

Uganda's equilibrium real exchange rate and its implications for non-traditional export performance

By

Michael Atingi-Ego
and
Rachel Kaggwa Sebudde
Bank of Uganda

AERC Research Paper 140
African Economic Research Consortium, Nairobi
June 2004

© 2004, African Economic Research Consortium.

Published by: The African Economic Research Consortium
P.O. Box 62882-00200
Nairobi, Kenya

Printed by: The Regal Press Kenya, Ltd.
P.O. Box 46116-00100
Nairobi, Kenya

ISBN 9966-944-34-6

Table of contents

Abstract	
Acknowledgements	
List of figures	
List of tables	
List of abbreviations	
1. Introduction	1
2. Macroeconomic environment and external sector developments	3
3. The equilibrium real exchange rate	12
4. Modelling the real exchange rate (REER) and the equilibrium real exchange rate (ERER) for Uganda	14
5. Estimation and results of the empirical analysis	23
6. Conclusion and recommendations	36
Notes	38
References	39
Appendixes	
A: Real effective exchange rate (REER) calculation	41
B: The model for Uganda's real exchange rate	42
C: Explanatory figures	46
D: Partial system and weak exogeneity	47
E: OLS estimations and variable deletion test results	50
F: Results of the cointegration and error correction analysis for non-traditional exports and exchange rate misalignments	51

List of tables

1.	The process of liberalization of the exchange rate systems in Uganda	6
2:	Time series properties of the variables, 1970–1999	22
3:	Johansen and Joselius cointegration procedure results	24
4:	Estimated normalized cointegrated vectors (\$-vectors) and adjustment matrixes (a-vectors) in the Johansen estimation	24
5:	Results of test of significance of a coefficient in the marginal model	26
6:	Ordinary least squares estimation of the parsimonious REER equation	27
7:	Granger (non)-causality test between over-valuation of exchange rate (OVER) and non-traditional export (NTE) performance	31
8:	Granger (non)-causality test between changes in over-valuation of exchange rate (OVER) and non-traditional export (NTE) performance	32
9:	Ordinary least squares estimation with over-valuation (MA method)	33
10:	Ordinary least squares estimation with over-valuation (HP method)	33
11:	Cointegration for the non-traditional exports (NTE) and the level of the ERER (moving average) – VAR = 4	34
12:	Ordinary least squares estimating with changes in ERER (HP method)	35
13:	Non-traditional exports and exchange rate misalignments, 1980–1999	35
D1:	Trade weights for Uganda’s trading partners (1970=100) (in millions of US\$)	49
D2:	Uganda’s nominal and real effective exchange rates	49
E1:	Over-parameterized model by ordinary least squares estimation	50
E2:	Variable deletion test (OLS case)	51
F1:	Time series properties of over-valuation and non-traditional exports	51
F2:	Johansen and Joselius cointegration with restricted intercepts and no trends in the VAR cointegration LR test based on maximal eigenvalue of the stochastic matrix	52
F3:	Johansen and Joselius cointegration with restricted intercepts and no trends in the VAR cointegration LR test based on trace of the stochastic matrix	52
F4:	Estimated cointegrated vectors in Johansen estimation (normalized in brackets) cointegration with restricted intercepts and no trends in the VAR	52
F5:	Ordinary least squares estimation of over-parameterized model (HP)	53
F6:	Variable deletion test (OLS case) and ordinary least squares estimation – HP	54
F7:	Ordinary least squares estimation with over-valuation under MA method	55
F8:	Variable deletion test (OLS case) and ordinary least squares estimation – MA	56

List of figures

1:	Uganda's nominal and real exchange rate (1992 = 100)	11
2:	Uganda's equilibrium real exchange rate (ERER) and real effective exchange rate (REER), 1975–1999	28
3:	Non-traditional exports and over-valuation of the exchange rate in Uganda, 1980–1999 (MA method)	30
4:	Non-traditional exports and over-valuation of the exchange rate in Uganda, 1980–1999 (HP method)	30
C1:	Uganda's terms of trade	46
C2:	Uganda's foreign exchange inflows	46
C3:	Uganda's real government expenditure	47
C4:	Uganda's degree of openness	47

List of abbreviations

AR	Autoregressive	A	Domestic absorption
BOU	Bank of Uganda	X_g	Government absorption
ERC	Economic recovery credit	X_p	Private absorption
ERER	Equilibrium real exchange rate	Y	Domestic income = GDP
ERP	Economic Recovery Programme	X_{GN}	Government expenditure on non-tradeables
ESAF	Enhanced structural adjustment facility	X_{PN}	Private expenditure on non-tradeables
GDP	Gross domestic product	P_x	Domestic price of exports
HIPC	Heavily indebted poor countries	P_m	Domestic price of imports
HP	Hodrick–Prescott	P_N	Domestic price of non-tradeables
IMF	International Monetary Fund	EXP_N	Total demand for non-tradeables
MA	Moving average	S_N	Total supply for non-tradeables
OGL	Open general licence	S_{PN}	Equilibrium supply of non-tradeables
PPP	Purchasing power parity	t_x	Effective tariff on exports
REER	Real effective exchange rate	t_m	Effective tariff on imports
SAP	Structural adjustment programme	P_x^*	International price of exports
SIP	Special import programme	P_m^*	International price of imports
		e	Real exchange rate
		PT	Price of tradeables
		E	Nominal exchange rate
		TOT	TT = Terms of trade
		NKI	Capital inflows
		OPEN	Openness = (Exports + Imports)/GDP
		DEBT	External debt service
		GOVEXP	GE = Total government expenditure
		CURRGEXP	Recurrent government expenditure
		FLOW	Foreign exchange inflows
		CREDIT	Domestic credit
		REER	Real effective exchange rate

Acknowledgements

We wish to express our sincere gratitude to the African Economic Research Consortium (AERC) for the technical and financial support that has facilitated the completion of this research work. While we also appreciate the comments and advice from members of the Research Function of the Bank of Uganda, the views expressed herein are those of the authors and not necessarily those of the Bank of Uganda, and we take full responsibility for any errors and omissions that may remain.

Abstract

Pursuit of an exchange rate policy that promotes the competitiveness of exports would be greatly facilitated if the policy maker were able to establish the level of misalignment of the exchange rate and thereby try to correct for it. The motivation of this study for Uganda was therefore to derive the equilibrium exchange rate path, determine the levels of misalignment of the exchange rate and assess their impact on the performance of non-traditional exports. Estimating the equilibrium real exchange rate (ERER) involved: (a) estimation of the real effective exchange rate (REER) by the cointegration and the error correction mechanism (ECM) approaches, (b) filtering transitory factors from the “fundamentals” using the Hodrick–Prescott filter approach and the Elbadawi moving average (MA) methodology, and (c) estimating the ERER using the permanent components of the fundamentals. We find that the magnitude of misalignment, derived as the deviation of REER from ERER, greatly reduced during the period 1991–1999, when the exchange and payments system was liberalized as part of the overall improved macroeconomic management. Further, given that over-valuation of the exchange rate in excess of 15% hampers non-traditional export performance, our results suggest that the exchange rate policy should aim at minimizing over-valuation and, in fact, albeit the inflation objective, over-depreciate REER to boost non-traditional export competitiveness. An explicit estimate of the equilibrium exchange rate is therefore an important variable in exchange rate policy and export competitiveness debates.

1. Introduction

Among the several policy measures that Uganda has undertaken to increase and sustain economic growth has been the diversification of the export base through the promotion of non-traditional exports. As part of this strategy, policy makers have emphasized the need to maintain a competitive exchange rate. Consequently, there has been a move away from the fixed exchange rate regimes that set the exchange rates without due consideration for market conditions. The gradual approach to deregulating the foreign exchange market eventually culminated in the fully market-based exchange rate regime that has been operational since 1993. The current “managed float” system allows the authorities to monitor the market developments with an objective of smoothing out fluctuations.

While the floating exchange rate regime allows for stabilization of the domestic goods market, it may not necessarily be consistent with the viability of the external position of the country and hence competitiveness. This is because not all short-run movements in the real and nominal exchange rate are equilibrating. Sometimes, the impact of these movements may exacerbate misalignments. Over the last decade, for example, following the good macroeconomic performance, Uganda has been a net receiver of significant foreign exchange inflows in the form of private transfers and foreign donor support. This combined with the boom in coffee prices in 1994/95 and gold exports in 1996/97 have had appreciative pressures on the Ugandan currency. In fact, while the nominal exchange rate had depreciated by almost 100% between 1986 and 1999, the real effective exchange rate depreciated by only 27% over the same period. The question is, “Is the real exchange rate consistent with the underlying economic fundamentals?” This and similar questions can only be answered empirically by assessing the movement of the real exchange rate relative to the equilibrium exchange rate determined by the economic fundamentals.

The motivation of the research study is to estimate empirically the equilibrium real exchange rate (ERER) and the real effective exchange rate (REER) for Uganda over the period 1970 to 1999. Specifically, the episodes of misalignments are identified in order to use this information to assess whether the misalignment itself is consistent with the macroeconomic performance and, in particular, the non-traditional exports.¹ Our approach is based on the Edwards (1989) and Elbadawi (1994) models of the real and equilibrium real exchange rate.

The study is presented in five sections. In Section 2, we review Uganda’s historical and ongoing experience with macroeconomic stabilization and reform within the context of developments in the real and nominal effective exchange rate. Section 3 highlights

the different measurements of the real effective exchange rate (REER) and introduces the concept of an equilibrium real exchange rate (ERER) and why misalignments between the two may provide important macroeconomic indicators for policy formulation. The models underlying the empirical estimation of the ERER and the dynamics of the REER in Uganda are presented in Section 4. In addition, this section discusses the empirical methodology used for an episodic analysis of the deviations between the estimated REER and ERER. The empirical findings in light of dynamics of the REER and the ERER in Uganda together with an assessment of the impact of the misalignment of the real exchange rate on the performance of the non-traditional export sector are presented in Section 5. We finalize by drawing conclusions and recommendations in Section 6.

2. Macroeconomic environment and external sector developments

Uganda's macroeconomic history is characterized by numerous eras of divergent economic conditions. The period immediately following independence was one of relatively good macroeconomic policies that led to economic growth and a highly buoyant export sector. The ascension into power of Idi Amin in 1971 and the subsequent declaration of economic war in 1972 reversed the economic gains recorded in the post independence period of the 1960s. It also marked the emergence of both internal and external imbalances that were to become unsustainable by the close of the 1970s. The economy was characterized by huge government deficits and consequently high rates of inflation and unsustainable balance of payments deficits.

The macroeconomic stabilization process in Uganda

Following the deposing of Idi Amin in 1979 and the contested elections of 1980, serious attempts were made to restore prudent macroeconomic management. The macroeconomic stabilization efforts were supported with financial assistance from the International Monetary Fund/World Bank, whose major effect was to restore some macroeconomic normalcy. In early 1983/84, however, fiscal slippage crept into the programme and by the end of the fiscal year, a number of performance criteria and benchmarks had been violated, resulting in the cancellation of the programme with the IMF.

A new government led by Yoweri Museveni assumed power in 1986 after waging a protracted guerrilla war and in May 1987 launched another Economic Recovery Programme (ERP) with the support of the IMF, World Bank and other donor resources. Efforts were largely directed at stabilizing the economy and kick-starting production. Thereafter, a consultative meeting was held in 1989 for all the stakeholders in the economy. The meeting decided that Uganda needed to overhaul the structure of its economy to overcome internal and external imbalances so as to remain resilient to shocks. With the financing from the IMF, World Bank and bilateral creditors, a structural adjustment programme (SAP) based on the recommendations of the consultative forum was formulated and implemented. It basically involved limiting the role of the state in economic activities. This involved further liberalization of the trade and exchange rate arrangements, and the liberalization of the financial sector, as well as of marketing activities. The liberalization of exchange and trade arrangements commenced with legalization of the parallel market in 1990, followed by the convertibility of the current

account in 1993. The capital account liberalization was announced in 1997 to complete the process of liberalization of both the domestic and the external sectors. Privatization and divestiture have also been gradually implemented in line with the objective of promoting private sector participation in production and economic growth.

The current macroeconomic environment is relatively stable. The economy grew at 6.5% per year on average over the period 1987–1998 and inflation was checked at single-digit numbers over the period 1994–1999. One of the consequences of these positive developments was the large inflow of foreign capital in the form of private transfers, which increased from US\$107.97 million in 1987/88 to US\$538.6 million in 1997/98. Over the same period, official inflows also steadily increased, from US\$300 million to US\$602 million. Despite the fact that outflows have also increased over this period to sustain the huge rehabilitation, reconstruction and new investment efforts in the country, gross international reserves held by Bank of Uganda (BOU) increased from 2.4 to 4.8 months of import cover between 1992/93 and 1998/99.

The exchange regimes and exchange rate developments

Among the main objectives of the exchange system liberalization, Kasekende and Ssemogerere (1994) depict the use of exchange and trade policies to restore confidence in the currency, reduce price distortions and shift resources from speculative to productive activities. The main focus was and has remained the prevention of the over-valuation of the shilling, mainly measured by the premiums between the official and the parallel exchange rates, and the gradual elimination and eventual convergence of the two-tier foreign exchange markets. In essence, the objective was to promote balance of payments viability by stimulating the real economic activity. This was in recognition of the fact that the price for foreign exchange, on the one hand, affects the domestic price of imports and with it the cost of imported inputs and subsequently the shilling price of consumer goods. On the other hand, it affects the domestic price of exports and hence profitability of exporters. Other things remaining the same, exchange rate depreciation (devaluation) would raise the costs of imported products, inducing increased use of local inputs and savings on imports, and it would raise the relative profitability of exports and import substitution industries. In contrast, an appreciation would increase the demand for imports and reduce the relative profitability of exports and import substitution industries. The main argument usually raised in defence of over-valuation is that it acts as a nominal anchor on inflation, and that devaluation would set off a cost-push inflationary spiral that would damage import-competing industries.

The conflict between the desire to limit inflation arising from increased cost of imports and the need to promote exports resulted in a policy dilemma in the mid 1980s. To a great extent, this perceived conflict in objectives delayed policy action, culminating in a prolonged period of over-valuation of the shilling. The delayed policy action by authorities in Uganda resulted in massive distortions in the fiscal, monetary and real sectors of the

economy in the mid 1980s. The economy suffered from high rates of inflation, a high budget deficit to GDP ratio, a high current account to GDP ratio, a high debt/GDP ratio, and over-valued exchange rates, all of which combined to complicate macroeconomic management. With these lessons in mind, the exchange rate policy in Uganda has been closely related to policies on exchange rate management and trade arrangements since 1987, as depicted in the summary of policies and actions in Table 1.

Table 1: The process of liberalization of the exchange systems in Uganda

Date	Exchange regime	Salient related actions/Developments	Objectives
Pre-1987	Independent peg regimes Authorities pegged the shilling to other currencies on an indefinite basis.	<ul style="list-style-type: none"> • Pre-1971, exchange rate fixed to the UK£ (gold standard). (Sh17.1/£) • 1971, shilling pegged to the dollar (Sh7.1/\$) • 1975, shilling pegged to the more stable SDR (Sh9.7/SDR) • By 1981, huge parallel market had developed at rates 30 times higher than official rate. • 1981–82 managed float adopted. • 1982, dual exchange rate system with two official windows at BOU. • 1984, two windows merged and weekly auctions adopted at the market clearing rate. Rate depreciated from Sh3 to Sh14.01/US\$ by end 1985. • Auction replaced with allocation system at fixed official rate of Sh14.70/US\$. 	<p>Use exchange rate as nominal anchor for controlling inflation</p> <p>Promote exports competitiveness</p>
		<ul style="list-style-type: none"> • Dual exchange adopted again in 1986 at rates of Sh14.00 and Sh50.00/US\$, respectively. • Mid 1986, revaluation to a single rate of Sh14/US\$. High inflation and parallel market raged. 	Use nominal anchor for monetary policy.
May 1987– June 1989	Crawling peg for a single official market Characterized by discrete adjustments in the official nominal exchange rate.	<ul style="list-style-type: none"> • In May 1987, together with a currency form, the exchange rate was massively devalued by 76% from Sh14 per US\$ to Sh60 per US\$. • Premium between official and parallel reduced from 1,000% to 50%. • By June 1988, due to high inflation of 240% p.a., the premium on the 	<p>Restore competitiveness of exports and hence their value.</p> <p>Increase government revenues from trade taxes.</p>

continued next page

		<p>official exchange rate increased to 600%.</p> <ul style="list-style-type: none"> • June 1988, shilling devalued by 60% from Sh60 to Sh150 per US\$. • OGL and SIP(I) at the official rate were introduced in January and November 1988 respectively. • Discrete devaluations in December 1988 and March 1989. • January 1989, surrender requirements for exports abolished and dual licensing introduced for exporters to import using the export proceeds. • Though premium first declined due to this move, the accelerating inflation raised it again and by July 1989, the premium had picked to 200%, indicative of an over-valuation of 30%. 	<p>Allocate forex to industries and other special sectors of the economy,</p> <p>Alleviate demand pressure on official channel.</p> <p>Promote non-coffee exports.</p>
July 1989–December 1991	<p>Crawling peg for a multiple official markets</p> <p>Characterized by discrete adjustments of official exchange rates and recognition of</p>	<ul style="list-style-type: none"> • July 1989, SIP(II) window launched at a rate of Sh400/US\$, twice the unrestricted official rate (for 3 months) • Premium stabilized at 200% over these months. • July 1990, Kibanda market legalized by sanctioning of 	<p>Introduced as a temporary mechanism to raise fiscal revenue to dampen huge overhang of liquidity.</p>
	<p>other market rates.</p>	<p>forex bureaus; another officially recognized rate was the bureau rate.</p> <ul style="list-style-type: none"> • October 1989, adjustments in the official exchange rate in line with the inflation differentials with major trading partners. • In line with this, the adjustments of 41%, 8.1% and 1% in October 1989, December 1989 and February 1990, respectively, saw the premium declining from 200% to 90% over the period. 	<p>Dampen the disruptive effects of large discrete jumps and remove the over-valuation of the shilling.</p>
January 1992 – October 1993	<p>Free float for multiple official markets</p> <p>Characterized by market</p>	<ul style="list-style-type: none"> • January 1992, a weekly Dutch auction for donor funds was introduced, only constrained by the negative import list. • March 1992, the weighted 	<p>Adopt a market-oriented approach to allocation of donor funds.</p>

continued next page

	determination of exchange rate in both the auction and the bureaus.	average bureau rate for traveller's cheques was adopted as the official rate. <ul style="list-style-type: none"> • Premium between the bureau rate and the auction rate declined from 28.3% in January 1992 to 5% in October 1993. 	Aim for convergence of multiple markets.
November 1993-1999	Managed float for official market Characterized by a market determined official rate and intervention into the market to stabilize and meet specific objectives.	<ul style="list-style-type: none"> • November 1993, inter-bank forex market introduced; requirement for surrender of coffee receipts, daily forex market at BOU and auctioning of forex by BOU abolished. • BOU stopped setting rates and instead adopted the market rate determined in the inter-bank forex market. • The mid-rate is the weighted inter-bank rate. • BOU purchases /sales forex in the inter-bank market at its own discretion to smoothen and stabilize market conditions. 	Move to a single market-based exchange system. Remove the implicit tax on coffee arising from the multiple forex markets. Maintain a stability in the foreign exchange market.

Note:

OGL = Open general licence scheme for industrial sector

SIP = Special Import Programme

Kibanda = Common name for the parallel market in Uganda

Sequence of liberalization

The process of liberalizing Uganda's exchange rate regime since 1987 has been a gradual one. Prior to 1987, the foreign exchange system was characterized by variant forms of fixed exchange rate systems ranging from single rate independent pegs to multiple rate "crawling" pegs (Table 1). The initiation of the May 1987 ERP also witnessed adoption of a more active approach to exchange rate management in the country. The massive 76% devaluation of May 1987 was followed by numerous discrete devaluations from then until October 1989, before a crawling peg² was adopted between November 1989 and July 1990. The crawling peg was designed to keep the real effective exchange rate (REER) constant. Since July 1990, market forces have largely determined the exchange rate. It should be noted that in the latter period the sequencing of reforms in the foreign exchange market was also to ensure the gradual adjustment of the agents to a market determined exchange rate regime.

Crawling peg episodes and supportive policies

In line with the currency devaluation of May 1987, the premium between the parallel and the official exchange rate was reduced to 50% from almost 1000% before May 1987. A gradualist policy reform stance was adopted in liberalizing the exchange market

with a series of discrete devaluations before full liberalization of the market would be effected. Supportive policies and special programmes such as the open general licence (OGL), the special import programmes (SIP) and the dual licensing scheme were clear testimony that the demand and supply for foreign currency could not be equilibrated at the given exchange rate.

After realizing that large discrete devaluations were not sufficient to maintain a constant real exchange rate, let alone prevent further over-valuation, a more active stance in the management of the official exchange rate was adopted. The policy rule was simply to adjust the exchange rate in line with the inflation differential between Uganda and its principal trading partners—the United States, United Kingdom and Kenya. This rule marked the baseline for exchange rate policy but also allowed authorities to implement discretionary adjustments far in excess of the inflationary differential with a view to converging the official and the parallel market exchange rates. Under this policy, the shilling was devalued by 41% in October 1989 followed by 8.1% in December 1989, which saw the premium fall dramatically to about 90% by February 1990.

In the meantime, government had in July 1989 launched the SIP II fund with a float of US\$40 million to dampen the huge overhang of liquidity that had built up over the 1988/89 fiscal year. These funds were sold at Sh400 per US dollar—twice the official rate—and in accordance with liberalized eligibility criteria. As this was a temporary mechanism to raise fiscal revenue and mop up excess liquidity, commercial banks were prohibited from lending for purposes of purchasing funds under the scheme. The impact of the sale of these funds was a reduction in inflation and excess demand in the parallel market as well. On termination of the fund three months later, the real effective official exchange rate had appreciated by about 40% relative to its May 1987 value. The introduction of another official fund at a different rate (SIP II) commissioned a regime of multiple exchange rates. The monetary authorities typically regulated the exchange rate for some imports such as government imports and other “essential” goods and services, while allowing the rate for other transactions by banks and bureaus to be market determined. The multiplicity of the exchange rate regimes promoted rent-seeking and speculative behaviour by well placed agents at the expense of real economic activities.

The dual-licensing scheme, where exporters were permitted to retain all their earnings for importation of any commodity not on the government negative list, was introduced in January 1989. Being directed at export diversification, the policy coincided with the removal of the foreign exchange surrender requirement on all non-coffee exporters. These were required to apply for an export licence and an import licence at the same time, allowing such exporters to enjoy implicitly much higher exchange rates that were more favourable than the official rate and heralded the recognition of the existence of an over-valued exchange rate and the intention to move away from total reliance on official channels. The dual licence system was beset by operational problems, however. In the first place, it presupposed the existence of double coincidence of wants. More critical was the fact that some trading partner countries had export/import laws that required one to have cash and/or letters of credit in order to participate in international trade.

In July 1990, government undertook what has been referred to as the most revolutionary step in Uganda’s exchange rate policy by sanctioning the establishment of

the foreign exchange bureaus, which legalized the *kibanda* market. The legalization of the *kibanda* market was an annexation to the multiplicity of the exchange rate regimes already existing in Uganda. Moreover, the premiums between the rates determined in the different markets were still very significant although to some extent these represented the transaction costs.

Floating exchange rate regimes

Another major step was taken in January 1992 towards the full liberalization of the exchange and payments regime and total convergence of the parallel and official exchange rate with the introduction of a weekly Dutch auction for foreign exchange at the official channel. The out-turn was disappointing, however, as auction sales were well below predictions. The marginal clearing rate depreciated by only 3.1% over the first ten auctions. This is because there was a consistent oversupply of dollars at these auctions since participation was restricted by a negative import list.³ Two months after the introduction of the auction system, the weighted average bureau rate for travellers cheques was adopted as the official exchange rate in order to attain a faster convergence of the trade and payments regime. The official rate immediately depreciated by 16% and the premium between the bureau and the auction clearing rate fell from 28.3% in January 1992 to about 5% in October 1993—largely because of increased demand at the auction channel.

Up to October 1993, Uganda's foreign exchange system was composed of three markets: the direct sales by BOU referred to as the official foreign exchange cash flow; the weekly Dutch auction for donor import support funds; and the foreign exchange bureaus financed by the private sector. While the exchange rates through the auction and bureau markets were market determined, BOU's sales were made at the "official exchange rate" determined by using a weighted average of the bureau rates for travellers cheques on a daily basis. Because of the segmentation in the markets, there existed a premium of 5.25% between the auction and the bureau rate resulting from efficiency costs in the exchange system. This shows that market convergence remained elusive.

When government introduced the inter-bank system in November 1993 to bring about a convergence of the exchange rates, Uganda completed the liberalization of its exchange and trade system. Subsequently, on 5 April 1994, the government accepted the obligations of Article VIII, Sections 2, 3 and 4 of the IMF's Articles of Agreement, expressing its commitment to a free and open exchange system. A market-based floating exchange rate system was under the circumstances expected to provide a more efficient and reliable mechanism for determining the official rate and allocating scarce foreign exchange resources. Apart from institutional considerations, the inter-bank system was chosen because it is more consistent with a market approach and minimizes the scope for administrative interference.

In line with these developments, the requirement of surrendering coffee export receipts and other excess invisibles to Bank of Uganda, the weekly foreign exchange auction of donor resources and the direct sales by BOU were all abolished. Commercial foreign exchange transactions were to be undertaken by commercial banks and foreign exchange

bureaus, which in turn would set the price of foreign exchange. Bank of Uganda ceased to set or announce an official exchange rate and instead uses rates set in the inter-bank market. The average mid rate has since then been computed as the weighted average of the inter-bank bid and offer rates. Bank of Uganda's intervention in the market is solely at its discretion and to smoothen wide fluctuations in order to stabilize market conditions.

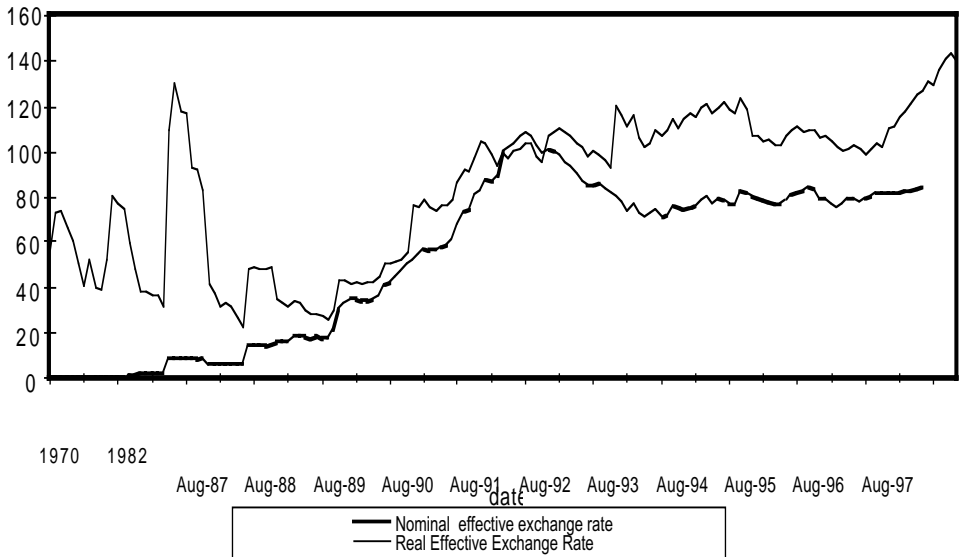
Impact on the real exchange rate and implications for export sector competitiveness

Although divergent objectives outlined the reform process, we find that these, together with the economy-wide policy reforms and developments, have had important implications for both the nominal and the real values of the Uganda shilling. Evidence provided by the time series of both the real exchange rate and the nominal effective exchange rate (calculated as in Appendix A), summarized in Figure 1, depicts the shilling generally depreciating except in the 1987/88 financial year and the three-year period between 1992 and 1994 when some appreciation was recorded. The real effective exchange rate (REER) has closely followed a similar trend. This evidence could be misleading, however, since a real appreciation following a successful liberalization could arise either from changes in economic fundamentals or from other non-fundamental factors. However, changes arising out of the latter lead to misalignment of the REER from its equilibrium. Earlier studies have depicted a clear relationship between the increased inflows of foreign exchange following Uganda's stabilization efforts and the appreciation of the nominal and real effective exchange rates (see Abuka and Sajjabi, 1996). Moreover, the temporary boom in world coffee prices in 1994/95 exacerbated the rise in these exchange rate indexes.

In addition, inflows including private transfers and foreign direct investment have increased in the post 1990 period. The increase in the former is attributed to repatriation of domestic flight capital, while that of the latter is associated with the improving macroeconomic environment, which offered better return for private investment. Foreign direct investment is estimated to have increased from US\$43.2 million in 1992 to US\$230 million in 1998. Indeed, economies such as those in Latin America and Asia experienced increased private inflows during periods of macroeconomic stabilization and economic reforms with the result that their exchange rates were subject to appreciation pressures. Given these developments, each of which may have had diverse impact on the real exchange rate, it is rather difficult to analyse external competitiveness using the trends of the exchange rate only. That aside, episodic appreciation of the currency justifies a continued assessment of competitiveness that the trend analysis of the nominal and real exchange rates cannot answer adequately.

Assessment of the time series of the nominal and real exchange rate aside, an alternative dimension for assessment of competitiveness would include the comparability of the import tariffs, productivity and/or profitability, and prices of tradeables relative to non-tradeables, to the level of these variables in Uganda's trading partners or competitors.

Figure 1: Uganda's nominal and real effective exchange rate (1992=100)



More specifically, such factors would depict how the real cost of production in Uganda compares with other competitors or partners. Unfortunately, the data on these variables cannot readily be obtained to facilitate such studies on competitiveness. Another measure of competitiveness thus has to be devised to allow a continued assessment of the country's export competitiveness.

3. The equilibrium real exchange rate

The real effective exchange rate (REER) has often been at the centre of policy debate in developing countries on issues such as economic development, export promotion and macroeconomic stabilization. Defined as the relative price of non-tradeables to tradeables, the REER is the pertinent relative price signal for inter-sector growth in the long run. In this paper, we define the REER as the ratio of the nominal effective exchange rate index multiplied by the weighted average consumer price index CPI of the major trading partners to Uganda's CPI. A more traditional definition of the real exchange rate that is sometimes used derives from the purchasing power parity (PPP) approach. With the PPP approach, the REER is defined as the nominal exchange rate corrected for the ratio of the foreign price level P_f to the domestic price level P_d :

$$\frac{E^* P^f}{P^d} \quad (1)$$

This approach, though consistent in the long run, is no longer used in academic literature but continues to be used in policy debates because of the difficulty of measuring the relative price of tradeables to non-tradeables.

REER movements may be optimal and could reflect equilibrium responses to macroeconomic shocks (Flood, 1981; Baldwin and Krugman, 1989; Aghelvi et al., 1991). However, sometimes they may also be exacerbating disequilibrium. Therefore, as noted earlier, another means of determining if there are misalignments is critical in the assessment of whether the REER is in line with the economic fundamentals and hence consistent with external viability of the economy. This is an unobserved variable commonly referred to as the equilibrium real exchange rate (ERER). Being a shadow price, several methods in both the theoretical and empirical literature have been proposed for its measurement.

The PPP approach to measurement of the ERER requires the identification of a base period when the economy is in external balance. The equilibrium value of the nominal exchange rate is then the base period value adjusted for by inter-country differences in inflation rates. Operationally, there are difficulties in identifying a base period when the external position is in balance. For example the 1994/95 coffee boom in Uganda may have been such a base period under the definition of a balanced external position. But because the boom in exports was temporary and the external position unsustainable, this would not have represented such a base period. An additional problem with the PPP base period approach is that it does not allow for the equilibrium value to change.

Work by Williamson (1994) postulates a normative target for the current account, which in turn identifies the equilibrium exchange rate. Frankel and Goldstein (1988) have also suggested three equivalent frameworks for measuring the ERER. In particular reference to developing countries, Edwards (1989) defines the ERER as the relative price of tradeables to non-tradeables that, for given sustainable or equilibrium values of other relevant variables (such as taxes, international prices and technology), results in the simultaneous attainment of internal and external equilibrium. For that matter, while internal balance is achieved when the market for non-tradeable goods clears in the present and is expected to clear in the future, external equilibrium holds when present and future current account balances are compatible with long-run sustainable capital flows (Elbadawi, 1994). Edwards' framework allows for a path for the equilibrium and therefore movements in the REER may be equilibrium responses to changes in the fundamentals (or sustainable) such as the terms of trade or changes in technology vis-a-vis trading partners or disequilibrium movements (described as misalignments) usually occasioned by economic policies. This leaves open the option for policy makers to possibly "engineer" an under-valued REER that is designed to promote and diversify the export base (the case for an optimal misalignment). Policy induced misalignments should be distinguished from structural misalignments, which according to Edwards (1988) occur when changes in the real determinants (therefore excluding monetary policy related shocks) are not translated into equilibrium movements in the REER in the short run.

Results from Elbadawi (1997) suggest that while the levels of the REER and ERER do not significantly explain export performance, indexes of competitiveness do. The results suggest that so long as countries avoid over-valuation, then a "correctly" valued REER or one that is under-valued could encourage export performance. In the case of Uganda, Ssemogerere and Ddamulira (1998) highlight the anti-export incentive effect generated by the high inflation rates and fixed exchange rate system in the 1970s. For Kenya, Mwega (1993) finds that the level of the real exchange rate does not explain the performance in the non-traditional exports, which is consistent with the results in the much wider study by Elbadawi (1997). However, both authors point out that under-valuation has positively influenced non-traditional exports.

4. Modelling the real exchange rate (REER) and the equilibrium real exchange rate (ERER) for Uganda

Elbadawi (1994) states that a successful strategy for modelling the equilibrium real exchange rate (ERER) and the realeffective exchange rate (REER) should at least:

- Specify the ERER as a forward-looking function of the fundamentals;
- Allow for flexible, dynamic adjustment of the REER toward the ERER; and
- Allow for the influence of short- to medium-run macroeconomic and exchange rate policies on the REER.

These three criteria for modelling the REER stem from the fact that in the short to medium run, it is macroeconomic and exchange rate policies that will influence movements in the REER although these may not necessarily be consistent with developments in long-run fundamentals.

Seminal work by Edwards (1989, 1994) was the first detailed attempt to develop a model of the ERER specifically for developing countries. The Edwards (1989) benchmark model of the real exchange rate is an inter-temporal model of a small open economy in full employment with no price rigidities and no inter-temporal credit rationing. The two-period model has agents with perfect foresight, and any debt accumulated in period 1 is paid in period 2 (a no Ponzi game condition). The agents immediately respond to an unsustainable current account position by adjusting their savings and investment decisions.

The main objective of the empirical analysis in Edwards' work is to disentangle temporary changes in the REER brought about by nominal shocks, such as monetary and fiscal policy, from permanent or fundamental changes in the REER. It is these fundamental changes in the REER that are in fact changes in the ERER. His methodology also pins down a path for the ERER thus allowing the equilibrium to change as structural changes occur in the economy vis-a-vis the trading partners.

The Edwards (1989) model forms the theoretical basis for the empirical methodology as suggested by Elbadawi (1994) and used in this paper. In the benchmark model, a path for the equilibrium REER is consistent with simultaneous internal and external balance for each period (two in the model) for given sustainable values of other variables such as world prices, technology and tariffs. The model has no rigidities, externalities or market failures implying that full employment exists. From this model we can study the impact of specific policies and distortions that affect the response of shocks to this stylized economy. Consequently, for the case of Uganda we can postulate what signs our variables will bear in the determination of the REER and ERER.

There are two equations that emerge from the theoretical model:

- 1.) The factors that determine the EREER
- 2.) The equation that represents the dynamics of the REER

The independent variables affecting the EREER are the fundamentals, which determine whether REER is internally and externally consistent (the definition of the EREER). The general equation for the determination of the EREER can thus be expressed as:

$$\log(e_t^*) = \beta_0 + \beta_1 \log(FUND_{it}) + u_t \quad (2)$$

where, e^* is the EREER and $FUND$ is the vector of fundamental variables. In the short-run the REER adjusts to the long-run EREER. In the Edwards model, the following equation summarizes the short-run dynamics of the REER:

$$\begin{aligned} \Delta \log(e_t) = & \Theta[\log(e_t^*) - \log(e_{t-1})] - \lambda[Z_t - Z_t^*] + \\ & \Phi[\log(E_t) - \log(E_{t-1})] \end{aligned} \quad (3)$$

where e is the REER, Z is the vector of monetary and fiscal policies, Z^* are the policies that are consistent with the equilibrium rate, and E is the nominal exchange rate.

This short-run equation states that the REER has a mean-reversion in the long run, although in the short run the deviations between the EREER and REER can become larger. The speed of adjustment parameters describes the frictions in the economy, which means that adjustment is gradual for reasons such as price rigidities in the economy.

The model for equilibrium exchange rate in Uganda

Following Elbadawi (1994), the simplified version of the seminal work of Edwards (1989), we formulate a model for Uganda's equilibrium real exchange rate. We use simultaneous equations involving both demand and supply sides of the various sectors that make up the economy so as to model the market conditions (see the model in Appendix B). We identify the fundamental variables affecting the EREER as:

- Terms of trade (TT),
- Openness (OPEN)
- Flows (FLOWS), and
- Government expenditure (GE).

These variables, if cointegrated, would form the basis for estimating the long-run relationship for REER:

$$REER = f(TT, OPEN, FLOWS, GE) \quad (4)$$

The vector F, the vector of sustainable fundamentals is given as:

$$F = [1, \log(TT), \log(OPEN), \log(FLOWS/Y), \log(GEDEV/Y), \log(GECURR/Y)] \tag{5}$$

yielding the following cointegrating relationship:

$$\log e_t = [1/(1 - \lambda)]\delta^{\circ}F_{t+j} + \eta_t \tag{6}$$

where the cointegrating vector is given by $[1/(1 - \lambda)]^*$

Equation 6 is the empirical version of the solution to the basic REER model that has been presented. Elbadawi solves his model (in this case, given by Equation 6) forward by recursive substitution to obtain a forward-looking expression for the equilibrium real exchange rate. Our study adopts the Johansen–Joselius procedure to estimate the cointegrating relationship in (6), and hence the long-run elasticities of the REER.

From Equation 6, we can write:

$$\Delta \log e_{t+1} = b_0[1/(1 - \lambda)\delta^{\circ}F_t - \log e_t] \tag{7}$$

Using the Engle and Granger (1987) approach, if there is cointegration in Equation 6, there also exists an error correction specification. For our equation the following error correction mechanism would be consistent:

$$\Delta \log e_{t+1} = \beta_0 \left[\left(\frac{1}{1 - \lambda} \right) \delta^{\circ}F_t - \log e_t \right] + \beta \Delta F_{t+i} + \beta_i \Delta x_{it+1} + \varepsilon_{t+i} \tag{8}$$

where $\left[\left(\frac{1}{1 - \lambda} \right) \delta^{\circ}F_t - \log e_t \right]$ is the error correction term (or loading vector) and

$\beta \Delta F_{t+i}$ are the first differences of the fundamental variables. Those variables that are not fundamentals but are expected to influence the REER in the short run are given by $\beta_i \Delta x_{it+1}$.

Equation 8 is estimated to obtain the parameters of the regression, which represents the reduced form relationship between the fundamentals and the REER. The error correction equation represents the short-run dynamics of the REER around the REER, based on the finding of cointegration and error correction (or mean reversion).

Having obtained the elasticities of the REER in Equation 6 from the cointegration process, we need to decompose the transitory effects from the permanent factors and hence a methodology for “extracting” the permanent or sustainable profiles of the

fundamental variables is needed. To ensure the validity of our results, we found it appropriate to use two methodologies: the Hodrick and Prescott (1980) and the Elbadawi moving average approaches to decompose the permanent and transitory factors from the series.

The Hodrick–Prescott filter method

This is used to decompose the variables in the REER into trend and stationary components, which are respectively induced by real and nominal shocks. The technique suggests that the real shocks cause permanent changes in real exchange rates, whereas nominal shocks cause only temporary effects on the real rates. As an example, a doubling of money supply in Uganda would most likely double prices and cause the Ugandan shilling price of the US dollar to also double. Consequently, over the longer term, the real exchange rate remains invariant to a money supply shock. It is thus supposed that if one can observe the values of a series y_t through y_T and it is possible to decompose the series into a trend (μ_t) and a stationary component ($y_t - \mu_t$), one can solve a minimization problem for the deviation of y_t from μ_t . Hence with the following sum of squares, for example:

$$\left(\frac{1}{T}\right)\sum_{t=1}^T (y_t - \mu_t)^2 + \left(\frac{\lambda}{T}\right)\sum_{t=2}^{T-1} [(\mu_{t+1} - \mu_t) - (\mu_t - \mu_{t-1})]^2 \quad (9)$$

The problem is selecting the $\{\mu_t\}$ sequence that minimizes this sum of squares. In the minimization problem, λ is an arbitrary constant reflecting the penalty of incorporating fluctuations into the trend. Increasing the value of λ acts to smooth out the trend. With $\lambda = 0$ the sum of squares is minimized when $y_t = \mu_t$, i.e. the trend is equal to y_t itself. And as $\lambda \rightarrow \infty$ then the trend approaches a linear time trend. Intuitively, for larger values of λ the Hodrick–Prescott decomposition forces the change in the trend, i.e., $(\Delta\mu_{t+1} - \Delta\mu_t)$, to be as small as possible.

Variables for which the decomposition reveals a permanent component will be included in the long-run cointegrating equations, while those for which only transitory components exist will be included in the error correction equations of the REER.

The Elbadawi moving average filter method

This methodology builds on the speed of adjustment from the short run to the long-run model of the fundamental factors. Hence with the error correction model, outlined in Equation 8, the speed of adjustment needed to eliminate a certain proportion of the exogenous shock in a given time period can be calculated from the following expression:

$$(1 - \alpha') = (1 - \beta') * T \quad (10)$$

where: α' = the speed of adjustment given by the estimated coefficient on the error correction term (β_0) in Equation 8, and β' is the proportion of exogenous shock that is to be eliminated.

Variables used in the estimation

As noted in the theoretical presentation of the model, the fundamental variables that determine Uganda's real exchange rate movements include the terms of trade, the degree of openness, government expenditure and sustainability of the capital flows. The impact of policy variables and other shocks is captured by including in the dynamic model the acceleration of credit as a measure of the monetary shocks. Study of the behaviour of these variables is valuable before estimation.

Terms of trade

The terms of trade, which depicts the number of units of imports a unit value of a country's exports can purchase, has, over the study period, shown a persistent downward trend save for the sharp deviations in the two periods 1977 and 1995. The pattern is shown in Appendix Figure C1. The pattern of Uganda's terms of trade is, to a great extent, determined by the trend of the international price of coffee. Coffee exports had until recently accounted for over 80% of the total value of Uganda's exports. The terms of trade were generally stable in the early 1970s, but the 1974/75 oil crisis saw them plummet in the study period. The coffee price boom of 1977 to 1979 accounts for the first positive shock in the series. However, because of the price boom in other export commodities that quickly followed, the country recorded generally higher terms of trade in the late 1970s than would have been dictated by the general trend. Unfortunately, after reaching a peak in 1980, the trend in commodity prices reversed and remained depressed for the greater part of the early 1980s. The recovery in the coffee prices beginning in 1985 accounted for the upward bumps in the terms of trade through 1986.

The decline in commodity prices, and the increase in oil prices associated with the Gulf War, had a further toll on the index in the early 1990s before it recovered with the 1994/95 coffee price boom. The latter part of 1990s saw a steep decline in the terms of trade for Uganda as the post-boom effects of coffee prices and the decline in other commodity prices was exacerbated by increased oil prices arising from an international cartel.

Capital flows

Over the study period, a substantial amount of foreign exchange has flowed into Uganda, in terms of both private capital and official aid to close the savings investment gap that had manifested itself in a widening current account deficit. In the early 1970s, such flows were a continuation of the post-colonial assistance; as the political and economic environment evolved, however, so did the composition of foreign flows into

Uganda. In the 1970s, Uganda recorded a considerable reduction in net flows into the country owing to the deterioration in both the economic and the political environment that began with the declaration of economic war by the then president in 1972. Not only did the tendency of the government of that day to lean towards socialism limit the interest of the donors, but the macroeconomic conditions also resulted in economic hardship that saw many Ugandans resort to capital flight.

In the early 1980s as a new government tried to revert to normal macroeconomic management, foreign exchange inflows also increased. In fact, not only did donor commitments more than triple, but the diversity of donor countries also increased to include even the multilateral bodies, IMF, World Bank and African Development Bank. Unfortunately, much as the efforts to achieve macroeconomic stability were short-lived, so were the inflows. After the cancellation of the IMF programme in 1984, the inflows of foreign exchange also started declining until 1987. The 12-year period effective 1987 witnessed a very sharp increase in both donor flows and private inflows. This presumably follows the macroeconomic policies that the country has pursued and the confidence the international community has in the revival and continued good performance of the economy. The trend of foreign exchange flows into Uganda is shown as having asymptotically increased over the period, with stagnating periods only indicative of the transition from one programme to another. The levelling of the series in the periods 1991–1992 and 1996–1997 coincide with expiration of ERC II and ESAFI, respectively. This suggests that being on a programme supported by the IMF and World Bank has been a restraint for the Uganda government to keep donor and private capital flowing into the economy. Appendix Figure C2 depicts these trends.

Government expenditure

The decline in real government expenditure in the 1970s and early 1980s reflects the monetization of the deficits, which was common during this period. This resulted into high inflation rates that reduced the real government expenditure. In the last 12 years, however, government budget deficits have been directly related to the pattern of donor inflows. This mode of financing the deficits has resulted in much lower inflation, hence the increasing real government expenditure. It is for this reason that real government expenditures as a proportion of GDP reverted to an upward trend beginning late 1980s after declining in the 1970s.

In 1987, the Government of Uganda adopted a structural adjustment programme (SAP) supported by the IMF and the World Bank. One of the critical elements of restructuring under such programmes is the policy of consolidation of the fiscal stance and scaling down of government operations in order to crowd in private sector investment. For reasons referred to above, however, total government expenditure in real terms (Appendix Figure C3) was on an upward trend between 1987 and 1999. Real government expenditures, after 1987, drastically improved on two accounts: (a) increased tax revenues as the tax-GDP ratio steadily rose from a low of 6% in 1987 to the current levels of 12.5%, and (b) the increased donor financing of the government rehabilitation efforts. In fact, the comparison of the trend of real government expenditure and aid flows shows a

similar pattern over this period. In the financial year 1998/99, external assistance is estimated to have financed 65% of the budget outlays, having averaged about 50% per year over the last 12 years.

Openness

Because of the scanty information relating to tariff and non-tariff barriers, which would be the most efficient measure of openness of an economy, we had to use other reliable indicators of openness. We have therefore used a proxy of the total trade volume (exports and imports) as a percentage of GDP. As depicted by Appendix Figure C4, the series has been increasing since 1987, when the country adopted the liberalization measures described above. This rise is mainly due to the increased imports needed to sustain the rehabilitation and restructuring process in the country, on the one hand, and increasing consumption as incomes increased, on the other hand. Growth in exports has been minimal.

Data limitations

Several issues pertaining to the data generation process of variables to be used in the estimation need to be pointed out before we proceed to our estimation of the model. The first issue relates to degrees of freedom of the estimation, since data pertaining to the variables we used is only available for the period 1970 to 1999. We opted to use annual data, which in turn implies estimation with at most 29 observations. Statistically, a higher number of observations would increase the degrees of freedom, but this was not possible because of the lack of higher frequency data.

Second, the period of the sample being studied is characterized by major changes in the economy and failure of institutional arrangements, which made generation of data within the country very difficult. This is especially true for the period 1983 to 1987. We have therefore relied more on the international publications, especially the International Monetary Fund's *International Financial Statistics* (IFS) to capture consistent trends of our variables.

Finally, we acknowledge the structural changes in the economy and keep this in mind as we assess the data generating process of the different variables we are using. Given these limitations, some caution, which is accordingly pointed out in the course of the analysis, is incorporated in interpreting our results.

Time series properties

Time series testing procedures for causality are complex when the variables have unit roots. As this is the case for most macroeconomic variables, we then have to use the equivalent of an error correction model that permits us to estimate the REER by a multivariate approach using a vector of fundamentals as explanatory variables.

The time series properties of the variables have been investigated and their order of integration determined using the Dickey–Fuller (DF) and augmented Dickey–Fuller (ADF) unit root test. The Dickey–Fuller (DF) tests the size of the coefficient β_1 in the following equation:

$$\Delta = \beta_0 + \beta_1 P_{t-1} + \varepsilon_t \quad (11)$$

The test is against the null hypothesis $H_0: \beta_1 = 0$. Rejection of the null suggests that the series is non-stationary and has to be differenced at least once in order to make it stationary. The DF statistic is the t-ratio on β_1 in the regression Equation 11. One major drawback of the DF test is the assumption that the data generating process (DGP) is an autoregressive process of order one (or AR(1)) under the null. In the event of it not being so, then autocorrelation in the error term in Equation 11 biases the estimates. As a remedy, the ADF test is adopted. The ADF regression model takes the form:

$$\Delta P_t = \beta_0 + \beta_1 P_{t-1} + \beta_2 \Delta P_{t-1} + \varepsilon_t \quad (12)$$

The estimation procedure is similar to the DF tests.

The time series properties presented in Table 2 indicate that all the fundamental variables become stationary after the first difference—hence I(1). The test for the order of integration of the growth in the credit variable that we wish to introduce to capture the monetary shocks in the dynamic equation shows that the variable is I(1).

Table 2: Time series properties of the variables, 1970-1999

Variable	Variable name X	ADF (X)	ADF (ΔX)	Order of integration
Real effective exchange rate	<i>Lreer</i>	-2.6951	-4.1549	I (1)
Openness	<i>Lopen</i>	-1.7911	-3.5776	I (1)
Real government expenditure	<i>Lge</i>	-2.8732	-3.5776	I (1)
Terms of trade	<i>Ltt</i>	-1.6172	-4.1248	I (1)
Foreign exchange Inflows	<i>Lflow</i>	-1.4011	-4.0543	I (1)
Bank credit growth	<i>Lcredit</i>	-2.1581	-3.7777	I (1)
Critical value at 5% level of significance		-3.5796	-3.58671	

Where: *Lreer*, *Lopen*, *Lge*, *Ltt*, *Lflow* and *Lcredit* are, respectively, the logarithmic notions of REER, OPEN, GE, TT, FLOW and CREDIT and the letter L denotes the logarithmic notion of the variable as defined earlier.

5. Estimation and results of the empirical analysis

Having established the order of stationarity, we proceed to enter the I(1) variables into the cointegrating vector. The test for cointegration establishes whether a linear combination of I(1) variables is stationary; for this we use the well known Johansen (1988) procedure. The two tests described by Johansen and Juselius (1990) are used to determine the number of cointegrating vectors, i.e., based on the maximal eigen value $(-T \cdot \ln(1 - \mu_i))$ and the trace of the stochastic matrix. $-(\Sigma - T \cdot \ln(1 - \mu_i))$

Cointegration and the long-run REER

To empirically test the hypothesis postulated by Equation 6, we re-specify the equation for REER

$$Lreer = f(\text{lopen}, \text{lge}, \text{ltt}, \text{lflow}) \quad (13)$$

Our study uses a direct quote for the exchange rate (i.e., Uganda shilling per unit of foreign currency), where theory would suggest $f_1 > 0, f_2 > 0$ or < 0 while $f_3, f_4 < 0$. The sign of f_2 is largely dependent on whether government expenditure is spent on tradeables or non-tradeables. To the extent that the bulk of expenditure goes for tradeables, then GE would have a depreciating impact on the REER and hence f_2 would be positive. Conversely, if the bulk of government expenditure is for non-tradeables, then GE would appreciate the REER and hence f_2 would be negative. Owing to lack of complete series of disaggregated data, it was not possible to make estimations pertaining to government expenditure on non-tradeables and tradeables, or even the proxy of recurrent and development expenditure, respectively. For that matter, the resultant sign on f_2 will be interpreted according to which component of government expenditure outweighs the other.

Given the time series properties of the variables, the search for a cointegrating vector for the LREER that is readily interpretable in economic terms is facilitated by using a VAR of two lags onto *lreer*, *lopen*, *lge*, *ltt* and *lflow*. Although the credit growth variable is I(1), we do not include it in our search for a cointegrating relationship between the fundamental variables and the real exchange rate. This is because monetary shocks have invariant effects on the real exchange rate and therefore cannot constitute a fundamental variable. It is true, however, that since these shocks could have some influence on the long run real exchange rate, the search for a cointegrating vector⁴ has included the credit

variable, as an I(0) variable to comprise the nominal shock (monetary shock), to capture its impact on the fundamental variables and the long-run REER. Acceleration of credit (i.e., second difference of credit), an I(0) variable, is thus used as the monetary shock.

The Johansen and Juselius (1990) cointegration procedure results are reported in Table 3. The results suggest that at the 5% critical value, the use of the maximum eigen values generates only one cointegrating vector, but the trace of the stochastic matrix suggests that the decision to reject the existence of two vectors is at the borderline. At the 10% critical value, however, the trace of the stochastic matrix indicates that we can reject the null hypothesis of there being one cointegrating vector and accept the alternative that there are two vectors.

Table 3: Johansen and Juselius cointegration procedure results

VAR = 2; Sample period: 1970-1999
Additional I(0) variables in VAR: Ddcredit

Null alternative		$-T \cdot \ln(1 - \mu_i)$	5% c.v	10% c.v	$\Sigma - T \cdot \ln(1 - \mu_i)$	5% c.v.	10% c.v
$r=0$	$r=1$	30.41	33.46	30.90	76.90	68.52	64.83
$r \leq 1$	$r=2$	22.83	27.07	24.73	46.50	47.21	43.94
$r \leq 2$	$r=3$	14.72	20.67	18.59	23.66	29.68	26.79
$r \leq 3$	$r=4$	7.27	14.07	12.07	8.94	15.41	13.33
$r \leq 4$	$r=5$	1.67	3.76	2.69	1.67	3.76	2.69

The two cointegrating vectors are reported in Table 4. Vector (ii) appears to be the one onto which we can normalize *lreer*. This is largely for two reasons:

- The β matrix, which is the vector of economic interest, seems to support the theoretical *a priori*s of the fundamentals in Equation 13. This is largely on the grounds of the signs attached to the respective variables.
- The β matrix, which is the adjustment/loading matrix, i.e., the feedback of deviations from the long-run to the short-run behaviour of the endogenous variables, allows us to endogenize on REER (*lreer*). This is based on the size and sign attached to the coefficient of *lreer*, which suggests that it can be endogenized on this cointegrating vector.

Table 4: Estimated normalized cointegrated vectors (β -vectors) and adjustment matrixes (α -vectors) in the Johansen estimation

		Lreer	lopen	lge	lflow	ltt
(i)	β	-1.000	-27.164	-1.707	24.797	-0.917
	α	0.030	0.057	0.00345	-0.048	0.056
(ii)	β	-1.000	0.503	-0.238	-0.201	-0.831
	α	0.536	0.166	0.192	0.181	-0.042

The long-run relationship for REER is consequently derived from vector (ii) and is expressed as:

$$lreer = 0.503*lopen - 0.238*lge - 0.201*lflow - 0.831*ltt \quad (14)$$

The error term err is thus:

$$err = lreer - 0.503*lopen + 0.238*lge + 0.201*lflow + 0.831*ltt \quad (15)$$

The results above show that over the long run, a 1% increase in openness will depreciate the REER by 0.503%. On the other hand, a 1% increase in foreign exchange inflows, terms of trade or government expenditure will exert appreciation pressure on the REER amounting to 0.201%, 0.831% and 0.238%, respectively.

In line with this estimated relationship, the observed trend of the real exchange rate over the sample period is explained by the relative movements of the fundamentals: the terms of trade, real government expenditure, openness and foreign exchange flows as shown by the time series of the variables analysed above. The appreciation pressures observed in the trend of the REER in the periods 1977–1981, 1984–1988 and 1991–1996, for example, could to a large extent have contributed to the significant improvements in the terms of trade as a result of the coffee boom and the corresponding increases in commodity prices in these periods. The movement in foreign exchange flows over these periods could have had additional appreciative pressures. It is interesting to note that the period 1991 to 1996 had a similar experience despite a very rapid increase in the level of openness following the liberalization of the trade and exchange arrangements rigorously pursued after 1992. Since then, the persistent increase in government expenditure and foreign exchange flows could have added more appreciation pressures on the REER. However, the worsening terms of trade after a reversal of their short-lived improvement in the mid 1990s (coffee boom period of 1994/95) exerted depreciation pressures, which more than offset the appreciation pressures arising from increased government expenditure and foreign exchange inflows.

It is important to note that in this model the government expenditure variable depicts appreciation pressures on the real exchange rate. This element is captured when the impact of the monetary shocks is modelled together with the cointegrated long-run variables. The cointegrating relationship without the monetary shocks shows that government expenditure has a depreciation impact on the real exchange rate. Going by our earlier supposition, we can argue that over the sample period, the bulk of government expenditure was being directed to non-tradeables.

In summary, the resultant depreciation of the REER over the post 1987 period was due to the depreciation impact of the worsening terms of trade and increased openness, which has fully offset the appreciation impact of the increased foreign exchange inflows and increased government expenditure.

Error correction model estimation for REER

Moving to the dynamic relationship requires using stationary variables and testing for exogeneity to determine which stationary variables can contemporaneously be modelled with the endogenous variables. To that effect, we also test for the significance of the adjustment matrix α by applying the partial and weak exogeneity tests proposed by Johansen.

The test results for the significance of the α coefficient in the marginal model as suggested in Appendix D are presented in Table 5. They basically reveal that at the 5% level of significance, *lopen*, *lge*, *lft*, *lflow* and *dlcredit* are weakly exogenous to *lreer*.

Table 5: Results for test of significance of α coefficient in the marginal model

Variable	α coefficient of the error correction term: error(-2)	t-value(p-ratio)
$\Delta lreer$	-0.539	-4.23 (0.000)
$\Delta lopen$	0.236	-1.31 (0.205)
Δlge	-0.272	-1.67 (0.111)
$\Delta lflow$	-0.251	-1.17 (0.256)
Δlft	0.054	0.268 (0.791)

To get a parsimonious model, we started from the over-parameterized model, which incorporated all the stationary variables up to the first lag, and the lagged endogenous variable, and acceleration of credit as an indicator of monetary policy shocks. Variable deletion was then used to come up to the final dynamic equation. Both the over-parameterized model and the variable deletion test for the REER are presented in Appendix E, tables E1 and E2, respectively. The final dynamic equation is shown in Table 6.

All the diagnostics of the dynamic real exchange rate equation suggest that this is a well-behaved model.

The dynamic equation implies that while the rate of change of the real exchange rate has significant inertia on its historical value in the previous period, changes in the degree of openness have the strongest impact in the short run. Changes in the terms of trade are also shown to strongly influence the dynamism of the real exchange rate. At the 90% confidence level, the monetary shock and terms of trade impact would significantly affect the REER.

Table 6: Ordinary least squares estimation of the parsimonious REER equation

Dependent variable is DREER

28 observations used for estimation from 1972 to 1999

Regressor	Coefficient	Standard error	T-ratio (Prob)
INPT (C)	1.097	0.259	4.243 (.000)
DREER(-1)	-0.362	0.182	-1.991 (.060)
DOPEN	0.461	0.118	3.899 (.001)
DOPEN(-1)	0.3757	0.157	2.393 (.026)
DTT(-1)	-0.189	0.106	-1.782 (.089)
DDLREDIT	0.155	0.0790	1.968 (.062)
ERROR(-2)	-0.439	0.104	-4.226 (.000)

R-squared 0.73

F-statistic F(6, 21) 9.53[.000]

R-bar-squared 0.65

S.E. of regression 0.151

Residual sum of squares 0.48

Mean of dependent variable 0.028

S.D. of dependent variable 0.26

Maximum of log-likelihood 17.217

DW-statistic 1.63

Durbin's h-statistic 3.487[.000]

Diagnostic tests

* Test statistics	* LM version	* F version *
* A: Serial correlation	*CHI-SQ(1)= 1.8475[.174]	*F(1, 20)= 1.4128[0.249]*
* B: Functional form	*CHI-SQ(1)= 1.3571[.244]	*F(1, 20)= 1.0187[0.325]*
* C: Normality	*CHI-SQ(2)= 4.3253[.115]	* Not applicable *
* D: Heteroscedasticity	*CHI-SQ(1)= 0.91410[.339]	*F(1, 26)= .87746[0.358]*

Where:

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residuals

D: Based on the regression of squared residuals on squared fitted values

Estimation of the equilibrium exchange rate

As discussed earlier, the equilibrium exchange rate is derived from the long-run real exchange elasticities after the transitory components in the fundamental factors have been filtered out. The Hodrick–Prescott (1984) filter methodology and the moving average methodology were used to filter out the transitory components of the fundamental series. The permanent component of each series was obtained and each of these was multiplied by the corresponding coefficients of the fundamentals derived in the cointegrating vector (ii) in Table 4. The objective in both methodologies is to smooth out any temporary components in the fundamentals (see Elbadawi, 1994).

The choice of the five-year moving averages (MA) for each of the fundamental variables was based on the coefficient on the error correction term in the final

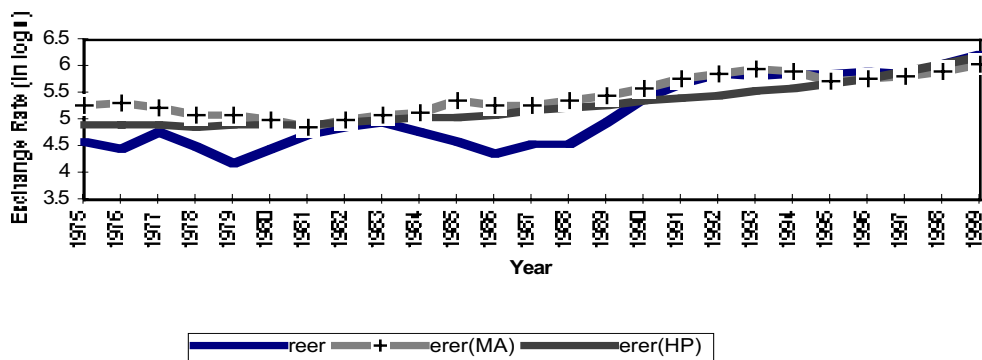
parsimonious dynamic equation presented in Table 6. With a speed of adjustment of 0.439 and in line with Equation 10, up to 88.8% of the exogenous shock would be eliminated in five years.

Statistically, the derived path of the EREER cannot correspond to the path of the estimated REER. For this reason, a base period where we recognize that the exchange rate was not misaligned is chosen to facilitate comparison of the two paths. As postulated by Edwards (1989) and Elbadawi (1994), the path for the equilibrium REER should be consistent with simultaneous internal and external balance each period for given sustainable values of other variables such as world prices, technology and tariffs, which results in the simultaneous attainment of internal and external equilibrium. Internal balance is achieved when the market for non-tradeables clears in the present and is expected to clear in the future; external equilibrium holds when present and future current account balances are compatible with long-run sustainable capital flows (Elbadawi, 1994). To the extent that Uganda achieved internal stability as measured by the low and sustainable inflation levels over the period 1995–1999 and that capital flows largely increased because of prudent macroeconomic policies, we have cause to believe that this could serve as a base period. Growth, inflation and external balance⁵ have all been encouraging largely because the government initiated and implemented a reform programme that has generally been greatly embraced by both its citizens and the donor community (Holmgren et al., 1999). Chances are that policy reversals are very unlikely as the programme was based on extensive dialoging with all the stakeholders in the economy including donors.

Both the estimated long-run real exchange rate (REER) derived from the cointegration and ECM approach, and the paths for equilibrium real exchange rate (ERER) estimated using the moving average and Hodrick–Prescott methodologies have been plotted in Figure 2.

The two methodologies yield roughly the same picture of a generally depreciating

Figure 2: Uganda's equilibrium real exchange rate (ERER) and real exchange rate (REER), 1975–1999



trend of the equilibrium exchange rate—a picture that is also in line with the trend of the estimated long-run REER. Such a pattern is also consistent with the macroeconomic developments and external sector policies, alluded to earlier, and the resultant effects on the fundamentals determining the EREER. In fact, going by the general trend of the four fundamentals included in our estimation, one can hasten to conclude that the impact of the worsening terms of trade, increasing openness and increasing real government expenditure has more than offset the appreciative pressures of increased foreign exchange inflows. The extent of misalignments of the exchange rate and hence its impact on the export sector competitiveness can only be assessed by comparing the estimated REER to the EREER path. When this is done, the degree of over-valuation is seen to have varied with the changing regimes of exchange rate management. The highest degree of misalignment is in 1987/88 at the outset of the structural adjustment programme. Under both methodologies, it is quite evident that during the periods 1981–1983 and 1996–1998, the real exchange rate was moving well within range of the equilibrium.

According to the path derived under the moving average, the EREER for Uganda is depicted to have slightly appreciated up to 1982, before generally depreciating thereafter. In spite of these developments, the real exchange rate did not move in tandem and was in fact appreciating between 1984 and 1987—a move that worsened the over-valuation of the shilling then. The sharp depreciation that commenced in 1988 could be associated with the crawling peg regime, which was adopted to adjust the NEER in line with the inflation differentials. With the commencing of the liberalization efforts in 1990, the real exchange rate gradually depreciated, thereby reducing the degree of over-valuation, which this methodology depicts to have been eliminated by 1992, when the exchange rate was fully liberalized. In the period after 1992, there is no evidence of significant misalignment of the exchange rate as the derived EREER closely tracks REER.

The Hodrick–Prescott methodology, which depicts a smooth path for the equilibrium real exchange rate, also portrayed a relatively stable path in the early 1980s, before a gradual depreciation is seen in the latter years. Unlike the moving average methodology results, the period 1990 to 1996 is depicted as an episode of under-valued shilling.

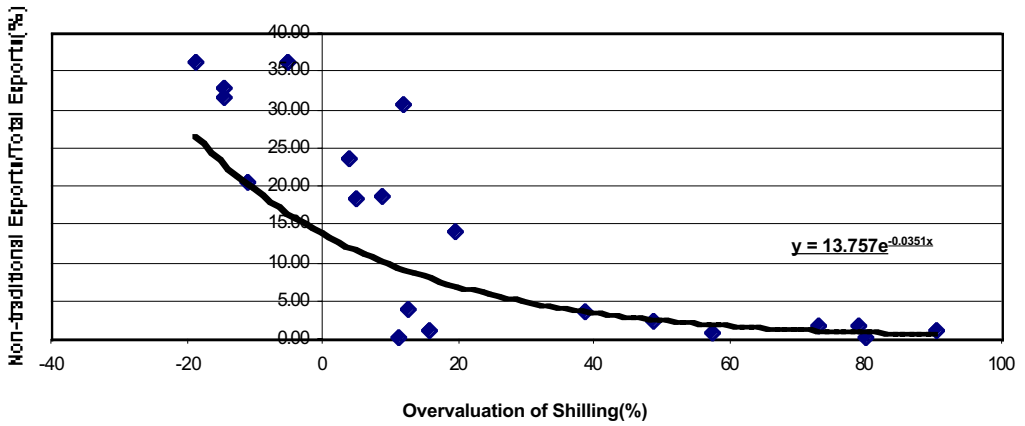
The episodes of misalignment yielded by these methodologies are also consistent with the other measures of misalignments like the premium between the exchange rate especially when Uganda was under fixed exchange rate regimes.

The exchange rate and export sector competitiveness

We analyse the misalignments derived from the two measures of EREER and compare these with the performance of non-traditional exports. The latter is measured as a percentage of total exports and the motivation is to assess whether there is any quantitative relationship between the performance and the magnitude of misalignment. As seen in Figure 3, there is a clear negative relationship between the performance of the non-traditional exports sector and the magnitude of the over-valuation of the exchange rate measured using the moving average approach.

According to the scatter diagram presented here, it is clear from the implied negative

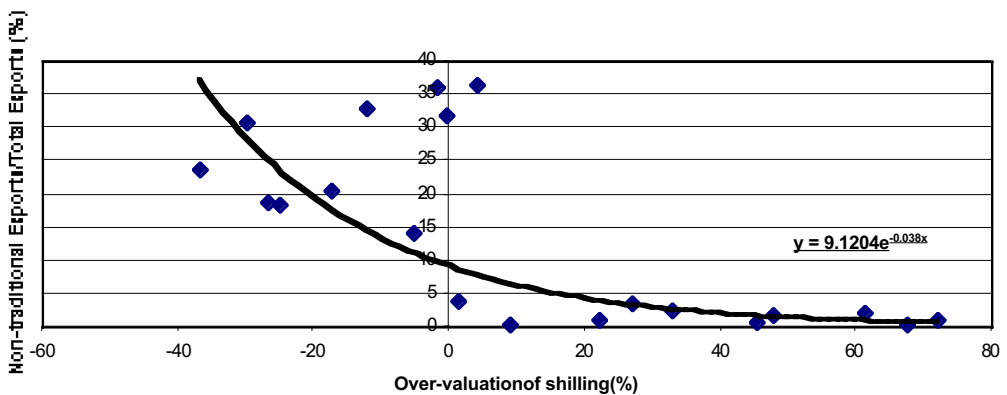
Figure 3: Non-traditional exports and over-valuation of the exchange rate in Uganda, 1980–1999 (MA method)



relationship that the contribution of non-traditional exports to total exports improves with a reduction in over-valuation. In fact the concentration of data points towards zero when the over-valuation is higher than 15% suggests that a significant contribution of the non-traditional export sector can only be attained when over-valuation of the shilling is less than 15%. The asymptotic or curvilinear relationship implied by this picture also suggests that non-traditional exports are highly inelastic to changes in the degree of misalignment with an overly over-valued exchange rate (particularly when the magnitude of over-valuation is higher than 15%), while the converse is true for an overly under-valued exchange rate.

The picture portrayed by the misalignments derived from the Hodrick–Prescott filter methodology depicts a similar relationship (see Figure 4).

Figure 4: Non-traditional exports and over-valuation of the exchange rate in Uganda, 1980–1999 (HP method)



While we appreciate the inference of a negative relationship between over-valuation and non-traditional exports, we recognize that performance of non-traditional exports may have been affected by several factors in the economy during the period. Take, for example, the fact that as the over-valuation of the shilling was being reduced, there may also have been change in the relative price movements of non-traditional exports compared with traditional exports, government policies and structural reforms aimed at promoting diversification of the export sector, liberalization of marketing and commercialization of agricultural policies, among others. For that matter, before a conclusion on the contribution of exchange rate policy to export sector performance is made, more rigorous econometric tests are applied. These include causality, cointegration and error correction analysis between over-valuation and non-traditional export sector performance.⁶

To determine the direction of causation, we used the Granger causality tests between the level of over-valuation and contribution of the non-traditional export sector. The results shown in tables 7 and 8 are the F-statistics from the Granger non-causality tests, and their associated probabilities are shown in the parentheses under each result.

Table 7: Granger (non) causality test between over-valuation of exchange rate (OVER) and non-traditional export (NTE) performance

To test if ↓ Does not	Granger cause →	
	NTE 2 lags	
OVER (hp)	0.597 (0.565)	
OVER (ma)	0.164 (0.851)	
To test if ↓ Does not	Granger Cause →	
	OVER (hp) 2 lags	OVER(ma) 2 lags
NTE	5.92 (0.01)	5.68 (0.02)

As depicted in Table 7, and at the 5% level, the null that over-valuation (*OVER*) does not cause non-traditional exports (*NTE*) is accepted, while the null that *NTE* does not cause *OVER* is rejected. The tests on the differenced variables show, however, that for the changes in these variables, the null of not Granger causing can be rejected in both directions. Hence, as shown in Table 8, there is a bi-directional causation between the differences in *OVER* and *NTE*.

Table 8: Granger (non) causality test between changes in over-valuation of exchange rate (OVER) and changes in non-traditional export (NTE) performance

To test if ↓ Does not	Granger cause → ΔNTE		
		2 lags	
ΔOVER (hp)	11.49 (0.002)		
ΔOVER (ma)	7.74 (0.007)		
To test if ↓ Does not	Granger cause → ΔOVER (hp) ΔOVER(ma)	2 lags	2 lags
ΔNTE	3.60 (0.06)	4.69 (0.03)	

The results that causality runs from non-traditional exports to over-valuation in the long run is also confirmed by the cointegration tests, which are presented in Appendix F. The cointegration results suggest that there is a unique vector that depicts a stationary relationship between *OVER* and *NTE*. The weak exogeneity test results, however, suggest that the *NTE* is weakly exogenous to *OVER*, which confirms the results from the Granger non-causality tests. Further analysis involving the over-parameterized ECM reveals that the LR relationship is only valid when normalized on *OVER*. This further confirms that it is the performance of *NTE* that influences the *OVER*. To get any meaningful equation that explains *NTE*, a VAR analysis in differences rather than levels has to be used. The parsimonious results of the VAR analysis in differences are presented in tables 9 and 10. In line with these results, a 1% change in over-valuation will negatively affect the growth of *NTE* by about 3.8%.

We must put a caveat on these results, however, because they were derived using a bi-variate analysis. We strongly believe a multi-variate analysis would have generated better results. Unfortunately, this analysis would have involved modelling the supply and demand side of non-traditional exports, with *OVER* as one of the explanatory variables. As good as this may be, it is well beyond the terms of reference of this study and we propose that future studies on performance of the non-traditional export performance build on this.

Table 9: Ordinary least squares estimation with over-valuation (MA method)

Dependent variable is DNT

17 observations used for estimation from 1983 to 1999

Regressor	Coefficient	Standard error	T-ratio (Prob)
INPT (C)	0.36394	.23043	1.5794 (0.138)
DNT (-1)	-.36946	.23435	-1.5765 (0.139)
DNT (-2)	-.42165	.25475	-1.6551 (0.122)
DMA (-1)	-3.8415	1.9587	-1.9612 (0.072)
R-squared	0.29848	R-bar-squared	0.13660
S.E. of regression	0.89735	F-stat. F(3, 13)	1.8438 (0.189)
Mean of dependent variable	0.26467	S.D. of dependent variable	0.96572
Residual sum of squares	10.4680	Equation log-likelihood	-20.0004
Akaike info.criterion	-24.0004	Schwarz Bayesian criterion	-25.6668
DW-statistic	1.4041		

Table 10: Ordinary least squares estimation with over-valuation (HP method)

Dependent variable is DNT

17 observations used for estimation from 1983 to 1999

Regressor	Coefficient	Standard error	T-Ratio (Prob)
NPT	0.43709	0.22058	1.9815 (0.069)
DNT (-1)	0.47696	0.23388	-2.0393 (0.062)
DNT (-2)	0.57230	0.26610	-2.1507 (0.051)
DHP (-1)	-3.9094	1.6270	-2.4028 (0.032)
R-squared	0.45323	R-bar-squared	0.27097
S.E. of regression	0.82457	F-stat. F(4, 12)	2.4868 (0.099)
Mean of dependent variable	0.26467	S.D. of dependent variable	0.96572
Residual sum of squares	8.1589	Equation log-likelihood	-17.8821
Akaike info. criterion	-22.8821	Schwarz Bayesian criterion	-24.9651
DW-statistic	1.7094		

Further, given that the Ugandan economy has experienced huge foreign exchange inflows, which our analysis has treated as a fundamental factor driving the equilibrium exchange rate, one would wonder whether such inflows have not had a negative impact on the export sector performance. To ascertain this, and whether the level of the equilibrium rate itself has any impact on the performance of non-traditional exports, an analysis of the performance of the export sector in relation to the movement in the equilibrium exchange rate itself has been done through cointegration and error correction (Table 11).

Table 11: Cointegration for the non-traditional exports (NTE) and the level of the ERER (moving average) – VAR=4

A. Johansen maximum likelihood test for cointegration based on maximal eigen value

Null	Alternative	Statistic	95% critical value	90% critical value
$r = 0$	$r = 1$	18.5809	14.9000	12.9120
$r \leq 1$	$r = 2$	1.8704	8.1760	6.5030

B. Test for cointegration based on trace of the stochastic matrix

Null	Alternative	Statistic	95% critical value	90% critical value
$r = 0$	$r \geq 1$	20.4513	17.9530	15.6630
$r \leq 1$	$r = 2$	1.8704	8.1760	6.5030

C. Normalized cointegrated vectors (b-vector) and adjustment matrixes (a-vectors)

	LNTE	LereR
(i)	$\Delta -1.00000$	4.1114
	$\Delta 0.53904$	-0.08797

As depicted in Table 11, the single cointegrating relationship found confirms the fear that appreciation of the ERER negatively affects the export sector performance. The long-run relation would thus be given as:

$$LNTE = 4.1114 * LERER \quad (16)$$

This suggests that a 1% depreciation in the ERER increases non-traditional exports by 4.1%. From the results in Equation 14, which depicts capital flows (*FLAWS*) to be negatively related to the REER, we can argue further that the increased foreign exchange flows that have appreciative pressures on REER have not augured well for the non-traditional export sector. However, our short-run analysis, presented in Table 12, suggests that the level of the ERER has no policy implications on changes in non-traditional exports. The current changes in non-traditional exports depend largely on their past values and the impact of the long run presented by the ECM term, and not on the changes in ERER.

Table 12: Ordinary least squares estimation with changes in ERER (HP method)

Dependent variable is DNTE

16 observations used for estimates from 1984 to 1999

Regressor	Coefficient	Standard error	T-Ration (Prob)
INPT	0.40844	0.15498	2.6354 (.0023)
DNTE(-1)	0.24606	0.17685	-1.3913 (0.192)
DNTE(-2)	0.51526	0.17935	-2.8729 (0.015)
DNTE(-3)	0.34472	0.20343	-1.6946 (0.118)
ECM (-4)	0.40252	0.18100	-2.2239 (0.048)
R-squared	0.46019	F-statistic F(4, 11)	2.3444(.119)
R-bar-squared	0.26389	S.E. of regression	0.41301
Residual sum of squares	1.8764	Mean of dependent variable	0.16364
S.D. of dependent variable	0.48139	Maximum of log-likelihood	-5.5571
DW-statistic	2.4252		

The results of the analysis of misalignment by both the MA and HP methods are shown in Table 13 for total exports, coffee and non-traditional exports for the period 1980 to 1999.

Table 13: Non-traditional exports and exchange rate misalignments, 1980-199

Year	Total exports (mil US\$)	Coffee exports (mil US\$)	Non-traditional exports (mil US\$)	Degree of misalignment (%) Moving average	Hedrick–Present Filter
1980	319.4	312.2	2.5	57.3	45.4
1981	229.3	224.2	2.5	15.5	22.2
1982	347.3	341.7	1.4	11.2	8.9
1983	367.7	340.2	14.2	12.6	1.5
1984	407.3	375.6	14.8	38.5	26.9
1985	347.8	325.8	6.62	78.8	47.9
1986	394.9	382.2	4.5	90.4	61.2
1987	333.6	321.0	6.6	73.0	61.2
1988	266.3	259.2	1.016	79.9	67.7
1989	277.7	262.8	7.1	48.6	32.9
1990	177.8	140.4	25.23	19.4	-5.1
1991	173.2	117.6	32.5	8.7	-26.7
1992	151.2	95.4	35.6	3.7	-36.9
1993	200.0	114.5	61.7	11.7	-29.7
1994	462.9	356.9	85.2	4.7	-24.9
1995	560.3	419.0	115.2	-11.0	-17.5
1996	639.3	396.1	211.1	-14.6	-12.2
1997	575.6	310.4	209.6	-5.4	4.2
1998	510.2	295.0	161.9	-14.5	-0.2
1999	536.9	285.5	194.7	-18.7	-1.9

Note: Degree of misalignment (+) is over-valuation and (-) is under-valuation Source: Bank of Uganda Annual Reports and computations by authors.

6. Conclusion and recommendations

This study shows that in spite of the huge depreciation in nominal exchange rates witnessed in Uganda over the last 30 years, the real exchange rate has had several episodes of over-valuation. The major factors contributing to the movement in the real exchange rate include the degree of openness, terms of trade movements, levels of government expenditure and capital flows. While these factors will change the real exchange rate in the long run, it was also established that in the short run, policies that change the degree of openness of Uganda will positively affect the REER, and improvements in the terms of trade will appreciate it. While government expenditure has been portrayed as not affecting the REER in the short run, monetary policy shocks measured by acceleration of credit also have a significant depreciative impact.

Both methodologies of estimation of the equilibrium real exchange rate (moving average and Hodrick–Prescott methodologies) suggest the existence of relative stability in the earlier years and a gradual depreciation of the EREER over the later part of the sample period. The movements in the EREER as measured by the MA methodology seem to neatly capture developments in the underlying fundamentals, especially the terms of trade, for which the improvement in 1993 to 1995 and the subsequent unwinding in the post 1995 period are clearly shown in the EREER path. Owing to the volatility of the real exchange rate, however, episodes of misalignment are observed with varying degrees and more pronounced in the pre-liberalization years (1993). For the post-liberalization era, the fact that the real effective exchange rate has moved well within the range of the equilibrium, especially in the later years, could suggest that the prudent macroeconomic policies being pursued have effectively minimized the occurrence of misalignments. The interventionist policy of the monetary authorities in the midst of the 1994 and 1995 coffee boom under-valued the shilling. On the other hand, the unwinding of the coffee boom is correctly captured by the depreciating REER as it adjusts towards its equilibrium.

The study has found, however, that the degree of misalignment is inversely related to the performance of the non-traditional export sector, irrespective of which methodology is used for estimating EREER. Further, it is found that while the non-traditional export performance is highly inelastic to changes in the degree of misalignments when the shilling is over-valued, particularly by more than 15%, the converse is true for an overly under-valued shilling. As a policy measure, though, the authorities could be advised that any over-valuation in excess of 15% is not healthy for the growth of non-traditional exports. Conversely, depending on the inflation objective of the authorities, over-depreciation of the REER would significantly boost the export competitiveness of the non-traditional exports. Policy makers will benefit from having an explicit estimate of

the equilibrium when discussing exchange rate related issues and export competitiveness. Going by the moving average method, which we believe captures the developments in the fundamentals and hence the ERER path better (as opposed to the smoothened path under HP method), we can conclude that the Uganda shilling was by 1999 slightly undervalued, a scenario that augurs well for export sector development.

Notes

1. We do not estimate an export equation for this purpose, but merely look for consistency between the misalignment profile of the real exchange rate and export performance in general.
2. A crawling-peg exchange regime is mid-course between fixed and floating rates. The government fixes the exchange rate on any one day but over time moves the rate in a pre-announced fashion. Under a crawling peg, exchange rate adjustments are much smaller but made more frequently than under the adjustable peg. The crawling peg combines the flexibility needed to accommodate different trends in inflation rates between countries while maintaining relative certainty about future exchange rates relevant to exporters and importers. The disadvantage is that the crawling peg, like the fixed exchange rate, leaves the currency open to speculative attack because the government is committed on any one day or over a period to a particular value of the exchange rate. Despite some drawbacks, a crawling peg can be a useful exchange rate system when a country has higher inflation than its major trading partners and cannot, therefore, credibly fix the exchange rate, but wants to give its exporters and importers relative certainty about future exchange rates. In countries with strong domestic capital markets, an alternative to the crawling peg is for the government to provide forward exchange cover or exchange rate guarantees for exporters.
3. This refers to the list of imports for which foreign exchange could not be obtained from the auction but had to be bought from the bureau market.
4. Johansen (1988) also argues that provided the $I(1)$ variables cointegrate, one can include an $I(0)$ variable in the cointegrating relationship to improve the coefficients of the long-run relationship.
5. Donors have largely supported the positive external balance, and we argue that the huge deficit in the current account primarily reflects the donor financing of the budget deficit. The budget deficit is mainly for social infrastructure investments (education, health, rural road networks), which should all lead to sustainable growth in the future. As long as government pursues prudent economic policies, we have every cause to believe that the donors' inflows to support the policies will continue.
6. We avoid estimating an export equation because it is beyond the scope of this research work.

References

- Abuka, C. and D. Sajjabi. 1996. "The importance of domestic and external factors in the appreciation of the real exchange rate in Uganda". Final report presented at the AERC workshop, 25–30 May.
- Aghelvi, B.B., M.S. Khan and P.J. Montiel. 1991. *Exchange Rate Policy in Developing Countries: Some analytical issues*. IMF Occasional Paper No. 78, March.
- Baldwin, R. and P. Krugman. 1989. "Persistent trade effects of large exchange rate shocks". *Quarterly Journal of Economics*, 104 (November): 635–54.
- Edwards, S. 1988. "Real and monetary determinants of real exchange rate behaviour: Theory and evidence from developing countries". *Journal of Developing Economies*, 29: 311–41.
- Edwards, S. 1989. *Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policy in Developing Countries*. Cambridge, Massachusetts: MIT Press.
- Edwards, S. 1994. "Real and monetary determinants of real exchange rate behaviour: Theory and evidence from developing countries". In J. Williamson, ed., *Estimating Equilibrium Exchange Rates*. Washington, D.C.: Institute for International Economics.
- Elbadawi, I. 1994. "Estimating long-run equilibrium real exchange rates". In J. Williamson, ed., *Estimating Equilibrium Exchange Rates*. Washington, D.C.: Institute for International Economics.
- Elbadawi, I. 1997. "Real exchange rate policy and non-traditional exports in developing countries". UN/WIDER project, Growth, External Sector and the Role of Non-Traditional Exports in Sub-Saharan Africa.
- Engle, R.F. and C. Granger. 1987. "Co-integration and error-correction: Representation, estimation and testing". *Econometrica*, 55: 251–76.
- Flood, R. 1981. "Explanation of exchange rate volatility and other empirical irregularities in some popular models in the foreign exchange market". Carnegie-Rochester Conference Series on Public Policy.
- Frankel, J. and M. Goldstein. 1988. "Exchange rate volatility and misalignment: Evaluating some proposals for reform". In *Financial Market Volatility*, a symposium sponsored by the Federal Reserve Bank of Kansas City.
- Hodrick, R.J. and E. Prescott. 1980. "Post-war U.S. business cycles: An empirical investigation". Working Paper, Carnegie-Mellon University.
- Holmgren, T., L.A. Kasekende, M. Atingi-Ego and D. Ddamulira. 1999. "Aid and reform in Uganda: Country case study". Study on Aid and Reform in Africa under the World Bank Development Research Group.

- Johansen, S. 1988. "Statistical analysis of co-integrating vectors". *Journal of Economic Dynamics and Control*, 12: 231–54.
- Johansen, S. and K. Juselius. 1990. "Maximum likelihood estimation and inference on co-integration with applications to the demand for money". *Oxford Bulletin of Economics and Statistics*, 52: 169–210.
- Kasekende, L.A. and G. Ssemogerere. 1994. "Exchange rate unification and economic development: The case of Uganda 1987–1992". *World Development*, August.
- Mongardini, J. 1998. "Estimating Egypt's equilibrium real exchange rate". Working Paper No. 98/5. International Monetary Fund, Washington, D.C.
- Mwega, F. 1993. "Real exchange rate misalignment and macroeconomic performance in Kenya". An interim report presented at the AERC Workshop. Capetown, 29 May–1 June.
- Ssemogerere, G. and D. Ddamulira. 1998. "Growth, external sector and the role of non-traditional exports in Uganda". UN/WIDER project, Growth, External Sector and the Role of Non-Traditional Exports in Sub-Saharan Africa.
- Williamson, J. 1994. *Estimating Equilibrium Exchange Rates*. Washington, D.C.: Institute for International Economics.

Appendix A: Real effective exchange rate (REER) calculation

The REER, defined as the NER adjusted for the relative price levels would have been presented as:

$$REER = NER * \frac{P^f}{P} \quad (A1)$$

where NER = the nominal exchange rate;
 P^f = the indexed unit export price
 P^d = the indexed domestic price level

However, we need to use the REER in our aggregate supply block in order to compute the domestic currency value of imported intermediate goods that enter the production function. Consequently, the REER computed above will not capture the actual implications of exchange rates on imports. An REER that affects both the imports and the exports has to be computed as:

$$REER = NEER_i * \left(\frac{\sum_{i=1}^n w_i P_i}{P^d} \right) \quad (A2)$$

where NEER is the nominal effective exchange rate for a particular period, defined as:

$$NEER_t = \sum_{i=1}^n [w_i * NER_{it}] \quad (A3)$$

w_i = trade weight assigned to the i th trading partner
 P_i = indexed price level for i th trading partner
 P^d = indexed domestic price level
 NER_i = indexed direct exchange rate quote with the i th trading partner

The trade weight, w_i is given as:

$$w_i = \frac{X_i + M_i}{X_p + M_p} \quad (\text{A3})$$

where X_i and M_i are, respectively, the exports and imports to/from i th trading partner.

X_p and M_p are, respectively, the total exports and imports to/from trading partners.

For our study, the computation of REER uses CPI, trade and exchange rate data from five of Uganda's major trading partners (UK, USA, Kenya, Japan, Germany). The resultant weights and nominal and real effective exchange rates are presented in the Appendix D, tables D1 and D2, respectively.

Appendix B: The model for Uganda's real exchange rate

Following Elbadawi (1994) and the simplified version of the seminal work of Edwards (1989), we formulate a model for Uganda's equilibrium real exchange rate by simultaneous equations involving both demand and supply sides of the various sectors that make up the economy so as to model market conditions.

The demand side

The demand side of the economy can be approached from the equation for domestic absorption, A , which is represented as:

$$A = X_g + X_p \quad (\text{B1})$$

where: X_g is government absorption and is assumed to be fixed and a policy variable and

X_p is private sector absorption.

$$X_g = gY \quad (\text{B2})$$

Government and private sector expenditure on non-tradeables can be respectively represented as:

$$X_{GN} = g_N \cdot X_g = g_n gY \quad (\text{B3})$$

$$X_{PN} = d_{PN}(P_x, P_m, P_N) \cdot X_p = d_{PN}(P_x, P_m, P_N) \cdot A[A - gY] \quad (\text{B4})$$

Equation B3 expresses government consumption of non-tradeables and is exogenously determined and fixed as a policy variable. Equation B4 is private sector expenditure on non-tradeables and is endogenously determined as a function of the domestic price of exports, P_x , imports, P_m , and non-tradeables, P_n . Therefore, the total demand for non-traded goods in this economy is the sum of equations B3 and B4, given below as:

$$EXP_N = X_{PN} = d_{PN}(P_x, P_m, P_N) \cdot X_p = d_{PN}(P_x, P_m, P_N) \cdot [A - gY] + g_N gY \quad (\text{B5})$$

The supply side

The supply of non-traded goods as a ratio of GDP is also stated as a function of the three aggregate prices:

$$S_N = s_N(P_x, P_m, P_N) \cdot Y \quad (\text{B6})$$

Equations B5 and B6 together state the equilibrium condition in the non-traded goods market given as:

$$S_{PN}(P_x, P_m, P_N) \cdot X_P = d_{PN}(P_x, P_m, P_N) \cdot [A/Y - g] + g_N g \quad (\text{B7})$$

We now need an expression for the real exchange rate in terms of domestic prices and also domestic prices as a function of foreign prices. The following expressions relate the domestic prices of exportables, P_x , and importables, P_m , to their international prices, which can be regarded as exogenous if we assume that Uganda is a small country and cannot affect international prices:

$$P_x = E(1 - t_x) P_x^* \quad (\text{B8})$$

$$P_m = E(1 - t_m) P_m^* \quad (\text{B9})$$

where t_x and t_m are the export and import tax rates, respectively, which create a wedge between domestic and international prices for importables and exportables.

If we define the real exchange rate as the ratio of non-tradeables and tradeables we have:

$$e = P_n / P_T \quad (\text{B10})$$

The price of tradeables can be defined as the weighted average of the price of exportables and importables so that:

$$P_T = P_x^\alpha P_m^{1-\alpha} \quad (\text{B11})$$

Substituting for P_x and P_m in terms of international prices of exportables and importables, we have the following equation for the real exchange rate:

$$e = P_N / E P_x^*{}^\alpha P_m^*{}^{1-\alpha} \quad (\text{B12})$$

The tariffs can be assumed to be constant and exogenously determined policy variables.

The alphas represent the shares of importables and exportables in the traded goods sector and will be a function of the tariff rates on the two (but since we assume them to be constant they play no dynamic role in the real exchange rate). E is the nominal exchange rate in units of domestic currency per US dollar. Solving for equations B1 to B12 gives us an expression for the level of the REER that ensures instantaneous equilibrium in the non-traded goods market for levels of exogenous and policy fundamentals (as indicated in Elbadawi, 1994). We relate the variables to the real exchange rate in the following expression (positive signs indicate that a higher level of the variable leads to a real appreciation and vice versa for a lower level of the variable).

$$e = e(A/Y, TOT, t_x, t_m, X_{GN}/X_G, X_G/Y) \quad (B13)$$

So far, our solution does not provide for the conditions set out by Edwards for the determination of the ERER; the solution does not take account of the anticipated future developments in the fundamentals (the forward-looking component), the dynamic path of the RER is not specified since our solution is instantaneous and does not take account of the sustainability of the fundamentals. There is need to complete the model by endogenizing domestic absorption (A). We do this by linking domestic absorption to the sustainable level of net capital (i.e., sustainable capital inflows) flows and real rate of interest, which determines the intertemporal price of consumption.

$$A/Y = \alpha(NKI/Y, r^* - \sigma [E_t \log(e_{t+1}) - \log(e_t)], r^* D/Y) \quad (B14)$$

A rise in the sustainable level of capital inflows, NKI , makes possible a higher level of sustainable domestic absorption. Also, a rise in the world interest rate or a rise in the expected rate of real depreciation relative to the current rate increases the demand for savings and therefore reduces the level of absorption relative to income. We add the debt service burden as a ratio of GDP because this reduces the sustainable level of domestic absorption. E_t is an expectations operator. Other authors, like Mongardini (1998) for the case of Egypt, have also done this. In Uganda's case, this variable is all the more pertinent because of the past debt restructuring policies and the recently agreed upon highly indebted poor countries (HIPC) debt initiative for Uganda. However, to the extent that HIPC effects increase government expenditures in some strategic social sectors without necessarily affecting the gross inflows, the effects of HIPC are captured in increased government expenditures.

For empirical estimation, we now linearize equations B13 and B14 by taking logs and simplifying into the following:

$$\log e = \alpha_0 + \alpha_1 \log(TOT) - \alpha_2 \log(OPEN) + \alpha_3 \log(A/Y) + \alpha_4 \log(GOV/Y) \quad (B15)$$

Equation B15 is the linearized empirical version of the non-traded goods market equilibrium condition for the RER of Equation B13.

$$\log(A/Y) = \beta_0 + \beta_1(NKI/Y)_t + \beta_2r^* - \beta_3(E_t \log(e_{t+1}) - \log e_t) + \beta_3 \log(DEBT), \tag{B16}$$

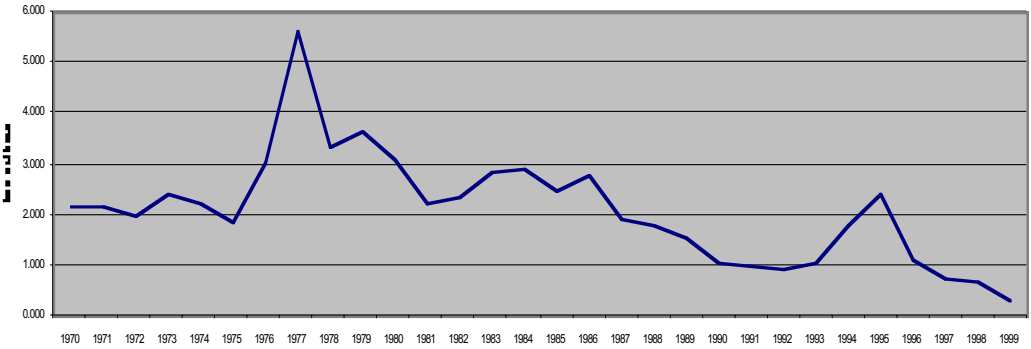
This is the linearized empirical version of equation (xiv).

We can now solve the system for simultaneous equilibrium in traded and non-traded goods (i.e. ,internal and external balance subject to the evolution in the sustainable profile of fundamentals). The following reduced form dynamic equation for the real exchange rate emerges:

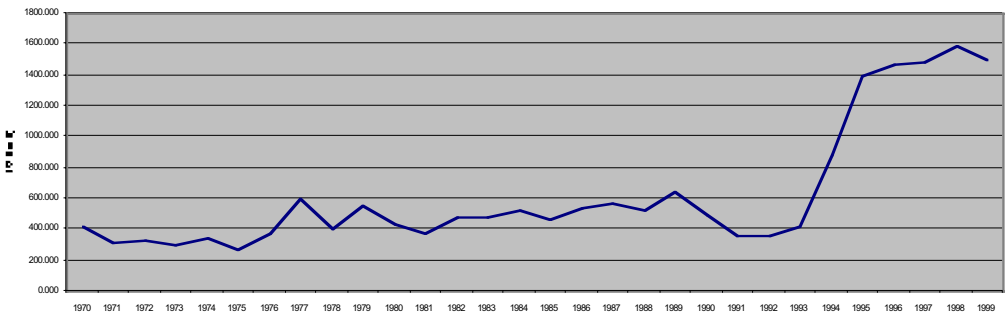
$$\log e_t - \lambda_t \log e_{t+1} = \delta_0 + \delta_1 \log(TOT)_t - \delta_2 \log(OPEN) - \delta_3(NKI/Y) + \delta_4 \log(GEXP/Y) + \delta_5 \log(CURRGEXP/Y) + \delta_6(DEBT) \tag{B17}$$

Where $OPEN = (EXPORTS+IMPORTS)/Y$ is proxying for commercial policy (t_x, t_y). This is because firstly, there is difficulty in obtaining a reliable time series for t_x and t_y . Also, the degree of openness of the economy is likely to proxy for implicit commercial

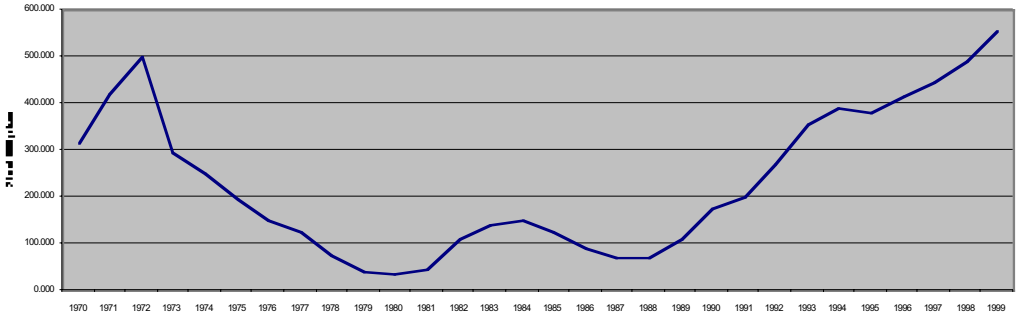
Appendix Figure 1: Uganda's Terms of Trade Movements



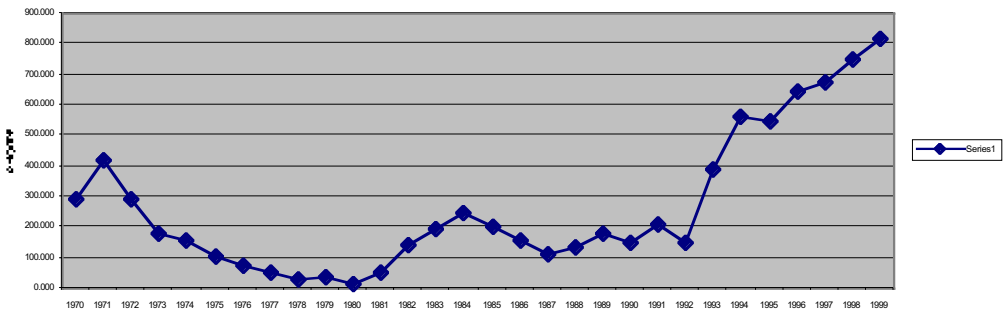
Appendix Figure 2: Uganda Capital Inflows



Appendix Figure 3: Uganda Real Government Expenditure



Appendix Figure 4: Uganda Degree of Openness



policy such as quota and exchange controls (Elbadawi, 1994).

$$\lambda = \alpha_3\beta_2 / (1 + \alpha_3\beta_2) < 1 \tag{B18}$$

Where δ 's (the coefficients on the right-hand side) are also combinations of the alphas and betas.

Let us define a vector of coefficients for the corresponding vector of fundamental variables:

$$\delta = (\delta_0, \delta_1, \delta_2, \delta_3, \delta_4, \delta_5, \delta_6) \text{ F}=[1, \log(\text{TOT}), \log(\text{OPEN}), \text{NKI/Y}, \log \text{GOVEXP/Y}, \log \text{CURRGEXP/Y}, \log \text{DEBT}, r^*] \tag{B19}$$

If the vector of the fundamentals is $I(1)$, then the following cointegrating relationship exists:

$$\log e_t = [1/(1 - \lambda)]\delta^c F_{t+j} + \eta_t \tag{B20}$$

where the F is the vector of sustainable fundamentals and the cointegrating vector is given by $[1/(1 - \lambda)]\delta$. Appendix C: Exploratory figures

Appendix D: Partial system and weak exogeneity

Using the a matrix, i.e., the adjustment/loading matrix, the hypothesis of weak exogeneity for the long-run parameters can be formulated as a parametric restriction on the adjustment coefficient. Using the VAR formulation enables us to express concisely a partial system as a conditional model and discuss its properties. In this case, we are not only able to model the endogenous variable but also to derive the stochastic properties of the conditioning variables in the VAR.

Consider the following equation:

$$\Delta X_t = \mu + \Gamma(L)\Delta X_{t-1} + \Pi_{t-1} + \epsilon_t \tag{D1}$$

where $X_t = (X_{1t}, X_{2t})'$, $\mu = (\mu_1, \mu_2)'$, $\Gamma(L) = \{\gamma_{ij}\}$,
 $\Pi = \{\pi_{ij}\}$ and Π is the matrix of long-run parameters
 $\epsilon_t = (\epsilon_{1t}, \epsilon_{2t})'$

If there is one unit root in Equation D1, this would correspond to the definition of cointegration given by Engle and Granger (1987), where x_1 and x_2 are integrated of order 1 but with a linear combination $\beta'X_{1t}$, which is stationary. Here $\Pi = \alpha\beta'$, and the 2×1 vectors α and β are both different from zero.

Equation D1 can be decomposed into a conditional model for x_1 given x_2 , i.e.:

$$\Delta x_{1t} = \bar{\omega}\Delta x_{2t} + (\alpha_1 - \bar{\omega}\alpha_1)\beta'X_{t-1} + \sum_{i=1}^{k-1} (\Gamma_{1t} - \bar{\omega}\Gamma_{2t})\Delta X_{t-1} + \mu_1 - \bar{\omega}\mu_2 + \epsilon_{1t} - \bar{\omega}\epsilon_{2t} \tag{D2}$$

where $\bar{\omega} = \Omega_{12}\Omega_{22}^{-1}$

and the marginal model of x_2 is

$$\Delta x_{2t} = \alpha_2\beta'X_{t-1} + \sum_{i=1}^{k-1} \Gamma_{2t}\Delta X_{t-1} + \mu_2 + \epsilon_{2t} \tag{D3}$$

If $\alpha_2 = 0$ in Equation D3, then β' enters only in the conditional model (D2), so that

$$\Delta x_{1t} = \bar{\omega}\Delta x_{2t} + \alpha_1\beta'X_{t-1} + \sum_{i=1}^{k-1} (\Gamma_{1t} - \bar{\omega}\Gamma_{2t})\Delta X_{t-1} + \mu_1 - \bar{\omega}\mu_2 + \epsilon_{1t} - \bar{\omega}\epsilon_{2t}$$

and

$$\Delta x_{2t} = \sum_{t=1}^{k-1} \Gamma_t \Delta X_{t-1} + \mu_2 + \epsilon_{2t}$$

This implies that x_2 is weakly exogenous because it does not react to disequilibrium errors emanating from X_{t-1} . Should the coefficient of Δx_1 happen to be statistically equal to zero in Equation D3 then x_2 is said to be strongly exogenous and can be used as a policy variable.

Appendix Table D1: Trade weights for Uganda's trading partners (1970=100) (in millions of US\$)

Country	Exports (To)	Imports (From)	Total	Total trade	Weight percentage
UK	50.38	38.98	89.36	20	0.31
USA	50.75	7.21	57.96	13	0.20
Kenya	28.14	46.75	74.89	17	0.26
Japan	26.22	13.97	40.19	9	0.14
Germany	11.24	11.06	22.30	5	0.08
World total	279.2	171.91	451.11	100	-
Major partners Total	166.72	117.98	284.70	63	1.00

Table D2: Uganda's nominal and real effective exchange rates

Year	NEER	REER	Year	NEER	REER
1970	0.16	134.17	1985	14.45	114.96
1971	0.16	177.03	1986	31.44	91.01
1972	0.16	179.74	1987	100.00	100.00
1973	0.19	161.60	1988	234.57	83.97
1974	0.22	144.13	1989	471.69	103.73
1975	0.26	120.82	1990	923.39	183.96
1976	0.28	97.39	1991	1525.73	252.33
1977	0.50	125.34	1992	2111.29	258.66
1978	0.73	94.60	1993	2031.16	290.78
1979	1.26	94.20	1994	1836.05	276.70
1980	2.30	125.95	1995	1838.84	257.30
1981	4.18	193.79	1996	1855.93	255.67
1982	5.12	187.41	1997	1940.08	266.84
1983	6.13	179.97	1998	2417.42	337.93
1984	7.62	143.18	1999		

DW-statistic

1.5246

Durbin's h-statistic

NONE

Appendix E: OLS estimations and variable deletion test results**Table E1: Over-parameterized model by ordinary least squares estimation**

Ordinary least squares estimation
Dependent variable is DREER

28 observations used for estimation from 1972 to 1999

Regressor	Coefficient	Standard error	T-ratio[Prob]
INPT (C)	1.1159	0.28512	3.9136 (.001)
DREER(-1)	0.32737	0.20670	-1.5838 (.133)
DOPEN	0.69081	0.30527	2.2629 (.038)
DOPEN(-1)	0.39689	0.35056	1.1322 (.274)
DGE	0.13547	0.18216	0.74369 (.468)
DGE(-1)	0.022452	0.14249	0.15756 (.877)
DTT	0.068505	0.13207	0.51869 (.611)
DTT(-1)	0.21167	0.13140	-1.6109 (.127)
DFLOW	0.16009	0.25799	0.62053 (.544)
DFLOW(-1)	0.016842	0.25252	0.066698 (.948)
DDLREDIT	0.12331	0.093630	1.3170 (.206)
ERROR(-2)	0.44979	0.11462	-3.9243 (.001)
R-squared	0.76953	F-statistic F(11, 16)	4.8566 (.002)
R-bar-Squared	0.61108	S.E. of regression	0.16034
Residual sum of squares	0.41133	Mean of dependent variable	0.028457
S.D. of dependent variable	0.25710	Maximum of log-likelihood	19.3576

Diagnostic tests

* Test Statistics	* LM Version	* F version*
* A: Serial correlation	* CHI-SQ(1)= 3.2207 (.073)	* F(1, 15)= 1.9496 (.183)*
* B: Functional form	* CHI-SQ(1)= 5.4258 (.020)	* F (1, 15)= 3.6053 (.077)*
* C: Normality	* CHI-SQ(2)= 2.7136 (.257)	* Not applicable*
* D: Heteroscedasticity	* CHI-SQ(1)= 1.0650 (.302)	*F(1, 26)= 1.0281 (.320)*

Table E2: Variable deletion test (OLS case)

 Dependent variable is DREER

List of the variables deleted from the regression:

DTT	DGE	DGE(-1)	DFLOW	DFLOW(-1)
-----	-----	---------	-------	-----------

28 observations used for estimation from 1972 to 1999

Regressor	Coefficient	Standard error	T-Ratio [Prob]
INPT (C)	1.0969	0.25855	4.2425 (.000)
DREER(-1)	-0.36152	0.18157	-1.9911 (.060)
DOPEN	0.46081	0.11820	3.8987 (.001)
DOPEN(-1)	0.37497	0.15672	2.3926 (.026)
DTT(-1)	-0.18870	0.10590	-1.781 (.089)
DDLREDIT	0.15544	0.078986	1.9679 (.062)
ERROR(-2)	-0.43861	0.10379	-4.2262 (.000)

Joint test of zero restrictions on the coefficient of deleted variables:

Lagrange multiplier statistic	CHI-SQ (5) = 3.969 (.554)
Likelihood ratio statistic	CHI-SQ (5) = 4.2807 (.510)
F statistic	F (5, 16) = .52860 (.751)

Appendix F: Results of the cointegration and, error correction analysis for Non-traditional exports and exchange rate misalignments

Table F1: Time series properties of over-valuation and non-traditional exports

Variable	Variable name	ADF(x) cointegration	ADF((x)	Order of
Over-valuation by MA	OVER(ma)	-	-3.6386	I(1)
Over-valuation by HP	OVER(hp)	-1.3396	-3.1046	I(1)
		-		
		-2.4049		
Non-traditional exports/total exports ratio	NTE	I(1)		
Critical value at 5%		2.9970	2.9970	

Table F2: Johansen and Joselius cointegration with restricted intercepts and no trends in the VAR cointegration LR test based on maximal eigenvalue of the stochastic matrix

17 observations from 1983 to 1999. Order of VAR = 3

List of variables included in the cointegrating vector:					List of variables included in the cointegrating vector:					
LNT	LOVER(ma)	Intercept	LNT	LOVER(hp)	Intercept	LNT	LOVER(hp)	Intercept		
List of eigenvalues: 0.56132 0.32141 0.0000					List of eigenvalues : 0.60391 0.34111 0.0000					
Null Statistic	Alternative 95% C.V.	90% C.V.	Null Statistic	Alternative 95% C.V.	90% C.V.	Null Statistic	Alternative 95% C.V.	90% C.V.		
R = 0	r = 1	14.0078	15.8700	13.8100		R = 0	r = 1	15.7438	15.8700	13.8100
R <= 1	r = 2	6.5917	9.1600	7.5300		R <= 1	r = 2	7.0923	9.1600	7.5300

Table F3: Johansen and Joselius cointegration with restricted intercepts and no trends in the VAR cointegration LR test based on trace of the stochastic matrix

17 observations from 1983 to 1999. Order of VAR = 3. List of variables included in the cointegrating vector:					17 observations from 1983 to 1999. Order of VAR =3. List of variables included in the cointegrating vector:				
LNT	LOVER(hp)	Intercept			LNT	LOVER(ma)	Intercept		
Null	Alternative	Statistic	95% C.V	90% C.V	Null	Alternative	Statistic	95% C.V	90% C.V
R = 0	r>= 1	22.8361	20.1800	17.8800	R = 0	r>= 1	20.5994	20.1800	17.8800
R<= 1	r = 2	7.0923	9.1600	7.5300	R<= 1	r = 2	6.5917	9.1600	7.5300

Table F4: Estimated cointegrated vectors in Johansen estimation cointegration with restricted intercepts and no trends in the VAR

Vector	LNTE	LOVER(ma)	Intercept
β	-1.000000	5.6711	1.1938
α		-	-
		LOVER(hp)	Intercept
β	-1.0000	-7.2596	-1.6526
α	0.102	-	-

Table F5: Ordinary least squares estimation of over-parameterized Model (HP)

Dependent variable is DNT

17 observations used for estimation from 1983 to 1999

Regressor	Coefficient	Standard error	T-ratio[Prob]
INPT	0.52487	0.23213	2.2612 (.045)
DNT(-1)	0.46660	0.23773	-1.9627 (.075)
DNT(-2)	0.55844	0.32363	-1.7256 (.112)
DHP(-1)	-4.8434	2.5958	-1.8658 (.089)
DHP(-2)	2.3976	1.7727	1.3525 (.203)
ECM2(-3)	0.10208	0.23152	0.44091(.668)

R-squared	0.46272	R-bar-squared	0.21851
S.E. of regression	0.85372	F-stat. F(5, 11)	1.8947 (.175)
Mean of dependent variable	0.26467	S.D. of dependent variable	0.96572
Residual sum of squares	8.0172	Equation log-likelihood	-17.7332
Akaike Info. criterion	-23.7332	Schwarz Bayesian criterion	-26.2328
DW-statistic	1.6885		

Diagnostic tests

* Test Statistics	* LM Version	* F Version
* A: Serial correlation	*CHSQ (1)= 0.36405 (.546)	*F(1,10)= 0.21883 (.650)
* B: Functional form	*CHSQ (1)= 3.3530 (.067)	*F(1,10)= 2.4570 (.148)
* C: Normality	*CHSQ (2)= 1.7471 (.417)	* Not applicable
* D: Heteroscedasticity	*CHSQ (1)= 0.23669 (.627)	*F(1,15)= 0.21180 (.652)

Table F6: Variable deletion test (OLS case) and ordinary least squares estimation - HP

Dependent variable is DNT

List of the variables deleted from the regression:

DHP(-2) ECM2(-3)

17 observations used for estimation from 1983 to 1999

Regressor	Coefficient	Standard Error	T-ratio [Prob]
INPT	0.43709	0.22058	1.9815 (.069)
DNT(-1)	-0.47696	0.23388	-2.0393 (.062)
DNT(-2)	-0.57230	0.26610	-2.1507 (.051)
DHP(-1)	-3.9094	1.6270	-2.4028 (.032)

Joint test of zero restrictions on the coefficients of deleted variables:

Lagrange multiplier statistic	CHSQ (2) = 2.4908 (.288)
Likelihood ratio statistic	CHSQ (2) = 2.6933 (.260)

Table F7: Ordinary least squares estimation with over-valuation under MA method

Dependent variable is DNT

17 observations used for estimation from 1983 to 1999

Regressor	Coefficient	Standard error	T-ratio [Prob]
INPT	0.35079	0.24706	1.4198 (0.181)
DNT(-1)	-0.37425	0.24447	-1.5309 (0.152)
DNT(-2)	-0.42294	0.26471	-1.5977 (0.136)
DMA(-1)	-3.7375	2.0915	-1.7870 (0.099)
DMA(-2)	-0.38659	1.7986	0.21494(0.833)

Diagnostic tests

* Test statistics	* LM version	* F version
* A: Serial correlation	* CHSQ(1)= 2.7485[0.097]	* F(1,11)= 2.1214[0.173]
* B: Functional form	* CHSQ(1)= 0.85294[0.356]	* F(1,11)= 0.58106[0.462]
* C: Normality	* CHSQ(2)= 0.12499[0.939]	* Not applicable
* D: Heteroscedasticity	* CHSQ(1)= 0.10728[0.743]	* F(1,15)= 0.095261[0.762]

Table F8: Variable deletion test (OLS case) and ordinary least squares estimation - MA

Dependent variable is DNT

List of the variables deleted from the regression: DMA(-2)

17 observations used for estimation from 1983 to 1999

Regressor	Coefficient	Standard Error	T-ratio[Prob]
INPT	0.36394	0.23043	1.5794 (0.138)
DNT(-1)	0.36946	0.23435	-1.5765 (0.139)
DNT(-2)	0.42165	0.25475	-1.6551 (0.122)
DMA(-1)	-3.8415	1.9587	-1.9612 (0.072)

Joint test of zero restrictions on the coefficients of deleted variables:

Lagrange multiplier statistic	CHSQ(1)= 0.065199 (.798)
Likelihood ratio statistic	CHSQ(1)= 0.065324 (.798)
F statistic	F(1,12) = 0.046200 (.833)

R-squared	0.29848	R-Bar-Squared	0.13660
S.E. of regression	0.89735	F-stat. F(3,13)	1.8438 (0.189)
Mean of dependent variable	0.26467	S.D. of dependent variable	0.96572
Residual sum of squares	10.4680	Equation log-likelihood	-20.0004
Akaike info. criterion	-24.0004	Schwarz Bayesian criterion	-25.6668
DW-statistic	1.4041		

For all diagnostics, the following signs stand for:

- A: Lagrange multiplier test of residual serial correlation
- B: Ramsey's RESET test using the square of the fitted values
- C: Based on a test of skewness and kurtosis of residuals
- D: Based on the regression of squared residuals on squared fitted values

Other recent publications in the AERC Research Papers Series:

- The Behaviour of Income Velocity in Tanzania 1967-1994*, by Michael O.A. Ndanshau, Research Paper 50.
- Consequences and Limitations of Recent Fiscal Policy in Côte d'Ivoire*, by Kouassy Oussou and Bohoun Bouabre, Research Paper 51.
- Effects of Inflation on Ivorian Fiscal Variables: An Econometric Investigation*, by Eugene Kouassi, Research Paper 52.
- European Economic Integration and the Franc Zone: The Future of the CFA Franc after 1999, Part II*, by Allechi M'Bet and Niamkey A. Madeleine, Research Paper 53.
- Exchange Rate Policy and Economic Reform in Ethiopia*, by Asmerom Kidane, Research Paper 54.
- The Nigerian Foreign Exchange Market: Possibilities For Convergence in Exchange Rates*, by P. Kassey Garba, Research Paper 55.
- Mobilizing Domestic Resources for Economic Development in Nigeria: The Role of the Capital Market*, by Fidelis O. Ogwumike and Davidson A. Omole, Research Paper 56.
- Policy Modelling in Agriculture: Testing the Response of Agriculture to Adjustment Policies in Nigeria*, by Mike Kwanashie, Abdul-Ganiyu Garba and Isaac Ajilima, Research Paper 57.
- Price and Exchange Rate Dynamics in Kenya: An Empirical Investigation (1970-1993)*, by Njuguna S. Ndung'u, Research Paper 58.
- Exchange Rate Policy and Inflation: The case of Uganda*, by Barbara Mbire, Research Paper 59.
- Institutional, Traditional and Asset Pricing Characteristics of African Emerging Capital Markets*, by Ino L. Inanga and Chidozie Emenuga, Research Paper 60.
- Foreign Aid and Economic Performance in Tanzania*, by Timothy S. Nyoni, Research Paper 61.
- Public Spending, Taxation and Deficits: What is the Tanzanian Evidence?* by Nehemiah Osoro, Research Paper 62.
- Adjustment Programmes and Agricultural Incentives in Sudan: A Comparative Study*, by Nasredin A. Hag Elamin and Elsheikh M. El Mak, Research Paper 63.
- Intra-industry Trade between Members of the PTA/COMESA Regional Trading Arrangement*, by Flora Mndeme Musonda, Research Paper 64.
- Fiscal Operations, Money Supply and Inflation in Tanzania*, by A.A.L. Kilindo, Research Paper 65.
- Growth and Foreign Debt: The Ugandan Experience*, by Barbara Mbire, Research Paper 66.
- Productivity of the Nigerian Tax System: 1970-1990*, by Ademola Ariyo, Research Paper 67.
- Potentials for Diversifying Nigeria's Non-oil Exports to Non-traditional Markets*, by A. Osuntogun, C.C. Edordu and B.O. Oramah, Research Paper 68.
- Empirical Studies of Nigeria's Foreign Exchange Parallel Market II: Speculative Efficiency and Noisy Trading*, by Melvin Ayogu, Research Paper 69.
- Effects of Budget Deficits on the Current Account Balance in Nigeria: A Simulation Exercise*, by Festus O. Egwaikhide, Research Paper 70.
- Bank Performance and Supervision in Nigeria: Analysing the Transition to a Deregulated Economy*, by O.O. Sobodu and P.O. Akiode, Research Paper 71.
- Financial Sector Reforms and Interest Rate Liberalization: The Kenya Experience* by R.W. Ngugi and J.W. Kabubo, Research Paper 72.
- Local Government Fiscal Operations in Nigeria*, by Akpan H. Ekpo and John E.U. Ndebbio, Research Paper 73.
- Tax Reform and Revenue Productivity in Ghana*, by Newman Kwadwo Kusi, Research Paper 74.
- Fiscal and Monetary Burden of Tanzania's Corporate Bodies: The Case of Public Enterprises*, by H.P.B. Moshi, Research Paper 75.
- Analysis of Factors Affecting the Development of an Emerging Capital Market: The Case of the Ghana Stock Market*, by Kofi A. Osei, Research Paper 76.
- Ghana: Monetary Targeting and Economic Development*, by Cletus K. Dordunoo and Alex Donkor, Research Paper 77.
- The Nigerian Economy: Response of Agriculture to Adjustment Policies*, by Mike Kwanashie, Isaac Ajilima and Abdul-Ganiyu Garba, Research Paper 78.

Agricultural Credit Under Economic Liberalization and Islamization in Sudan, by Adam B. Elhiraika and Sayed A. Ahmed, Research Paper 79.

Study of Data Collection Procedures, by Ademola Ariyo and Adebisi Adeniran, Research Paper 80.

Tax Reform and Tax Yield in Malawi, by C. Chipeta, Research Paper 81.

Real Exchange Rate Movements and Export Growth: Nigeria, 1960-1990, by Oluremi Ogun, Research Paper 82.

Macroeconomic Implications of Demographic Changes in Kenya, by Gabriel N. Kirori and Jamshed Ali, Research Paper 83.

An Empirical Evaluation of Trade Potential in the Economic Community of West African States, by E. Olawale Ogunkola, Research Paper 84.

Cameroon's Fiscal Policy and Economic Growth, by Aloysius Ajab Amin, Research Paper 85.

Economic Liberalization and Privatization of Agricultural Marketing and Input Supply in Tanzania: A Case Study of Cashewnuts, by Ngila Mwase, Research Paper 86.

Price, Exchange Rate Volatility and Nigeria's Agricultural Trade Flows: A Dynamic Analysis, by A.A. Adubi and F. Okunmadewa, Research Paper 87.

The Impact of Interest Rate Liberalization on the Corporate Financing Strategies of Quoted Companies in Nigeria, by Davidson A. Omole and Gabriel O. Falokun, Research Paper 88.

The Impact of Government Policy on Macroeconomic Variables, by H.P.B. Moshi and A.A.L. Kilindo, Research Paper 89.

External Debt and Economic Growth in Sub-Saharan African Countries: An Econometric Study, by Milton A. Iyoha, Research Paper 90.

Determinants of Imports In Nigeria: A Dynamic Specification, by Festus O. Egwaikhide, Research Paper 91.

Macroeconomic Effects of VAT in Nigeria: A Computable General Equilibrium Analysis, by Prof. D. Olu Ajakaiye, Research Paper 92.

Exchange Rate Policy and Price Determination in Botswana, by Jacob K. Atta, Keith R. Jefferis, Ita Mannathoko and Pelani Siwawa-Ndai, Research Paper 93.

Monetary and Exchange Rate Policy in Kenya, by Njuguna S. Ndung'u, Research Paper 94.

Health Seeking Behaviour in the Reform Process for Rural Households: The Case of Mwea Division, Kirinyaga District, Kenya, by Rose Ngugi, Research Paper 95.

Trade Liberalization and Economic Performance of Cameroon and Gabon, by Ernest Bamou, Research Paper 97.

Quality Jobs or Mass Employment, by Kwabia Boateng, Research Paper 98.

Real Exchange Rate Price and Agricultural Supply Response in Ethiopia: The Case of Perennial Crops, by Asmerom Kidane, Research Paper 99.

Determinants of Private Investment Behaviour in Ghana, by Yaw Asante, Research Paper 100.

An Analysis of the Implementation and Stability of Nigerian Agricultural Policies, 1970-1993, by P. Kassey Garba, Research Paper 101.

Poverty, Growth and Inequality in Nigeria: A Case Study, by Ben E. Aigbokhan, Research Paper 102.

Effect of Export Earnings Fluctuations on Capital Formation, by Godwin Akpokodje, Research Paper 103.

Nigeria: Towards an Optimal Macroeconomic Management of Public Capital, by Melvin D. Ayogu, Research Paper 104.

International Stock Market Linkages in South Africa, by K.R. Jefferies, C.C. Okeahalam, and T.T. Matome, Research Paper 105.

An Empirical Analysis of Interest Rate Spread in Kenya, by Rose W. Ngugi, Research Paper 106.

The Parallel Foreign Exchange Market and Macroeconomic Performance in Ethiopia, by Derrese Degefa, Research Paper 107.

Poverty, Growth and Inequality in Nigeria: A Case Study, by Ben E. Aigbokhan, Research Paper 102.

Market Structure, Liberalization and Performance in the Malawi Banking Industry, by Ephraim W. Chirwa, Research Paper 108.

Liberalization of the Foreign Exchange Market in Kenya and the Short-term Capital Flows Problem, by Njuguna S. Ndung'u, Research Paper 109.

- External Aid Inflows and the Real Exchange Rate in Ghana*, by Harry A. Sackey, Research Paper 110.
- Formal and Informal Institutions' Lending Policies and Access to Credit by Small-Scale Enterprises in Kenya: An Empirical Assessment*, by Rosemary Atieno, Research Paper 111.
- Financial Sector Reform Macroeconomic Instability and the Order of Economic Liberalization: The Evidence from Nigeria*, by Sylvanus I. Ikhinda and Abayomi A. Alawode, Research Paper 112.
- The Second Economy and Tax Yield in Malawi*, by C. Chipeta, Research Paper 113.
- Promoting Export Diversification in Cameroon: Toward Which Products?* by Lydie T. Bamou, Research Paper 114.
- Asset Pricing and Information Efficiency of the Ghana Stock Market*, by Kofi A. Osei, Research Paper 115.
- An Examination of the Sources of Economic Growth In Cameroon*, by Aloysius Ajab Amin, Research Paper 116.
- Trade Liberalization and Technology Acquisition in the Manufacturing Sector: Evidence from Nigeria*, by Ayonrinde Folasade, Research Paper 117.
- Total Factor Productivity in Kenya: The Links with Trade Policy*, by Joseph Onjala, Research Paper 118.
- Kenya Airways: A Case Study of Privatization*, by Samuel Oyieke, Research Paper 119.
- Determinants of Agricultural Exports: The Case of Cameroon*, by Daniel Gbetnkon and Sunday A. Khan, Research Paper 120.
- Macroeconomic Modelling and Economic Growth: An Analysis for Kenya*, by Jan Kabubo-Mariara and Tabitha W. Kiriti, Research Paper 121
- Determinants of Regional Poverty in Uganda*, by Francis Okurut, Jonathan Odwee, Asaf Adebua, Research Paper 122
- Exchange Rate Policy and the Parallel Market for Foreign Currency in Burundi*, by Janvier D Nkurunziza, Research Paper 123.
- Structural Adjustment, Poverty and Economic Growth: An Analysis for Kenya*, by Jane Kabubo-Mariara and Tabitha W. Kiriti, Research Paper 124.
- Liberalization and Implicit Government Finances in Sierra Leone*, by Victor A.B. Davis, Research Paper 125.
- Productivity, Market Structure and Trade Liberalization in Nigeria*, by Adeola F. Adenikinju and Louis N. Chete, Research Paper 126.
- Productivity Growth in Nigerian Manufacturing and its Correlation to Trade Policy Regimes/Indexes (1962–1985)*, by Louis N. Chete and Adeola F. Adenikinju, Research Paper 127.
- Financial Liberalization and its Implications for the Domestic Financial System: The Case of Uganda*, by Louis A. Kasekende and Michael Atingi-Ego, Research Paper 128.
- Public Enterprise Reform in Nigeria: Evidence from the Telecommunications Industry*, by Afeikhen Jerome, Research Paper 129.
- Food Security and Child Nutrition Status among Urban Poor Households in Uganda: Implications for Poverty Alleviation*, by Sarah Nakabo-Sswanyana, Research Paper 130.
- Tax Reforms and Revenue Mobilization in Kenya*, by Moses Kinyanjui Muriithi and Eliud Dismas Moyi, Research Paper 131.
- Wage Determination and the Gender Wage Gap in Kenya: Any Evidence of Gender Discrimination?* by Jane Kabubo-Mariara, Research Paper 132.
- Trade Reform and Efficiency in Cameroon's Manufacturing Industries*, by Ousmanou Njika, Research Paper 133.
- Efficiency of Micro-Enterprises in the Nigerian Economy*, by Igbekele A. Ajibefun and Adebisi G. Daramola, Research Paper 134.
- The Impact of Foreign Aid on Public Expenditure: The Case of Kenya*, by James Njeru, Research Paper 135.
- The Effects of Trade Liberalization on Productive Efficiency: Some Evidence from the Electrical Industry in Cameroon*, by Ousmanou Njikam, Research Paper 136.
- How Tied Aid Affects the Cost of Aid Funded Projects in Ghana*, by Barfour Osei, Research Paper 137.
- Exchange Rate Regimes and Inflation in Tanzania*, by Longinus Rutasitara, Research Papers 138.
- Private Returns to Higher Education in Nigeria*, by O.B.Okuwa, Research Paper 139