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Speculative Flows, Exchange Rate Volatility and Monetary Policy: the South African Experience

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Non-technical summary

Long-term real exchange rate volatility raises the risks associated with investment in the tradable sector, and it is detrimental to long-term growth. Short-term volatility can however be hedged; reduces the currency's attractiveness as a carry trade target; induces necessary caution against the build-up of liabilities denominated in foreign currency; helps maintain the scope for independent monetary policy; and, through rapid up and down movements, it can help reduce prolonged misalignment and long-run volatility.

Capital flow variability affects exchange rate volatility; restrictions (e.g., as adopted in Brazil) on the *level* of inflows do not necessarily reduce the variability of inflows. Measures of external vulnerability have a strong association with emerging market currencies' sensitivity to global flows. South Africa's external financing requirement leaves its currency vulnerable, and points to unused scope for foreign exchange reserve accumulation. (Existing restrictions on outflows by residents could also vary depending on the size and direction of non-resident inflows.) Macro fundamentals matter for long-run rand behaviour. Upper variance bounds implied by fundamentals are not systematically breached at low frequencies.

Speculative carry inflows can be destabilizing, and may reduce the effectiveness and scope for independent monetary policy – depending on the responsiveness of domestic credit growth to capital inflows. In South Africa, this responsiveness has been comparatively low (under QE-driven liquidity). Yields at the short end of the South African term structure of interest rates are significantly responsive to the domestic factors which affect the (domestic) monetary policy stance. Changes in long-term yields are however highly responsive to changes in global yields, but not more so than long yields in advanced economies.

Low and stable inflation serves a counter-speculative role. It permits low nominal interest rates (and interest differentials), which reduces the rand's appeal as a speculative target, without the repression of negative real interest rates. Low interest differentials are associated (cross-section) with low exchange rate volatility.

Speculative Flows, Exchange Rate Volatility and Monetary Policy: the South African Experience *

Shakill Hassan †

This version: February 2015

Abstract

This paper presents a discussion on the volatility of the South African exchange rate, its relationship to capital flows, and the currency carry trade; and on the channels through which (potentially destabilizing) carry inflows can erode the effectiveness and independence of monetary policy. I note the different consequences of short and long-term currency volatility; the benefits from a moderate degree of short-term volatility; the scope for foreign exchange reserve accumulation (and other prudential tools); and argue that low and stable inflation serves a counter-speculative role – by permitting low nominal interest rates, which reduce the currency's speculative appeal, without the repression of negative real interest rates. Low interest differentials are also associated (cross sectionally) with lower exchange rate volatility.

Keywords: carry trade, capital flows, currency volatility, monetary policy independence, inflation targeting.

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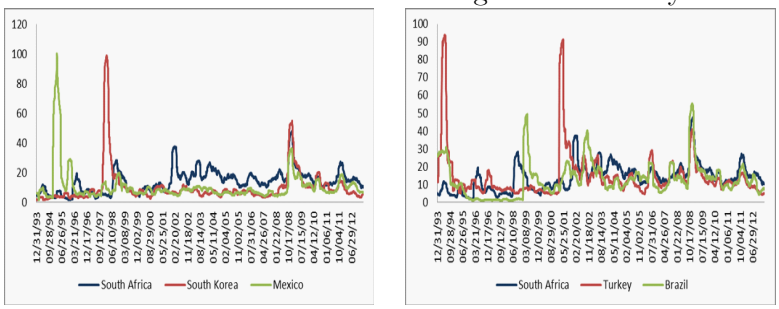
1 Introduction

The South African currency (the rand) is volatile. The first figure in Table 1 shows the three-month historical volatility (standard deviation, annualized) of the rand per dollar exchange rate since 1993. From the early 2000s, rand volatility consistently exceeds that of the Mexican and South Korean currencies, and moves very closely with that of the Brazilian and Turkish currencies.

Table 1: Three-month exchange rate volatility



Source: Bloomberg

One of the immediate determinants of rand exchange-rate movements is the volume of portfolio capital flowing to and from the country. Of particular concern is the increasing volume of portfolio debt inflows – notoriously volatile, primarily driven by global factors (risk and liquidity), and the long-term economic benefits of which, remain elusive.[1]

Debt inflows into relatively high-interest economies (emerging and advanced) are at least partly, and often largely, driven by the currency carry trade – a class of currency speculation strategies designed to profit from a favorable interest-rate differential, when the high-interest currency does not depreciate substantially (as to erode the interest 'carry') relative to the low-interest currency. The evidence is that in the short term and on average, it does not. If it appreciates, as it often does, the speculator gains on both the exchange rate and the yield differential.[2]

[1] See Hassan (2013, 2014) on the evolution of bond inflows (non-resident purchases of South African debt).

[2] The profitability of carry trades is evidence that uncovered interest-rate parity does not hold in the short to medium term. The simplest way to implement the carry trade is to borrow in the low-interest currency (the "funding currency"), buy the high-interest currency (the "target currency") in the spot market, deposit the proceeds or buy fixed-income securities denominated in the target currency, and finally convert the terminal payoff back into the funding currency – facing the exchange rate risk. This is the conventional (textbook) understanding of the carry trade. But it can also be implemented through the derivatives market, for example selling the currency forward when it is at a significant forward premium, or using currency options to hedge the exchange rate risk component.

1.1 Complications

The interaction between currency speculation and monetary policy can be destabilizing and lead to policy ineffectiveness – especially in inflation targeting regimes. In brief, the mechanism is as follows. Debt inflows tend to be expansionary, either by reducing yields, or by fueling credit extension, or both. The expansionary impetus can cause the economy to "over-heat". The associated increase in the inflation forecast, if beyond target, requires the central bank to tighten the monetary stance. But increasing the policy rate raises market rates, at least across short and medium term maturities, which increases the yield differential, and attracts further carry inflows, generating a 'vicious cycle'. The erosion in the effectiveness of monetary policy in containing inflation follows from the tension between the (intended) contractionary effect on demand from an increase in the policy rate; and the expansionary effect of more inflows due to the same rate increase.

This feedback loop leads to an accumulation of debt inflows, and exchange rate appreciation. If the currency is misaligned (and overvalued), the central bank may be impelled to intervene in the currency market, to mitigate possible losses in export competitiveness. Sterilized purchases of foreign currency, funded by issuance of domestic currency securities, both raises the appetite (by exerting upward pressure on yields), and feeds (by increasing the supply of bonds) carry traders. Moreover, if the intervention succeeds in halting exchange rate appreciation, the stability of the exchange rate reduces exchange rate risk, and traders may anticipate eventual appreciation once sterilized intervention becomes too costly. Again, the policy response (in the currency market) attracts further inflows.

Capital may move in slowly, due to the opportunity cost of holding "standby capital", so target currencies appreciate gradually, which attracts momentum trading, in turn fueling further appreciation. [3] The further this process goes, the greater the degree of currency misalignment; and the greater the eventual abrupt fall in the value of the currency, when the carry trade unwinds and capital inflows reverse.[4] The process leads to unstable currency dynamics: the "up the stairs, down the elevator" pattern in exchange rate behavior.

Note that central to the preceding argument is the effect of debt inflows

[3] The existence and magnitude of carry returns are likely to be due to a combination of reasons, including compensation for crash risk (e.g., Brunnermeier, Nagel and Pedersen (2009)), infrequent portfolio adjustments (Bachetta and van Wincoop (2010)), and the interaction between carry trades and monetary policy (Plantin and Shin (2014)).

[4] Gagnon and Chaboud (2007) document the exchange rate effects of unwinding carry trades.

on credit – the main channel through which inflows cause overheating. In the absence of such a causal effect, the precise channel through which inflows induced by the currency's carry appeal are destabilizing is not clear. Note also that it is not entirely clear what form of currency volatility is induced by the instability caused by carry trades: high-frequency short-lived oscillations, or short-term stability coupled with sporadic large adjustments?

1.2 Outline of the paper

The remainder of the paper is organized as follows. I start with a brief discussion of indirect indications of rand-targeting carry activity; the rand's carry appeal; and the effect of short-term volatility on the carry trade. At the monthly frequency, the relationship between carry trade returns and portfolio debt inflows, seems quite strong when the Japanese yen is used as funding currency. The same applies for the relationship between carry and rand swaps turnover

From a policy-maker's viewpoint, it is useful to distinguish long-term currency volatility from short-term volatility. Long-term volatility has distortionary effects. It raises the risks associated with investment in the tradable sector, and it is detrimental to long-term economic growth. Short-term exchange-rate volatility matters for currency speculators – it encourages derivatives traders, and discourages carry traders for example. But there is no evidence of, nor compelling theoretic arguments for, a negative relationship between high-frequency short-term nominal exchange rate volatility and measures of economic welfare. Indeed, I argue that a moderate level of short-term nominal exchange rate volatility has some benefits, and may help reduce the distortionary effects of volatile inflows. There is however substantial international evidence showing a negative relationship between long-term real exchange rate misalignment (and its volatility), and economic growth. The section on exchange rate volatility is organized into two subsections reflecting this distinction.

The first sub-section shows the high-frequency effect of non-resident inflows on the currency; and the relationship between bond inflows and exchange rate movements. The second section turns to long-term volatility. It draws on evidence showing that long-run low-frequency rand volatility can be (but it is generally not) "excessive" once we use a defensible benchmark for normal volatility. At lower frequency and considering long-term statistics, the relationship between capital flow levels and exchange rate volatility is weak. There appears to be a strong relationship however between the variability (second moment) of net purchases of domestic securities by non-

residents, and long-run currency volatility. Gross outflows (net purchases of foreign securities by residents) tend to move in the opposite direction, so although of lower magnitude (and subject to regulatory quantitative limits), help reduce the volatility caused by gross inflow variability.

Section 4 turns to the effects of carry driven inflows on monetary policy – its effectiveness in an inflation targeting framework, and the scope for independence from monetary conditions in global financial centres. I argue that US and global monetary conditions restrict, but do not determine, the scope of domestic monetary policy; and recently the effect of capital inflows on credit growth is weak in South Africa. Section 5 is a discussion of the potential benefits of allowing a moderate degree of short-term currency volatility. Section 6 contains concluding remarks on policy responses to high long-term capital flow and exchange rate volatility. It contains a comment on the case for capital controls; the scope for currency market intervention to build reserves which help buffer the currency against sudden and large movements in capital; discusses macro-prudential tools; and presents a counter-speculative case for low inflation.

2 The rand as a carry trade target

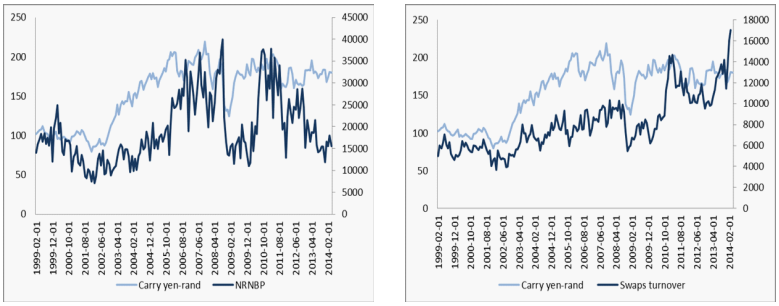
Carry trade flows are fungible. There is no exact information on the extent of targeting on any specific currency. The are numerous ways to implement the trade, including through over-the-counter derivative contracts (which in turn give rise to hedging trades by counter-parties); participants include unregulated non-bank financial institutions (especially hedge funds and commodity trading advisors); and target currencies are heavily traded offshore. Moreover, the scale of positioning on any currency will vary over time. Evidence on the extent of rand targeting is therefore indirect and merely indicative.

The carry-to-risk ratio, defined as the ratio of the interest-rate differential to expected exchange rate volatility, is a standard measure of a currency's carry appeal. Periods of high correlation between foreign exchage turnover and the carry-to-risk ratio, suggests that turnover is likely to be related to carry trade implementation. Galati, Heath, and McGuire (2007) report a low-frequency correlation of 0,36 for the rand, the third highest after the Norwegian krone and the Autralian dollar.[5]

[5] More tentatively, rand foreign exchange derivative transactions (especially swaps) far outweigh spot transactions; and the former are often linked to non-resident activity in the domestic bond market. (See the appendix, and Hassan and Smith (2011).) The evidence

Figures in Table 2 contrast the Bloomberg carry index (short yen, long rand, three month trade horizon) with, first, monthly net bond inflows, and second, the swaps (dominant) component of rand FX turnover (US dollars, millions). The sample correlation between yen-funded rand-targeting carry returns and net purchases of South African bonds is approximately 0,5 (50%); with currency swap turnover it is approximately 0,6.

Table 2: Carry returns, bond inflows, currency swap turnover



Source: Bloomberg

These observations suggest that the return from Japanese yen-funded rand-targeting carry might be an important driver of net purchases of South African bonds, and of rand swap turnover, suggesting carry implementation through a combination of spot and derivative transactions.

2.1 Attractiveness of rand-targeting

Currency speculators targeting the rand and other high-interest currencies through the carry trade were exposed to very large losses between 2007 and 2008. The appeal of the rand as a carry target, as well as that of other emerging market currencies, was firmly restored from 2009. The annualized average return from targeting the rand through Japanese yen-funded

from Turkey suggests that hedge funds and investment banks implementing carry trades are the main swap counterparties. As of June 2010, portfolio fixed-income flows to South Africa were primarily intermediated through a set of financial centres comprising Luxembourg, Jersey, Cayman, British Virgin Islands, Bermuda, Bahamas, and Liechtenstein (IMF, 2011) - jurisdictions where hedge funds (and off balance-sheet structured investment vehicles until recently) are typically domiciled. Interestingly, the largest net flows of yen between 2002 and 2007, were from Japan to the Caribbean financial centres, according to Bank for International Settlements data (see Galati, Heath and McGuire, 2007).

speculation, using the forward currency market and trading at the weekly frequency, between January and December 2010, was approximately 32% (before transaction costs), with a ratio of mean return to volatility of 1,89.[6] This large return-to-volatility figure is close to the historic average performance of the rand as a (yen-funded) carry trade target over the last decade. The high returns from multi-target international carry trade portfolio strategies are well documented.[7]

Hassan and Smith (2011) and Hassan (2014) show that the average cumulative returns from Japanese yen-funded rand-targeting speculation through the forward market are volatile but high, though highly sensitive to trade initiation date; and with a particularly attractive risk-return profile after crashes in the rand.[8]

2.2 Interest differentials and currency volatility

Carry returns depend positively on the interest differential, and negatively on exchange rate volatility – specifically, depreciation of the target currency erodes carry returns. Low exchange rate volatility coupled by a favorable interest differential (and an under-valued target currency) induces currency carry speculation.[9]

This observation is important in understanding to what extent high domestic interest rates drive bond portfolio flows. To the extent that such inflows are driven by the carry trade, the interest differential (domestic versus funding currency), only drives inflows when volatility is low. The rand's attractiveness depends on volatility being low (and its covariance contribution to the mean-variance profile of carry trade portfolios).

[6] The ratio of mean return (in excess of a risk-free rate when applicable) to the standard deviation of returns, commonly known as the Sharpe ratio, is a widely used (albeit imperfect) measure of "reward-for-risk." The average Sharpe ratio for buy-and-hold investment in the JSE is around 0.5, and anything above 1 is generally regarded as highly attractive.

[7] See Burnside, Eichenbaum, and Rebelo (2007, 2008), Brunnermeier, Nagel, and Pedersen (2009), and Lustig and Verdelhan (2009). Carry trade payoffs are uncorrelated with stock market returns, and cannot be easily explained by standard risk factors. (See Burnside (2011)).

[8] Note that the payoffs from rand-targeting vary, and are of course often negative. The documented average returns from rand-targeting are strongly influenced by the extraordinarily high gains in the period following the 2001 rand crisis.

[9] These inflows in turn tend to lead to currency crashes.

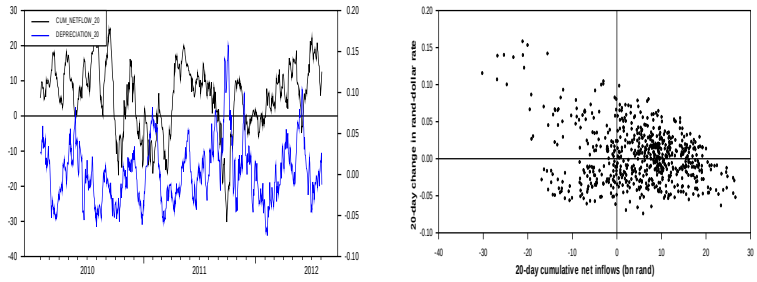
3 Capital flows and exchange rate volatility

3.1 Short-term volatility

3.1.1 Portfolio flows and exchange-rate behavior

Portfolio inflows reflect foreign demand for domestic securities and naturally have an effect on exchange rate levels. High-frequency (daily) cumulative net purchases of domestic securities (stocks and bonds) by non-residents are negatively associated with rand depreciation (i.e. positively associated with the dollar value of the rand). This is immediately apparent for the recent past, for cumulative net inflows over twenty days, from the first figure in Table 3; and confirmed by the scatter plot, as well as simple regression analysis.[10]

Table 3: Twenty-day cumulative net inflows and rand depreciation



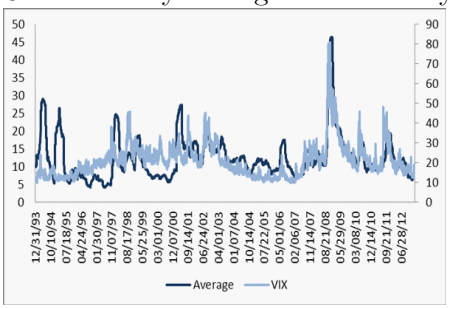
Source: JSE, SARB and author's calculations

The relationship is strong for large (positive or negative) flows. For net purchases above 20 billion accumulated over 20 days, there is no single event (day) of currency depreciation over the same 20-day period (between January 2010 and August 2012) – the currency always appreciates, though not necessarily by the same magnitude. Conversely, for negative inflows: each day recording cumulative net sales over the preceding 20 days above 20 billion rand is associated with rand depreciation over the same 20-day period.

The relationship is indeterminate for smaller net flows, with a wide range of currency movements consistent with any given level of portfolio flows, including net flows close to zero. When inflows are very large, they represent

[10] Net inflows (non-resident purchases of bonds and equities) are measured in billions of rand; rand depreciation is measured in log change, so for example 0.05 corresponds to 5% depreciation, -0.05 corresponds to 5% appreciation, over n days (in this figure $n = 20$).

Figure 1: Cross-country average FX volatility and VIX

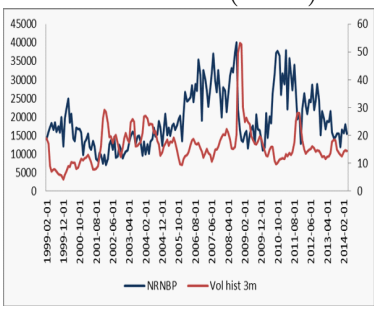


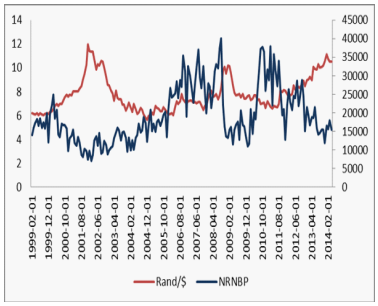
a significant share of rand turnover, and become a dominant determinant of the direction of rand movements. When not, the range of currency outcomes associated with either inflows or outflows is wide: "anything goes".

Figure 1 shows how the VIX drives short-term currency volatility (average of Brazilian, Mexican, South African, South Korean, and Turkish currencies' volatilities) since the 2007 US sub-prime crisis.

In this note we are particularly interested in bond flows, which are affected by currency speculation strategies based on the carry trade. Although bond inflows affect the value of the currency, as expected, the historical relationship between bond inflows and currency *volatility* (the second moment) seems weak.

Table 4: Bond inflow (levels) have little effect on the second moment





Source: JSE, SARB

The relationship between capital flows and rand volatility requires accounting for foreign initiated transactions, as well as domestically initiated transactions. Data on the latter are available at lower frequency, and this is relationship is discussed below.

3.2 Long-term volatility

3.2.1 Evolution in South Africa

Figure 2 shows the evolution of the rand per dollar exchange rate. There is an upward shift in the long-run average level, which coincides with the adoption of a flexible exchange rate regime and inflation targeting as the monetary policy framework.

Figure 2: Rand per US dollar

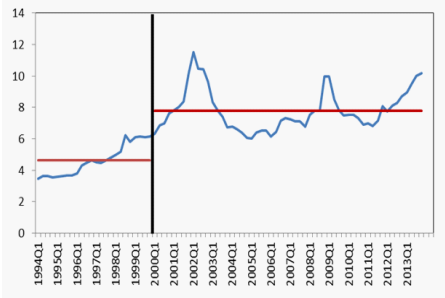
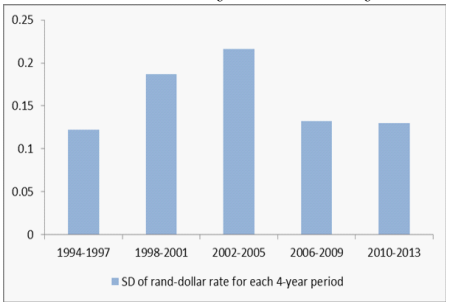


Figure 3 shows the standard deviation of the exchange rate over four-year intervals, as a measure of medium to long-run volatility, based on the average length of the business cycle in South Africa. There is a marked increase between 1994 and the early 2000s. Examining the quarterly series shows that long-run volatility peaks at nearly 30 percent in 2003; but is on a declining trend since then – interrupted by the global financial crisis in 2007-2008.

The last two bars show that long-run volatility is down to pre-inflation targeting levels, despite less restrictions on capital movements and far larger capital flows, as shown below. But it remains high.

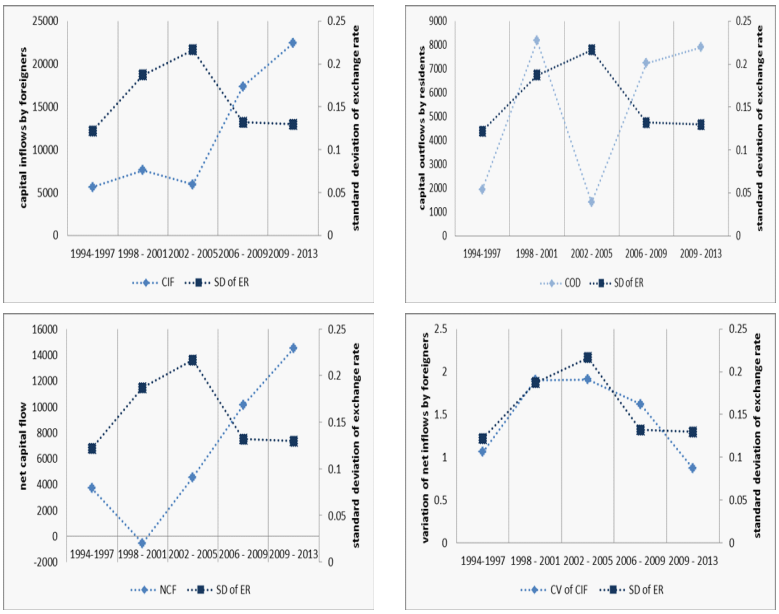
Figure 3: Rand volatility over four-year intervals



3.2.2 Have larger capital flows led to more volatility?

No low-frequency relationship is evident between low-frequency long-term means (i.e., averages taken over four-year intervals of quarterly data) of portfolio flows, and long-term exchange-rate volatility (standard deviation of quarterly observations over the same four-year periods). This applies to net capital inflows by non-resident or foreign agents (CIF, first figure in Table 5), net capital outflows by domestic agents (COD, second figure), and net capital flows (i.e., the difference between CIF and COD, third figure).

Table 5: Capital flow mean levels, coefficient of variation, currency volatility

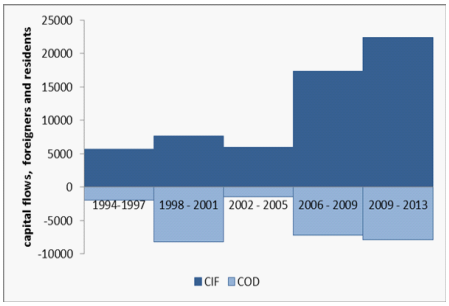


Source: SARB, author's calculations

The closest visual relationship between measures of portfolio flows, and of the long-run volatility of the nominal exchange rate at low frequency, is with the volatility (measured by the coefficient of variation)[11] of gross inflows (net capital inflows by non-residents) – this is shown in the fourth quadrant in Table 5. The relationship between the variability in net capital flows (CIF minus COD) and exchange rate volatility is much weaker. Note

[11] The coefficient of variation is the ratio of the standard deviation to the mean. The adjustment of the standard deviation is due to the mean level of total gross flows increasing significantly over the sample.

Figure 4: Capital inflows by foreigners and outflows by residents (net)



the implication: restrictions on the level of capital inflows may have no effect on the long-term volatility of the exchange rate, if they do not reduce the volatility of flows.

CIF and COD may be driven by different factors. Periods of outflows or lower inflows by non-residents, might be associated with reduced outflows, or retrenchments, by residents. In South Africa, regulations restrict foreign holdings by domestic agents to 25 per cent of investment assets. Large outflows cause the currency to depreciate, which pushes the rand value of foreign holdings up, beyond the regulatory limit for any agent initially at or near the limit. Such agents are obliged to retrench the portion above the limit, acting as a partial buffer. Domestic agents have however one year to retrench in order to obey the regulatory limit, so CIF and COD transactions, even when associated, can be asynchronous. The evolution of CIF and COD (four year quarterly averages) is shown in Figure 4. COD flows tend to partly buffer the volatility generated by CIF volatility.

3.2.3 Is the rand excessively volatile?

The preceding observations do not tell us whether the rand is 'excessively volatile'. Any such claim requires a benchmark for normal volatility. Standard exchange-rate models imply upper bounds for the 'fundamentally justified' long-run variance of the exchange rate, determined by the change in monetary model fundamentals (growth, money and inflation differentials), and the discount factor which translates the expected future path of fundamentals to the current value of the currency.

If, or when, the variance of the currency exceeds this bound, the currency can be regarded as "excessively volatile" in a meaningful manner. The method used to compute the upper variance bound are presented and discussed in detail in Amod and Hassan (2014).

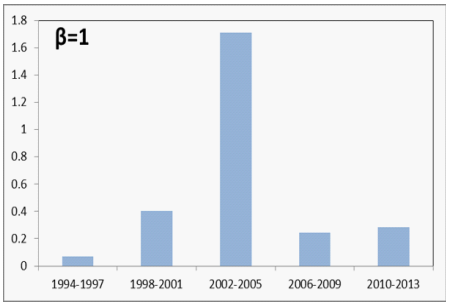


Figure 3.2.3 shows (highly) excessive volatility in the early 2000s (when the currency crashed). For the remaining four-year blocks, long-run volatility is not excessive. Note however that short-term volatility may often have been very high. The economic costs of long-run real exchange rate volatility and misalignment are well established; those associated with short-term high-frequency movements in the exchange rate are not, however – this issue is discussed further below.

The empirical performance, in terms of out-of-sample forecasting ability, of monetary exchange rate models is notoriously weak at short to medium term horizons. Variance bounds based on such models are not applicable at such horizons.

3.2.4 Remark: do macro fundamentals matter?

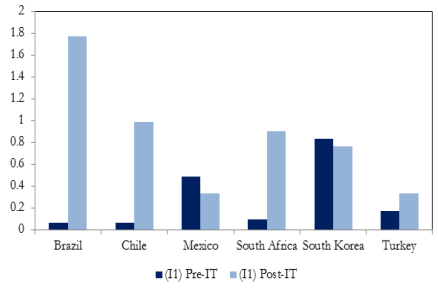
The most important insight of classic exchange rate models is that of the exchange rate as an asset price, responsive to changes in expectations of future macro fundamentals (domestic and international). Despite their poor out-of-sample forecasting performance, currency analysts and the financial press routinely attribute movements in currencies to changes in fundamantals. In Hassan and Paul (2014), we use rand movements at the per (half) second frequency during a statement by the monetary authority, as an illustration of how the currency responds at very high frequency to information on macro fundamentals (growth and inflation), but its movements may appear inconsistent with fundamentals at lower frequencies.

3.2.5 Has inflation targeting led to excess volatility?

Amod and Hassan (2014) compare the observed long-run variance of the exchange rate to the respective variance bound, for a set of floating emerging currencies, for which Gagnon and Hinterschweiger (2011) document the highest long-term volatilities. The main finding is summarized in Figure 5,

which shows, for each country, the ratio of the long-term variance of the exchange rate (deviations from fundamentals) to the maximum long run variance justified by the variability of the respective country's fundamentals – before and after the adoption of inflation targeting. The bound is clearly breached only for Brazil in the period after adoption of inflation-targeting. It increases substantially for Chile and South Africa, but stays below one.

Figure 5: Variance ratios, pre- and post-IT



4 Capital flows and monetary policy effectiveness

I now turn to the relationship between capital flows driven by carry trades (i.e., portfolio debt and direct cross-border credit), the effectiveness of monetary policy, and the scope for carry target economies to conduct monetary policy independently of global (specifically US) monetary policy.

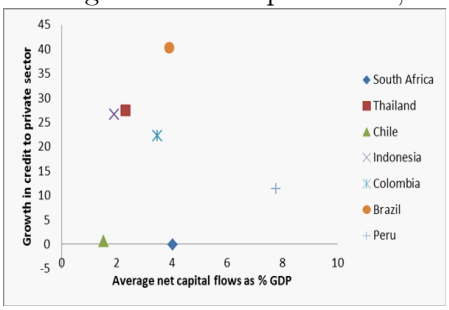
4.1 Capital flows and credit growth

Capital inflow surges reduce the effectiveness of monetary policy by stimulating excessive credit growth. This causal link seems to be weak for South Africa, compared to other emerging economies (e.g., Brazil and Turkey) – see Figure 6. This channel plays a central role in the modern case for capital controls (e.g., Ostry (2011), Rey (2014)). If inflows do not cause credit booms and domestic overheating (in turn causing pressure to raise interest rates and attracting more inflows), the constraints imposed on monetary policy and threat to financial stability are limited.

There are two likely reasons, in addition to possible institutional peculiarities, behind different credit responses to capital inflows.[12] First, reliance

[12] These are tentative thoughts, based on current work in progress.

Figure 6: Domestic credit growth and capital flows, averages for 2009-2012



on non-core funding from abroad (to finance domestic credit extension) depends on the availability of domestic retail and wholesale funding.[13] South African banks have access to a large deposit base, and above all, ample access to domestic non-core liabilities – large and liquid domestic bond and money markets. The threshold level of credit growth which triggers the need for non-core funding from abroad is therefore relatively high. Second, the expansionary effect of inflows is likely to be an increasing function of the degree of currency market intervention:[14] purchases of foreign currency may help in halting exchange rate over-valuation and the associated loss of export competitiveness; but they accentuates the carry cycle. If the intervention succeeds in halting exchange rate appreciation, the stability of the exchange rate reduces currency risk, and traders (or foreign lenders) anticipate eventual appreciation once intervention becomes too costly. Again, the policy response (in the currency market) attracts further inflows. Observe that Brazil and Turkey intervened significantly in response to inflow surges; and experienced exceptional growth in cross-border credit. These are economies where the relationship between capital flows and domestic credit growth is strong. South Africa has allowed more exchange rate flexibility, since the adoption of inflation targeting in 2000; and experienced comparatively lower direct cross-border credit flows.[15]

[13] See Hahm, Shin and Shin (2013) on the role of non-core liabilities (sources of funding other than retail deposits) in financial intermediation.

[14] See Magud, Reinhart and Vesperoni (2014) for empirical evidence.

[15] The Bank for International Settlement's figure for direct cross-border credit to the banking sector (all instruments, amounts outstanding, billions of US dollars) to South Africa, between 2009 and 2012, averages approximately 35. The amount for Turkey is between 150 and 200; and for Brazil, close to 300.

4.2 Bond yields and monetary autonomy

I estimate the following regression equation (following Obstfeld (2014)) to examine the extent to which global capital flows, which are largely driven by monetary conditions in the US, constrain the scope for independent monetary policy in carry target economies,

$$\Delta i_t = \alpha + \beta \Delta i_t^w + \boldsymbol{\gamma}' \mathbf{x}_t + \epsilon_t, \tag{1}$$

where t is the time subscript, i is the interest rate in the domestic economy, i^w is the 'world' interest rate for the same term to maturity, and $\mathbf{x}$ is a vector of domestic variables that monetary policy responds to. Δ converts the variable to its one period change. All variables are measured in log differences to avoid spurious regressions. Monetary conditions in the United States represent global conditions. The equation is estimated using three-month and ten-year interest rates; using quarterly data from 2000 to 2014. For the results in Table 6, the components of $\mathbf{x}$ are simply the changes in the domestic rates of inflation and economic growth.

The larger the estimated value of parameter β, the greater the dependence on US monetary conditions, with total loss of monetary policy independence if $\widehat{\beta} = 1$. Instead, I find that for short-term interest rates, $\widehat{\beta} \cong 0$ and not statistically significant; while $\widehat{\boldsymbol{\gamma}}$ is statistically significant. For long-term yields however, $\widehat{\beta}$ is far larger though strictly lower than one. Obstfeld (2014) finds on average higher monetary policy dependence on US monetary conditions in advanced economies, than emerging economies. Sweden is an advanced economy which is also a common carry target, and I performed the same exercise for Swedish rates. The short-term rate is not systematically tied to US monetary policy and responds significantly to domestic conditions, but long yields are more tightly dependent on US long yields than South Africa's.

Table 6: Simple test of monetary independence

	Parameter	*3m*	*10y*
South Africa	$\widehat{\beta}$	± 0	0.6
Sweden	$\widehat{\beta}$	± 0	0.7

This finding is inconsistent with the view that global capital does not "interfere in any substantial way with the ability of domestic monetary policy

to maintain control over dynamics of inflation" (Woodford (2010), written before the 2007 crisis). The high dependence of domestic long rates on US long rates shows that it does. But it is also *not* consistent with the view that "independent monetary policies are possible if and only if the capital account is managed", as argued by Rey (2014). This, in turn, is evinced by the lack of a systematic dependence of (South African on US) interest rates towards the short end of the yield curve, when we control for domestic factors which affect the policy stance. US and global monetary conditions significantly restrict the policy scope domestically; but do not determine it.

5 Benefits of moderate short-term exchange rate volatility, or "I love the smell of volatility in the morning"

In economies with reasonably developed financial systems, which is the South African case, short term volatility can be hedged.[16] Less evidently, a moderate degree of short-term volatility has non-trivial benefits.

5.0.1 Volatility reduces attractiveness (and increases cost) of carry trades

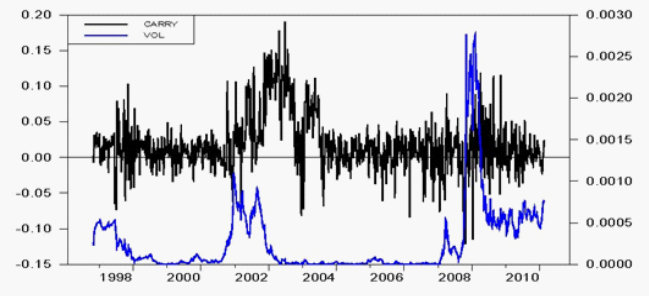
Rising volatility discourages carry trade speculators from targeting the currency. Carry trades benefit from high interest differentials (or large forward discounts/premia) and either target currency appreciation relative to the funding currency, or low volatility in the rate of exchange between the target and funding currencies. Periods of high volatility, in the currency and financial markets generally (domestic or international, usually reflected in the VIX index), are empirically associated with capital flow reversals, away from high-interest/target currencies like the rand, and into low-interest/funding currencies. Such reversals lead to carry trade losses for speculators who maintain long positions in high-interest currencies, and short positions in low-interest currencies.[17]

There is substantial international evidence of a strong and systematic in-

[16] Access to hedging instruments by SMEs is perhaps more limited however. And for all firms, hedging long-term exchange rate risk is complicated if not impossible. But in the long term, exchange rates are influenced by macroeconomic stability.

[17] A *long* (respectively, *short*) position in an asset reflects the expectation of an increase (resp., decrease) in the price of the asset.

Figure 7: Rand carry returns and conditional exchange rate volatility



verse relationship between exchange rate volatility and carry trade returns.[18] Observations on the rand indicate consistency with the international evidence. Peaks in exchange rate volatility coincide with sharp carry trade losses; and the period producing the largest and most persistent gains to the rand-targeting speculator (circa 2002-2003), is accompanied by a sharp decrease in *short-term* exchange rate volatility (see Figure 7, from Hassan and Smith (2011)).

In addition, carry traders can buy currency options to hedge the exchange rate exposure component (i.e. buy protection against unfavorable exchange rate movements). When volatility decreases, the price of these options, and hence the cost of hedging against unfavorable exchange rate movements, decreases – making the carry trade more attractive, for a given yield differential.

Conclusion: attempts to reduce *high-frequency/short-term* exchange rate volatility (which could be desirable on other grounds), will not be counter-speculative. On the contrary: options-hedged targeting becomes cheaper; and un-hedged targeting becomes less risky. Both forms of carry trades become more attractive.

5.0.2 Volatility induces caution: disincentive to currency mismatch

Capital flow reversals led to severe contractions in economic output in South East Asia in the aftermath of the 1997 crisis. Private sector firms had accumulated large foreign currency liabilities, but earned revenue mainly in domestic currency. Currency mismatch in corporate balance sheets generates a high degree of financial vulnerably; and a 'fear of floating' by the

[18] See Clarida, Davis, and Pedersen (2009), and Brunnermeier, Nagel, and Pedersen (2009).

authorities (in anticipation of distress in the event of a large depreciation). When currencies crashed in 1997, firms found it difficult to meet foreign currency obligations, and net worth reduced, in turn reducing ability to refinance. The IMF-led response then (criticized at the time by Furman and Stiglitz (1998), and Krugman (1999)), which involved severe tightening of monetary policy, aggravated the problem, by also raising the cost of domestic currency funding.

The accumulation of un-hedged foreign currency liabilities, in economies where borrowers face high interest rates on domestic currency debt, is very tempting and can be perfectly rational – if the probability of exchange rate depreciation over the term of the loan is low. The East-Asian economies most affected by the 1997 crisis, were characterised by attractive interest spreads, yet lower exchange rate volatility, between 1991 and 1997, than the Japanese and German currencies – see Eichengreen and Hausmann (1999).

Volatility induces caution against the build-up of large foreign currency exposures (by non-exporters). Given the high interest rate differentials offered by carry target economies, low currency volatility increases the attractiveness of foreign currency liabilities, by reducing the probability of a large adverse movement in the currency.

5.0.3 Volatility helps maintain the scope for independent monetary policy

Volatility may increase the scope for independent monetary policy. If the currency of an emerging economy becomes consistently as stable as that of low-interest advanced economies, its yields will have to converge with the latter. The same applies, with greater force, to carry target advanced economies (e.g., Australia, Canada, Norway, Sweden), due to similar risk premia to lower interest advanced economies. Exchange rate volatility prevents perfect substitutability between domestic and foreign assets, which helps maintain scope for independent monetary policy despite the fluidity of international capital – a point made in Eichengreen, Tobin and Wyplosz (1995).[19]

Consider the standard link between domestic and foreign interest rates, exchange rate movements, and risk,

$$i_t = i_t^w + E_t(e_{t+1} - e_t) + \zeta_t, \tag{2}$$

where e represents the exchange rate and ζ the currency risk premium. If

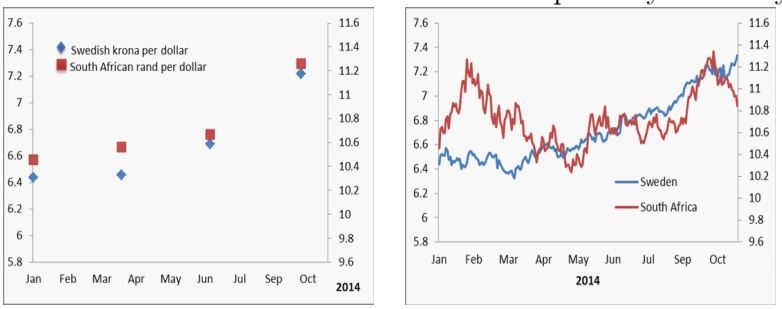
[19] See also Obstfeld (2014).

volatility is zero, there is no uncertainty about the exchange rate path and no risk premium, so $i_t = i_t^w + (e_{t+1} - e_t)$. That is, domestic yields become deterministically tied to yields in the global financial centre.

5.0.4 Short volatility can reduce long-term misalignment and volatility

High frequency but temporary up and down movements in the currency can help prevent the exchange rate from deviating too far and/or for too long from intrinsic value (i.e., may help prevent large and/or prolonged misalignment), thereby reducing the magnitude of crashes when there is an eventual correction. In this sense, some short term volatility can help reduce the long-term instability which is detrimental to economic growth.[20] Consider the figures in Table 7 for illustration. The quarterly movements in the rand and the Swedish krona were remarkably similar for 2014. At this frequency, the krona was the more volatile of the two currencies (with about twice the coefficient of variation). Yet, the daily movements in the rand were far more erratic; the variation within each quarter far higher.

Table 7: Swedish krona and South African rand: quarterly and daily, 2014



Source: Datastream, author's calculations

6 Concluding remarks: policy options

6.1 Capital controls

There are situations where a degree of capital account regulation (e.g. capital controls) is desirable – see for example Stiglitz (2010), IMF (2012),

[20] See for example Eichengreen (2008), Aghion, Bacchetta, Ranciere, and Rogoff (2009), Guzman, Ocampo and Stiglitz (2014).

Rey (2014) for comprehensive and thoughtful discussions. As observed in the extensive Pardee Center Task Force Report (p.2), "(...) the design and monitoring of such regulations is essential for their effectiveness" (Gallagher, Griffith-Jones and Ocampo (2012)). The design of capital flow regulation in South Africa (and the desirability of prudence before adopting measures that may be distortionary), beyond existing restrictions on outflows (by residents), needs to address facts about the South African economy which limit the threat to financial stability due to capital flow volatility and/or limit the effectiveness of standard capital account regulation measures.

First, the critical causal link between inflows and credit growth is historically weak, compared to, e.g., Brazil and Turkey. If inflows do not cause credit booms and domestic overheating (in turn causing pressure to raise interest rates and attracting more inflows), the constraints imposed on monetary policy and threat to financial stability are limited.

Second, the threat to financial stability is weakened further (though not eliminated) by the fact that government and private sector firms borrow mainly in domestic currency in South Africa, and issue securities (to a domestic and international clientele) locally. The comparatively low degree of foreign exchange indebtedness means that sudden stops in inflows, and the associated currency depreciation, need not cause sudden un-hedged increases in the rand value of domestic liabilities.

Third, it is estimated that approximately three-quarters of total rand trading is offshore. There is also a secondary market for SA treasuries offshore. Domestically imposed capital account restrictions might move rand trading further offshore. Moreover, the derivatives market, especially for FX and interest rate products traded over-the-counter, is substantial. (See tables in the appendix.) These can, and normally are, used to circumvent capital flow management restrictions.

Take for example taxes on portfolio debt inflows (and later on certain derivatives), implemented in 2009 in Brazil. The speculative carry trade is one of the main drivers of portfolio debt flows, as noted in the report. The payoff from borrowing in low-yield currencies to invest in high-yield currencies can be replicated by trading forward currency contracts (the "forward bias" trade) – i.e. without access to the bond markets of either the funding or the target currency. Speculators can use the OTC derivatives market, domestically and offshore, to circumvent any taxes on bond inflows. Long-term bond investors might not do so, but passive long-term investment is beneficial. It is impossible to know exactly how effective the Brazilian taxes have been, and I do not wish to claim that they were ineffective – because we cannot know what the situation would have been without them. But

the real reached a twelve-year high in 2011; and perhaps not coincidentally, OTC turnover in Brazilian real FX derivatives increased five-fold between 2007 and 2010.[21] OTC foreign exchange derivatives turnover in South Africa was about twice Brazilian turnover in 2010.

Without addressing the issues above, neither the need for further capital controls in South Africa, nor their appropriate design, are entirely clear. The case for more reserve accumulation, and prudential measures targeting the channels through which capital flows can be destabilizing (e.g., adjustable capital buffers, credit market regulations, domestic currency borrowing incentives) seems more compelling.

6.2 Scope for more aggressive reserve accumulation

There is no contradiction between pursuing a flexible inflation targeting framework, and adopting a degree of foreign exchange market intervention required to minimize long run real exchange rate instability and misalignment. (See for example Fisher (2010), IMF (2012), Ostry, Ghosh and Chamon (2012).)

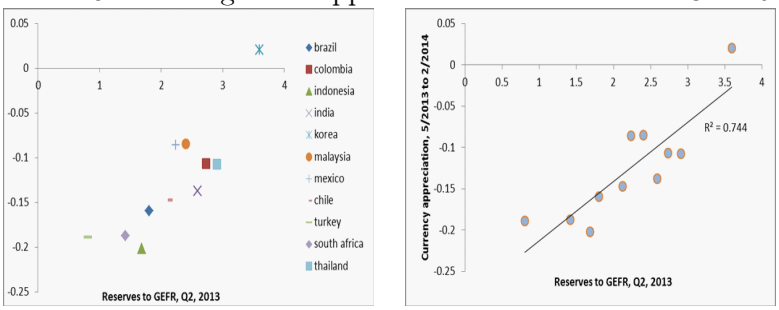
Foreign exchange reserves, which are costly to accumulate in high-interest countries, are quite large in some emerging economies (see Gallagher, Griffith-Jones and Ocampo (2012)). But this is not the case for South Africa, where reserves pale in comparison to numerous other emerging economies. There is still ample scope to accumulate reserves to absorb large inflows, when the exchange rate is highly likely to be overvalued and contributing to a loss of competitiveness. There is an interest cost to reserve accumulation, and valuation losses when the rand appreciates; but there will be valuation gains when the rand depreciates.

As an indication of the space left for further reserve accumulation, and the likely benefits in buffering the currency against sudden large movements in capital, consider exchange rate behavior in response to tapering (talk and action) by the US Federal Reserve between 2013 and 2014. The figures in Table 8 show, along the vertical axis, currency appreciation (negative numbers denote depreciation) between 1 May 2013 and 1 February 2014. Along the horizontal axis is the ratio of foreign exchange reserves to a measure of the gross external financing requirement (the sum of the current account deficit and short-term external debt), for the first half of 2013. There is a strong relationship between a country's ratio of reserves to external financing requirement, and the extent of the sell-off of its currency over this period.

[21] BIS Quarterly Review, December 2012.

South Africa ranks quite poorly. Reducing its vulnerability requires moving it in the North-Eastern direction: reducing the deficits or/and increasing reserves. Of the three variables that constitute this indicator of external vulnerability, one is more amenable to "engineering", and that is the stock of foreign exchange reserves.

Table 8: Exchange rate appreciation and reserves to GEFR



Source: BIS, IMF, World Bank; author's calculations

6.3 Role of macro-prudential tools

Since excessive credit growth is the main channel through which capital inflows lead to instability, there is little doubt about the desirability of designing appropriate prudential tools aimed directly at this channel – see IMF (2012), Rey (2014); and Stiglitz and Greenwald (2003) for a discussion of the centrality of credit that predates the 2007 crisis. But the merits of monitoring the credit channel and preventing excessive leverage and credit growth, apply irrespective of the economy's exposure to capital flow volatility.

In addition, South Africa retains restrictions on capital outflows by residents. This tool could be made more effective by varying (judiciously and infrequently) the quantitative limits depending on the size and direction of capital flows: relaxing the limit in response to excessive inflows, and contracting the limit in response to excessive outflows.[22]

[22] See the discussion with Raghuram Rajan on varying foreign exchange limits as a macro prudential tool, in Jeffery (2014).

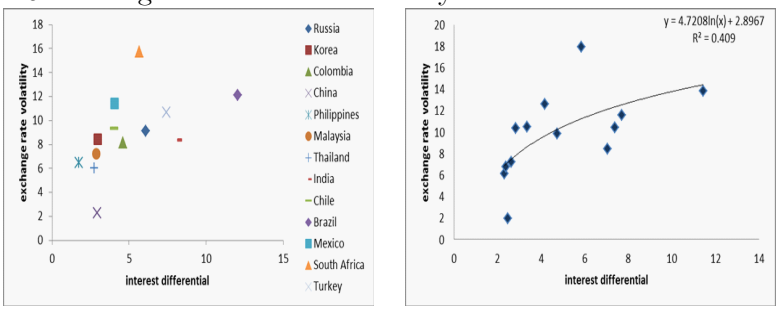
6.4 The counter-speculative case for low inflation

The tentative evidence of a weak relationship between capital inflows and credit growth in South Africa may be sample specific.[23] It is probable that there will be periods when South Africa faces the same tension as other emerging economies have (e.g., Brazil and Turkey), where inflows lead to rapid credit growth and overheating, and the interaction between monetary policy (under inflation targeting) and currency speculation generates a vicious cycle.

A natural long-term solution is to aim at low and stable inflation, so that nominal interest rates can stay low–which reduces the currency's speculative appeal, and the cost of reserve accumulation–while allowing for positive real interest rates, which are necessary (but not sufficient) to stimulate saving and investment.[24] Lower carry-driven portfolio debt and credit inflows mean less scope for destabilizing debt inflows, and for excessive credit growth while the monetary authority tries to restrict demand. The associated increase in the ratio of equity liabilities to total liabilities would also help reduce exposure to financial instability.

Figure 9 shows a positive relationship between nominal interest rate differentials and nominal exchange rate volatility (three month horizons).[25] It suggests, tentatively, that if the low nominal rate corresponds to a low interest rate differential, relative to funding currencies, such a policy will help reduce exchange rate volatility.

Table 9: Average three month volatility and interest rate differentials



[23] "Religious economists" are in any case uninterested in evidence, ardently convinced either that unimpeded international capital flows are always and necessarily bad, or that they are always good – beliefs as enlightening as burning books.

[24] Note, in interpreting "low inflation", that the target band for inflation in South Africa is from three to six percentage points –"low" need not mean anywhere near the zero lower bound.

[25] See also Alvarez, Atkeson and Kehoe (2007).

Plantin and Shin (2014) model the interest differential as a coordination device, turning carry trade positions into strategic complements for speculators, i.e. high yields help coordinate low-interest capital supply.[26] Their analysis implies that all policy responses designed to repel carry trades "amount to sufficiently reducing the official rate in response to carry trade activity(...)," and "(...) a decrease in the official rate is the appropriate response when foreign speculative inflows bid up domestic asset prices". Stiglitz (2012) advocates the same interest rate response, in conjuction with raising reserve requirements (and capital inflow restrictions). Such a policy response is less of a threat to macroeconomic stability in a low inflation environment.

7 References

Aghion, Philippe, Philippe Bacchetta, Romain Ranciere, and Kenneth Rogoff. 2009. Exchange Rate Volatility and Productivity Growth: The Role of Financial Development. *Journal of Monetary Economics,* 56(4), 494-513.

Alvarez, Fernando, Andrew Atkeson, and Patrick Kehoe. 2007. If Exchange Rates are Random Walks, Then Almost Everything We Say About Monetary Policy is Wrong. *American Economic Review*, 97(2), 339-345.

Amod, Shaista, and Shakill Hassan. 2014. Variance Bounds as Thresholds for 'Excessive' Currency Volatility: Inflation Targeting Emerging Economies. *Working Paper WP/14/09*, South African Reserve Bank.

Bacchetta, Philippe, and Eric van Wincoop. 2010. Infrequent Portfolio Decisions: A Solution to the Forward Discount Puzzle. *American Economic Review*, 100(3), 870-904.

Brunnermeier, Markus, Stefan Nagel, and Lasse Pedersen. 2009. Carry Trades and Currency Crashes, in Acemoglu, D., Woodford, M & Rogoff, K., eds., *NBER Macroeconomics Annual 2008*, University of Chicago Press, Chicago.

Burnside, Charles. 2011. Carry Trades and Risk, *NBER Working Paper 17278*, August.

Burnside, Charles, Martin Eichenbaum, and Sergio Rebelo. 2007. The Returns to Currency Speculation in Emerging Markets, *American Economic Review*, 97(2), 333-338.

[26] Of course, in practice, co-ordination devices might be somewhat more prosaic – see "Traders' forex chatroom banter exposed", Financial Times, 12 November 2014.

Burnside, Charles, Martin Eichenbaum, and Sergio Rebelo. 2008. Carry Trade: the Gains of Diversification, *Journal of the European Economic Association*, 6(2-3), 581-588

Clarida, Richard, Josh Davis, and Niels Pedersen. 2009. Currency Carry Trade Regimes: Beyond the Fama Regression, *Journal of International Money and Finance*, 28(8), 1375-1389.

Eichengreen, Barry. 2008. The Real Exchange Rate and Economic Growth. Commission on Growth and Development Working Paper 4. Washington DC: International Bank for Reconstruction and Development.

Eichengreen, Barry, and Ricardo Hausmann. 1999. Exchange Rates and Financial Fragility. In *Proceedings: Economic Policy Symposium*, Jackson Hole, Federal Reserve Bank of Kansas City, 329-368.

Eichengreen, Barry, Ricardo Hausmann, and Ugo Panizza. 2005. The Pain of Original Sin. In B. Eichengreen and R. Hausmann (eds.), *Other People's Money.* Chicago: Chicago University Press.

Eichengreen, Barry, James Tobin, and Charles Wyplosz. 1995. Two Cases for Sand in the Wheels of International Finance. *Economic Journal*, 105 (428), 162-172.

Fisher, Stanley. 2010. Myths of Monetary Policy, *Israel Economic Review*, 8(2), 1-5.

Furman, Jason, and Joseph Stiglitz. 1998. Economic Crises: Evidence and Insights from East Asia. *Brookings Papers on Economic Activity*, 2, 1-114.

Gallagher, Kevin, Stephany Griffith-Jones and José Ocampo. 2012. Regulating Global Capital Flows for Long-Run Development, Boston University, Pardee Center Task Force Report, March.

Gagnon, Joseph, and Alain Chaboud. 2007. What Can the Data Tell Us About Carry Trades in Japanese Yen? Board of Governors of the Federal Reserve System, International Finance Discussion Paper 899.

Gagnon, Joseph, and Marc Hinterschweiger. 2011. *Flexible Exchange Rates for a Stable World Economy.* Washington DC: Peterson Institute for International Economics.

Galati, Gabriele, Alex Heath, and Patrick McGuire. 2007. Evidence of Carry Trade Activity, *BIS Quarterly Review,* Part 3, September, 27-41.

Guzman, Martin, Antonio Ocampo, and Joseph Stiglitz. 2014. Real Exchange Rate Policies for Economic Development. Paper presented at the Department of Trade and Industry, Pretoria, South Africa.

Hahm, Joon-Ho, Hyun Song Shin, and Kwanho Shin. 2013. Noncore Bank Liabilities and Financial Vulnerability. *Journal of Money,*

Credit and Banking, 45(S1), 3-36.

Hassan, Shakill, and Sean Smith. 2011. The Rand as a Carry Trade Target: Risk, Returns and Policy Implications. Working Paper 11/01. Pretoria: South African Reserve Bank.

Hassan, Shakill. 2013. South African Capital Markets: An Overview. Working Paper 13/04. Pretoria: South African Reserve Bank.

Hassan, Shakill. 2014. Capital Markets. In *The Oxford Companion to the Economics of South Africa, edited by* H. Bhorat, A. Hirsch, R. Kanbur, and M.Ncube. Oxford: Oxford University Press.

Hassan, Shakill, and Merissa Paul. 2014. Four Thousand Half Seconds in the Currency Market: Rand Behavior During the March 2014 MPC Statement. Economic Note 14/08. Pretoria: South African Reserve Bank.

IMF. 2011. Recent Experiences in Managing Capital Inflows. Strategy, Policy and Review Department (February). Washington, DC: International Monetary Fund.

IMF. 2012. The Liberalization and Management of Capital Flows: An Institutional View. Washington DC: International Monetary Fund.

Jeffery, Christopher. 2014. Raghuram Rajan on the Dangers of Asset Prices, Policy Spillovers and Finance in India. *Central Banking Journal*, 6 August.

Krugman, Paul. 1999. Balance Sheets, the Transfer Problem, and Financial Crises. In Isard, P., and A. Rose (eds), *International Finance and Financial Crises - Essays in Honor of Robert Flood.* Dordrecht: Kluwer.

Lustig, Hanno, and Adrien Verdelhan. 2009. Discussion of Carry Trades and Currency Crashes. in Acemoglu, D., Woodford, M and Rogoff, K., eds., *NBER Macroeconomics Annual 2008*, University of Chicago Press, Chicago.

Magud, Nicolas, Carmen Reinhart, and Esteban Vesperoni. 2014. Capital Inflows, Exchange Rate Flexibility, and Credit Booms. *Review of Development Economics*, 18(3), 415-430.

Obstfeld, Maurice, and Kenneth Rogoff. 2003. Risk and Exchange Rates. In *Economic Policy in the International Economy: Essays in Honor of Assaf Razin*, edited by Elhanan Helpman and Efraim Sadka. Cambridge: Cambridge University Press.

Obstfeld, Maurice. 2014. Trilemmas and Tradeoffs: Living with Financial Globalization. BIS Annual Conference, Lucerne, June.

Ostry, Jonathan. 2011. Managing Capital Inflows: What Tools to Use. Managing Capital Flows to Emerging Markets, Rio de Janeiro, May 26-27.

Ostry, Jonathan, Atish Ghosh, and Marcos Chamon. 2012. Two Targets, Two Instruments: Monetary and Exchange Rate Policies in Emerging Market Economies. IMF Staff Discussion Note.

Plantin, Guillaume, and Hyun Shin. 2014. Destabilizing Carry Trades. Systemic Risk Centre Discussion Paper 17, London, London School of Economics and Political Science.

Rey, Hélène. 2014. Dilemma not Trilemma: the Global Financial Cycle and Monetary Policy Independence. In *Global Dimensions of Monetary Policy*, Proceedings of the 2013 Jackson Hole Symposium. Kansas: Federal Reserve Bank of Kansas City.

Stiglitz, Joseph, and Bruce Greenwald. 2003. Towards a New Paradigm in Monetary Economics. Cambridge, Cambridge University Press.

Stiglitz, Joseph. 2010. Risk and Global Economic Architecture: Why Full Integration May be Undesirable. *American Economic Review (Papers and Proceedings)*, 100 (2), 388-392.

Stiglitz, Joseph. 2012. Monetary Policy in a Multi-Polar World. Paper presented at an International Economics Association Conference in Izmir, Turkey.

Woodford, Michael. 2010. Globalization and Monetary Control. In *International Dimensions of Monetary Policy*, edited by Jordi Gali and Mark Gertler. Chicago: University of Chicago Press.

8 Appendix

Foreign Exchange Turnover, 2013[27]

Rank	*Currency*	*Total*	*Spot*	*Domestic*	*Offshore %*[28]
3	Japan	1231	612	374	70
5	Australia	462	196	182	61
6	Switzerland	275	84	216	21
7	Canada	244	93	65	73
8	Mexico	135	57	32	76
10	New Zealand	105	39	12	89
16	Turkey	70	16	27	61
17	South Korea	64	19	48	25
18	**South Africa**	**60**	**19**	**21**	**65**
19	Brazil	59	11	17	71
20	India	53	15	31	42

Source: Bank for International Settlements, Hassan (2013)

Foreign Exchange Derivatives Turnover, 2013[29]

Rank	*Currency*	*Forwards*	*FX Swaps*	*Options*	*Total*[30]
3	Japan	123	332	153	619
5	Australia	50	183	27	266
6	Switzerland	27	149	14	191
7	Canada	36	101	12	151
8	Mexico	14	58	6	79
10	New Zealand	11	50	3	66
16	Turkey	10	39	3	54
17	Brazil	34	1	11	48
18	South Korea	24	16	4	45
19	**South Africa**	**7**	**31**	**2**	**40**
20	India	24	10	3	38

Source: Bank for International Settlements, Hassan (2013)

[27] Daily averages in April 2013, billions of US dollars (adjusted for double-counting). Data source: BIS (2013).

[28] These are estimates, based on the difference, for each currency, between global foreign exchange turnover for that currency, and turnover in the respective country's foreign exchange market.

[29] Daily averages in April 2013, billions of US dollars, net-net basis (adjusted for double-counting). Source: BIS (2013).

[30] Including 'currency swap'as a separate category to 'foreign exchange' swaps.