Why are some exchange rates more volatile than others? Evidence from middle-income countries

Roy Havemann[1] and Chandana Kularatne[2]

Abstract

All real exchange rates, pegged or floating, are characterised by currency volatility. In the literature, 'dirty floats', where the central bank intervenes to manage the value of the currency, are not found to be necessarily less volatile than 'free floats'. Indeed, some researchers have found that central bank intervention increases volatility.

To better understand why some currencies are more volatile than others, this paper considers the cross-country determinants of exchange rate volatility, paying particular attention to the role of the terms of trade. The data set consists of a panel of 24 macroeconomic indicators for 50 countries between 1981 and 2003. From this data set, a group of 25 relatively homogenous, middle-income emerging markets was chosen, including South Africa.

Overall, the paper finds that higher levels of reserves reduce volatility, and it is estimated that an appropriate level of reserves is approximately 4 ½ months of imports. Volatility is increased by increased uncertainty and loose fiscal policy increase volatility. In addition, a volatile terms of trade spills over into a volatile currency. From a policy perspective, whilst it is clear that prudent macroeconomic policy is the best course of action to reduce exchange rate volatility, the influence of external volatility on the exchange rate (over which the authorities have no control) should not be underestimated.

JEL Codes: F31, C23

1 Introduction

Floating exchange rates are an increasingly common feature of monetary policy regimes, often in combination with an inflation-targeting framework. The benefits of a fully floating exchange rate were set out as early as Friedman (1958). In particular, many countries rely on the currency to absorb external shocks. Notwithstanding the strong theoretical case for fully floating exchange rates, Calvo and Reinhart (2002) still find a pervasive 'fear of floating' – many countries are reluctant to allow their exchange rates to freely float, due in no small part to the fact that floating exchange rates can be extremely volatile.

[1] Strategic Finance & Strategy, Deloitte. roy.havemann@gmail.com
[2] School of Economics, University of Cape Town. chandana.kularatne@gmail.com

Hausmann (2005) has argued that this volatility may be due to commodity price volatility. To assess this empirically, this paper extends the econometric framework of Canales Kriljenko and Habermeier (2004) and Hviding, Nowak and Ricci (2004) to incorporate commodity prices. It is found that the Hausmann predictions are indeed empirically correct: After controlling for other macroeconomic variables, term of trade volatility does contribute to exchange rate volatility.

Another result that emerges from the preliminary data analysis is that, although it often does not seem that way, South Africa is not among the most volatile of world currencies. In the data set used in this study, it is found that the rand is the eighteenth most volatile out of a sample of fifty developed and developing countries over the period 1980 to 2000. In terms of volatility, South Africa ranks near Hungary (17), Mexico (19) and Paraguay (20). These countries are also in South Africa's peer group for many other indicators, not least of which their international credit rating.

2 Literature survey

Firstly, it is important to realise that all countries experience real exchange rate volatility, regardless of the exchange rate regime. This is because the real exchange rate measures both internal prices and external prices (tradables and non-tradables). A country with a fixed exchange rate and high inflation will experience a rapidly depreciating currency. Indeed, a flexible exchange rate may bring about real exchange rate stability, by reducing the likelihood of speculative attacks against the currency.

Clark *et al* (2004) collected data for almost all IMF-member countries, and found that less flexible exchange rate regimes do not necessarily guarantee reduced real exchange rate volatility. It could be argued that pegged currencies have a greater likelihood of becoming 'freely falling', as speculators may force the central bank to abandon a peg when reserves dry up (see, for example, Krugman 1996).

As shown in Table 1, commodity-exporting countries such as Australia and New Zealand also experience amongst the highest levels of volatility. A similar finding is made by Hausmann (2005) and in the data set compiled below. There is a large

literature[3] on the link between commodity-exporting countries and the *level* of the exchange rate, so it would follow that *volatility* in commodity prices may also filter through to volatility in exchange rates.

Table 1 Most and least volatile exchange rates, 1970 to 2002

Five most volatile currencies	
Advanced	Japan, Australia, Israel, New Zealand, United Kingdom
Emerging	Argentina, Uruguay, Turkey, Chile, Indonesia
Developing	Congo (Dem Rep of), Sudan, Angola, Bolivia, Ghana
Five least volatile currencies	
Advanced	Austria, BenLux, Canada, Netherlands, Denmark
Emerging	Panama, Singapore, Malaysia, Venezuela, Mexico
Developing	Martinique, French Guiana, Réunion, Netherlands Antiles, Bahamas

Source: Adapted from Clark *et al* (2004)

Turning to the recent empirical literature, it is clear that exchange-rate volatility is often due to poor macroeconomic fundamentals. Using a model selection algorithm, Canales-Kriljenko and Habermeier (2004) found that the following variables were significant determinants of volatility in the nominal exchange rate:

- Inflation;
- Real GDP growth;
- Fiscal deficit (% of GDP); and
- External trade (% of GDP)

Subsequent research by a former South African IMF team (Hviding, Nowak and Ricci, 2004) has shown that after controlling for macroeconomic conditions, increasing the level of reserves (relative to short-term debt) also reduces the volatility of the real effective exchange rate. Hviding *et al* (2004) argue that although theoretically freely-floating exchange rates do not require large reserve holdings, in practice the level of reserves may be an important signal for outside investors: for example, a low stock of reserves may reflect a history of populist monetary policy.

After decomposing daily and intra-daily exchange rate volatility into a continuous and jump components, Beine *et al* (2006) investigate the effect of intervention on realised

[3] See, for example, Clinton (2001), Cashin et al (2002) and Chen and Rogoff (2002).

volatility. After controlling for the impact of macroeconomic announcements on volatility, they find that co-ordinated exchange rate intervention may be a 'primary' cause of discontinuous jumps in the exchange, suggesting that intervention may exacerbate exchange rate volatility, rather than reduce it.

The role of exchange controls is also an area of debate. Canales-Kriljenko and Habermeier (2004) find that prudential limits on banks' foreign exchange positions may reduce volatility, by reducing speculative position taking. Glick and Hutchinson (2005) argue that reducing capital flow restrictions may reduce the likelihood of currencies being prone to speculative attacks and currency crises by reducing foreign exchange market distortions.

3 Data

The full data set used in this study comprises 50 countries with macroeconomic data from 1981 to 2003 sourced from the World Development Indicators (WDI) data set. Out of this data, a smaller sample of 25 middle-income countries with similar macroeconomic characteristics was chosen.

There are a number of different approaches to measuring exchange rate volatility and as a result, there is no generally accepted measure. Most countries do not publish monthly real exchange series. Consequently, this paper creates a real exchange rate series in the standard way, by deflating the nominal exchange rate relative to the United States using that country's consumer price index relative to the US consumer price index. However, the disadvantage is that this is not a trade-weighted measure, although for a significant proportion of countries there is substantial trade with the United States, suggesting this not a particularly important problem. An annual coefficient of variation[4] of the real exchange rate was calculated based on this monthly real exchange rate for each country in the sample.

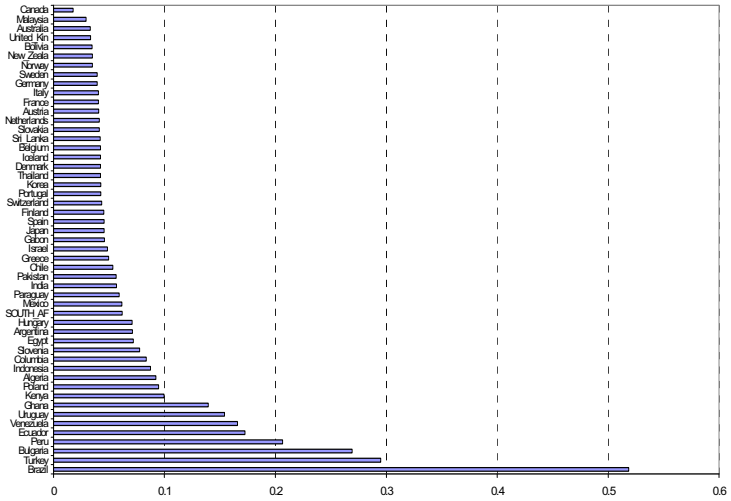
A number of interesting observations emerge from the data. In terms of volatility against the US dollar, South Africa is ranked with approximately the same level of

[4] The coefficient of variation is the standard deviation divided by the mean and is a more appropriate measure of volatility if data series have significantly different means.

volatility as Paraguay, Mexico and Hungary. In this particular sample, Brazil and Turkey are the two most volatile currencies, whilst Canada is the least volatile.

The data set consists of the following data series for each country: External debt (US dollars), GDP deflator, GDP growth, GDP per capita (PPP), GDP (PPP), gross reserves (US dollars), reserves (weeks of import cover), CPI inflation, GDP inflation, savings rate, M3 money supply as percentage of GDP PPP, growth in M3, domestic credit extension, net financial flows (World Bank definition), net financial flows (IMF definition), net foreign assets, net reserves, debt to GDP ratio, budget deficit, population, private capital flows, PPP conversion, real interest rate, current account balance and deposit interest rate.

Figure 1 Average exchange rate volatility against US dollar, 1980 – 2000 (full data set)



Using standard panel regression techniques the statistically significant variables in the regression were identified. These are discussed in more detail in the following section.

4 Econometric methodology

We proceed with an estimation using the panel estimator is provided by the Pooled Mean Group estimator (PMGE) provided by Pesaran, Shin and Smith (1999). We estimation technique employed is Autoregressive Distributed Lag (ARDL). This estimation technique is valid as the panel contains non-stationary variables.

4.1 The Panel estimator

PMGE provides an intermediate case between the dynamic fixed effects (DFE) estimator which imposes the homogeneity assumption for all parameters except for the fixed effects, and the mean group estimator (MGE) proposed by Pesaran and Smith (1995), which allows for heterogeneity of all parameters. It exploits the statistical power offered by the panel through long-run homogeneity, while still admitting short-run heterogeneity. The crucial question is whether the assumption of long-run homogeneity is justified, given the threat of inefficiency and inconsistency noted by Pesaran and Smith (1995). We employ a Hausman (1978) test (hereafter h test) on the difference between MG and PMG estimates of long-run coefficients to test for long run heterogeneity. Note that as long as the homogeneity Hausman test is passed in our estimations, we report only PMG estimation results.

4.2 Advantages and disadvantages

The natural advantage of using a panel data set and panel estimation is that the number of data points available becomes sufficiently large to draw meaningful results. However, one essentially obtains results for a group of countries, rather than one country separately. Thus the results are best interpreted as being true of the 'average' or 'representative' country.

It is worth pointing out that a crucial advantage of the estimation approach of the present paper, is that the dynamics of adjustment in the mark-up are explicitly modelled, while recognizing the presence of a long run equilibrium relationship underlying the dynamics.

4.3 Long-run homogeneity

One fundamental assumption underlying the panel approach is that over the long run, homogeneity exists across the countries: i.e. that is that the countries are sufficiently similar to justify arguing that they can be used together in a panel data set. The Hausmann test establishes that in this case the result does indeed hold.

5 Results

During the process of estimation, two groups of variables were found to have a significant influence on real exchange rate volatility. The first group is the country's macroeconomic fundamentals, i.e. variables that carry specific information about the country itself. The second group of variables – commodity price volatility – captures the effect of volatility in international markets.

In the 'fundamentals' category, the following variables were found to be significant:

5.1 Macroeconomic variables ('fundamentals')

- **Reserves**. In this paper, import cover, measured in number of weeks, is found to be a significant determinant of exchange rate volatility. It is estimated that that an *increase in foreign reserves of 1 week reduces exchange rate volatility by 4 per cent*. This result is robust across specifications. Although Hviding *et al* (2004) argue that this result may be non-linear, with 'decreasing returns to reserves', a non-linear result is not found in this study. This may be as a result of the countries in the sample being relatively homogenous with low reserves.

- **Fiscal policy**. Two different variables were used to measure the fiscal policy stance. A better budget balance to GDP ratio (i.e. a narrowing of the budget deficit or increase in the budget surplus) reduces real exchange rate volatility. Referring to regression (1) it can be seen that *a one percentage point improvement in this ratio leads to a 0.8 percent decrease in real exchange rate volatility*. Similarly a higher debt-to-GDP ratio is associated with higher real exchange rate volatility. As indicated in regression (2) *a one percentage point increase in the debt-to-GDP ratio leads to a 0.27 percent rise in exchange rate volatility*. Both variables are significant at the 5 per cent level. Note that the number of countries in the sample falls from 25 to 19 if the debt-to-GDP ratio is used rather than the fiscal balance variable. This is due to a lack of a consistent debt data set across countries.

- **GDP growth**. This is found to be only *weakly significant* and not robust to different specifications. One regression that did include this variable is reported – regression (4). It suggests that *a one percentage point increase in growth leads to a 2.7 percent decrease in real exchange rate volatility*. However, it cannot be overemphasised that this variable is problematic in this context. It is not robust across different specifications. There is also an inherent endogeneity problem with it not being theoretically or empirically clear if exchange rate volatility reduces growth or if growth reduces exchange rate volatility (for example, a strongly growing country may be at less risk of a currency crisis as it able to attract sufficient capital inflows).

5.2 Terms of trade shocks

Given the small and open nature of most of the middle-income emerging markets in the data set, *a priori* there is reason to believe that the terms of trade may influence the exchange rate. By extension, terms of trade volatility should influence exchange rate volatility. To the knowledge of the authors this has yet to be incorporated in the empirical literature, although Hausmann (2005) provides a strong theoretical case for how terms of trade volatility may influence the exchange rate.

Intuitively, under a flexible exchange rate regime, countries experiencing volatile terms of trade will also experience volatile exchange rates; whereas under fixed regimes, the consequences of a sharp increase in commodity prices (such as the oil price) will be reflected in higher inflation. As a result, inflation will be volatile and hence the underlying real exchange rate will become volatile too.

Due to data constraints, it was not possible to construct a direct measure of the term of trade volatility as this data is not available for all countries at a high frequency and as the terms of trade measure is highly correlated with the exchange rate. Second best is thus to proxy this volatility. This paper chooses oil price volatility as the measure best suited to proxy terms of trade volatility. This is because the oil price is an important part of either the import or export basket for almost all the countries in the sample.

It is found that a one percent increase in the volatility of the oil price leads to a 0.06 to 0.07 percent increase in the volatility of the exchange rate depending on the specification. Table 2 reports two of the regressions, one with the budget-balance measure and one with the GDP growth measure.

	Regression (1)	Regression (2)	Regression (3)	Regression (4)	Regression (5)	Regression (6)	Regression (7)	Regression (8)	Regression (9)
Variables	Reserves, Budget surplus -to-GDP, uncertainty, oil volatility	Reserves, Debt-to-GDP, uncertainty	Reserves, GDP growth, uncertainty, oil volatility	Reserves, GDP growth, uncertainty dollar/euro volatility	Budget surplus -to-GDP, openness, uncertainty	Openness, uncertainty, oil volatility	Change in the current account, import cover, uncertainty	Inflation rate, change in the inflation rate, oil volatility	Debt-to-GDP, inflation rate, change in inflation rate
Macroeconomic variables	N = 25 T = 15	N = 19 T = 22	N = 19 T = 21	N = 19 T = 20	N = 19 T = 21	N = 19 T = 23	N=19 T=23	N=19 T=22	N=19 T=22
Import cover (weeks) mpco	-0.043** (-2.98)	-0.044** (-3.09)	-0.037** (-4.45)	-0.044** (-3.64)	n/a	n/a	-0.022** (-2.78)	n/a	n/a
Budget surplus to GDP ratio dfgd	-0.008* (-1.89)	n/a	n/a	n/a	-0.013** (-2.36)	n/a	n/a	n/a	n/a
Log debt-to GDP ratio ldgp	n/a	0.279** (2.90)	n/a	n/a	n/a	n/a	n/a	n/a	0.398** (4.04)
GDP growth dgdp	n/a	n/a	-0.574 (-1.50)	-2.378** (-4.33)	n/a	n/a	n/a	n/a	n/a
Openness	n/a	n/a	n/a	n/a	-0.221* (-1.72)	-0.122** (-2.14)	n/a	n/a	n/a
Inflation rate (proxy for expected inflation)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.178** (3.70)	0.32** (5.25)
Change in the inflation rate	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-0.037** (2.77)	-0.032** (-1.99)
Log Uncertainty lunc	0.103** (9.65)	0.100** (9.10)	0.117** (16.20)	0.132** (9.25)	0.105** (8.392)	0.096** (9.29)	0.100** (8.97)	n/a	n/a
Terms of trade volatility									
Log Oil volatility loiv	0.062** (2.44)	n/a	0.074** (3.94)	n/a	n/a	0.064** (2.79)	n/a	0.060** (2.20)	
Change in Balance of Payments (current account)	n/a	n/a	n/a	n/a	n/a	n/a	-0.068** (-3.95)	n/a	n/a
World volatility									
Dollar/euro volatility	n/a	n/a	n/a	2.309** (2.82)	n/a	n/a	n/a	n/a	n/a
Φ	-0.858** (-13.27)	-0.842** (-12.46)	-0.915** (-7.24)	-0.827 (-8.85)	-0.908** (-17.90)	-0.985** (-10.56)	-0.913** (-7.55)	-0.86** (12.90)	-0.79** (-12.87)
Joint Hausman test (p-value)	1.80 (0.77)	0.53 (0.91)	7.10 (0.13)	5.39 (0.25)	4.08 (0.25)	4.14 (0.25)	6.15 (0.10)	5.99 (0.11)	5.35 (0.15)

** Significant at the 10% level. ** Significant at the 5% level. t-ratios in parenthesis. Pooled MGE Estimates. Hausman test null is that there is long-run homogeneity across countries.*

Table 2 Regression results

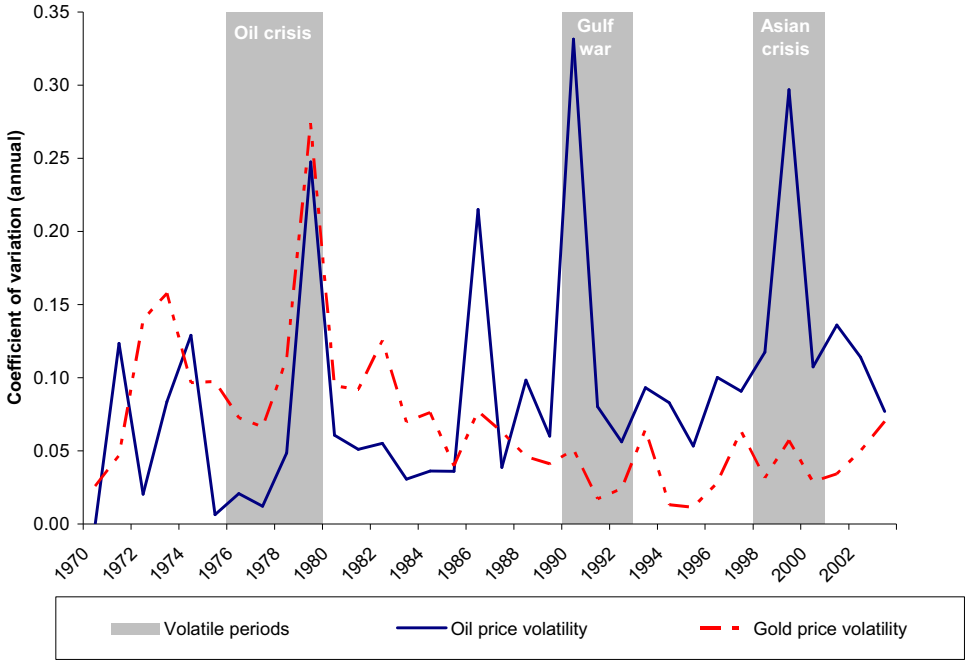
5.3 World volatility

There is a strong argument that there are time-specific factors at play when considering exchange rate volatility: i.e. one can identify periods such as the Asian crisis for example. Although the effects of the sudden devaluation of the Thai bhat during the 1998/9 Asian crisis were initially only felt in south-east Asia, financial contagion quickly spread throughout global financial markets. This is a good example of a case where the poor fundamentals of one country (in this case Thailand) led to exchange rate volatility in other (emerging) countries.

There are a number of approaches that may be used to capture this type of effect. As indicated in Figure 2, the measure of terms of trade volatility may also be a good indicator of world volatility.

An alternative measure, the volatility in the dollar-euro exchange rate, is also found to be significant in some specifications (see regression 4 in Table 2) for an example. However, in most specifications it is found to be not statistically significant.

Figure 2 Oil and gold price volatility, 1970 to 2002



6 Conclusion

The literature and the results in this study suggest that prudent macroeconomic policy (a combination of low inflation, health budget balance and reserves accumulation) lowers exchange rate volatility. Particularly, results in other studies underscore the role of reserves in reducing volatility, even if this is merely as a signal to market participants.

This study extends the literature to consider the role of the terms of trade. It is found that terms of trade volatility (proxied by oil price volatility) increases exchange rate volatility for the countries in the sample. This is not surprising as many of the countries are either significant importers or exporters of oil.

The relationship between GDP growth and exchange rate volatility appears complex and raises a number interesting puzzles: Does GDP growth lead to lower exchange rate volatility as capital inflows are strong and stable? Or, does lower exchange rate volatility lead to higher GDP growth? Or, controversially, does a volatile exchange rate buffer the economy from external shocks? There is a large literature on the relationship between trade and exchange rate volatility (see, for example, Clark 2004). However, in general the results are mixed and it is not clear what the nature of this relationship is. Clearly more research is required regarding the impact of exchange rate volatility on GDP growth in the South African case.

This study concentrated on the cross-country determinants of exchange rate. Future research will focus on South Africa-specific considerations. In particular, the relatively concentrated market structure raises questions about whether or not participants have sufficient power to 'move' the market, or whether large transactions create temporary exchange rate misalignment, which then is corrected after a period of relative volatility.

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