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By

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Contents

List of tables

List of figures

Abstract

This study estimated an error correction model of the impact of real effective exchange rate volatility on the performance of non-traditional exports for Zambia between 1965 and 1999. Using a generalized autoregressive conditional heteroscedasticity (GARCH) measure of real exchange rate volatility, the findings show that exchange rate volatility depresses exports in both the short run and the long run. The results also suggest that supportive macroeconomic factors are important in enhancing non-traditional exports in the country. This requires packaging a set of incentives aimed at removing anti-export bias policies so as to promote exports, particularly of non-traditional products, given their standing in the economic growth agenda for the country.

Keywords: Real exchange rate, volatility, GARCH, error correction model, non-traditional exports

JEL classification: **F30, F31, F47**

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1. Introduction and background

Since the breakdown of the Bretton Woods fixed exchange rate system in the early 1970s, the effect of exchange rate volatility on trade flows and other macroeconomic variables has attracted a lot of attention. Exchange rate volatility is a statistical measure of the tendency of the exchange rate to rise or fall sharply within a short period and is important in understanding foreign exchange market behaviour. Be it of the nominal or real exchange rate, volatility creates uncertainty in macroeconomic policy formulation, investment decisions and international trade flows.[1]

Although there is a growing body of literature on the impact of exchange rate volatility on trade, empirical evidence has been ambiguous both within developed and developing countries and across countries (Cote, 1994). Many empirical findings support the hypothesis that an increase in exchange rate volatility leads to a decrease in trade flows because in most international transactions, goods are denominated in terms of the currency of either the exporting or importing country. Therefore, unanticipated variation in the exchange rate should adversely affect trade flows through the effects on profits. There is also some conflicting evidence on the relationship between exchange rate volatility and trade, which suggests that exchange rate volatility has a positive impact on trade. Given such contradictions, the debate on the impact of exchange rate volatility on trade remains inconclusive.

In this paper, we estimate an error correction model of the impact of exchange rate volatility on Zambia's non-traditional exports. Non-traditional exports are defined as all non-mineral exports;[2] among others these are animal products, primary and processed agricultural products, cement, asbestos and other building materials, sugar, engineering products, floriculture and horticultural products, textiles, cotton yarn and garments, semi precious stones, and electricity. Of these exports, primary agricultural products may be subject to seasonal factors and consequently supply of the same may be low during low production periods. However, the proportion of this subsector in total non-traditional exports is small, accounting for less than one-fifth of the total. The market for non-traditional exports is diverse, with demand concentrated in the United Kingdom and European Union (EU), but has been rising in regional markets, especially South Africa, Democratic Republic of Congo (DRC) and Burundi. The rest of the market includes Japan, Malaysia and the United States of America.

The paper is organized as follows. Section 2 looks at the research problem and motivation of the study, highlighting the research objectives and rationale. The evolution of exchange rate policy and export performance in Zambia is described briefly in Section 3, while Section 4 reviews relevant literature. The specification of the model and estimation techniques are discussed in Section 5 and Section 6 presents the empirical findings. Section 7 draws conclusions from the findings and provides policy implications.

2. Research problem and motivation

Zambia's market for non-traditional exports has grown over the years, with demand increasing in the European Union, South Africa, DRC and Burundi. But even though the market has been diversified, the performance of these exports has been low for many reasons, including the fluctuating exchange rate, structural supply impediments and a narrow production base (Commonwealth Secretariat, 1996). The average annual growth rate of non-traditional exports between 1990 and 1999 was 13.8% while as a share of total exports, non-traditional exports averaged 19.1% over the same period.

Although the Government has implemented policy reforms and undertaken measures to revitalize the non-traditional exports sector, persistent real exchange rate variability coupled with policy inconsistency and reversals have undermined these efforts. Sekkat and Varoudakis (1998) argue that Zambia suffered real exchange rate volatility during the 1990s, a situation that is detrimental to non-traditional exports promotion. The most affected have been producers of horticultural, floricultural and other non-traditional agricultural exports.

Motivation of the study

Non-traditional exports are known to be vulnerable to real exchange rate variability, but exchange rate risk hedging facilities in Zambia are virtually nonexistent. Even where hedging opportunities are readily available, however, they tend to be very costly especially for small exporting firms. Consequently, exporters bear all the risk of unexpected exchange rate movements. To our knowledge there has been no study undertaken in Zambia to document the degree to which exchange rate volatility affects non-traditional exports although similar works have been done elsewhere in Africa. This study attempts an empirical assessment of the magnitude and direction of the impact of exchange rate volatility on non-traditional exports. The study differs from other African research efforts in that it pays particular attention to the non-traditional exports sector and uses a superior measure of exchange rate volatility based on the generalized autoregressive conditional heteroscedasticity (GARCH) method.

It is expected that the research findings will help policy makers in making informed decisions on the conduct of exchange rate policy with a view to stimulating non-traditional exports. Further, it is hoped that the results of the study will serve as a vehicle through which exporters can argue their case to Government by lobbying for an export-friendly macroeconomic environment and assist them to plan their export activities more effectively.

Research objectives

The major objective of this study is to estimate an all-encompassing but simple export econometric equation for Zambia's non-traditional exports between 1965 and 1999. We focus on the impact of the real effective exchange rate volatility, among other factors. Specific objectives are to:

- Evaluate the impact of real exchange rate volatility on Zambia's non-traditional exports.
- Estimate the degree of response of non-traditional exports to the level of the real exchange rate.
- Measure the impact of terms of trade in Zambia's trade policy vis-à-vis non-traditional exports performance.
- Ascertain the role of demand factors as measured by foreign income in the growth of non-traditional exports.
- Gauge the impact of structural changes and liberalization measures (through incentive creation) on the performance of non-traditional exports.
- Draw conclusions and make policy recommendations.

3. Exchange rate policy and exports performance

Exchange rate policy in Zambia has undergone marked changes over the years, ranging from the fixed exchange rate system between 1965 and 1985, through to the auction system of 1985–1987 and again the fixed regime for a brief period of 1987–1989. This was then followed by the dual managed exchange rate system between 1989 and 1991. In 1992, Zambia adopted a freely floating exchange rate, doing away with long-standing exchange controls in 1994 by abolishing the Exchange Control Act of 1965. Subsequently, the current and capital accounts were liberalized to attract foreign capital and investment inflows into the country. The policy was also meant to ease foreign exchange problems previously encountered by importers during the interventionist period. Table 1 summarizes the evolution of exchange rate policy in Zambia.

Table 1: Exchange rate policy regimes

Period	Exchange rate policy description
1964–1971	Rates fixed to the British pound sterling
1972–1976	Rates fixed to the US dollar
1977–1982	Pegged to the SDR with occasional devaluations
1983–1984	Pegged to a basket of major trading partners' currencies
1985–1987	Foreign exchange Dutch auction system introduced
1988–1989	Fixed parity to the US dollar re-introduced with occasional devaluations
1990–1991	Dual exchange rate system (managed float)
1991–1992	Open general licence (OGL) system, rate unified
1992–to date	Fully liberalized exchange rate policy

Source: Bank of Zambia.

Besides the exchange rate reforms made over the years, there have been other price and non-price policy reforms principally aimed at eliminating structural distortions in the non-traditional exports sector. Among the structural factors critical to the promotion and development of the sector in Zambia were the restructuring of the tariff regime, abolition of export licensing requirements, and streamlining of export related paperwork and border export handling procedures. A key expected impact of these reforms was to strengthen export competitiveness. The Government also set up supportive agencies to facilitate the diversification of the sector. Overall, there have been several efforts to stabilize the macroeconomic environment and strengthen the institutional framework in order to provide an environment conducive to exports development. In view of these developments, the performance of non-traditional exports in Zambia is closely linked to exchange rate episodes and other supplementary structural and trade policy measures.

During the fixed exchange rate system both price and non-price factors played an important role in shaping trade policy and the performance of non-traditional exports in the country. These were a less than competitive real exchange rate, shortage of foreign exchange for non-traditional exporters to purchase inputs, and a prohibitive trade tariff structure and other quantitative trade restrictions. In addition, the war following the Unilateral Declaration of Independence (UDI) (1965–1980) by Ian Smith in former Southern Rhodesia (now Zimbabwe) led to the disruption of trade links between Zambia and the rest of the world through the port of Durban in South Africa.

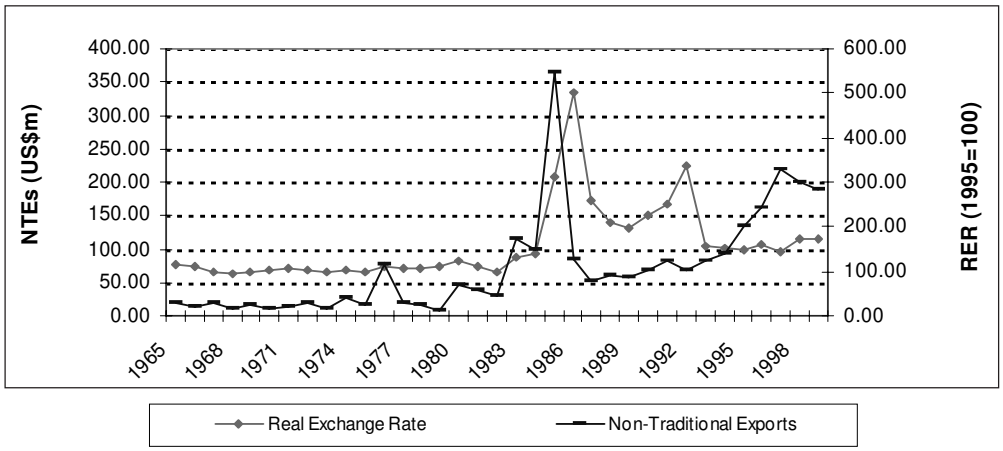
Meijer (1990) and Sekkat and Varoudakis (1998) argue that real appreciation in the Zambian kwacha coupled with other tighter trade controls restricted trade flows, especially exports of non-traditional products in the country. The shortage of foreign exchange further limited the growth and efficiency of the agriculture sector and led to low capacity utilization in the manufacturing sector (Sakala et al., 1984), the two sectors critical to the improvement of Zambia's terms of trade.

The introduction of the auction system in 1985 played a crucial role in making a legal market for foreign exchange in that it was the first time in many years the country had an experience of a market determined exchange rate insofar as weekly price setting was concerned. The nominal and real exchange rates also depreciated (Bates and Collier, 1995), providing some level of competitiveness in the export market. The life of the auction system was short, however, as the rise in domestic prices spurred by rapid exchange rate depreciation precipitated political discontent, prompting the government to abandon the IMF/World Bank supported adjustment programme in May 1987. Consequently, the Zambian government reverted to a fixed exchange rate system thereby reversing all the gains made during the auction period.

Given the problems experienced with fixed and quasi-fixed exchange rate systems prior to the 1990s, the government commenced the liberalization of the foreign exchange market in the late 1980s and eventually removed all administrative controls on the determination of the exchange rate in the early 1990s. The rationale for these reforms was to further stimulate the growth of non-traditional exports and promote export diversification in order to achieve a favourable balance of payments position. Between 1990 and 1999, the performance of non-traditional exports was relatively favourable, mainly because of an increase in exports of floriculture and horticulture products, which grew by an average of 36.1%. The increase in the floriculture and horticultural subsector was spurred by favourable investment flows into the sector. A sizable increase in sugar exports also contributed to the increased non-traditional exports during the same period.[3] The relationship between exchange rate policy and performance of non-traditional exports is better understood by graphical illustration as shown in Figure 1.

From the figure, it can be concluded that non-traditional exports performance was low during the fixed exchange rate system and restrictive trade regime. With the depreciation in the real exchange rate that occurred during the auction period between 1985 and 1987, non-traditional exports grew but then declined following the exchange rate policy reversal implemented in May 1987. During the 1990s, non-traditional exports recorded some improvement, mainly because of increased investment flows into the floriculture and horticulture subsectors and preferential treatment of sugar exports by the European Union under the Lomé II agreement.

Figure 1: Real exchange rate (RER) and non-traditioal exports (NTEs)



However, exports of building materials (cement and related products) and textile products such as cotton yarn and cotton lint have not fared well. The low performance may be explained in part by an unfavourable macroeconomic environment, including exchange rate volatility. In addition, it has been suggested that rising competition in international markets and other structural factors also led to a further decline in exports of Zambia's products during this period. Table 2 shows the performance of non-traditional exports between 1990 and 1999. Refer to Appendix A, tables A1–A4, for background data on non-traditional exports performance.

Table 2: Trend of non-traditional exports performance (1990–1999)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Aver
Total exports (US$ mn)	1,269.7	1,162.5	1,174.0	1,029.8	1,114.1	1,238.0	996.8	1,190.8	873.6	771.6	1,082.1
Total exports growth (%)	-7.1	-8.4	1.0	-12.3	8.2	11.1	-19.5	19.5	-26.6	-11.7	-4.6
Total NTEs (US$ mn)	102.2	121.3	102.0	124.1	156.5	202.5	240.8	328.6	301.8	284.9	196.5
NTEs growth (%)	17.9	18.7	-16.0	21.7	20.0	33.9	18.9	36.5	-8.2	-5.6	13.8
NTEs as % of total exports	8.0	10.4	8.7	12.1	12.5	16.4	24.2	27.6	34.5	36.9	19.1
Metal exports (US$ mn)	1,167.5	1,041.2	1,072.0	905.7	975.2	1,035.5	756.0	862.2	571.8	486.7	887.4
Metal exports as share of total exports	92.0	89.6	91.3	87.9	87.5	83.6	75.8	72.4	65.5	63.1	80.9

NTEs: Non-traditional exports
Source: Export Board of Zambia Exporter Audit Report, Bank of Zambia and author's estimates.

4. Review of the literature

Greater exchange rate volatility places significant adjustment costs on trade flows and also sends conflicting signals to investors as it creates uncertainty about their profits. On the other hand, lower volatility of the real exchange rate implies greater certainty about this important relative macroeconomic price (Kent and Naja, 1998).

The analytical argument

Effects of exchange rate variability on trade flows are analysed in terms of risk or uncertainty. Exporters are either very risk-averse or less risk-averse and therefore would react differently to changes in real exchange rates. Hooper and Kohlhagen (1978) and IMF (1984) postulate that if agents are risk-averse an increase in exchange rate variability induces them to reduce the volume of trade and reallocate production towards domestic markets.

De Grauwe (1988), however, argues that the effect of an increase in the exchange rate will depend upon the convexity of the utility function, which in turn depends on the degree of risk aversion. If agents are sufficiently risk-averse, an increase in risk associated with higher exchange rate volatility raises the expected utility of export revenue and induces exporters to export more to avoid a possibility of a reduction in their revenues. This is known as the income effect of exchange rate volatility. Conversely, the less risk-averse group views the increase in exchange rate variability in terms of greater risk. More real exchange rate volatility would prompt this category of exporters to reduce exports and divert resources to other sectors. This is the substitution effect. Under these assumptions, exports would increase with exchange rate volatility the greater the income effect and be depressed if the substitution effect outweighs the income effect. Ultimately, the effect of real exchange rate volatility on exports is ambiguous (Fountas and Aristotelous, 1999a/b; Cote, 1994).

Empirical evidence

Although there is a voluminous body of empirical literature on the effect of real exchange rate volatility on international trade, much of the attention has focused on industrial countries. For Africa and other developing countries, empirical evidence on the impact of exchange rate volatility on trade flows is scanty. Studies that have

found a negative impact include Grobar (1993) for a number of developing countries, Gonzanga and Terra (1997) for Brazilian exports, and Sekkat and Varoudakis (1998) for a panel study of sub-Saharan African manufactured exports.[4] According to Ogun (1998) and Adubi and Okumadewa (1999), there is a negative effect on Nigeria's non-oil and agricultural exports, respectively. Furthermore, Darrat and Hakim (2000) found a significant negative effect for Moroccan exports with the GARCH-based measure of nominal exchange rate volatility, but not with the standard deviation version of volatility.

Other developing country empirical evidence in support of the negative effect of exchange rate volatility on trade flows includes Kumar and Dhawan (1991) for Pakistan's exports to the developed world, Savvides (1992) for a combined sample of developed and developing countries, and Hassan and Tufte (1998) for Bangladesh's exports. Others are Asafu-Adjaye (1999) for Fiji export growth, Ozbay (1999) for Turkish exports, Hook and Boon (2000) for Malaysian exports, and Arize et al. (2000) for exports by 13 developing countries. In addition, Sauer and Bohara's (2001) comparative study of developed and developing countries on exchange rate volatility and aggregate exports found a negative effect for developing but not for developed countries.

In developed countries, the evidence in support of the adverse effect of exchange rate volatility on trade flows includes, among others, Hooper and Kohlhagen (1978) for the United States (US) and German bilateral exports, and Gotur (1985) for a number of developed countries. Maskus (1986) used sectoral analysis of exchange rate risk to study US trade and Kenen and Rodrik (1986) looked into the effect of short-term real effective exchange rate volatility. Koray and Lastrapes (1989) applied a VAR model to US bilateral imports from European countries, Chowdhury (1993) used a multivariate error correction model for the G-7 countries, and Arize (1997) studied seven industrialized countries. Other studies were those by De Arcangelis and Pensa (1997) for Italian export data; Fountas et al. (1998) for Irish exports; Arize and Malindretos (1998) for Australian and New Zealand exports, Fountas and Aristotelous (1999a/b) in the model of exports for the European Monetary System (EMS); and Dell'Ariccia (1999) with panel data for volatility-trade flows in the European Union.[5] On the other hand, Sauer and Bohara (2001) found a positive relationship between aggregate exports and volatility for industrial countries.

Clearly, a large number of studies has found a negative effect of exchange rate volatility on trade flows, but others point to a positive relationship. Therefore, the theoretical ambiguity of real exchange rate volatility effect on exports is also evident in empirical work. Cote (1994) reviewed some studies, mostly for industrial countries and observed the effect of exchange rate volatility on trade flows was mixed. Overall, however, a larger number of studies appeared to favour the conventional assumption that exchange rate volatility depresses the level of trade.

5. Model specification and estimation technique

Various export models have been used in the literature with similarly varying results. The findings depend on many factors, such as the sample period, frequency and disaggregation of data, and measures of volatility. They also depend on the country specific context (developed versus developing countries).

Model specification

In modelling the impact of exchange rate volatility on non-traditional exports, we take special interest in the model by Savvides (1992). This approach is typical of a two-country model of international trade. It assumes that demand for a country's exports depends on real foreign income and relative (foreign) prices as follows:

$$X^d = X^d (Y^f , P^f_x) \tag{1}$$

where X^d denotes the demand for exports of a country; Y^f is the level of real foreign income; P^f_x is the relative prices of exportables abroad; $P^f_x = P_E / (EP^f)$; P_E is the price of exportables in domestic currency; E is the nominal exchange rate defined as amount of local currency per unit of foreign currency; and P^f is the foreign price level.

The supply of exports depends on domestic relative prices, exchange rate volatility and the terms of trade as follows:

$$X^s = X^s (P_x , V , TOT) \tag{2}$$

where X^s is supply of exports; $P_x = (P_E / P)$ is the domestic relative price of exportables; P is the domestic price level; V is exchange rate volatility; and TOT denotes the terms of trade. In addition, the relative price of exportables abroad is then defined as $P^f_x = P_x / Q$, where $Q = (EP^f) / P$ is the real exchange rate. Expressing these functions in log form (lower cases denote natural logs), except for V, which can take negative values, and replacing P^f_x by P_x / Q, equations 1 and 2 look like so:

$$x^d = \alpha_0 + \alpha_1 y^f - \alpha_2 p_x + \alpha_3 q + \mu \tag{3}$$

$$x^s = \beta_0 + \beta_1 p_x + \beta_2 V + \beta_3 tot + \upsilon \tag{4}$$

where μ and υ are uncorrelated error terms. Assuming equilibrium in the export market (i.e., $x^s = x^d = x$) and solving for p_x from Equation 4 we get:

$$p_x = \frac{\beta_0}{\beta_1} + \frac{1}{\beta_1} x - \frac{\beta_2}{\beta_1} V - \frac{\beta_3}{\beta_1} tot - \frac{1}{\beta_1} \upsilon \tag{5}$$

Then, solving for x by substituting (5) into (3), we obtain the reduced form equation:

$$x = \frac{\alpha_0 \beta_1 + \alpha_2 \beta_0}{\Pi} + \frac{\alpha_1 \beta_1}{\Pi} y^f + \frac{\alpha_3 \beta_1}{\Pi} q + \frac{\alpha_2 \beta_3}{\Pi} tot + \frac{\alpha_2 \beta_2}{\Pi} V + \omega \tag{6}$$

where $\Pi = \alpha_2 + \beta_1$ and $\omega = \upsilon + (\beta_1 \mu)/\Pi$. Equation 6 shows that a country's exports depend linearly on the foreign (trading partners') real income, real exchange rate, terms of trade and exchange rate volatility. For estimation purposes (6) may be reformulated to obtain Equation 7, which may be considered as a solution to a system of behavioural export demand and supply functions, yielding:

$$x = \delta_0 + \delta_1 y^f + \delta_2 q + \delta_3 tot + \delta_4 V + \omega \tag{7}$$

where $\delta_1 > 0$; $\delta_2 > 0$; $\delta_3 > 0$; $\delta_4 >< 0$ and $\delta_0 - \delta_4$ correspond to the reduced form coefficients in Equation 6. The sign on the coefficient of V is so denoted to show the ambiguity of the effect of exchange rate volatility on exports as demonstrated in the literature.

Data

The study uses annual data on the following variables: Non-traditional exports *(NTEs)*, real foreign income (*WY*), terms of trade (*TOT*), real effective exchange rate *(REER$_{it}$)* and real effective exchange rate volatility, *V*. Data sources and measurements are in Appendix B.

In calculating the real effective exchange rate, we have used the period average nominal exchange rate and the prices for non-tradeable and tradeable goods measured by domestic consumer price index (p_{dt}) and trading partners' consumer price index (p_{it}), respectively. In order to construct a broad multilateral index of the real exchange rate to avoid arriving at misleading inferences regarding the evolution of a country's degree of competitiveness and capture the changing trade patterns between Zambia and its trading partners, the study uses annual trade shares for eight of Zambia's major trading partners accounting for over 70% of Zambia's trade flows (exports plus imports). This approach overcomes the bias of using single-year (or period average) data in view of the changing trade patterns (see Appendix A, Table A3, for country shares).[6] Data transformations

and estimations were conducted using *Eviews 4.0* while simulation analysis was undertaken using the CEF modelling software. Equation 8 gives a measure of the REER:

$$REER_t = \sum_{i=1}^{8}\left[w_{it} * \left(\frac{e_{it} * p_{it}}{p_{dt}} \right) \right] \tag{8}$$

where *REER* is the real effective exchange rate, e_{it} is the bilateral nominal exchange rate defined earlier, w_{it} is the ith trading partner trade weight, and p_{it} and p_{dt} are as defined above.

6. Empirical analysis of real exchange rate volatility and non-traditional exports performance

Before proceeding with the estimations, we undertook tests for unit roots in the series using both the augmented Dickey–Fuller (ADF) and the Phillips–Perron (PP) tests. The results (Table 3) show that we cannot reject the null hypothesis of stationarity at the 5% level and hence the series were differenced once to obtain stationarity.

Table 3: Unit root tests

a.) Augmented Dickey–Fuller (ADF)

Levels	Without trend	With trend
Log(NTEs)	-1.53	-2.87
Log(REER)	-1.99	-2.65
Log(WY)	-0.61	-3.26
Log(TOT)	-1.88	-1.48
VOL	-1.86	-1.83
First differences		
Log(NTEs)	-4.21**	-4.18**
Log(REER)	-4.63**	-4.57**
Log(WY)	-3.94**	-3.89*
Log(TOT)	-4.20**	-4.29**
VOL	-4.32**	-4.38**

b.) Phillips–Perron (PP) unit root test results

Levels		
Log(NTEs)	-2.16	-3.60
Log(REER)	-1.54	-2.22
Log(WY)	-0.52	-2.24
Log(TOT)	-1.70	-1.61
VOL	-1.77	-1.76
First differences		
Log(NTEs)	-9.92**	-10.2**
Log(REER)	-6.99**	-6.91**
Log(WY)	-3.66**	-3.57*
Log(TOT)	-5.83**	-5.88**
VOL	-6.50**	-6.93*

Note: *(**) indicate rejection of the null hypothesis of unit root at 5 % (1 %) level of significance.

VOL= h_t^2, generated from the GARCH equation below.

A GARCH model of exchange rate volatility

A prerequisite to using the GARCH method of estimation is to test for the presence of the ARCH effects in the real effective exchange rate process. To do this the Lagrange Multiplier (LM) ARCH test was employed. The real effective exchange rate was assumed to follow a primitive first-order autoregressive (AR) process, denoted AR (1), and the following equation was run:

$$\Delta Log\ (REER)_t = \alpha_0 + \alpha_1\ \Delta Log\ (REER)_{t-1} + \upsilon_1 \tag{9}$$

where *(REER)* is as defined above and υ is a disturbance term. The LM ARCH test was significant at the 1% level with a χ_1^2 distribution test statistic of 5.51 against the critical value of 3.84. The test was reinforced by the F-form statistic of 6.22 against the critical value (at 5%) of 4.17. Thus, the real effective exchange rate follows an ARCH (1,1) process. This test permitted us to generate the GARCH (1,1) series as a measure of real effective exchange rate volatility.

The general assumption is that disturbances from Equation 9 are not autocorrelated. Therefore, the GARCH process of this equation takes the relationship in Equation 10:

$$h_t^2 = \varphi_0 + \varphi_1 \varepsilon_{t-1}^2 + \varphi_2 h_{t-1}^2 \tag{10}$$

where h_t^2 is the time variant conditional variance of the real effective exchange rate, ε_{t-1}^2 is the squared residuals obtained from Equation 9, and φ_0, φ_1 and φ_2 are the parameters estimated. Equation 10 is the regression equation of our interest and gives the conditional variance, which is a function of three terms – the mean (constant); news about the volatility from the previous period measured as a lag of the squared residual from Equation 10, ε_{t-1}^2, also known as the ARCH term; and the last period's forecast variance, h_{t-1}^2, the GARCH term. Our estimation produced a GARCH (J*f*1) process, consistent with Siregar and Rajan (2002), who showed that experiments with GARCH models of higher order yield undesirable results. Thus, using the GARCH (1,1) result, the following maximum likelihood estimation (MLE) regression results were obtained.

The mean equation in Table 4 is an empirical mirror reflection of Equation 9 where the real effective exchange rate is derived as a function of its one-period lag, while the GARCH equation is the operational counterpart of Equation 10. In practice, this MLE may be interpreted as a prediction by Zambian non-traditional exporters of the current period's real exchange rate variance by forming a weighted average of a long-term average (the constant in the GARCH equation), the forecast variance from last period (the GARCH term) and the information about volatility of the real effective exchange rate observed in the previous period (the ARCH term). Thus, the predicted (fitted) series h_t^2 from the GARCH equation give an appropriate (GARCH) measure of real effective exchange rate volatility.

Table 4: GARCH model of real effective exchange rate volatility

Mean equation of the real exchange rate process (*ΔLog (REER)*)

Variable	Coefficient	t-statistic
Constant	0.68	1.33
$\Delta Log\ (REER)_{t-1}$	0.84	6.95

GARCH equation of the real exchange rate volatility h_t^2

Variable	Coefficient	t-statistic
Constant	-0.001	0.79
ε_{t-1}^2	1.69	2.22
h_{1-t}^2	0.35	1.72

Accounting for exchange rate regime shifts in ARCH models

Shifts in foreign exchange rate regimes may lead to shifts in policy parameters of national governments and/or shifts in the optimal response functions of economic agents (Liang, 1998). This was clearly evident in 1992 when moves to free the foreign exchange market from administrative controls led to a dramatic depreciation in both nominal and real exchange rates. What is not known, however, is whether the conditional variance of the real effective exchange rate also shifted. To test for the possible shift in the conditional variance, Liang (1998) proposes adding a dummy variable to Equation 10, yielding Equation 11:

$$\Delta h_t^2 = \phi_0 + \delta * Fixed + \phi_1 \varepsilon_{t-1}^2 + \phi_2 \Delta h_{t-1}^2 \qquad (11)$$

where *Fixed* =1 for fixed exchange rate regime (from 1964–1991) and 0 elsewhere. In this equation, if $\delta = 0$, that is, if the coefficient of the dummy variable *(Fixed)* is not significantly different from zero, then the equation reduces to the GARCH equation estimated above. This means that the intercept of the conditional variance does not depend on the exchange rate regime, implying that exchange rate volatility is regime neutral. Empirical testing of this equation yielded the results in Table 5 with the corresponding t-statistics and probabilities.

From the results in Table 5, we can deduce that exchange rate volatility does not necessarily depend on the exchange rate regime, as evidenced by the statistical insignificance of the coefficient on the dummy variable. Although the parameter estimate on the dummy variable indicates that the fixed exchange rate regime reduces exchange rate volatility, the effect is rather small and insignificant. We therefore proceeded to model the impact of exchange rate volatility on non-traditional exports for the entire sample period.

Table 5: Accounting for exchange regime shifts in ARCH models

Dependent variable: Exchange rate volatility (h_t^2)				
Variable	**Coefficient**	**Std error**	**t-statistic**	**Prob**
Constant	0.022885	0.024	0.969	0.341
Fixed	-0.000283	0.021	-0.013	0.990
ε_{t-1}^2	0.425532	0.067	6.383	0.000
h_{t-1}^2	0.622585	0.084	7.413	0.000

Formulation of an error correction model (ECM)

Given that the test results for stationarity indicate the presence of a unit root in all the series, we undertook a cointegration test using the Johansen (1991) procedure. Cointegration test results are given in Table 6. The outcome indicates that there is at most one cointegrating vector as shown by the trace (λ_{Trace}) statistic (at 1%). Hence we can reject the null of no cointegration in the variables at this level of significance, suggesting that there is a static long-run equation as shown in Table 6.

Table 6: Johansen procedure cointegration test results

Cointegration analysis 1965 to 1999				
Eigenvalue	**Trace statistic**	**5% critical value**	**1% critical value**	**Hypothesized No. of CE(s)**
0.6484	75.1835	68.52	76.07	None *
0.4689	41.7325	47.21	54.46	At most 1
0.3935	21.4828	29.68	35.65	At most 2
0.1377	5.48076	15.41	20.04	At most 3
0.0228	0.73937	3.76	6.65	At most 4

SERIES: Non-traditional exports (NTES), Foreign income (WY), Real effective exchange rate (REER), Terms of trade (TOT), Exchange rate volatility (VOL).
*(**) Denotes rejection of the null hypothesis at 5%(1%) significance level.
Trace test indicates 1 cointegrating equation(s) at 5% significance level.
Solved static long-run equation
Log(NTES) = -1.98 +1.05*Log(REER) + 0.10*Log(WY) – 2.91*VOL– 0.34*Log(TOT)
ECM=Log(NTES) + 1.98 –1.05*Log(REER) – 0.10*Log(WY) + 2.91*VOL + 0.34*Log(TOT)
Wald Test: χ_4^2 = 106.26

Given the presence of cointegration, we estimated an ECM of the form in Equation 12 in order to tackle the problem of spurious regression. The attractiveness of the ECM is that it provides a framework for establishing links between the short-run and long-run approaches to econometric modelling.

$$\Delta Log(NTES)_t = \delta_0 + \sum_{i=1}^{n} \delta_i \Delta Log(NTES)_{t-i} + \sum_{i=0}^{n} \phi_i \Delta Log(WY)_{t-i} + \sum_{i=0}^{n} \alpha_i \Delta Log(REER)_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_i \Delta Log(TOT)_{t-i} + \sum_{i=0}^{n} \rho_i \Delta VOL_{t-i} + \lambda ECM_{t-i} + \psi DUM92 + \Omega DUM80 + \omega_t ..... \quad (12)$$

In the equation, the coefficient (λ) on the ECM gives the speed of adjustment to the long-run equilibrium. As noted earlier, it has been argued that the reform to the exchange rate system and other policy measures beginning in 1992 were meant to boost the performance of non-traditional exports through the incentive structure associated with the reform efforts. During the sample period, significant structural changes pertinent to the performance of non-traditional exports also occurred.

To account for these reform measures and structural changes, we have included a step dummy, *DUM92*, in the short-run dynamic equation (one before 1992 and zero otherwise). Ordinarily, a variable quantitatively capturing the impact of these measures would be appropriate. Because of the lack of data, however, we have used the dummy variable. In addition, another step dummy, defined as *DUM80* (1 between 1965 and 1980 when the UDI war was in force and zero elsewhere), capturing the impact of the war was also included to quantitatively account for the adverse effects of the war on trade during this period.

Hypotheses

In order to determine the interaction of exchange rate volatility and the performance of non-traditional export, the following hypotheses were tested:

a.) Real effective exchange rate volatility has a depressing impact on the performance of non-traditional exports in Zambia. Thus the sign of the coefficient on the volatility variable is anticipated to be negative.

b.) A real depreciation in the exchange rate creates competitiveness in the export market and thus is expected to boost the growth of non-traditional exports. This is because real exchange rate depreciation acts as an incentive tool for economic agents to increase exports because of associated higher domestic currency returns. In addition, an exchange rate policy pursued in a stable and supportive macroeconomic environment is sure to be successful in promoting trade. Therefore, we postulate that the level of the real effective exchange rate will have a positive impact on non-traditional exports.

c.) Demand for exports depends to a certain degree on growth in real income in foreign markets. To this end, real foreign income is expected to increase the demand for foreign goods and thus Zambia's non-traditional exports. Hence, the coefficient on real foreign income is expected to be positive.

d.) Favourable terms of trade are anticipated to increase the volume of international trade. Therefore, it may be postulated that the terms of trade variable in the ECM equation will exert a positive impact on non-traditional exports.

Analysis of research findings

Equation 12 was estimated using the general to specific approach. A summary of estimation results for the parsimonious equation is presented in Table 7. The analysis that follows refers to the results of the parsimonious regression equation arrived at after eliminating the jointly insignificant variables and carrying out necessary diagnostic

Table 7: Parsimonious error correction mechanism (ECM) of non-traditional exports

	Dependent variable: Log(NTES)			
Variable	**Coefficient**	**Std. error**	**t-statistic**	**Prob.**
Constant	0.031	0.090	0.347	0.731
$\Delta Log(NTES)_{t-2}$	0.221	0.127	1.747	0.092
$\Delta Log(REER)_t$	1.381	0.378	3.657	0.001
ΔVOL_t	-2.798	1.287	-2.174	0.039
ECM_{t-1}	-0.892	0.183	-4.882	0.000
Adj. R^2 = 0.52	D– W =1.91	AIC = 1.63	SIC = 1.85	S.E = 0.52
F-stat. = 9.34 (0.00)	RSS=6.97			
Diagnostic tests				
Normality=0.797(0.671)		LM (2)=0.66(0.72)		Chow=3.86 (0.57)
ARCH=2.47(0.12)		White =14.31(0.07)		RESET(1) =0.12 (0.72)

tests. During the estimation process, both dummy variables were insignificant even though they carried correct signs. Furthermore, real foreign income also carried a theoretically inconsistent negative and insignificant coefficient in the short-run dynamic equation as did the terms of trade variable. Consequently, these variables were eliminated from the final regression equation and hence do not form part of the analysis.

The remaining variables in the preferred model explain just over half (52%) of the regression equation. This should not be surprising given that low adjusted R^2 is not unusual for regressions involving variables in first difference. A further check to model adequacy indicates that diagnostic tests render credence to the results.

The major focus of this paper is on the impact of the real effective exchange rate volatility on non-traditional exports. From the regression equation it has been shown that exchange rate volatility adversely affects non-traditional exports with a coefficient statistically significant at 5% level. This result is consistent with other findings for developing country exports as shown in the literature. Therefore we can argue that in the Zambian case, exporters may be risk averse and so would negatively react to real exchange rate volatility by substituting foreign trade with domestic production. Informal discussions with leading export analysts also revealed that the decline in export earnings may in part be attributed to unpredictable exchange rate movements. They argued that exchange rate instability had created an unfavourable climate for exports because of the associated risks.

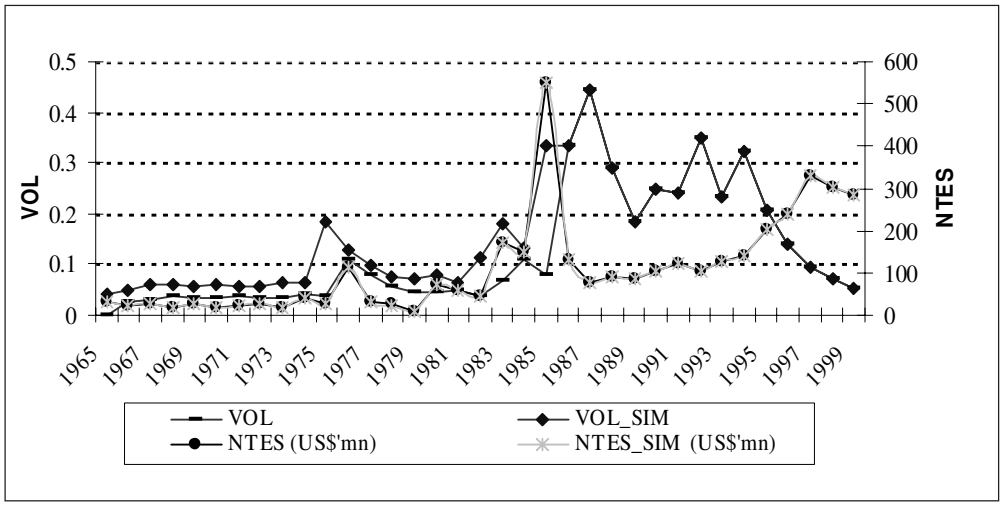
Regression results also show that the speed of adjustment on the ECM term is significant at 1% and carries the expected negative sign. The coefficient shows that 89.2% of the adjustment to equilibrium condition occurs within the first period. The effect of the real effective exchange rate is also statistically significant at 1% and appropriately signed. This result indicates that the contemporaneous effect is important in boosting exports, as shown by the size of the coefficient of about 1.4% adjustment response of non-traditional exports to the incentive structure of real exchange rate depreciation. This means that correcting for exchange rate over-valuation/under-valuation may have an important positive impact on Zambia's non-traditional exports in both the short run and the long run.

Dynamic simulation analysis

In evaluating the potency of exchange rate volatility on the performance of non-traditional exports, we have undertaken some simulation analyses. The essence of this dynamic simulation exercise is to show that with flexible exchange rates, volatility of the real exchange rate[7] dampens trade flows more than it does under a fixed exchange rate system. As explained earlier, the adoption of the floating exchange rate system in 1992 led to significant depreciation of both the nominal and real effective exchange rate. Thus, we may argue that the real exchange rate for 1992 may be representative of the "equilibrium" rate. We therefore took the difference of the average percentage of the actual real effective exchange rate for the subsample period (1965–1991) from the equilibrium 1992 rate and applied this change to the exchange rate volatility measure. The choice of the subsample period was dictated largely by the fact that prior to 1992 the exchange rate system was characterized by what may be termed a hard peg regime. This change was approximately 65%.

During this subsample period, the real exchange rate was allowed to increase by 65% using the CEF modelling software as a means of demonstrating that had the authorities pursued a flexible exchange rate regime throughout the sample period, the volatility of the real exchange rate would have been more harmful to non-traditional exports. Using dynamic simulation, the real exchange rate volatility was shocked by as much as 65% in order to fully account for the approximate true value of the volatility movements. The results of both the simulated exchange rate volatility and non-traditional exports are presented in Figure 2.

Figure 2: Simulated exchange rate volatility and non-traditional exports



A comparison of the simulated versus baseline series shows contradictory results. Although significantly large, the shock yielded little movement in non-traditional exports, indicating that even though our estimated parameter is relatively large in statistical terms, the simulated impact of the volatility variable on exports is rather muted. The figure

shows that there is very little difference between actual and simulated non-traditional exports, as indicated by the near matching of actual and simulated non-traditional exports series. Clearly, this may suggest that we cannot rely wholly on the statistical estimates to evaluate the effectiveness of real exchange rate volatility in affecting exports in Zambia.

The link between exchange rate volatility and non-traditional exports appears weak with dynamic simulation. Where a 1% change in exchange rate volatility leads to an almost 3% decline in non-traditional exports in the econometric regression results, the results from the simulated series indicate only a small decline in export performance. The lesson to be drawn from this exercise is that rather than target exchange rate stability in itself, other non-policy factors that account for export performance but cannot easily be picked up by econometric techniques must also be addressed.

7. Conclusions and policy implications

This paper has analysed the impact of real effective exchange rate volatility on non-traditional exports in Zambia using an error correction model. The study is unique from other previous works in that it applies the GARCH approach to measuring real effective exchange rate volatility.

The results of the error correction model corroborate the theoretical predictions of the impact of real effective exchange rate volatility on exports. The level of the real effective exchange rate and real exchange rate volatility are correctly signed and highly significant. However, the negative albeit insignificant effect obtained on the foreign income variable contradicts the economic law of income elasticity of demand. This result does not have any meaningful economic interpretation and thus the variable was omitted from the final regression equation. The coefficient on terms of trade was also found to be insignificant and wrongly signed, and we therefore omitted this variable from the analysis as well. The same applied to the dummy variables.

These results have significant policy implications in relation to exchange rate management, in particular, and overall macroeconomic policy formulation and management, in general. In relation to the exchange rate measures, it is clear that an unstable exchange rate will erode external competitiveness of the export sector because it undermines the incentive structure. For this reason, wild exchange rate fluctuations should be avoided, deregulation notwithstanding. If real exchange rate volatility is not checked, the influence of expectations on prices may decimate the desirable effects of changes in the structure of sectoral prices and then feed back to neutralize the much needed external competitiveness.

Given that the demand factors do not play a major role in influencing the performance of Zambian non-traditional exports, it may be suggested that being a small country, Zambia is a price taker in international exports markets. Therefore, exporters are not really constrained by demand factors. Hence, trade policy reform should be complemented by overall macroeconomic stability and removal of anti-export bias constraints.

Thus, to boost export performance, both domestic policy and non-policy supply impediments must be removed to level the playing field for non-traditional exporters. With regard to the latter, non price incentives such as lower electricity tariffs, better road infrastructure, and efficiency in processing export papers and other logistics at border points should be encouraged. Producers have in the past bemoaned the high electricity tariffs as a hindrance to efficient production, especially for manufactured products. Future research may endeavour to establish the empirical evidence of some of these factors and extend the results beyond this analysis.

Notes

1. In this study we define the nominal exchange rate as the amount of domestic currency per unit of foreign currency and the real exchange rate as the nominal exchange rate adjusted for inflation differentials between Zambia and its trading partner(s). Therefore, an increase (decrease) implies depreciation (appreciation) in the nominal or real exchange rate.

2. Traditional exports in Zambia are defined to mean all mineral and other metal exports, e.g., copper, cobalt, lead and zinc.

3. Sugar exports have grown as Zambia Sugar Company Plc has taken advantage of the existing trade agreements entered into between European Union (EU) member countries and the African, Caribbean and Pacific (ACP) countries (of which Zambia is a member).

4. In other studies reviewed by Grobar (1993) the relationship was found to be positive between standard deviation measure of exchange rate volatility and exports.

5. Fountas and Aristotelous (1999a/b) also provide a rich array of other empirical literature, some of which shows mixed results on the impact of exchange rate volatility on international trade flows.

6. Some studies (see Ajayi, 1991) have used a single year's trade shares. An attempt was made to calculate the real exchange rate using single-year share. Results from this approach were not significantly different from the approach adopted in the study.

7. Following the argument advanced by McKenzie and Brooks (1997), comparing results from the nominal and real exchange rates that are fitted by an ARCH model, it would be irrelevant whether the volatility coefficients are estimated from real or nominal exchange rates as the volatility is sourced solely from the nominal exchange rate.

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Appendix A: Supplementary tables

Table A1: Summary performance of non-traditional exports

Period	NTEXP (%)	NTEs growth (%), period average
1965–1968	3.2	1.5
1969–1976	4.5	8.0
1977–1991	6.1	-12.0
1992–1999	13.1	21.6

Notes: NTEXP= Non-traditional exports as a share of total exports.
Source: Author's own calculations (based on various data sources).

Table A2: Data bank

Year	Non-traditional exports (US$mn)	Real exchange rate (index 1995=100)	Trading partners real income (US$bn)	Real exchange rate (index 1995=100)	Terms of trade (index 1995=100)
1965	30.0960	-	828.6890	77.4880	356.3620
1966	21.3570	2.4356	829.6890	72.8510	425.1220
1967	26.7540	2.9119	830.6890	65.8870	312.4800
1968	17.8140	3.5688	831.6890	62.1980	344.3720
1969	26.5210	3.5238	832.6890	65.4480	407.5040
1970	16.0120	3.4253	833.6890	67.3070	380.0320
1971	20.4690	3.5554	834.6890	70.0360	238.5760
1972	28.5920	3.3389	835.6890	67.7310	217.3810
1973	16.9770	3.3375	836.6890	65.2050	321.2620
1974	42.7760	4.0600	837.6890	69.3500	103.9910
1975	25.1110	3.7020	838.6890	67.1150	66.2370
1976	113.0790	11.0085	839.6890	73.5720	67.3280
1977	30.6200	7.7589	840.6890	70.2530	57.8930
1978	24.8470	5.8106	841.6890	70.6640	59.8300
1979	11.0890	4.6107	842.6890	74.6480	38.3180
1980	70.8480	4.3586	843.6890	81.7740	34.9610
1981	56.5650	4.7916	844.6890	73.6980	28.9920
1982	44.1480	3.9400	845.6890	67.0200	26.7920
1983	173.6810	6.7147	846.6890	87.7550	31.5220
1984	148.1140	10.7037	847.6890	94.0310	28.3030
1985	548.4470	7.8286	848.6890	208.7970	30.3830
1986	129.1320	33.2926	849.6890	334.8190	56.7200
1987	77.4000	43.9854	850.6890	173.8260	57.4310
1988	89.0000	29.0933	851.6890	139.8820	103.2850
1989	86.9000	18.6746	852.6890	132.3680	93.3030
1990	102.2000	24.9818	853.6890	150.1250	67.9420
1991	121.3000	24.2587	854.6890	166.7440	70.8540
1992	101.9700	34.9733	855.6890	223.9130	70.4290
1993	124.1000	23.3349	856.6890	105.1590	66.9370
1994	138.9000	32.4869	857.6890	101.8710	84.8220
1995	202.5000	20.9741	858.6890	100.0000	100.0000
1996	240.8000	14.1112	859.6890	108.1260	66.0530
1997	328.6000	9.4202	860.6890	96.6710	69.2920
1998	301.8000	7.1427	861.6890	115.1470	74.2200
1999	284.9000	5.2838	862.6890	114.8770	51.3060

Notes:
1.) Trading partners total weighted real income (US$bn); 2.) Real exchange rate; 3.) Terms of trade; 4.) Zambia's total non-traditional exports (US$mn).

Table A3: Trade shares (1965–1999)

Year	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
USA	0.02	0.04	0.07	0.05	0.04	0.03	0.05	0.04	0.03	0.03	0.11	0.22	0.16	0.15	0.17
France	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.07	0.06	0.11
Germany	0.10	0.10	0.07	0.10	0.10	0.10	0.07	0.07	0.09	0.11	0.17	0.18	0.20	0.19	0.14
Italy	0.17	0.14	0.13	0.12	0.09	0.09	0.11	0.11	0.08	0.06	0.13	0.13	0.11	0.10	0.11
UK	0.31	0.29	0.25	0.27	0.25	0.23	0.20	0.21	0.20	0.21	0.34	0.28	0.29	0.30	0.29
South Africa	0.11	0.12	0.13	0.10	0.07	0.06	0.08	0.07	0.04	0.03	0.06	0.05	0.05	0.05	0.07
Saudi Arabia	0.13	0.10	0.10	0.09	0.07	0.07	0.09	0.08	0.06	0.05	0.10	0.08	0.08	0.10	0.09
Japan	0.09	0.11	0.15	0.15	0.19	0.18	0.14	0.16	0.19	0.16	0.21	0.19	0.18	0.22	0.22

Year	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
USA	0.20	0.18	0.11	0.15	0.16	0.12	0.15	0.16	0.06	0.04	0.06	0.12	0.11	0.03	0.03	0.16	0.09	0.08	0.05	0.04
France	0.16	0.10	0.09	0.10	0.03	0.03	0.07	0.05	0.08	0.04	0.02	0.01	0.04	0.06	0.03	0.03	0.02	0.06	0.04	0.2
Germany	0.13	0.12	0.13	0.08	0.09	0.08	0.07	0.12	0.11	0.04	0.05	0.07	0.05	0.05	0.06	0.04	0.04	0.04	0.03	0.04
Italy	0.14	0.13	0.12	0.15	0.10	0.09	0.12	0.16	0.17	0.06	0.06	0.07	0.08	0.03	0.07	0.02	0.01	0.01	0.01	0.01
UK	0.31	0.32	0.19	0.28	0.18	0.22	0.24	0.29	0.24	0.12	0.18	0.30	0.17	0.13	0.22	0.12	0.16	0.14	0.11	0.16
South Africa	0.00	0.00	0.14	0.00	0.21	0.20	0.22	0.11	0.24	0.12	0.16	0.26	0.32	0.45	0.36	0.37	0.44	0.50	0.40	0.65
Saudi Arabia	0.06	0.11	0.18	0.05	0.19	0.22	0.02	0.04	0.03	0.04	0.08	0.17	0.18	0.18	0.17	0.24	0.21	0.16	0.09	0.04
Japan	0.23	0.31	0.26	0.33	0.27	0.23	0.36	0.52	0.54	0.22	0.28	0.42	0.27	0.20	0.27	0.27	0.19	0.14	0.08	0.08

Note the shift in trade relations between Zambia and South Africa. The favourable shift coincides with change in the political landscape following the abolition of the apartheid regime in South Africa and subsequent resumption of trade relations with Zambia. South Africa is one of the largest trading partners in Southern Africa.
Source: Author's own calculations based on trade flows between Zambia and trading partners.

Table A4: Non-traditional exports by subsector (US$'000)

Subsector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Animal products	2,291	1,185	456	740	355	654	1,972	3,412	4,116	4,374	3,374
Building products	3,597	3,699	3,838	3,695	3,048	6,000	9,223	12,001	8,582	7,044	8,674
Chemical products	3,090	2,552	1,967	1,006	2,249	2,334	8,135	7,815	6,895	5,942	7,047
Engineering products	19,622	27,792	24,829	31,284	34,494	40,000	39,600	33,794	30,205	23,211	20,606
Floricultural products	1,050	1,902	2,987	5,506	9,110	18,000	4,784	7,385	32,355	42,607	33,863
Garments	2,514	2,566	1,360	688	501	402	239	248	371	328	394
Gemstones	7,638	10,189	9,947	13,301	9,437	8,000	11,845	14,544	11,584	13,333	15,435
Handicrafts/curios	187	95	64	80	85	100	0	95	163	208	251
Horticultural products	4,544	5,807	2,934	2,391	2,421	2,589	3,286	5,637	19,002	23,128	27,355
Leather	1,039	675	375	1,259	1,235	1,211	2,131	2,220	3,134	1,859	4,331
Minerals	1,713	1,824	1,548	1,361	821	751	1,020	542	532	981	1,137
Mining equipment	367	75	75	20	52	90	0	3,748	3,134	3,337	7,327
Other manufactures	1,086	907	389	30	28	18	10,850	3,021	3,090	6,040	4,359
Petroleum oils	11,144	3,742	1,081	173	3,917	11,000	3,251	1,808	6,814	6,412	439
Primary agric. products	14,542	22,761	19,968	25,072	10,008	24,000	44,527	90,959	57,642	61,973	37,103
Processed foods	6,196	4,758	14,177	15,117	22,193	26,000	33,441	30,938	47,163	32,832	35,553
Re-exports	0	0	0	0	0	0	0	3,896	4,839	2,685	3,958
Scrap metals	0		0	0	0	0	0	6,019	7,389	6,110	5,104
Textiles	8,586	9,380	13,670	11,062	18,461	35,000	40,766	50,638	42,370	35,190	36,034
Wood products	791	520	647	550	893	1,225	2,284	3,375	7,332	2,352	3,893
Other								31,648			
Subtotal	89,997	100,429	100,312	113,335	119,308	177,374	217,354	313,743	296,712	279,946	256,236
Electricity	12,205	20,893	1,658	10,756	19,552	25,124	23,470	14,814	5,080	5,000	…
Total NTES	**102,202**	**121,322**	**101,970**	**124,091**	**138,959**	**202,498**	**240,824**	**328,557**	**301,792**	**284,946**	**256,236**

Source: Exporter Audit Reports (various years), Export Board of Zambia (EBZ); Monthly Macroeconomic Indicators (2001), Ministry of Finance and National Planning; Balance of Payments (2000), Bank of Zambia.

Appendix B: Sources and definitions of variables

Domestic and foreign prices (consumer price indexes); Source: International Monetary Fund (IMF), *International Financial Statistics (IFS).*

Real foreign income measured by real gross domestic product (GDP) converted to a common US dollar currency; source: IMF's *International Financial Statistics (IFS).*

Nominal exchange rates; source: IMF's *International Financial Statistics (IFS)*, Bank of Zambia, *Fortnightly Statistics.*

Non-traditional exports, calculated as total exports less mineral exports in millions of US dollars; source: Export Board of Zambia, Bank of Zambia; IMF's *Supplement of Trade Statistics;* The World Bank, *World Tables (1994), African Development Indicators (1995), World Development Indicators CDROM (2001);* Monthly Macroeconomic Indicators from the Ministry of Finance and National Planning.*

Terms of trade, calculated as ratio of copper price index to oil index; source: IMF's *IFS.***

Trade shares; source: Bank of Zambia, *Non-Traditional Exports database* and IMF's *Direction of Trade.*

Trading partners accounting for 70% of Zambia's trade: *United Kingdom (UK), Republic of South Africa (RSA), Japan, United States of America (USA), Germany, Saudi Arabia, France and Italy.*

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*This approach of calculating the non-traditional exports is crude and is likely to pose some problems insofar as data accuracy is concerned. Preferably, the export data should have been disaggregated into different categories of non-traditional exports for a concrete analysis. Unfortunately, because of the poor data capture until 1994, this task was practically impossible to achieve.

**Zambia's major export is copper, while oil accounts for a significant share in the country's import bill. Therefore, the absence of export and import price indexes prompted us to use price indexes for copper and oil, respectively.

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