. higher, compared to the base run and all other runs except run 4, for which, as noted above, we also assumed higher foreign savings.
 2. total foreign savings (in constant prices) increase by much less: the terms of trade loss remains unaffected.

results appear in the summary tables (5.4.2 and 5.4.3). Although the change is very modest - foreign savings in 1985 are only Tsh 45 million (only 0.3% of GDP) higher - multiplier effects are strong: in the final year domestic savings are 19%, and investment is 21% higher. This results in higher growth (in the final year GDP is 3% higher), higher incomes both for urban and for rural households, a reduction in the size of the free-entry sector (in spite of higher migration), a reduced incidence of rural and urban poverty and a more equal urban income distribution. It appears that if Tanzania is to reduce its dependence on foreign capital - either by choice (increased 'self-reliance') or by necessity - she has to pay a stiff price, both in terms of economic growth and in terms of distributional objectives.

For the next simulation experiment (run 6) we assume better agricultural performance: all exogenous production growth rates are raised by one third¹. The results (tables 5.4.2, 5.4.3) reveal a trade-off: mean rural incomes rise by 6%, the number of rural households below the poverty line is reduced substantially and there is a large fall in the urban-rural income ratio; but the growth of the urban sector is reduced and the urban income distribution becomes even more unequal than in the base run. This is caused by the phenomenon noted in section 4.3: higher agricultural growth lowers the economy's savings rate. Policies aimed at raising agricultural output therefore need to be complemented by

1. i.e. not those for the food crops sold to urban centres (maize, rice, wheat), output of which continues to be determined by urban demand.

measures which raise total investment.^{1.}

In our final simulation (run 8) we assume a lower (7% rather than 8% p.a.) growth rate of public consumption.^{2.} Not unexpectedly, this leads to considerably higher economic growth: by 1985 GDP is 4.2% and investment even more than 50% higher^{3.} (table 5.4.2.).

The effect of higher growth on personal incomes is offset - and early in the projection period, more than offset - by the effect of lower public sector employment, an effect which is in the case of rural households reinforced by a fall in the urban demand for food crops:^{4.} only at the end of the projection period does the favourable effect on incomes of the higher growth rate begin to dominate. While this induces more migration, the effect is strong enough to lead to a more equal urban distribution of income.

-
1. this might include lower wages (cf. run 3), an industrial strategy with more emphasis on efficiency (such as the one assumed in run 4), and lower public consumption (as in run 5, discussed below). Such a policy package is assumed for run 7, which combines the changes of runs 3-6: wages grow at 7% (as in run 3), the industrial strategy is that of run 4, net foreign capital flows are higher (as in run 5) and we use the growth rates of agricultural production of run 6. As it turns out (tables 5.4.2, 5.4.3) the policies of runs 3, 4 and 5 are not strong enough to offset the effects of run 6: total GDP, investment and urban poverty are still higher than in the base run, although less so than in run 6. The results illustrate the model's nonlinearity: if one were to add the differences with the results of the base run for runs 3, 4 and 6 one would obtain a very bad prediction of the differences for run 7: one can not assume effects to be additive.
 2. such an experiment is of course biased to the extent that the model only takes the effect on savings, employment and output into account; public expenditures do not increase anyone's utility nor do they affect e.g. agricultural productivity in the model.
 3. the investment rate is then 20%, a rate which has been surpassed in the past.
 4. cf. Gunning (1977), table X.5, p. 66; in that version both urban and rural incomes were still lower than in the base run in 1980, by 1990 however they were 2-3% higher.

5.4. Summary

The design of the simulation experiments is summarised in table 5.4.1.

The next two tables present the most important results in a format which facilitates comparison between runs.

Our results paint a very grim picture for Tanzania, in terms of both economic growth and of income distribution. The low long-term growth rate of GDP is partly due to external factors: low foreign capital availability and unfavourable world price levels. The results of run 5 indicate the importance of these factors. However, they also indicate that maintaining the economy's growth will require more than just an increase in foreign savings. In all our projections the domestic savings rate is falling. Three factors are responsible for this: first, the high growth of public consumption; secondly, the protection of real wages in the formal sector;^{1.} and, finally, the inclusion of a number of highly inefficient activities in the industrial investment programme.

Our results also suggest that the problem of urban poverty which emerged in the period 1969-1975 is likely to get worse. Over the period 1976-1985 mean urban incomes fall by at least 10% in all runs, the percentage of households who may be classified as poor increases from 23% to at least 35% and the Gini coefficient from 0.35 to at least 0.42.^{2.}

-
1. which may of course also be questioned on grounds of equity: the sector comprises a tiny minority of the labour force whose income are four times as high as those of smallholders.
 2. our model does not include the long-run Harris-Todaro equilibrium condition of equality of rural income and expected urban income. It is therefore legitimate to ask whether migration continues to be rational. In the worst case (run 7) expected urban income in 1985 is at a level below which the incomes of about 40% of rural households fall. Since the expected income of migrants will be higher - they are on average better educated - and since their opportunity cost must be far below rural household income, our results do not imply that migration continues beyond the long-run equilibrium point.

Table 5.4.1 : Key to Simulation Runs ^{1.}

Run	Differences from Base run
1 Base run	-
2 Migration	number of potential migrants grows at 6% rather than 12.3% p.a.
3 Wages	nominal wages increase by 7% rather than 8% p.a.
4 Industrial Strategy	less emphasis on iron and steel and on activities which are inefficient at shadow prices (cf. section 5.3 for details); net capital flows 10% higher (as in run 5)
5 Foreign Savings	net capital flows 10% higher in current prices
6 Agriculture	exogenous growth rates of production one third higher ^{2.}
7 Combination	combines the changes of runs 3-6
8 Public Consumption	public consumption grows at 7% (in real terms) rather than 8% p.a.

1. the base run is discussed in section 5.2, all other runs in 5.3.

2. this applies to subsistence production and to export crops, but not to (marketed) food crops.

Table 5.4.2 : Summary of Results for 1985

	simulation run								results for:	
									1969	1976 (5)
	1	2	3	4*	5	6	7	8		
value added (1):										
agriculture	4928	4987	4924	4918	4922	5570	5557	4925	3081	3791
manufacturing	1876	1848	2031	2149	2054	1299	1501	2253	548	865
government	2241	2241	2241	2241	2241	2241	2241	2041	464	1121
other	6990	6950	7279	6895	7291	6340	6647	7484	3367	4741
total	16035	16026	16475	16578	16508	15450	15946	16703	7460	10518
GDP (2):	17891	17870	18415	18553	18454	17091	17680	18739	8271	11858
private consumption	10834	10833	10683	10911	10924	11285	11153	10803	5966	7885
domestic savings	2486	2416	3162	3072	2961	1235	1957	3772	1310	1688
foreign savings	-21	-41	-20	+33	+30	-183	-129	-21	-25	516
investment	2465	2375	3141	3105	2991	1052	1829	3750	1285	2204
urban labour force (3):	858	803	861	870	866	827	838	862	220	419
regular wage earners	388	386	401	408	401	357	376	397	141	232
high income self employed	19	19	19	19	19	19	19	19	12	19
low income self employed	163	147	148	149	152	184	184	145	27	69
casuals	87	78	78	80	82	96	96	79	17	36
unemployed	203	174	216	217	214	173	166	224	22	65 (6)
migration (4)	132	82	138	141	139	111	109	143	41	61

Notes: (1) GDP at factor cost, Tsh millions, 1969 prices. (2) at market prices
 (3) thousands. (4) of which a fraction 0.35 represents labour force members.
 (5) results of run 1. (6) 70 thousand in 1975.

* to be compared with run 5, rather than run 1.

Table 5.4.3 : Summary of Results for 1985

	simulation run								results for:
	1	2	3	4*	5	6	7	8	1976 (6)
<u>urban incomes (1):</u>									
wage earners (W_r)	371	372	345	365	368	379	350	364	335
free entry sector:									
- actual (W_1)	57	63	60	64	62	47	46	64	77
- expected (W^e)	68	75	72	76	74	57	55	76	92
<u>mean household incomes (2)</u>									
- urban (1976=100)	84	90	82	85	86	82	79	85	4056 (7)
- rural (1976=100)	108	108	107	109	109	114	113	108	1894 (7)
- urban/rural ratio (3)	1.7	1.8	1.6	1.7	1.7	1.5	1.5	1.7	2.1
% of households with incomes below Tsh 2000 per year									
- urban	38.8	34.6	39.2	36.7	37.2	40.8	41.0	37.6	23.0
- rural	72.2	72.4	72.7	72.0	71.8	70.4	70.9	72.4	75.7
<u>urban income distribution (5):</u>									
share of bottom 40%	11.0	12.9	11.7	12.1	11.7	9.5	10.4	11.5	19.0%
share of next 40%	39.8	39.3	39.2	39.5	39.6	40.5	39.8	39.6	37.4
share of top 20%	49.2	47.8	49.1	48.4	48.7	50.0	49.8	48.9	43.6
Gini coefficient	.45	.42	.44	.44	.44	.47	.46	.45	.35

1969 prices: see section 4.4 for symbols.

(1) after tax incomes in 1969 prices, see section 4.1 for details;
(2) in 1969 prices;
(3) rural incomes recalculated at urban prices;
(4) in 1969 prices, after taxes.

(2) in 1969 prices. (3) rural incomes recalculated at urban prices. (4) in 1969 prices. (5) these indicators (including the Gini coefficient) are based on the household income distribution, so the percentages apply to the number of households, not to the population.

(6) results for run 1. (7) absolute numbers.

* to be compared with run 5, rather than run 1.

VI KENYA : INTRODUCTION

6.1. Introduction. For a thousand years, until late in the 19th century, the interior of what now is Kenya was characterized by subsistence production and had few outside contacts. The coastal region however was involved in trade, exporting ivory and - especially after the Arabs replaced the Portuguese in the 18th century as the dominating group - slaves. In the interior the geographical distribution of the population adjusted itself to ecological differences so that, except when upset by tribal conflicts, the distribution of income probably was fairly equal.^{1.}

The British did not appear on the scene until 1885 when the Imperial British East Africa Company was founded. Their motives were both strategic: they were concerned about the German presence in Tanganyika and wanted to control the head waters of the Nile; and economic: Uganda was seen as the great prize in the colonial scramble for Africa. In 1901 the railway from Mombasa on the coast of the Indian Ocean to Lake Victoria was completed. In the first half of this century settlement of Europeans was encouraged^{2.} in the hope that agricultural exports would both repay the railway loans and pay for the administration of what was now officially a protectorate. Land close to the railway - the 'White Highlands' - was alienated from the Africans and made available to Europeans on extremely favourable terms. The settlers' production of coffee, sisal, tea, wheat and maize finally ended the coast's dominant position. The establishment of the economy of the European settlers had two very important consequences. First, African

1. Bigsten (1978), Chapter 2 and references there cited.

2. there were about 100 European settlers in 1903, 3000 in 1942; Leys (1974), p.29 and sources there cited.

smallholders were forced into agricultural wage labour and pushed back into subsistence production. At least initially, the colonisation did not lead to a land shortage for Africans: 'there really was more land than the Africans could use'.¹ But the settlers could not farm their extensive holdings without wage labour and since, at least in the early period, their agricultural technique differed little from those of the African farmers,² they could not afford to offer a wage above the Africans' reservation wage. The resulting labour shortage problem was solved by: increasing the need for cash income (by imposing Hut and Poll taxes) and simultaneously restricting the means - other than wage labour - open to Africans of getting it (by prohibiting the growing of certain cash crops); the use of compulsion in recruiting; allowing squatting of Africans on European land in return for labour. African export production declined and by the mid-1920s more than half of the African labour force was working for Europeans, the rest being engaged in subsistence production on the 'reserves'.³ The second consequence was the erection of an elaborate system of protection of the economy of the settlers: the large farms not only faced lower factor prices, they also received higher producer prices, paid lower transportation charges and received virtually all the benefits of extension services and other government programmes.⁴ This protection contributed to the myth of the importance of the large mixed farms to the Kenyan economy and this may have influenced the decision to pass a large part of the Highlands after independence (1963) intact (i.e. without subdivision) into African ownership. Smallholder agriculture continued to be neglected

1. Leys (1924), p. 177, quoted by Leys (1974), p.30.

2. Van Zwanenberg (1971).

3. Leys (1924), p. 179, cited by Leys (1974) p. 31.

4. The railway branch lines were sited through the European areas, railway charges were higher for African grown crops (e.g. cotton) than for those grown by Europeans; Europeans were paid twice as much for maize as Africans. For a discussion of this system of protection of the settler economy, cf. Leys (1974), ch. 2.

until the Swynnerton Plan (1954), which provided for land concentration and registration, lifted the restrictions on the growing of cash crops and gave smallholders access to credit and to extension services.

The early period after independence (1964-1972) was one of spectacular growth: GDP grew at about 7% per year. A summary of much that has been written about this period can be found in two influential reports by international organisations.¹ These reports expressed concern about four aspects of Kenya's development: the extent of protection, the disequilibrium in the labour market, high rates of rural-to-urban migration and the inequality of the distribution of income.

Kenya pursued an import substitution strategy and, as in many countries, this policy was reflected in high wages, low capital costs, the establishment of industries for which (at world prices) value added was negative, an over valued exchange rate and a shift of the terms of trade against agriculture.² In protecting the domestic industry, the government relied increasingly on direct controls rather than tariffs. Controls were tightened both in 1971 -- a year of very high imports -- and again in 1974-75.³ While agriculture remains by and large an open sector - in which changes in world prices for export crops are (unlike in Tanzania) passed on to farmers - manufacturing is heavily protected by import controls.⁴ The World Bank feared that as protection in the early 1970s was increased it could be used as a justification for price control. Price control however, is rigidly enforced for only a small number of items and evaded to such an extent that

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1. ILO (1972), World Bank (1975). For the government's official reaction to the ILO report see Kenya (1973). For a critical review of the implementation of the report's recommendations see Godfrey (1977).
 2. for an excellent survey see World Bank (1975) annex III; also ILO (1972), ch.11
 3. more recently - now that duties no longer have the disadvantage of requiring EAC approval - duty increases have been used again: some very large increases were introduced in the 1977/78 budget. Cf. Gray (1977), p.144.
 4. this is reflected in the specification of our model but not in the other Kenya models which we discuss in section 6.2.

the system is of considerable less significance in practice than in Tanzania.¹ The present system dates from the foreign exchange crisis of 1971. Under 'general control' deviations from 1971 price levels have to be approved for a large number of items. This system is of little practical relevance: allowed price levels are not even published and firms which do not produce items which weigh heavily in the consumer price index (CPI) often do not even bother to apply in the expectation that they will not be found out. Of greater importance is 'specific control' which applies to important CPI items, especially to food. From Mukui's discussion it would appear that this control is rather effective.² This situation is reflected in the design of the model: while for Tanzania we assumed complete price control, in the Kenya model only food prices are controlled.

Disequilibrium in the labour market was seen to be reflected in levels of modern sector wages far above incomes elsewhere in the economy; in the rationing of jobs on the basis of educational criteria and the resulting explosion in the demand for education; and in the large rise of, and the low incomes in the informal sector. The ILO report especially was concerned that, while the labour force would continue to grow rapidly³ and employment both in agriculture and in the modern sector would grow slowly, an ever larger number of people would be forced into the urban informal sector, which, as long as the government continued to harass it and the formal sector did

1. See Mukui (1978).

2. He estimates (Ch.4) that general control covered only 8.5% of the consumption basket of lower income urban households, vs. an additional 24.9% for specific control; for upper income households the percentages are 18.4% and 17.5% respectively. The fact that consumer prices for bread did not change from June 1970 until February 1974 and for sugar from July 1971 to February 1974 would suggest that the control of food prices was effective. However, even these facts may mask evasion: Mukui cites practices of conditional sales and (in the case of sugar) of charging separately for the bag.

3. Kenya's population growth rate - estimated at 3.5% for the period 1970-76 - is one of the highest in Africa. World Bank (1978), p.14.

not use it via sub-contracting, would not provide adequate incomes for what it termed the 'working poor'. High wages in the modern sector date from the colonial period;¹ that they were maintained after independence in spite of excess supply, requires explanation. Unlike in Tanzania, the government is not a wage leader and minimum wage orders have followed the market rather than established a floor. Firms' ability to pay seems to be the most important variable.² The willingness to pay is usually there: firms want to reduce turnover,³ to maintain a good corporate image and to avoid costly battles in the Industrial Court; the ability to pay is there if the wage bill (other than for skilled labour) represents a small fraction of total costs and if the firm is an oligopolist, protected from foreign competition. Modern sector wages were not reduced by excess labour supply in the period reviewed in the ILO report, but real urban wages have fallen since 1972. In appendix 1 we argue that this fall does not indicate responsiveness of wages to market forces but rather the effect of deliberate government policy, the aim of which was not to reduce excess labour supply. Rationing of jobs on the basis of educational qualification certainly is a feature of the Kenya labour market and this is reflected in the model. The ILO's view of the informal sector is by now however outdated. Recent data indicate that only a small part of the sector consists of poor people; that the sector caters largely for final demand, rather than producing inputs for the formal sector; that many of the self employed are in no sense frustrated job seekers but have on the contrary gained access to wage employment and left it after accumulating savings to start their business. Most importantly, our data for 1974 indicate that only a very small percentage of urban households can

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1. at the higher levels because those jobs were held by Europeans; for unskilled labour because of the problem of circulatory migration: migrants would accept employment for only a short time and then return to the land. Since they did not have a legal title to it the present value of this land was much higher than what they could sell it for. This made the circulatory pattern necessary and rational. Cf. Elkan, (1973). Employers tries to reduce labour turnover by raising wages.
 2. House and Rempel (1976), Gray (1977), pp. 27-31.
 3. which is high. cf. Collier and Lal, (1979), p.45.

be classified as poor.^{1.}

What perhaps concerned observers in the early 1970s most was rural-to-urban migration. If the high rate of migration and the low rate of urban wage employment growth observed in the 1960s were to continue this would imply a growing problem of urban poverty. Our model presents a very different picture. There are four reasons for this. First, underlying the view that if migrants are not employed in the modern sector they will stay in urban centres (either in unemployment or in the informal sector) is the rural-urban dichotomy of the Harris-Todaro model.^{2.} But (again: unlike in Tanzania) migrants in Kenya maintain strong rural ties;^{3.} this means that return migration is easy. Our data for 1969-77 indicate that migration has fallen dramatically, to a large extent because of substantial out-migration.^{4.} Secondly, the ILO saw the stagnation of urban wage employment in the late 1960s as a trend but it has grown rapidly since that time thereby making the absorption of the immigration that did occur easier, while real wages fell thereby discouraging immigration. Thirdly, both reports were pessimistic about the growth of agricultural employment. Intensification and switches in product mix towards more labour intensive crops have however rapidly increased the labour requirements of smallholdings.^{5.} Finally,

1. Appendix 3.

2. Harris and Todaro (1970).

3. Whitelaw (1971) found that 84% of heads of households in Nairobi owned land; migrants often leave part of their household on the land, returning at times of peak labour requirements, Weisner(1969); remittances to rural areas represent a very high share (about 20%) of urban incomes, Whitelaw (1971), Johnson and Whitelaw (1974). The maintaining of rural ties is facilitated by the fact that a large part of migrants into Nairobi come from nearby districts, see Rempel, Harris and Todaro (1970). Elkan (1973) sees the strength of the rural ties as a reason for answering the question of his title (Is a proletariat emerging in Nairobi?) in the negative.

4. Appendix 2.

5. See Gwyer (1972) for a discussion of the effect of the adoption of coffee, tea, pyrethrum, cotton and livestock on labour intensity. Collier and Lal (1979), p.112 and appendix 1 estimate that in Central province in the period 1963-1973 labour use would have increased by 29% (keeping the land area constant) because of changes in product mix.

what the traditional view of migration ignores is the benefit of the process for smallholders. In Kenya, the incomes of migrants provide an important supplement to smallholders' incomes. In addition, evidence from the 1974/75 rural survey (IRS) indicates that non farm income plays an important role in enabling smallholders to innovate by removing a financial constraint.¹.

1. Appendix 8.

6.2. Other Models

Before giving a simplified description of our own model (section 6.3) three other recent models of the Kenyan economy¹ will be briefly discussed in this section. Of these, the World Bank's model is basically a traditional one-sector, two-gap model. This is not immediately clear from the description. First, the model has twelve sectors, but this disaggregation is used only for output, employment and investment: the input-output framework is not used so that consistency of supply and demand at the sectoral level can not be guaranteed. This is the more serious since the model is used for experiments in which the 'pattern of growth' is changed: output levels are raised (exogenously) in some sectors and reduced in others. Since the model does not disaggregate demand, the question as to how excess supply or demand (which would result from the output changes) are eliminated can not be answered: consistency is required only at the aggregate (i.e. one-sector) level. Secondly, the author claims that he has extended the traditional two-gap model (p. 89) by bringing prices into the model: price changes would ensure the equality of the trade and savings gaps (p. 97). This would be true if (at least) consumption demand were price elastic and if the model solved for a price level which would equate ex ante and ex post consumption. But in fact consumption is simply derived as a residual. Price changes are thrown in as a symptom of disequilibrium but - since they have neither income nor substitution effects - play no equilibrating role, hence in no sense can prices be said to ensure the equalisation of the two gaps. The model's structure is very simple: output and exports are exogenous, investment is derived from output growth (using

1. World Bank (1975), pp. 86-159; Slater et al. (1977); Bigsten (1978). The ILO's BACHUE - Kenya model is not yet completed; cf. ILO (1979) pp. 46-48 and Rodgers and Anker (1978).

Cobb-Douglas production functions and an exogenous factor price ratio), imports are a function of output and investment and consumption is residual. Feasibility of the results is judged outside the model: by comparing ex ante and ex post consumption and by comparing the resource deficits with forecasts of the availability of foreign savings. The beneficial effects of government policies which lower the wage-rental ratio are emphasised; these results are suspect not only because of the high substitution elasticities implicit in the Cobb-Douglas specification but especially because the production functions apply to the whole economy, implying that it is as easy for the government to affect factor proportions in smallholder agriculture and in the urban informal sector as it is in the modern sector.

The model has little to say about labour markets or distributional issues. Within each sector, formal and informal employment grow at the same rate;^{1.} there is no unemployment or migration; and the only distributional indicator is a 'poverty index', which is the ratio of (exogenous) GDP in agriculture and a residual of the labour force (which accounts for 86% of the total).^{2.} Finally, the link between output and consumption, via employment, factor prices and personal incomes, is modeled in a way which defies comprehension.^{3.}

The other two models are more sophisticated. Both are input-output models in which output is determined by demand. Both models are - unlike the World

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1. this is especially curious since in the rest of the report a concern is repeatedly expressed about the rapid growth of the informal sector and the slow growth of modern sector employment.
 2. p. 149, column 1. The residual is derived as the difference between the labour force and non-agricultural employment.
 3. two examples. First, if high wage sectors were to grow at the expense of low wage sectors leaving total monetary GDP unchanged, then (in spite of the increase in the wage bill) ex ante consumption remains unaffected. Secondly, on p. 153 (last two parts of table 23) two runs are compared in one of which labour productivity is kept constant. This results in a 60% increase in wage employment. One would expect such a change (with factor prices remaining the same) to have dramatic macro-economic consequences. In fact it has no effects whatsoever: absorption of more than half a million people in the modern sector does not even affect private consumption (either ex ante or ex post): only

Bank model - genuine multi-sector models in which equality of supply and demand for each sector is ensured. Equilibrium in that sense is however achieved exclusively through quantity adjustments: changes in supply and demand do not affect prices.¹ We have four objections to the specification of the KENSIM (Slater et al.) model. First, it ignores Kenya's protectionism: there are no import controls so that if output exceeds capacity (as determined by investment) then the difference is eliminated by imports. Secondly, there is no guarantee that there are no imports of non-tradeables. Thirdly, investment in this model always reduces the labour-output ratio.² Finally, income distribution is modelled very crudely: neither rural nor urban incomes are affected by labour supply and the number of people within a given income class is related by fixed coefficients to output levels. This specification is, as far as earners is concerned, at most credible for modern sector wage employment.

The focus of Bigsten's study is regional inequality and its great merit is the estimation of a large number of socio-economic variables at the level of provinces.³ His input-output model is also disaggregated by province. The basic model is similar to KENSIM in being demand-driven but differs from that model in having an exogenous investment rate: investment is not related to savings and there is no foreign exchange constraint.⁴ While Bigsten recognises this as a weakness, he seems to think that it does not matter greatly as far

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1. Bigsten's model is expressed in constant prices while Slater et al. use Leontief pricing.
 2. The coefficients giving employment and intermediate inputs per unit of output change over time, the ratio of the present and the preceding year's value being a linear function of investment in the sector in the present year. Apart from consistency problems - there is no guarantee that the coefficients in an IO column continue to sum to one - this implies a curious production function whereby the capital-output ratio remains constant.
 3. see also Bigsten (1977).
 4. the results for the period 1971-76 are not very encouraging; even if demand components are given their actual values, the model generates a GDP growth rate of 3% for a period when the actual rate was 5%. Imports are overestimated

regional inequality is concerned.¹ Our own results suggest however that trade policies and foreign exchange availability - through their effect on prices - not only strongly influence rural incomes but also that there are considerable inter-provincial differences in these effects. Non-marketed agricultural output is treated as if produced in a separate sector, the growth of which is determined by the size of the rural population.² Agricultural growth does not affect exports (although these consist largely of agricultural commodities). The model inevitably reproduces the ILO report's prediction of slow growth in formal sector and rapid growth in informal sector employment: the former is related to output by coefficients which decline over time (at an exogenous labour productivity growth rate), while the latter is related to modern sector output by a fixed coefficient. Migration is related to employment in the receiving region but not to income; the equation generates massive migration into Nairobi for a period (1971-76) for which we estimate migration to have fallen dramatically.³ Finally, Bigsten does not derive personal incomes; his inequality measures are based on a comparison of regional per capita monetary GDP variables. This has the curious implication that Coast is considered to be almost twice as rich a province as Central (p. 263), while the vast majority of the population in Coast province are smallholders whose incomes are much lower than those in Central province.

In the next section we will give a short outline of our own model. The main

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1. some of the resulting errors are extremely large, e.g. for 1976 the model gives, instead of a current account surplus of K£28.2 million, a deficit of K£83.2 million (p.359).
 2. Bigsten recognises that smallholders do produce for the market but he makes virtually no use of the IRS data which allow one to model smallholder production (see section 7.2 and appendix 8 below) and since he ignores prices he can not explain the distribution of smallholder production between marketed output and own consumption.
 3. appendix 3 below.

differences from the three models considered here are: (a) output is not determined by demand alone: supply factors (land, labour, capital) matter, (b) the effect of trade policies on output and prices is considered, (c) prices are determined by supply and demand, (d) smallholder incomes are endogenously determined, (e) the effects of changes in supply and demand (in both the formal and the informal sector labour market) on the distribution of urban household incomes is modelled.

6.3. The Model

The model is a dynamic simulation model in which output, prices and incomes are determined endogenously. It has four distinctive features. First, it is an input-output based model in which the 'consumption loop' is closed: production affects incomes, incomes expenditures and expenditures output levels. Secondly, its focus is on the effects of growth on poverty and it therefore treats the largest group of poor people - smallholders - in considerable detail. Thirdly, while it includes the main elements of a general equilibrium model - utility maximization determines consumption; output in agriculture and in manufacturing is given by profit maximization; prices are related to excess demand - it has a number of non-neoclassical features. Some product prices, notably food prices, are controlled and in these cases, equilibrium is achieved through quantity adjustments (international trade) rather than through price adjustments; wages are not market clearing; the distribution of land is fixed; opportunities for agricultural innovation differ between smallholders, reflecting imperfections in rural financial markets. Finally, it is designed as a tool for policy experiments, rather than as a projection model.

The model is fairly disaggregated. There are:

- 12 sectors: agriculture (food), agriculture (non food), mining, manufacturing (food), manufacturing (non food), electricity and water supply, construction, trade, transport, ownership of dwellings, government, other services.
- 8 agricultural products: maize, other food crops, coffee, tea, sugarcane, cotton, cashew and coconuts, livestock products.

- 48 groups of smallholders : eight size of holding classes in each of six provinces.
- 7 groups of urban workers : modern sector employees (four skills), self-employed (two income groups), unemployed.
- 8 groups of urban households, defined by occupation of the head of household.
- 3 levels of educational attainment of urban workers.

Smallholders' incomes from farming are a function of five variables :

(a) land availability, (b) producer prices, (c) rural wages, (d) productivity growth (exogenous), (e) product mix. A production function relates output to land and labour and the model solves for profit maximizing levels of output and employment. The land area available to smallholders is exogenous, but not necessarily constant: in one of the simulation runs we model land redistribution as a transfer of land from large farms to smallholdings. Population growth reduces farm sizes; this induces more intensive cultivation and contributes significantly to the growth of agricultural output. Given total labour use, the demand for hired labour depends on the availability of family labour for farm work. As non farm employment opportunities increase, this implies : an increase in the use of hired labour on smallholdings, a rise in the incomes of households with surplus family labour and increasing costs for other smallholders. While smallholders' farm incomes are, in good neoclassical fashion, determined by their endowments (of land and of family labour) these factors can not be said to explain the rural income distribution in the model since smallholders derive only 56% of their income from farming. Three sources of non farm income are considered : wage employment (on other smallholdings, on large farms, or outside agriculture); non farm

enterprises (the growth of which depends on income growth in the province); and remittances (a function of the level and distribution of urban incomes). As access to nonfarm income, the extent of agricultural innovation (as reflected in the product mix) and land availability differ between provinces, the model gives some indication of regional inequality and its development over time. The considerable intra- and inter-provincial differences in the distribution of non farm income are in fact the justification for the disaggregation by province in the model. The product mix is partly endogenous: the adoption of coffee and of livestock is a function of the smallholder's non farm income (either because it enables him to self finance the innovation or because it is an income source which gives him access to loans in an imperfect financial market in which such access is used as a rationing device). Government policies affect smallholders in three ways: through their effect on producer prices, on the distribution of land and on the location of non agricultural employment. Finally, consumption functions determine how much of food output is retained for own consumption; hence prices do not only affect total output but also the share of marketed output in the total.

For large farms the model is simpler. Output is a function of prices and wages only (with elasticities the same as those implied by the smallholder production functions). Intensification as a result of population growth plays no role here (although land availability does matter : output is, of course, reduced if land is redistributed to smallholders). All of the large farm production is assumed to be marketed.

For manufacturing we use a (CES) production function in capital and labour. With the capital stock predetermined by past investment, profit maximization

gives output and employment as a function of prices and the wage rate.

In the services sectors, investment determines capacity, but output may differ from this, depending on product prices and on costs. Hence, output depends on prices in all sectors.^{1.}

For each sector the model generates the four components of domestic demand : private consumption (related to prices and the level and distribution of incomes by (rural and urban) consumption functions), public consumption (exogenous), intermediate demand (linked to output levels by input-output coefficients) and investment demand.^{2.} The market must clear for each of the twelve sectors and this is achieved either through changes in prices or through international trade. In this respect the model's specification differs by sector :

- for two sectors - agriculture (food) and manufacturing (food) - there is no scope for price adjustments; domestic food prices are controlled and imports are derived residually so that excess demand is eliminated.
- for agriculture (non food) and for mining, domestic prices follow world prices and the market is cleared by exporting whatever is left of production after domestic demand is satisfied. This ensures consistency of e.g. coffee output and coffee exports.
- services are treated as non tradeables : market clearing is achieved through price changes rather than through trade.
- for manufacturing (non food) - by far the most important sector in terms of imports - we use different specifications, reflecting different trade policies. In the 'closed economy' version the sector is protected. Imports

1. The exception is mining, but this sector is very small.

2. Total investment is endogenous; its distribution by sector of source depends on the distribution by destination.

are linked to consumption and investment (by coefficients which may change over time if import controls are relaxed or tightened) and given this level of imports the burden of adjustments rests on the price level. In the 'open economy' version however the domestic price is tied to the world price and imports are not controlled but allowed to clear the market.

Only exports of services are exogenous : exports of goods are either residual (agriculture (non food) and mining) or a function of output (manufacturing). Imports are always endogenous and are either given as a function of demand (services and manufacturing in the 'closed economy' version) or residual.

Apart from productivity growth, population growth and innovation in agriculture and the effects of pricing and trade policies, economic growth is determined by investment. We do not model the supply and demand for investible funds, but derive domestic savings directly as the difference between output and consumption. To this foreign savings (exogenous) are added to arrive at total investment. The allocation of this total between sectors is fixed, so that rates of return may differ, even in the long run.

The introduction of a foreign exchange constraint into the model (note that with foreign savings given the resource deficit is predetermined) implies that, in each period, the model has to solve for a set of output, trade and price levels which satisfies both internal and external equilibrium: internal equilibrium in the sense that all material balances are satisfied : there is no excess demand or supply; external equilibrium in the sense that the aggregate difference between imports and exports implied by those balances equals the predetermined resource deficit. We use an iterative procedure to ensure this, iterating on prices and on the level of investment.

The model differs fundamentally (as do all price endogenous models) from those models in the 'two gap' tradition, in which the equality of the savings and trade gaps is ensured by making either consumption or imports residual. In this model - while investment is residual and hence always equal to savings - satisfying the foreign exchange constraint will in general require price adjustments. While two gap models describe a disequilibrium situation (reconciling the two gaps at fixed prices implies a solution which does not lie on agents' demand curves), here the issue does not arise because prices change until equilibrium is reached.

Urban incomes are largely determined, directly or indirectly, in the market for formal sector employment. This market is not in equilibrium : nominal wages are fixed at levels which do not clear the market. Labour demand is linked to output, by fixed coefficients in the case of services but as a function of wages (consistent with the production function) in the case of manufacturing. While wages are fixed for each skill category, there are differentials between sectors and sectors also differ in the skill composition of their labour force. As long as there is excess supply, the size distribution of wages is determined entirely by demand and depends on wage levels, wage differentials, the sectoral composition of output and the composition of each sector's demand in terms of skills. Hence the rationing to which excess supply gives rise can not affect the size distribution; but it does affect the distribution of income between households. This distribution is derived by taking into account that in Kenya rationing is mainly based on educational criteria. The groups of households which we distinguish in the model have different endowments in terms of the number of household members at each level of education. Since employment probabilities (for a job of a given skill and hence income level) depend on one's

educational qualification, this provides a link between the household and the size distribution of income. This has important implications for the time path of urban inequality; e.g. in this 'bumping model' reduced employment will affect educationally poorly endowed households - who may lose all access to modern sector employment - more than those with better qualified household members - who may only be forced to accept lower skill jobs; to the extent that household incomes are correlated with educational endowments, this would increase inequality.

Wage employment is not the only source of urban incomes. We distinguish two groups of self employed. One group is involved in activities where skill and capital requirements pose barriers to entry which protect incomes. Others work in a free-entry sector. Here, demand for total output is given - by the consumption functions - but this output may be produced by different numbers of self employed and hence at different income levels. All labour force members who have not succeeded in getting a modern sector wage job or in gaining entry into the elite of high income self employed compete in this sector. The model solves for such a distribution of this group between low income self employed and open unemployment that expected incomes are equalized, taking into account that the unemployed can more easily engage in the search for a modern sector wage job and therefore have a higher employment probability.

There are three important links between the urban and the rural economy. First, agriculture produces a surplus which feeds urban households and frees foreign exchange for the financing of the growth of the urban sectors. Secondly, the model includes a migration equation of the Harris-Todaro type.

However, migration is a less important phenomenon than in most other models, both because the initial level of migration is very low compared to the size of the urban labour force and because the elasticity of migration with respect to relative income changes is very high, so that, in the first few years of the projection period (when as a result of the coffee boom the rural-urban income gap narrows) migration is reduced even further. Finally, urban incomes are the source of remittances to smallholders and thereby, do not only supplement rural incomes but also, indirectly, finance agricultural innovation. It is noteworthy that urban demand does not affect the prices received by farmers for food crops: food prices are controlled (except in one simulation run in which food products are treated as non tradeable and prices are determined by domestic demand and supply). As a result, the rural/urban terms of trade are less volatile than in models which impose self sufficiency in food.

The coverage of the model is economy-wide for the 'monetary economy'; the coverage of subsistence output is restricted to that of the Integrated Rural Survey 1974/75 (IRS). This excludes pastoralists, smallholders in large farm areas and Northeastern province. The model's parameters are based on the national accounts, the 1971 input-output table, the IRS, the 1974 urban Household Budget Survey and various demographic surveys. Time series were used to estimate capital-output ratios and the production function in manufacturing, while the consumption functions, the agricultural production functions and the functions determining innovation by smallholders are based on cross-section regressions. Most other parameters are based on single observations, while estimates for the supply elasticities of the services sectors and of smallholder output were derived by comparing the model's results for the beginning of the projection period with actual data.

VII THE KENYA MODEL

7.1. INTRODUCTION

We concluded the previous chapter with a simplified description of the Kenya model. This chapter is devoted to a detailed description.

The chapter is organised as follows. Sections 7.2 and 7.3 describe the treatment of agriculture and of the rural income distribution in the model. We consider the effects of population growth, producer prices, rural wages and land distribution on agricultural output and employment; the contribution of non-farm income to household income and its effect on product mix; and the determinants of the demand for hired labour on smallholdings. The next section (7.4) describes the combination of quantity and price adjustments which in the model ensures the equality of supply and demand for each sector. For most sectors, both supply and demand are a function of prices and the model solves for market clearing prices. The determinants of imports and exports are also discussed in this section. In section 7.5 we describe the effects of the foreign exchange constraint on the solution; the relation between investment and output levels; and employment in the formal sector. Equations which determine urban incomes and the distribution of the labour force over wage employment, self-employment and unemployment are the subject of section 7.6. Here, the bumping-model is used to link the household to the size distribution of income, given households' educational endowments. In the next section we discuss the consumption functions for rural and urban households and the implications for that part of agricultural output which is marketed, rather than used for subsistence consumption. Some miscellaneous equations, including those regarding two important rural-urban links (migration and remittances), are given in section 7.8. Finally, in section 7.9 the model is summarized with the aid of a simplified flow chart. A list of symbols is given at the end of the chapter.

7.2. SMALLHOLDERS

In the model we distinguish between smallholdings¹ according to province (6 provinces) and size of holding (8 farm sizes); there are 48 groups of smallholder households. In 1975 these accounted for 10.3 million people, i.e. the vast majority of the Kenya population.

Incomes are determined by the size of the holding, the product mix, producer prices, the wage rate and access to non-farm income.

Farm output is given by a Cobb-Douglas production function with land and labour as factors:

$$(7.2.1) F_{ij} = A_j L_{ij}^{\alpha_j} N_{ij}^{\beta_j} \quad (i: \text{farm size}, j: \text{province})$$

where F is output at constant prices (crops only), L is the size of holding and N total (family and hired) labour use. If the wage rate for hired labour (w) is an adequate proxy for the opportunity cost of family labour and assuming profit maximization, this reduces to

$$(7.2.2) F_{ij} = A_j^{1/(1-\beta_j)} (\beta_j p_j / w_j)^{\beta_j/(1-\beta_j)} L_{ij}^{\alpha_j/(1-\beta_j)}$$

where p_j is the producer price. The IRS data indicate a strong inverse relationship between land productivity and farm size: for all provinces the cross-section regressions give an estimated value of the elasticity $\alpha_j/(1-\beta_j)$ far below unity.² The low value of this elasticity has two important implications. First, there will be a strong production (and employment) response to land redistribution in the model and, secondly, population growth (to the extent that it reduces farm size) will raise productivity. Note that, within a province, all farms are assumed to face the same prices (p and w);

¹. The concept of smallholding is that of the Integrated Rural Survey 1974-1975 (IRS 1). This excludes (a) North-eastern province (b) the landless and holdings larger than 20 ha. (c) smallholdings in the former scheduled areas which are still designated as large farm areas in spite of significant subdivision; as a result the coverage of smallholdings in Eastern, Coast and Rift Valley provinces is only partial. Cf. Kenya (1977), Chapter 3.

². The results by province are: .36 (Central), .40 (Coast), .27 (Eastern), .37 (Nyanza), .34 (Rift Valley), .33 (Western). Cf. Appendix 8.

hence, of the three explanations of the phenomenon of land productivity declining with farm size,¹ we allow for two.

If total labour use (as determined by the production function and profit maximization) exceeds the supply of family labour, the residual is assumed to be hired. The supply of family labour (for crops) is a function of household size, off-farm employment and the use of family labour for livestock. Hence,

$$(7.2.3) \quad N_{ij}^F = \begin{cases} N_{ij} & \text{if } N_{ij} \leq \alpha_j H_{ij} - \bar{N}_{ij}^F \\ \alpha_j H_{ij} - \bar{N}_{ij}^F & \text{otherwise} \end{cases}$$

$$(7.2.4) \quad N_{ij}^H = \max \{0, N_{ij} - N_{ij}^F\}$$

where N^F and N^H are family and hired labour use for crops, $\bar{N}^F$ is family labour use for livestock, H is household size and α measures the supply of labour for on-farm work per household member. This coefficient changes over time with off-farm employment. Since ownership of livestock is only weakly correlated with farm size and household size is not constant, hired and family labour use cannot be written as a function of land availability alone.²

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1. The low value of the elasticity may reflect both diseconomies of scale and the fact that, on the larger farms, land is not only held as a productive asset but also as e.g. an inflation hedge. The reasons advanced by Griffin and others for the possibility that farmers with different sizes of holding face different prices are unlikely to be very important if the comparison is between smallholdings with one exception: the cost of borrowing. However, capital plays no role in (7.2.1). Regarding changes in product mix (which is the most important form of investment for smallholders) the model does take capital market imperfections into account.
Cf. Sen (1966), Warriner (1969), Griffin (1969, 1972), Bardhan (1973).
 2. In this respect our formulation differs from that used by Collier and Lal (1979) in their analysis of labour use in Central province. They relate family and hired labour use per acre by constant (but different) elasticities to per capita land availability (L_{ij}/H_{ij}). That specification is not consistent with any reasonable production function.

We now have to consider the product mix. The model distinguishes seven crops: maize (the staple food), other food crops, coffee (the most important export crop), tea, sugarcane, cotton and coco or cashew nuts (important only in Coast province). As one would expect land use differs greatly between provinces (see table 7.2.1).¹

Table 7.2.1: Smallholder Land Use 1974/75

(thousands of ha.)

<u>Crop</u>	<u>Province</u>					
	<u>Central</u>	<u>Coast</u>	<u>Eastern</u>	<u>Nyanza</u>	<u>Rift Valley</u>	<u>Western</u>
Maize	359	121	495	343	126	254
Other food	506	87	821	342	27	300
<u>Total food crops</u>	865	208	1316	685	153	554
Coffee	50	-	68	15	-	1
Tea	60	-	12	6	6	2
Sugar	5	1	11	47	1	8
Cotton	-	1	25	28	2	22
Coco/Cashew	-	106	-	-	-	-
<u>Total Industrial crops</u>	115	109	116	96	9	33
<u>Grand Total:</u>	980	317	1432	781	162	587

-
1. From IRS, Kenya (1977), p. 79. The table involves double-counting in two senses: (a) pure and mixed stands are added together (b) areas planted in both long and short rains are counted twice. Since for the model only the proportions matter, this double counting is not serious as long as the effect of the two factors does not change over time. Areas under industrial crops other than the five listed have been distributed proportionately over these five. These areas represent less than 1½% of the total crop area of smallholders.

While (7.2.2) relates (aggregate) output to an (average) real price index and (total) land availability we now use that equation in the form:

$$(7.2.5) \quad F_{ijk}/F_{ijk}^o = (p_k/w_j)^{\epsilon_k^p} (L_{ijk}/L_{ijk}^o)^{\epsilon_j^l} \quad (i: \text{farm size}; j: \text{province}; k: \text{product})$$

where the superscript o denotes the baseyear and ϵ^p, ϵ^l are the elasticities with respect to the real price and to the area under the crop.¹ Hence production is a function of ~~four~~^{three} variables:

- producer prices (p), which are subject to government control and hence exogenous in the model.
- land availability and distribution (L_{ij}), which is endogenous to the extent that population growth reduces farm sizes in the model, but exogenous otherwise (in one of the simulation runs we experiment with land redistribution).
- product mix, which is partly exogenous (e.g. we impose the expansion of the area under tea envisaged in the Plan), partly endogenous (the adoption of coffee is a function of non-farm income, see below).

1. At this stage data limitations are severe. First, we have data on labour use by province, but not by size of holdings (N_{ij}). The production functions could therefore not be estimated in the form (7.2.1) but only as (7.2.2). Since farmers are assumed to face the same prices, the regression equation was of the form

$$\ln F_{ij} = a_j + b_j L_{ij}$$

This gives an estimate of the (aggregate) elasticity

$$\epsilon_j^l = \alpha_j / (1 - \beta_j)$$

but (since we do not assume constant returns to scale) it does not give α_j and β_j separately. Secondly, we do not have crop-specific data on F_{ijk} and L_{ijk} to repeat this regression for each of the crops. We therefore assume in (7.2.5) that the effect of land (the elasticity ϵ_j^l) is the same for all crops. There is clearly an aggregation problem: Cobb-Douglas functions for crops do not imply a Cobb-Douglas function for the aggregate. Thirdly, there are no data on land use by size of holding; we only have the provincial means of table (7.2.1). Fortunately this limitation proved not too serious, since we can correct for the most important difference between smallholders in land use: the extent of adoption of the two leading cash crops: coffee and tea. Unpublished IRS data give the number of coffee and tea trees per holding. Using the provincial means we have converted these data to the corresponding land areas. The rest of the holding is assumed to be allocated between crops in the same proportions as the province mean. Finally, we used published production data for 1975, 1976 and 1977 to arrive at estimates for the supply elasticities ϵ_k^p .

Changes in product mix also affect labour use. Profit maximization implies:

$$(7.2.6) \quad N_{ijk}/N_{ijk}^0 = \beta_k (p_k/w_j) (F_{ijk}/F_{ijk}^0)$$

where β_k is given by $\beta_k = p_k / (1 - \beta_k)$. The value of N_{ij} to be used in (7.2.3) and (7.2.4) then is the sum $\sum_k N_{ijk}$.¹

For livestock production and employment we use fixed technical coefficients:

$$(7.2.7) \quad \bar{F}_{ij} = c_1 L_{ce}$$

$$(7.2.8) \quad \bar{N}_{ij}^F = c_2 L_{ce}$$

$$(7.2.9) \quad \bar{N}_{ij}^H = c_3 L_{ce}$$

where $\bar{F}$ is production (milk and beef consumed or sold; net sales of stock) in constant prices; $\bar{N}^F(\bar{N}^H)$ is family (hired) labour use and the herd (L_{ce}) is measured in cattle equivalents.²

Having arrived at total farm production ($\sum_k F_{ijk} + \bar{F}_{ij}$) still leaves us two steps removed from smallholder household incomes; we have to allow for farm costs and for non farm income. Table 7.2.2 illustrates the relative importance of the three components of household incomes in 1974/75.

¹ Again, we do not have data on N_{ijk}^0 . But we construct those by imposing that for each province the ratios between products of mean labour use per acre (taking the land distribution into account), should be the same as those which can be derived from the Nyeri District Survey, Kenya (1968), tables 5, 44 and 45. To ensure consistency with our concept of crop area we have added long and short rain averages.

² Cf. Appendix 8. The coefficients c_2, c_3 are in fact not strictly constant. We take into account that labour requirements are considerably higher for improved stock.

Table 7.2.2: Sources of Smallholder Income(Ksh/year)Province

	<u>Central</u>	<u>Coast</u>	<u>Eastern</u>	<u>Nyanza</u>	<u>Rift Valley</u>	<u>Western</u>
1. Value of production ¹	3171	1271	3115	2270	3676	1482
Sales of crops	780	170	758	1186	590	311
Sales of livestock	711	379	576	2	1316	239
Farm costs in kind ³	150	52	114	40	85	36
Own consumption	1530	670	1667	1047	1686	896
2. Farm costs ⁴	1019	392	576	314	950	335
Crops	516	107	359	187	423	169
Livestock	257	26	47	15	217	31
Labour	246	259	170	112	310	135
3. Non farm income	2122	2495	1574	1123	1491	1307
Non farm enterprises	326	626	491	365	303	126
Wages	1286	923	721	523	931	724
Remittances ²	510	946	362	235	257	457
Household income	4274	3374	4113	3079	4217	2454

Regarding farm costs, hired labour use (N^H and $\bar{N}^H$) and the wage rate ^{5.} give the wage bill. The other two components of farm costs are in the model linked to the level of production (F and $\bar{F}$) by fixed coefficients which differ

1. Excludes valuation changes.

2. Includes 'other gifts'.

3. Output used as seed, fed to stock or given to labour.

4. 'Farm repairs' is included under crops.

5. wage control affects large farms but not smallholdings. For hired labour on smallholdings we assume that the wage rate is constant in terms of food prices; cf. appendix 8.

between smallholder groups (i.e. by province and size of holding).^{1.}

More interesting and important is the role of non farm income in the model. First, it clearly makes a very significant contribution to household income (the national average is 44%). The usual identification in models of rural income with farm income would in the case of Kenya be extremely misleading. Secondly, its distribution is such that inter-province income inequality is reduced: with the notable exception of Central Province, the ratio of non farm to farm income declines ^{as} with the level of farm income. ^{rises} Thirdly, the source of this income is largely urban. Trading and home crafts are the most important non farm enterprises and demand in those cases is largely rural based, but then this represents only a fairly small part of non farm income. Remittances are sent by rural-to-urban migrants. Some of the wage income will originate within the smallholder sector but this can explain only a small part of the total; the rest comes from modern sector employment (large farms plus non-agricultural activities).^{2.}

In the model the distribution (over provinces ^{3.} and farm size groups) of these three components of non farm income (wages, remittances and income from non farm enterprises) is kept constant, but the size of these flows is endogenous:

1. this is crude, especially for crops where one would like to capture the effect on farm costs of changes in product mix. The cost data are however not disaggregated by crop.
2. Casley and Marchant (1978) suggest that for Western Kenya (where wages are the most important source of non farm income) it is probable that these are derived from working on the large commercial tea and sugar estates (p. 17). However, wage income in this area was K£23M. while earnings in 'agriculture and forestry' in Western, Nyanza and Rift Valley provinces combined in 1974 were only K£16M. in 1974 (Kenya (1976), table 29). Smallholders cannot have been the only source of labour supply, nor can the tea and sugar estates account for all of the wage bill. Hence, even in Western Kenya, smallholders derive their wage income to a significant extent from non-agricultural employment.
3. Except for wages, where the distribution over provinces changes endogenously over time with the sectoral composition of (modern sector) output.

(a) Wages. The major part of wage incomes is earned in the modern sector. The model determines modern sector wage employment (including large farm employment) by province; its distribution over smallholder groups within a province (i.e. by size of holding) remains constant. Hence in assigning jobs to households we do not take into account whether a household is in a surplus labour situation or hires labour for on farm work. Implicitly we assume that a smallholder upon taking up off-farm employment substitutes hired labour for his own work on the holding. This is rational since wages in the modern sector are higher (cf. appendix 8). For households with surplus labour, income from working on other smallholdings is added to wages from employment in the modern sector.¹

(b) Remittances grow with urban incomes (see section 7.8) and depend on the urban income distribution (the percentage of household income remitted by urban households falls with income). Growth of the non-agricultural sectors of the economy therefore affects smallholders in two ways: first, directly, by creating rural employment opportunities, and secondly, indirectly, by raising urban incomes and thereby remittances.

(c) Income from non farm enterprises. This income is mainly derived from trading, simple processing of local raw materials and from 'traditional services',² activities which presumably serve mainly a local market. In the model, therefore, non farm income is related to total smallholder income for each province (and grows at the same rate). Non farm income does not only

1. The distribution of the two types of employment over smallholder groups is derived from employment data for 1974 and IRS data for 1974/75 by (a) distributing modern sector jobs in proportion to total wage income (i.e. dividing wage income by mean modern sector wages) for deficit labour households and (b) assuming that for surplus labour households the share of modern sector wage income in total wage income does not differ between household groups.

2. A detailed analysis is given in Kenya (1977c).

supplement farm income; in the model it also affects product mix. Several students of the IRS data have noted that innovation (shifts from the traditional food crops to coffee, tea and livestock) seem to be related to access to non farm income.¹ In all three cases, innovation implies a substantial investment (in the case of the tree crops there is an output lag of several years and hence, in addition to the initial outlay on the trees, a considerable opportunity cost of land in terms of food output foregone). To the extent that access to loans will be biased in favour of those smallholders who have risk-free sources of income, one would indeed expect a correlation between non farm income and the adoption of livestock, coffee and tea. The evidence however is mixed.

In the case of livestock there is a correlation only for three provinces: Central, Nyanza and Western. For these provinces:²

$$(7.2.10) L_{ce\ ij} = a_j + b_j Y_{ij}^{NF} \quad (j = 1, 4, 6)$$

where L_{ce} is the number of cattle and Y^{NF} non farm income (in constant prices) per household.

Coffee is important only in Central and Eastern provinces. We use a linear relation:

$$(7.2.11) T_{ij}^c = c_j + d_j Y_{ij}^{NF} \quad (j = 1, 3)$$

where T^c is the number of coffee trees ~~and L the land area under crops~~.³

Finally, for tea there is no correlation at all:⁴ changes in the area

1. Casley and Marchant (1978), Collier and Lal (1979).

2. Regression results are given in appendix 8.

3. When the area under coffee increases, the area under other crops is reduced proportionately. For land under coffee, the number of trees per acre remains constant.

4. In the work of Collier and Lal and of Casley and Marchant this is obscured by aggregation. Collier and Lal measure innovation through a composite variable involving livestock, coffee and tea while Casley and Marchant look at all export crops taken together.

under tea are entirely exogenous in the model. In summary, non farm income affects livestock production in the model for three provinces (together these accounted for 52% of livestock production in 1974/75) and coffee for two provinces (which in 1974/75 accounted for 86% of production).

7.3. Large Farms

Although the contribution of the large farm areas to agricultural production has declined,¹ they still account for some 25% of total and about half of marketed production. However, since our main interest is in distributional issues and the number of people in large farm areas is very much smaller than in smallholder areas, the treatment of the sector in the model is simple. The only effect modeled is that of changes in real product prices on production and employment. Production, land use and employment of smallholdings and large farms are compared in Table 7.3.1.²

We assume that the price elasticity of crop production (F_k^L) is the same as for smallholders (cf. 7.2.5):

$$(7.3.1) \quad F_k^L / F_k^{L_0} = (p_k / W) \epsilon_k^P$$

while for livestock, production is again given by fixed coefficients.³

All large farm production is assumed to be marketed. Smallholders' and large farm production are added (separately for non food/food products)

1. The share of smallholdings in marketed output quickly rose from 41% at Independence (1964) to 51% three years later. It has since fluctuated around the latter figure. Maitha (1976, p. 57) and Kenya (1978, p.97).
2. The two columns in the first part of the table are not strictly comparable due to differences in definition. Hence, parts A and B of the table are not to be used to compare land productivity.
3. Land availability and product mix are exogenous for large farms. They change (a) in 1976 when there was a significant shift of fallow land into food production and (b) in runs in which land is redistributed from large farms to smallholdings.

Table 7.3.1: Comparison of Large Farms and Smallholdings (1975)A: Land under crops (thousand of ha.)

	<u>Smallholdings</u>	<u>Large Farms</u>
Maize	1695	68
Other Food	2249	209
TOTAL FOOD	3944	277
Coffee	134	28
Tea	86	26
Sugar	73	32
Cotton	78	not available
Nuts	106	3
Sisal	-	74
Other	-	32
TOTAL NON FOOD	481	195
TOTAL CROPS	4425	472

B: Value of Production (KfM.)

Food crops	94.6	12.7
(sold)	23.3	12.7
(own use)	71.3	-
Non food crops	33.0	51.4
TOTAL CROPS	127.6	64.1
Livestock products	62.3	4.0
(sold)	32.1	4.0
(own consumption)	31.2	-
TOTAL PRODUCTION	190.0	68.1
(Of which: marketed)	88.4	68.1

C: Employment (thousands)

Farm population	10,310	
Hired Labour		184.5

and, after subtraction of that part of the smallholder food production which is consumed by the smallholder¹ and conversion to constant prices, this gives the two aggregates which are needed in the rest of the model: $X_{3(1)}$ and $X_{3(2)}$ (gross marketed agricultural output in constant prices; non food/food products). These two variables enter the material balances (equation (7.4.1) below). They do not affect prices - producer prices are tied to world prices for non food crops and controlled for food products - but they do affect imports and exports, which, for agriculture, are residual.

7.4. Market Equilibrium: Quantity and Price Adjustments

While in the long run investment, and its allocation over sectors, is the main mechanism for overcoming supply-demand imbalances, in the short run² the economy's flexibility is constrained in each sector: the capital stock cannot be changed. Equilibrium must then be ensured by changes in domestic prices, by international trade, or by a combination of the two.

In this context, equilibrium means that the material balance holds:

$$(7.4.1) \quad X_i = \sum_j A_{ij} X_j + C_i + G_i + IS_i + E_i - MF_i$$

where: X is gross output

A the input-output matrix³

C private consumption

G public consumption

IS investment (by sector of source)

E exports.

MF imports of final (consumer or capital) goods

-
1. Subsistence consumption is discussed below: section 7.7.
 2. i.e. within the model's period of one year.
 3. Restricted to intermediate inputs produced domestically. Imports of intermediate inputs are considered non-competitive and are treated separately. The matrix A is, as usual, in producer prices.

and all variables are expressed in constant (1972) domestic market prices.¹ We distinguish twelve sectors² for which (7.4.1) must hold; table 7.4.1 illustrates the differences between them in size and in the relative importance of the various demand components. At this level of aggregation all sectors are involved in international trade. We will, however, not treat all goods as tradeable.

We will call a sector's output tradeable if:

- (a) the price is not determined by domestic supply and demand but is pre-determined, either because the government controls it directly or because it is tied to world prices through fixed tariff rates.
- (b) excess demand is eliminated through quantity adjustments: international trade (either exports or imports) is residual.

In this sense, agriculture, mining and manufacturing (food) are treated as tradeables (see table 7.4.2); services (sectors 6 - 12) are treated as non tradeables.³ Sectors classified as non tradeable do of course engage in trade, but (net) international trade is not determined by domestic excess demand: the equality in (7.4.1) is satisfied through price, rather than quantity adjustments. Hence, for non tradeables domestic price levels are endogenously determined; the model solves for price levels which yield zero excess demand.

Exports of non factor services are exogenous, but exports of goods are not.

For agriculture (non food) - a sector which is dominated by two commodities: coffee and tea - and for mining⁴ exports are derived residually from the

1. Hence MF is valued at the c.i.f. price plus duties.

2. Together these constitute what in the National Accounts is called the monetary economy, subsistence consumption having been subtracted from agricultural output. Hence for sector 3 (2) - agriculture (food) - X refers to marketed output only. Value added coefficients are fixed hence GDP (at factor cost) is a linear function of the output levels X_i .

3. Manufacturing (non food) is an intermediate case, discussed below.

4. Together these accounted in 1971 for only 17% of exports, but in 1977 (through large increases in both the volume and price of coffee exports) the share had risen to 43% (in current prices).

material balance . Since there is no domestic final demand for these sectors, this amounts to specifying that, after intermediate demand is satisfied all output is exported. For manufacturing we do not attempt to explain the share of exports in production. In fact, we keep that share constant so that the distribution of production between the domestic and the external market does not change.

For non tradeables (and for tradeables if exports, rather than imports, are residual) we need an equation for imports of final goods (MF). Imports are linked to final demand components by (sector-specific) coefficients:

$$(7.4.2) \text{ MF}_i = \mu_i^C C_i + \mu_i^I IS_i$$

This specification implies an assumption on the operation of import controls: e.g. when applied to non food manufacturing,¹ (7.4.2) implies (a) that quota are set in relative rather than absolute terms and (b) that imports are distinguished by end-use (consumption vs. investment).² It further implies that constraints imposed by import controls are met through price changes (i.e. a movement along demand curves) rather than rationing (in which case

1. This is clearly the case where the specification matters most: in 1971 (see Table 7.4.1) this sector accounted for 77% of final goods imports.

2. Using different values for μ^C and μ^I also helps to reduce the effect of the high aggregation level. Output of manufacturing (non food) is of course very heterogeneous. Use of a single μ coefficient would ignore that some 85% of the investment demand in this sector consists of imported capital goods.

Table 7.4.1.1: Value Added, Output and Demand by Sector 1971⁽¹⁾ (K£M. 1971 prices)

Sector	Y	X	$\Sigma_j A_{ij} X_j$	C(4)	G	IS	E	imports (cons. goods)	imports (cap. goods)	imports (final goods)
	value added (factor cost)	gross output	intermediate demand	private consumption	public consumption	investment (by source)	exports			MF(5)
3 (1) Agriculture (non food)	77.5	33.1	6.9	-	-	-	26.2	-	-	-
3 (2) Agriculture (food)		61.7	39.2	23.2	-	2.8 (2)	-	3.4	0.1	3.5
4 Mining	2.9	6.5	3.6	0.2	-	-	2.7	-	-	-
5 (3) Manufacturing (food)	18.7	107.3	18.1	74.1	-	-	26.4	11.3	-	11.3
5 (4) Manufacturing (non food)	52.2	169.1	79.2	77.8	-	57.6	48.4	44.7	49.2	93.9
6 Electricity and water	8.2	12.4	10.1	1.8	-	-	0.5	-	-	-
7 Construction	23.2	66.2	13.6	-	-	52.8	-	-	0.3	0.3
8 Trade	51.1	85.5	41.6	17.3	-	10.0	17.8	1.1	-	1.1
9 Transport	43.1	86.1	41.0	21.1	-	-	29.0	5.0	-	5.0
10 Ownership of dwellings	24.6	29.5	-	28.8(3)	-	-	1.1	0.3	-	0.3
11 Government	98.5	137.8	1.5	26.8	114.1	-	0.5	5.0	-	5.0
12 Other services	46.9	77.1	20.1	39.8	-	0.8	18.3	1.8	-	1.8
TOTAL:	447.0	872.3	274.7	310.8	114.1	124.1	170.9	72.6	49.7	122.3

Source: 1971 Input - Output table, Kenya (1976b); for adjustments, cf. appendix 7.

Notes: (1) see appendix 7 for details
(2) increase in breeding stock
(3) imputed rents
(4) includes increases in stocks
(5) incl. duties.

Table 7.4.2. Output, Trade and Prices - Summary of Specification

Sector	X	MF	E	P ^D	Remarks
	Output	Imports (final goods)	Exports	Prices	
3 (1) Agriculture (non food)	Submodel (1)	C, μ^I (5)	Residual	Given (6)	export crops (mainly coffee and tea)
3 (2) Agriculture (food)	Submodel (1)	Residual	None	Given (7)	
4 Mining	ID, ICOR (2)	μ^C, μ^I (5)	Residual	Given (6)	
5 (3) Manufacturing (food)	CES	Residual	Endogenous	Given (7)	
	μ^C, μ^I (5)			Market clearing (9)	'closed economy'
	Residual			Constraint effective (10)	variant (11)
5 (4) Manufacturing (non food)	Production				
	μ^C, μ^I (5)				
5 (4) Manufacturing (non food)	Function (3)	Residual		Given (6)	'open economy' variant (11)
6 Electricity & water	Residual	μ^C, μ^I (5)	Exogenous	Cost (8)	
7 Construction	ID, ICOR	"	"	Market clearing (9)	
8 Trade	plus	"	"	"	
9 Transport	supply function (4)	"	"	"	
10 Ownership of dwellings	ID, ICOR (2)	"	"	Cost (8)	CP residual
11 Government	Residual	"	"	"	
12 Other services	ID, ICOR	μ^C, μ^I (5)	"	Market clearing (9)	
	plus supply function (4)				

- (1) Smallholders plus large farm output, converted to 1972 prices; subsistence consumption of smallholders is subtracted; only marketed output enters the material balance.
- (2) Output is given by past investment and a fixed incremental capital output ratio.
- (3) Output given by past investment, price level and wage rate; 'cf. equation (7.5.6).
- (4) Increases in output over and above that given by investment related to increases in net price by fixed elasticity.
- (5) Related to total demand for consumption and capital foods (C_i, IS_i) by fixed coefficients: equation (7.4.2).
- (6) Tied to world prices; implicit tariff rate kept constant.
- (7) Domestic price policies; ratio of domestic to world prices may vary.
- (8) Rate of return kept constant; price increases at the same rate as a (sector-specific) index of costs (domestic and imported intermediate input, wage bill).
- (9) Prices changed until excess demand is zero i.e. equation (7.4.1) holds; note that for all sectors for which market clearing pricing is not imposed zero excess demand is ensured by making one variable in the material balance residual (E, MC, X or C).
- (10) If market clearing would require an excessive price increase, the price is fixed at the level corresponding to the maximum increase allowed and additional imports are allowed to ensure market equilibrium.
- (11) The 'closed economy' variant is used in most runs, including the base run; the 'open economy' variant is used only in runs involving devaluation.

the final allocation would be off the demand curve). In other words, prices and quantities cannot be controlled simultaneously; if prices are given the adjustment is through international trade, if trade is not residual prices are free to move to their (market clearing) equilibrium values. Table 7.4.2 illustrates that there are considerable differences between sectors in the way the model treats the adjustment process.

For agriculture output is endogenously determined (cf. sections 7.2. and 7.3). Prices affect output through factor substitution (between land and labour), but within a period prices are given: for food products (food crops plus livestock products) they are controlled, for export crops the domestic price follows the world price. Imports are residual in the former, exports in the latter case.¹

For mining - a very small sector in Kenya, see table 7.4.1 - output is predetermined, related to past investment by a fixed capital - output ratio and hence independent of the domestic price. All output, net of intermediate demand, is exported.²

For manufacturing the price level does affect output. Given the capital stock (which is predetermined by past investment), output and employment are given as a function of the price-wage ratio by a CES production function.³ The

1. Excess supply of maize and of milk is a distinct possibility. In either case, exporting the surplus would involve a loss. Since all food products are lumped together in one sector, we cannot explore this issue with the model.
2. Table 7.4.1. shows some private consumption in 1971, but the amount is very small. In the model this is ignored: $C_4 = 0$.
3. The production function applies to all manufacturing; we assume that the composition in terms of the two sub-sectors (food and non food manufacturing) does not change. Since statistics on investment by sector of destination exist only for manufacturing as a whole, it is impossible to estimate separate production functions. The production function for manufacturing is given in equation (7.5.6).

treatment of manufacturing (food) is the same as for agriculture (food): the domestic price is controlled and imports are residual. Non food manufacturing is the sector most affected by import controls and protective tariffs. In most runs we use the non tradeable specification (closed economy variant), which also applies to the services sectors (6-12): neither exports (which are exogenous) nor imports (which are given by (7.4.2)) are residual and the model solves for a market clearing price level. We assume, however, that the government is willing to restrain imports (and pay the price in terms of inflation) only up to a limit: if reliance on price adjustment alone would involve a price increase exceeding a given maximum growth rate then

(a) the domestic price is fixed at the level given by the maximum and

(b) imports are no longer determined by (7.4.2) but, residually, by (7.4.1).

$$(7.4.3) \quad p_{it}^D = (1 + \gamma) p_{it-1}^D \quad \text{if } i = 5 \text{ (4) and } p_{it}^{D*} > (1 + \gamma) p_{it-1}^D$$

$$(7.4.4) \quad MF_i = \sum_j A_{ij} X_j + C_i + IS_i + E_i - X_i$$

where γ is the maximum growth rate, p^D the domestic price and p^{D*} the (unconstrained) equilibrium price. In some runs we explore a policy of trade liberalization (open economy variant); non food manufacturing is then treated as tradeable with the domestic price tied to the world price and imports residual.

Most services (sectors 7, 8, 9 and 12: construction, trade, transport and other services) are handled in the same way as non food manufacturing in the closed economy variant: the model solves for market clearing prices.¹ For services we do not use production functions (as we do for

¹. The only difference is that there is no constraint on price increases: imports are never residual.

agriculture and for manufacturing). Initially, the capital stock determines both output and employment through fixed coefficients. However, a supply function relates output over and above this capital - constrained level to changes in profitability: if prices increase more than the cost of intermediate inputs, imports and labour then output rises:

$$\left. \begin{aligned} (7.4.5) \quad \pi_i &= \sum_j p_j^D A_{ji} + p_{int}^W \sum_j MIM_{ji} + \sum_l W_{il} N_{il} / X_i \\ (7.4.6) \quad X_i^* &= X_{it-1}^* + \xi_i ID_{it-1} \\ (7.4.7) \quad N_{il} &= \lambda_{il} X_i^* \\ (7.4.8) \quad X_i / X_i^* &= c_i \rho_i^{\eta_i} \end{aligned} \right\} i = 7, 8, 9 \text{ and } 12.$$

where π is an index of costs (1972 = 1)

A the input-output matrix

p^D an index of domestic prices (1972 = 1)

p_{int}^W an index of the price of imported intermediate imports (1972 = 1)

MIM a matrix giving imports of intermediate goods by sector of source (rows) and sector of destination (columns)

W_{il} an index of wages (1972 = 1) by sector (i) and skill (l)

N modern sector employment

ρ the profitability index ($\rho_i = p_i^D / \pi_i$)

X^* capital-constrained level of output

ξ output-capital ratio

ID investment (by sector of destination)

λ employment coefficient

η supply elasticity

Note that the capital-labour ratio remains constant: employment is determined in (7.4.7) by X^* rather than by actual output X . Hence the price responsiveness of output is the result of increased labour

productivity, not of factor substitution.¹

The supply functions² are essential for the price adjustment process and in this respect there is an important difference between manufacturing³ and services. Excess demand for manufacturing is eliminated through price increases which both raise output and reduce private consumption.⁴ But for services the burden of adjustment rests almost entirely on output: private consumption demand for services is related by fixed coefficients to that for goods,⁵ hence there is no substitution effect (and the income effect would be weak).

Equations (7.4.5) - (7.4.8) apply to four of the seven services sectors. There are three special cases, in which output is not given by

¹. It will be clear that the supply function does not imply a production function: while the capital-labour ratio remains constant capital and labour productivity rise.

². Supply functions are also used by Adelman and Robinson (1978) in their model for Korea (pp. 30-32). There are however three important differences. First, instead of our (sector-specific) concept of costs (π) they use 'the average price level in the non-service sectors'. This ignores that the effects of domestic, imported and wage inflation will differ between sectors because of differences in the composition of costs. Such differences are substantial, e.g. for 1971 we find:

	Composition of Costs (%)			
	Construction	Trade	Transport	'Other services'
Intermediate inputs	54	50	49	42
(of which: manufacturing)	(28)	(10)	(21)	(25)
Intermediate imports	16	8	11	10
Wages	31	42	40	48
Total	100	100	100	100

Secondly, in the Korea model the supply function determines X_t relative to X_{t-1} rather than X_t relative to X_t^* . This implies that if relative prices remain constant, output does not change over time. Thirdly, for some of the services sectors the output-labour (rather than the capital labour) ratio is fixed; what the role of investment is in this case is unclear.

³. When prices are market clearing, i.e. for non food manufacturing in the closed economy variant.

⁴. In addition, there are some indirect effects on other variables in the material balance (7.4.1) which we ignore at this stage.

⁵. Cf. section 7.7 below.

a supply function and the price is not market clearing. For sectors 6 (electricity and water) and 11 (government) output is residual, i.e. given by (7.4.1), while for sector 10 (ownership of dwellings), output is given by a fixed capital-output ratio ($X = X^*$, where X^* is given by (7.4.6)). In this last case consumption is residual. Equilibrium being achieved through quantity adjustments, we need an equation for the price level in those three sectors. We assume that prices are set on a cost-plus basis (so that profitability remains constant: ρ of (7.4.5) equals 1 throughout):

$$(7.4.9) \quad p_{it}^D / p_{it-1}^D = \pi_{it} / \pi_{it-1} \quad i = 6, 10, 11$$

This completes the description of the adjustment process. Computationally, the procedure is an iterative one. First, the value of all variables in the material balance equation are calculated for a given price vector p_τ^D (where τ denotes the current iteration). This gives demand X^D :

$$(7.4.10) \quad X_i^D = \sum_j A_{ij} X_j + C_i + G_i + IS_i + E_i - MF_i$$

Then, where applicable,¹ values for the price vector to be used in the next iteration are given by:

$$(7.4.11) \quad \frac{p_{i\tau+1}^D - p_{i\tau}^D}{p_{i\tau}^D} = \zeta \frac{X_i^D - X_i}{X_i}$$

The procedure stops when the excess demand vector ($|X^D - X|$) is sufficiently close to zero.

In conclusion, it should be noted that the way in which zero excess demand is ensured in the model does not just determine relative prices. Absolute prices are determined as well, since (a) several prices are either controlled or tied to world prices, (b) the exchange rate is not an endogenous variable.

1. i.e. for those sectors for which equilibrium is reached through price adjustment; for other sectors the price remains constant (if controlled or tied to world prices) between iterations or changes only as a result of change in costs.

7.5. Investment, Employment and the Balance of Payments

We do not aim to model the allocation of investment between sectors: this allocation is exogenous in the model. A matrix equation relates investment by source (IS: the vector needed in (7.4.1) to investment by destination (ID):

$$(7.5.1) \quad ID_i = \delta_i (IT - ID_3 - ID_6 - ID_{11}) \quad (i \neq 3, 6, 11)^1.$$

$$(7.5.2) \quad IS_i = \sum_j B_{ij} ID_j$$

Total investment (IT) is endogenously determined in the model as the sum of foreign and domestic savings. As in the Tanzania model, foreign savings are exogenous. Data on the structure of existing debt plus assumptions on the availability, terms and disbursement patterns of new loans and grants plus assumptions on transfers and changes in reserves² are used in a detailed accounting model to give foreign savings in current world prices ($\overline{FS}$). We have yet to ensure that this amount equals the deficit on the trade balance (imports minus exports of goods and non factor services, in current world prices).

1. Using fixed ICORs, investment requirements in agriculture (for which we treat capital as a complementary factor) and for the two sectors in which output is determined residually (electricity and water; government) are computed first. Note that these are subtracted from the total in (7.5.1): the exogenous investment allocation applies only to the remaining sectors.

2. All these flows are exogenous with the exception of changes in reserves which are related to changes in imports.

Imports of final goods were discussed in the previous section.

Imports of intermediate goods (MI) are given by: ¹

$$(7.5.3) \text{ MI} = \sum_i \sum_j \text{MIM}_{ij} X_j$$

The demand for foreign savings is then given by:

$$(7.5.4) \text{ FS}_d = e_o \left[p^{mi} \text{ MI} + \sum_i (p_i^{mf} \text{ MF}_i / (1 + \tau_i^{mf}) - p_i^e E_i / (1 + \tau_i^e)) \right]$$

where FS_d is demand for foreign savings (in current dollars)

p^{mi} , p^{mf} indices of world (c.i.f.) prices of imports in dollars

p_i^e indices of world (f.o.b.) prices of exports in dollars

$1 + \tau_i^{mf}$ the ratio in the base year of domestic and import (c.i.f.) prices

$1 + \tau_i^e$ the ratio in the base year of domestic and export (f.o.b.) prices

e_o the exchange rate (\$/Ksh) in the base year: ²

1.

Unlike MF, MI is expressed in baseyear world (c.i.f.) prices, i.e. excluding duties. Note that we sum over sectors of origin (i) in (7.5.3): one sector (non food manufacturing) dominates the total so there is little point in distinguishing between sectors even though world price movements may differ. We correct for the one relative price change which is important: the rise in the oil price.

2. The exchange rate in the current year plays a role in those sectors where domestic prices are tied to world price because in that case

$\frac{p_{it}^D}{p_{it-1}^D} = \frac{(p_{it}^{mf}/p_{it-1}^{mf})}{(e_t/e_{t-1})}$ hence a devaluation raises prices by the full amount in those sectors.

In equilibrium:

$$(7.5.5) \quad FS_d = \overline{FS}$$

This equilibrium condition determines the level of investment. There is nothing residual in the model to ensure that the condition is satisfied: if $\overline{FS}$ changes, prices, production and consumption have to change to restore equilibrium. The issue of the ex post equality of the savings and trade gaps if those differ ex ante does not arise: price changes ensure that ex post values are equal to ex ante values.^{1.}

The effect of changes in foreign exchange availability depends, of course, on what is assumed about the use of policy instruments. In the simulation runs we experiment with (a) price control, (b) import controls (i.e. changes in μ^C, μ^I in (7.4.2)), (c) exchange rate adjustments. Table (7.4.2) indicates how investment affects output levels. In the case of manufacturing we use a CES production function:^{2.}

$$(7.5.6) \quad Y_i = (\alpha K_i^{-\rho} + \beta N_i^{-\rho})^{-1/\rho} \quad i = 5$$

where Y, K and N denote value added, the capital stock and employment.

-
1. In this respect the model differs (as does any general equilibrium model) from the widely used two-gap planning models (Chenery and Strout (1966); see also Fei and Ranis (1968)). These are (implicitly) fix-price and, hence disequilibrium models. The ex post identity $M-E = C+I-Y$ is satisfied by making one of the variables residual. In a popular variant consumption is residual. Adjustment then implies a move off (rather than along) the consumption function. Investment would change by the full amount of a change in foreign savings (M-E). In our model this equality does not hold in general: changes in foreign savings will (through price movements) induce changes in domestic savings: the two variables are not independent.
 2. The estimated substitution elasticity is considerably lower than one (0.48). Maitha (1975)'s estimate is higher (0.76) but his analysis is suspect if only because what he calls a 'reasonable' rate of technical progress turns out to be equal to 35% p.a. Agarwala (pp. 86-159 in Burrows (1975)) imposes a Cobb-Douglas specification. On the estimation of (7.5.4) see Appendix 5.

For sectors other than agriculture and manufacturing, total (formal sector) employment is given by fixed coefficients:

$$(7.5.7) \quad N_i = \gamma_i X_i \quad (i = 3, 5)$$

while for all sectors the distribution of this total by skill (l) and location (p) is also given by fixed coefficients:

$$(7.5.8) \quad N_{ilp} = \lambda_{ilp} X_i$$

N_{ilp} affects urban households for $p = 1$ and rural households (by province) for $p = 2, \dots, 7$. Five skill/income levels are distinguished:

1. unskilled, semi-skilled and skilled workers.
2. clerks, shop assistants, secretaries, salesmen, etc.
3. technicians, professionals, executive and managerial personnel.
4. teachers.
5. casuals.

Within a period, wage levels for these five categories are given (changes between periods may be affected by supply and demand). Wage differentials (between sectors for a given skill) are kept constant over time:

$$(7.5.9) \quad W_{il} = \xi_{il} W_1$$

where W is the mean wage. The distribution of wages for given (i,l) is assumed to be lognormal¹ with mean W_{1l} and log variance σ_1^2 . This within cell distribution of wage income is used in the derivation of the urban income distribution (section 7.6) but not for the rural sector (where wage income is less important). The extent of wage differentials and the differences between sectors in the skill composition of employment can be seen from Table 7.5.1.

1. In Appendix 1 we use data for 1974 to show that this gives a very close approximation to the overall distribution of wage income. The log mean μ_{il} is given by $W_{il} = \exp(\mu_{il} + \frac{1}{2} \sigma_1^2)$.

Table 7.5.1: Skill Composition of Employment and
Wage Differentials (1974)

A: Employment (thousands)

Sector	<u>Skill</u>					<u>Total</u>
	1	2	3	4 Teachers	5 Casuals	
Agriculture	171.3	8.5	4.5	-	76.9	261.1
Mining	2.2	0.2	0.3	-	1.3	3.9
Manufacturing	72.4	7.4	8.1	-	13.4	101.3
Electricity	2.4	0.5	0.5	-	2.3	5.7
Construction	25.7	1.9	2.6	-	14.3	44.4
Trade	34.6	12.0	6.1	-	4.4	57.0
Transport	30.9	10.0	3.7	-	1.8	46.3
Government	77.7	23.3	21.8	-	} 10.4 }	306.5
Other Services	68.2	8.6	4.4	92.1		
Total:	485.4	72.2	51.9	92.1	124.7	826.3
(of which: regulars, skills 1-4)						(701.6)

B: Wages (KSh/month)

Sector	<u>Skill</u>					<u>Total</u>
	1	2	3	4 Teachers	5 Casuals	
Agriculture	148	578	1954	-	193	
Mining	413	1096	3207	-	386	
Manufacturing	435	1101	3141	-	608	
Electricity	689	1132	3131	-	541	
Construction	453	873	2584	-	503	
Trade	377	962	3082	-	750	
Transport	641	1100	3169	-	918	
Government	348	847	2130	-	504	
Other services	348	847	2130	641	504	
Total:	318	898	2496	641		553
(of which: regulars, skills 1-4)						(582)

Ideally, one would like to replace equations (7.5.8) and (7.5.9) by a formulation which recognises substitution possibilities between skills and which allows for changes in wage differentials over time. We have not done this because the time series data on employment and wages by skill are not reliable.¹ In the absence of such data it is impossible to say whether changing wage differentials and substitution between skills are important in Kenya. Relative income changes between modern sector wage employment and the rest of the urban economy are probably more important than relative changes between different skill groups.

1. the data imply e.g. that between 1973 and 1974 the number of unskilled workers rose by 61.2 thousand while the number of (semi)skilled workers fell by 32.6 thousand. There is no reason to believe that such a large number of skilled workers was downgraded or left wage employment. The Central Bureau of Statistics believes that such data mainly reflect changes in the way the respondents chose to interpret the definitions of the skill categories in the questionnaire.

7.6. Urban Income Distribution

The ILO report, published in 1972, has been influential in shaping conventional wisdom on the Kenyan urban income distribution. The report noted that the urban population was growing at some 9% p.a. (due both to a high natural rate of increase and to high rural-to-urban migration), that formal sector employment was growing very little and that real wages were kept constant in the face of increasing excess supply of labour. This led to the gloomy prediction that the share of the labour force in formal sector wage employment would continue to fall rapidly, that next to this 'wage elite' there would be a rapidly growing number of people either in open unemployment or in low income self employment and that as a result income distribution would worsen. In fact, a picture very similar to that suggested by the results of our Tanzania model, but one which, ironically, is probably much less realistic for Kenya.

Data which have since become available suggest a rather different story. First, while urban employment did indeed stagnate in the late 1960's (Nairobi employment was 163.7 thousand in 1967, 164.0 in 1970), it has since grown rapidly (at an annual rate of 5.8% for Nairobi 1970-76). Secondly, while a comparison of 1962 and 1969 Census data did indeed suggest high rural-to-urban migration rates, after 1969 population growth accounted for by migration fell dramatically: to 2.2% for the period 1969-73 and to only 0.3% in the 1973-77 period.¹ Taking natural growth into account, we estimate the growth of the Nairobi population in these two periods as 6.9% and 3.4% respectively. Thirdly, real wages in the formal sector have not been protected: they fell in fact quite considerably (by some 17%)

¹. These data are for Nairobi; see Appendix 2.

between 1969 and 1977. Finally, recent survey data indicate that the number of self employed is much smaller and their incomes much higher than would be consistent with the ILO analysis.^{1.} In fact, the vast majority of the self employed in the informal sector are not using the sector as a stepping stone while queueing for wage employment, but, on the contrary, have usually been regular wage employees for several years and have entered self employment once they have accumulated sufficient savings.

Modern sector wage employment accounts for two thirds of the labour force (table 7.6.1) and for 74% of urban incomes. This is the justification for the greater attention we pay to wage employment in the specification of the Kenya model, compared to the Tanzania model.^{2.} We have discussed above how output levels and (in the case of agriculture and manufacturing) factor substitution determine wage employment by sector, location and wage level. Given total urban employment by wage level (n_i^D), the distribution of these jobs is generated by the modified version of the bumping model discussed in section 1.3. Hence, that distribution is a function of (a) total labour demand and its distribution over wage levels and (b) labour supply by educational qualification and its distribution over households. We repeat the specification:^{3.}

$$\begin{aligned}
 (7.6.1) \quad n_{ik} &= \begin{cases} n_k - \sum_{i=1}^{i-1} \pi_{ik} n_{ik} & \text{if } i > 1 \\ n_k & \text{if } i = 1 \end{cases} \\
 (7.6.2) \quad n_{ik}^C &= \sum_{k=1}^{k-1} \pi_{ik} n_{ik}^C + p_{ik} n_{ik} \\
 (7.6.3) \quad \pi_{ik} &= \begin{cases} p_{ik} & \text{if } n_{ik}^C \leq n_i^D \\ (n_i^D - n_{ik-1}^C) / n_{ik} & \text{if } n_{ik-1}^C < n_i^D < n_{ik}^C \\ 0 & \text{if } n_{ik-1}^C \geq n_i^D \end{cases} \\
 (7.6.4) \quad n_{ik}^* &= \pi_{ik} n_{ik}
 \end{aligned}$$

1. cf. appendix 3.

2. In Tanzania in 1974 regular wage employment accounted for only 54% of the urban labour force and the percentage was falling rather than rising. Collier (1977), Appendix A, Table 4 and Gunning (1977), Table IX. 3.

3. cf. appendix 3 on the relevance of the bumping model for Kenya.

where i stands for the wage class ($i = 1$ is the highest level)

k for the educational attainment ($k = 1$ is the highest level)

n for labour supply (including those with the same education who have been unsuccessful in getting higher wage jobs)

n^C for cumulative labour supply (including those with higher educational qualifications)

n^D for labour demand

n^* for employment

p for employment probabilities in the absence of rationing

π for actual employment probabilities, i.e. after rationing.

Job seekers are assumed to try their luck first in the market for the highest wage jobs ($i = 1$) and then (if unsuccessful) to move to lower wage jobs. Hence, in the first equation, labour supply (for given i , k) is defined as all job seekers with that education level minus those who have obtained higher wage jobs (i.e. at wage levels $i = 1, 2, \dots, i - 1$). Cumulative labour supply for type i jobs is then defined in the second equation by multiplying n_{ik} by the (ex ante) probability p_{ik} and taking into account those jobs already allocated to job seekers with higher qualifications ($k = 1, 2, \dots, k - 1$). The difference between supply and demand then determines the (ex post) probability π_{ik} in the third equation.

Given labour demand by wage level (n_i^D), labour supply by educational level (n_k) and the matrix p^1 , (7.6.1) - (7.6.4) gives the distribution of job seekers over wage groups (n_{ik}^*) and, residually, the number of unsuccessful job seekers ($n_k - \sum_i n_{ik}^*$).²

1. n_i^D and n_k are generated by the model; the matrix p is estimated for 1974 (see Appendix 3), and kept constant over time.

2. Note that the four equations imply:

(a) $\sum_k n_{ik}^* \leq n_i^D$

(b) $\sum_i n_{ik}^* \leq n_k$

See appendix 3 for the treatment of the case of excess demand: $\sum_k n_{ik}^* < n_i^D$.

Of course, the bumping model does not change the size distribution n_i^D , which is already known at this stage, and although the end result (n_{ik}^*) is of some interest in itself, this is not the justification for the model. The main function of the model is in mapping the transition from the size to the household distribution of income. Given the distribution of educational endowments over households, the bumping model determines the distribution of wage income over households.

In the model we distinguish between eight household types (index h). Using the 1974 Household Budget Survey data these types were defined by the occupation and income of the head of household,¹ but our specification differs from other household formation models² in that the correspondence between household type and occupation of the head holds only for the base year. The eight household-types are defined (for 1974): $h = 1 \dots 4$: head of household a regular wage earner (with wages up to 400, between 400 and 1000, between 1000 and 2000 and over Ksh. 2000 per month), $h = 5, 6$: self employed (with incomes up to/over Ksh. 400 per month) $h = 7$: unemployed, $h = 8$: other occupations.

Within the urban labour market we distinguish three subsectors:

- (a) high income self employed who are assumed not to compete for regular wage jobs.
- (b) regulars
- (c) free entry sector consisting of unemployed, casuals and low income self employed, all of whom are assumed to compete for regular wage jobs.

Table 7.6.1 indicates the size of these sub-sectors.³

¹. See Appendix 3.

². See section 1.4.

³. The number of regulars is from the Statistical Abstract, the ratio of that number to the other numbers from the Household Budget Survey (see Appendix 3, table 1).

Table 7.6.1: The Urban Labour Force: Nairobi 1974

	(thousands)
Regulars	206.1
High income self employed	23.8
Low income self employed	18.7
Unemployed	40.4
Others (incl. casuals)	20.2
TOTAL	309.3

Our distinction between high and low income self employed is not that between 'modern sector' and 'informal sector' self employed which is used by the Central Bureau of Statistics. Under the CBS criterion establishments are considered to be part of the informal sector if they have no fixed postal address or permanent location; House (1977) included enterprises not operating out of a permanent structure. Such criteria are poor proxies for labour market segmentation and income differences and are therefore not useful for our purposes. House's preliminary data suggest that a stratification by income captures a labour market segmentation as well: high incomes are earned in activities characterized by high skill and capital requirements, i.e. by barriers to entry (this applies e.g. to food kiosks, vehicle repairs, furniture and metal goods manufacturing; mean incomes in these four activities are five times as high as the minimum wage). A large number of respondents (presumably those with high incomes) had been wage employees in the formal sector and expressed no desire to return to it. Low incomes are earned in activities with low skill and capital requirements (e.g. barbers, shoeblacks, people engaged in footwear or clothes repair), activities where one expects entry to be free. Contrary to the view of the ILO report, which considered the whole of the informal sector as

consisting of people who will engage in search for a formal sector job, that description is probably valid only for this sub-sector.

We assume:

- for high income self employed that the number of people grows at the same rate as urban consumption demand for their activities and their incomes at the same rate as gross output prices.
- for low income self employed (as in the Tanzania model) that total output of the sub-sector is given by consumption demand and the number of self employed and their income by the equilibrium condition requiring equality of expected income of unemployed and low income self employed.

The Household Budget Survey gives us (for 1974) for each household type ($h = 1, \dots, 8$):

s_h^0 the number of high income self employed

E_{hk}^0 the number of job seekers ¹ by education level ($k = 1, 2, 3$).

The number of household members who are in the labour force is equal to $s_h^0 + \sum_k E_{hk}^0$; this sum remains constant (although s and E do not). ²

Together with (7.6.1) - (7.6.4), the following equations determine the occupation and income levels of these labour force members and, hence, the household income distribution.

$$(7.6.5) \quad S/S^0 = \sum_i w_i (C_{ui}/C_{ui}^0)$$

$$(7.6.6) \quad s_h/s_h^0 = S/\sum_h \gamma_h s_h^0$$

$$(7.6.7) \quad \beta_{hk} = E_{hk}^0 / \sum_{k=1}^2 E_{hk}^0$$

$$(7.6.8) \quad E_{hk} = \begin{cases} E_{hk}^0 + \beta_{hk} (s_h^0 - s_h) & k = 1, 2 \\ E_{hk}^0 & k = 3 \end{cases}$$

$$(7.6.9) \quad n_k = \sum_h \gamma_h E_{hk}$$

¹. By 'job seekers' we mean all labour force members competing for formal sector wage employment, i.e. the labour force excluding the high income self employed.

². Since the number of households of type h (γ_h) grows at the same rate as the urban population, this does imply a simplification: in the model the labour force grows at the same rate as the population

$$(7.6.10) \quad n_{ikh} = \begin{cases} E_{hk} & i = 1 \\ E_{hk} - \sum_{l=1}^{i-1} \pi_{lk} n_{lkh} & i > 1 \end{cases}$$

$$(7.6.11) \quad n_{ikh}^* = \pi_{ik} n_{ikh}$$

$$(7.6.12) \quad f_h = (s_h^0 + \sum_k E_{hk}^0) - (s_h + \sum_i \sum_k n_{ikh}^*)$$

$$(7.6.13) \quad N_1 + N_2 = \sum_h \gamma_h f_h$$

$$(7.6.14) \quad p_1 N_1 + p_2 (N_2 + \sum_i n_i^D) = \sum_i n_i^D$$

$$(7.6.15) \quad p_1 = \xi p_2$$

$$(7.6.16) \quad p_1 W_r + (1-p_1) W_s = p_2 W_r$$

$$(7.6.17) \quad N_1 W_s / N_1^0 W_s^0 = \sum_i \omega_i (C_{ui} / C_{ui}^0)$$

$$(7.6.18) \quad (f_{1h} / f_h) = \alpha (f_{1h}^0 / f_h^0)$$

$$(7.6.19) \quad N_1 = \sum_h \gamma_h f_{1h}$$

$$(7.6.20) \quad W_{sh} = \beta W_{sh}^0$$

$$(7.6.21) \quad W_s = \sum_h \gamma_h f_{1h} W_{sh} / \sum_h \gamma_h f_{1h}$$

$$(7.6.22) \quad (Y/Y^0) = \sum_i \bar{w}_i (p_i^D / p_i^{D0})$$

$$(7.6.23) \quad (Y_h/Y) = \gamma (Y_h^0/Y^0)$$

$$(7.6.24) \quad Y = \sum_h \gamma_h s_h Y_h / \sum_h \gamma_h s_h$$

Here: s is the number of high income self employed (total)

s the number of high income self employed (by household type)

C_u urban private consumption in constant prices (by sector)

w weights giving the sectoral distribution of high income self employed

γ number of households (by type)

n labour supply by income, education and household type

n^* regular wage employment by income, education and household type

f labour supply to the free entry sector

N_1 total number of low income self employed

N_2	others in the free entry sector (including unemployed and casuals)
$p_1(p_2)$	employment probability for those in low income self employment (for those in the rest of the free entry sector)
ξ	1974 ratio of p_1 and p_2 .
W_r	mean urban wage (in constant prices)
W_s	mean income in low income self employment (in constant prices)
ω	weights giving the sectoral distribution of low income self employed
f_1	low income self employed (by household type)
Y	income of high income self employed
o	a superfix denoting the baseyear.

These 20 equations fall naturally into four groups:

- (a) three equations (5, 17 and 22) give S , Y and $(N_1 W_s)$ as a function of prices and urban consumption (p^D , C_u). Note that while for high income self employment both the number of people and their income is determined, for low income self employment only total income is determined: mean incomes depend on the size of sector which is yet to be determined.
- (b) three equations (9, 10 and 11) apply the bumping model at the household level. Given educational achievements (E_{hk}), labour supply n_k is defined in (7.6.9); (7.6.1) - (7.6.4) then determine π_{ik} , the (ex post) employment probabilities. Regular wage employment (n_{ikh}^*) is then given by (7.6.10) and (7.6.11) which are the disaggregated versions of (7.6.1) and (7.6.4).

- (c) (four equations (13 through 16) describe labour allocation in the free entry sector. With the product $N_1 W_s$ already known, these equations determine the five unknowns P_1, P_2, N_1, N_2 and W_s simultaneously. As in the Tanzania model, we assume that, amongst those competing for formal sector employment, the intensity of job search differs between those in self employment and others. The difference is considered independent of market conditions: (7.6.14) keeps the ratio of the employment probabilities for the two groups constant.¹ The crucial equation is (7.6.16); this equilibrium condition states that expected incomes in the free entry sector are (instantaneously) equalized.²
- (d) The remaining ten equations (apart from (7.6.12) which is an identity) are simplifications introduced to close the model. Note that we assume (1) that the distribution of high income self employed over household types remains constant over time: (7.6.6) (2) that high income self employed are recruited from those with the higher educational qualifications: (7.6.7) and (7.6.8) (3) that the share (f_{1h}/f_h) of low income self employed in the free entry sector changes by the same ratio for all household types: (7.6.18) and (7.6.19) (4) that the distribution of self employment income over household types remains constant over household types: (7.6.20) (7.6.21), (7.6.23) and (7.6.24).

The core of the model consists of the bumping model, the relation between consumer demand and the number of high income self employed and the free entry sector equilibrium condition. Of these elements of the model the first two are by far the most important: regular wage earners and high income self employed, taken together account

¹. cf. Fields (1975) for a similar specification.

². We could have included a term $(1 - p_2) W_0$ on the right hand side of the equation where W_0 would be the earnings of those who are not in low income self employment. W_0 is however so low that we ignore this.

for almost three quarters of the labour force and for almost 90% of household income (table 7.6.2).

Table 7.6.2: Household Composition and Income: Nairobi 1974

	labour force members (mean per household)	income per household (Ksh./month)
<u>head of household</u>	.95	1008
regular self employed:	.71	779
high income	.08	189
low income	.09	23
unemployed	.03	-
others	.04	16
<u>other members</u>	.58	258
regular self employed:	.31	225
high income	.01	} 23
low income	.03	
unemployed	.17	-
others	.06	12
<u>other</u>		92
<u>Total</u>	1.53	1358

In summary, the key relationships in the model which determine the urban income distribution:

- within a period wages are given; formal sector jobs are rationed on the basis of educational qualifications.
- high income self employed do not compete for wage employment; their number and income are determined by the price of and demand for, the output of the sectors in which they are engaged.

- low income self employed do compete for wage employment; they are part of a free-entry sector in which expected incomes are equalized; this determines their number and incomes while total income is a function of demand.
- for each household type the number of labour force members per household and their educational endowment is given; this provides the link between the size and the household distribution of income.

7.7. Consumption Functions

For both rural and urban households we assume that households maximise a Stone-Geary utility function:

$$(7.7.1) \quad u = (c_1 - \bar{c}_1)^{\beta_1} \dots (c_n - \bar{c}_n)^{\beta_n} \quad (\sum_i \beta_i = 1)$$

subject to a budget constraint $y = \sum_j p_j c_j$. This implies the well-known linear expenditure system (LES).¹

$$(7.7.2) \quad p_i c_i = p_i \bar{c}_i + \beta_i (y - \sum_j p_j \bar{c}_j).$$

where $\bar{c}$ are 'committed expenditures'. We have used unpublished IRS and HBS data to obtain regression estimates of $\bar{c}$ and β .²

Unlike the Tanzania model, prices have income as well as substitution effects. However, the limitations of the LES approach should be noted. First, the implied price elasticities should be treated with caution since no price responses have been measured.³ Secondly the linearity of (7.7.2)

¹. See Lluch, Powell. and Williams (1977).

². HBS stands for the 1974 Nairobi household budget survey. For a description of the survey see Kenya (1977b). Since all households are assumed to face the same consumer prices and since we have data for only one time period (ruling out a pooled cross section-time series approach, cf. Pollak and Wales (1978)), there is an identification problem. The restriction we impose to ensure identification is that committed expenditures ($\bar{c}$) for non-food consumption are zero. It is readily seen that this implies unitary own-price elasticity.

³. Cf. Brown and Deaton (1972): 'the linear expenditure system, like other additive models, will impose a structure on estimated price effects largely independently of the structure of actual price effects'. p.119.

implies that income distribution does not affect the composition of total consumption (if there are n_k households with total consumption $y_k = \sum_j p_j c_{jk}$ then any vector y satisfying $\sum_k n_k y_k = y$ will give the same results for total consumption ($\sum_k p_i c_{ik}$)). While in the Tanzania model any change in income distribution generally affected total consumption, in the Kenya model the intra-rural and intra-urban distributions are irrelevant: only the distribution between the rural and the urban sector matters (since the form of (7.7.2) is different for rural and urban households)¹. For rural households we distinguish six commodities:

- 1 food crops (own produced)
- 2 food crops (purchased)
- 3 livestock products (own produced)
- 4 livestock products (purchased)
- 5 other food (manufactured)
- 6 non food

Ideally, for food crops, the consumption function should give total demand (subsistence plus cash consumption) for a crop; (net) sales would then be the difference between production and consumption. However, the data impose a level of aggregation at which (for commodities 1 - 4) there typically

1. While in the theoretical literature the effect of redistribution on the composition of demand has received considerable attention, the effects people seem to have in mind (consumption of 'luxury' goods by the rich, for example, cf. Bacha and Taylor (1976)) are unlikely to be important at our level of aggregation. This is confirmed by the results of simulation models surveyed by Cline (1975, p. 379) and by experiments with the Tanzania model (which uses piece-wise linear rather than linear functions).

are both sales and purchases for the same household. We allow for heterogeneity by defining purchased and own produced items as different commodities. The specification implies that the share of marketed output in total production of a commodity rises with its price. This is important because it is only marketed output of food crops which (as $X_{3(2)}$) enters the material balance (7.4.1)).

Table 7.7.1 shows the price and income elasticities implied by the regression results¹ at three levels of consumption.² There are three notable results. First, the price elasticity of subsistence consumption is high (- 1.3 at the mean) implying a high price sensitivity of marketed output. Secondly, the income elasticity of non food consumption is only very slightly higher than one: at smallholders' income levels, Engels law apparently does not yet apply. Thirdly, (and rather unexpectedly) the income elasticity of subsistence consumption is substantially higher than one (cf. appendix 4).

To arrive at consumption as used in the material balances - i.e. using the sectoral classifications - trade and transportation margins are taken into account and (with that adjustment):³

- commodities 2 and 4 are assigned to sector 3(2):agriculture (food)
- commodities 5 and 6 are assigned to sectors 5(3) and 5(4): manufacturing (food and non food respectively).

¹. Regression results are given in Appendix 4. From (7.7.2) income and price elasticities (E_y , E_p) are:
 $E_y = \beta_i y / c_i$ and $E_p = [(1 - \beta_i) \bar{c}_i / c_i^y - p_i]$

². In 1974/75 mean household consumption was KSh. 3450, Kenya (1977) p. 58.

³. The margins are derived from the input-output table. The national accounts and the input-output table do not cover the informal sector. To that extent the model overstates rural demand. Hence, for the material balances the distinction between food crops and livestock products is irrelevant. But given the concern about the possibility of excess domestic supply of livestock products, it is useful to be able to project supply and demand separately for livestock.

Table 7.7.1. Income and Price Elasticities of
Rural Household Consumption

Commodity		Total 2000	Consumption 3500	(Ksh/year) 5000
1 food crops (own produced)	E	-1.6	-1.2	-1.2
	E_y^P	2.1	1.4	1.3
2 food crops (purchased)	E	-0.3	-0.4	-0.5
	E_y^P	0.3	0.4	0.5
3 livestock products (own produced)	E	-1.7	-1.3	-1.2
	E_y^P	1.9	1.4	1.2
4 livestock products (purchased)	E	-0.5	-0.6	-0.7
	E_y^P	0.5	0.6	0.7
5 other food (manufactured)	E	-0.7	-0.8	-0.8
	E_y^P	0.6	0.7	0.8
6 non food	E	-1.0	-1.0	-1.0
	E_y^{P**}	1.0	1.0	1.0
1,3 food (own produced)	E	-1.7	-1.3	-1.2
	E_y^P	2.0	1.4	1.3
2,4,5 food (purchased)	E	-0.5	-0.6	-0.7
	E_y^P	0.4	0.6	0.6
1-5 total food	E	-0.9	-0.9	-1.0
	E_y^{P**}	1.0	1.0	1.0
6 non food	E	-1.0	-1.0	-1.0
	E_y^{P**}	1.0	1.0	1.0

* implied by assumption ($\bar{c}_6 = 0$)

** close to unity because $\Sigma \bar{c}$ close to zero.

For urban households the LES applies only to consumption of goods. Demand for services is determined by fixed coefficients. For food consumption we distinguish again between livestock products and other food and (as for rural households) we assume that committed expenditures for non food are zero.

The 1974 Nairobi household budget survey has been used to estimate the functions; implied elasticities are given in table 7.7.2

Table 7.7.2. Income and Price Elasticities of Urban Household Consumption (excl. services)

Commodity		Total consumption of goods (Ksh/month)		
		500	900	1300
1 livestock products	E_p	-0.86	-0.93	-0.96
	E_y	0.95	0.97	0.98
2 other food	E_p	-0.86	-0.90	-0.95
	E_y	0.87	0.92	0.95
3 non food	E_p^*	-1.00	-1.00	-1.00
	E_y	1.11	1.06	1.03

* by assumption ($\bar{c}_3=0$)

Other consumption items (transportation; medical expenses; private and public school fees; electricity; water; telephone; rents; other services) are related by piece-wise linear functions (in income alone) to non food consumption. The mapping to the sectoral classification is as follows (again, after adjusting for trade and transportation margins):

- food consumption is assigned to sectors 3(2) (agriculture (food)), 5(3) (manufacturing (food)) and 12 (other services) in ratios which ensure consistency with the national accounts.
- non food consumption is assigned to sector 5(4) (manufacturing (non food)).
- transportation is assigned to sector 9 (transport and communications), electricity, etc. to sector 6 (electricity and water supply), public school fees to sector 11 (government) and all else to sector 12 (other services).

It will be clear that the main role of the consumption functions in the model is (a) to divide smallholder food production between marketed output and subsistence consumption, (b) to determine the distribution of total consumption between food and non food expenditures.

7.8. Miscellaneous Equations

The equation for rural-urban migration is of the Harris-Todaro form: migration is iso-elastic function of the ratio of expected urban income and actual rural income:

$$(7.8.1) \quad m = c(\tilde{\pi} \bar{W}_r / \bar{y}_s)^{\eta^*}$$

when m is an index of the (net) number of male migrants, age 20-60.

$\bar{W}_r$ an index of real urban wages (deflated by urban prices)

$\bar{y}_s$ an index of real, smallholder incomes (deflated by rural prices)¹

$\tilde{\pi}$ an index of the employment probability (measured as the ratio of the increase in the number of urban formal sector jobs and the number of males of age 20-60 years).

η^* an elasticity estimated on the basis of 1969-77 data (see Appendix 2)

The estimated elasticity (η^*) is close to unity, considerably higher than that used in the Tanzania model. This reflects an important difference between the two economies. While in Tanzania migrants come predominantly from areas far removed from the main urban centre, Dar es Salaam, do not maintain rural ties and are therefore less willing to return to the countryside when their urban incomes fall, in Kenya most migrants come from areas close to Nairobi, and are therefore in a position to keep their smallholdings. The result is that while in Tanzania the main adjustment mechanism in the urban labour market is changes in the size of the free-entry sector (low income self employment and unemployment), in Kenya it

1. $\bar{y}_s$ is based on a weighted average of provincial means of smallholder incomes, as generated by the model. The weights are derived from Rempel's data on the origin of migrants; Rempel, Harris and Todaro, (1970), p. 11.

is changes in net migration (reflecting significant return migration, Appendix 2). Under these circumstances one would indeed expect the elasticity to be higher for Kenya.

In Appendix 2 we present estimates through 1977 of both the concept of migration used here (males aged 20-60) and total net migration. In the projections we keep the ratio of these two flows constant after 1977. Population growth is then given by the natural rate of increase (exogenous, but different for rural and urban households) and migration. As noted before (section 7.6) the composition of the urban population in terms of household types (γ_h) remains constant.

Urban household incomes determine urban-to-rural remittances:

$$(7.8.2) \quad R/R^0 = \sum_h \gamma_h I_h / \sum_h \gamma_h^0 I_h^0$$

where R stands for total remittances received by smallholders and I is urban household income.

7.9. Summary

The flowchart shows the main relationship in the model. Variables not shown in boxes are exogenous. There are twelve such variables.

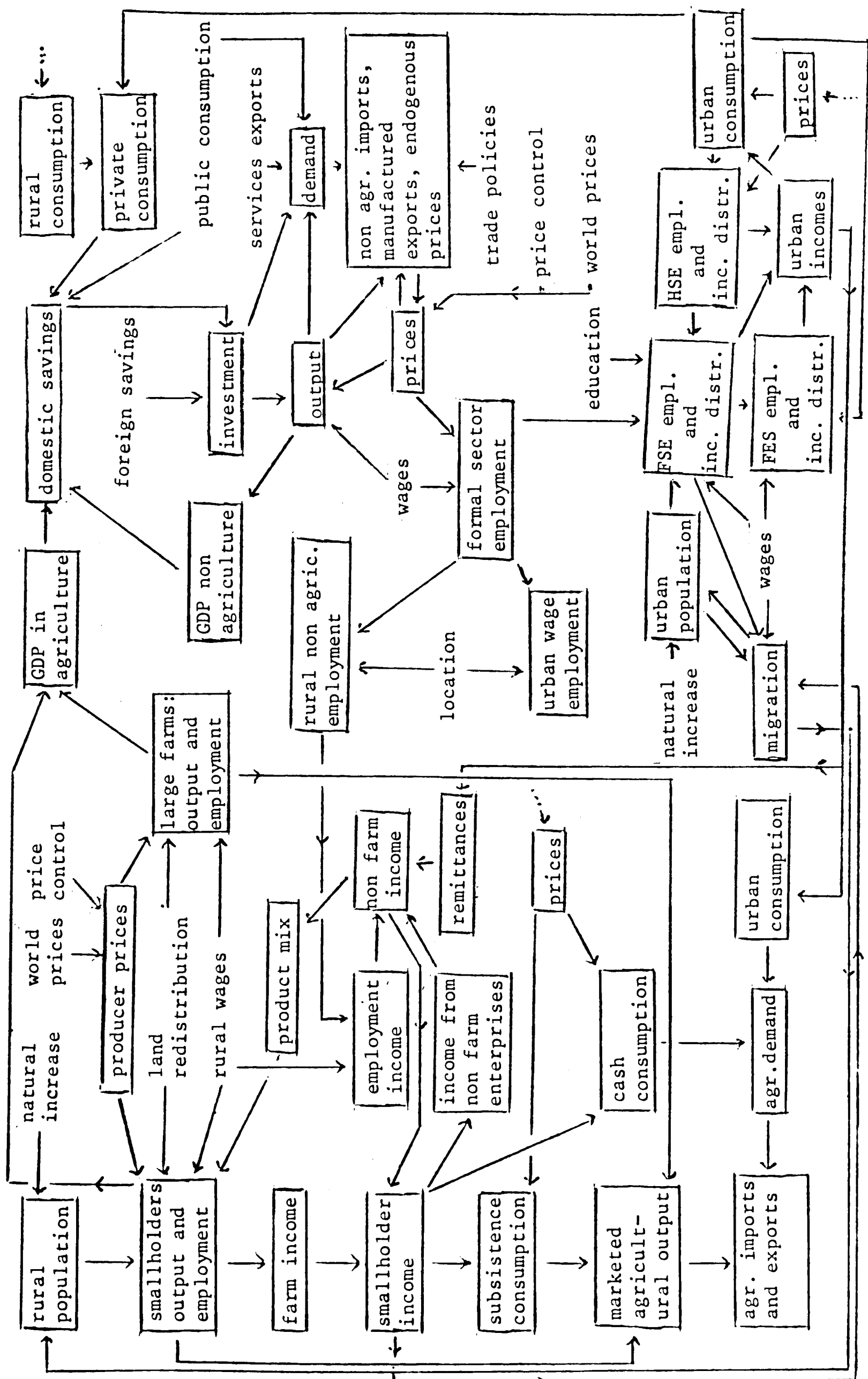
- 1 natural population growth rates
- 2 government programmes affecting product mix in agriculture
- 3 exports of non factor services (note that exports of goods, which in 1977 accounted for 72% of the total, are endogenous)
- 4 world prices for imports and exports
- 5 educational endowments of urban households
- 6 land redistribution
- 7 price control (retail prices for food, all agricultural producer prices and the maximum rate at which prices for (non food) manufacturing are allowed to increase are exogenous).
- 8 wages

- 9 the (rural/urban) location of non-agricultural formal sector employment
- 10 foreign savings
- 11 public consumption
- 12 trade policies, involving (a) import controls (b) exchange rate changes (c) protection of the (non food) manufacturing sector.¹

For the first five variables there is no difference between our simulation results. The runs differ in what is assumed about the remaining seven variables, all of which can be considered policy instruments.

¹. i.e. whether the 'open economy' (domestic prices follow world prices and imports are residual) or the 'closed economy' (domestic prices market clearing, imports controlled) variant of the model is used.

KENYA MODEL: FLOW CHART



FSE formal sector employment
agr. agricultural

FES free entry sector HSE
empl. employment
inc. distr. income distribution

HSE high income self employed

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List of Symbols in the Kenya Model¹

A_j	7.2.1.	constant term in the smallholder production function
A	7.4.1.	input-output matrix
B_{ij}	7.5.2.	share of sector i in the supply of investment in sector j
C	7.4.1.	private consumption
C_u	7.6.5, 7.6.17	urban private consumption
c	7.7.2.	urban private consumption
$\bar{c}$	7.7.2.	committed expenditures in the urban consumption function
E_i	7.4.1.	exports
E_{hk}	7.6.8.	number of job seekers
F	7.2.1, 7.2.5.	smallholder production, crops
$\bar{F}$	7.2.7.	smallholder production,
F^L	7.3.1.	crop production on large farms
$\overline{FS}$	7.5.5.	supply of foreign savings
FS_d	7.5.5.	demand for foreign savings
f	7.6.12.	labour supply, free entry sector
f_1	7.6.18	number of low income self employed
G	7.4.1.	public consumption
H	7.2.3.	household size (smallholders)
I	7.8.2.	urban household income
ID	7.5.1.	investment (by destination)
IS	7.5.2.	investment (by source)
IT	7.5.1.	total investment

1. except for elasticities and matrices this list does not cover fixed coefficients or subscripts.

K	7.5.6.	capital stock in manufacturing
L	7.2.1.	size of holding
L _{ce}	7.2.7- 7.2.10.	smallholder livestock ownership
MF	7.4.1. 7.4.2.	imports of capital and consumer goods (in domestic prices)
MI	7.5.3.	total imports of intermediate goods (in c.i.f. prices)
MIM _{ij}	7.5.3.	ratio of sector i type imports of intermediate goods (in c.i.f. prices) to sector j output (in domestic prices)
m	7.8.1.	migration
N	7.2.1.	total labour use (smallholders) for crops
N ₁	7.6.14	number of low income self employed
N ₂	7.6.14	number of labour force members in the free-entry sector, excluding the low income self employed (i.e. unemployed, casuals and 'others')
N ^H	7.2.4.	hired labour use (smallholders) for crops
N ^F	7.2.3.	family labour use (smallholders) for crops
N ^F	7.2.8.	family labour use (smallholders) for livestock
N ^H	7.2.9.	hired labour use (smallholders) for livestock
n	7.6.1.	labour supply, urban modern sector wage employment
n ^C	7.6.2.	cumulative labour supply, urban modern sector wage employment
n ^D	7.6.3.	labour demand, urban modern sector wage employment
n [*]	7.6.4.	employment
p _j	7.2.2.	producer prices (by province)
p _k	7.2.5.	producer prices (by crop)
p	7.7.2.	consumer prices

p_{ik}	7.6.2.	employment probability in the absence of rationing
p_1	7.6.15.	probability of modern sector wage employment for low income self employed
p_2	7.6.14	probability of modern sector wage employment for unemployed labour force members
p^D	7.4.3, 7.4.9, 7.4.11.	gross output prices
p^{D*}	7.4.3.	unconstrained gross output price in manufacturing
p^{mf}	7.5.4.	index of world prices for imports of final goods
p^{mi}	7.5.4.	<u>idem</u> , for intermediate goods
p_{int}^W	7.4.5.	<u>idem</u> . (but in domestic currency)
R	7.8.2.	urban-rural remittances
S	7.6.5.	number of high income self employed (total)
s	7.6.6.	number of high income self employed (by household type)
T^c	7.2.11.	number of coffee trees
u	7.7.1.	household utility
W	7.5.9.	modern sector wages (nominal)
W_r	7.6.16	mean real urban wage rate
W_s	7.6.16, 7.6.20, 7.6.21.	mean real income of the low income self employed
w	7.2.1, 7.2.5.	rural wages (nominal) on smallholdings
X	7.4.1, 7.4.8.	gross output (in the case of agriculture, marketed output only)
X^*	7.4.6.	investment determined output level in services sectors
X^D	7.4.10	demand for gross output
Y	7.6.23,	nominal income of high income self employed

y^{NF}	7.2.10.	non farm income (deflated by a weighted average of the asset price and of rural wages)
y^s	7.8.1.	index of real smallholder incomes
α	7.2.3.	supply of family labour for farm work (per capita)
α_j	7.2.1.	elasticity of crop production with respect to the size of holding
β_j	7.2.1.	elasticity of crop production with respect to employment
ϵ^p	7.2.5. 7.3.1.	elasticity of crop production with respect to the producer price/wage ratio
η	7.4.8.	elasticity of the output of the services sector with respect to profitability
η^*	7.8.1.	elasticity of migration with respect to the ratio of expected urban and rural incomes.
π_i	7.4.5.	index of costs
π_{ik}	7.6.3.	employment probability (after rationing)
$\tilde{\pi}$	7.8.1.	index of employment probability for migrants
ρ	7.4.8	index of profitability in services sectors
τ^e	7.5.4.	relative excess of domestic over export (f.o.b.) prices
τ^{mf}	7.5.4.	implicit tariff rate on imports of final goods

VIII SIMULATION RESULTS: KENYA

8.1. INTRODUCTION

In this chapter we present the results of thirteen simulation experiments with the Kenya model. In the next section we discuss the base run. The assumptions made in this case imply, to a large extent, the continuation of present policies. Notably, we assume that there will be no redistribution of land, no significant further erosion of real wages in the modern sector and no change in trade policies. In section 8.3 five experiments with trade policy and foreign exchange availability are discussed. In these runs we assume higher net foreign capital inflows, a devaluation, relaxation of import controls or the removal of protection for the manufacturing sector. The runs discussed in section 8.4 focus on the growth of the urban economy. Here we experiment with the growth rate of government expenditure, with a policy which keeps real wages constant and with a drastic change in wage policy, aimed at restoring equilibrium in the urban labour market. In section 8.5 we consider four policies which directly affect smallholders. Producer prices are raised, land is redistributed from large farms to smallholdings, food prices are determined by domestic demand and supply rather than by world prices, or the urban bias in the location of new employment is reduced.

The model is solved for each year in the projection period 1975-1985. In its complete version it is first solved for 1977: for 1975 prices are given and in 1976 investment is given so that, while the model solves for internal equilibrium (prices are endogenous) it does not have to solve for a level of investment which ensures external equilibrium. At the time of writing the

model's results could be compared with national accounts, balance of payments and agricultural production statistics for 1975 and 1976, while provisional estimates were available for 1977. Except for the parameters which were estimated on the basis of time series, this provides the only opportunity for the model's validation. Even this possibility is limited: much of the distributional information exists for only one year (e.g. urban income distribution data are available only for 1974, rural data only for 1975). With this limitation in mind, we can state that the model's results for the years 1975-77 (a short period, but one which saw extraordinary changes in the Kenyan economy, starting with a recession-cum-drought year and ending in the middle of the coffee boom) seem quite reasonable.

Most results are given in the text. Tables which allow comparisons between the simulation runs are collected at the end of this chapter.

8.2. BASE RUN

8.2.1. Assumptions

Before discussing the base run, we must outline the main assumptions on which it is based. The key assumptions in the field of trade and price policies are:

- the (non-food) manufacturing sector remains protected; imports are controlled and domestic price adjustments achieve market clearing: we use the 'closed economy version' of section 7.4.
- after 1977 the exchange rate (in terms of the US dollar) remains unchanged, but this already represents a 16% devaluation compared to the rate in the base year (1972) and a 13% devaluation since 1975 (the first projection year).

- very strict import controls (consistent with the historically low import ratio of 1975) remain in force.
- foreign savings are (through 1983) derived from detailed projections of interest payments - and receipts, amortisation, transfers, commitments and disbursements of loans and of changes in reserves. These projections imply a fall (of about 9%) in foreign savings in nominal terms. The need for a drastic reduction of the resource deficit (in real terms) is thereby imposed. We assume that foreign exchange reserves are increased each year by one sixth of the increase in imports, i.e. a policy aimed at maintaining a reserve level equivalent to two months of imports. For the last two years of the projection period foreign savings are kept constant in real terms.
- for world prices we use the most recent (October 1978) World Bank projections. These are not only used to derive exports and imports in current prices and to determine the gross output prices in sectors where the domestic price follows the world price;^{1.} in addition we assume that where prices are controlled, they will in fact be allowed to rise at the same rate as world prices. This applies to all producer prices (both for food products and non-food products, i.e. the export crops) and to gross output prices in the two food sectors: agriculture (food) and manufacturing (food). This does not imply a trade liberalisation policy whereby domestic prices equal world prices, but only that the ratio of the two - and hence the implicit tariff or subsidy rate - remains constant over time.
- the treatment of the food sectors is that which we specified in section 7.4: we are using, what we called for manufacturing, the 'open economy version'. Hence in the base run increases in food production do not affect prices, but only international trade.

1. i.e. mining and non-food agriculture, cf. table 7.4.2.

Secondly in the field of investment and wages, the assumptions (which are important for urban household incomes because of their effects on the urban wage bill) are:

- public consumption grows at the rate of 5% in constant prices. This compares with an average of 9.8% in the period 1964-72 and of 3.9% in the 1972-75 period and, since this is lower than the growth rate of GDP projected by the model, contributes to an increase in the domestic savings rates.
- nominal wages grow at the rate of 7%. Since, at least from 1979 onwards, consumer prices are growing at less than 7% in the base run, this is an assumption which can not be justified as the continuation of present policies. It implies that the policy of the early and mid 1970s whereby full compensation of inflation in wage settlements was not allowed is abandoned. Even so, it takes until 1981 for the real wage to reach its 1975 level again.

Finally, the most important assumptions affecting agriculture are:

- in addition to the endogenous growth of productivity (as a result of changes in land/man ratios and in product mix) there is exogenous productivity growth of 1.5% p.a.
- milk and beef production recovers from its low (drought affected) 1975 level: for the rest of the projection period livestock productivity is 15% higher than in that year.
- there is no redistribution of land.
- except for the effect of non-farm income on cattle purchases,¹ livestock ownership per holding remains unchanged. In other words, the number of cattle on smallholdings grows at the same rate as the population.

1. cf. equation (7.2.10)

- the total area of smallholdings grows at 1% per year. This corresponds to the increase ('mainly at the expense of grass lands') assumed in the Plan.^{1.}
- there is no change in the locational distribution of modern sector employment: for each sector, the distribution of employment between rural and urban areas (and, within rural areas, between provinces) remains as observed in 1974.^{2.}

Almost all of these base run assumptions are relaxed for the simulation runs described in the following sections.

8.2.2. Results: Macro-economic developments

The base run projections for macro-economic variables are summarised in tables 8.2.1 - 8.2.4. The projected development of the economy is not one of steady state growth. In this connection it is useful to distinguish between the first four years of the projection period (1975-78) and the long term (1978-85).

-
1. But spread out over a slightly longer period: the fourth Five Year Plan ends in 1983. Presumably, the switch from grass land to crop area would reduce the production by pastoralists. But since these fall outside the model's coverage, the increase in the smallholder area is a 'free lunch'. Kenya (1978b), p. 96a.
 2. This does not imply that the share of rural areas in total modern sector employment remains constant; as the urban bias differs between sectors that share will change with the sectoral composition of output.

Table 8.2.1.: Production

(Gross domestic product at factor cost in 1972 prices, K£M.)

	1976	1977	1978	1980	1983	1985	growth rate (%)		
							75-80	78-83	80-85
agriculture	104	109	112	124	138	147	4.8	4.3	3.5
(inc. subsistence)	175	187	188	198	220	236	4.8	3.2	3.6
industry	113	119	126	155	173	186	7.7	6.6	3.7
other sectors	396	413	459	516	587	640	6.7	5.0	4.4
total	613	640	698	795	897	973	6.6	5.1	4.1
(inc. subsistence).	684	718	773	869	979	1062	6.4	4.8	4.1

Table 8.2.2.: National Accounts*

(K£M, 1972 prices)

	1976	1977	1978	1980	1983	1985	growth rate (%)		
							75-80	78-83	80-85
GDP (market prices)	676	704	771	873	985	1067	6.6	5.0	4.1
Private consumption	374	383	392	472	552	591	5.7	7.1	4.6
Public consumption	148	155	163	179	208	229	4.3	5.0	5.0
Investment	133	154	255	222	211	228	11.1	-3.7	0.5
Exports**	223	220	224	250	286	314	3.8	5.0	4.7
Imports**	200	208	261	250	269	291	7.6	0.6	3.1
Domestic savings	156	166	218	222	228	251			
Foreign savings	-23	-12	37	0	-17	-23			

* the GDP identity does not hold exactly, not only because of rounding but also because the iterative procedure will stop even if the material balances are not exactly satisfied as long as price and quantity changes between iterations do not exceed the tolerance level. The maximum error which this causes is 0.3% of gross output and 0.5% of GDP. Hence foreign savings as given in the table (as the difference between investment and domestic savings, differ slightly from the resource deficit (imports minus exports).

** for 1976 the model overestimates exports by K£9 million and imports by K£14 million, so that the resource surplus is underestimated by K£5 million; for 1977 the (provisional) data are K£220 million for exports and K£211 million for imports, so the model's estimates are very close.

	1976	1977	1978	1980	1983	1985
including subsistence: GDP (market prices)	747	782	847	947	1067	1157
consumption	592	615	630	727	842	910

Table 8.2.3. Balance of Payments*

(millions of US\$)

	1978	1980	1983	1985
exports	1443	1704	2276	2818
imports	1814	2029	2606	3162
factor service income (net)	-217	-240	-309	405*
transfers (net)	83	136	167	
current account balance	-505	-429	-472	
capital imports (net)	342	449	540	
change in reserves	187	-20	-37	
total foreign savings= resource deficit	371	325	330	344

* the sum of factor service income, transfers, capital imports and change in reserves differs from foreign savings for the reasons given in the note to table 8.2.2. Since foreign savings are small compared to output, the relative error is larger in this case.

** detailed balance of payments projections are made only through 1983; for later years the total of items other than exports and imports is specified exogenously (cf. section 8.2.1).

Table 8.2.4.: Trade

	1976	1977	1978	1980	1983	1985
A: constant prices (KfM, 1972 prices)						
exports:						
agriculture	59.4	68.4	64.5	63.3	68.1	72.9
mining, manufacturing	66.1	56.0	57.8	72.3	81.8	88.1
other (NFS)	97.4	96.1	101.7	114.3	136.3	153.1
total	222.9	220.5	224.0	249.9	286.2	314.1
imports:						
consumer goods	54.7	50.0	53.6	36.9	43.4	47.3
intermediate goods	87.9	92.9	103.5	120.1	133.0	143.3
capital goods	47.4	55.7	93.3	79.7	76.6	82.8
other (NFS)	9.6	9.7	10.4	13.6	16.1	17.4
total	199.6	208.4	260.8	250.3	269.1	290.7

	1976	1977	1978	1980	1983	1985
B: current prices (millions of US\$)						
exports: agriculture	341.9	681.5	479.2	415.2	501.8	628.1
mining, manufacturing	417.3	443.2	499.1	699.7	938.4	1134.5
other (NFS)	383.4	407.0	464.7	589.5	836.2	1055.5
total	1142.6	1531.7	1443.0	1704.4	2276.4	2818.1
imports:						
consumer goods	263.0	259.1	299.1	232.4	325.4	398.7
intermediate goods	659.7	751.1	901.2	1179.7	1556.7	1884.0
capital goods	248.1	314.3	566.3	546.5	625.2	759.2
other (NFS)	37.7	41.2	47.3	70.3	98.8	119.7
total	1208.5	1365.7	1813.9	2028.9	2606.1	3161.7

C: Price Indices (1972=100)

exports	215	288	250	264	308
imports	253	271	270	314	376
terms of trade	85	106	93	84	82

The first period is one of rapid growth, marking both the recovery from the 1975 recession¹ and the effect of the coffee boom on agricultural production, on the balance of payments and on investment.² While almost all of the increased production on smallholdings is reflected in higher consumption, incomes in the rest of the economy grow little (only 10½% over the three year period), largely because real wages are eroded by inflation. The result is a significant increase in domestic savings which explains most of the dramatic rise in the level of investment; while investment showed no change

1. GDP at factor cost (excluding subsistence) grew at 0.5% in 1975 and 7.3% in 1976. The model reproduces this recovery: the projected growth rate for 1976 is 6.1%.

2. on the basis of 1975=100 producer prices for coffee are 236 in 1976, 370 in 1977 and 236 in 1978. Prices continue to decline until 1982, but by 1985 the index has reached 238 again.

from 1975 to 1976, by 1978 it has doubled. Some of this is due to the improved balance of payments position - in 1978 foreign savings are positive for the first time and finance some 15% of investment - but that contribution is modest. The rapid growth is reflected in a boom in the construction sector (from which the self employed benefit) and in sharp price rises in that sector and, to a lesser extent, in manufacturing, trade and transport. In the case of non-food manufacturing the growth of demand is such that import controls have to be relaxed in order to avoid excessive price increases:¹ throughout this period additional imports are allowed in to clear the market.²

Long term developments are radically different. The terms of trade deteriorate (largely because of the fall in the price of coffee)³; foreign savings rise slightly in current prices but become negative in real terms; the real wage recovers and this contributes to a fall in the domestic savings rate;⁴ investment never reaches the peak of 1978 again; and the growth rate falls in all sectors, in agriculture because of unfavourable prices, in the rest of the economy mainly because of the reduction in the investment rate.

The difference between the two periods is reflected in the development over time of imports as a percentage of GDP: this indicator peaks in 1978 and by 1985 - when foreign savings have fallen and import controls are tight again -

1. cf. equations (7.4.3), (7.4.4).

2. this explains the fall in the level of consumer goods imports after 1978 (table 8.2.4): demand pressures are reduced because investment stops growing and manufacturing production grows (both because of high investment levels and because of price increases). As a result, the constraint on price rises is no longer effective and there is no longer a need for additional imports.

3. excluding coffee the terms of trade index (table 8.2.4, panel C) would have fallen by 12% over the period 1977-1985 rather than by 23%.

4. excluding subsistence, the rate is 28% in 1978, 24% in 1985.

has returned to its 1975 level. As noted above, the relatively low long term (post 1978) level of imports is caused - in addition to the effect of the reduced demand for capital goods - by a fall in imports of consumer goods. There are two reasons for this. First, domestic supply of (manufactured) food grows faster than demand. Eventually this virtually eliminates the need for food imports. Secondly, the constraint on price rises in manufacturing is no longer effective and hence the category of 'additional' imports disappears (table 8.2.5).

While the growth rate projected for private consumption (excluding subsistence) is 5.7% in the period 1975-80 and 4.6% in 1980-85 (table 8.2.2) it is considerably higher for the Plan period, 1978-83 (7.1%). This is the result of: (a) rapid growth in urban incomes, caused (both directly and indirectly) by the recovery of real wages and expansion of modern sector employment. This

Table 8.2.5.: Imports

(K£ million, 1972 prices)

	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1983</u>	<u>1985</u>
index of the ratio of imports to GDP (1975=100)	109	109	125	105	100	100
total imports	199.6	208.4	260.8	250.3	269.1	290.7
consumer goods	54.7	50.0	53.6	36.9	43.4	47.3
of which:						
food	13.1	17.8	10.8	1.4	0.9	1.9
non food	28.4	29.0	29.0	35.5	42.5	45.3
'additional' non food	13.2	3.2	13.8	-	-	-

is reflected in a growth rate of urban consumption^{1.} of 8.3% in the 1978-83 period (which falls to 5.1% for 1980-85 when real wages rise at less than 2% per year and the growth of wage employment slows down); (b) the 'trickle-

1. urban consumption is used here as shorthand for all cash private consumption except that by smallholders.

down' of urban prosperity to smallholders, whose cash consumption grows at 5.2% in 1978-83 but at 3.9% in 1980-85. The composition of consumption changes little in the short run (although relative price changes do induce substitution between manufacturing and agriculture); in the long run the most important change is (as one would expect) the fall in the share of agriculture: this share drops from 13% (25% if subsistence is included) in 1975 to 11% (23%) in 1985.

The slow down in growth is most marked in the manufacturing sector (table 8.2.1). Three factors interact here. First, the stagnation of investment is a two-edged sword in the case of manufacturing, affecting not only the growth of the sector's capital stock but also the demand for its output (almost half of total capital formation represents demand for manufactured goods). Secondly, output prices rise very little after the rapid inflation of the early years and this raises the real wage to the producer. During the Plan period, these two effects are mitigated by the growth of consumption demand. When growth of that demand component slows down (from 6.9% in 1978-83 to 4.8% in 1980-85) the full implications of the two other factors become evident.

8.2.3. Results : Agriculture and Rural Incomes

We will now consider agricultural production (table 8.2.6). Two developments deserve emphasis. First, smallholder production grows rapidly (as a result of land intensification induced by population growth and of changes in the product mix towards livestock and coffee: adoption of these innovations contributes significantly to the rise in the value of output); in fact marketed output grows almost twice as fast as production in large farm areas. Coffee prices (which in 1985 are only 11% higher in terms of wages than in 1975) are

Table 8.2.6.: Agriculture

(Kf million, 1972 prices)

	1975	1980	1985	Growth rate 1975-85 (%)
<u>smallholders</u>				
food crops	55.1	66.1	79.5	3.7
livestock products	45.6	65.8	82.6	6.1
total food	100.7	131.9	162.1	4.9
own use*	67.6	86.2	104.7	4.5
total marketed food	33.1	45.7	57.3	5.6
coffee	12.5	16.8	21.2	5.4
other non-food crops	10.1	12.8	15.2	4.2
total non food	22.6	29.6	36.4	4.9
total production	123.3	161.5	198.5	4.9
of which: marketed	55.7	75.3	93.8	5.4
<u>large farms</u>				
food	11.0	13.8	15.6	3.6
coffee	13.2	14.9	15.7	1.7
other non food	22.8	27.8	31.7	3.4
total production	47.0	56.5	63.0	3.0
<u>total agriculture</u>				
food	111.7	145.7	177.7	4.8
of which: marketed	44.1	59.4	73.0	5.2
own use*	67.6	86.2	104.7	4.5
non food	58.6	72.3	83.8	3.6
total production	170.3	218.0	261.5	4.4
<u>producer prices</u> **				
food	100	155	219	8.2
non food	100	181	246	9.4
total	100	160	224	8.4

* largely (95% in 1975) own consumption, but also output used as seed, fed to livestock or used for wage payment in kind.

** weighted by 1975 smallholder production.

an important reason behind the slow growth of large farm production.

Secondly, marketed food production grows at a rate of almost 6% per year

(largely because of increased livestock ownership on smallholdings). As

we noted above the effect of this is that Kenya's food imports are eliminated.

Since milk can not be exported and some other food products only at a loss

this raises questions about the long run desirability of the food price

control policy which we have assumed. ^{1.}

In current prices, the value of production on smallholdings grows by more than 10% per year; farm costs, however, rise even faster (largely because of the increased need for hired labour) so that income from farming grows at 8.7% (table 8.2.7). Total household income grows slightly faster, but the terms of trade remain virtually constant^{2.} so that in real terms smallholder incomes show very little improvement and this applies to all provinces. In 1977 all provinces show substantial income gains - this is especially true for Central and Eastern provinces, which benefit from high coffee prices and where real per capita incomes are 19% and 25% respectively higher than in 1975 - but these gains are transient.

The distributional indicators in the table have to be treated with more than usual^{3.} caution. This is because, within a province, our disaggregation of smallholders is based on the size of the holding, not on income. The correlation between the two variables is weak, so that our procedure has the effect of underestimating inequality; this explains the low level of the Gini coefficient. With this caveat in mind the time path of these indicators still is of some interest. For the smallholder population taken as a whole there is little change; although the percentage of people who can be classified as poor falls, the absolute number remains virtually the same. Similarly, the income share of the bottom 40% and the aggregate Gini

1. that assumption is relaxed in run 11, section 8.5.

2. while producer prices grow at 8.4%, consumer prices grow at between 7 and 8%.

3. the properties of the Gini coefficient - in particular its insensitivity to certain forms of distributional change - are by now well known; cf. Atkinson (1970), Champernowne (1974).

coefficient show little change. There are however considerable inter-provincial differences, as a result of differences in the need for hired labour; employment and other non-farm income opportunities and product

Table 8.2.7.: Smallholder Incomes

(Ksh per year)

	1975	1980	1985	growth rate 1975-85
<u>income per household</u> (current prices)				
value of production	2528	4518	6718	10.3
farm costs	566	1350	2220	14.6
farm income	1962	3168	4498	8.7
non farm enterprises	354	579	842	9.1
wages	818	1447	2219	10.5
remittances	399	587	839	7.7
total non farm income	1571	2613	3900	9.5
household income	3533	5781	8398	9.0
<u>number of households</u> (thousands)	1483	1717	1987	3.0
<u>migration</u> (thousands of people, net)	3.3	4.2	4.6	3.4
<u>income per household</u> (1974 prices)				
Central	3221	3471	3551	1.0
Coast	2633	2841	2985	1.3
Eastern	3170	3492	3653	1.4
Nyanza	2407	2481	2609	0.8
Rift Valley	3289	3696	3944	1.8
Western	1916	1986	2085	0.8
<u>distributional indicators</u> *				
Gini coefficient	0.141	0.147	0.144	
share of bottom 40%(%)	30.5	29.7	29.9	
% of population poor**	19.1	14.6	14.6	

* these are based on per capita income in 1974 prices; see text for the interpretation of the low Gini coefficient.

** based on a poverty line of Ksh 287 (1974 prices) per year or Ksh 2000 in terms of household income; this is the poverty line used by Collier and Lal (1979, p. 171)

mix. Inequality (as measured by the Gini coefficient) is reduced in Central, Eastern, Rift Valley and Western provinces but it increases in Coast and Nyanza provinces. These effects approximately cancel each other out in the aggregate.

As smallholders are increasingly involved in non agricultural employment and as production grows faster than the population, surplus family labour is reduced and the sector depends increasingly on hired labour (which accounts for 8% of total labour use in 1975, for 23% in 1985). This increase in rural employment opportunities is important not only for smallholders themselves but also for the landless (a group which falls outside the model's coverage).

8.2.4. Results: Urban Labour Markets and Incomes

Rapid growth of modern sector wage employment - the growth rate is almost 5.5% or 2% in per capita terms - is the most important cause of the changes in the urban labour market and in the urban distribution of income (tables 8.2.8, 8.2.9).

Quantity changes, i.e. the shift of the labour force into high income self employment and modern sector wage employment out of the free-entry sector dwarf the rise of the real wage and of the incomes of the (low income) self employed.

The demand for the services of the self employed grows rapidly, but, while this draws more and more people into the elite of high income self employment,¹ it does not offset the effect of increased employment

1. this represents a once and for all bonus for those who enter, since we assumed that incomes in this sector remain constant.

probabilities on the number of low income self employed. That group continues to grow but it expands much more slowly than the urban labour force. The composition of the labour force changes substantially: while in 1975 65% are wage employees and 23% unemployed (including 'other' occupations), in 1985 those percentages are 76% and 13% respectively.

There are two other favourable developments. First, the growth of employment differs between skill/income levels: it is biased towards the higher income jobs. Secondly, as those with higher educational qualifications are drawn into high income self employment, the bumping model works in reverse: jobs formerly reserved for those with higher qualifications are now opened up to those with less education.

Finally, table 8.2.8 shows a significant narrowing of the gap between wages and incomes in the free-entry sector (the ratio falls from 2.6 to 1.8); in other words, the projected development is one which brings the economy closer to urban labour market equilibrium. This adjustment process is not disturbed by rural to urban migration; although migration increases by almost 40%, this growth occurs from such a low base that the negative effects on urban incomes which we projected for Tanzania (chapter 5) are averted. There are differences in real income gains between types of households (table 8.2.9), but the overall distribution shows little change,² although there is some improvement.

1. while the national growth rate is 3.1%, migration raises the population growth rate to only 3.4%.

2. at least in terms of the two indicators which we present. Note that these are calculated in terms of per capita incomes. They would show greater inequality if based on household incomes, since as the table shows, household size is correlated with income, so that the per capita distribution is more equal. The caveat about the interpretation of the low level of the Gini coefficient (see above) applies here as well.

Table 8.2.8.: Urban Labour Force and Employment

	1975	1985	growth rate 1975-85
<u>A</u> mean number of people per household.			
high income self employed	0.093	0.115	2.1%
regular wage earners	1.002	1.235	2.1
low income self employed	0.084	0.068	-2.1
unemployed, others	0.352	0.209	-5.1
labour force	1.531	1.627	0.6
job seekers by education level (k)*			
1	0.145	0.136	
2	0.556	0.542	
3	0.492	0.588	
total job seekers	1.193	1.266	0.6
total wage employment	1.002	1.235	2.1
wage employment by income level (i)*			
1	0.100	0.138	3.3
2	0.126	0.164	2.7
3	0.343	0.441	2.5
4	0.434	0.492	1.3
employment probability (p_2)*	0.71	0.83	
<u>B</u> real incomes (1974 prices), Ksh/month			
wage earners (W_r)*	885	958	0.8
low income self employed (W_s)*	344	533	4.5

* see section 7.6.

In the short run (1975-78) the differences in income growth between households are more pronounced; this is because the fall in the real wage (13%) does not affect all household types equally.

While the base run therefore does not project much change in either the rural or the urban income distribution - the former becomes slightly more, the latter slightly less unequal - the overall distribution does

Table 8.2.9.: Urban Income Distribution

household type*	% of households	household size	1975		1978	1985
			incomes in 1974		household incomes	(1974 prices)
			prices			
			(mean=100)			
			per house- hold	per capita	(1975=100)	
1	17.8	2.8	43	66	112	143
2	30.0	4.2	66	69	103	137
3	17.8	5.0	119	103	97	130
4	7.5	4.7	284	262	93	132
5	8.9	4.2	31	32	101	126
6	8.4	4.7	241	223	100	107
7	4.0	4.2	60	62	106	118
8	5.5	3.5	82	102	106	108
total	100.0	4.1	100	100	103	130
number of households (1975=100)			100		111	140
Gini coefficient**			0.30		0.28	0.28
share of bottom 40%(%)**			23.5		24.4	25.0

* see section 7.6 and appendix 3.

** these indicators are based on per capita incomes in 1974 prices.

deteriorate: urban household incomes grow at 2.7% per year (in real terms) but on smallholdings (where most of Kenya's poor are to be found) incomes rise much less (table 8.2.7).

8.3. TRADE AND PRICES

In run 2 the base run assumption on the supply of foreign savings is relaxed; in this run foreign savings are 10% higher (in terms of current world prices), starting in 1978.¹ The results - see table 8.6.2. - are predictable up

1. in all simulation runs, differences from the base run first occur in 1978. Since we maintain the assumption that after 1983, in the absence of the 10% increase, foreign savings would be equal to the preceding year's value in real terms, the nominal increase in the last two years is in fact larger than 10%

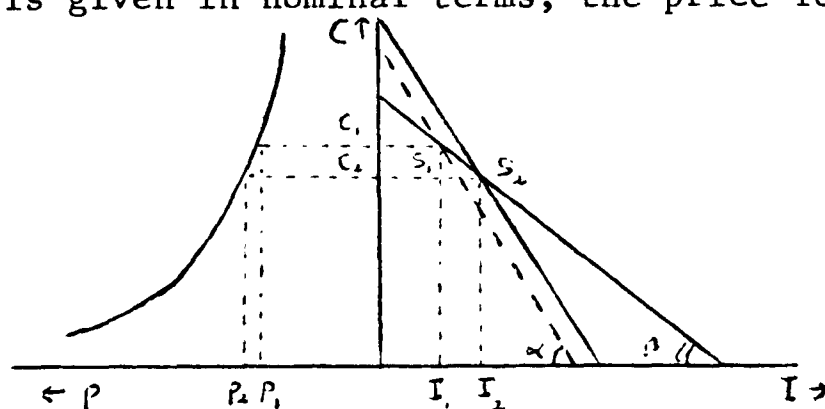
to a point. As expected, investment rises (in 1985 it is 10% higher, in real terms, than in the base run). What requires comment is that this increase is larger than the real increase in foreign savings. For the early years the reason is that the increased expenditure financed out of foreign savings leads to inflationary pressures in the economy. As prices rise, real incomes of both farmers and of wage earners are eroded since producer prices and wage rates remain fixed in nominal terms. Hence private consumption falls and the increase in foreign savings is complemented by an increase in domestic savings.

The effect may be illustrated with the aid of a very simple model. Assume a one-sector economy which does not export, in which output is predetermined and in which imports are related to consumption and investment by fixed coefficients:

$$(8.3.1) \quad \text{GDP} = (1-\mu_C) C + (1-\mu_I) I$$

$$(8.3.2) \quad \text{FS} = \mu_C C + \mu_I I$$

Consumption is given in nominal terms, the price level is to be determined.



The two equations are shown in the right hand half of the diagram, the steeper line representing (8.3.2). One would expect $0 < \mu_C < \mu_I < 1$, hence $\alpha > \beta$ and this implies that an increase in FS^1 will raise I but lower C ; therefore I will rise by more than FS . As long as nominal wages and producer prices are not adjusted (so that personal incomes (in current prices) are highly inelastic with respect to consumer prices) and as long as a large

1. which shifts the equilibrium from S_1 to S_2 .

part of imports is affected by controls (so that the 'closed economy' specification of (8.3.1) and (8.3.2) applies), the economy's rate of investment will be very sensitive to the level of foreign savings: any increase in the latter will be complemented by an increase in domestic savings.^{1.}

This erosion of real incomes by inflation is however a transient effect: real wages are lower than in the base run only during the first four years (1978-81). Thereafter, the increased supply - the result both of higher investment and of higher domestic prices - offsets the effect of the demand shift; in the final year of the projection consumer prices show virtually no difference from the base run results. Hence what causes the increase in investment over and above the increase in foreign savings in this later period is simply a multiplier effect: as output increases domestic savings rise and this finances a further increase in investment. The cumulative increase (over the period 1978-85) in foreign savings (measured in constant prices) is Kf 59 million, that in investment Kf 102 million. By 1985 GDP is 2% higher (table 8.6.2), the increase in production being largest for manufacturing (3.8%). This extra growth benefits urban households most (tables 8.6.3. and 8.6.4); while their real incomes rise by almost 3%, smallholder incomes - which are of course less sensitive to expansion of modern sector employment - rise much less (by almost 2% in Coast province, by about 1% in other provinces).

1. this must be kept in mind in interpreting the results; the differences with the base run would be smaller if some nominal incomes were to be adjusted for inflation.

The next four experiments are all concerned with trade policies and here we do assume that wage policies are adjusted for the resulting changes in consumer prices: as in run 9 (which is discussed in the next section) wages are assumed to be at levels which keep the real wage constant. Hence the results of these four simulations are to be compared with the results of run 9 rather than with the base run (table 8.3.1).

In run 3 the Kenyan shilling is assumed to be devalued by 15%. Producer prices for non food crops go up by the same percentage - the gain in the value of exports is passed on to farmers - and this implies a substantial shift in the domestic terms of trade in favour of agriculture, and production increases as a result.¹ But while real wages are protected smallholders' real incomes are eroded by inflation; on balance they lose rather than gain from this policy. The growth of the non-agricultural sectors is reduced (table 8.6.2), leaving total GDP virtually unchanged. This reduced growth of the urban-based sectors can, again, be traced to the policy of compensating wage earners for inflation: the growth of manufacturing is retarded, partly because of lower private consumption, but largely because wages rise in terms of output prices. As the manufacturing sector's demand for services is reduced, the slowdown spreads to other sectors. This reduces the rise in smallholders' non farm income and is the second reason why their real

1. but not by as much as one might expect. There are two reasons for this. First, the policy of compensating wage earners in the modern sector for the rise in prices affects large farms; the higher producer prices are partly offset by higher wages. Secondly, because we assume that food prices remain at their pre-devaluation (controlled) levels. Hence less than one third of total agricultural production is affected. Since the wage on smallholdings is fixed in terms of food prices, the price-wage ratio would not rise at all for smallholders if this assumption were dropped.

incomes are slightly reduced in spite of the positive effect of the devaluation on farm incomes.

In the second trade policy experiment (run 4) we use the 'open economy' specification for non food manufacturing: from 1978 on, the price of industrial goods follows the world price - i.e. the ratio between the domestic and the world price remains constant - and imports are allowed in to clear the market. The results are somewhat counterintuitive (table 8.6.2). One might expect reduced growth of output and prices in the industrial sector as the pressure of domestic demand would be translated into imports rather than into price rises, but in fact the results point in the opposite direction. This is because in the base run inflationary pressures were concentrated in the first few years (1975-78) of the projection. After these boom years, prices in the manufacturing sector rose very little in the base run (and in run 9), largely because of the stagnation in investment demand.¹ The implication of the 'closed economy' specification is therefore that during this later period the implicit tariff rate falls as domestic prices remain above, but grow more slowly than world prices. That effect is now reversed: when from 1978 onwards domestic prices grow at the same rate as world prices, the tariff rate remains at the high level reached in 1977 induced by demand pressures in these years. The experiment yields three notable results. First, smallholders suffer a terms of trade loss as their producer prices remain unchanged while they have to pay higher consumer prices. Real incomes fall and this significantly increases the number of rural poor

1. cf. the discussion in section 8.2.2. which is valid for run 9 as well.

(table 8.6.3). Secondly, the rise in the real wage rate (to the producer) in manufacturing is now mitigated by the higher price level. Industry and the services sectors - which heavily depend on demand from the manufacturing sector - grow more quickly as a result and urban households benefit from this through an increase in modern sector wage employment (tables 8.6.2 and 8.6.4). Finally, there is a substantial increase in the level of investment, which now does surpass the peak of the late 1970s. In terms of income distribution the results are regressive: while urban households benefit, rural households lose.

Hence, if the switch to the 'open economy' trade policy is to have the effects one expects of trade liberalisation, relaxing import controls needs to be complemented by reducing tariff rates since otherwise - in this peculiar situation in which implicit tariffs would otherwise have fallen - the strategy would amount to replacing one form of protection by another. Given this characteristic of the run (of higher industrial protection but in another form), the results should not come as a surprise: the growth of the urban based sectors is stimulated and urban groups gain at the expense of the rural poor.¹

Run 5 combines the devaluation and 'open economy' specification of the two preceding experiments. As far as production is concerned (table 8.6.2) the positive effect of the latter change almost completely offsets the small negative effect which, as we have seen, a devaluation has on output: in run 5 GDP (at factor cost) is very close to its value in run 4 and some 3½% higher than in run 9. But, again, much of this increase can not be interpreted as the traditional effect of trade liberalisation. Similarly, much of the

1. Cf. Little, Scitovsky and Scott (1970), Healey (1972).

increase in the rate of investment - which is 24% higher than in run 9 - is achieved at the expense of the real incomes of smallholders who are not protected against the resulting inflation (table 8.6.3). Interestingly, both run 4 and run 5 show a narrowing of the gap between the incomes of wage earners and those of the low income self employed:¹ the self employed gain as the demand curve for services shifts with urban growth.

The final trade policy experiment (run 6) involves a relaxation of import controls. The allowed level of consumer good imports (to the extent that they are non food manufactures) is raised by 30%.² This leads to two changes in the projected macro-economic development (table 8.6.2). First, as protection is removed, the profitability of the industrial sector is reduced and this reduces growth of non-agricultural GDP. Secondly, investment is reduced, not only because of a fall in domestic savings (consumption increases while output falls) but also, with consumer goods now claiming a larger part of total imports, the burden of the foreign exchange constraint rests more heavily on investment as there is less room for imports of capital goods. The results provide an interesting illustration of the extent to which import controls favour urban over rural groups. Urban unemployment increases (table 8.6.4), incomes of the self employed fall and urban household incomes fall by more than 10%. On the other hand, smallholders benefit from lower consumer prices: their real incomes rise by 9-11%.³ The effect on rural poverty is quite substantial: 1½% of the rural population sees its incomes now rise above the poverty line.

1. W_r and W_s in Table 8.6.4.

2. As table 8.2.5. shows, sector 3(4): non food manufacturing dominates consumer goods imports. In terms of section 7.4 what is changed is the coefficient μ^C in equation 7.4.2. but only for this one sector (which however is by far the most important one).

3. The extreme cases are 9.0% for Central and 10.9% for Eastern province.

What may we conclude from the five simulation experiments discussed in this section? First, that the economy's growth rate depends strongly on Kenya's ability to import capital - investment rising by considerably more than an increase in foreign savings. But such foreign-financed growth benefits urban households much more than smallholders. Secondly, that the removal of protection of the manufacturing sector through import controls should be complemented by a gradual reduction in the tariff rate if one form of protection is not to be replaced by another. Thirdly, that a devaluation - unless accompanied by a change in food pricing policies - hurts smallholders as much as consumers as it helps them as producers of export crops. Fourthly, that import controls protect urban groups at the expense of the rural population, which would benefit enormously from the effect on inflation of their removal. Fifthly, that trade policies can not be considered in isolation: counter intuitive results may occur if trade policies are not co-ordinated with policies affecting wages, food prices and agricultural producer prices. Finally, that the presumption that smallholders are largely unaffected by trade policies is ill-founded. This common presumption is based on an identification of smallholders with 'subsistence' production and consumption. The IRS results have shown how misleading that characterisation is: consumption of 'own produced items' is only 38% of total consumption by smallholders.^{1.} Given the extent of smallholders' participation in markets - both as producers and as consumers - we feel justified in our valuation of all of their production and consumption at market prices (as a proxy for opportunity costs in the case of non marketed items). But this implies that smallholders are vulnerable to the effects of trade policies on prices, especially if producer prices remain unchanged.

1. Kenya (1977), p.58.

We have assumed that wages in the modern sector would be fully adjusted for changes in consumer prices. While we consider this assumption realistic - claims for inflation corrections would be very hard to resist considering the substantial erosion of real wages which has already occurred since 1969 - it would be interesting to see the effect of adopting the opposite extreme, i.e. no change in nominal wages. This is illustrated in table 8.3.1 where runs 3-6 are compared with the base run for the case when nominal wages are not, and with run 9 for the case when they are adjusted for price changes.

Table 8.3.1.: Trade Policies and the Effect of Wages Adjustments, 1985

	simulation run							
	3	4	5	6	3	4	5	6
	without adjustment (run 1 result =100)				with adjustment (run 9 result = 100)			
GDP at factor cost:								
agriculture	100.3	99.5	100.6	99.2	100.8	100.4	100.8	100.8
industry	102.3	110.1	124.6	91.2	98.6	110.7	109.8	92.1
other sectors	100.8	103.0	106.2	98.3	99.1	102.9	102.4	95.3
total	100.9	103.5	108.2	97.3	99.4	103.8	103.5	95.9
investment	98.4	114.1	134.1	89.4	100.0	121.2	123.8	83.5
real wages (1)	100.1	96.8	91.3	101.6	98.2	100.1	97.6	98.7
real incomes:								
urban	100.6	101.0	100.0	98.9	97.1	104.4	101.5	95.0
rural	103.3	98.6	98.6	101.5	99.9	83.0	83.2	109.1

(1) cf. note 2 to table 8.6.4.

8.4. INVESTMENT AND WAGES

In run 7 public consumption grows at 7% per year, compared to the 5% assumed in the base run. The analysis of such a policy change must of course be partial, since, while the model recognises its effects on output, prices and employment, the additional expenditures do not increase anyone's welfare: our real income measures ignore the provision of public goods. Hence our concern here is with the macro-economic implications and here the difference with the Tanzania results is striking. In that model demand does not affect prices and therefore the main effect of increased public consumption is to reduce domestic savings. Eventually this leads to a reduction in growth. But in the Kenya model prices are endogenous and while the fix-price results in the Tanzania model are valid in the short run, in the long run they are reversed through price effects. (Table 8.4.1). The price rises induced by increased expenditures erode real wages - we assume that the (nominal) wage policy remains unchanged - and thereby, through lower urban consumption, leads to a higher level of investment. By 1985 urban modern sector employment is 3% higher: because the public sector is larger, because the lower wage level has induced factor substitution and because the additional investment has raised labour requirements. But this extra employment does not fully compensate for the real wage reduction: in 1985 urban incomes are 5% lower. While the results illustrate that in the long run public consumption is not necessarily bad for growth - in 1985 GDP is in fact almost 2% higher than in the base run - the price rises do have serious implications: real incomes, both of urban household and of smallholders fall. While rural incomes fall less, the losses are still quite substantial, e.g. in Nyanza real incomes fall by 3½%.

In the next two runs (8 and 9) the wage policy of the base run is abandoned. In run 9 the policy aims at keeping the real wage constant (hence, compared

to the base run it implies a higher real wage until 1979, but a lower one thereafter.) The policy of run 8 is less simple, its aim being to restore equilibrium in the urban labour market by reducing the gap between incomes of wage earners and of the low income self employed.¹ Under

Table 8.4.1.: Investment and Wages

	1 9 7 8				1 9 8 5			
Simulation run:	1	7	8	9	1	7	8	9
regular wage employment (1)	1.145	1.148	1.161	1.138	1.235	1.272	1.331	1.335
unemployment, other (1)	.256	.255	.257	.254	.209	.215	.219	.210
total job- seekers (1)	1.199	1.203	1.213	1.193	1.266	1.320	1.398	1.398
nominal wage (2)	134	134	125	143	215	215	125	137
consumer prices (2), (3)	154	154	153	155	199	215	140	146
real wages (2)	87	87	82	92	108	100	90	94
GDP (market prices) (4)	771	773	774	771	1067	1082	1131	1136
private consumption (4)	392	393	377	407	591	564	599	610
public consumption	163	166	163	163	229	267	229	229
investment	255	254	273	239	227	233	280	273
real urban incomes (5)	3645	3652	3440	3842	4615	4380	4084	4267

Notes: (1) average number of labour force members per household.

(2) index 1975 = 100

(3) urban

(4) excludes subsistence consumption

(5) per capita, 1974 prices.

1. W_r and W_s in the notation of section 7.6.

this policy, the model solves for nominal wages which - once the effect of wages on consumer prices is taken into account - imply a real wage rate satisfying:

$$(8.4.1) \quad W_r = 0.8 W_{rt-1} + 0.2 W_{st-1}$$

but with the constraint that wages can not fall in nominal terms. As it turns out, this constraint is effective throughout the period so that what we model is in fact a very extreme policy of keeping nominal wages constant at their 1977 levels.¹ This might be expected to lead to a rapid narrowing of the gap between W_r and W_s - a gap which can be considered to be an indicator of the extent of labour market disequilibrium: wages fall and increased employment would reduce the size of the free-entry sector and thereby raise the incomes of the self employed. But two factors work the other way. First, at lower wages open unemployment is a less attractive job search strategy; job seekers shift from open unemployment into self employment,² thereby, through competition, forcing down incomes in that sector. Secondly, the fall in wages reduces urban incomes and thereby the demand for the services of the self employed. The four factors offset each other exactly: in 1985 W_s is 56% of W_r , both in run 8 and in the base run. In that sense, the policy fails entirely in solving the disequilibrium problem.

As far as macro-economic effects is concerned (table 8.4.1) run 9 (the case of constant real wages) is intermediate between run 1 (real wages rise by 8%) and run 8 (real wages fall by 10%): GDP (at market prices) is 6.5%

-
1. given our base run assumptions: under other assumptions the policy may imply modest nominal wage increases at the end of the projection period. Similarly, nominal wages would rise if the projection period was longer: in 1985 W_r is less than 6% above the value given by (8.4.1).
 2. this shift can be seen from table 8.4.1.: 'unemployment, other' falls as a percentage of 'total job seekers' from 16.5 to 15.7%; the number of job seekers is higher because fewer people are absorbed into high income self employment.

higher in 1985 than in the base run (compared to 6.0% for run 8), investment 20% (23% in run 8).

The household incomes which are most strongly affected by wage policies are - somewhat unexpectedly - not those of urban households but those of smallholders. The reduction in inflation as a result of the wage restraint in run 8 implies a massive shift in the terms of trade in favour of smallholders (table 8.6.3). In current prices smallholder incomes are reduced because of a fall in non farm income - remittances fall with urban incomes and employment income falls with wages - in real terms smallholders gain immensely from the policy as the value of producer prices in terms of the rural consumption basket rises: in four out of the six provinces per capita incomes are at least 30% higher in 1985 than in the base run. This is reflected in a considerable drop in the number of people under the poverty line (from 14.6% to 6.6%). Since urban incomes fall and rural incomes rise, the most important effect of the two wage restraint policies is a massive redistribution of income from urban to rural households.^{1.}

Although the main purpose of run 9 is to provide a basis of comparison for the trade policy experiments which we discussed above, table 8.4.1. reveals one very interesting result. The wage policies assumed in runs 8 and 9 are radically different but the ultimate effect on real wages, on urban incomes and on the urban labour market is very similar: the attempt to stabilize real wages results in run 9 in a very strong wage-price spiral, leaving the real wage in 1985 only 4½% higher than in run 8 in spite of an enormous difference in nominal wages. Paradoxically, urban households are almost as

1. the overall Gini coefficient in 1985 is .59 in the base run, .51 in run 8, and .52 in run 9.

well off under constant nominal wages as under constant real wages, and from the point of view of its effect on the rural population the former policy is to be preferred.

8.5. AGRICULTURE

The most obvious way in which the government can influence agricultural growth is through its pricing policies and this is the subject of two of our simulation runs.

In run 10 all producer prices are set at levels 10% higher (in nominal terms) than in the base run.¹ The differences with the results of the base run are caused by the interaction of four factors. First, profit maximising levels of output and employment are higher at the new prices. Production rises, both on large farms and on smallholdings, but there are substantial differences between crops in the supply responses; e.g. on smallholdings (at the end of the period), production of food crops is up by 5% but cashew and coconut production rises by less than 2%.² Secondly, smallholders' non farm income rises, both because of the higher demand for hired labour - on smallholdings without surplus family labour production can only be increased by hiring extra labour and this increases the income of other smallholders - and because the demand for the output of non farm enterprises rises with smallholders' incomes. However, in spite of this rise in non farm income, innovation may slow down rather than accelerate and in fact this happens in the short run (table 8.5.1). This is because we assume that higher product prices will be reflected in the cost of

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1. in chapter 7 we pointed out that while wages on large farms are subject to wage controls, the supply price of hired labour on smallholdings remains constant in terms of food prices. If wages on smallholdings would also rise by 10%, real product prices would be unchanged and production would be unaffected by the policy (although on large farms it would increase). But in this run we assume that the supply price is the same as in the base run, so real product prices rise by the full amount both on large farms and on smallholdings.
 2. these differences of course simply reflect the values of the supply elast-

agricultural investment: as the present value of assets increases so do their prices. Hence, if non farm income were to remain constant, its value in terms of cattle or coffee trees is reduced and this will reduce the rate at which these innovations are adopted. Total agricultural production therefore increases less than one might expect and the rural income distribution improves, to the extent that smallholders who do not innovate gain relatively more from the policy.¹ By 1985 the net effect on total agricultural production is a modest 1.9% increase. Thirdly, as food prices rise, the real wage and thereby urban incomes are reduced: in 1978 (the first year of the policy) urban per capita incomes are 3.6% lower than in the base run. This effect however is only temporary: at the end of the projection period the real wage is virtually identical in the two runs: by that time the rise in food prices is offset by lower inflation in other sectors, the result of a higher level of investment. Finally, the balance of payments position improves as agricultural exports rise - again, the effect is small in the early years since higher tea exports are partly offset by lower coffee exports - and this (given the need for imported capital goods) allows a higher level of investment.² Urban households benefit from this but so do smallholders: their wage incomes increase not only because of the increased need for hired labour on farms but also because non-agricultural employment expands.

There are considerable differences between provinces in the net effect of these developments. The policy results in a 3.8% increase in real incomes

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1. the short run results must be treated with caution since the model ignores gestation lags, i.e. it treats an innovating farmer, unrealistically, as if he would buy e.g. mature coffee trees.
 2. this is the reason that - rather unexpectedly - the increase in producer prices raises production as much in agriculture as in the rest of the economy: total GDP (at factor cost) in 1985 is 2.1% higher and so is GDP in agriculture (table 8.6.2.). This additional growth is reflected in the rise of modern sector wage employment; it explains why urban incomes are higher in run 10 than in the base run (table 8.6.4).

Table 8.5.1.: Agriculture

	1 9 7 8					1 9 8 5				
simulation run:	1	10	11*	12	13	1	10	11*	12	13
<u>agricultural</u> <u>production (1)</u>										
food	135	138	127	135	135	178	182	159	177	178
of which:										
livestock products	65	64	65	65	65	88	87	86	88	89
non food	72.1	73.3	72.1	72.2	72.3	83.8	85.0	90.0	84.2	84.8
of which: coffee	32.7	32.9	33.1	32.7	32.9	36.9	39.6	37.3	37.0	37.9
<u>smallholders</u> <u>real household</u> <u>income:</u>										
Central	3472	3465	3548	3474	3485	3551	3687	4303	3555	3684
Coast	2795	2722	2915	2794	2828	2985	3024	3115	2980	3202
Eastern	3506	3536	3571	3512	3512	3653	3840	4470	3682	3792
Nyanza	2428	2489	2442	2428	2426	2609	2780	3362	2607	2675
Rift Valley	3422	3466	3441	3428	3434	3944	4159	4558	3967	4124
Western	1937	1917	1984	1937	1937	2085	2147	2338	2082	2156
% of population poor	14.6	14.6	14.6	14.6	14.6	14.6	14.7	6.7	14.6	13.8
migration	3.5	3.4	3.7	3.5	3.4	4.6	4.5	3.3	4.5	4.2
<u>national accounts (1)</u>										
total value added (2)	773	779	773	773	773	1062	1084	1073	1060	1065
investment	255	270	240	255	260	228	235	241	226	232
exports	224	225	224	224	224	314	319	329	314	316
<u>agricultural exports</u>										
in constant prices(1)	64.4	65.5	64.5	64.5	64.6	72.9	73.8	78.7	73.4	73.8
in current prices (3)	479	493	478	480	481	628	647	617	632	636
<u>urban incomes</u>										
real wages	772	740	816	773	774	958	959	830	958	1003
per capita income	3645	3513	3837	3645	3579	4615	4690	4102	4603	4500

notes (1) in K£ million, 1972 prices

(2) GDP at factor cost, including subsistence

(3) in US \$ million

* strictly comparable only with run 9; see tables 8.6.2 - 8.6.4.

in Central province, 1.3% in Coast, 5.1 in Eastern, 6.6% in Nyanza, 5.5 in Rift Valley and 3.0% in Western province. The distributional effect is

mixed. Of the three poorest provinces, two show the smallest gains (Coast and Western), while Nyanza registers the highest percentage increase.

Similarly, the Gini coefficient rises in Central, Eastern and Rift Valley provinces but falls in the other three provinces. The effect of the policy on poverty is very disappointing: the percentage of smallholders whose incomes fall under the poverty line remains the same:¹ the poor - whose consumption consists largely of food - lose as much as consumers as they gain as producers from the change in prices.

The next simulation (run 11) involves a change in the policy of food price control. So far we have treated the two sectors (i.e. the subsector of agriculture and of manufacturing which produces food) in 'open economy' fashion with excess demand eliminated by imports and the domestic price tied to the world price. In this run we use the 'closed economy specification', with imports controlled and the price determined by domestic demand and supply. The results of the base run suggest that this would result in a drop in prices. We assume however that a fall in nominal prices would in practice be an infeasible policy; prices stay constant if market clearing (without a change in imports) would dictate a fall. As it turns out, this constraint is effective throughout the projection period so that the experiment models a very drastic policy, namely one of keeping food prices constant in nominal terms. The three producer prices involved also stay constant.²

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1. this represents a slight reduction in the absolute number of poor since (as a result of lower migration) the smallholder population now is somewhat larger than in the base run.
 2. namely the prices for maize, 'other food crops' and for livestock products. We assume that the wage rate on smallholdings is not affected (cf. the discussion of the devaluation run on this point) so that the profitability of smallholder food production declines.

The direct effect of the lower prices is, of course, a massive drop in food production. There is a shift of agricultural production into non food crops - reflected in an increase in agricultural exports - but this does not prevent a fall in the sector's total output. In current prices, smallholders suffer a very large cut (40%) in their farm income (table 8.6.3). However, this income loss is to a very large extent offset by a fall in their consumer price index in which food prices carry a very high weight. As a result, real incomes do not fall dramatically - but the poorest smallholders, who depend most on food production, lose most¹. - and in two provinces (Central and Nyanza) actually increase somewhat.² While total agricultural food production falls by 11%, non food production increases by 6%, leaving total agricultural productions reduced by 5%. The fall in output does not remain restricted to agriculture. A mini-recession occurs as agriculture's demand for intermediate input slackens, modern sector employment contracts, incomes in self employment fall and private demand is reduced. Some of the demand-led growth in the non agricultural sectors now does not occur and this is reflected in a drop in non-food prices.³

A modest programme of land redistribution is assumed in run 12. Of that part of the large farm area which is used for food crops 100,000 ha. is transferred to smallholders in Central, Eastern and Rift Valley provinces.⁴

-
1. an additional 0.8% of the population (compared to run 9) now fall under the poverty line, an increase in the absolute number of rural poor of about 100,000 (table 8.6.3).
 2. One of the reasons for this is that more smallholders in these provinces switch to livestock production - in spite of the fact that it has become much less profitable - as it becomes easier to finance: the value of non farm income (although reduced in nominal terms) rises in terms of the purchase price of cattle. But for the smallholder sector as a whole this effect is more than offset by the fall in the production of maize and other food crops
 3. As a result nominal wages are much lower and this softens the impact of the policy on the production of large farms.
 4. these are the provinces in which large farm food production is concentrated, Kenya (1977d), pp. 126-7.

This reduces the large farm areas by about 6% and increases the total area of smallholdings by about 5%. The land is transferred over a five year period (1978-82) and distributed over the three provinces such as to increase the smallholder area in each by the same percentage (almost 8%). Within each province, the smaller farms gain relatively most: for farms of up to 1 ha. the percentage increase is three times, and for holdings of 1-2 ha. twice as large as that for holdings in the 2-4 ha. size group. Holdings larger than 4 ha. do not benefit from the programme.¹ Food production on large farms is reduced by the same percentage as the acreage. This clearly is a devil's advocate's way of designing a land reform experiment. It will underestimate the programme's effects, both in terms of efficiency and of equity. First, while on smallholdings the elasticity of output with respect to land is less than 0.4,² we now assume for large farms equality of marginal and average productivity, i.e. an elasticity of one. On this ground alone we would expect the redistribution to lead to a substantial fall in agricultural output: not much more than one third of the fall in large farm production would be offset by a rise in smallholders' production. Secondly, while in practice at least part of the area involved might be uncultivated land, in the experiment all of the land is already under crops. Thirdly, regarding equity, the poverty reducing effect of the change will be small because the beneficiaries are not the landless but people who already have smallholdings and who depend for not much more than half of their income on their farming activities.

1. these size limits apply to the 'original' (1975) holdings; during the redistribution period actual holdings are already smaller because of population growth since 1975.

2. section 7.2.

One would expect the impact of the programme on the incomes of smallholders in the three provinces involved to be small in the final projection year (table 8.6.3) for several reasons. First, because cet.par. a 7.8% increase in the size of the holding would increase crop production by less than 3%, but this effect will be mitigated by the programme's bias in favour of the smallest farms. Secondly, because farm income would rise even less than this modest production increase; smallholders face rising marginal costs.¹ Thirdly, because - as noted above - farm income is not a very large part of total income and, finally, because, while in 1982 (the year in which the redistribution is completed) the effect will be largest, by 1985 the relative income increase will be less as other income categories have continued to grow.

The results for 1982 are summarised in table 8.5.2.

Table 8.5.2.: Land Redistribution

Production and Income Effects, 1982

	Run 1	Run 12	% increase
smallholders:			
food production	143.1	145.4	1.6
non food production	31.7	32.1	1.3
total	174.8	177.5	1.5
large farms: total	58.4	54.9	-6.0
total production	233.2	232.4	-0.3
real incomes of smallholders:			
Central	3512	3522	+0.3
Eastern	3543	3579	+1.0
Rift Valley	3838	3869	+0.8

Given our reasons for pessimism, these results are encouraging. The most

1. because some farms will need to start hiring labour. While this does reduce the benefits of those who receive land it does not affect our real income variable since that is a mean for the whole province and the addition to the wage bill is an intra-provincial transfer, increasing the incomes of those hired (who are assumed to be smallholders in the same provinces).

impressive result is that the fall in production is insignificant. Production actually increases if measured in more recent prices than the model's 1972 base: the land which was formerly used only for growing food crops is used by the recipients to increase their production of both food and export crops and relative price changes since 1972 have been in favour of the latter. The case against redistribution based on its effect on output would appear to be very weak. The second conclusion is illustrated by the bottom half of the table: if one argues for land reform on equity grounds and the beneficiaries are not the landless but those who already own land - although in very small holdings - then the effect is very small, at least if one considers total income rather than farm income (or just farm receipts)¹.

In chapter 7 we stressed the importance of wage employment as a source of smallholder income (in 1975 it accounted for almost a quarter). Although some of this represents employment on other smallholdings, much of it is in the modern sector i.e. on large farms or in non-agricultural activities. The location of modern sector employment is therefore an important determinant of smallholder incomes. In the base run 72% of new modern sector jobs are located in urban areas; this represents a slight increase in the share of the urban sector in total employment. In our last simulation run (run 13) we assume that some of this increase will occur in rural areas; from 1978 onwards, 25% of the new jobs which otherwise would have been created in urban centres are now assumed to be located in rural areas, thereby giving smallholders access to them. The resulting increase in smallholder incomes is considerably less than the part of the wage bill which is now shifted from urban to rural households. This is because not all of the new wage employees

1. the small income gains reflect of course the size of the area involved which represents only a 5% addition to the total smallholder area.

are drawn from surplus labour households; many come from smallholdings on which this reduction in the supply of family labour creates or increases the need for hired labour.¹ Since modern sector wages are higher, this substitution of hired for family labour (leaving total labour use unchanged) is, of course, entirely rational. It implies that as farm costs go up, the increase in non farm income is partly offset by a fall in farm income (table 8.6.3). Hence to what extent smallholders in different provinces benefit from this change, does not only depend on how modern sector employment is distributed over provinces, but also on differences in the extent of labour surplus. Table 8.5.3 illustrates the point. Agricultural production is hardly affected by this policy (table 8.5.1); the main difference is a small increase in coffee and livestock production as a result of the rise in non farm income.

This policy implies, again, a substantial reduction in the rural-urban income gap: the rise in rural incomes is accompanied by a 2.3% fall in urban incomes (table 8.6.4).

Table 8.5.3.: Hired Labour Use and Employment Relocation, 1985.

province	hired labour as % of total labour use		per capita real incomes, run 13 (run 1 = 100)
	run 1	run 13	
Central	28.8	30.1	103.7
Coast	15.6	16.8	107.3
Eastern	19.6	21.0	103.8
Nyasia	17.2	17.8	102.5
Rift Valley	28.5	29.5	104.6
Western	28.4	29.3	103.4

The reduction in wage employment induces substantial shifts in the urban labour force; the unemployment rate goes up by some 12% and as the demand

1. i.e. the coefficient α in equation (7.2.3) falls as more household members gain access to modern sector employment.

curve for the services of the low income self employed shifts to the left, their incomes fall.¹ But the poorest urban households lose least and since there is a substantial reduction in rural poverty the policy is attractive from the point of view of equity.²

8.6. SUMMARY

The design of the simulation runs is summarised in table 8.6.1. The next three tables present the most important results in a format which facilitates comparison between runs.

Table 8.6.1.: Key to Simulation Runs

Run	Differences from Base Run
<u>A Base run</u>	(section 8.2)
1 base run	-
<u>B Trade and Prices</u>	(section 8.3)
2 foreign savings	foreign savings 10% higher (in current prices).
3 devaluation	15% devaluation; constant real wages; food prices unchanged.
4 open economy	for non-food manufacturing, the domestic price follows the world price, and the market is cleared by imports; constant real wages.
5 trade policy	the changes of runs 3 and 4 combined.
6 import controls	controls on the imports of non-food manufactured consumer goods are relaxed: the maximum allowed is raised by 30% (in constant prices); constant real wages.

-
1. a curiosum in the results is the rise in the real wage rate (by almost 5%) which partly offsets these negative effects on urban incomes. As income is redistributed from urban to rural households the share of food - of which the price is controlled - in total private consumption rises. This reduces inflationary pressures in sectors in which prices are determined by demand and supply. The effects is quite strong: in non food manufacturing the price now is 8% lower than in the base run. This would of course be avoided if entrepreneurs responded to the reduced growth of domestic demand by exporting a larger share of their output but we have assumed (section 7.4) that this share remains constant.
 2. it would have to be complemented by either a change in investment policies (reducing the production of urban goods) or an export promotion policy (to increase manufactured exports) to avoid a loss in efficiency; cf. the previous footnote.

C Investment and Wages

(section 8.4)

7 public consumption

growth rate of public consumption raised from 5% to 7% (in constant prices).

8 flexible wages

long term adjustment to urban labour market equilibrium: nominal wages set at levels ensuring a lagged adjustment of real wages to the level of real income of the self employed, but nominal wages are not allowed to fall.

9 constant wages

nominal wages tied to urban consumer prices: real wages remain constant.

D Agriculture

(section 8.5)

10 producer prices

all producer prices raised by 10% (in current prices).

11 terms of trade

price control for food prices (both producer and consumer prices) abandoned: food prices determined by domestic demand and supply; constant real wages.

12 land redistribution

100,000 ha. of land under food crops in the large farm areas redistributed to smallholders in Central, Eastern and Rift Valley provinces. Relative increases are largest for the smallest holdings.

13 employment location

25% of new job openings in urban centres are relocated in rural areas.

Table 8.6.2.: Summary of Results for 1985

	simulation run												
	1	2	3*	4*	5*	6*	7	8	9	10	11*	12	13
<u>A Production (1)</u>													
agriculture	236	237	239	238	239	239	237	239	237	241	227	236	237
industry	186	193	211	237	235	197	181	217	214	194	205	185	187
other sectors	640	654	660	685	682	635	665	655	666	649	642	639	643
total value added	1062	1083	1110	1160	1156	1071	1082	1110	1117	1084	1073	1060	1065
<u>B National Accounts (2)</u>													
GDP (market prices)	1067	1091	1124	1163	1156	1093	1082	1131	1136	1092	1085	1065	1068
private consumption	591	606	596	574	559	615	564	599	610	609	591	591	588
public consumption	229	229	229	229	229	229	267	229	229	229	229	229	229
investment	228	251	273	331	338	228	233	280	273	235	241	226	232
exports	314	317	328	334	337	321	313	329	327	319	329	314	316
imports	291	307	300	304	306	299	288	308	301	295	306	291	292
<u>C Agriculture (3)</u>													
food production	178	178	178	178	178	178	178	178	178	182	159	177	178
of which:													
marketed	73	73	81	75	79	86	70	86	82	78	61	71	72
own use	105	105	97	103	99	92	108	93	96	103	98	105	107
non food	84	84	88	85	87	86	85	86	85	85	90	84	85
total production	262	262	266	263	266	264	263	265	263	267	250	261	263

Notes: (1) cf. table 8.2.1.; subsistence consumption is included under agriculture and in the total. (2) cf. table 8.2.2. monetary economy only. (3) cf. table 8.2.6.

* to be compared with run 9 rather than run 1.

Table 8.6.3.: Summary of Results for 1985

	simulation run												
	1	2	3*	4*	5*	6*	7	8	9	10	11*	12	13
Smallholders (1)													
farm income	4497	4483	4992	4562	4635	4901	4338	4894	4860	5116	2885	4517	4274
non farm income	3901	3942	2883	3752	3954	2690	4208	2781	2795	4016	1869	3910	4220
total income	8398	8426	7875	8314	8589	7591	8547	7675	7655	9132	4753	8427	8494
real household income:													
Central	3551	3595	4242	3448	3438	4617	3455	4318	4236	3687	4303	3555	3684
Coast	2985	3038	3103	2862	2850	3464	2952	3270	3144	3024	3115	2980	3202
Eastern	3653	3693	4440	3514	3510	4951	3570	4572	4463	3840	4470	3682	3792
Nyanza	2609	2633	3305	2532	2543	3613	2521	3338	3266	2780	3362	2607	2675
Rift Valley	3944	3987	4813	3821	3726	5455	3830	5030	4938	4159	4558	3967	4124
Western	2085	2110	2320	1997	1982	2583	2064	2416	2347	2147	2338	2082	2156
Gini coefficient	0.144	0.144	0.161	0.145	0.144	0.166	0.142	0.163	0.164	0.147	0.163	0.145	0.144
share of bottom 40%	29.9	29.9	28.8	29.9	29.9	28.7	29.8	28.9	28.8	29.9	28.3	29.8	29.7
% of population poor	14.6	14.6	6.6	14.6	14.6	4.4	14.6	5.3	5.9	14.6	6.7	14.6	13.8
migration	4.6	4.7	3.4	4.65	4.5	3.0	4.5	3.3	3.6	4.5	3.3	4.5	4.2

Note (1) cf. table 8.2.7; the first three lines are in current prices.

* to be compared with run 9 rather than run 1.

Table 8.6.4.: Summary of Results for 1985

simulation run													
1	2	3*	4*	5*	6*	7	8	9	10	11*	12	13	
Urban Incomes and Employment (1)													
A labour force members (mean per household)													
regular wage employment	1.235	1.267	1.321	1.415	1.416	1.261	1.272	1.331	1.261	1.269	1.232	1.126	
self employment:													
high income	0.115	0.118	0.103	0.111	0.107	0.104	0.109	0.104	0.117	0.100	0.115	0.112	
low income	0.068	0.068	0.071	0.070	0.070	0.072	0.070	0.072	0.068	0.069	0.068	0.069	
unemployment, other	0.209	0.197	0.216	0.196	0.199	0.229	0.215	0.219	0.202	0.226	0.210	0.233	
B real incomes													
wage earners (W _r) (2)	958	967	814	830	809	818	887	794	959	830	958	1003	
low income self-employed (W _s)	533	556	459	499	483	442	494	447	545	454	531	512	
total per capita income	4615	4748	4148	4450	4323	4057	4380	4084	4690	4102	4603	4500	
Gini coefficient	0.279	0.279	0.272	0.276	0.275	0.273	0.277	0.275	0.279	0.270	0.279	0.282	
share of bottom 40%	25.0	25.1	25.1	25.1	25.1	25.0	25.0	25.0	25.1	25.1	25.0	24.9	

Notes (1) cf. tables 8.2.8 and 8.2.9.

(2) although runs 3,4,5,6 and 11 all use the constant real wage policy, there are slight differences in the value of W_r between those runs: nominal wages are adjusted until W_r is within 1½% of the 1977 value of 820. Hence W_r may lie in the range 808-832.

* to be compared with run 9, rather than run 1.

A P P E N D I C E S

Appendix 1 : Modern Sector Wage Employment

1. Data on employment and earnings in the modern sector - defined as 'the entire urban sector, the entire public sector, large scale farms and other large scale enterprises such as saw mills and mines, located outside towns',¹ - have been published for 1963-1974. Some, but not all of the results, for 1975 and 1976 are available; our main source is the last published data set, that for 1974.²

Table 1 presents data on the distribution of non-agricultural wage employment by sector and skill. The report classifies regular wage employees in eleven occupational groups; these are aggregated to six skill levels as follows:³

- 1 unskilled labourers;
- 2 semi-skilled workers;
- 3 skilled workers;
- 4 teachers;
- 5 shop assistants, technical sales representatives and brokers, auctioneers, salesmen; general clerks, book-keepers, cashiers and book-keeping clerks; secretaries, stenographers and typists;
- 6 other middle level executive and managerial personnel; technicians, works managers, workshop foremen and semi-professionals; professionals; salaried directors; top level administrators and general managers.

1. Kenya (1976) p. ii.

2. Kenya (1976); see pp. ii-iii for this report's methods and definitions.

3. in the model we aggregate even further: skills 1, 2 and 3 are combined.

Data on 'cash remuneration' by skill and sector are summarised in Table 2.¹ These data provide the initial sector w_1 (wages by skill)

Table 1 : Non-Agricultural Wage Employment by Sector and Skill, 1974

sector	total casuals	1	regulars 2	3	by 4	skill 5	6	total regulars	grand total
mining	1251	1426	436	341	-	161	254	2618	3869
manufact- uring	13435	34364	20832	17174	-	7393	8134	87897	101331
electr- icity	2331	884	875	639	-	463	502	3363	5694
constr- uction	14329	14426	5446	5781	-	1857	2598	30108	44437
trade	4354	18622	11699	4316	-	11959	6071	52667	57021
trans- port	1795	14397	10102	6401	-	9967	3648	44515	46310
services	10364	88033	27962	29937	92049	31913	26194	296088	306452
total	47859	172152	77352	64589	92049	63713	47401	517256	565115

source: Kenya (1976) tables 20 (regulars) and 8 (casuals)

in the model and the matrix of wage differentials (ξ ; cf. equation (7.5.9)). There are considerable differences in wages between sectors and skills - which is why we disaggregate employment by these two variables in the model - but even if these are taken as given, a considerable part of the observed variance in the distribution of wage income remains to be explained. We

1. elsewhere in the publication the concept of 'earnings' is used which - as its definition on p. iii suggests - is wider than 'monthly cash remuneration'. We have no choice since data disaggregated by skill exist only for the latter concept. In the aggregate the difference is very small: total earnings are Kf 249 million (p. 57), total cash remuneration Kf 244 million (p. 79), but there are larger differences at the sectoral level (monthly earnings by sector can be derived from tables 8 and 27).

Table 2 : Non-Agricultural Regular Wage Employment
Monthly Cash Remuneration by Sector and Skill, 1974.

(KSh per month)

sector	s k i l l						total
	1	2	3	4	5	6	
mining	309	571	648	-	1096	3207	725
manufacturing	334	435	638	-	1101	3140	742
electricity	428	737	984	--	1132	3133	1114
construction	332	482	727	-	873	2583	663
trade	283	426	652	-	962	3082	822
transport	467	761	844	-	1099	3168	951
services	273	387	531	641	847	2129	650
total	309	466	622	641	942	2547	714

source: table 1 above and Kenya (1976), table 26.

assume that the within - cell distribution is log normal.¹ If all log variances are put equal to 0.45 we obtain a very close approximation to the observed distribution.²

1. If w_{il} is distributed log normally with log mean μ_{il} ($\mu_{il} = \ln w_{il} - \frac{1}{2} \sigma_1^2$) and log variance σ_1^2 , then of total within-cellemployment N_{il} a fraction Q_c would have wages not exceeding the upper limit of income class c (UP_c), where

$$Q_c = \int_{-\infty}^{\ln UP_c} \frac{1}{\sigma_1 \sqrt{2\pi}} \exp - \frac{1}{2} \left(\frac{x - \mu_{il}}{\sigma_1} \right)^2 dx = \int_{-\infty}^{X_c} \frac{1}{\sqrt{2\pi}} \exp - \frac{1}{2} x^2 dx \quad \text{and}$$
$$X_c = (\ln UP_c - \mu_{il}) / \sigma_1$$

The estimated number of people in income class c is then obtained as:

$$\hat{N}_c = \sum_{i,1} N_{il} (Q_c - Q_{c-1}). \text{ Cf. Aitchison and Brown (1957).}$$

2. experiments in which σ_1 differed between sectors and skills did not appreciably improve the fit.

Table 3 : Log Normal Approximation to the Wage Distribution

($\sigma_{il} = 0.45$ all i, l ; wage differentials between sectors and skills taken as given)

class	upper limit (sh/month)	N_c	N_c/N	$\hat{N}_c/N$
1	100	9926	1.9	0.5
2	150	11377	2.2	3.1
3	200	46637	9.0	6.2
4	400	159761	30.9	31.0
5	600	114798	22.2	21.7
6	800	56795	11.0	12.8
7	1000	37378	7.2	7.3
8	1500	34689	6.7	8.0
9	2000	18205	3.5	3.3
10	3000	14156	2.7	3.4
11	∞	13534	2.6	2.6
total		517256	100%	100%

source: (for N_c): Kenya (1976), table 33.

2. Formal sector wages in the model are exogenous. While we do not assume - as did the ILO report - that real wages are rigid, we do not believe that such changes as have occurred (the real wage in Nairobi fell by 17% over the period 1969-1977) can be interpreted as a response to market pressures.^{1.}

1. The evidence of House and Rempel (1976) who conclude that wages are not responsive to growing labour supply pressures - a conclusion which Bigsten (1978, p. 182) accepts - is not persuasive: their data are for 1962 and 1969 whereas the drop in real wages occurred after 1969.

Nairobi real wages (on a basis 1969 = 100) stood at 100 in 1972, fell to 95 in 1973 and to 83 in 1977. Some observers interpret this development as evidence that wages are responsive to market pressures.^{1.} We find this unconvincing for two reasons. First, if this were true it is not clear why wages fell in the period 1972-1977 but not in 1969-1972: there was excess supply in both periods but less in the later period: from 1973-1977 excess supply fell, not only as a percentage of those seeking wage employment but probably even absolutely.^{2.} Secondly, from 1973 on it was deliberate government policy to reduce real wages and the aim of this policy was certainly not to reduce excess supply in the urban labour market. In its guidelines on wage increases to the Industrial Court^{3.} the government stresses that productivity increases realised in the period 1974-76 may not be used as justification for wage increases; that on average wages should rise considerably less than consumer prices, full price compensation being allowed only for the lowest paid (a category to which less than one quarter of Nairobi wage earners belong); that compensation for past price increases should be spread over the period of the agreement (usually two years) and that the possibility for a voluntary midterm review of an agreement (revisions which were previously allowed) should be severely limited. The government's concern was the general economic situation: rapid rises in import prices in 1974 and 1975, stagnation of export prices and, domestically, recession and inflation. There is no indication that the policy of letting

1. Collier and Lal (1979), p. 136.

2. cf. Collier and Lal (1979), table 17, p. 133. They base their estimates of the labour force on the data which we present in appendix 2, table 1. Their table is inconsistent because of the inclusion of those of age 60 and over. Excluding these plus students and those in modern self-employment and subtracting the wage employed from the number of job-seekers (thus defined) gives excess labour supply as 30.5 thousand in 1969, 36.1 in 1973 and 34.3 in 1977 (for Nairobi).

3. see Sessional Paper No. 1 1974.

wages be eroded by inflation was motivated by a desire to restore labour market equilibrium.

In the model therefore nominal wages are exogenous. Since neither the improvements since 1975 in the macro-economic situation (especially the increase of the coffee price) nor the high level of consumer price inflation during the period of wage agreements concluded under the policy could have been foreseen, we think it likely that the government will in retrospect consider the policy to have gone too far. The wage policy which we assume in the model therefore allows for a recovery of real wages from their 1977 low; but at the end of the projection period they are still slightly lower than in 1969.

Appendix 2: The Population of Nairobi 1969-1977*

In Chapter 8 we have emphasised that our fairly optimistic results for the urban labour market depend on an estimate for the Nairobi population in the period 1969-1977. The ILO report based its pessimism on a comparison of census data for 1962 and 1969 which implied that Nairobi was growing at more than 10% per year in that period.¹ Our estimates suggest that the rate fell to 7% in the period 1969-1973 and to less than 3½% in 1973-1977. This appendix explains the source of these estimates.

The first step in the calculation is to apply fertility and mortality rates to the Nairobi population of 1969². (disaggregated by sex and age, the first column of table 1) to arrive at an estimate of what the Nairobi population would have been in 1973 if only natural growth had occurred, i.e. in the absence of migration. Age specific fertility rates for Nairobi are given in volume 4 of the Census; survival rates are calculated from the life expectancy tables. This gives a prediction for 1973 which appears in the second column of table 1. For 1973 we do have the age and sex distribution of the Nairobi population³. but not the absolute size. If we take our estimates of the natural growth rate (1.99% for males and 3.52% for females) as given and assume that the population growth rate for 'base line urban'⁴. can be used for Nairobi alone in the period 1969-1973, then we would, residually arrive at net migration rates of 3.49% for males and 2.88% for females. However, there is independent evidence that this assumption is not justified: data for 1973-1974 indicate

* this work was done jointly with Paul Collier who is the only other researcher to have had access to some of the data used. See Collier and Lal (1979) pp. 119-127.

1. these trends were assumed to be valid for projections. Other researchers still base their projections on this out dated 1962-1969 evidence. International Labour Office (1972), Shah (1978), Bigsten (1978).
2. these data are from the 1969 Census, Kenya (1969).
3. these data were taken from unpublished printouts of the Demographic Baseline Survey 1973. For a description of this survey see Kenya (1975).
4. 'baseline urban' is a wider concept than Nairobi alone; it covers Nairobi and 15 other towns which together accounted for 62% of the population which in the 1969 Census was classified as urban.

as one would expect that net migration into Nairobi is considerably higher than for other urban areas.¹ If we assume that the ratio between the rates for Nairobi and other urban areas observed in 1973-76 is also valid for 1969-73 our estimated net migration rates change to 3.86% for males and 3.45% for females. A final adjustment is needed. Since if we used these rates the 1973 male/female ratio would be slightly lower than observed and since in 1969 this sex ratio was lower in Nairobi than in other towns there must have occurred an adjustment process in 1969-1973 which would imply higher female net migration rates in 1969-73 than in 1973-74. One obtains the observed 1973 sex ratio if the female migration rate is raised to 4.7% per year.

At this stage we have for both sexes natural growth rates and migration rates.² This gives the 1973 population by sex and (since we know the age distribution) also by age (column 4 of table 1). Migration flows by age and sex are now derived as the difference between the actual and predicted figures for 1973 (column 3 of table 1).

For the second period (1973-1977) we have, again, the age and sex distributions³ for the final year but no absolute numbers. We first estimate the 1977 male population and, after having established a lower bound of 430 thousand and an upper bound of 435 thousand use the midpoint of this range. The minimum

-
1. The data are from Kenya (1976 d). This gives male (female) net migration rates as 3.1% (6.3%) for Nairobi and as 1.8% (2.1%) for other towns included in 'baseline urban'.
 2. There are three independent observations which confirm these estimates; cf. Collier and Lal (1979), pp. 124-125.
 3. unpublished computer printout (dated December 1978) of the National Demographic Survey 1977.

estimate is based on data for male wage employment. This rose by 25,210 over the period June 1973-January 1977.¹ If male migration in age cohorts 5-9 (age 20-60) would have been equal to this increase in employment then one arrives at the estimate of 430 thousand.² Any lower estimate would imply implausible reductions in unemployment and informal sector employment as wage employment grew much faster than the male labour force. Of greater importance (since our estimate of population growth is so much lower than those previously still accepted as valid) is the derivation of the upper bound.

Out-migration of older males (cohorts 8,9 and 10) was 8% per year in 1969-73 and the data for 1973-74 suggest that it must have fallen since.³ Our upper bound is derived from the assumption that this rate fell to 4½%.

As a residual we finally derive the migration flows for 1973-1977 (column 6 in table 1). These show two features which one would expect a priori and thereby increase our confidence in the results. There is (a) high net in migration of men in the 20-25 age group and of women in the 15-20 age group and (b) out migration of women over 30 years and of children (5-10 years). The baseline data on household composition (in terms of relationship to the head of household) show a sharp drop between 1969 and 1973 in the categories other than 'head', 'wife' or 'child' and a corresponding rise in the number of

-
1. the figure for the latter date is obtained by interpolation between the employment data for June 1976 and June 1977.
 2. column 5 is derived in the same way as column 2, i.e. by applying fertility and mortality rates only. In spite of the fact that we apply the same rates our estimates of natural growth rates for the period 1973-1977 are substantially higher than for 1969-1973 (table 2); this reflects rapid change in Nairobi's age and sex distribution.
 3. if we assumed that the rate remained at 8% the age distribution data for 1973 and 1977 would imply that the male population actually fell over this period which is completely implausible, if only because of the rapid expansion in modern sector employment. The population estimate of 430 thousand implies a rate of 5.7, hence the estimate of total population is fairly insensitive to the rate assumed.

Table 1: Nairobi Population 1969-1977

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
age cohort	actual 1969 August	predicted 1973	migration 1969-73	'actual' 1973 June	predicted 1977	migration 1973-77	'actual' 1977 January
1 0-5	39107	43208	15422	58630	62485	141	62626
2 5-10	29166	33354	516	33870	47100	-5104	41996
3 10-15	19694	26410	996	27406	31451	770	32221
4 15-20	24748	20649	6379	27028	27028	8048	35071
5 20-25	44247	28806	20373	49179	32774	19905	52679
6 25-30	38155	41966	12657	54623	49784	5100	54884
7 30-40	56787	62857	4996	67853	80970	-4418	76553
8 40-50	30758	39600	-703	38897	47970	-1866	46105
9 50-60	13309	19103	-6024	13079	21395	-1241	20155
10 60 & over	7248	11007	-3560	7447	10887	-680	10207
total (males)	<u>303219</u>	<u>326961</u>	<u>51051</u>	<u>378012</u>	<u>411882</u>	<u>20618</u>	<u>432500</u>
1 0-5	38161	43933	14046	57979	63648	-5936	57712
2 5-10	29275	33445	1690	35135	47988	-4936	43052
3 10-15	21017	26912	2162	29074	32946	6094	39040
4 15-20	25095	21802	13474	35276	30589	11476	42065
5 20-25	28525	25573	24604	50177	39008	3612	42620
6 25-30	20971	26315	850	27165	42993	-11236	31757
7 30-40	22507	29447	-3348	26099	35612	-6448	29164
8 40-50	10776	14940	-5763	9177	14930	-2986	11944
9 50-60	5396	7192	-2309	4883	6202	-986	5216
10 60 & over	4344	5708	-39	5669	6595	-546	6049
total (females)	<u>206,067</u>	<u>235267</u>	<u>45366</u>	<u>280633</u>	<u>320511</u>	<u>-11893</u>	<u>308618</u>
total population	<u>509,286</u>	<u>562228</u>	<u>96417</u>	<u>658645</u>	<u>732393</u>	<u>8725</u>	<u>741118</u>

couples and children. This change in household composition explains why the number of children (age 0-5 years) in 1973 is very much higher - cf. columns 2 and 4 of table 1 - than predicted on the basis of fertility rates. But 'once these urban children born in the 1969-73 period come of school age there is a tendency for husbands to send both wife and children back to rural areas where the cost of living is lower, and where relatives can care for the children part of the day, enabling the wife to work' (Collier and Lal (1979), p. 126). Hence the estimated 1973-77 migration flows for 1973-1977 are plausible if the changes which occurred in the earlier period are taken into account.

Table 2: Migration and Natural Population Growth, Nairobi 1969-1977

	males	females	total
<u>absolute numbers</u> (thousands)			
August 1969	303.2	206.1	509.3
June 1973	378.0	280.6	658.6
January 1977	432.5	308.6	741.1
<u>growth rates (%)</u>			
1969-1973			
natural	1.99	3.52	2.61
migration	3.86	4.71	4.22
total	5.92	8.39	6.94
1973-1977			
natural	2.42	3.78	3.01
migration	1.37	-1.05	0.33
total	3.83	2.69	3.35

Our use of these results in the model still errs on the pessimistic side for two reasons. First, because we apply the Nairobi results to the model's

concept of urban which is wider¹. and migration into Nairobi is likely to have been higher than into other towns in which wage employment grew much less rapidly.² Secondly, in the model we assume that in the projection period (in the absence of natural growth) the number of urban households grows at the same rate as the number of male migrants in the 20-60 age group. As table 2 indicates, male immigration was to a considerable extent offset by female out migration. Although that out migration is likely to be a temporary phenomenon the assumption implicit in our procedure - namely, that migration flows are balanced in terms of its age and sex composition - may well overestimate urban population growth.

The empirical basis for the elasticity used in the migration equation - equation (7.8.1) - is much less rigorous than in the Tanzania model, where we could use the econometric cross-section estimates of Barnum and Sabot (1975) and where we had household budget survey data for two years on which to base an estimate of the growth of real rural incomes.

Our estimate for Kenya is based on averages for the two periods 1969-1973 and 1973-1977:

(a) for Central and Nyanza provinces we have estimates of smallholder incomes in 1975 (from the IRS data); in 1977 (from the model's projections) and for 1963 for Central province (from Kenya (1968)) and for 1970 in the case of Nyanza province (from Kenya, Central Bureau of Statistics (1977): Rural Household

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1. it includes Mombasa, Kisumu and Nakuru as well. In 1976 Nairobi accounted for 69% of wage employment in these four towns.
 2. employment grew at 5.9% p.a. in Nairobi (1969-1976) but at only 3.3% p.a. in the other three towns.

Survey Nyanza Province 1970/71). These data are deflated - using the IRS data on the composition of rural consumption to reweight the published (urban) consumer price indices - to arrive at real incomes. For Central province we interpolate between 1963 and 1975 (exponentially) to get estimates for 1969 and for 1973 and for Nyanza we extrapolate the 1970-1975 growth rate backwards to get a 1963 estimate and we interpolate between 1970 and 1975 for the 1973 estimate.

(b) the data in Rempel et al. (1970, p.11) on the province of origin of Nairobi migrants are used to construct a weighted average. We then estimate that real incomes (for the two provinces taken together) increased by 9.2% in real terms from 1969-73 to 1973-1977. This gives the index y_s of (7.8.1). In the Rempel survey the two provinces accounted for 62% of migrants (excluding those from other urban centres or from Uganda and Tanzania) into Nairobi.

(c) on a basis 1969=100 real urban wages fell from an average of 100.1 in the former to 86.9 in the latter period. Hence w_u in (7.8.1) is equal to 86.9/100.1.

(d) in the absence of time series data on the employment probability π as used in the model we use as a proxy the ratio of the increase in Nairobi modern sector wage employment and the number of males (age 20-60 years) from table 1. For 1973-1977 we find (on a basis 1969-1973 = 1) that πw_u equals 0.599: expected urban incomes fell by 40% between the two periods.

(e) migration of males in the relevant age group fell from 31.30 thousand in the earlier to 17.48 thousand in the later period. Substituting our estimates in (7.8.1) we solve for the elasticity η^* from:

$$(17.48/31.30) = (0.599 / 1.092)^{\eta^*}$$

which gives the elasticity as 0.97.

Appendix 3: The Urban Distribution of Income

1. Almost all students of the Kenyan income distribution have had to use indirect estimates of the urban distribution for recent years. While for most countries the rural data present most problems, for Kenya the reverse is true. Since the publication of the IRS data rural statistics are quite satisfactory but analyses of urban incomes have been based on wage income data, combined with crude guesses about the informal sector.¹ A recent survey exists: the Household Budget Survey (HBS) conducted in Nairobi from August to December 1974. But the purpose of this survey was to collect data for a new cost-of-living index and (while extremely important information on incomes, (un)employment and household composition was recorded) only expenditure data were published.²

The survey used a stratified sample of 595 Nairobi households. We faced two problems. First, our data - after exclusion of three households for which no income data had been recorded - covered only 499 out of the original 595 households. Secondly, stratification of the sample was based on type of housing - as a proxy for income - and we did not know for each household to which stratum it belonged and, hence, which weight to apply. Fortunately, we could impose three restrictions: (a) the unweighted number of households is given by stratum

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1. The CBS collects data on the informal sector since 1973. However these data have to be treated with great caution since the coverage is not comprehensive and changes from year to year as the methodology improves; in this series employment in the informal sector rises from 34 thousand in 1972 to 95 thousand, showing an 84% increase in 1974. This (as the CBS agrees) has more to do with changing coverage than with real world developments.
 2. Kenya (1977 b). For the survey methodology and sample weights, see there, appendix D. Paul Collier and I are the only researchers to have had access to the original data. A number of the results given in Collier and Lal (1979) are biased since they have been derived from the HBS results without reweighting and are thus affected by the stratification procedure. Since upper income households must have been disproportionately represented in the missing cases, the unadjusted data overstate poverty.

(b) the stratum weights are known (c) the distribution of the weighted number of households over three income classes can be derived.^{1.}

In assigning households to strata it turned out that these three restrictions left very little room between the two possible extremes (no correlation or perfect correlation between strata and income levels) so that we are fairly confident that we have applied the correct weights.^{2.} Stratum weights were adjusted to allow for the 96 missing cases.

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1. Expenditure data for 'lower income' (up to KSh 700 per month of household income), 'middle income' (700-2500), 'upper income' (over KSh 2500) and 'all groups' are given in Kenya (1977 b), appendix C. The implied₁₄ distribution of households over the three income groups is 46%, 40%, ~~19~~%. This is quite different from the data given on pp. 1-2 of the publication (25%, 50%, 25%), which however are suspiciously round numbers and impossible to reconcile with the data. We use the former distribution.
 2. Our income concept differs from that used in the publication, which includes subsistence income and housing allowances. Subsistence income is unlikely to be important for urban households - for a Tanzanian example see Gunning (1977), table G.1, where we found that subsistence accounted for only 1½% of urban household income. Housing allowances are substantial only for households with incomes in the range KSh 1700-2500 per month; for these households the mean is KSh 450. But the number of households for which inclusion of housing allowances would raise income over the KSh 2500 class boundary (which is the only thing that matters for our present purpose) is very small. In assigning households to strata we have however allowed for this; but in all tables in this appendix the narrower definition of income is used so that our income distribution differs slightly from the one implied by the published data.

2. The labour force is defined as consisting of those between the ages of 20¹ and 60 excluding housewives and people in school. By occupation, members of the labour force are classified as: (a) regulars (b) self employed (c) unemployed and (d) others (a category used for part time workers, casuals and family workers). By the occupation of the head of household, we define eight household types:

1-4 regular wage earners (with wages of 0-400, 400-1000, 1000-2000 and over KSh 2000 per month)

5-6 self employed (with incomes up to/over KSh 400 per month)

7 unemployed

8 other

Table 1: Nairobi Household Composition and Income 1974

	household type ¹								
	total	1	2	3	4	5	6	7	8
household size (mean)	4.1	2.8	4.2	5.0	4.7	4.2	4.7	4.2	3.5
labour force ⁴	1.53	1.53	1.52	1.56	1.55	1.43	1.66	1.65	1.33
head of household	.95	.95	.99	.97	1.00	1.00	.94	.69	.66
others	.58	.58	.53	.59	.55	.43	.72	.96	.66
regular wage earners	.31	.37	.28	.31	.43	.08	.24	.59	.29
self employed (<Sh 400)	.03	.01	.01	.03	-	.09	.10	-	.05
self employed (≥Sh 400)	.01	-	-	.01	.02	-	.08	.07	-
unemployed	.17	.13	.17	.20	.05	.26	.17	.30	.20
others	.06	.06	.06	.05	.06	-	.13	-	.13
income per earner ² (KSh/month)									
head of household	1008	281	606	1289	4236	259	2255	-	289
others	442	217	322	473	1216	118	788	464	380
regular wage earners	725	302	513	845	1549	402	1696	559	756
self employed	567	70	353	301	500	189	890	1751	120
others	200	185	340	172	65	-	40	-	239

1. this may seem high but is consistent with the high average age of school leavers, Collier and Lal (1979), p. 128. The Household Budget Survey data indicate that in 1974 75% of males in the age group 15-20 years were still attending school; the school leaving age has increased since.

Table 1 (contd:)

	total	1	2	3	4	5	6	7	8
household income (KSh/month)	1358	455	794	1596	5048	354	3065	771	1029
earned by head of household ²	1008	281	606	1289	4236	259	2255	-	289
earned by others ²	258	125	171	281	675	51	564	445	253
other sources ³	100	49	17	27	137	44	246	326	487
% of house- holds	100.0	17.8	30.0	17.8	7.5	8.9	8.4	4.0	5.5

- Notes: (1) see text for classification
 (2) includes earners not included in our concept of the labour force
 (3) secondary incomes of earners and unearned income, inc. gifts and remittances received.
 (4) people between the ages of 20 and 60 excluding housewives and students.

Table 1 summarises data on the composition of the labour force, and on levels and sources of income for the eight household types thus defined,¹ and table 2 the income distributions.

There is some correlation between household size and income; as a result the distribution over the population is somewhat less unequal than that over households. In terms of the Gini coefficient the difference is quite significant.² Comparing household types (table 1), three things may be noted.

1. the classification by household type leads, of course (by ignoring within-type variance) to an underestimate of inequality: the Gini coefficient of the distribution of income over the eight types is 0.44 rather than 0.52. In the projection the coefficient is even lower than 0.44 because wages are lower in real terms than in 1974.
2. This indicates that analyses (such as that in the ILO report, Crawford and Thorbecke (1978)) which assume away differences between the income distribution (a) over earners (b) over households (c) over household members are quite misleading. Thorbecke assumes one earner per household and a uniform household size. Our data suggest that the latter assumption alone leads to a significant overestimate of inequality.

Table 2: Urban Income Distribution 1974.

household income	mean income	% of income	% of households	% of population
0-100	65	0.0	1.0	1.0
100-200	164	0.2	1.8	1.0
200-300	240	1.8	10.2	6.5
300-400	335	2.4	9.9	8.0
400-500	443	2.7	8.4	6.0
500-700	588	6.2	14.3	14.1
700-1000	825	9.9	16.3	18.1
1000-1500	1217	15.5	17.3	17.6
1500-2000	1650	7.4	6.1	8.4
2000-2500	2202	3.5	2.2	3.0
over 2500	5443	50.2	12.5	16.4
total	1358	100.0	100.0	100.0
Gini coefficient	-	-	0.52	0.44
share in income:				
bottom 40%			11%	15%
next 40%			29%	31%
top 20%			60%	54%

First, the poorest households are not those of the unemployed but those where the head is (low income) self employed (group 5). While other groups (1, 7 and 8) have low income levels for the head of household, the effect is mitigated by other sources of income. But for group 5, this raises household income from KSh 259/month to only KSh 354. The main difference is that the other earners in these households apparently have no access to modern sector wage employment, presumably reflecting poor educational qualifications. Secondly, while for most households there is no clear relation between household income

and the percentage of job seekers ¹. who have succeeded in gaining regular wage employment the difference between the richest and the poorest households (types 4 and 5) in this 'success rate' is striking: 81 vs. 18%. Thirdly, (table 3) unemployment is high amongst second earners but very low amongst heads of households. Also, the common presumption that unemployment is concentrated in the richer households turns out to be false. On the contrary, unemployment rates for all but the two extreme groups are very similar and for these two the relation is negative: the rate is 9% for the richest and 60% for the poorest household.

Table 3: Unemployment rates

household type	head	others	total
1	-	22	8
2	-	32	11
3	-	34	13
4	-	9	3
5	-	60	18
6	-	24	10
7	100	31	60
8	-	30	15
total	3%	29%	13%
(males only)	3%	37%	13%

The data can also be used to derive an income distribution of the self employed (table 4). Of the self employed 56% earned less than KSh 400 per month in 1974 (the cut-off point we use in the model for classifying people as low income self employed).

1. We define job seekers here as members of the labour force who are not high income self employed (who are assumed not to compete for wage employment).

Table 4: Income Distribution of the Self Employed

upper limit of income group (KSh per month)	all labour force members			male labour force members		
	% of people	% of income	mean income	% of people	% of income	mean income
100	4.8	0.3	65	0.0	0.0	-
200	8.7	1.1	133	8.8	0.8	144
300	20.0	4.3	231	15.9	2.2	219
400	18.8	5.9	343	17.1	3.6	332
500	9.3	3.6	426	6.7	1.8	434
700	8.3	4.1	539	8.1	2.8	549
1000	7.9	6.1	846	9.9	5.2	844
1500	2.2	2.2	1090	3.0	2.1	1115
2000	4.4	6.3	1564	3.8	3.7	1528
2500	3.9	7.7	2126	6.8	3.1	2126
∞	11.5	58.4	5521	19.9	68.8	5521
total	100.0	100.0	1090	100.0	100.0	1599

The HBS data have been used to estimate the parameters of the bumping model described in section 7.6. If we denote income groups for wage earners by a subscript i, household type by h and level of education by k, then:

$$(1) \sum_k E_{hk} \tilde{p}_{ik} = \bar{n}_{ih}$$

$$(2) \sum_h \gamma_h E_{hk} = \bar{n}_k$$

Where E is the number of job seekers per household, γ the number of households and $\tilde{p}$ the probability of employment.¹ With 8 household types, 3 education levels and 4 income groups, this gives 34 independent equations.² There are

1. these differ from the probabilities π of section 7.6 which apply to cumulative labour supply.

2. the shares $\bar{n}_k / \sum_k \bar{n}_k$ are known; these sum of course to unity so that (2) need not be solved for all k.

32 unknowns: E_{h1} and E_{h2} (for $h = 1, \dots, 8$)¹, $\tilde{p}_{ik}$ (for $i = 1, \dots, 4$; $k = 1, 2, 3$) and E_h , the total number of jobseekers in a household (for $h = 5, \dots, 8$ ²). Our data are from two sources. First, HBS itself gives for each household type the number of wage employees by income level ($\bar{n}_{ih}$), i.e. the right hand side of equation (1). The distribution of job seekers by level of education - i.e. $\bar{n}_k$ in equation (2) - is derived from demographic data. Unpublished National Demographic Survey data give the level of education for males by age group. These data are for June-August 1974 and apply to 'base line urban' (in terms of population Nairobi accounts for about two-thirds of this concept of urban). An estimate of the age-distribution of males in Nairobi in November 1974 (the time of the HBS) is obtained through exponential interpolation between our own estimates for the Nairobi population in June 1973 and January 1977 (appendix 2, table 1). This distribution is used to weight the base line data. Thus weighted, our estimates are that of males in the age group 20-60 years. 45.3% had not completed primary education, 35.5% had completed primary but not secondary education, while the remaining 19.2% had completed secondary education.

We solve for the 32 unknowns by minimizing the sum of squares:

$$(3) \text{ SSQ} = \sum_h \gamma_h \sum_i S_{ih}^2 + \sum_{k=1}^2 S_k^2$$

where:

$$(4) S_{ih} = \bar{n}_{ih} - \sum_k E_{hk} \tilde{p}_{ik}$$

$$(5) S_k = \bar{n}_k - \sum_h \gamma_h E_{hk}$$

1. E_{h3} is determined residually as $E_h - E_{h1} - E_{h2}$

2. as may be seen from table 1, the number of job seekers, if simply defined as labour force members who are not high income self employed would be high for household types 5-8. If these data were accepted the number of people without completed primary education would become unreasonably high for these household types - especially in view of the high incomes earned in household type 6 which would make a poor educational endowment very unlikely - and the employment probabilities at the lowest education level unreasonably low. We believe that a high percentage of the labour force members in those households is not actually seeking wage employment. We estimate this percentage implicitly by making the number of job seekers a variable.

The limitation of this approach is of course that it provides no direct test of the bumping model. We have no observations on the distribution of education within households ¹. and therefore have to estimate households' educational endowments (E_{hk}) and employment probabilities ($\tilde{p}_{ik}$) simultaneously.²

The relevance of the bumping model for Kenya has been stressed by several researchers including Collier and Lal (1979). Their indirect evidence (p. 62) is not convincing. In chapter 2 to which they refer they do not present evidence that 'the composition of the unemployed should be heavily biased towards the more educated' - and that in fact need not be implied by the bumping model - while a fall in the rate of unemployment is no evidence at all of bumping. More convincing is the evidence (p.131) that the educational profile of migrants has changed over time (while in 1964-68 34% of migrants had secondary education, in 1969-1977 this was true for 48%) and that strict educational criteria are used in recruitment for public sector jobs (in 1974 one could not get a clerical job without secondary education(form IV), while in 1977 only those from IV leavers with grade 4 examination results were eligible, p. 136).

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1. Thias and Carnoy (1972) present data on the education levels of wage employees. We do not use these because they are out of date (1968), because they cover only those who are employed rather than all who are seeking jobs and because their data do not provide information at the level of households.
 2. a second limitation of the approach as pointed out in section 1.3 is that we have to assume that in 1974 ex ante and ex post probabilities are equal. In general this non-linear estimation problem can be solved with Powell's 'hybrid method', Powell (1970, 1970b). If this would give a solution violating non-negativity constraints, the inequalities $E_{hk} \geq 0$, $p_{ik} \geq 0$ (all i, h, k) and E_h ($h \geq 5$) may be added. Thus amended, the extremum problem can be solved with e.g. the penalty function method of Lootsma (1972).

The final step is to convert the estimates p to the ex ante probabilities p as used in the model (see section 7.6) where they apply to cumulative labour supply (cf. equations (7.6.1)-(7.6.4)).

For 1974 we now have estimates of the incomes of wage-earners (W_r in section 7.6), of low-income self employed (W_s) and - from the estimation of the bumping model - of the number of job seekers, i.e. those competing for modern sector employment. Inserting those values in the two equilibrium conditions - equations (7.6.14) and (7.6.16) - allows us to solve them for the employment probabilities p_1 (for low income self employed) and p_2 (for unemployed). One's expectation that $p_2 > p_1$ is confirmed: we find $p_1 = 0.54$ and $p_2 = 0.74$.^{1.}

Finally, we have to allow for the possibility that for one or more labour categories there is excess demand rather than supply. We assume that in this case labour force members who do not seek jobs^{2.} are drawn into the market until it clears (with ex ante and ex post probabilities equalized: $p = \pi$).

1. the 1974 ratio of these two variables (0.74) is the value we use for the constant ξ in (7.6.15). The probabilities themselves change of course over time; in the base run they finally reach values 12% higher than in 1974. Note that, while for Tanzania we had estimates for two years (1969 and 1975) for Kenya we have data for 1974 only. An important implication is that we have no data on which to base our estimate of the planning horizon, hence - instead of the multi-period formulation of chapter 4 - we use the one-period version of the equilibrium condition.
2. i.e. those which we excluded from E_h for $h=5, \dots, 8$; these new entrants are assigned to the lowest education level ($k=3$).

Appendix 4: Consumption Functions

Our estimates of the coefficients of rural consumption functions are based on IRSI data.¹ The relation between our commodities and the IRS categories is:

<u>model</u>	<u>IRS</u>
1 food crops (own produced)	own produce, excluding: beef, other meat and poultry and milk
2 food crops (purchased)	purchased items: grains, flours and root crops
3 livestock products (own produced)	own produce: beef, other meat and poultry, milk
4 livestock products (purchased)	dairy products and eggs, meat and fish
5 other food (manufactures)	total food purchases, excluding items listed under 2 and 4
6 non-food	total non food purchases plus miscellaneous expenses.

Equation (7.7.2) - with $p_i = 1$ - is estimated in the form ².

$$c_i = a_i + b_i y$$

Regression results and the derived estimate of $\bar{c}_i$ and β_i are given in table 1.

Elasticities calculated at the mean,³ are given in table 2.

1. Kenya (1977) p. 59.
2. observations are weighted by the number of households in each income class. We do not have access to observations on individual households, so that the data set is restricted to the group means for the eight income groups, a severe limitation.
3. Since we are using the base year data all prices are equal to unity. The expressions for the elasticities thus reduce to $\beta_i y / c_i$ for the income elasticity and $(1 - \beta_i) c_i / \bar{c}_i - 1$ for the (own) price elasticity. The elasticities at three income levels are given in the main text (table 7.7.1).

Table 1: Rural Consumption Function Regression Results

commodity							
food crops:	a	b	t_a	t_b	R^2	$\bar{c}$	β
1 own produced	-219.9	.3173	37	203	.965	-54.3	.3173
2 purchased	+335.1	.0726	61	50	.625	373.0	.0726
livestock products:							
3 own produced	-160.7	.1680	50	197	.963	-73.0	.1680
4 purchased	+105.1	.0512	119	220	.970	131.8	.0512
5 other food	+ 85.3	.0994	49	214	.969	137.2	.0994
6 non food	-152.1	.2915	25	180	.956	0.0*	.2915
total						514.7	1.0

* by assumption

Table 2: Elasticities of Rural Consumption Functions

	income elasticity	price elasticity
1 food crops (own)	1.25	-1.04
2 food crops (purchased)	0.43	-0.41
3 livestock (own)	1.38	-1.14
4 livestock (purchased)	0.63	-0.68
5 other food	0.80	-0.71
total food	0.94	-0.94
6 non food	1.17	-1.00*

* implied by the assumption $\bar{c}_6=0$

Three implications of these estimates should be noted. First, as one would expect, the share of food in total consumption falls as income rises and, simultaneously, there is a substitution of meat and milk consumption for other food items. Secondly, price elasticities are high for own produced and low for purchased food. Hence higher prices will induce an increase in marketed production. Thirdly, the income elasticities for own produced items are higher than one, which implies, rather curiously, that the share of subsistence in total consumption would

increase with income.^{1.} The result is confirmed by the original data.^{2.}

A possible explanation for this result is that higher income levels give farmers access to inputs (improved seeds, fertilizers, etc.) with which they increase their productivity in food production. In this case the effective price of the good produced in the subsistence activity would rise with income: the opportunity cost of time devoted to subsistence production falls as labour productivity rise

For urban consumption we have used the 1974 Nairobi Household Budget Survey.

The published data give the composition of consumption at only three income levels;^{3.} we have based our estimates on unpublished data for

eight income groups. Table 3 gives the results, while the implied elasticities are given in table 4 (these are, again, calculated at the mean).⁴

-
1. This is indeed what happens in the early years of the projection, but is later offset by price effects: at the end of the projection period the share is exactly the same as in 1975.
 2. excluding households with negative incomes the observed share of subsistence in total consumption is .25 (estimated: .28) for the lowest income groups and .31 (.35), .35 (.36), .37 (.35), .39 (.38), .42 (.40) and .43 (.45) at higher income levels.
 3. Kenya (1977b); the same limitation prevented us from using a more recent survey (Kenya 1977e), in which data are presented at four income levels. In this latter case we did not have access to more disaggregated data.
 4. these estimates will be biased to the extent that the mean is calculated by using the number of households in the sample as weights. For the model this does not matter since the initial income distribution is derived from reweighted HBS results (cf. appendix 3).

Table 3: Urban Consumption Function Regression Results

commodity	a	b	t_a	t_b	R^2	$\bar{c}$	β
1 livestock product	3.63	.143	0.8	26.3	.99	10.7	.143
2 other food	23.88	.307	1.5	16.3	.98	39.2	.307
3 non food	-27.40	.549	2.0	32.6	.99	0.0*	.549
total ^{1.}						49.9	1.0

* by assumption

Table 4: Elasticities of Urban Consumption Functions

	income elasticity	price elasticity
1 livestock products	0.98	-0.93
2 other food	0.90	-0.91
total food	0.93	-0.94
3 non food	1.07	-1.00*

* implied by the assumption $\bar{c}_3=0$.

Note that - as for rural households - the share of food in total consumption will fall and the share of meat and milk in food consumption will rise with income.

1. except for transportation and medical expenses this total excludes the items listed in the main text after table 7.7.2. With the exception of rents, these excluded items account for too small a part of consumption - especially for the poor households - to warrant an econometric approach. We have therefore related the consumption of these items by piece-wise linear functions - the coefficients changing with household income - to total non food consumption (c_3). In applying the LES this is taken into account by including the prices of these items in the calculation of the weighted average p_3 .

Appendix 5: ICORs and the Production Function in Manufacturing

1. The data which we have used in the estimates of the CES production function for the manufacturing sector are collected in table 1. The data on prices, wages and employment - but not those on putput - refer to large scale manufacturing but this seems to cover most of the sector.^{1.}

Note that although our period is very short, those seven years were a period of remarkable changes. Labour productivity fell by 9% while real wages (to the producer) fell by 25%.

The CES function implies (under the usual conditions) a double-log relationship between real wages and labour productivity. Our estimation results for the wage equation are:

$$\ln (w/p) = .0077 + 2.095 \ln (Y/L) \quad R^2 = 0.943$$

(8.2) n = 6 (1969-1974)

implying a substitution elasticity^{2.} of 0.48 (note that we exclude the recession year 1975). The definitions of Y and L used in the model are different. A new series of Y is derived by applying the index series to our figure for GDP in manufacturing in 1972. Similarly, the series for L is forced through the observation on employment in the whole manufacturing sector for 1974.^{3.} We now derive residually a series $\alpha K^{-\rho} = Y^{-\rho} - \beta L^{-\rho}$. Since there are no data on the capital stock, nor on replacement investment we are forced to make two somewhat arbitrary assumptions. The first one

1. in terms of employment the coverage is 89% in 1969, in terms of value added 78% in 1969 and 85% in 1974.

2. the slope coefficient corresponds to $\rho + 1$ in equation (7.5.6) and $\sigma = 1/(1+\rho)$

3. after these differences are taken into account our estimate of β in equation (7.5.4) can be derived from the regression constant.

has the effect of forcing the estimated series of $\alpha K^{-\rho}$ through the begin and endpoints of the observed (i.e. residually derived) series. The second assumption is that each year 10% of the capital stock has to be replaced. The latter assumption is used in conjunction with data on gross investment to arrive at the net increase in the capital stock over the period. We then have for 1969:

$$\alpha K_0^{-\rho} = .00594$$

and for 1975:

$$\alpha (K_0 + 127.1)^{-\rho} = .00381$$

Table 1: Data Used in the Estimation of the Production Function for Manufacturing

year	Y(1)	L(2)	Y/L(3)	p(4)	w(5)	w/p(6)
1969	100.0	59.4	1.000	1.000	1.000	1.000
1970	110.0	69.3	0.943	1.040	0.958	0.921
1971	121.6	76.3	0.947	1.071	0.945	0.882
1972	127.8	88.1	0.862	1.252	0.967	0.772
1973	142.8	98.4	0.862	1.395	0.975	0.699
1974	156.7	111.2	0.837	1.635	1.137	0.695
1975	159.8	104.5	0.908	1.741	1.301	0.747

- notes¹.
- (1) quantity index of manufacturing production (1969=100); SA 76 p. 149 for 1969-72 and SA 77 p.150 for 1973-75, the latter data are on a basis of 1972=100 and chain indexing has been used to link the two series; for the overlapping years the data in the old series are: 140.4 (1973), 150.8 (1974) and 159.5 (1975, provisional).
 - (2) numbers engaged in thousands (large scale firms and establishments); SA 1976 p. 152, SA 77 p.154.
 - (3) index series of labour productivity: ratio of columns 1 and 2 converted to 1969 = 1.
 - (4) price index: SA 1976 p. 152 and SA 77 p. 154 gives a series of gross product in current prices. This series is converted to 1969=100 basis and divided by the column (1) output series.
 - (5) wage index: SA 76 p. 152 and SA 77 p. 154 gives a series of labour costs in current prices. This series is converted to 1969=100 basis and divided by the column (2) employment series.
 - (6) index of real wages: ratio of columns 5 and 4.

1. SA stands for Statistical Abstract: Kenya (1976c) for 1976 and Kenya (1977d) for 1977.

from which we can solve for K_0 (K£ 238.7 million) and $\alpha(2.5546)^1$

In the model the production function is used to arrive in four steps at value added in manufacturing. First, given wages and prices, labour productivity is calculated as:

$$y = \left(\frac{w}{\beta p} \right)^{1/(\rho+1)}$$

and capital intensity as:

$$k = \left(\frac{y^{-\rho} - \beta}{\alpha} \right)^{-1/\rho}$$

Then: $L = (0.9 K_{t-1} + I_{t-1})/k$

$$Y = y L$$

2. Incremental capital output ratios (ICORs) for other sectors are based on the ratio of the increase in GDP (at factor cost in 1972 prices) between 1972 and 1977 and total investment in the period 1972-1976 (i.e. assuming a one-year output lag).^{2.}

We assume radio-active depreciation - i.e. a constant percentage of the capital stock has to be replaced each year - and, while keeping net ICORs constant, allow for the effect on gross ICORs of a difference in a sector's growth rate between the estimation period and the projection period.^{3.}

If the depreciation rate is δ and the growth rate g then:^{4.}

$$ICOR_{gross} g_t = ICOR_{net} (g_t + \delta)$$

-
1. for $\alpha K^{-\rho}$ the observed series is: .00594 (1969), .00560, .00499, .00503, .00445, .00409 and .00381 (1975); the estimated series: .00594, .00565, .00528, .00486, .00441, .00404, .00381.
 2. the data are from Kenya (1977d) pp.42,49 and Kenya (1978) pp.13,24. Note that the break between the 1964 and 1972 series in the National Accounts prevents us from using data before 1972.
 3. We use the well-known Chenery and Eckstein (1970) formula which seems to be popular with Kenya modelers: World Bank (1975), p.118, Bigsten (1978), p.120.
 4. If $K_t = (1-\delta)K_{t-1} + I_{t-1}$, $I_{t-1} = ICOR_{gross} (Y_t - Y_{t-1})$ and $K_t = ICOR_{net} Y_t$ then $K_t - K_{t-1} = I_{t-1} - \delta K_{t-1} = ICOR_{net} g_t Y_{t-1}$ from which the equation in the text is easily derived.

This equation is used to derive estimates of net ICORs, using the IO table data on depreciation for estimates of δ .^{1.}

Table 2: Incremental Capital Output Ratios

	net ICOR	gross ICOR	growth rate	gross ICOR
		1972-1977	1972-1977	(for $g=.05$)
agriculture	1.41	3.77	3.6%	3.11
mining	3.67	5.44	9.7	7.11
electricity	8.11	9.84	9.9	11.53
construction ^{1.}	7.78	3.00	-2.7	-
trade	1.40	3.10	3.7	2.66
transport ^{1.}	4.54	11.30	2.1	-
dwellings ^{2.}	21.40	21.40	2.4	21.40
government	3.45	3.54	6.5	3.57
other services	1.12	1.60	8.6	1.95

notes: (1) in this case the method gives an unreasonably high value for the ICOR and estimates for Tanzania are used instead.
 (2) according to the IO table $\delta = 0$; this is just as well since the net ICOR already appears to be rather high.

Note that the formula implies that a sector's gross ICOR will be lower if the the growth rate is higher than in the period 1972-1977.

1. for manufacturing this gives $\delta = .099$ which is why we assumed a 10% depreciation rate in the estimation of the production function parameters. It hardly needs to be said that published depreciation data are based on accounting practices and may be a poor measure of the economic concept; the estimates and especially the sectoral differences seem however quite reasonable.

Appendix 6: Computational Methods

1. Our models are not suitable for direct computation; instead, they are solved by iterative methods. We have not attempted to apply an existing or to develop a new algorithm but have in both cases used a modified version of the Gauss-Seidel method (which, since convergence is not guaranteed, is not strictly an algorithm).

2. In the case of the Tanzania model our procedure gives special treatment to two simultaneities in the model, those illustrated by the two diagrams in sections 4.1 and 4.4. In the former case the problem is-as we noted in section 4.1 - one of inter-temporal simultaneity. In our discussion there of the simplified two-sector model we mentioned that we iterated on ID_{2t-1} a lagged variable (which in the full model corresponds to investment in manufacturing). The procedure involves four steps:

(a) in the beginning of an iteration the previous iteration's value for last year's investment in manufacturing is used in the submodel for the industrial sector to calculate this year's manufacturing output. With output of agriculture and mining predetermined and that of manufacturing now known the material balances ^{are} ~~one~~ solved for imports (MF_1 in equation (4.1.1)) of those three sectors.

(b) in the two-sector example of section 4.1 the next step was to calculate this year's investment and output in the second sector (X_2) from the balance equation. In the full model X_2 is a vector, giving output levels of the seven services sectors. Before we solve for this vector we remove the simultaneity resulting from the presence of investment demand (IS_1) in (4.1.1). Total

investment (IT) is the sum of domestic and foreign savings. The latter are exogenous and the former can, using (4.1.7) be written as a linear function of output levels (i.e. as $\sum_i \gamma_i X_i - \sum_i (C_i + G_i)$; note that we ignore the relation between C and X; private consumption does of course change between iterations but we have found that the procedure converges quickly even if that simultaneity is ignored). Secondly, using (4.1.3) IS_i can be written as a linear function of IT - and hence of X_i - since the columns of the matrix B are identical. After this substitution all terms on the right hand side of (4.1.1) are either linear in X_i or (treated as if) independent from X_i . The system of linear equations defined by (4.1.1) is then solved by matrix inversion for the output level of the services sectors.

(c) given the current output levels, (4.1.6) is solved for the vector of last year's investments (ID_{2t-1} in the simple model) in the services sectors.

(d) a new value for investment in manufacturing is obtained residually and used in the next iteration.

The second simultaneity originates in the urban labour market.

Our solution method is applied within each Gauss-Seidel

iteration.¹ At the beginning of an iteration we define maximum and minimum levels ($p_2^{\max}$, $p_2^{\min}$) for the probability of employment p_2 . Each subiteration starts by calculating p_2 as the average of $p_2^{\max}$ and $p_2^{\min}$. The model is then solved for demand and supply for unemployment (cf. equation (4.4.7), (4.4.8)). If the difference between these two is below a specified tolerance level the procedure stops. If not, $p_2^{\min}$ ($p_2^{\max}$) is replaced

1. hence (while macro-economic equilibrium is reached only in the final Gauss-Seidel iteration) demand and supply for unemployment are equal at the end of each iteration.

by the current value of p_2 if excess supply is positive (negative) and this new value is used in the next subiteration.

With the Gauss-Seidel method thus amended, the solutions converge quite quickly and we have not found it necessary to resort to more sophisticated methods. The average number of iterations per year is 11.3.

3. For the Kenya model we have also used Gauss-Seidel iteration, with two amendments. The equilibrium assumed in the urban labour market (i.e. equal expected incomes for unemployment and informal sector employment) is the same as that in the Tanzania model and we therefore used the same bisection method.

The second amendment concerns the endogeneity of most output prices. The procedure was briefly described at the end of section 7.4. Within an iteration the price vector p^D is given. The vectors of output (X) and demand (X^D) are calculated using those prices. The price vector to be used in the next iteration is then calculated from (7.4.11), i.e. on the basis of excess demand. There is no particular reason why this procedure would be computationally efficient; in fact one might expect it to be inefficient because (a) it ignores that excess demand in one sector may require an adjustment of prices in other sectors: cross-elasticities in (7.4.11) are ignored (b) it quite arbitrarily uses the same elasticity for all sectors. Prices are adjusted only if the absolute value of excess demand as a percentage of output exceeds a tolerance level. This tolerance level is initially high (2%), but it falls linearly with the number of iterations.

This method is similar to that of Adelman and Robinson (1978, pp. 241-243),

but there are two differences. First, they change the value of ζ in (7.4.11) if the sign of the price change differs between iterations: price changes are damped to reduce the possibility of cycling. We have not found this necessary. Secondly, their version of (7.4.11) determines net rather than gross prices. Changes in product prices are calculated from the changes in net prices thus determined by use of the Leontief inverse.

A typical run of the Kenya model (for the 11 year projection period 1975-1985) requires about 80 seconds of CPU time on Oxford's ICL 2980 computer; four of the eleven solutions are obtained in less than 10 iterations, another four require from 10 to 19 iterations and only three solutions take 20 iterations or more.

Appendix 7: The Input-Output Table

1. Of the published input-output tables for 1971¹, we have used the one expressed in producer prices, table 3. Several adjustments were made to arrive at the matrices used in the model. First, the table was aggregated to correspond to the sector definitions used in the model. The mapping is shown in the table.

Table 1: Correspondence between Sectors in the Model and in the IO Table.

sector	model	IO table
subsistence	(1,2) ² .	1,2
monetary agriculture (non food)	3(1)	} 3
monetary agriculture (food)	3(2)	
mining	4	4
manufacturing (food)	5(3)	5,6,7
manufacturing (non food)	5(4)	8-19
electricity and water	6	20
construction	7	21
trade	8	22
transport	9	23
ownership of dwellings	10	25
government	11	28
other services	12	24,26,27
'ownership of business premises' and 'unspecified (inc.hunting)'	see text	29,30

Two problems are involved. As Bigsten³ points out, the appearance of sectors 29 and 30 in the IO table implies that intermediate deliveries have been underestimated and - since consumption is derived residually - that consumption has been overestimated by the same amount; the latter error is compensated in the published table by large negative entries in rows

1. Kenya (1976b).

2. these two IO activities play no role in the model; there are - by definition - no entries for other sectors in these two rows and instead of the entries in the two columns, we use IRS information on the use of inputs in smallholder agriculture.

3. Bigsten (1978) pp. 70-73; our treatment of this problem roughly follows his. Cf. also Kenya (1976b), p.13.

29 and 30 in the column for consumption. Entries in these rows were distributed proportionately over other rows.¹ The second problem is that in the model we distinguish between food and non food agriculture while no such distinction is made in the IO table. The row for agriculture in the IO table is disaggregated by assuming (a) that the flow of intermediate inputs from agriculture to manufacturing (food) comes from agriculture (food) and is the only intermediate delivery of that sector (b) that all consumption belongs in the row for food and all exports² in the non food row (c) that the capital formation item is a delivery from the agriculture (food) sector.³ Now that the two rows have been obtained gross output for the two subsectors is known. Entries in the column for agriculture are now distributed over food and non food agriculture in the same ratio as output. The second adjustment is the conversion of the table from 1971 to 1972 prices. No gross output prices are published. But if one uses the IO coefficients for intermediate inputs, imports, indirect taxes and duties and has index series (1971=1) for import prices, indirect tax rates and duty rates one can - by matrix inversion - solve for output prices in 1972 (on a basis 1971=1) which are consistent with the published data on GDP deflators in the two years. The only problem is that there is no information on indirect tax and duty rates at the sectoral level. We iterated until our estimates yielded exactly the right national totals (in current prices) for indirect taxes and duties. These estimates imply that - in constant prices - indirect tax rates remained unchanged while

1. excluding agriculture, mining and construction; cf. Bigsten (1978), p.71.

2. comparison with detailed trade statistics shows that at least 95% of agricultural exports consisted of non food items (under which heading we include coffee); Kenya (1976c), p. 68.

3. since much of it probably consists of increases in 'breeding stocks and dairy cattle'.

duty rates fell. Having arrived at an estimate of the change in output prices, the whole IO table is revalued so as to be expressed in 1972 prices.¹ The same method was used to arrive at output price indices (1972=1) for the model's first year (1975).

The third, and final, correction to the table concerns the treatment of import duties. The published IO table presents flows of domestically produced intermediate inputs exclusive of (net) indirect taxes but flows of imported intermediate inputs inclusive of duties. The result is that the data presented for 'gross value added' conform neither to the GDP at factor cost nor to the GDP at market prices concept and that, on the expenditure side, imports are not valued c.i.f. However, in table 4 of the publication import duties are given by sector of origin (i.e. row) and separately for intermediate, consumer and capital goods imports. To arrive at the MIM matrix as used in the model - cf. equations (7.4.5) and (7.5.3) - we assume that (for a given sector of origin) the duty rate does not depend on the sector of destination; similarly, the published data allow one to derive imports of final (consumer and capital) goods both in - and exclusive of duties.²

-
1. since our estimates suggest some relative price changes - prices would have risen by 7½% in agriculture, by 8½% in manufacturing and by only 4% in other sectors - the exercise is not trivial in spite of the fact that only one year's change has to be allowed for.
 2. both concepts are needed: the material balances - equation (7.4.1) - are expressed in domestic market prices (hence MF is inclusive of duties) but for the balance of payments we need the c.i.f. concept. Total GDP at market prices is of course derived by adding to the sum of sectoral GDPs (which only include duties on imports of intermediate goods) duties on imports of consumer and capital goods.

2. While the IO table presents the final demand vectors net of imports - so that the material balances appear as:

$$X_i = \sum_j A_{ij} Y_j + C_i^* + G_i + IS_i^* + E_i$$

- the data on imports in table 4 allow us to convert these vectors to the vectors C, IS and MF used in the model and also to distinguish between the consumer goods part of MF (say MF^C) and the capital goods part MF^I ($C^* = C - MF^C$, $IS^* = IS - MF^I$). These vectors are used to derive the import coefficient μ^C and μ^I of equation (7.4.2).

Table 2: Calculation of Import Coefficients

sector	C	MF^C	μ^C	IS	MF^I	μ^I
3(1) agriculture (non food)	-	-	-	-	-	-
3(2) agriculture (food)	23.2	3.4	0.147 ¹	2.8	0.1	0.036
4 mining	0.2	-	-	-	-	-
5(3) manufacturing (food)	74.1	11.3	0.152 ¹	-	-	-
5(4) manufacturing (non food)	77.8	44.7	0.575 ²	57.6	49.2	0.854
6 electricity and water	1.8	-	-	-	-	-
7 construction	-	-	-	52.8	0.3	0.006
8 trade	17.3	1.1	0.064	10.0	-	-
9 transport	21.1	5.0	0.237	-	-	-
10 ownership of dwellings	28.8	0.3	0.010	-	-	-
11 government	26.8	5.0	0.187	-	-	-
12 other services	39.8	1.8	0.045	0.8	-	-
total	310.8	72.6		124.1	49.7	

Notes: (1) not used, except in run 11; in all other runs imports are residual
(2) not used in runs 4 and 5 when imports are residual

The values of MF^I for agriculture and construction are so low that we ignore them in the model. A final (and drastic) adjustment is needed because 1971 was a year in which imports were unusually high, while in the first year of our projection tight controls were in force.¹ Except for the IO table itself, no import data exist which can be easily matched to the

1. From the Statistical Abstract data on imports and on GDP at market prices - Kenya (1976c), p.40 for 1969-1973 and Kenya (1977d), p.40 for 1974, 1975 - one finds a time series for the import ratio - 0.29 (1969), 0.31, 0.34 (1971), 0.28, 0.27, 0.29, 0.22 (1975) - which clearly illustrates how unusual 1971 was. Bigsten recognises that 1971 was an exceptional year but makes no adjustment; this leads to huge errors (which, to his great credit, he repeatedly emphasises); his model gives e.g. a current account deficit for 1976 of Kf83 million while there was in fact a surplus of Kf 28 million. Bigsten (1978), p. 359.

sectoral classification. However, data from which imports grouped as intermediate, consumer and capital goods can be derived do exist. From these we conclude that capital goods were not affected: no adjustment of μ^I is needed. Consumer goods imports in 1975 were substantially lower than one would expect on the basis of the 1971 data and to allow for this the μ^C coefficient for non food manufacturing is reduced by 40%.¹ Coefficients for imports of intermediate goods were reduced by about one third and for each sector the IO column was adjusted proportionately to ensure that after this change the usual identities would continue to hold.

3. The Kenyan National Accounts are published in two series, one in 1964 prices (available for 1964-1973) and one in 1972 prices (available for 1972-1977). Unfortunately, there are discrepancies between the two series if we compare them in current prices for the overlapping years. Changes in sector definitions² can provide only part of the explanation; not even the national totals are identical.³ While we have chosen the model's prices to be 1972 in order to be able to use post 1973 data on e.g. capital formation, our use of the IO table restricts us to the sector definitions and production estimates of the 1964 series. Hence there will inevitably be some differences with the published data since our results are based on the 1964 series but converted to 1972 prices.⁴

1. note that in run 6 - in which import controls are relaxed - this coefficient is again increased by 30%.

2. Kenya (1976c), p. 39.

3. Kenya (1976c), pp.42, 44; total GDP at factor cost in 1973 is almost Kf20 million (2.6%) higher in the 1972 series.

4. this implies that national accounts variables can be compared only by extending the 1964 series beyond 1973. This can only be done by applying GDP growth rates (for each sector) in the 1972 series to the last value in the published 1964 series. The drawbacks of this chain index linking will be obvious.

4. The IO data are combined with the data in the Statistical Abstract¹ on the distribution of capital formation by type of asset to derive the mapping from investment by sector of destination to investment by sector of source.² This information does not permit a very satisfactory estimate of the B matrix, but it does enable us to allow for what is probably the major difference in the composition of investment, that between investment in agriculture and in other sectors. The first step is to correct the mapping—from the vector of investment by sector of destination (ID) to investment by type of asset—given in the Statistical Abstract for revisions in the 1971 data.³ Secondly, a matrix giving the mapping from investment by type of asset to investment by sector of source (IS) is constructed by assuming that agriculture is the source for 'breeding stock and dairy cattle' and 'land improvement and plantation development' and that after trade margins are subtracted, manufacturing and construction share in all other investment in the ratio .552:448 (these averages having been derived from the IO tables). The final step is to use our price indices to convert the product of these two matrices (i.e. the B matrix) into 1972 prices. The end result is a very simple B matrix: the shares of agriculture, manufacturing and construction in monetary investment (excluding housing) are 22.1%, 42.5% and 35.1% for investment in agriculture and 0%, 55% and 45% for all other investments.

1. Kenya (1972), table 54; the data for 1971 in this table are provisional; we allow for the later corrections.

2. i.e. the matrix B in equation (7.5.2)

3. investment in cattle is lowered from Kf 2.06 million to 0.40; in 'land improvement and plantation development' from 2.43 to 2.40; in 'modern dwellings' increased from 12.85 to 13.83; the whole column for 'transport equipment' is multiplied by the ratio of 26.36 and 20.92 and, finally, for each sector, investment consisting of other assets than the four mentioned is derived residually from the (revised) totals. Kenya (1976c), pp. 50, 54.

Appendix 8: Data on Smallholders (IRS)

1. Farm size. We have used unpublished IRS printouts to estimate the effect of farm size on output.¹ For each province we have run three double-log regressions, with size of holding as the independent variable and farm production, farm income or crop production as the dependent variable (table 1).

First consider the estimates using total farm production (i.e. including livestock) or income as the dependent variable. We find that the correlation is high, especially for Central, Rift Valley and Western provinces; that the estimated elasticities are very low (about one third) and, remarkably, very similar across provinces;² and that the elasticities are not very much affected by the choice of dependent variable. This last result is important. It suggests that innovation and changes in product mix (which involve higher use of purchased inputs and of hired labour) are independent of farm size; this provides a justification for the specification of the model (where product-mix is indeed independent of the size of holding). There are two extreme observations, which we exclude in the rest of our analysis: those for the largest size class (≥ 8 ha.) for Eastern and Nyanza provinces.

-
1. Since we want to allow for inter-provincial differences, the published data can not be used: these would give output by province or by size of holding but no cross-tabulation of the two. Production, as used here, is the sum of sales of output; output used for own consumption; and output used for seed, feed or wage payments in kind. Income is obtained by subtracting from production its third component (i.e. farm costs in kind) and cash current farm costs (purchased farm inputs, wages paid to labour and farm repairs). Valuation changes are excluded.
 2. We find this remarkable to the extent that if the low elasticity is the result of the largest holdings being owned by urban residents (whose main occupation is not farming and who hold the land not as productive asset but for its attractive properties as a speculative asset) then one would expect the elasticity to be lowest in Central province where much land has been bought by members of the Nairobi urban elite.

Here farm income is only one-quarter and one-half respectively of the income of the preceding class (5-8 ha.).

The fact that - after this adjustment - our estimates of the elasticities differ very little between provinces is interesting. Curiously, Collier and Lal, who also use the IRS data, reach the opposite conclusion.^{1.} There are two problems with their results. First they are based on means for smallholders grouped not by size of holding but by (total) income; since these two variables are not perfectly correlated this implies a bias. Secondly, their method does not use all available information; their estimates of the effect of land on farm income are the slope of a line connecting two points in a scatter diagram.^{2.}

It should be emphasised that although in section 7.2. we refer to 'production function' as a short hand expression for the estimated relationships the elasticity can not be interpreted as a purely technical coefficient, i.e.

1. Collier and Lal (1979), table 10 (p.14). They claim (p.16) that the correlation between size of holding and farm income is significant at only the 5% level for Western province and not significant for Central province. These correlations are apparently based on data tabulated by total smallholder income, rather than by size of holding (see also their appendix 4, especially table 4, p. 146). Since total income - as they themselves repeatedly stress - is only very weakly correlated with farm size, this procedure is inappropriate. It leads to radically different results; e.g. they conclude (p.54) from the absence of a correlation between farm income and farm size for Central province that 'the larger farms are being farmed relatively inefficiently compared with the small smallholder farms in Central province as well as the larger farms in Nyanza'; while this might be plausible it is not supported by the data. On the contrary while in Central province farm income continues to rise with farm size, in Nyanza, as we noted above, it actually falls.

2. pp.145-148, especially table 5.

indicating very strongly decreasing returns to land. The coefficient is behavioural to the extent that it reflects the difference between those who hold land as a productive asset and those who buy land mainly for capital gains.¹.

Table 1: Farm Output and Size of Holding: Regression Results

Dependent variable	p r o v i n c e							
	Central Coast		Eastern		Nyanza		Rift Valley	Western
<u>production:</u>								
elasticity	0.35	0.39	0.34	(0.16 [*])	0.27	(0.18 [*])	0.37	0.33
R ²	0.91	0.44	0.87	(0.21 [*])	0.47	(0.30 [*])	0.88	0.80
<u>farm income:</u>								
elasticity	0.36	0.38	0.32	(0.09 [*])	0.22	(0.12 [*])	0.40	0.37
R ²	0.89	0.42	0.84	(0.06 [*])	0.50	(0.19 [*])	0.93	0.84
<u>crop production:</u>								
elasticity	0.36	0.40	0.27		0.37		0.34	0.33
t-score	7.0	2.2	4.5		2.4		5.0	5.6
R ²	0.89	0.46	0.80		0.53		0.81	0.84

* if observations for the last size of holding class (≥8 ha.) are included; for provinces other than Eastern and Nyanza these observations are always included.

The estimates which we use appear in the third part of the table. Our use of crop production as the dependent variable - i.e. subtracting livestock production but not farm costs - requires justification. The reason is that we want to keep our estimates independent of the effect of differences in product mix. Since livestock production (at least at 1974/75 prices which make it highly profitable) require^s much less land - even if the indirect

1. A serious limitation of the model is that the distribution of land (except when we model a land reform policy, section 8.5) is exogenous, thereby ignoring the effect of urban incomes on land concentration, via land purchases by the urban rich. But that limitation also provides a justification for using the estimated elasticities as constants in the model: if we were to model urban-financed land concentration the elasticities would have to become endogenous variables.

requirements in terms of fodder production are taken into account - than crops, we want to treat the two separately. This affects the elasticities if livestock is disproportionately held on the smaller holdings and if it accounts for a high percentage of farm income. This is the case for Nyanza, where as a result our estimate (of the elasticity of production with respect to farm size) rises from 0.27 to 0.37. Secondly, farm costs (as reported in the IRS) is not a satisfactory concept because while it measures the input of hired labour it excludes family labour. We have therefore adopted (in section 7.2) a two-stage approach, whereby production is determined first, and the associated labour requirements only later.¹

A possible objection to our use of the correlation between output per hectare and farm size is that it may only capture the effect of land quality. In the absence of IRS data at the level of primary sampling units the best way to correct for differences in land quality is to use data at the level of the eight agro-ecological zones used in the survey (cf. Kenya (1977), ch. 3). I am indebted to Gene Tidrick for the observation that using IRS data at this level one can reject the hypothesis with two (simplistic) tests. First, a cross-section regression of mean output per hectare and mean farm size for the eight zones reveals no significant correlation. Secondly, if one constructs a hypothetical mean for output per hectare for each holding size group by weighting a zone's mean output per hectare by that zone's share in total land in that holding size group then the hypothetical means should be equal to those observed if the effect

1. the exclusion of livestock is straightforward for marketed, but not for total production, since (at least in the set of tables used for this exercise) no breakdown is given of subsistence consumption. We have used our consumption function to estimate how much of this total consists of livestock products.

of land quality explains the correlation ~~and the hypothetical means should be equal across farm sizes if the hypothesis is false.~~ The hypothetical means are in fact very nearly equal, *while the observed means decline as the size of the holding rises.*

2. Innovation

In section 7.2. - equations (7.2.10) and (7.2.11) - we postulated linear relationship between the number of cattle or coffee trees and the level of non farm income.¹ The regression results are given in table 2.

Table 2: Livestock Coffee and Non-Farm Income: Regression Results

province:	<u>livestock</u>		
	b	t _b	R ²
Central	.0003	8.6	0.84
Nyanza	.0027	5.3	0.82
Western	.0004	6.0	0.86

province:	<u>coffee</u>		
	d	t _d	R ²
Central	.632	2.2	0.50
Eastern	.682	10.1	0.95

1. in the projection non farm income is deflated by a weighted average of the price of coffee and of rural wages.

3. Labour

The IRS collected data on family and hired labour use on smallholdings, separately for livestock and crop work.^{1.} But only provincial means are presented. However, we do know (for each of the eight groups of smallholders which we distinguish within a province) the household size and its production. These data are used to derive for each province an estimate of the coefficient α in equation (7.2.3) which is consistent with the published aggregate for hired and total labour use. This measures the availability of family labour for work on the smallholding.^{2.}

Over time the coefficient α changes if a household gains access to modern sector employment. Within a province new jobs are distributed over smallholder on the basis of the base year distribution of income from wage employment. Hence, this distribution remains constant. Since, as in urban areas, access to modern sector employment is largely a matter of education^{3.} this amounts to assuming (again: as we did for urban households) that over the projection period the distribution of educational endowments remains unchanged. It should be noted that this procedure allocates jobs to smallholders without regard to whether they are in a labour surplus or deficit position. This is justifiable, since modern sector wages are much higher so that it is rational for a smallholder upon taking up off-farm employment to substitute hired labour for his own work on the holding. This implies that growth of rural non-agricultural employment has two effect: a direct one (increasing the non-farm income and reducing the family labour supply of the smallholders who gain access) and an indirect one (as other households benefit from an increase in the demand

1. Kenya (1977) chapter 11; some inaccuracies may be involved since the data have to be read from bar graphs.

2. the estimates differ between provinces, reflecting differences in the extent of access to non-farm employment.

3. cf. Collier and Lal (1979) p.41 and the evidence of Momanyi (1976) there cited.

for hired labour).

Data limitations prevent us from modelling the supply of hired labour in the smallholder sector satisfactorily. We assume that the wage rate remains constant in terms of food prices. While competition by the landless, whose opportunity cost probably is very low, may well keep the wage rate low, the assumption of infinitely elastic supply is obviously too extreme¹. To this extent, the model underestimates the incomes of those who supply farm labour. A second limitation of our labour market model is that (since it does not cover the landless) wages paid on smallholdings accrue to the smallholders. To that extent the model exaggerates the effect on poor smallholders of increased labour demand: some of the benefits of that projected development would not accrue to poor smallholders but to poor landless.

In calculating labour requirements for livestock we have made use of data from the Nyeri survey to convert 'sheep, goats and pigs' to 'cattle equivalents'². The IRS data on livestock gives us total labour use, herd size (after converting to 'cattle equivalents') and the percentage of the herd which is improved (i.e. non native cattle). Using these data, a cross-section over provinces gives:

$$y = \frac{30.42}{(9.0)} + \frac{0.48}{(3.7)} x \quad R^2 = 0.82$$

where y is labour use (mandays per head of cattle equivalent) and x is the

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1. in fact there is evidence that rural wages rose substantially during the coffee boom in Central province. Interestingly, in the formal sector negotiated wages for coffee pickers were not adjusted in 1976-77 (Gray (1977), pp. 27-28).
 2. Kenya (1968). The average number of heads of livestock per farm was 11 in the survey (7.5 dairy cows - 4.3 grade cows, 2.6 other grade dairy cattle and 0.6 'native cattle' - and 3.5 other livestock, i.e. sheep, goats and pigs). The former category required 2740 manhours of labour, the latter 215, or : 365 manhours per head of dairy cattle and 61 per head of other livestock. Our conversion uses the ratio 61/365.

percentage improved. This equation is used in the projections to adjust the labour use coefficients in equations (7.2.8), (7.2.9). We assume that exogenous changes in livestock ownership leave the percentage improved (and hence labour intensity) unchanged but that endogenous increases are all in the form of improved stock.

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Abbreviations:

IDS	Institute for Development Studies, University of Nairobi
IDS (Sussex)	Institute of Development Studies, University of Sussex
IIASA	International Institute for Applied Systems Analysis, Laxenburg, Austria
ILO	International Labour Office, Geneva
UNRISD	United Nations Research Institute for Social Development, Geneva

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ABSTRACT

Income Distribution in Models for Developing Countries:
Kenya and Tanzania

thesis submitted for the degree of Doctor of Philosophy in
Trinity Term 1979 by Jan Willem Gunning, Nuffield College, Oxford

At the core of the theoretical part of this thesis is a review of recent attempts at incorporating income distribution in economy-wide models. Most existing models are very detailed and complex but the mechanisms which dominate the results are simple and determined by conveniently extreme assumptions about prices and wages. Typically, prices are either all rigid or all flexible; the treatment of agriculture is unsatisfactory; and dualism in the labour market is ignored. A convincing case for the alleged insensitivity of the distribution of income to policy interventions can not be based on these models.

The major part of the thesis describes two models, for Tanzania and Kenya, and their results. In the first model the emphasis is on the effects of migration and economic growth on the urban income distribution. It describes an economy in which neither prices nor wages respond to changes in market conditions. Distinctive features of the Kenya model include its submodel for smallholder agriculture, educational 'bumping' in the labour market and its emphasis on trade and pricing policies.

The models are used to estimate the effects of policies (wages, trade, pricing, investment allocation, land redistribution) on growth and income distribution. The results contradict some of the conventional wisdom about the two countries. The models explicitly recognise a number of market

imperfections, especially in the labour market, which are crucial in determining distributional changes but which are usually ignored in modelling. The results reveal a greater sensitivity of the distribution of income to changes in policies than has been found with some other models.

