External aid inflows and the real exchange rate in Ghana

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Abstract

This paper develops an empirical model for Ghana's real exchange rate with special focus on foreign aid. The novelty of this study is the interfacing of exports with a policy environment, using aid as proxy, to see how it affects export performance. The paper finds that although aid dependence is quite high, aid inflows lead to depreciations in the real exchange rate. Aid inflows have also had a positive impact on export performance. The paper concludes that for external aid to be an effective investment, policy management needs to focus on ensuring the prevalence of sound macroeconomic fundamentals, among others.

1. Introduction

The Ghanaian economy, with support from the World Bank and International Monetary Fund (IMF), has since September 1980 witnessed the introduction of mechanisms to halt the downturn of the economy and to move on a path of sustained growth and development. This change elicited tremendous donor assistance in the form of grants, concessional loans and technical assistance. Net official development assistance (ODA), which constituted about 4% of GDP in 1980, rose to 10% in 1990 and has been in that neighbourhood ever since. The overwhelming dependence on external aid inflows from developed countries for the supply of basic import commodities has made the Ghanaian economy vulnerable to policy conditionality that might accompany such assistance (Loxley, 1998).

Depending on whether these aid inflows have been temporary or permanent, and whether they were spent on imports or domestically produced goods and services, they have had various repercussions. Throughout the economic adjustment agenda, exchange rate and trade reform occupied a core position. The real exchange rate, by virtue of its impact on the international competitiveness of an economy, assumed an overriding importance among the cohort of policy variables.

Surges in external aid inflows are believed to be causing "Dutch disease" problems for the macroeconomic management of the Ghanaian economy. The management of aid has been characterized by a combination of foreign exchange accumulation (both building reserves and eliminating arrears), credit to the banking system, and increased public spending especially on development projects. Efforts to maintain the real exchange rate in an era of increased aid inflows have kept inflation high (Younger, 1992). Yet, arguably, in the absence of aid inflows Ghana's growth and development efforts would have been stifled.

This paper, in broad terms, seeks to develop an empirical model for the real exchange rate in Ghana with special focus on the role of foreign aid. The paper then attempts to link this with an export performance model in order to identify policy implications and management issues. Generally, it is hypothesized, first, that external aid inflows to Ghana result in real exchange rate appreciations, and second, that exports respond positively to a good policy environment.

There are five main sections to this paper. This introductory section provides some reflections on the Ghanaian economy and the general orientation of the paper. In Section 2, issues pertaining to theoretical and empirical literature on aid and real exchange rate are addressed. Section 3 deals with an analysis of performance trends in external aid inflows and exchange rate, aid dependency, and real exchange rate misalignment in Ghana. Empirical aspects of the paper are dealt with in Section 4. The final section of the paper is devoted to conclusions and policy implications.

2. Survey of the literature

There is a substantial amount of literature on the macroeconomics of aid. In the orthodox macroeconomics of aid literature, major themes covered include the two-gap model; aid and growth; aid, investment and imports; and the savings debate. The discussions of the two-gap model focus on the complementarity of aid. Griffin (1970), for example, stresses that whenever there is a foreign exchange gap, growth would be impaired unless the gap is filled by foreign aid. Chenery and Strout (1966) argue that aid's impact on income depends on the regime facing the recipient economy, and that under a binding trade gap, marginal productivity of aid is higher. Edwards and van Wijnbergen (1989) have criticized applications of the two-gap model on the grounds that it ignores relative prices, and thus turns the focus away from the real exchange rate as the crucial variable influencing the effectiveness of aid.

In the new macroeconomics of aid, however, authors like Loxley (1998) point to the quality of assistance and direction of aid, Mosley (1987) to aid effectiveness, Mutasa and White (1993) to aid dependence, White (1992a) to the macroeconomic impact of development aid, and White (1992b) to the link between aid and economic growth through investment. Others, such as Edwards and van Wijnbergen (1989), Vos (1989), and Younger (1992), have focused on aid as causing Dutch disease. Morrisey (1992) has argued that the link between aid and growth is indirect and that aid affects the (real) exchange rate, which in turn may constrain any beneficial impact on the growth rate. From a structural adjustment and macroeconomic perspective, Edwards and van Wijnbergen (1989) have stressed the similarity between increased income from natural resources and aid inflows by indicating that both come in the form of additional foreign exchange and when spent on non-traded goods put pressure on the real exchange rate.

White (1992a) points out that aid will lead to real exchange rate appreciation so long as part of the aid inflows is spent on non-traded goods. The upward pressure on the real exchange rate is greater, the higher is the marginal propensity to spend on traded goods; the lower is the responsiveness of supply of non-traded goods; and the higher is the responsiveness of demand to price changes. The impact of previous aid inflows is that the real exchange rate has to depreciate when aid flows cease (White, 1992c). On his part, Vos (1993) indicates that if the aid boom is temporary, there may be an inclination to consume the additional wealth or accumulate reserves to safeguard the economy against future losses. Where aid is of a permanent nature, the rational choice would seem to be to invest the "windfall gain" in order to maximize future consumption.

Analysing the macroeconomic aspects of the effectiveness of foreign aid, van Wijnbergen (1986) points out that temporary aid flows will lead to temporary appreciation

of the real exchange rate and will lead to a decline in the production of traded goods as well as exports. Collier and Gunning (1992), on the other hand, writing on aid and exchange rate adjustment in African trade liberalizations, note that the basic goal for liberalization is export promotion. In a simple exchange-rate-only model, a higher export price is the only effect of liberalization. Aid-only liberalizations, although technically feasible, produce perverse resource shifts and require massive rapid nominal wage flexibility to avoid unemployment.

Within the context of the Ghanaian economy, empirical studies on various facets of aid and real exchange rate have been undertaken. Younger (1992) in his article on aid and Dutch disease drew attention to the macroeconomic problems confronting the Ghanaian authorities as a result of massive aid inflows. He noted that these inflows have sometimes worked at cross purposes with both stabilization and structural adjustment objectives. Jebuni et al. (1991), on the other hand, observed that in Ghana, liberalization with a real depreciation of the exchange rate was more prone to result in improved export performance. Asea and Reinhart (1996) found that failure to deal appropriately with the heavy capital inflows could derail the significant structural reform programme that had been undertaken.

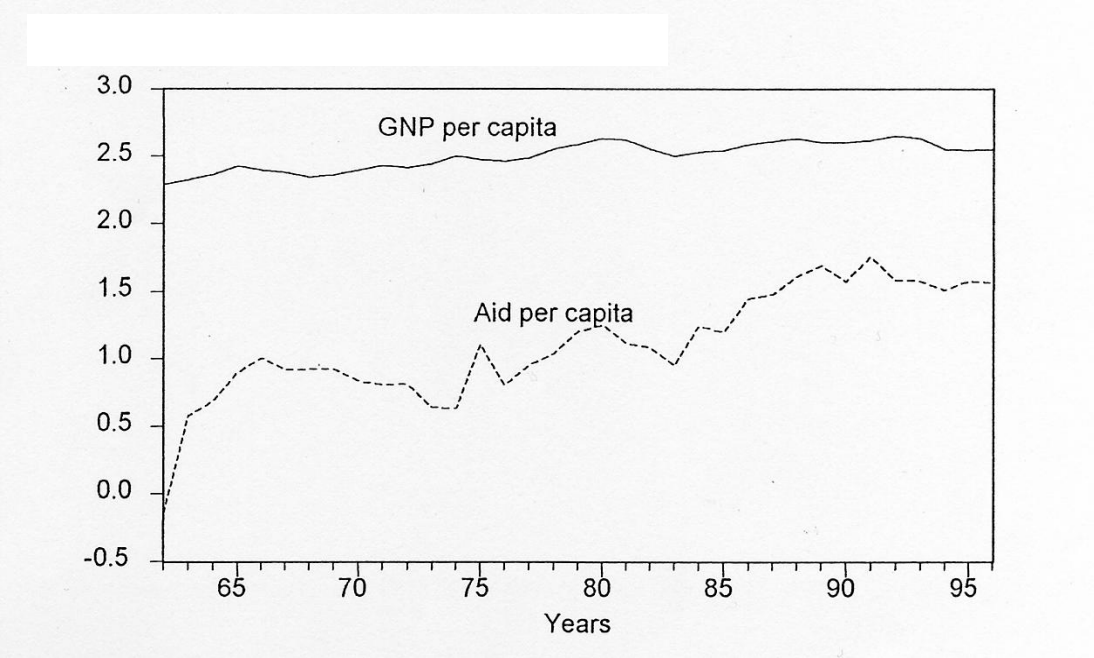
This study adds to existing works on the real exchange rate in Ghana in a unique way. In most Dutch disease empirical literature, especially on developing economies in sub-Saharan Africa, export contractions are only casually touched upon as off-shoot problems without systematically estimating the relationship between export performance and the real exchange rate. This study fills this gap by considering how exports interface with the policy environment. In fact, it attempts to see whether external aid, serving as a proxy for the policy environment, elicits positive macroeconomic performance from such variables as exports.

3. Stylized facts on aid and the real exchange rate in Ghana

The Ghanaian economy: Some reflections

Ghana's foreign aid per capita, which was about US$7 in 1970, increased to US$18 in 1980 and then further to US$33 in 1990; by 1996 it had reached US$37. Generally, aid inflows to the economy have been far from stable, as both negative and positive fluctuations have been registered. In recent times, however, aid per capita has constituted about one-tenth of Ghana's GNP per capita. This contrasts sharply with the 1970s, when it was about 3% of GNP per capita. Figure 1 captures the logarithmic trend in aid and GNP per capita in Ghana.

Figure 1: Aid and GNP per capita (in log values)



Since the commencement of the reforms, economic performance has generally been encouraging, discounting for some few slippages. Real GDP growth has been around 5% on an annual basis. Structural transformation appears to be taking place in the Ghanaian economy. The broad structure of the economy in terms of sector contribution to GDP, which had agriculture as the leading sector contributing no less than 45% of economic output, has been altered. In relative terms there has been a decline in agriculture, while an increase in service sector activity is pervading the production structure of the economy (about 50%). Growth in the economy is now service-sector driven, which to a large extent is evidence of Dutch disease.

However, the service sector, which is dominated by the wholesale and retailing subsector, is to a large measure a non-tradeable sector. Hence, the spending effect of increased aid inflows to the economy is likely to cause price increases in this sector that will invariably spill over to the other sectors as well. It is no surprise that government is still grappling with inflation. With the services sector being low on the extent of tradeability, such inflationary tendencies have had a potential appreciating effect on the real exchange rate. However, through nominal devaluations, often in excess of the rate of inflation, government has prevented the real exchange rate from appreciating. The industrial sector still appears to be struggling to make an imprint on the economy. Perhaps the appropriate incentive structure and conducive environment have still not been created for enhanced performance from industry.

In Ghana's search for economic renewal, accelerated growth and poverty reduction, the real exchange rate and its interplay with external aid inflows have been crucial for purposes of strategic economic decision making and efficient policy management. External aid inflows continue to play a tremendous role in Ghana’s development efforts.

External aid performance and real exchange rate trends

Historically, receipts of external aid inflows have been a common feature of theGhanaian economy. In real terms net ODA dropped to US$187 million in 1980 from an initial level of US$223 million in 1970. This declining pattern continued through 1983. These were periods when foreign aid from a global perspective declined sharply and aid was withdrawn in some cases following the debt crisis. Since 1984 aid inflows have generally followed an upward trend, and by1996 real net aid inflows had reached US$572 million. Japan, UK, USA, Canada, Germany and the Netherlands constitute Ghana’s major bilateral donors. Among the multilateral donors, the International Development Association (IDA) predominates. Aid to the Ghanaian economy is multi-purposed. Table 1 captures donor intentions.

Aid distribution in Ghana in terms of broad categorization shows that in the 1980s commitments to the production sectors of the economy (defined specifically in this context as agriculture, industry, mining, construction, trade, tourism and banking) benefited most, receiving an average of 29%. Programme assistance was to the tune of 21%.

Table 1: Distribution/purpose of aid commitments to Ghana (in percentages)

Distribution/purpose	1984-89	1991-96
1. Social infrastructure and services	8.8	28.0
2. Economic infrastructure and services	25.0	34.5
3. Production sectors	29.3	14.5
4. Multi-sector	1.5	3.7
5. Programme assistance	20.7	15.7
6. Food aid	5.5	3.8
7. Debt reorganization	0.8	3.1

Source: Author's calculation based on data from OECD's *Geographical Distribution of Financial Flows to Developing Countries*, various issues.

On the issue of infrastructural development, economic infrastructure (i.e., energy, transport and communication) had an edge over social infrastructure (i.e., education, health, water supply and sanitation), being perceived as basic to all forms of development, and attracting average shares of 25% and 9%, respectively. In terms of ranking, there has not been any change in donor priority for food aid, multi-sector aid and debt reorganization for Ghana as they occupy the same ranks in both the 1980s and the 1990s (i.e., 5, 6, and 7, respectively). The relatively large commitments of aid to economic and social infrastructure in the 1990s conform to the general global consensus and World Bank position that infrastructural development is a prerequisite to socioeconomic development.

Actual disbursements of aid have in the past been known to be very slow, and often less than initial expectations. Between 1983 and 1988, the actual disbursement ratio of programme aid was 43%, while that for project aid was only 35%. Reasons accounting for these included structure of commitments, delays in commitment translation, and implementational problems of both donors and recipient. As the structure of aid commitment gets skewed towards project aid as opposed to quick disbursing programmes, as well as food and commodity assistance, the tempo of actual disbursements is reduced. The cumbersome nature of procedures especially for procurement also tends to contribute to slow disbursements of multilateral aid.[1] An insight into Ghana's predominant multilateral donor's (i.e., the IDA) project aid profile, highlighting the number of projects, amount involved and non-disbursements is given in Table 2.

Table 2 confirms the generally slow disbursements of project aid to the economy. In recent times, however, there has been an increase in the disbursement ratio for both programme and project aid. Actual disbursement of programme aid was 91% (i.e., US$183.6 million) of the revised commitments, while that for project aid was 58% (i.e., US$454.3 million) of pledged commitments.

For the period under consideration both the real exchange rate and real effective exchange rates tended to move in the same direction, with the latter lagging slightly behind. The real exchange rate provides a measure of the relative price of domestic (i.e., Ghanaian) goods in terms of foreign (i.e., US) goods. The real effective exchange rate, also regarded as the multilateral real exchange rate, provides a measure of the degree of competitiveness of a country relative to a group of its partners (Edwards, 1989). Here, it compares movement in Ghana's domestic currency with those in a basket of trading partners' currencies (UK, US, Germany, France, Italy, Japan, Netherlands).

Table 2: IDA project credits to Ghana, 1988–1996

Year	No. of projects	Original credit (US$ million)	Undisbursed (US$ million)	Undisbursed ratio (%)
1988	1	40.0	4.89	12.2
1989	3	94.4	12.49	13.2
1990	3	130.0	43.82	33.7
1991	5	176.5	53.21	30.1
1992	4	202.8	83.56	41.2
1993	7	347.85	238.97	68.7
1994	3	81.96	75.93	92.6
1995	6	289.5	239.76	82.8
1996*	5	271.35	269.1	99.2
Total	37	1,634.36	1,021.73	62.5

Note: * Data provided is as of 9 June 1996.
Source: Author's calculations based on World Bank data.

The real exchange rate changed over time depending on whether inflation was more or less rapid in Ghana than in the USA (or in the economies of Ghana's major trading partners in the case of the real effective exchange rate). Relative to the base year value, both real exchange rate indexes rose from 1970 to 1976 (i.e., depreciated), declined from 1977 to 1983 (i.e., appreciated) and generally followed an upward trend thereafter (i.e., depreciated). As observed by Loxley (1988), from 1977 onward, the failure to adjust the official exchange rate in line with the deteriorating relative price situation strongly appreciated the real exchange rate and led to the emergence of a flourishing black market. The appreciation of the real exchange rate also shifted relative incentives away from exports into import trade with adverse effects for Ghana's current account balance. Since the mid 1980s, however, there has been a trend towards exchange rate depreciation.

Movements in the real exchange rate index are the result of changes in the nominal exchange rate index and the difference between Ghana's and foreign inflation rates. In terms of annual changes, Ghana's real exchange rate falls or rises whenever there is a change in the nominal exchange rate that is lower or higher than the difference between inflation rates across trading partners. With the exception of five years in the 1970s, three years in the 1980s and three years in the 1990s, real depreciation of the cedi occurred and in some cases (such as in 1984) was about 198%. The extent of fluctuations in the real exchange rate for the domestic currency accentuates its unstable nature. This in turn could be explained by government's continued inability to bring inflation under control.

Aid dependence and exchange rate misalignment

The notion of aid dependence has been used in both quantitative and qualitative senses. In the case of the former, it has been used to connote receipt of large flows of external aid, while in the latter it entails an insignificant contribution towards self-sustaining development in spite of continuous aid provision (Lancaster and Wangwe, 1998). To a

large extent aid dependence in the context of any given country could be perceived as a situation in which the country becomes overly dependent on aid for its survival.

The Ghanaian economy exhibits rather high aid dependence. The intensity of aid, which is a crucial element in aid dependence analysis, is quite high for the economy (refer to Table 3). In terms of selected aid intensity indicators it can be seen that external aid inflows relative to GDP, imports, government expenditures and domestic investment are on the higher side. The aid–GDP share, which was about 3% in the 1970s, has moved close to 11% in the 1990s; aid–imports share from 15% to 43%; aid–government expenditure share from 12% to 55%; and aid–investment share from 21% to 61%. The length of time during which high levels of aid have been provided (which is another element in aid intensity consideration) is also quite long (i.e., no less than nine years). This also buttresses the high aid intensity situation, and hence the high aid dependence.

In light of typical Dutch disease issues, one may ask the implications of these inflows for the real exchange rate and particularly its becoming misaligned as a result of excessive external aid inflows. Real exchange rate misalignment as defined by Edwards (1989) refers to a situation where the real exchange rate diverges from its long-run equilibrium, though the equilibrium rate is not observed. Ghana's real exchange rate has been noted for being misaligned virtually throughout its development history. Various studies have come out with varying degrees of misalignment. For instance, Ghura and Grennes (1994) give Ghana's real exchange rate misalignment for 1972–1987 as about 247%, on average. This study, using the black market premium as the gauge for misalignment, puts the misalignment index in the neighbourhood of 400% for the same period. It must be noted that the misalignment index is sensitive to the choice of method for computation, among others. Notwithstanding these differences in the magnitude of misalignment, a common portrait emerges from all the studies on the pattern of misalignment.

Table 3: Aid intensity indicators in Ghana (in percentages)

	Aid/GDP	Aid/Imports	Aid/Govt. Expen.	Aid/Investment
1971-1979	2.79	14.81	12.32	21.35
1980-1984	3.76	24.46	33.48	40.30
1985-1989	8.78	51.08	62.74	74.08
1990	9.57	46.92	73.58	62.03
1991	13.37	67.18	102.81	76.86
1992	9.55	42.02	59.66	54.66
1993	10.92	35.78	57.47	57.38
1994	10.56	34.63	48.00	66.42
1995	10.57	38.73	48.06	56.84
1996	10.30	33.73	44.80	55.10

Source: Author's calculations based on data from OECD's *Geographical Distribution of Financial Flows to Developing Countries,* World Bank's *World Tables* and *African Development Indicators,* and Ghana Statistical Services' *Quarterly Digest of Statistics*, various issues.

First, Ghana's real exchange rate has generally been over-valued. Second, the extent of misalignment was relatively higher before the structural adjustment period. Third,

since the inception of the SAP there has been a tendency for the official rate to move closer to the parallel market rate (the latter reflected in the foreign exchange bureau rates). Thus, a relatively small misalignment, generally not above 10%, has prevailed in the 1990s.

4. Empirical estimation

Models and technique for estimation

In estimating the impact of external aid inflows on the real exchange rate, the model of real exchange rate determination will be established. The equilibrium real exchange rate can be conceived of as the relative price of tradeables to non-tradeables compatible with the attainment of internal and external equilibrium. Internal equilibrium presupposes that the market for non-tradeables clears in the current period and is envisaged to be so in the future. External equilibrium implies that the current account balances both in current and future periods are compatible with long-run sustainable capital flows (Elbadawi, 1994).

On the basis of the works of Nyoni (1997) and Abuka and Sajjabi (1996), and as observed by Edwards (1989), the dynamics of the behaviour of the real exchange rate are given by Equation 1 as follows:

$$LogRER_t = [\beta(LogRER_t^* - LogRER_{t-1}) - \tau(MAC_t^*) +$$

$$\alpha(LogNER_t - LogNER_{t-1})] \qquad (1)$$

where

$LogRER_t^* - LogRER_{t-1}$	= deviation of the actual real exchange rate from its equilibrium level
$MAC_t - MAC_t^*$	= inconsistency in the macroeconomic policy framework
$LogNER_t - LogNER_{t-1}$	= nominal exchange rate devaluation
β, τ, α	= positive parameters capturing vital aspects of the adjustment process

Equation 2 gives an indication of the main fundamentals that influence the behaviour of the equilibrium real exchange rate:

$$LogRER_t^* = \beta_0 + \beta_1 \log(TOT)_t + \beta_2 \log(AID)_T + \beta_3 \log(GCN)_t +$$

$$\beta_4 \log(CPS)_t + \beta_5 \log(TEP)_t + u_t \quad (2)$$

where

RER^*	=	the equilibrium real exchange rate
TOT	=	external terms of trade
AID	=	external aid inflows (defined as real net ODA to Ghana)
GCN	=	government consumption of non-tradeables (measured by share of government consumption in GDP)
CPS	=	commercial policy stance (using the parallel market premium as proxy)
TEP	=	technological progress (proxied by index of agricultural production)

Replacing the variable RER^*_t in Equation 1 by its fundamentals gives Equation 3, which embodies such short-term variables as nominal exchange rate.

$$LogRER_t = \beta_0 + \beta_1 \log(TOT)_t + \beta_2 \log(AID)_t + \beta_3 \log(GCN)_t +$$

$$\beta_4 \log(CPS)_t + \beta_5 \log(TEP)_t + \beta_6 \Delta(MAC_t - MAC_t^*) +$$

$$\beta_7 \Delta LogNER_t + \beta_8 LogRER_{t-1} + u_t \quad (3)$$

The expected theoretical impacts of the respective fundamentals are as follows:

TOT	(?)	–	Its impact on the *RER* depends on the relative strengths of income and substitution effects. If the income effect associated with a *TOT* deterioration is stronger than the substitution effect, a depreciation of the *RER* will occur.
AID	(-)	–	By increasing real incomes and consequently the demand for both traded and non-traded goods, it tends to cause the *RER* to appreciate.
GCN	(-)	–	Increases in government expenditure on non-tradeables appreciates the *RER*, while those on tradeables causes the *RER* to depreciate.
CPS	(-)	–	Increases in the parallel (or black) market premium tend towards *RER* appreciation.
TEP	(-)	–	Technological progress appreciates the *RER* if gains emanating from productivity enhancement in the tradeable sector override those in the non-tradeable sector.
$MAC_t - MAC_t^*$	(-)	–	Expansionary macroeconomic policy causes an appreciation of the *RER*, other things being equal.
$NER_t - NER_{t-1}$	(+)	–	Nominal devaluation tends to depreciate the *RER*.

Following our definition of the real exchange rate, a negative sign (i.e., -) represents an appreciation of the real exchange rate.

The paper adopts a cointegration technique to examine the aid–real exchange rate relationship using annual time series data for 1962–1996. This technique appears to offer a mechanism for identifying and, consequently, avoiding the spurious regressions so easily specified and accepted with non-stationary series (Engle and Granger, 1987).[2] Cointegrated variables presuppose that a linear combination of their data sets is stationary even though the individual series are non-stationary.

In estimating the relationship between export performance and real exchange rate, an expanded export performance model abstracted from Vos (1993) is used. In this model, and propelled in part by conventional trade theory, growth of real exports (*EXP*) is assumed to be a function of (change in) relative prices (i.e., *RER*), income or rate of output growth of the trading partners (*YTP*), real exchange rate misalignment (*REMIS*), and external aid inflows (*AID*). Thus the export model to be estimated is:

$$LogEXP = f[LogRER, LogYTP, REMIS, LogAID] \quad (4)$$

The expected theoretical impacts are as follows:

RER	(+)	–	Increases in the real exchange rate are expected to result in exports expansion.
YTP	(+)	–	Output growth of trading partners is envisaged to have a positive effect on Ghana's exports.
REM	(-)	–	Real exchange rate misalignment (proxied by parallel market premium) has a disincentive effect on exports and is thus likely to reduce export growth.
AID	(?)	–	A good policy environment (proxied by real net ODA to Ghana) tends to elicit positive response from the export sector. Aid inflows, by providing some sort of assistance to the export sector, tend to encourage export competitiveness and output enhancement.

The export model (Equation 4) shows a linkage with the real exchange rate model through the real exchange rate and aid variables. In addition to the RER effect in the export model, the aid variable permits the analysis of foreign aid on exports. Thus we have the indirect effect of aid on exports through the *RER* and the direct linear effect of the policy environment (captured by the coefficient of *AID*).

Time series examination: Unit roots and Granger causality test

The time series properties of all variables were ascertained prior to estimation. In this connection, tests to detect non-stationarity and determine the order of integration of

the variables in the model as well as tests to determine the causality between the variables were rigorously conducted. Elbadawi and Soto (1995) point out that such tests for non-stationarity also verify whether the series could be represented more appropriately as a difference or trend stationary process. The Augmented Dickey–Fuller (ADF) test for the existence of unit roots was used and the Granger causality test was pursued for determining causality. The causal relationships between the real exchange rate and its determinants were thus examined. Generally, the real exchange rate variable is said to be Granger caused by a specific fundamental, say aid variable, if the current values of the real exchange rate can be predicted with more accuracy through the use of the aid variable's past values. The real exchange rate is regressed on its own lags and that of the fundamental. Feedback effects for mutual causality were checked by running the test in a reverse manner.

The results of the unit root test are presented in Table 4. As is evident from the results, the Augmented Dickey–Fuller tests point to the existence of non-stationarity for the levels of the various variables but these variables become stationary when the first difference is taken.[3]

Table 4: Unit root test for real exchange rate model variables

Variable	Lags	Augmented Dickey–Fuller	Order of integration
LogRER	1	-1.782670	I(1)
ΔLogRER	1	-3.758770	I(0)
LogTOT	1	-2.019038	I(1)
ΔLogTOT	1	-5.805912	I(0)
LogAID	3	-1.890935	I(1)
ΔLogAID	3	-3.805741	I(0)
LogGCN	1	-2.336646	I(1)
ΔLogGCN	1	-4.094197	I(0)
LogCPS	1	-1.388132	I(1)
ΔLogCPS	1	-4.289981	I(0)
LogTEP	1	-2.154584	I(1)
ΔLogTEP	1	-6.404580	I(0)
LogNER	1	0.560687	I(1)
ΔLogNER	1	-3.504976	I(0)

Note: For the ADF test, the MacKinnon critical values for rejection of the null hypothesis of a unit root are -2.9472 at the 5% level and -2.6118 at the 10% level. For the first difference, the critical levels are -2.9499 and -2.6133 at the 5% and 10% significant levels, respectively.

The outcome of the Granger causality test to ascertain the direction of causality between the real exchange rate and its fundamentals is shown in Table 5.[4] Generally, the results are in consonance with the notion of the real exchange rate being caused by the fundamentals. The only exception in Ghana's case was that of government consumption of non-tradeable goods (i.e., GCN), which showed that causality was neither way. However, due to the importance of this variable it was included in the estimation process. This, to some extent, calls for careful interpretation of results from the empirical model.

Table 5: Pairwise Granger causality tests for RER model (Sample: 1962–1996)

Null hypothesis:	Lags	F-Statistic	Probability
AID does not Granger cause RER*	1	5.69731	0.02307
RER does not Granger cause AID		0.40035	0.53141
TOT does not Granger cause RER*	1	4.63051	0.03906
RER does not Granger cause TOT		0.59908	0.44461
CPS does not Granger cause RER*	3	3.41213	0.03159
RER does not Granger cause CPS		0.20646	0.89102
TEP does not Granger cause RER*	2	4.65078	0.01740
RER does not Granger cause TEP		0.77646	0.46906
GCN does not Granger cause RER	3	1.19897	0.32894
RER does not Granger cause GCN		0.12406	0.94508

Note: (*) rejects the null hypothesis at 5%. The choice of the optimal lag length was based on the Schwartz information criterion.

Estimation of empirical model

The results of the Granger causality test (which show that the real exchange rate is generally caused by the fundamentals) and the unit root test allow for the direct estimation of the cointegration regression. The results of the long-run static cointegrated equilibrium model are provided in Table 6. Taken together, these fundamentals explain 92% of the variation in the real exchange rate. The negative parameters on the commercial policy stance, technical progress and government consumption of non-tradeables variables imply a tendency towards real exchange rate appreciation. However, the terms of trade and aid variables exhibit positive coefficients and, therefore, tend to depreciate the real exchange rate. The positive sign on the terms of trade variable implies that the substitution effect associated with such improvements dominates the income effect.

Table 7 shows the results of tests for cointegration on the residuals of the static long-run real exchange rate model. Overall, the results show that the errors in the cointegration regression are stationary as these tests support cointegration. A comparison of the computed Dickey–Fuller and Augmented Dickey–Fuller test results with the critical values of about -2.947 and -2.612 at the 5% and 10% significant levels, respectively, tends to support cointegration between the real exchange rate and its fundamentals. The existence of cointegration is also upheld by the Phillips–Perron test, whose critical values at the 5% and 10% significant levels are -2.945 and -2.611, respectively.

Table 6: Long-run cointegrated equilibrium model results

Dependent variable: LogRER
Method: Least squares
Sample: 1962–1996
Included observations: 35

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.926703	0.623100	4.697003	0.0001
LogTOT	0.604622	0.199083	3.037041	0.0050
LogAID	0.331217	0.076248	4.343969	0.0002
LogGCN	-0.656057	0.201528	-3.255415	0.0029
LogCPS	-0.480067	0.034575	-13.88497	0.0000
LogTEP	-1.349036	0.204858	-6.585242	0.0000

R-squared	0.921089	Mean dependent var	2.447457
Adjusted R-squared	0.907484	S.D. dependent var	0.346284
S.E. of regression	0.105328	Akaike info criterion	-1.508679
Sum squared resid	0.321723	Schwarz criterion	-1.242048
Log likelihood	32.40188	F-statistic	67.70063
Durbin–Watson stat	1.266033	Prob (F-statistic)	0.000000

Table 7: Static model: Tests of cointegration between RER and explanatory variables

Dickey–Fuller (DF) test on residuals	-3.843635
Augmented Dickey–Fuller (ADF) test on residuals	-4.580185
Phillips–Perron (PP) test on residuals	-3.737265

Unlike the typical approach that has characterized the estimation of the short-run error correction real exchange rate model (i.e., via the Engle–Granger approach), this study, by virtue of the relatively small sample size, used the Hendry (1993) one-step methodology.[5] This in effect is a single equation estimation of cointegrating relationships. The appropriateness and uniqueness of this methodology stems from the fact that it responds to a problem raised by the Engle–Granger two-step approach. This problem has to do with the issue of possible bias of the coefficient of the explanatory variable in small sample sizes. Under such a situation, the computed residuals tend to be erroneous. The results from the estimated single equation model based on the Hendry one-step methodology are provided in Table 8.

Table 8: Short-run parsimonious RER model results

Dependent variable: ΔLogRER
Method: Least squares
Sample: 1962–1996
Included observations: 35

Variable	Coefficient	Std. error	t-statistic	Prob.
C	1.531223	0.595260	2.572362	0.0170
ΔLogAID	0.289298	0.095322	3.034938	0.0059
$LogAID_{t-1}$	0.294369	0.102922	2.860133	0.0089
$LogRER_{t-1}$	-0.368626	0.132344	-2.785360	0.0105
ΔLogGCN	-0.610661	0.209010	-2.921685	0.0077
$LogGCN_{t-1}$	-0.444609	0.188352	-2.360520	0.0271
ΔLogCPS	-0.159201	0.063056	-2.524748	0.0189
$LogCPS_{t-1}$	-0.220441	0.057924	-3.805667	0.0009
ΔLogTEP	-0.522746	0.209142	-2.499478	0.0200
$LogTEP_{t-1}$	-0.575663	0.255290	-2.254942	0.0340
ΔLogNER	0.629319	0.128728	4.888732	0.0001
$LogNER_{t-1}$	-0.073846	0.025788	-2.863548	0.0088

R-squared	0.848944	Mean dependent var	0.008221
Adjusted R-squared	0.776700	S.D. dependent var	0.151753
S.E. of regression	0.071710	Akaike info criterion	-2.166509
Sum squared resid	0.118274	Schwarz criterion	-1.633247
Log likelihood	49.91391	F-statistic	11.75106
Durbin–Watson stat	2.060605	Prob (F-statistic)	0.000001

Variables found to be insignificant (notably excess domestic credit and terms of trade) were excluded in the parsimonious model below. Of major interest, for the purpose of this study, is the impact of external aid inflows on the real exchange rate in Ghana. Generally, with the exception of the aid variable, the other variables captured in the estimation bear the expected theoretical signs. Unlike the conventional negative impact of aid on the real exchange rate as postulated in theoretical real exchange models, Ghana's experience exhibits a positive impact. In other words, aid inflows lead to real exchange rate depreciations rather than appreciations. This finding, though startling, reflects similar findings by Nyoni (1997) for the Tanzanian economy and Ogun (1998) for the Nigerian economy. As expected, commercial policy stance, government consumption and technological progress bear negative signs, meaning they tend to appreciate the real exchange rate. Nominal devaluations, however, lead to real exchange rate depreciation. This has theoretical underpinnings.

The results from tests for cointegration on the residuals in the single equation real exchange rate model (as shown in Table 9) attest to the existence of cointegration. All three tests (i.e., DF, ADF and PP) show values that compare favourably with their respective critical values to support cointegration.

Table 9: Parsimonious model: Tests of cointegration between RER and determinants

Dickey–Fuller (DF) test on residuals	-5.987487
Augmented Dickey–Fuller (ADF) test on residuals	-4.368345
Phillips–Perron (PP) test on residuals	-5.993277

The residuals from the cointegrated relationship are shown in Figure 2, which is seen to exhibit stationarity. Table 9 provided the results of tests on residuals (i.e., serial correlation and ARCH tests), model specification (i.e., RESET test) and coefficient restrictions (i.e., Wald test). From the results shown, it is evident that the single equation model provided in Table 10 passes the various diagnostic tests. The Breusch–Godfrey LM test statistic is given by the product of the number of observations and the coefficient of determination (i.e., Obs.*R-squared) and is asymptotically distributed as chi-squared. The serial correlation test suggests the absence of second order serial correlation as evidenced in LM test statistic of 0.795 being less than its critical value of 5.99 (at the 5% level). In other words, the null hypothesis of no serial correlation is accepted. There are no ARCH effects in the residuals since the computed statistic of 0.87 is relatively lower than the critical F value of about 4.17. Apart from these tests, there is an implication of appropriate specification in the sense that the Ramsey RESET test provides credence for this. Finally, the test for restrictions on the coefficients of the lagged variables on the right-hand side of our model as suggested by Hendry rejects the null hypothesis of these being equal to zero. The computed chi-squared statistic of 20.3 exceeds the critical value of 12.59 at the 5% level. Thus, in a more general sense these coefficients are jointly statistically significant.

Figure 2: Residuals from single equation real exchange rate model

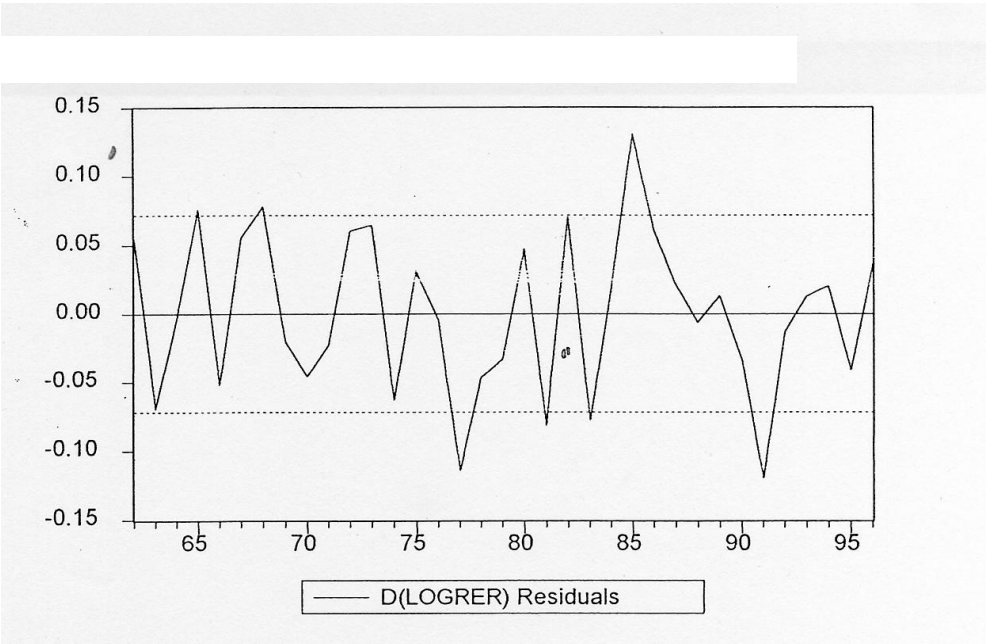


Table 10: Diagnostic and specification tests for parsimonious RER model

Breusch–Godfrey (2nd order) serial correlation LM test:			
F-statistic	0.244088	Probability	0.785610
Obs*R-squared	0.795143	Probability	0.671950
ARCH (1) test:	(34 observations)		
F-statistic	0.871137	Probability	0.357630
Obs*R-squared	0.901053	Probability	0.342499
Ramsey RESET test			
F-statistic	0.753110	Probability	0.394861
Log likelihood ratio	1.178079	Probability	0.277747
Wald test:		Restriction: $(\beta_2 = \beta_3 = \beta_5 = \beta_7 = \beta_9 = \beta_{11} = 0)$	
F-statistic	3.377761	Probability	0.015475
Chi-square	20.26656	Probability	0.002482

Note: $\beta_2, \beta_3, \beta_5, \beta_7, \beta_9,$ and β_{11} are the coefficients on the lagged variables on the right hand side of the parsimonious short-run model in Table 8.

The novelty of this study is that it interfaces exports with a policy environment variable (using aid as proxy) so as to see whether it has positive impact on export performance. The results of the unit root test for the export model are presented in Table 11, which shows non-stationarity for levels of the various variables but stationarity after first difference.

Table 11: Unit root test for export model variables

Variable	Lags	Augmented Dickey–Fuller	Order of integration
LogXPS	1	-2.116744	I(1)
ΔLogXPS	1	-6.378682	I(0)
LogYTP	1	-0.832908	I(1)
ΔLogYTP	1	-3.855363	I(0)
LogREMIS	1	-1.388132	I(1)
ΔLogREMIS	1	-4.289981	I(0)
LogRER	1	-1.782670	I(1)
ΔLogRER	1	-3.758770	I(0)
LogAID	3	-1.890935	I(1)
ΔLogAID	3	-3.805741	I(0)

Note: Critical values for rejection of the null hypothesis of a unit root are -2.9472 at the 5% level and -2.6118 at the 10% level.

The outcome of the Granger causality test to ascertain the direction of causality between export performance and its determinants is shown in Table 12. As the results from this test show, in our model causality runs from the independent variables to the dependent

variable and not vice versa. The main exception is the variable on trading partners' income, in which case causality was neither way. Trade theory, however, underscores the importance of foreign income in influencing the demand for exports, therefore this variable was retained in the model.

Table 12: Pairwise Granger causality tests for export model (Sample: 1962–1996)

Null hypothesis:	Lags	F-Statistic	Probability
YTP does not Granger cause XPS	3	2.13121	0.11960
XPS does not Granger cause YTP		0.54058	0.65860
RER does not Granger cause XPS*	1	10.6189	0.00265
XPS does not Granger cause RER		0.62966	0.43332
REMIS does not Granger cause XPS*	1	12.3376	0.00135
XPS does not Granger cause RERMIS		0.11742	0.73409
AID does not Granger cause XPS*	1	10.3697	0.00294
XPS does not Granger cause AID		0.78346	0.38269

Note: (*) rejects the null hypothesis at 5%.

To ascertain the possibility of cointegration between exports and its determinants, DF, ADF and PP tests were performed on the residuals of the static export model. These are shown in Table 13. Having established cointegration, we then applied the Hendry one-step approach to the estimation of the export model, the results of which are summarized in Table 14.

Table 13: Static model: Tests of cointegration between exports and explanatory variables

Dickey–Fuller (DF) test on residuals	-3.506807
Augmented Dickey–Fuller (ADF) test on residuals	-4.519555
Phillips–Perron (PP) test on residuals	-3.372684

The estimated export performance model (Table 14) shows rather standard but interesting results. As expected, increases in output and for that matter income of Ghana's trading partners positively affects the performance of exports. Changes in the real exchange rate variable also bear the expected positive sign. Generally, depreciations in the real exchange rate positively affect export performance. The negative coefficient on the real exchange rate misalignment term (proxied by the black market premium) highlights the adverse effect this has on export performance. For the policy environment proxy (i.e., aid), a positive relationship is seen to exist. This suggests that improvements in the policy environment elicit a favourable response from non-cocoa/non-gold exports. The DF, ADF and PP tests on the residuals of this single equation export model are given in Table 15. The results show that the residuals are stationary. This is buttressed by Figure 3, which shows a plot of the residuals from the estimation.

Figure 3: Residuals from single equation export model

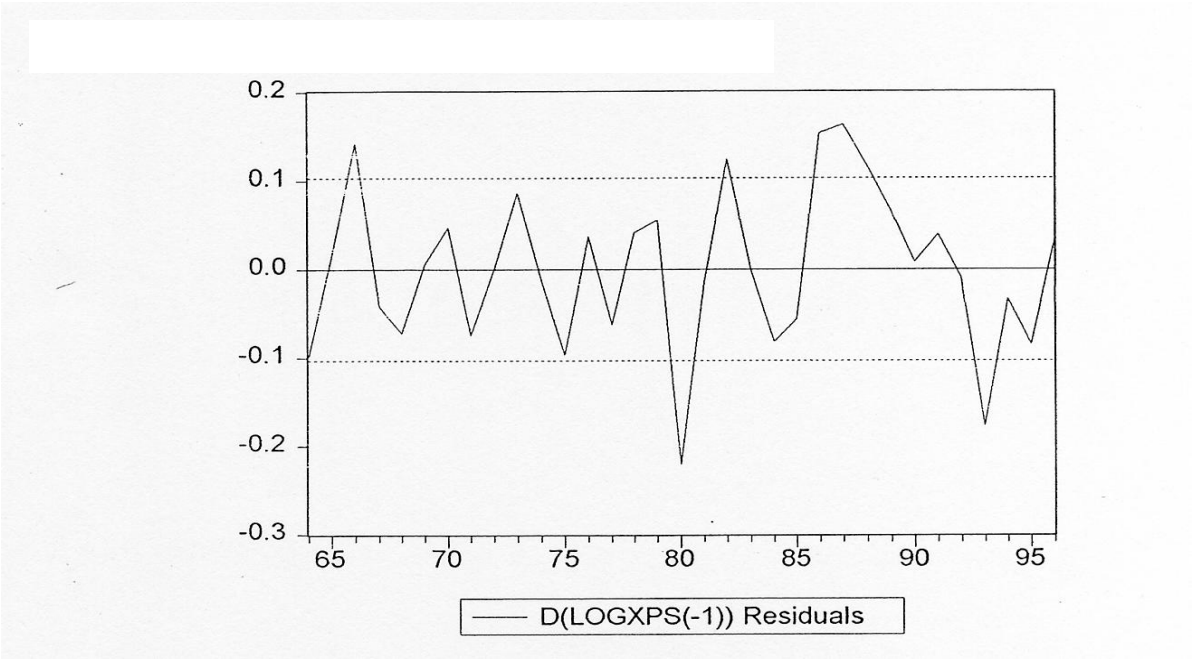


Table 14: Results of the export performance model

Dependent variable: $\Delta LogXPS_{t-1}$
Method: Least squares
Sample (adjusted): 1964–1996
Included observations: 33 after adjusting endpoints

Variable	Coefficient	Std. error	t-statistic	Prob.
C	-0.909189	0.433808	-2.095833	0.0468
$\Delta LogRER_{t-1}$	0.445810	0.189974	2.346688	0.0275
$LogRER_{t-1}$	-0.550093	0.181821	-3.025470	0.0058
$LogXPS_{t-1}$	0.725450	0.174324	4.161503	0.0004
$\Delta LogYTP_{t-3}$	2.591263	1.084411	2.389559	0.0251
$LogYTP_{t-1}$	0.146574	0.140607	1.042435	0.3076
$\Delta REMIS_{t-2}$	-0.026148	0.005323	-4.912161	0.0001
$REMIS_{t-1}$	-0.017450	0.010168	-1.716257	0.0990
$\Delta LogAID_{t-2}$	0.191873	0.095003	2.019651	0.0547

R-squared	0.703813	Mean dependent var	0.006284
Adjusted R-squared	0.605084	S.D. dependent var	0.164472
S.E. of regression	0.103358	Akaike info criterion	-1.474238
Sum squared resid	0.256388	Schwarz criterion	-1.066099
Log likelihood	33.32492	F-statistic	7.128737
Durbin–Watson stat	1.699779	Prob (F-statistic)	0.000080

Table 15: Single equation model: Tests of cointegration between exports and determinants

Dickey–Fuller (DF) test on residuals	-4.893763
Augmented Dickey–Fuller (ADF) test on residuals	-4.786390
Phillips–Perron (PP) test on residuals	-4.859233

Table 16 summarizes the results from the various tests conducted on the parsimonious export model. The Breusch–Godfrey LM test statistic shows the possibility of absence of serial correlation. The LM test statistic of 5.55 is smaller than its critical value of 5.99 at the 5% level and 9.21 at the 1% level. The ARCH test suggests the presence of homoscedastic errors up to the second order since the computed statistic of 0.53 is smaller than the critical F value of about 4.17. The model appears to be rightly specified and is authenticated by the F-statistic from the RESET test. This is lower than the critical value. Finally, in terms of tests on coefficient restrictions, the Wald test results show that the assertion of zero restrictions on the coefficients of the lagged level variables in the model is untenable. The critical value of 12.59 at the 5% level is below the computed chi-squared statistic of 19.36.

Table 16: Diagnostic and specification tests for export model

Breusch–Godfrey (2nd order) serial correlation LM test:			
F-statistic	2.225314	Probability	0.131781
Obs*R-squared	5.552638	Probability	0.062267
ARCH (1) test:	(34 observations)		
F-statistic	0.533254	Probability	0.470906
Obs*R-squared	0.558871	Probability	0.454716
Ramsey RESET test			
F-statistic	2.668682	Probability	0.115957
Log likelihood ratio	3.622655	Probability	0.056998
Wald test:		Restriction:	$(\alpha_2 = \alpha_3 = \alpha_5 = \alpha_7 = 0)$
F-statistic	4.839280	Probability	0.005261
Chi-square	19.35712	Probability	0.000669

Note: $\alpha_2, \alpha_3, \alpha_5,$ and α_7 are the coefficients on the lagged variables on the right-hand of the export model in Table 14.

Drawing from the works of Nakamura and Nakamura (1981), Hausman (1978), and Wu (1973), and recognizing the possibility of simultaneity between the export variable and real exchange rate variable (the existence of which will render inappropriate the use of OLS as the estimation technique), we conducted a simultaneity test, the results of which are shown in Table 17. The test is to find out whether a (endogenous) regressor is correlated with the error term (Gujarati, 1994). Basically this entailed taking the residuals from the parsimonious real exchange rate model (in Table 11) and including them in the

export performance model as provided by Table 14. Using a "t" test, the null hypothesis is that the coefficient on *Uhat* is zero. Our results show that the coefficient on *Uhat* is statistically insignificant at the 5% level as evidenced by an absolute t-value of 0.259. Therefore, we accept the null, which suggests the possible absence of a simultaneity problem.

Table 17: Results of simultaneity test for the export performance model

Dependent variable: $\Delta LogXPS_{t-1}$
Method: Least squares
Sample (adjusted): 1964 1996
Included observations: 33 after adjusting endpoints

Variable	Coefficient	Std. error	t-statistic	Prob.
C	-0.872579	0.464554	-1.878314	0.0731
$\Delta LogRER_{t-1}$	0.460087	0.201477	2.283568	0.0320
$LogRER_{t-1}$	-0.557684	0.187766	-2.970094	0.0069
$LogXPS_{t-1}$	0.726650	0.177875	4.085170	0.0005
$\Delta LogYTP_{t-3}$	2.592808	1.106141	2.344013	0.0281
$LogYTP_{t-1}$	0.139742	0.145831	0.958243	0.3479
$\Delta REMIS_{t-2}$	-0.026583	0.005683	-4.677358	0.0001
$REMIS_{t-2}$	-0.017968	0.010562	-1.701141	0.1024
$\Delta LogAID_{t-2}$	0.187131	0.098623	1.897445	0.0704
Uhat	-0.099879	0.385913	-0.258812	0.7981

R-squared	0.704673	Mean dependent var	0.006284
Adjusted R-squared	0.589110	S.D. dependent var	0.164472
S.E. of regression	0.105427	Akaike info criterion	-1.416540
Sum squared resid	0.255644	Schwarz criterion	-0.963053
Log likelihood	33.37291	F-statistic	6.097756
Durbin–Watson stat	1.695912	Prob (F-statistic)	0.000220

Note: *Uhat* represents the residuals from the one-step single equation real exchange rate model (i.e., Table 8). All other variables are as defined earlier.

Our test for exogeneity (given in Table 18) involved taking the real exchange rate variable obtained by estimating the single equation model (Table 8) and including it in the export performance model (Table 14). Since there is only one restriction, the conventional "F" test reduces to a "t" test. The null hypothesis is that the coefficient of the *RERhat* is zero. The rejection of this null would mean that the *RER* variable is perceievd to be endogenous but if otherwise, it could be treated as exogenous. Our results show that with a computed t-statistic of less than approximately 2 (i.e., 0.866), the coefficient on *RERhat* is statistically insignificant. Thus, to some extent, we conclude that the real exchange rate variable could be treated as exogenous.

Table 18: Results of the exogeneity test in the export performance model

Dependent variable: $\Delta LogXPS_{t-1}$
Method: Least squares
Sample (adjusted): 1964–1996
Included observations: 33 after adjusting endpoints

Variable	Coefficient	Std. error	t-statistic	Prob.
C	-0.930795	0.436800	-2.130942	0.0440
$\Delta LogRER_{t-1}$	0.188943	0.083113	2.273326	0.0327
$LogRER_{t-1}$	-0.265507	0.085117	-3.119322	0.0048
$LogXPS_{t-1}$	0.785139	0.188309	4.169418	0.0004
$\Delta LogYTP_{t-3}$	2.908907	1.150170	2.529111	0.0187
$LogYTP_{t-1}$	0.153911	0.141599	1.086950	0.2883
$\Delta REMIS_{t-2}$	-0.028457	0.005978	-4.759965	0.0001
$REMIS_{t-1}$	-0.020615	0.010855	-1.899163	0.0702
$\Delta LogAID_{t-2}$	0.211664	0.098199	2.155463	0.0418
ΔLogRERhat	0.149179	0.172275	0.865937	0.3955

R-squared	0.713164	Mean dependent var	0.006284
Adjusted R-squared	0.600924	S.D. dependent var	0.164472
S.E. of regression	0.103901	Akaike info criterion	-1.445714
Sum squared resid	0.248294	Schwarz criterion	-0.992226
Log likelihood	33.85427	F-statistic	6.353925
Durbin–Watson stat	1.729014	Prob (F-statistic)	0.000163

5. Conclusion and policy implications

The Ghanaian economy has beyond any shadow of doubt been the recipient of substantial aid inflows for its development activities, and these inflows have been somewhat steady in the 1990s. With rather high aid dependence indicators it is obvious that any current curtailment of these inflows could have adverse effects on the economy. One implication for macroeconomic management is that rather than using aid for current consumption it is vital for it to be used in infrastructural development or invested so as to lay the foundation for higher growth in the economy. This will further pave the way for curtailment of aid dependence in the future. Global trends show that there is a tendency towards reduced aid flows from the donor community. For developing economies like Ghana, this trend has serious implications for development activities. In order that the economy not be overtaken by events, it is appropriate to adopt strategies for reducing aid intensity and hence dependence by continuously improving the institutional mechanisms of aid delivery.

The paper sought to develop an empirical model of the real exchange rate in Ghana with special focus on the role of foreign aid and to link this with an export performance model to examine aid's impact on exports. The empirical estimation concludes that terms of trade, aid inflows, government consumption and commercial policy stance, and technological progress are salient variables in the long-run equilibrium real exchange rate model for Ghana. In the short run, however, pertinent variables as far as the parsimonious model is concerned are nominal exchange rate together with all the real fundamentals with the exception of terms of trade. Aid inflows have a depreciating effect on the real exchange rate. This finding, though contrary to standard Dutch disease economics, is not an exceptional feature of the Ghanaian economy, as a similar impact has been found in Tanzania and Nigeria. Consequently, the hypothesis that aid inflows lead to real exchange rate appreciation is refuted as the Ghanaian situation exhibits the inverse. The finding that the parallel market premium has an appreciating effect on the real exchange rate has implications for pursuing policies that minimize the over-valuation of the exchange rate and ensuring that markets are well aligned.

The estimated export performance model shows rather standard but interesting results. As expected, increases in output and for that matter income of Ghana's trading partners positively affect the performance of exports. Appreciations in the real exchange rate negatively affect export performance. Exchange rate misalignment negatively affects exports and enhancement in the policy environment elicits improved export performance. Thus, arguably, external aid inflows, by serving as proxy for policy environment, generate improvements or positive growth in macroeconomic variables such as exports. Being in

consonance with the empirical finding, therefore, the hypothesis that exports respond positively to a good policy environment is accepted. These findings imply that government should endeavour to maintain a sound policy environment so as to elicit good macroeconomic performance. Policy management thus needs to focus on ensuring the prevalence of sound macroeconomic fundamentals, among others. With a good policy environment, external aid could be an effective investment in the Ghanaian economy and could spur the realization of the country's vision of becoming a middle-income country.

Notes

1 Slow disbursement of aid commitments has impaired the aid cycle and delayed the potential benefits of some aid programmes. Some donors have been reluctant to make new commitments because of large undisbursed funds in the country's aid pipeline. See Aryeetey (1995).

2 Characteristically, stationary series have a finite variance, transitory innovations from the mean and a tendency for the series to return to their mean value. Conversely, non-stationary series exhibit an asymptotically infinite variance, permanent innovations to the series and a mean rarely crossed by the series. See Adams (1992).

3 The Dickey–Fuller (DF) test for any given variable, say RER, is obtained by running the regression: $\Delta RER = \alpha RER_{t-1} + et;$ the Augmented Dickey–Fuller (ADF) is as follows: $\Delta RER = \alpha RER_{t-1} + \Sigma_{j=1}^{k} \beta \Delta RER_{t-1} + u_t$. The statistic of interest is the "t" on the distributed lag term.

4 For causality from a fundamental, say AID, to the RER t,he regression run was: $RER = \Sigma_{i=1}^{n} \alpha \Delta RER_{t-1} + \Sigma_{i=1}^{n} \beta \Delta AID_{t-1} + u_t$. For reverse causality this was as follows: $AID = \Sigma_{i=1}^{n} \alpha \Delta AID_{t-1} + \Sigma_{i=1}^{n} \beta \Delta RER_{t-1} + u_t$. The statistic of interest is the "F", which is given by: $F = [RSS_R - RSS_{UR})/m] / [RSS_{UR} / (n-k)]$. RSS_R and RSS_{UR} are the residual sum of squares from the restricted and unrestricted regressions, respectively, m is the number of lagged terms and k is the number of parameters estimated in the unrestricted regression. See Gujarati, 1995.

5 My special appreciation goes to Prof. Jean-Paul Azam of Université des Sciences Sociales for his exposition and direction on this methodology. The first of the two steps in the Engle–Granger approach is to test for the cointegration of two variables by estimating through OLS the following equation:

$$Y_t = \alpha X_t + e_t \qquad \text{(a)}$$

with $e_t = re_{t-1} + u_t$ and with r being less than one to ensure stationarity. This being the case, an error correction representation, which is the second step, is formulated as follows:

$$Y_t - Y_{t-1} = \alpha(X_t - X_{t-1}) + (1-r)e_{t-1} + u_t \text{ or}$$
$$\Delta Y_t = \alpha \Delta X_t + (1-r)e_{t-1} + u_t \quad \text{(b)}$$

Generally, the residuals of the cointegrating equation in (a) are lagged and used in (b) for e_{t-1}. The problem is that the estimate of α in (a) is biased in small samples so that the computed residuals are erroneous. Hendry therefore suggests the direct estimation of the following equation:

$$Y_t - Y_{t-1} = \alpha(X_t - X_{t-1}) + (1-r)Y_{t-1} - (1-r)\alpha X_{t-1} + u_t \text{ or}$$

$$\Delta Y_t = \alpha \Delta X_t + (1-r)Y_{t-1} - (1-r)\alpha X_{t-1} + u_t \quad \text{(c)}$$

If the lagged values of Y_t and X_t are really cointegrated, then they would be significant in the estimation of (c).

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Appendix A. Supplementary tables

Table A1: Data sources and definitions

Variable	Definition and source
RER	***Real exchange rate***. This corresponds to the multilateral real effective exchange rate or trade weighted real exchange rate. The RER = $\Delta w_i BNER_i P_i^*/P$ where RER, w_i, BNER, P_i^* and P are trade weighted real exchange rate; weight for country i; bilateral nominal exchange rate; country i's wholesale price index; and domestic country's consumer price index. A decrease in the index implies an appreciation of the RER. This by interpretation is a loss of competitiveness. The opposite is true. Ghana's main trading partners and their respective trade weights were UK 0.3; France 0.06; Italy 0.08; Japan 0.09; Netherlands 0.1; Germany 0.19; and US 0.18. Data sources were World Bank's *World Tables* and *Direction of Trade Statistics*, and IMF's *International Financial Statistics.*
TOT	***Terms of trade***. This was obtained/computed from export and import price indexes as they appear in the World Bank's *World Tables* and *African Development Indicators*.
AID	***External aid inflow***. This variable is operationally defined as real net official development assistance and was obtained by deflating net nominal ODA obtained from the OECD's *Geographical Distribution of Financial Flows to Developing Countries* by Ghana's import price index.
GCN	***Government consumption***. This is expressed as a share of GDP. Data source were World Bank's *World Tables* and *African Development Indicators*.
CPS	***Commercial policy stance***. The parallel market premium was used as proxy for this variable. This is computed as the difference between parallel market and official rates expressed as a ratio of the official rate. The data source was basically Bank of Ghana's *Annual Reports* and *Quarterly Economic Bulletins*.
TEP	***Technological progress***. This variable is proxied by the index of agricultural production. Data for this variable emanated from Ghana Statistical Services' *Quarterly Digest of Statistics* and World Bank's *World Tables*.
NER	***Trade weighted nominal exchange rate***. The weights were for Ghana's seven major trading partners. This was calculated based on data from IMF's *International Financial Statistics* and World Bank's *World Tables*.
EXP	***Export performance***. This variable was measured by non-cocoa/non-gold exports expressed as a share of GDP. The sources of the data were World Bank's *World Tables* and *African Development Indicators*, Ghana Statistical Services' *Quarterly Digest of Statistics*, and Bank of Ghana's *Annual Reports*.
REMIS	***Real exchange rate misalignment***. This was measured by the parallel market premium. The data sources included Bank of Ghana's *Annual Reports* and *Quarterly Economic Bulletins.*
YTP	***Trade weighted real output of trading partners***. This was obtained by weighting the real output performance of Ghana's seven major trading partners. Data source was IMF's *International Financial Statistics*.

Table A2: Basic data on key variables for model estimation

obs	RER (Index)	TOT (Index)	AID (Real $)	GCN (%)	CPS (Ratio)	TEP (Real)	NER (Index)	XPS (Real $)	YTP (Real $)
1962	297.9	92.33	22.4	11.56	0.41	15.15	16.38	342.7	438.5
1963	269.4	91.47	116.6	12.27	0.62	14.99	16.36	234.5	458.1
1964	450.5	97.80	152.0	12.81	0.66	15.09	30.67	308.4	485.5
1965	403.6	80.68	269.5	17.36	0.99	18.17	30.69	408.2	511.0
1966	350.3	72.22	323.0	15.70	0.94	18.46	35.39	424.2	536.0
1967	328.7	100.4	293.2	15.37	1.11	19.38	33.18	367.4	536.1
1968	348.2	122.8	316.9	16.78	0.82	19.14	33.04	369.5	563.8
1969	316.4	133.5	310.4	15.10	0.66	20.46	33.01	417.6	583.0
1970	336.8	106.9	240.2	8.90	0.70	22.76	33.07	393.2	594.7
1971	368.1	79.56	207.7	7.70	0.48	23.84	33.82	372.5	615.9
1972	529.9	102.0	237.8	8.76	0.46	24.76	45.79	504.4	664.4
1973	536.2	113.3	116.1	6.819	0.30	24.26	41.58	527.2	725.6
1974	291.8	99.82	74.5	7.839	0.50	26.40	39.40	303.6	713.3
1975	333.8	81.66	221.7	9.109	0.73	21.14	39.32	386.6	709.7
1976	224.1	113.5	109.4	9.65	1.53	20.79	34.96	362.3	706.4
1977	107.0	159.3	143.8	12.20	7.00	19.66	35.01	223.9	743.5
1978	111.0	139.0	160.4	13.06	2.26	23.41	57.87	217.3	829.6
1979	127.8	133.1	204.6	10.92	4.66	24.29	96.99	177.0	878.8
1980	100.0	100.0	191.6	12.17	4.77	24.82	100.0	161.5	893.1
1981	43.88	82.32	140.4	14.50	8.55	24.18	86.58	344.8	841.7
1982	35.21	73.21	144.4	13.79	21.43	22.87	78.01	296.5	789.4
1983	49.44	89.23	114.4	14.14	7.67	21.27	232.3	68.7	792.8
1984	138.2	96.31	234.5	11.32	2.75	23.34	868.8	92.45	805.1
1985	193.3	90.61	224.4	10.44	1.94	23.39	1281	158.5	824.8
1986	310.8	87.00	423.6	10.11	1.07	24.77	2503	193.7	954.0
1987	442.2	84.62	420.6	10.01	0.39	24.78	4849	228.2	1063
1988	476.6	80.56	564.4	10.33	0.25	25.67	6670	304.7	1150
1989	505.8	63.21	682.7	10.99	0.22	26.76	8392	360.3	1145
1990	505.3	51.73	488.8	10.74	0.11	26.22	11004	561.4	1209
1991	500.5	50.42	785.9	10.80	0.04	27.47	12321	612.5	1225
1992	575.3	47.66	536.1	13.30	0.03	27.29	15067	625.4	1280
1993	654.3	46.86	533.8	12.56	0.00	76.85	20902	633.5	1292
1994	810.2	54.13	460.3	14.10	0.04	28.58	31495	574.1	1360
1995	636.3	57.27	524.2	12.70	0.08	29.65	42136	552.5	1454
1996	638.6	57.39	525.5	13.70	0.30	31.20	55434	569.9	1436

Source: IMF's *International Financial Statistics Yearbooks*, OECD's *Geographical Distribution of Financial Flows to Developing Countries*, Ghana Statistical Services' *Quarterly Digest of Statistics,* and World Bank's *World Tables*, various issues.

Table A3: External aid inflows (Real net ODA in million 1980 US$)

	Bilateral	Multilateral	Total net	Grants
1962	24.33	-1.93	22.40	13.59
1963	73.11	43.53	116.64	16.60
1964	80.51	71.49	152.00	26.92
1965	199.41	70.10	269.51	31.10
1966	306.00	16.96	322.96	38.32
1967	293.49	-0.26	293.23	50.87
1968	286.67	30.24	316.91	53.88
1969	264.35	46.09	310.43	97.39
1970	208.13	32.11	240.24	95.12
1971	180.66	27.01	207.66	88.69
1972	203.25	34.55	237.80	83.74
1973	102.83	13.31	116.15	62.89
1974	46.63	27.87	74.50	54.10
1975	184.13	37.57	221.69	56.08
1976	58.12	51.28	109.40	77.61
1977	82.02	61.83	143.85	83.44
1978	80.56	53.94	160.42	94.23
1979	107.39	77.21	204.61	81.33
1980	107.10	59.30	191.60	64.90
1981	84.44	42.13	140.39	73.43
1982	66.97	74.44	144.38	65.85
1983	61.94	57.14	114.39	77.61
1984	103.47	135.94	234.53	142.45
1985	105.97	124.97	224.42	116.24
1986	137.51	282.21	423.60	196.58
1987	128.31	292.26	420.57	149.29
1988	243.58	320.86	564.43	225.58
1989	337.54	345.15	682.69	254.53
1990	230.93	257.84	488.76	445.96
1991	399.67	378.29	785.89	491.79
1992	291.31	248.58	536.13	280.54
1993	269.76	267.86	533.83	276.67
1994	279.53	185.76	460.32	258.21
1995	287.64	241.42	524.17	278.01
1996	280.50	246.90	525.47	253.49

Source: OECD's *Geographical Distribution of Financial Flows to Developing Countries,* various issues.

Table A4: Summary of descriptive statistics for RER model

Sample: 1962–1996

	LogAID	LogCPS	LogGCN	LogNER	LogRER	LogTEP	LogTOT
Mean	2.383391	-0.236000	1.066370	2.498162	2.447457	1.371309	1.931092
Median	2.376221	-0.180000	1.085291	1.892146	2.527398	1.377306	1.950523
Maximum	2.895360	1.330000	1.239547	4.743780	2.908592	1.885617	2.202232
Minimum	1.350190	-0.520000	0.833690	1.213884	1.546666	1.175932	1.670808
Std. dev.	0.316750	0.810160	0.097592	1.199184	0.346284	0.119431	0.138039
Skewness	-0.853253	-0.555887	-0.382483	0.658213	-1.136384	2.000124	-0.254394
Kurtosis	4.418891	3.480128	2.649885	1.766301	3.492266	11.16563	2.404561
Jarque-Bera	7.182900	2.138741	1.032142	4.746862	7.886379	120.5743	0.894560
Probability	0.027558	0.343224	0.596861	0.093161	0.019386	0.000000	0.639365
Observations	35	35	35	35	35	35	35

Table A5: Summary of descriptive statistics for export model

Sample: 1962–1996

	LogXPS	LogRER	LogYTP	LogREMIS	LogAID
Mean	2.509667	5.635477	2.904859	-0.236000	2.383391
Median	2.559128	5.819549	2.899164	-0.180000	2.376221
Maximum	2.801768	6.697281	3.162684	1.330000	2.895360
Minimum	1.836942	3.561330	2.641970	-2.520000	1.350190
Std. dev.	0.228870	0.797349	0.150744	0.810160	0.316750
Skewness	-1.039104	-1.136384	0.096113	-0.555887	-0.853253
Kurtosis	3.939200	3.492266	1.976194	3.480128	4.418891
Jarque-Bera	7.584851	7.886379	1.582482	2.138741	7.182900
Probability	0.022541	0.019386	0.453282	0.343224	0.027558
Observations	35	35	35	35	35

Appendix B. Supplementary figures

Figure B1: Composition of aid to Ghana (percentage share of total real net ODA)

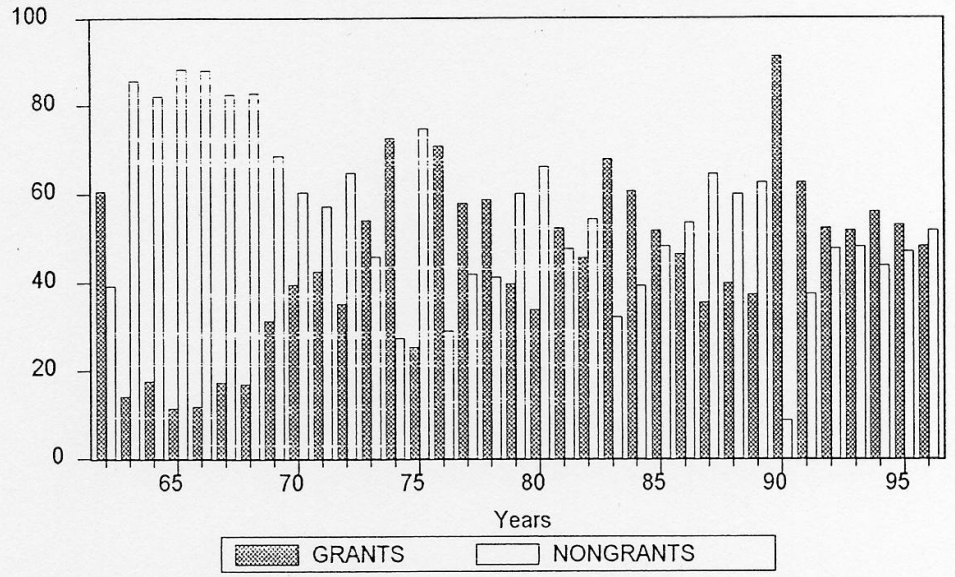


Figure B2: External aid source contribution (in percentages)

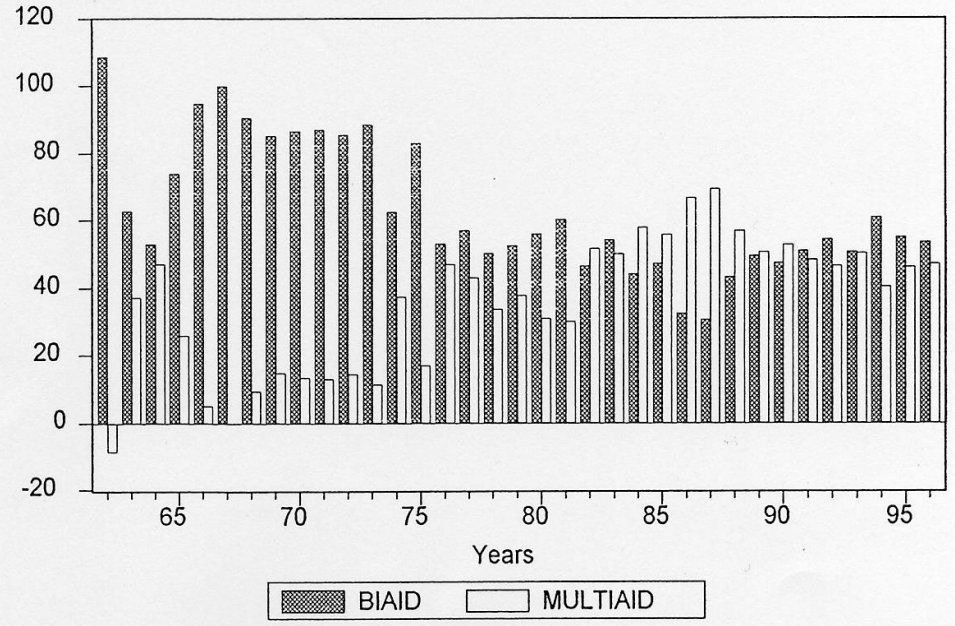


Figure B3: Ghana's multilateral and bilateral real exchange rate indexes (1980=100)

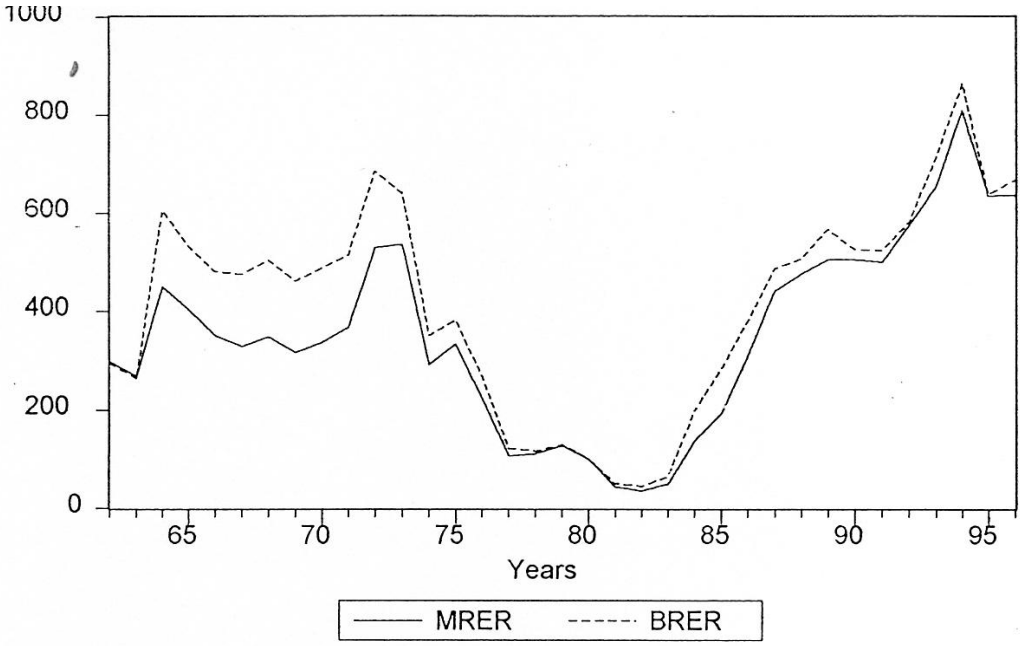


Figure B4: Ghana's multilateral nominal exchange rate indexes (in log values)

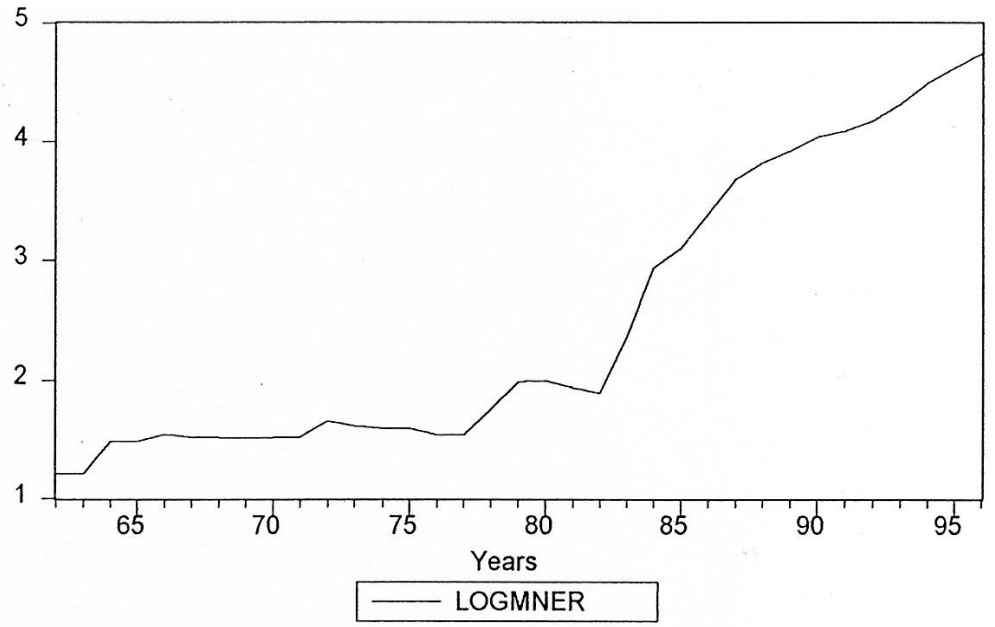


Figure B5: Ghana's exchange rate movements (in percentages)

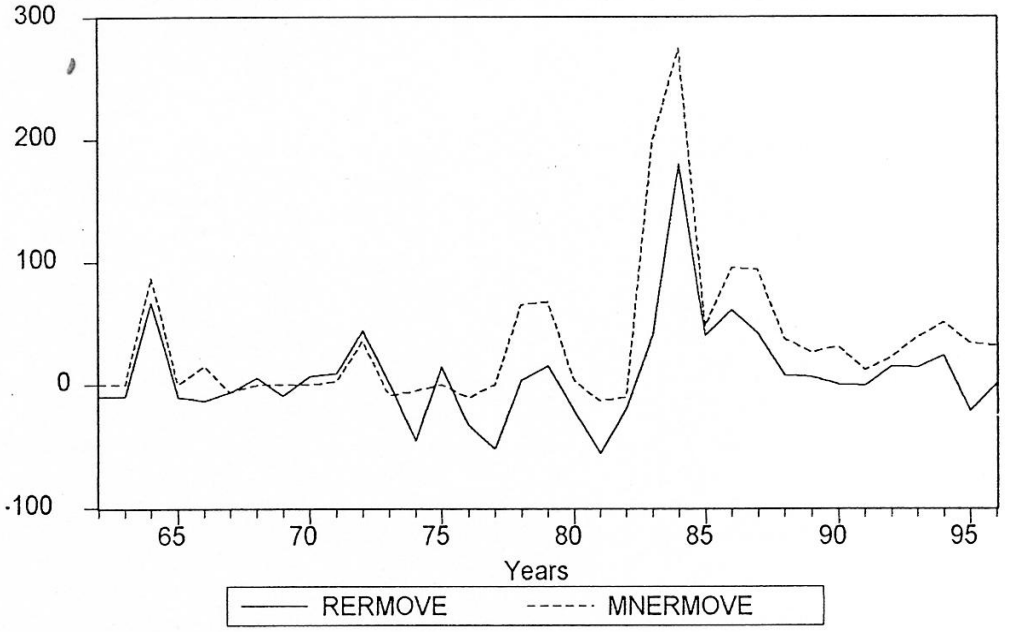


Figure B6: Non-cocoa/non-gold export shares in Ghana's GDP (in percentages)

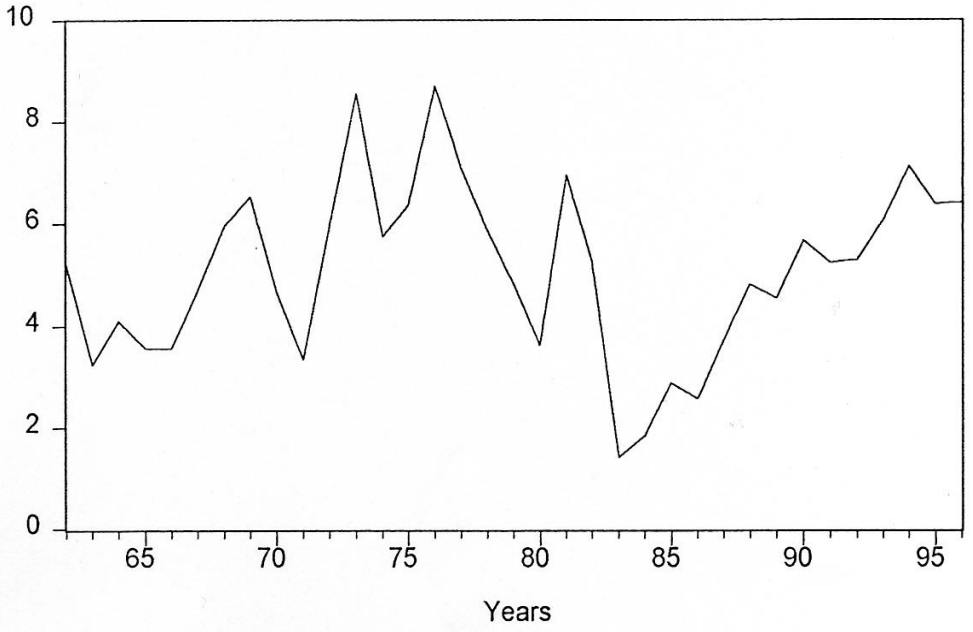


Figure B7: Ghana's exchange rate misalignment (in log values)

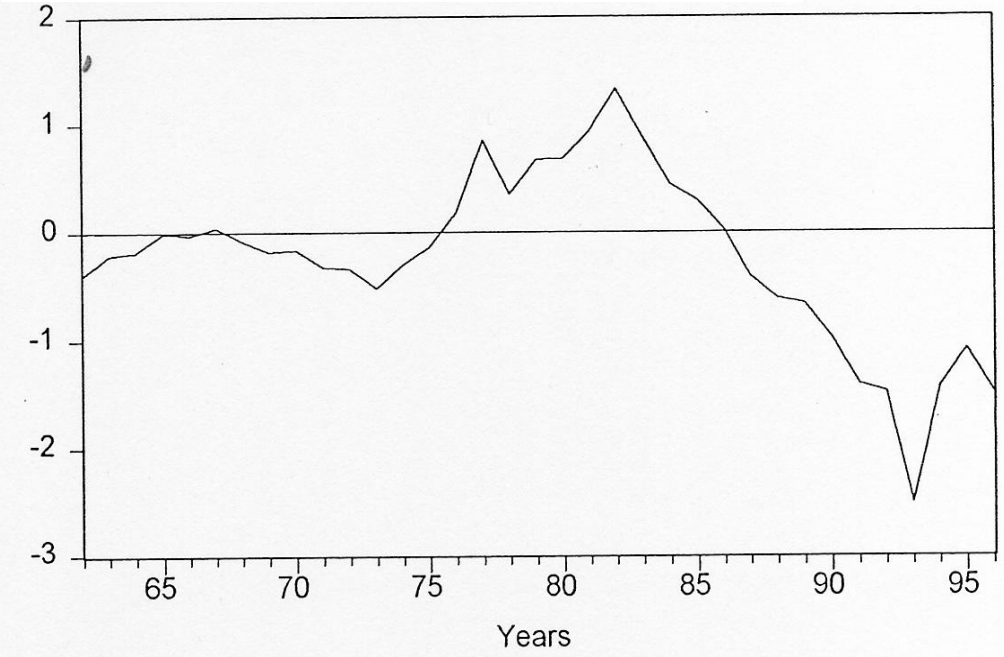
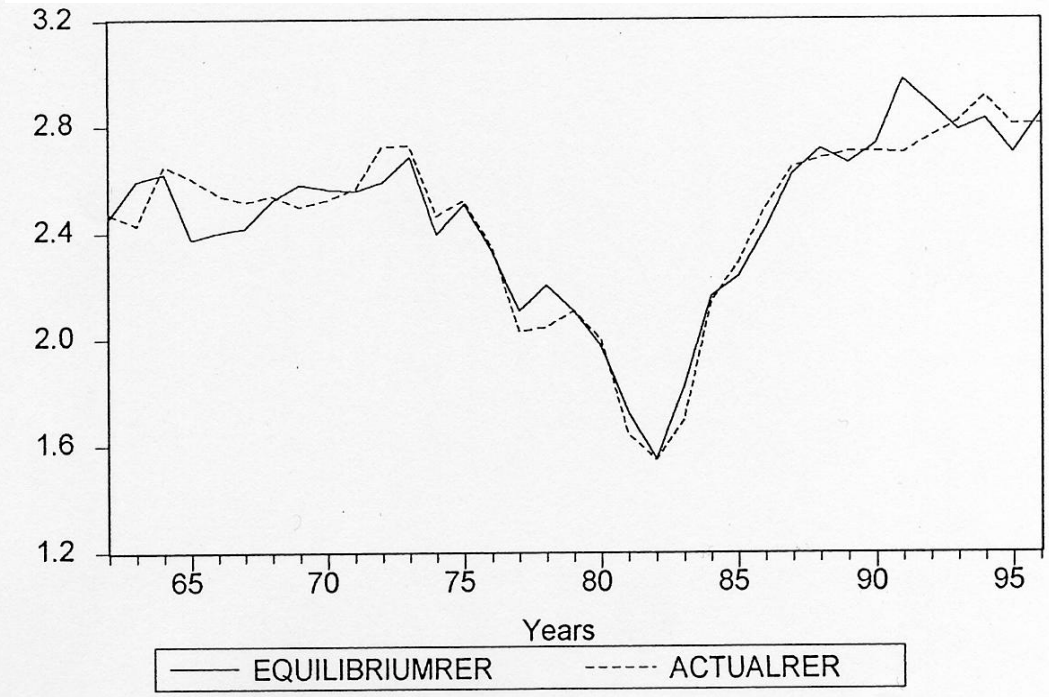


Figure B8: Equilibrium and actual real exchange rates, 1962–1996 (in log values)



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