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A Note on Private Sector Asset Portfolios in Developing Economies: Econometric Estimates from the Kenyan Economy.

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ABSTRACT: This paper provides a set of benchmark estimates of the private sector's income and price elasticities of demand for the asset market components of this class of AGE models calibrated for low-income developing economies. The results presented in this paper are based on the estimation of a cointegrated asset demand system for Kenya, where the private sector is assumed to hold its wealth in terms of five assets and one liability. The estimating model is based on the almost-ideal demand system developed by Deaton and Muellbauer (1980) and is estimated on quarterly data for the period from 1970 to 1990.

KEYWORDS: Asset Portfolios; Developing Country Computable General Equilibirum Models; Applied Econometrics.

JELit Classifications: O11 , O41, G1.

1. Introduction

In recent years, applied general equilibrium (AGE) models have increasingly been used to examine the consequences of macroeconomic adjustment programmes in developing economies. To address macroeconomic issues, models have been built which attempt to integrate financial asset markets with the neo-classical real-economy structure of a standard AGE model (see for example, Bourguinon *et al.*, 1991; Lewis, 1992; and Rosensweig and Taylor, 1990). Typically, however, the behavioural structure of the asset markets in these models is not based on econometric estimation, but is calibrated using best guess parameter values. This paper provides a set of benchmark estimates of the private sector's income and price elasticities of demand for the asset market components of this class of AGE models calibrated for low-income developing economies. The results presented in this paper are based on the estimation of a cointegrated asset demand system for Kenya, where the private sector is assumed to hold its wealth in terms of five assets and one liability. The estimating model is based on the almost-ideal demand system developed by Deaton and Muellbauer (1980a) and is estimated on quarterly Kenyan data for the period from 1970 to 1990. The choice of country and sample period has been dictated by data availability, but the history and structure of the Kenyan economy over this period means that the results may be generalized to other developing countries.[1]

The paper is set out as follows: section 2 outlines the model to be used; section 3 discusses the data and the context, while Section 4 considers issues in econometric specification. Section 5 presents and discusses the results and Section 6 is in conclusion.

2. The Model

The econometric model is designed to quantify four specific characteristics of the data. First, it is used to estimate the private sector income and wealth elasticities of demand for real and financial assets. Second, the model will be used to examine the role of relative prices in determining portfolio composition. Third, the model can be used to examine the impact of inflation on the composition of private sector wealth — concentrating in particular on the extent of the "flight from money" in response to rising inflation. Finally, the error-correction specification of the model allows us to examine the relative speed of adjustment between different types of asset towards their long-run equilibrium.

Models of asset accumulation typically employ a capital asset pricing structure (see, for example Spencer, 1986). More recently, an alternative approach (based on a two-stage budgeting approach) has been employed. In this case, the first stage involves the representative agent making labour supply / leisure and consumption / saving decisions which determine the total value of the agent's saving behaviour. The second stage considers how the revised stock of wealth is allocated between different groups i.e. money; bank deposits and loans (the latter being treated as negative assets); real assets (in the form of equity); government securities, foreign exchange, etc.. Implicit in the two-stage budgeting

[1]See Bevan, Collier and Gunning (1990) , Killick and Mwega (1990), and Adam, Ndulu and Sowa (1996) for a description of the Kenyan economy over the period.

problem is the idea that only information relevant to each stage is required in each allocation decision. In other words, the allocation of assets across a portfolio depends only on the relative prices and quantities within the group of assets in the portfolio, and does not require information on the higher level processes (i.e. the consumption /saving decision).[2] This approach has the added advantage that it mimics the structure of many AGE models. Typically, wealth (and its composition) is assumed fixed at the beginning of the period and the model is solved for its flow equilibrium. This generates a volume of saving which is then used to update the stock of wealth.

This approach has been used to model asset demands by Taylor and Clements (1983), Perraudin (1987) and, most recently, by Barr and Cuthbertson (1991). Taylor and Clements and Barr and Cuthbertson estimate asset demand-share models for financial assets (principally cash in circulation, sight and time deposits and national savings certificates) for Australia and the UK respectively, while Perraudin uses a broader classification of demand shares — including real assets, capital uncertain financial assets and also financial liabilities (treated as negative assets). These authors conclude that the models successfully describe the data and, in the case of Barr and Cuthbertson (1991), are consistent with results from single-equation demand for money models estimated for the UK.

The model starts from the utility maximization dual problem where the representative agent minimizes the cost function subject to some budget constraint. The cost function used is generally of the form

(1) $$lnc\,(u,p) = a(p) + ub(p)\,,$$

where $u = u(x,p) = (lnx - a(p))/b(p)$ is the indirect utility function, x is total expenditure, and $a(.)$ and $b(.)$ are functions of prices, p. By using a second-order Taylor approximation to the cost function (1) we let

(2) $$a(p) = \alpha_o + \sum \alpha_i lnp_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij} lnp_i lnp_j$$

and

(3) $$b(p) = \beta_o \Pi p_k^{-\beta k}.$$

Substituting these values into the cost function (1) and using Sheppard's Lemma:

$$s_i = \frac{\partial lnc(u,p)}{\partial lnp_i},$$

(where s_i is the share of the *ith* good in total expenditure, x) we derive the demand share equations as:

[2] This has the additional implication that demand share models can be estimated conditional on current period wealth. This approach is adopted here.

(4) $$s_i = \alpha_i + \sum \gamma_{ij} lnp_j + \beta_i ln(\frac{x}{P}),$$

where

(5) $$lnP = \alpha_i + \sum_i lnp_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij} lnp_i lnp_j.$$

When price movements are relatively collinear within the group (as in the case with the price vector considered in the subsequent asset demand models), then (5) can be replaced by a weighted price index defined over all the elements of the price vector, of the form $\Sigma_i s_i lnp_i$ (Deaton and Muellbauer, 1980a). Calculating this index prior to estimation ensures that (4) is linear in the parameters, thereby facilitating estimation.

2.1 Adapting the Model for Asset Demands

In an economy such as Kenya's, where asset and equity markets are thin and/or non-existent, a number of problems for estimation and inference are encountered. Four, in particular, may be noted. The first concerns the validity of the model structure. It is clear that the model is unlikely to encompass single-equation conditional models of investment behaviour for any or all of the assets taken separately. The system estimation does, however, allow price, income and wealth effects to be jointly estimated for the private sector aggregate wealth portfolio as a whole, rather than on an asset-by-asset basis, albeit at the cost of some econometric precision.

Second, there is a problem of reconciling the decision by representative private sector agents to hold both financial assets and liabilities concurrently. The main reason for simultaneous holdings of assets and liabilities is that agents differ in their preferences, their income, and their stock of wealth. Consequently, a model based on the behaviour of a representative agent may be inappropriate. However, it is clear that even a representative agent may rationally hold both assets and liabilities simultaneously, particularly if the combination of assets and liabilities generates a different flow of utility to the equivalent net-asset or net-liability position of the agent.[3] It is therefore possible to define the model in terms of the stocks of gross assets and gross liabilities, and maintain the representative-agent structure.[4]

The third issue concerns the durability of assets. The standard neo-classical approach to this problem assumes that the indirect utility function is defined inter-temporally over the flow of utility from the asset, where asset prices are defined analogously to the user cost of

[3]This may reflect differences in the term structure or tax treatment of assets or may also reflect difference in the risk characteristics of assets and liabilities.

[4]An alternative approach would be to consider the demand over net assets only. This assumes that credit is weakly separable from the other assets in the portfolio, a condition that is unlikely to hold.

durable goods, *inclusive of any expected capital gain*.[5] From an empirical perspective, however, the issue of durability may be less easily solved. A number of problems arise. First, the presence of stocks of assets create strong inter-temporal links which impart significant persistence effects in the data. This has important implications for the dynamic specification of an empirical model (see below). Second, the expected rate of return on each asset must include the expected capital gain to holding the asset as well as its yield. It is obviously difficult to model expectations formation, particularly for shock-prone developing countries — not least where there are considerable uncertainties about the credibility of the government — and we do not attempt to do so here. In fact, we assume that agents have perfect foresight by proxying the expected capital gain at the beginning of period t by the actual capital gain realized over the period. Third, the asset accumulation process (especially for real assets) is asymmetric: whereas agents can choose to accumulate assets at any rate, the absence of perfect asset markets and the irreversibility of fixed capital formation means that decumulation of fixed assets is not possible beyond the rate of physical depreciation without active destruction of the capital stocks. This asymmetry may bias the estimates of the relative price elasticity of demand for assets. Moreover, selling constraint in markets for real assets, reflecting informational assymetries between buyer and seller (Akerlof, 1970) may dampen the response of asset accumulation to (capital-gain inclusive) changes in asset prices. However, it may be noted that the severity of this effect may be offset somewhat in the current instance by the fact that the period under investigation is one where, in aggregate, the net capital stock has been non-decreasing through time.

Finally, the presence of liquidity constraints in the form of credit rationing provides further restrictions on the simple demand model described above. If agents are unable to borrow (i.e. accumulate a stock of credit) then they will be unable to alter their asset holdings as quickly in response to relative price changes as they could in an un-rationed context. Thus, in the face of credit rationing, the estimated relative price elasticities from an unrestricted demand share model may be biased.

2.1.1 Credit Rationing

Credit to the private sector may be rationed for two main reasons. The first is the existence of aggregate and sectoral lending ceilings imposed on the financial sector by government, as occurred in Kenya throughout this period (see Killick and Mwega, 1990). The second is the existence of market-based credit, rationing as described by Stiglitz and Weiss (1981). Introducing rationing in the demand system does not, however, fundamentally alter the specification of the model (see Deaton, 1981) although the implications of the adjustment are important. If preferences can be assumed to be weakly separable over the rationed and un-rationed goods (and the ration is binding) then the demand shares in (4) are unchanged save for the reduction in the total outlay available on the un-rationed goods.[6] However,

[5]See Deaton and Muellbauer, 1980b, Chapter 4.2.

[6] Assume that good 1 is rationed so that $q_1 = z$, where z is fixed, or at least pre-determined. Letting $\bar{p}$ and $\bar{q}$ denote the price and quantity vectors for the un-rationed goods, the restricted cost function can be expressed as:

credit is not, in general, weakly separable from the other assets in the portfolio. It is therefore necessary to introduce credit rationing more explicitly. To do so we define the cost function with one rationed good, z, as:

(6)
$$lnc(u,p,z) = \alpha_o + \sum \{\alpha_k + \eta_k z\} lnp_k + \frac{1}{2}\sum_j \sum_k \gamma *_{kj} lnp_k lnp_j + \beta_o \Pi p_k^{\beta k}\{u + \theta_o z + \frac{1}{2}\theta_1 z^2 + \frac{1}{2}\theta_2 uz\}$$

where θ_i are the parameters of the generalized restricted utility function.

The demand shares from this equation are then

(7)
$$s_i = \alpha_i + \eta_i z + \sum_j \gamma_{ij} ij lnp_j + \beta_{iln}\{\frac{(x - p_o z)}{P}\},$$

where

(8)
$$lnP = \alpha_o + \sum \{\alpha_k + \eta_k z\} lnp_k + \frac{1}{2}\gamma_{ij} lnp_i lnp_j .$$

As before, $\gamma_{ij} = 1/2\ (\gamma^*_{ij} + \gamma^*_{ji})$, while the adding up restrictions are $\Sigma\alpha_i = 1$, $\Sigma\gamma_{ij} = 0$, $\Sigma\beta_i = 0$ as before , with the addition that $\Sigma\eta_i = 0$. Here, the effect of the ration is via the total expenditure effect as before $(x - p_o z)$ but also in each share equation, through the η_i term, and in lnP. Since we still employ a non-parametric index for lnP, this latter effect is not explicit.

Finally, we follow Barr and Cuthbertson (1991) by amending the model (7) by a flow variable to indicate the expected volume of transactions per period. The reason for doing so is that a model in which assets are modelled in terms solely of total wealth captures only the portfolio motives in the demand function. However, since asset stocks also provide an intermediate input into the aggregate production function, it seems advisable to model the individual demand shares both in terms of their stock elasticity with respect to total wealth, and their flow elasticity with respect to aggregate demand. Thus the income elasticity of the demand shares will reflect the liquidity of each asset relative to the level of transactions in the goods market. Adding this term we get

where $ln(Wz/ P)$ is the log of real rationed wealth and lny is the log of real total final expenditure. This is the estimating demand system.

$$c*(u,p,z) = \min_q [p.q; v(q_1,\bar{q}) \geq u, q_1 = z]$$

which simplifies to:

$$p_1 z + \min[\bar{p}.\bar{q}; v(z,\bar{q}) \geq u]$$

Differentiating with respect to p_i generates the Hicksian demands

$$\frac{\partial lnc^*(u,p,z)}{\partial lnp_i} = h_i^*(u,\bar{p},z)$$

which, crucially, do not depend on the price of the rationed good, p_1.

(9) $$s_i = \alpha_i + \eta_i z + \sum_j \gamma_{ij} ij ln p_j + \beta_{iln}(\frac{Wz}{P}) + \delta_i lny,$$

To derive price, income and wealth elasticities from the demand share model, (9), we multiply the share equations by real wealth Wz/P and differentiate with respect to (log) prices, income and wealth. The price elasticities of demand are thus

(10) $$E_{pij} = \frac{\gamma ij}{s_i} ;$$

the income (or transactions) elasticities are

(11) $$E_y = \frac{\delta_i}{s_i} ;$$

the elasticities of demand with respect to the ration are

(12) $$E_z = \frac{\eta_i}{s_i} ;$$

and the wealth elasticities are

(13) $$E_w = (\frac{\beta_i}{s_i}) + 1 .$$

3. Econometric Specification of the Model

The demand share model can be re-stated as:

(14) $$A(L)s_t = B(L)X_t + \epsilon_t, \quad \epsilon_t \sim IN(0,\Sigma)$$

where s is a $(n \times 1)$ vector of asset shares; X is an $(n \times m)$ matrix of explanatory variables (real prices, income, wealth etc.); and A(L) and B(L) are appropriately dimensioned polynomial coefficient matrices. Early demand system models tended to estimate the system in the static levels of the variables i.e. A(L)=A(1), B(L)=B(1), thereby admitting no dynamic adjustment process (see for example Taylor and Clements, 1983). It is clear, however, from the foregoing discussion that an adequate dynamic specification of the model is essential to capture at least some of the inter-temporal effects of durability. Anderson and Blundell (1982) consider the identification issues relevant to this form of singular equation system when dynamic adjustment is present. The general autoregressive distributed lag representation of the form (14) can be re-parameterized in a familiar manner to yield an error-correction dynamic specification of the form

(15) $$\Delta s_t = A(L)\Delta s_{t-1} + B(L)\Delta X_t + C\Pi_{t-1} + \epsilon_t, \quad \epsilon_t \sim IN(0,\Sigma),$$

where s and X are as before; C is an $(n \times m)$ vector of feedback coefficients; and Π_{t-1} is the (lagged) long-run solution to (14) defined by:

(16) $$\Pi_t = s_t - [A*(L)]^{-1}[B*(L)]X_t.$$

$A^*(L)$ and $B^*(L)$ are defined respectively as:

(17) $$A*(L) = I + A_1L + A_2L^2 + ... + A_pL^p$$

and

(18) $$B*(L) = I + B_1L + B_2L^2 + ... + B_pL^p.$$

The presence of lagged dependent variables as regressors in (15) means that not all the parameters of the singular system (i.e. the long-run and dynamic parameters) can be estimated. They can, however, be recovered by estimation of (15) subject to the deletion of the *i-1th* row of the lagged Δs vector and the error-correction vector, Π_{t-1}. The parameters on the deleted variables are then recovered through the adding-up conditions on the singular system.

Direct estimation of (15) renders the search for an efficient data representation difficult, especially if at the same time we are interested in examining the long-run properties of the demand system. We avoid this problem by first investigating the structure of the long-run solution to the model defined by (16) to test for cointegration between the demand shares and the explanatory variables. This stage is implemented using a Seemingly Unrelated Regression Estimation (SURE) method to allow for possible cross-equation covariance in the equation errors. If the demand share equations are cointegrated, they can then be incorporated in the general dynamic specification (15). Because of the relatively small sample and the autoregressive nature of the data, biases in the estimation of long-run cointegrating relationships using the Engle-Granger two-step procedure are likely to be high (see Banerjee *et al* (1993). We therefore derive the cointegrating parameter vectors from the long-run solutions to the dynamic equations, (14).[7] We then re-estimate the long run model using a systems estimator; and sequentially impose restrictions on the coefficients to test the theory-based restrictions of symmetry and homogeneity of the static, long-run, demand functions. Finally, having identified the long-run matrix and its restrictions these are built into the dynamic systems (15) through pre-defined error-correction terms, where C is now constrained to be a diagonal matrix. This implicitly imposes the restrictions which deny any cross-share disequilibrium feedback from the long-run solution in share s_i on the current demand for s_j.

4. The Data

The data in this paper are from Kenya and span the period of the two coffee booms in 1976/7 and 1986. The first coffee boom generated a terms-of-trade gain to Kenya of

[7]An alternative approach would be to employ the Johansen maximum likelihood method. However, the dimensionality of the long run cointegrating matrix rendered this approach unmanageable.

approximately 24% of GDP over its lifetime,[8] which was accompanied by a sharp increase in fixed capital formation (both tradable and non-tradable) which rose from 22% of GDP in 1974 to 29% in 1978. The 1986 boom was of shorter duration and lesser magnitude. The terms of trade rose by 20% from 1985 to 1986, but by the next year had fallen below pre-boom levels. Moreover, unlike the earlier period, the 1986 boom occurred during a period of active adjustment and was not accompanied to the same extent as before by a surge in investment. Whereas gross domestic investment rose in the two years following the first coffee boom by 35% and 24% respectively, the corresponding growth in 1987 and 1988 was 16% and 9% respectively.

The period was also characterized by programmes of economic reform. A World Bank-supported trade liberalization programme was implemented in 1982, which removed the majority of the quantitative restrictions on trade and began to implement a programme of tariff reductions which continued throughout the decade. Liberalization in the financial sector proceeded gradually over the period, although the most marked progress occurred after 1986, and by 1991 all controls on domestic interest rates were removed. Domestic real interest rates became less negative over the period (turning positive in the late-1980s), while financial deepening increased, principally as a result of the rapid growth in the activities of the Non-Bank Financial Institutions (NBFIs).[9] Nonetheless, as in many developing countries, the access of the private sector to financial assets has been limited by the thinness of financial markets, high transactions costs, and extensive market regulation. In Kenya, the most obvious constraints to the functioning of markets were (until the late 1980s), the repression of nominal interest rates (for both deposits and loans), and the proscription on holding foreign financial assets by parties other than the Central Bank of Kenya.[10]

During the period under review, the most liquid assets were obviously cash and non-interest-bearing money. Other financial assets (which were slightly longer-term in nature and consequently less liquid) were available to domestic investors, the most common being the interest-bearing deposits with the banking system (commercial banks and NBFIs). Beyond this, however, the range of financial assets was limited. The capital and government bond markets were dominated by the Central Bank and other public-sector institutions, with the private sector holding on average only 7% of total stock over the period from 1973 to 1989 — although this mean value masks a steady decline in the private sector's share from around 15% in 1975 to only 4% in 1986. There was virtually no secondary trading in government paper, and the bulk of the debt issued by the Government was held by the initial purchaser (principally public sector institutions such as the National Social Security Fund) until maturity. As a result, although government bonds were *de jure* liquid, capital-uncertain assets, the lack of a secondary markets means that *de facto* they were more like fixed-term, capital-certain assets, but of a correspondingly lower liquidity.

[8]Bevan *et al.*. (1990, Chapter 5).

[9]Killick and Mwega (1990).

[10]Commercial banks were allowed to hold foreign exchange balances to facilitate authorised transactions with the private sector.

The equity market was similarly limited. Market capitalization averaged around 2% of GDP throughout the 1980s; although there has been some increase since 1986 following the decision by the three main commercial banks (Barclays, Standard Chartered and the Kenya Commercial Bank) to issue equity through the Nairobi Stock Exchange. Turnover in the market was only approximately 0.1% of capitalization.[11] Financial asset holdings are thus confined principally to cash and interest-bearing deposits as well as to an unspecified volume of illegal cash and foreign exchange holdings. On the liability side, the only debt instrument available to the private sector was credit from the commercial banks and NBFIs. At the time, the domestic private sector had no access to the foreign debt market.

The private sector also held (non-marketed) equity claims against real assets. We can distinguish between tradable capital (i.e. exportable or, more commonly, importable capital goods) consisting principally of plant, machinery and machine tools and transport-related capital goods; and non-tradable capital, consisting almost entirely of land and buildings.

We therefore define the wealth portfolio to consist of a total of six assets. Three financial assets: notes and coin in circulation (denoted NC); private sector deposits with the banking system (D); and government stock held by the non-bank private sector(GS). One financial liability: credit from the banking system (TL). Two real assets: traded capital (denoted TK); and non-traded capital (NTK).

Details of the construction of the stock and flow data and the calculation of the rate of return on each asset are provided in Appendix 1. Here we confine attention to the main trends in the data. Table 1 reports summary statistics on the shares of each asset (where the share of asset X is denoted sX), while Figures 1(a) to (h) plot (the log of) total rationed wealth, the individual asset shares as a proportion of the total non-rationed expenditure, and (log) real income. In each case the asset share is reported as a proportion of total net wealth, where liabilities are recorded as negative assets.

Table 1: Gross Asset and Liability Shares 1973-1990

Asset Share	Mean	Max	Min	Std. Dev
sNC	0.0805	0.0928	0.0665	0.0063
sD	0.5231	0.6758	0.3216	0.0929
sTL	-0.4055	-0.5582	-0.1989	-0.0916
sGS	0.0178	0.0303	0.0085	0.0063
sNTK	0.1919	0.2215	0.1628	0.0157
sTK	0.5922	0.6667	0.5311	0.0167

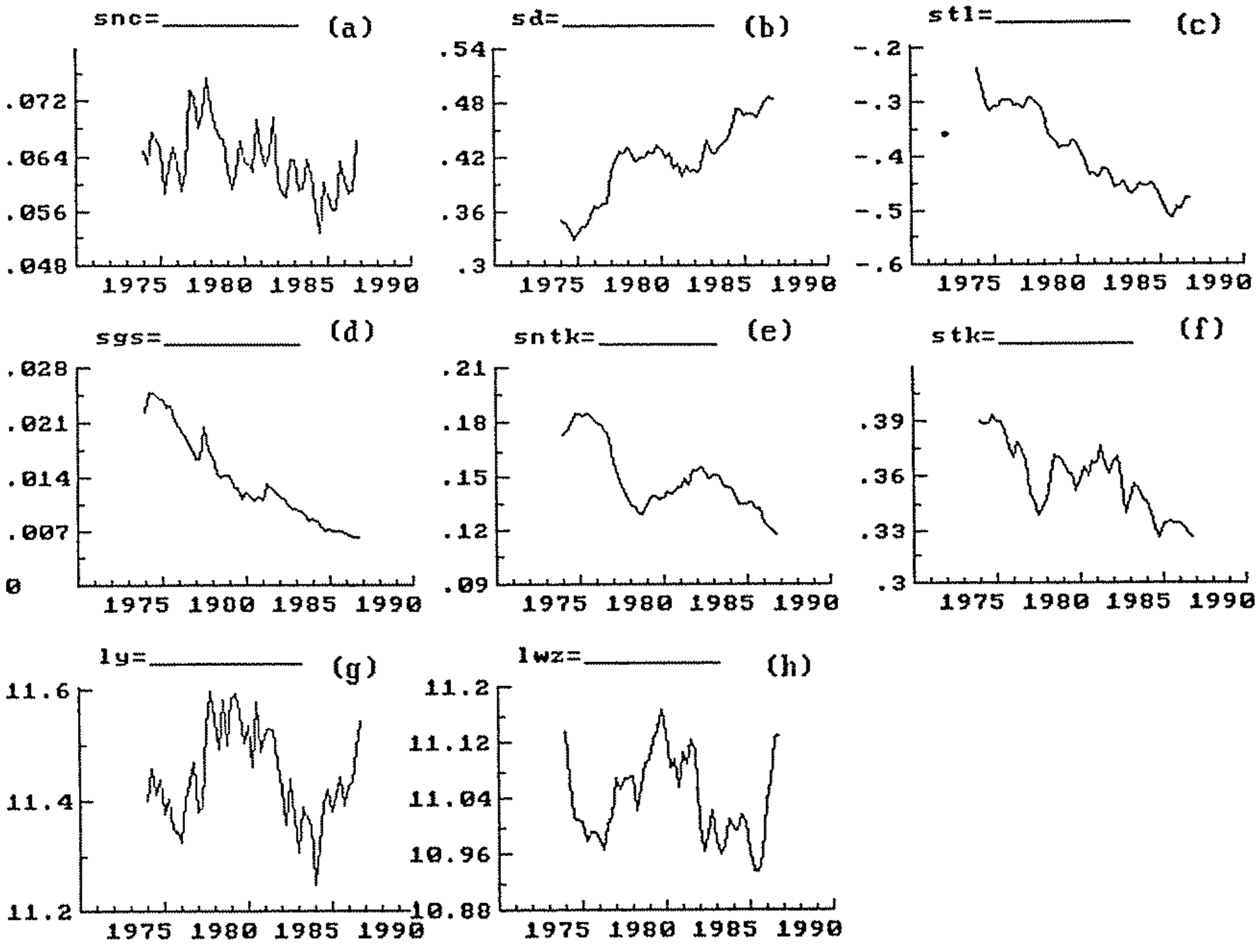
Notes: (1) All data are quarterly; (2) $\Sigma s_i = 1$.

The wealth portfolio is dominated by equity claims against real assets, which account for 78% of total net wealth. Net claims on the banking sector account for 12% of wealth on average and claims on the government in terms of base money and government stock for

[11]IFC Emerging Markets Yearbook (1991)

a further 10%. Equity claims against fixed capital are split three-quarters in traded capital and one quarter in non-traded capital. Movements in the asset shares over time are, as expected, relatively small with the average standard deviation per quarter ranging between 1% and 25% of the total stock.

Figures 1a - 1h



Net financial assets thus account for approximately 22% of the total net asset stock. Over the period, however, there has been a discernable pro-cyclical shift from real to financial assets. This is particularly marked at the time of the two trade shocks where instantaneous asset accumulation occurs almost exclusively through holdings of inside and outside financial assets, which are only gradually dissipated as agents adjusted their portfolios back into real assets. However, there has, in addition, been a trend increase in financial assets over the period with holdings of net financial assets rising from around 20% of the total in 1974 to 25% by the end of the period. Excluding the period of the first coffee boom, this growth has been accounted for principally by the rise in net interest-bearing assets, and within this most of the growth came from deposits with the NBFIs, which rose from around 15% of all deposits in 1973 to almost 52% by 1986. This reflected both the active promotion by the government of indigenous African financial institutions, and a lower level of regulation and less stringent ceilings on domestic credit expansion than were imposed on the commercial banking sector. As a result, not only did the volume of intermediation through the NBFIs increase, but their numbers also proliferated as the commercial banks acquired NBFIs so as to maintain lending to the private sector.

The split between tradable and non-tradable capital has remained virtually constant over the entire period, although their dynamics differ substantially, especially over the period of the coffee boom. Tradable capital formation increased rapidly during the period of the boom, while non-tradable accumulation was slightly slower, but more long-lived, partly as a result of the lower elasticity of supply associated with capital formation in the construction sector. Over the period of the boom and its immediate aftermath, from 1977 to 1981, the real value of the private sector non-traded capital stock increased by 22% as opposed to the tradable capital stock where the increase was approximately 17%.

As Figure 1(h) indicates, although mean real (rationed) wealth was broadly constant over the period there was a clear cyclical pattern. Real private sector wealth rose rapidly in 1976 and 1977, and although it faltered slightly in 1978, a second, and more sustained growth in wealth occurred from 1979 to 1982. Wealth fell sharply from 1982 to 1986 during the period of adjustment, but by the end of the period had begun to increase again in response to the 1986 coffee boom.

5. Results

5.1 Cointegration and the Long-Run Solution

The asset shares plotted in Figures 1(a) to 1(h) indicate that the principal data series in the model are probably non-stationary, and consequently standard estimation methods may not be satisfactory, since the demand share model must be estimated within a stationary stochastic model. However, if the variables are cointegrated then the residuals from the long-run relationship (which define the deviations from the long-run relationships) will be stationary and can be combined in the dynamic demand system. We therefore commence by investigating the time-series characteristics of the data and test for the presence of cointegrating relationships between the variables. If these exist, we may proceed to transform the model into an error-correction, stationary, system.

Table 2 reports the results of Sargan-Bhargava Durbin Watson (SBDW) and Augmented Dickey-Fuller (ADF(4)) tests.

Table 2: Unit Root Tests for Demand Share Model Data

Series	SBDW	ADF (4)'t'	Order of Integration
sNC	0.66	-2.38	I(1)
sD	0.04	-1.64	I(1)
sGS	0.03	-2.60	I(1)
sNTK	0.04	-2.25	I(1)
sTK	0.11	-1.56	I(1)
LpNC	1.05	-2.22	I(0)/I(1)
LpD	1.32	-3.30	I(0)
LpNTK	0.82	-4.85	I(0)
LpTK	0.37	-2.53	I(1)
Lwz	0.23	-2.11	I(1)
Ly	0.37	-1.53	I(1)
z	0.05	-1.63	I(1)

Notes: sX indicates the share of asset X in the portfolio; LpX denotes the log of the real user cost of asset X ; Lwz is the stock of real (rationed) wealth ; Ly is real total final expenditure; and z is the stock of real domestic credit to the private sector. SBDW is the Sargan Bhargava Durbin Watson Test; ADF is the Augmented Dickey Fuller t test with 4 lags. Critical Values for T = 50 for SBDW and ADF are 0.78 are 0.78 and -2.93 respectively (Banerjee et al, 1993).

Given the small sample size and the presence in the sample of a large, temporary (and thus "stationary") shock to the economy, we would naturally expect the data to tend to reject the null of non-stationarity. Moreover, as Banerjee *et al.* (1993) suggest, small sample biases in both tests are likely to be large. There is a more fundamental statistical problem arising from the fact that these series are strictly bounded, and at least in the region of the upper and lower bounds will not have the properties of an I(1) series defined under the null in the ADF tests. However (with the exception of the sGS variable) none of the series approach the bound, and thus, at least over the sample, it may be a reasonable approximation to test their order of integration against the null of a genuine random walk model.

These problems notwithstanding, the asset shares, transactions, wealth, and ration variables seem to be non-stationary, while the vector of prices seems to be more stationary. We may therefore expect to find evidence that the long-run demand share equations defined in (9) are cointegrated relationships.

The approach we adopt to test for cointegration is to estimate a dynamic version of (9) and solve for the long-run solutions from the dynamic model. In this way we hope to avoid the short-sample biases in the Engle-Granger two-step procedure. To ensure efficient estimation of the parameters we estimate each *n*-1 set of long-run relationships simultaneously, using a SURE method to allow for cross equation covariance in the equation errors. The long-run solutions to the dynamic models are shown in Table 3, where the equation for inventories was derived from the adding up restrictions that $\Sigma_i\alpha_i = 1$ and $\Sigma_i\eta_i = \Sigma_i\gamma_{ij} = \Sigma_i\beta_i = \Sigma_i\delta_i = 0$. For a sample size of 50 and nine regressors, the 5% critical values for the DW and ADF tests are 1.28 and -4.15 respectively. Given that we are estimating long-run regressions with a greater number of regressors, the critical values will

Table 3: Demand Share Model Estimated Long Run Solutions. Sample 1974:1 to 1986:4

Asset	Share	Const	zp	Lpnc	LpD	LpOS	LpNTK	LpTK	Lwz	Ly	Inflation Impact	R2	s.d	s.e	DW	ADF(4)
sNC*	0.063	-0.125	0.000	-0.488	0.334	-0.067	-0.011	-0.006	-0.033	0.014	-0.154	0.8393	0.0049	0.0022	1.52	-4.1225
		(6.37)	-	(2.69)	(1.73)	(5.24)	(2.61)	(0.34)	(2.73)	(1.68)						
sNA*	0.419	-3.732	0.025	5.835	-6.453	-0.377	0.040	0.423	0.273	0.114	-0.618	0.8833	0.0399	0.0155	0.574	-3.3403
		(5.09)	(0.57)	(4.64)	(4.64)	(4.26)	(1.41)	(4.04)	(3.22)	(1.93)						
sOS*	0.013	0.258	0.017	-0.272	0.317	0.025	0.004	-0.029	0.009	-0.027	0.045	0.9340	0.0052	0.0015	0.659	-3.8428
		(3.59)	(4.03)	(2.20)	(2.41)	(2.92)	(1.62)	(2.85)	(1.02)	(0.36)						
sNTK*	0.148	2.081	0.044	-0.716	0.938	0.239	-0.032	-0.155	-0.032	-0.050	0.222	0.8893	0.0183	0.0069	0.768	-2.703
		(6.37)	(2.28)	(1.28)	(1.57)	(6.07)	(1.85)	(3.32)	(2.18)	(1.90)						
sTK*	0.357	2.518	-0.085	-4.359	4.864	0.179	-0.002	-0.234	-0.216	-0.051	0.505	0.8191	0.0183	0.0069	0.583	-3.2122
		(6.37)	(3.55)	(6.35)	(6.66)	(3.93)	(0.02)	(4.09)	(4.75)	(1.31)						
SUM	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					

Breusch-Pagan Test on Independence of Error Covariance: Chi-Square (6) = 155.097 [Pr = 0.000]

Notes: [1] Coefficient on zp in sNC equation restricted to zero; [2] t values in parenthesis; [3] Critical Values for DW and ADF(4) for cointegration with T=50 are 1.19 and -4.15 respectively.

be somewhat higher and lower respectively for the two tests. On the basis of these statistics, however, it seems as if all the demand share equations are close to being stationary. This tentatively supports the inclusion of the long-run levels demand share equations within a dynamic error-correction model. First, however, we shall discuss the economic interpretation of the long-run demand system.

5.2 Interpretation of the Equations

In the light of our initial caveats concerning problems with this class of model when applied to the analysis of durable commodities such as assets, the revised long-run share equations are reasonably well specified. The long-run share equations perform relatively well in terms of the standard criteria of goodness-of-fit and the reduction in standard error, relative to the standard-deviation of the dependent variable (reported in Table 1), although the highly significant value for the Breusch-Pagan test validates the use of the SURE method. The long run price income and wealth elasticities of the model (evaluated at the mean shares of each asset) are presented in Table 4.

A number of interesting patterns emerge from Tables 3 and 4. First, as demand theory would suggest, the own-price coefficients γ_{ii} are negative and significant, with the exception of government securities, where the own price effect is positive. Given the fact that the private sector's holdings of government securities are virtually negligible, we should not be too surprised by the poor results for this equation. In general, with the exception of the inflation and domestic interest rate effects (see below), the magnitude of the price effects is quite low, reflecting our earlier comments concerning the dampening effect of durability of assets on measured price elasticities. Other than the demand for government securities, the price matrix is quite well defined, with all but two of the cross-price effects being sign-symmetric (the exception being γ_{23} and γ_{32}, and γ_{53} and γ_{35}) and a reasonably high proportion (18 out of the 25) freely estimated own- and cross-price effects being individually significant in terms of the 't' statistic. We can conclude (at least in the long-run) that relative prices do matter for the determination of asset holdings. Similarly, both the wealth and income effects are now statistically significant and interpretable (see below).

Second, using the Hicksian classification of complements and substitutes (where a positive cross-price elasticity $\gamma_{ij}>0$ means that goods are substitutes, and $\gamma_{ij}<0$ implies complementarity) we note that there is evidence of substitution *between* financial and real assets (taking the combined effect of the LpNC and LpD coefficients) but complementarity *within* different forms of fixed capital formation. There is thus some evidence of substitution between government stock and real capital, providing weak evidence for crowding out (although because of the relatively poorly defined long-run solution for the government stock equation, it would be inadvisable to place any stronger weight on this conclusion). The other important result from these price effects concerns the different price responses between tradable and non-tradable capital formation. Though their cross-price effects indicate complementarity between the assets, tradable capital is significantly substitutable for deposits, while non-tradable capital is not. One possible explanation for this result (which we shall discuss in more detail below) is that tradable capital, which is predominantly imported, is subject to a more binding "cash-in-advance" constraint. Accum-

Table 4. Price, Income and Wealth Elasticities from Asset Demand Share Model (Evaluated at Mean Share).

Asset	Own and Cross Price Elasticities Lpnc	LpD	LpGS	LpNTK	LpTK	Wealth Lwz	Transactions Ly	Net Inflation	Ration zp
sNC*	-7.705	5.274	-1.056	-0.168	-0.080	0.472	0.227	-2.432	0.000
sNA*	13.929	-15.405	-0.899	0.095	1.009	1.653	0.272	-1.475	0.059
sGS*	-20.811	24.254	1.940	0.343	-2.240	1.650	-2.071	3.443	1.298
sNTK*	-4.831	6.329	1.614	-0.217	-1.044	0.781	-0.339	1.498	0.294
sTK*	-12.227	13.644	0.502	-0.004	-0.655	0.394	-0.144	1.417	-0.239

Source: Table 3

ulation of predominantly imported capital in the long-run requires prior accumulation of financial assets (in order, for example to secure foreign exchange or finance trade credit). On the other hand, domestic accumulation of non-tradable capital may be expected to be less dependent on access to credit from the formal financial sector and more dependent on own-labour, and other non-financial inputs.

Third, because of the very high correlation between the rates of return on base money and deposits (both being dominated by the rate of inflation) it is difficult to interpret the coefficient on LpNC and LpD separately.[12] This is a problem encountered in all other such portfolio model studies. However, if we take the net effect of LpNC and LpD, it is clear that inflation leads to a reduction in the relative share of long-run holdings of financial assets (particularly non-interest bearing assets) and an increase in real assets. Government bonds seem to offer the safest (*ex ante*) hedge against inflation, followed by non-tradable capital and tradable capital.

Fourth, the reported long-run rationed wealth elasticities suggest that cash and fixed capital are "necessities" (i.e. $E_w < 1$), while deposits and government securities are "luxuries"(i.e. $E_w > 1$).[13] In general these forms of Engel curve are very much as expected, although it is difficult to evaluate results for government stock which suggest that it is a "luxury" asset. While this is plausible, the fact that the coefficient is non-significant suggests that no firm inference can be drawn. Finally, it needs to be noted that these Engel curve effects are based on an aggregate rather than a per capita basis. Given the rapid growth in population, per capita estimates for the Engel curves may differ substantially.

Fifth, using the interpretation of Barr and Cuthbertson (1991) (in which a positive value for the income coefficient indicates that the asset has a positive liquidity and can be interpreted as a "transactions" asset) we note that, as expected, cash and deposits are classed as transactions (or liquid) assets in this model. The other assets are all interpretable as "speculative" assets, while the relative size of their coefficients is consistent with prior expectations, where non-tradable capital is marginally less liquid than tradable capital. Thus we would expect that in periods where transactions levels were high, for a given stock of wealth, the share of financial assets in the portfolio may be expected to rise.

Finally, we turn to the issue of the interpretation of the ration. In the long-run estimates we have imposed coefficients of zero on the effect of the ration on the share of cash, since it was found to be insignificant. Otherwise, the other estimates from Table 4 indicate that as the ration is relaxed (i.e. z falls),[14] the relative share of tradable capital rises, while the shares of bonds, non-tradable capital and deposits fall. This suggests that the rationed good (i.e. credit) is complementary with tradable capital formation. Thus, when rationed in the credit market, the private sector is forced to accumulate bonds; deposit assets (which have constituted the persistent excess liquidity of the banking system in Kenya over the period);

[12] i.e. the nominal interest rate effect in LpD is dominated by the price deflator, which is simply LpNC.

[13] Combined with the "inferior" Engel curve for cash this accords with other evidence of financial deepening in Kenya (Killick and Mwega, 1990).

[14] Since z is credit, it is modelled as a negative asset.

and, to a lesser extent, non-tradable capital. Again, this is consistent with our earlier comments concerning the relative importance of "cash-in-advance" constraints. Credit rationing acts as a break on the accumulation of real tradable capital assets in the economy. As the level of real credit is increased (i.e. a relaxation in the ration) the private sector increases its borrowing, which allows it to substitute deposit assets (whose real rate of return is low or negative) with real tradable capital assets (whose combined expected rate of return, given the low real borrowing costs is significantly higher than that payable on deposits). Across the other assets, which serve as non-financial alternatives for accumulation when credit is rationed, we note that the pattern of the coefficients is consistent with the characteristics of the assets in the portfolio: a relaxation in the ration results principally in a shift out of deposits and non-tradable capital, and into tradable capital.

5.3 Dynamic Demand Share Equations

Finally, we estimate the dynamic error-correction version of the demand system. To do so we use the long-run solutions from Table 3, subject to the restrictions that the own price effects on sGS is set equal to zero ($\gamma_{33} = 0$), along with all other price effects that were insignificant in the long-run levels equations.[15] These restriction are accepted by the data.[16] The dynamic demand share equations are summarised in Table 5, where Δ is the quarterly difference operator and *EcSi* is the error correction coefficient corresponding to C in equation (15).

As indicated in the table, the dynamic equations fit relatively well, both statistically and in terms of their economic interpretation. Starting with the diagnostic statistics, we note that in general there is no evidence of statistically significant error autocorrelation or heteroscedasticity. The exception is with the sGS equation which exhibits very high first-order autocorrelation. Re-examination of the dynamic structure of the lagged variables in the equation (principally LpNC and Lwz) suggested that a first order common-factor restriction could be accepted, and thus the equation for sGS was re-estimated using a first-order autoregressive least squares procedure. This amendment notwithstanding, the dynamic models seem relatively well specified. In all cases, the equations significantly reduce the standard error of the dependent variable, while the dynamic equation residuals are distributed independently and homoscedastically normal. Additionally, the dynamic models track the actual movements in the shares well, both across the sample as a whole and also in relation to the large changes in asset shares during the coffee-boom, where the errors in the long-run equations were most marked.

5.4 Interpretation of Dynamic Equations

In general, the interpretation of the dynamic equations is straightforward. In terms of their coefficients, the most striking results from the models are the significant feedback effects

[15]Specifically we set $\gamma_{14} = \gamma_{24} = \gamma_{34} = 0$.

[16]The value of the LR test is 16.54 against a 1% critical value of 20.09.

towards the long-run equilibrium model. In all cases, the coefficient on the error correction term is correctly signed (i.e. short-run disequilibrium is corrected by a negative feedback) and the speed of adjustment is consistent with the relative liquidity of the assets, ranging from approximately two quarters in the case of cash to three quarters for government bonds, and to around five quarters for traded and non-traded capital. The combination of the well defined error-correction terms, and the presence of significant lagged dynamic effects, underlines the strong inter-temporal linkages in asset demands. It may also be noted that (in contrast to the long-run levels equation) the short-run transactions elasticity is quite well defined across all the equations; while the relative magnitude of the coefficients bears out the implicit hypothesis suggested by Barr and Cuthbertson (1991) that, while asset stocks are determined as a function of wealth in the long-run, their relative liquidity with respect to the production process is an important short-run determinant of demand.

Table 5: Summary Demand Share Models: OLS Estimates (1973(1)-1986(4))

Explanatory Variables	Asset Shares ΔsNC	ΔsD	ΔsGS	$\Delta sNTK$	ΔsTK
EcS_i	-0.429	-0.148	-0.295	-0.154	-0.187
	(3.56)	(1.76)	(2.69)	(3.09)	(2.11)
$\Delta LpNC$	-0.107	0.742	0.026	-0.101	-0.196
	(1.84)	(5.00)	(3.96)	(3.99)	(5.39)
ΔLrd	-0.418	3.146	-0.328	-2.091	-
	(1.86)	(3.88)	(3.30)	(7.72)	
$\Delta LpGS$	-0.016	-0.065	-0.008	0.019	-0.043
	(2.20)	(4.51)	(3.28)	(2.37)	(2.95)
$\Delta LpNTK$	-	0.006	-0.001	-0.002	-0.002
		(1.84)	(2.16)	(2.60)	(1.74)
$\Delta LpTK$	-	-	0.012	-0.024	-0.054
			(2.38)	(2.35)	(2.09)
ΔLy	0.011	-0.074	0.003	0.016	0.023
	(2.19)	(2.39)	(2.65)	(5.07)	(2.52)
ΔLwz	-	0.121	0.013	-0.039	-0.134
		(7.14)	(5.49)	(4.87)	(8.01)
Δz	-	0.076	0.006	0.025	-0.040
		(4.91)	(2.02)	(1.11)	(2.75)
Δs_{it-i}	-	0.621	-	0.415	0.421
		(3.00)		(5.50)	(5.20)
R^2	0.814	0.850	0.604	0.818	0.722
σ	0.18%	0.42%	0.06%	0.17%	0.34%
DW	1.78	1.80	1.49	1.65	2.06
ξ_1	0.89	0.85	1.65	1.91	0.84
ξ_2	0.40	0.64	0.89	0.79	0.34
ξ_3	0.41	1.11	0.52	0.62	0.42
ξ_4	4.47**	0.32	1.12	1.19	1.20

Notes:
(1) All equations estimated by OLS except Delta sGS which is estimated using first-order autoregressive least squares;
(2) 't' statistics are reported in parenthesis; sigma iis the equation standard error;
(3) DW the first-order error autocorrelation Durbin-Watson statistic;
(4) ξ_1 is the fourth-order Lagrange Multiplier test for auto-correlation;
(5) ξ_2 is the fourth order Lagrange Multiplier test for auto-regressive conditional heteroscedasticity;
(6) ξ_3 is White's (1980) test for unconditional heteroscedasticity;
(7) ξ_4 is the Jarque-Bera test for error normality;
(8) ξ_1, ξ_2, ξ_3 have small sample adjusted F distributions and ξ_4 has a Chi-square distribution.

Examination of the individual coefficients of the dynamic models reveals a number of features. First, the effect of the ration is the same as in the levels model, with relaxations in the ration leading to asset switching out of deposits and into tradable capital formation. Second, while accumulation of tradable and non-tradable capital have roughly the same short-run dynamics, adjustments in tradable capital are consistently more elastic to changes in relative prices and to changes in income, wealth and credit rationing — reflecting the closer dependence of the tradable capital sector on the financial sector. Moreover, in the short-run, the inflation process is also more complex: whereas in the long run inflation was accompanied by a shift into non-tradable capital, the growth in inflation in the short run has the opposite effect on capital accumulation. One possible explanation for this sign-switch is the absence in the model of any independent measure of investment uncertainty. The construction of the rates of return generally used the *ex post* actual capital gain as a measure of *ex ante* expected capital gains. Consequently, this provides only a point estimate of investment expectations and does not capture any measure of the variance of the expected capital gain. Since it is plausible that the variance in the expected capital gain is correlated with the short-run acceleration in prices, then the latter may be expected to have a dampening effect on investment in real capital.

Finally, on the issue of the accumulation of government stock, it is not surprising that the overall explanatory power of the sGS equation is relatively weak (again, the cross-price effects are low) given the evidence from the long-run demand share equation. However, given that the private bond market is so thin, and turnover so low, it is surprising to note the importance of the bond-price in the other demand share equations. Again, a possible explanation for this concerns the issue of uncertainty and expectations, caused by the fact that the capital gain to holding bonds has been proxied by the Nairobi Stock Exchange Index. In the short-run, increases in the price of bonds may be dominated by the decline in the growth of the NSE index rather than by changes in the yield on bonds.

6. Conclusions

The results from the estimation of the demand share model for Kenya point to a number of conclusions. The first is that, although the long-run solutions to the model exhibited some statistical weaknesses, the demand shares model provides a reasonably robust and economically coherent description of the nature of (and changes in) financial and real asset holdings in Kenya since 1973. In particular, it describes an environment where the private sector has a long-run equilibrium or target asset portfolio, which is consistent with basic assumptions of demand theory, and that short-run deviations from this target are corrected relatively rapidly. Moreover, the interaction of the dynamic and long run features of the model accurately captures the salient features of the coffee-boom of 1976-79, and is consistent with existing research on the impact of temporary trade shocks on aggregate savings behaviour. Inflation plays an important role in the model and, in accordance with theoretical expectations the model, provides strong evidence of a "flight-from-money" in response to rising inflation. As expected, interest-bearing deposits are partially sheltered from the effects of inflation, while it seems that non-traded capital has provided the best hedge against inflation.

Second, it is apparent that despite the presence of thin financial and asset markets, there is evidence that relative price effects do impact on the determination of aggregate asset demands. Moreover, there is quite clear evidence of a differential response pattern between tradable and non-tradable fixed capital formation, with the former exhibiting higher short-run price responsiveness and a concomitantly more rapid adjustment to disequilibrium. However, because of the absence of markets and the presence of a high degree of inter-temporal linkages in asset demands, the magnitude of relative price effects is low.

Third, the model indicates that the composition of the asset portfolio is determined by changes in the financial policy environment. In particular, changes in the level of credit rationing and alterations in the structure of relative prices (including inflation) are important factors, with tradable capital accumulation being much more sensitive to the nature of the financial policy environment than is non-tradable capital.

Appendix I

Construction of Data Series

Full details on the source and definition of data are provided in Appendix II. The real value of each asset a^*_{it} can be defined as $a^*_{it} = p_{it}a_{it}$, where a_{it} is the nominal value of the asset, p_{it} is the inverse of the real one-period expected rate of return to holding the asset i, defined as:

(19) $$p_{it} = [(1 + r_{it})/(1 = g_{it})^{-1}.$$

The expected nominal return (including any expected capital gain) on asset i over the period is denoted r_{it}, and g_{it} is the expected rate of inflation appropriate to the asset.[17] p_{it} is thus the real rental-price-equivalent of asset i. Given the relatively collinear behaviour of asset prices in general, we follow Deaton and Muellbauer and proxy the aggregate price (8) by:

(20) $$lnP = \sum s_i lnp_{it}$$

Asset Stocks Data on the stocks of financial assets are readily obtained from monetary sector data published by the Central Bank of Kenya. The construction of the data series for real assets is, however, more complex, and involves a decomposition of the total fixed capital stock into tradable and non-tradable components. In each case the nominal value of the stock of real assets is defined as:

(21) $$a_{it} = \frac{1}{p_k}[(1 - \rho)a^*_{t-1} + k_t]$$

where k is the current period physical investment in the capital stock; ρ the rate of physical depreciation of the existing real capital stock a^*_{t-1}; and p_k is the current price of capital. Equation (21) thus defines the current period nominal value of the stock of asset i inclusive of revaluation. While flow data are available on capital formation, stock data are less common. The three series for physical assets are defined below.

The private sector's stock of non-tradable assets consists principally of commercial and residential buildings. The change in this series was computed from quarterly data on private sector buildings completions. Revaluations of the non-tradable capital stock were computed using a Property Value Index (PVI) and the physical rate of depreciation was taken to be 4% per annum. The series was then scaled to be consistent with estimates of the non-tradable capital stock provided by the World Bank for the years 1973 and 1986.[18]

The tradable capital stock series was constructed in an analogous manner. Using the decomposition of total annual tradable capital formation into public sector and private sector by Bevan *et al* (1990), a quarterly series was then constructed using data on imported manufactures and transport equipment for the imported component of the capital stock, and quarterly industrial production data for the domestic production. As with non-tradable

[17] We have been obliged to proxy g_{it} by the consumer price index.

[18] *Kenya: Industrial Sector Policies for Investment and Export Growth.* (World Bank Report 6711-KE ,1987).

capital, the data series was scaled against the World Bank capital stock estimates for 1973 and 1986. A physical depreciation rate of 8% per annum was assumed.

Rates of Return For each asset, a total quarterly rate of return is constructed in terms of (19). For capital-certain assets, notes and coin, and interest-bearing deposits, the rate of return is simply the one period interest rate. For capital-uncertain assets, a measure of the expected capital gain is also computed. The nominal rates of return are defined below.

Notes and Coin Notes and coin do not earn interest and therefore their nominal rate of return is zero. The real price of this asset is simply the inverse of the domestic inflation rate, taken to be the quarterly growth in the consumer price index.

Interest-Bearing Deposits Since we have aggregated all deposit accounts with the banking sector into one asset, the (quarterly) nominal rate of return on total deposit account assets at the margin is a weighted rate of return defined as:

(22) $$(1 + r_{Dq})_t = \sum d_i rdq_{it}$$

where d_i is the share of the *ith* class of deposit in total deposits, and rdq_{it} the rate of interest on that class. We consider three classes of deposits: demand deposits with the commercial banks; savings deposits with the commercial banks; and deposits with the non-bank financial institutions. The interest rates used are the official rates published by the Central Bank of Kenya.

Capital-Uncertain Assets To calculate the rate of return on capital-uncertain assets we define the point at which the capital gain is realized, and also the basis upon which the current yield is calculated. We assume that the yield is calculated on the start-of-period value of the asset. The capital gain is defined as the change in the value of the asset over the period. We assume that the total one period rate of return is additive and is of the form:

(23) $$(1 + r)_t = [(1 + x)_t + (1 + \Delta y)_{t+1} - 1]$$

where x is the rate of interest based on the beginning of period value of the asset, and Δy_{t+1} the ex-post actual change in the value of the asset over the period. This method clearly creates endogeneity problems for the price series since the current price of the asset is simultaneously determined by its value, which may be a function of the demand. To check for this simultaneity we re-estimated the demand-share equations for the real assets using an generalized instrumental variable estimator. The IV estimates of the price effects were not significantly different from those derived from the cointegrating regressions, estimated by OLS and reported in the paper.

Government Stock The rate of return on long-term government stock consists of the average yield on stock as calculated by the Bank of Kenya plus the ex-post actual change in the NSE index, the latter being used to proxy the expected capital gain to holding government stock. The return is defined as follows:

(24) $$(1 + r_{gsq}) = [(1 + i_{gsq}) + (1 + \Delta_{NSE}) - 1]$$

Traded Capital The rate of return on traded capital has two components. The first is the real yield as measured by the current period marginal efficiency of investment. The second is the expected capital gain and is proxied by the actual change in the real traded capital price deflator. The total rate of return is defined as:

(25) $$(1 + r_{TKq})_t = [(1 + \lambda * 0.25)_t + (1 + \Delta p_k)_{t+1} - 1]$$

where λ is the annual marginal efficiency of investment.[19] The nominal expected capital gain, Δp_k is measured by the one period change in the price deflator for tradable capital.

Non-Traded Capital The current rate of return on non-traded capital is the sum of the rental rate plus the capital gain. The rental rate is constructed by taking the real rate of return as at end- 1977[20] (estimated by the *Statistical Digest* to be 3% per annum = 0.7417% per quarter) and extrapolating forwards and backwards using the change in the rental cost index relative to the building cost index. In other words, if the rental index is rising faster than the cost of replacement of buildings, then the implicit rate of return is increasing and *vice versa*. The capital gain is defined as the change in the property value index, as discussed above. The final expression for the rate of return on non-traded capital is thus:

(26) $$(1 + r_{NTKq})_t = \{[1.0077417 * (1 + \Delta(\frac{RCI}{BCI}))_t] + [1 + \Delta PVI_{t+1}] - 1\}$$

where RCI is the rental cost index, BCI the building cost index, and PVI the building value index.

[19]The marginal efficiency of investment is calculated as:

$$\frac{\partial \log Y}{\partial \log K},$$

where Y is real GDP and K is the stock of tradable capital. This rate of return has been adjusted for the difference between the CPI and the gross traded fixed capital deflator to express the rate of return in terms of consumption prices.

[20]The rental cost index is constructed from the survey of rents for the period 1977-81 published in *Statistical Digest*(Government of Kenya,1982).

Appendix II

Data Sources and Definitions

Appendix Table: Data Sources and Definitions

Series	Definition	Source
NC	Notes and Coin in Circulation with Private Sector	CBKQR
DD	Total Non-Interest Bearing Demand Deposits	CBKQR
CBD	Private Sector Deposits with Commercial Banks	CBKQR
OFID	Private Sector Deposits with Non-Banks	CBKQR
TD	Total Interest-Braring Deposits (CBD + OFID)	CBKQR
CBL	Commericial Bank Credit to Private Sector	CBKQR
OFIL	Non-Bank Credit to Private Sector	CBKQR
TL	Total Credit to Private Sector	CBKQR
RCD	Commercial Bank Saving Rate	CBKQR
ROFI	Non-Bank Saving Rate	CBKQR
EX	Kenya Shilling / US dollar Exchange Rate (Official)	CBKQR
TFE	Total Final Expenditure	CBKQR
NSE	Nairobi Stock Exchange Index	CBKQR
CPI	IFS Consumer Price Index	IFS
BCI	Building Cost Index	KSD
RCI	Rental Price Index	KSD
BUILD	New Building Completions	KSD
PVI	Property Value Incex	KSA
PTK	Trade Capital Goods Deflator	Bevan *et al* (1990)
TC	Total Traded Capital Formation	KSD
TK	Trade Capital Stock	World Bank / KSD
NTK	Non-Tradable Capital Stock	World Bank / KSD
MEI	Estimated Marginal Efficiency of Investment	World Bank / KSD

Sources: CBKQR = Central Bank of Kenya Quarterly Review; KSA = Kenya Statistical Abstract (Annual); KSD = Kenya Statistical Digest;(Quarterly); IFS = International Financial Statistics (IMF).

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