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Vulnerability to Normalization of Global Financing Conditions: An Operational Approach

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EXECUTIVE SUMMARY

We construct two simple indicators of external vulnerability. The construction criterion is that they work, in the following sense. Take a set of significantly traded emerging market currencies (and government bond and stock markets); construct indicators which explain the cross-sectional variation in asset (especially currency) market reaction to the May 2013 onwards "taper tantrum".

We then update the values for the most effective indicator, for all countries in the sample, using latest available data. Comparing external vulnerability in early 2013 and early 2015 gives us a relative (but concrete) sense of where we stand, ahead of monetary policy normalization by the United States Federal Reserve. (Both shocks, i.e., tapering and normalization, represent significant changes to global financing conditions.)

Our findings are consistent with a role for macro-economic conditions in determining vulnerability to normalization of US monetary policy; and, more important from the point of view of practical policy-making, point to the importance of rapid improvements in a specific set of macro-economic variables -- the determinants of the ratio of foreign exchange reserves to the gross external financing requirement (i.e., the sum of the current account balance and external debt due in the short-term).

India is an interesting case of an emerging economy which rapidly increased its ratio of reserves to external financing requirement -- through a mutually consistent set of measures which improved each component of the indicator; and forcefully reduced inflation.

If these measures were successful in reducing vulnerability to normalization, we should observe reduced sensitivity of the rupee, compared to other vulnerable currencies, to new information used by market participants to re-assess the likely timing and intensity of US Fed rate increases.

We pulled the date of each FOMC meeting held since the beginning of 2013, and computed the two-day change in the exchange rate around each of these meetings (from one day before to one day after). We document a marked reduction in high-frequency reactions of the rupee to official meetings on the stance of US monetary policy. It is possible to rapidly reduce external vulnerability, through interventions which are carefully aimed at the specific source of immediate vulnerability, and pursued with conviction; longer-term deep structural problems notwithstanding.

At the time of writing, South Africa is not significantly less vulnerable to face imminent policy rate rises by the US Fed, than it was during the taper tantrum. Its external financing requirement has improved only slightly between early 2013 and the end of 2014, partly due to the effect of the drop in the oil price on the current account; with no meaningful increase in the stock of foreign exchange reserves. External debt increased precipitously. The country's relative position is only marginally better, and it remains amongst the most exposed among emerging economies with developed financial markets. (The ratio of reserves-to-GEFR deteriorated also in Brazil and Malaysia, and remained unchanged, at the bottom, for Turkey.) The recent growth in its export dependence on Chinese demand is an added complication.

Vulnerability to Normalization of Global Financing Conditions: An Operational Approach *

Shakill Hassan † Merissa Paul ‡ Siobhan Redford §

July 2015

Abstract

A simple ratio of foreign exchange reserves to the gross external financing requirement (GEFR) largely explains the cross-sectional variation in exchange rate depreciation over the "taper tantrum" in 2013. We update the ratio for a set of emerging markets, and compare current to previous exposure. South Africa's relative position barely changed between mid 2013 and early 2015. In contrast, India rapidly increased its ratio of reserves-to-GEFR – through improvements in each component of the indicator; and forcefully reduced inflation. We document a reduction in high-frequency reactions of the rupee to FOMC meetings. Reducing vulnerability to imminent tightening in US monetary policy requires, above all, reducing the external financing requirement and/or increasing the stock of reserves.

Keywords: gross external financing requirement; foreign exchange reserves; normalization; China, India, South Africa; FOMC meetings.

*With thanks to Chris Loewald and members of the SARB's Monetary Policy Committee for very helpful discussions; and to an external referee for helpful comments. The authors are entirely responsible for any errors, of course. The views expressed herein are those of the authors, and do not necessarily represent the views of the South African Reserve Bank.

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1 Introduction

Changes in global financing conditions force large corrections in emerging markets. The perfect recent example is the "taper tantrum" triggered by a speech to the United States Congress, by Ben Bernanke, then Federal Reserve chairman, on 22 May 2013 – signaling a gradual reduction in the monthly volume of US Federal Reserve (the Fed, henceforth) stimulus. The source of the shock is external, and the set of countries affected is wide. The magnitude of exchange rate corrections however, tends to vary by country – it is affected by country-specific conditions. These conditions determine a country's vulnerability to external events.

Based on the current outlook, Janet Yellen (chairwoman of the Fed's Board of Governors), expects that "it will be appropriate at some point later this year to take the first step to raise the federal funds rate and thus begin normalizing monetary policy" (Yellen (2015)).[1] The federal funds rate was brought down to near zero in 2008.

Monetary policy normalization by the Fed is the follow-up to tapering. Both shocks (tapering and normalization) represent significant changes to global financing conditions – albeit the US Fed has provided careful warning of its intention to begin raising interest rates soon, while the 2013 taper announcement was largely a surprise to global markets.[2]

We construct two simple indicators of external vulnerability. The construction criterion is that they work, in the following sense. Take a set of significantly traded emerging market currencies (and government bond and stock markets); construct indicators which explain the cross-sectional variation in asset (especially currency) market reaction to the May 2013 onwards taper event. (The indicators also have to be reasonably related to a country's susceptibility to changes in international financing conditions.)

We then update the values for the most effective indicator, for all countries in the sample, using latest available data. Comparing external vulnerability

[1] Moreover, fifteen of the seventeen Federal Reserve system presidents and governors expect a rate rise during 2015.

[2] The empirical literature on the role of macro imbalances and determinants of vulnerability during tapering is mixed – see Eichengreen and Gupta (2014), Aizenman, Binici, and Hutchison (2014), Bowman, Londono and Sapriza (2014), Prachi, Moriyama, N'Diaye and Nguyen (2014). This apparent ambiguity may be, at least partly, due to a two-stage process: a first stage, driven by a rush to safety and liquidity, where markets sell across the board and largely indiscriminately; a second stage where macro imbalances affect the extent to which specific country's assets are targeted.

in early 2013 and early 2015 gives us a relative (but concrete) sense of where we stand, ahead of normalization in the United States. [3]

Our findings are consistent with a role for macro-economic conditions in determining vulnerability to normalization of US monetary policy; and, more importantly from the point of view of practical policy-making, point to the importance of rapid improvements in a specific set of macro-economic variables – the determinants of the ratio of foreign exchange reserves to the gross external financing requirement (i.e., the sum of the current account balance and external debt due in the short-term).

The remainder of the paper proceeds as follows. In Section 2 we document the limited strength of relationships between individual macro-economic variables, commonly associated with external and internal imbalances, and the degree of currency depreciation during the taper tantrum; and show that the cross-sectional variation in exchange rate responses are largely explained by differences in the ratio of foreign exchange reserves to the external financing requirement – a simple, yet effective, indicator of vulnerability to tightening of global financing conditions. Section 3 reports on India, where we observe a rapid improvement in the ratio of reserves to external financing requirement since the tantrum, achieved through set of mutually consistent measures which improved each component of the indicator. We look at changes in the value of the rupee over two-day intervals around each FOMC (Federal Open Market Committee) meeting since 2013, to gauge the market's perception about the currency's vulnerability to Fed policy normalization; and document a gradual decline in the rupee's responsiveness, concurrent with the improvement in the ratio of reserves to financing requirement. This is shown in Section 4. Section 5 compares current vulnerabilities with the state of affairs during the tantrum. We then note the additional complication from economic adjustment in China. Section 7 briefly extends the analysis (with less success) to the bond and equity markets.

[3] Caveat. There are some important differences between the global economy in 2013 and 2015/6, which will affect reactions to normalization. First, quantitative easing by the European Central Bank may partly offset normalization in the United States. (To what extent is unclear – dollar and euro assets have a high degree of substitutability; euro-funded dollar-targeting may absorb much of the ECB liquidity which would otherwise target emerging market assets.) Second, the slowdown and re-adjustment of the Chinese economy (towards consumption and less reliance on investment) leaves the world's mineral commodity exporters more vulnerable.

2 External vulnerability indicators

2.1 Macro variables and currency depreciation during the taper tantrum

Figure 1 shows the relationships between a range of macro-economic variables and the extent of currency movement, for fifteen emerging market currencies (including ex-EM Korea) during the taper tantrum. In each graphic in the exhibit, the vertical axis shows the magnitude of exchange rate (relative to the US dollar) depreciation between April 2013 and early February 2014, when actual tapering started. The horizontal axis gives the reading for a specific macro variable at the time. That is, each point (in each graph) represents the pair $(macro\ variable, change\ in\ exchange\ rate)$ for one of the economies in the sample, during the taper tantrum.

None of the variables, including the current account and fiscal balances, can *by itself* fully explain the differences in currency impact between countries. There is also an apparent difference between the set of macro variables associated with dependence on external financing (four top graphs), and the set of macro variables which are not (the four bottom graphs, broadly associated with internal imbalances). Of the latter group, only inflation has a clear relationship with the strength of exchange rate reactions.[4]

2.2 Composite vulnerability index

The composite effect is however not trivial – countries with poor outcomes for many macro variables were more heavily targeted (sold) during the tantrum. The composite indicator draws on BGFRS (2014), and is a naïve average of the following: ratio of the current account balance to GDP; ratio of gross government debt to GDP; average annual inflation over the previous three years; change in bank credit to the private sector as percentage of GDP over previous five years; ratio of total external debt to annualized exports; and the ratio of foreign exchange reserves to GDP, obtained for each country i simply as $\Xi_i = \frac{1}{n}\sum_{j=1}^{n} x_{ij}$, where each x_{ij} denotes the value of macro variable j, for economy i, during the taper tantrum, where $i = 1, ...15$, and $j = 1, ..., 6$.[5]

[4] Caveat: output growth is much more significant if we restrict the end of the taper period to December 2013.

[5] Inverse variance weighting reduced the regression fit. The choice of variables is based on the Board of Governors of the Federal Reserve System's Monetary Policy report, of

Figure 1: Macro variables and currency depreciation during taper tantrum

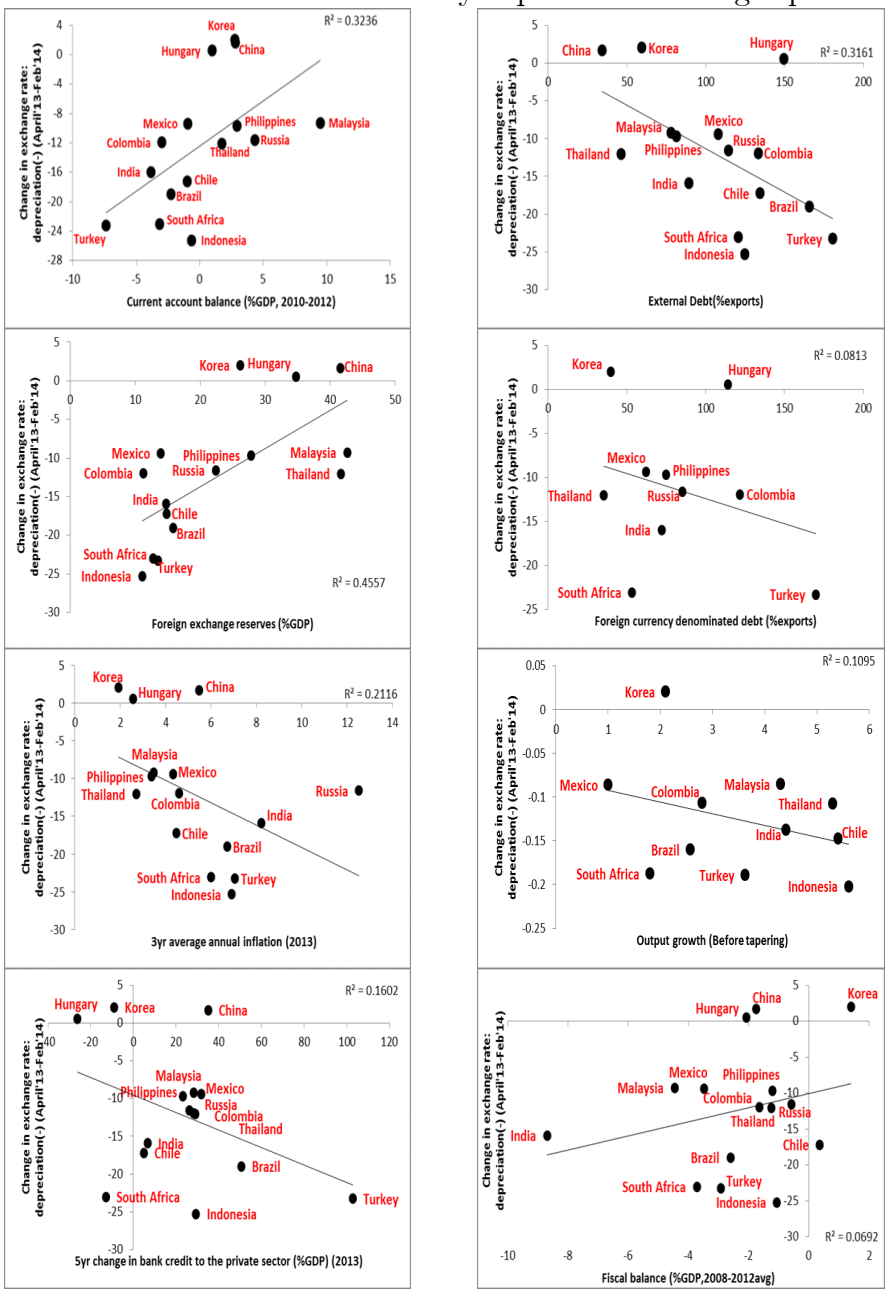


Figure 2: Composite vulnerability indicator and currency depreciation during taper tantrum

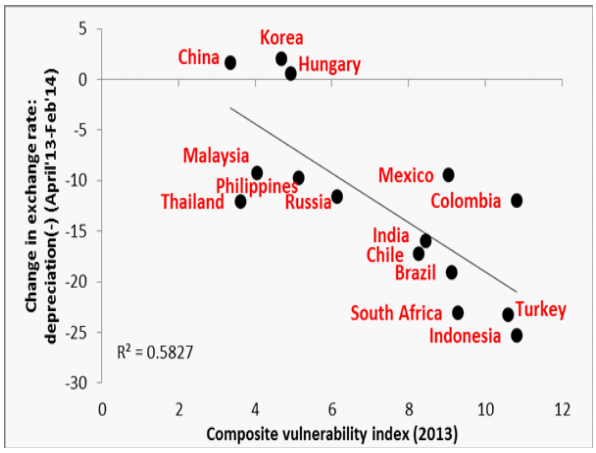


Figure 2 shows the relationship between this indicator and exchange rate changes between April 2013 and February 2014. The fitted line shows the estimated exchange rate response to the naïve composite indicator, obtained from a simple cross-sectional linear regression of the former variable on the latter. Differences in the value of the composite indicator explain nearly sixty percent of the differences in exchange rate reactions during the tantrum.

The next section shows that we can do better (in the sense of improving empirical fit) with an even simpler indicator which uses only the variables that seem, from Figure 1, to be the most significant; and combines them in a meaningful manner. However, the composite indicator produces a similar ranking, and is a more 'diversified' index, which could perform less poorly when the source of the external shock is not directly related to global financing conditions, or the weights assigned to each macro variable are adjusted to reflect changing focal points or "scapegoats" in the currency market. [6]

February 2014.

[6] See Fratzscher, Rime, Sarno, and Zinna (2015) on empirical support for the "scapegoat theory" (and central bankers' frequent observation) – that market participants may attach excessive weight to individual fundamentals (which shift over time), to rationalize currency movements driven by unobservable shocks. See Board of Governors of the Federal Reserve System (2014) for an emerging market vulnerability index construction based on the same variables as the composite index here.

2.3 Reserves to external financing requirement

The global event behind the taper tantrum was the anticipation of reduced global financing availability. We conjecture that (after an initial general sell-off) international markets focused on assets (especially currencies) of countries with large external financing requirements, and narrow our focus to the associated variables. Figure 1 shows that the ratio of foreign reserves to GDP, the average current account balance in the preceding two years (ratio to GDP), and the ratio of external debt to exports, are comfortably the variables which had the strongest effects. The sum of the last two variables constitutes a country's gross external financing requirement (GEFR).

We calculate the ratio of foreign exchange reserves to the sum of the current account and external debt (i.e. the ratio of a country's reserves to its gross external financing requirement) for each country in the sample. It is by design a measure of susceptibility to changes in global financing conditions; and straightforward to compute – an important consideration when we need to capture indicators that market participants may focus on.[7]

For each country i, the "reserves-to-GEFR indicator" Θ is simply,

$$\Theta_i = \frac{FXR_i}{CA_i + ED_i}, \tag{1}$$

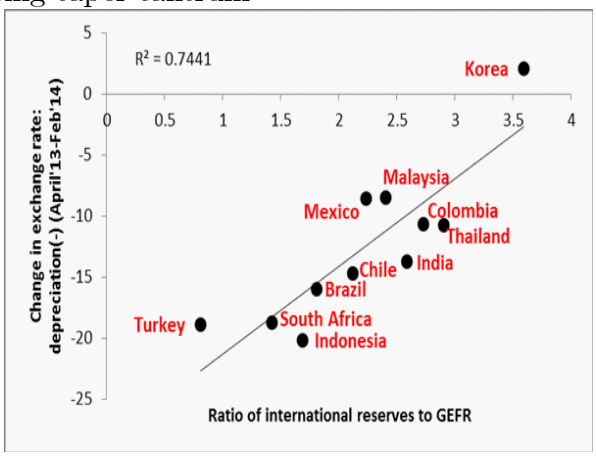
where FXR is the stock of foreign exchange reserves, CA is the current account balance, and ED is external debt maturing within one year. The ratio may be interpreted as the country's foreign reserves cover, in number of years, of its gross external financing requirement. The cross-sectional relationship between exchange rate reactions from April 2013 and February 2014, and reserves-to-GEFR in the third quarter of 2013, is shown in Figure 3.

The simple reserves-to-GEFR ratio explains 74 percent of the cross-country variation in depreciation rates over the tantrum period.[8] The tight fit shows that there is a strong relationship between an emerging economy's reserves-to-GEFR cover, and its currency's subsequent relative performance against the US dollar during the tantrum. The lower the ratio of reserves to GEFR,

[7] See for example James Kynge, "Look Beyond Doom-laden Labels for EM Victims," the *Financial Times*, 15 January 2014.

[8] This slightly exceeds the empirical fit achieved by the Emerging Market Vulnerability Index in Board of Governors of the Federal Reserve System (2014, p. 28-30), while relying on a smaller, and readily accessible, information set.

Figure 3: Ratio of reserves to external financing requirement against currency depreciation during taper tantrum



the greater the country's external vulnerability; more vulnerable economies, as indicated by low ratios of reserves-to-GEFR, experienced larger currency depreciations. The external debt figure is not adjusted to reflect the proportion of external debt denominated in foreign currency.[9] The fact that we get a close linear fit nevertheless suggests that markets did not pay much attention to this distinction. The value of the reserves-to-GEFR ratio for South Africa in 2013 was the second lowest in the sample – larger only than Turkey.

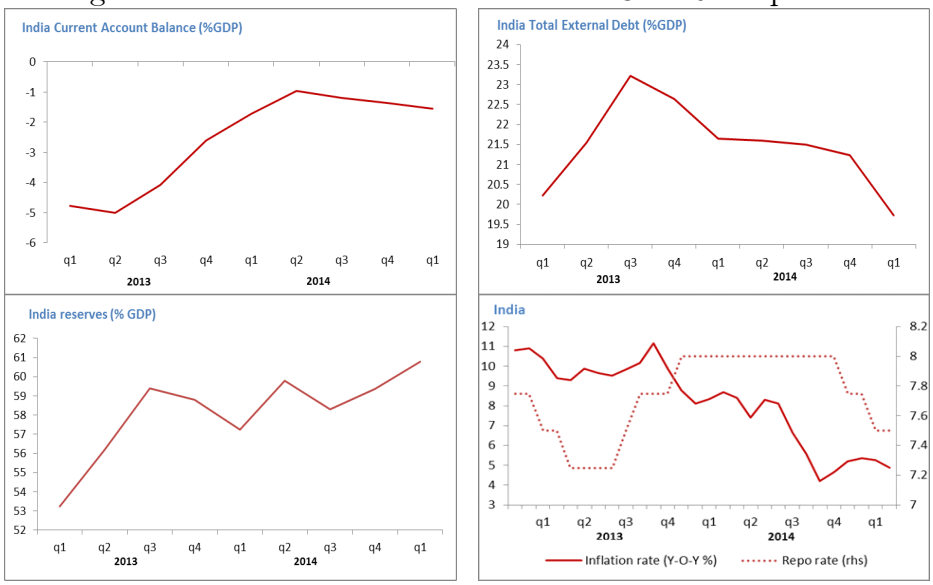
3 India: a case study

India was heavily affected by the taper tantrum, and Indian authorities responded resolutely and expeditiously.[10] Monetary policy adopted a new focus on bringing down inflation. The monetary policy stance was tightened, with the repo rate raised by a cumulative 75 basis points between September 2013 and January 2014. Reserves grew by approximately 45bn US dollars between September 2013 and December 2014, through spot and forward intervention; and external debt dropped substantially. A duty on gold imports (third

[9] Figure 13, in the appendix, illustrates the relationship between currency depreciation during taper tantrum, and foreign currency debt.

[10] See for example "Rajan's Surgical Strikes," *Euromoney Magazine*, October 2014; and IMF (2015a).

Figure 4: India: evolution of reserves-to-GEFR components



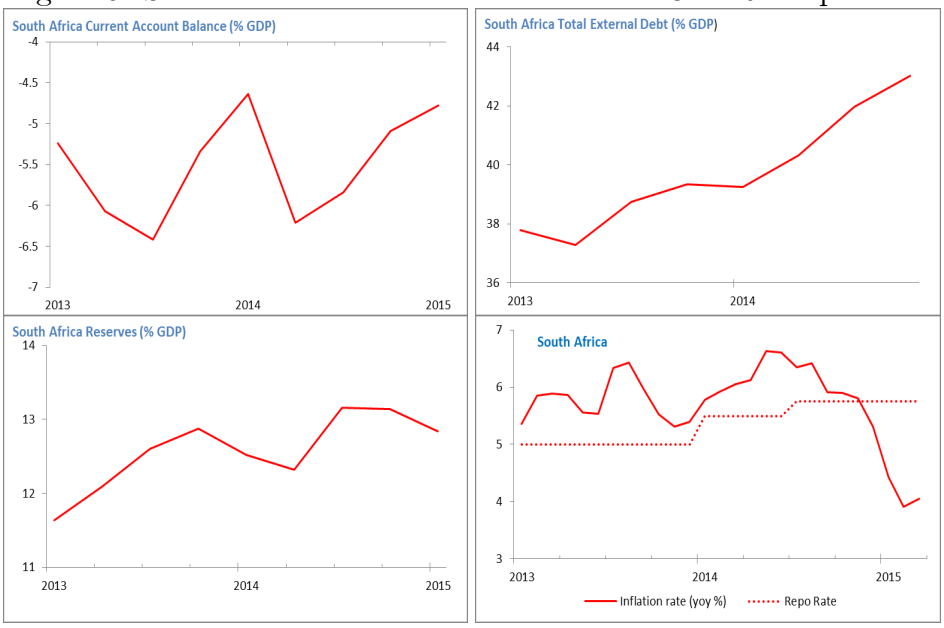
largest import category in India) was imposed.

The set of macro-economic management measures worked. Inflation was more than halved, from 11 to 5 percent, between November 2013 and December 2014.[11] Gold imports dropped from a monthly average of 5.9bn US dollars in the 6 months to May 2013, to an average of 1.5bn US dollars in the subsequent (approximately) 6 month period. This reduction explains half of the 3 percentage points of GDP reduction in the current account deficit (subsequently helped by the drop in the oil price), which the IMF expects to remain below 2 percent. As a result, the ratio of reserves to external financing requirement increased rapidly. See Figure 4; and contrast with the evolution of the same variables for South Africa, shown in Figure 5.

If these measures were successful in reducing vulnerability to normaliza-

[11] The reduction in inflation was not uniquely due to the tight policy stance. Additional measures include limited increases in agricultural procurement prices and the release of food grain stocks (IMF (2015)). Food is an important component of the targeted price basket. Lower oil prices accelerated the fall in inflation. On the rapid current account improvement, it helps that a relatively moderate duty on gold imports has a large impact on the Indian trade balance.

Figure 5: South Africa: evolution of reserves-to-GEFR components



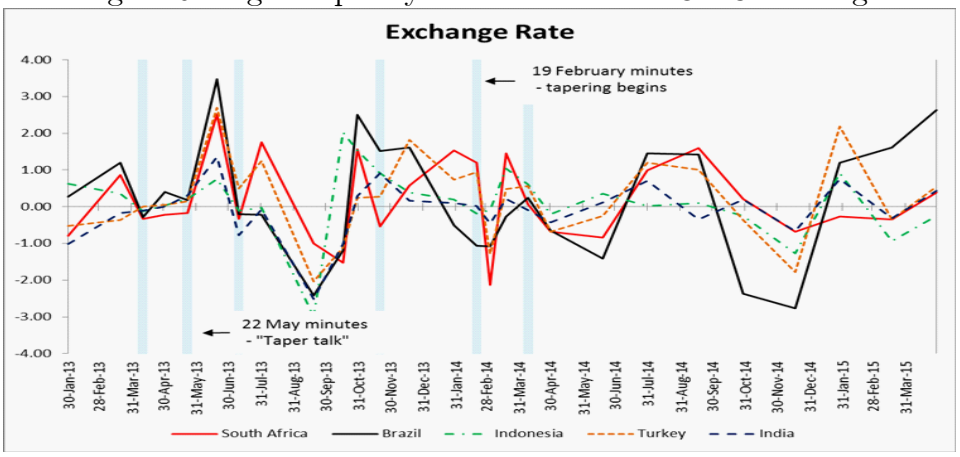
tion, we should observe reduced sensitivity of the rupee, compared to other vulnerable currencies, to new information which is used to re-assess the likely timing and intensity of US Fed rate increases. This is examined in the next section.

4 Reactions to FOMC meetings

We pulled the date of each FOMC meeting held since the beginning of 2013, and computed the two-day change in the exchange rate around each of these meetings (from one day before to one day after).[12] These are shown, for selected currencies, in Figure 6, where each date represents an FOMC meeting. The exhibit allows us to track the evolution of emerging market exchange rates' reactions to FOMC pronouncements, over a time period when these pronouncements are carefully analyzed for indications about the timing and

[12] See also Mishra, Moriyama, N'Diaye, and Nguyen (2014), which we update.

Figure 6: High-frequency FX reactions to FOMC meetings



degree of interest rate normalization in the US.[13]

We also include a subset of FOMC meeting minute releases, including Bernanke's speech to congress on the 22nd of May 2013 (which triggered the taper tantrum). These are the releases of 10 April 2013, 22 May 2013, 10 July 2013, 20 November 2013, 19 February 2014 and 9 April 2014. The minutes for 10 April and 10 July 2013 include no particularly important information, however they fell before and after the meeting and minute release related to the first "taper talk" and thus give some indication of an ordinary response to FOMC meeting minutes releases. The minutes released on 22 May 2013 coincided with then Governor Ben Bernanke's testimony to congress, these both included suggestions that if economic conditions in the United States showed (continued) improvement that tapering of quantitative easing could begin during the course of 2013. This surprised the market and is the reason why this minute release is included. Actual tapering eventually began in February 2014 leading to response analysis at the time of the release of the minutes from the January 2014 meeting (released 19 February 2014). The other two minute releases (20 November 2013 and 9 April 2014) relate to meeting months (October and March) in which there were two meetings, the official scheduled meeting and an unscheduled one day meeting earlier in the same month.

Observe the Indian rupee's reaction over time: high in early 2013, but very

[13]The same exercise is performed for long-term bond yields and stock market indices. The magnitude of each market's response is shown in the appendix.

low from late 2013, in sharp contrast to the Brazilian real and Turkish lira. (See Table 2 for numerical detail.) The rupee's sensitivity to expected changes in global financing conditions reduced. India is one of the least vulnerable in the set of emerging market currencies we track. The lower relative sensitivity matches the rapid reduction in India's external vulnerability.

5 Comparative external vulnerability in 2015

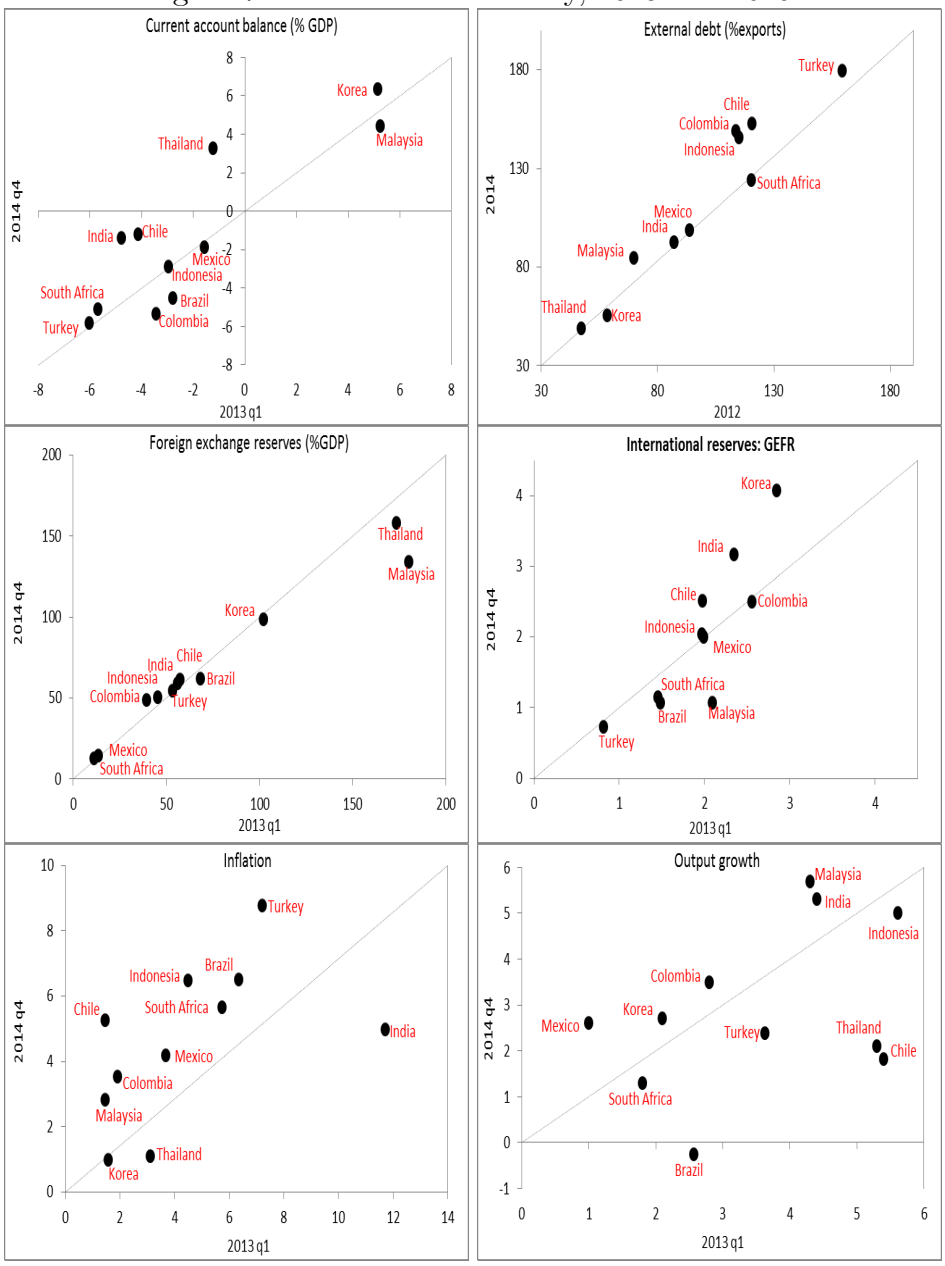
5.1 Relative position ahead of normalization

Figure 7 shows very little improvement in South Africa's *relative* position by virtually any of the components of the reserves-to-GEFR ratio, inflation, or growth. (Improvements are reflected by placement above the 45 degree line.) Brazil and Turkey show deterioration in foreign reserves cover of gross external financing requirement; so does Malaysia, significantly. These three economies' vulnerability to rapid changes in global financing conditions is greater now than it was during the taper tantrum. Due to increased vulnerability in Brazil and Malaysia, South Africa's ranking improves from second to fourth most vulnerable. So it remains among the five most vulnerable in our sample. It does particularly poorly, in comparative terms, on foreign exchange reserves (lowest ratio of reserves to GDP in the sample), economic growth, and the current account balance.

The following economies show notable reductions in external vulnerability (measured by improvements in the reserves-to-GEFR ratio) since the taper tantrum period: South Korea, India and Chile. Indonesia, like South Africa, shows an essentially unchanged foreign reserves cover of external financing requirement. See in particular the fourth panel (middle row, second column) of Figure 7.

There is also little improvement in absolute terms for South Africa, with a severe deterioration in external debt. The evolution of each component of the reserves-to-GEFR ratio for South Africa, as well as inflation and the policy rate, were shown in Figure 5. The improvement in the current account is small and tentative; the increase in reserves timid; and there is an aggressive recent increase in external debt.

Figure 7: External vulnerability, 2013 and 2015



5.2 Level of foreign exchange reserves

Less vulnerable countries with comparable buffers of international reserves (e.g., Chile), have external financing requirements equal to approximately half of South Africa's – see Table 1.[14]

Table 1: Current reserves, GEFR and ratio

Country	Stock of Reserves ($US billion)	GEFR ($US billion)	International reserves/GEFR
	2014 Q4		
Turkey	106.906	147.789	0.7234
Brazil	360.965	337.387	1.0699
Malaysia	114.572	107.023	1.0705
South Africa	44.267	38.745	1.1425
Mexico	190.923	95.576	1.9976
Indonesia	108.836	53.275	2.0429
Colombia	46.408	18.605	2.4944
Chile	40.438	16.124	2.5080
India	303.455	95.920	3.1636
Korea	358.785	88.069	4.0739
Thailand	151.253	30.150	5.0167

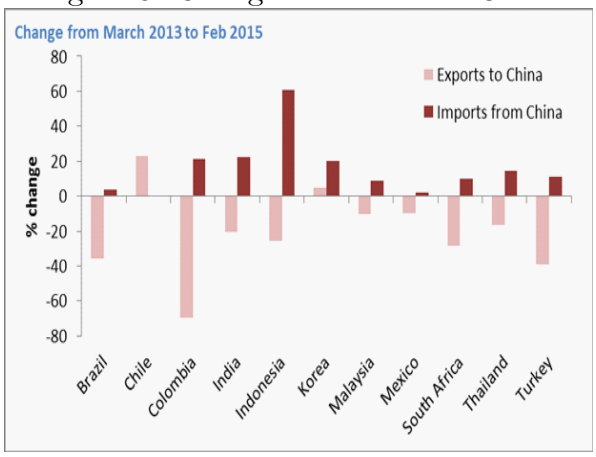
To match India's current "relative invulnerability" without reducing the external financing requirement, would require a nearly threefold increase in South Africa's foreign exchange reserves. The increases required by Malaysia, Brazil, and Turkey, would be larger.

6 Complications: China

The rate of growth in China has slowed, and Beijing intends to reorient the Chinese economy from investment towards consumption (IMF (2015b)). The pair of adjustments raises the vulnerability of economies where domestic activity is most dependent on investment-led and commodity-intensive growth in China. This was not such a strong aspect during the taper tantrum; it might be during Fed normalization. Exporters of non-food commodities

[14] Countries are sorted from lowest to highest ratio of reserves to external financing requirement.

Figure 8: Change in trade with China



(especially metals), with China as a dominant market, will be hit by a double-whammy.

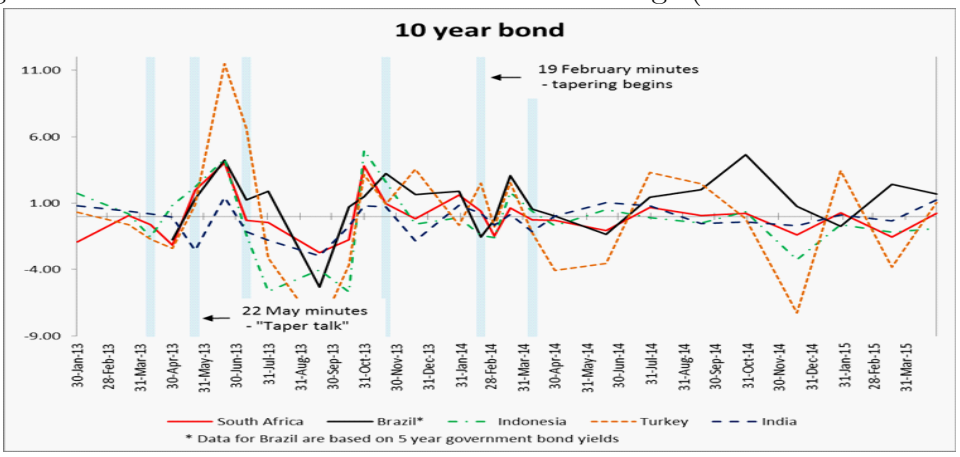
Figure 8 shows the change in exports to, and imports from China, between March 2013 and February 2015. We restrict our attention to the same list of emerging economies for consistency; some of the economies most heavily dependant on trade with China are however advanced economies, including Australia, New Zealand, and Japan.[15] Notice the change in circumstances in Colombia. The near collapse in exports to China will arguably negate Colombia's relative comfort in reserves-to-GEFR cover (two-and-a-half years). Brazil and Turkey have also experienced heavy declines in exports to China.

The evolution of South African exports between 2000 and 2013 places it among the (five to ten, depending on metric used) most dependant on China; and its exports to China consist almost entirely of non-food commodities.[16] These exports have fallen by approximately 28 percent over the last two years. Other exports to the rest of Africa help; but growth in the rest of Africa was largely driven by the commodities boom from the early 2000s, in turn largely driven by growth in China.

[15] See for example Gauvin and Rebillard (2015).

[16] See Table 8, and James Kynge, "Ranking EM Vulnerability to China," *Financial Times*, 13 March 2014. For alternative measures see for example Gauvin and Rebillard (2015).

Figure 9: Bond market reactions to FOMC meetings (and selected minutes)



7 Reactions in other asset markets

7.1 Bonds

Figure 9 shows substantial two-day changes in ten year bond yields around each FOMC meeting since 2013. In contrast to the rand exchange rate, South African government bond yields respond less aggressively than peers.

However, both vulnerability indicators have weak explanatory power for the international cross-section of bond market reactions to the taper tantrum: see Figure 10.

7.2 Equities

On high-frequency reactions to FOMC meetings: Figure 11 shows substantial two-day changes in aggregate stock market valuations around each FOMC meeting since 2013.

However, neither reserves-to-GEFR nor the composite vulnerability index are of any use in explaining the cross-sectional variation in stock market behavior during the taper tantrum. Indeed, the Johannesburg Stock Exchange was peculiar in that it increased very substantially in value, like advanced economy stock markets – see Figure 12 (and Hassan and Paul (2014)).

Figure 10: Vulnerability indicators and bond market reactions during taper tantrum

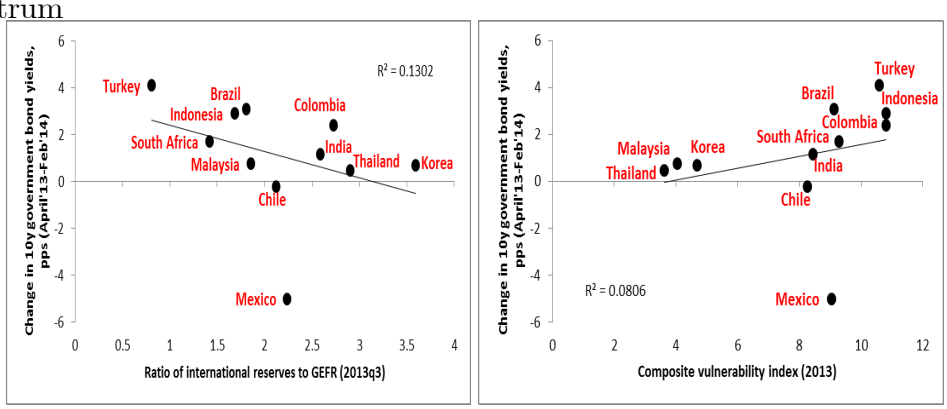


Figure 11: Stock market reactions to FOMC meetings (and selected minutes)

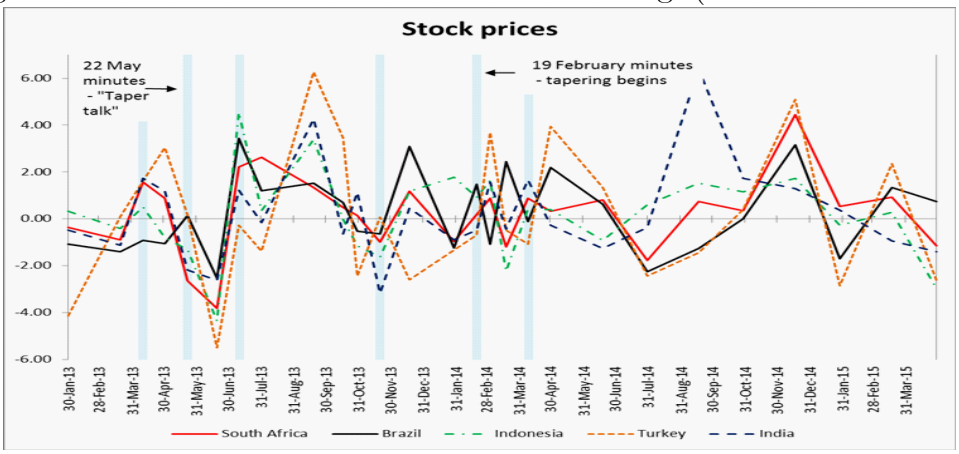
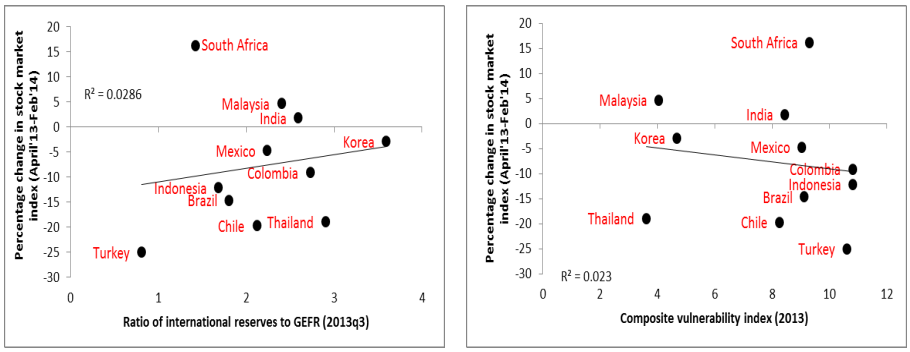


Figure 12: Vulnerability indicators and stock market reactions during taper tantrum



8 Conclusion

Countries with larger ratios of external financing needs to foreign exchange reserves, are more vulnerable to changes in global financing conditions. This was vividly demonstrated during the taper tantrum episode in 2013; and will, in all likelihood, be seen during (anticipated) Fed policy normalization.

The ratio of reserves-to-GEFR might be viewed as a simple proxy for the strength of buffers against shocks to global financing conditions. At the time of writing, South Africa is not significantly less vulnerable to face imminent policy rate rises by the US Fed, than it was during the taper tantrum. Its external financing requirement has improved only slightly between early 2013 and the end of 2014 (latest available data), partly due to the effect of the drop in the oil price on the current account; with no meaningful increase in the stock of foreign exchange reserves. External debt increased precipitously. The country's *relative* position is only marginally better (from second to fourth most vulnerable in our sample), and it remains amongst the most exposed among emerging economies with developed financial markets. (The ratio of reserves-to-GEFR deteriorated also in Brazil and Malaysia, and remained unchanged, at the bottom, for Turkey.) The recent growth in its export dependence on Chinese demand is an added complication.

The simplicity and conceptual transparency of the approach used in this paper helps to focus the issue – away from ubiquitous but often vague al-

lusions to "sound fundamentals"– by mapping vulnerability to Fed normalization to a manageable set of variables, in a manner that facilitates (to a point) urgent and preemptive surgical action by policy-makers.

9 References

Aizenman, Joshua, Mahir Binici, and Michael Hutchison. 2014. "The Transmission of Federal Reserve Tapering News to Emerging Financial Markets." *NBER Working Paper* 19980

BGFRS. 2014. *Monetary Policy Report.* Board of Governors of the Federal Reserve System, Semi-Annual Report to Congress, 11 February.

Bowman, David, Juan Londono, and Horacio Sapriza. 2014. "US Unconventional Monetary Policy and Transmission to Emerging Market Currencies." *Board of Governors of the Federal Reserve System, International Finance Discussion Paper* 1109.

Eichengreen, Barry, and Poonam Gupta. 2014. "Tapering Talk." *World Bank Policy Research Working Paper* 6754.

Fratzscher, Marcel, Dagfinn Rime, Lucio Sarno, and Gabriele Zinna. 2015. "The Scapegoat Theory of Exchange Rates: The First Tests." *Journal of Monetary Economics*, 70, 1–21.

Gauvin, Ludovic, and Cyril Rebillard. 2015. "Towards Recoupling? Assessing the Global Impact of a Chinese Hard Landing Through Trade and Commodity Price Channels." *Banque de France, Document de Travail 562.*

Hassan, Shakill, and Merissa Paul. 2014. "Recent Capital Raising by Firms Listed on the JSE," *South African Reserve Bank Economic Note 14-10*, October.

IMF. 2015a. India: Article IV Consultation – Staff Report. *International Monetary Fund, Country Report* 15/61.

IMF. 2015b. "IMF Staff Completes the 2015 Article IV Consultation Mission to China." Press Release 15/237. 26 May.

Mishra, Prachi, Kenji Moriyama, Papa N'Diaye, and Lam Nguyen. 2014. "Impact of Fed Tapering Announcements on Emerging Markets." *International Monetary Fund, Working Paper* 14/109.

Nechio, Fernanda. 2014. "Fed Tapering News and Emerging Markets." *Federal Reserve Bank of San Francisco, Economic Letter* 2014-06, 3 March

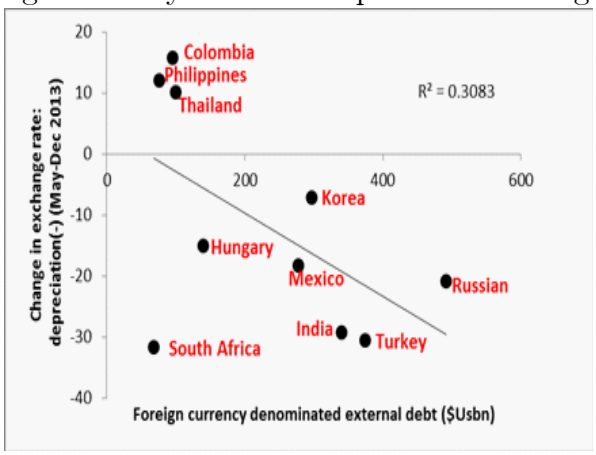
Yellen, Janet. 2015. "Recent Developments and the Outlook for the Economy." Remarks at the City Club of Cleveland. *Board of Governors of the Federal Reserve System*, 10 July.

10 Appendix

10.1 Foreign currency debt

Figure 1 shows little relationship between foreign currency denominated debt as a share of exports, and exchange rate sensitivity to taper news. Note however that the absolute amounts of foreign currency debt did matter, especially during the early phase of the tantrum – this is shown in Figure 13.

Figure 13: Foreign currency debt and depreciation during taper tantrum



10.2 Detail on reactions to FOMC meetings

Tables 2, 3, and 4, show the exact magnitudes of, respectively, the exchange rate, bond yield, and stock market high-frequency responses to each Federal Open Market Committee meeting since 2013.

Table 2: Exchange rate responses to each FOMC meeting since 2013

if meeting day = t	t-1, t+1 used					
Meetings	Exchange rate					
	South Africa	Brazil	Indonesia	Turkey	India	minutes
30-Jan-13	-0.79	0.28	0.62	-0.53	-1.02	0.00
20-Mar-13	0.86	1.20	0.36	-0.36	-0.17	0.00
10-Apr-13	-0.33	-0.28	-0.12	0.01	-0.11	1.00
01-May-13	-0.22	0.39	0.04	0.05	0.01	0.00
22-May-13	-0.17	0.18	0.20	0.15	0.31	1.00
19-Jun-13	2.52	3.48	0.75	2.70	1.37	0.00
10-Jul-13	-0.34	-0.20	-0.10	0.49	-0.77	1.00
31-Jul-13	1.76	-0.22	-0.03	1.25	-0.07	0.00
18-Sep-13	-1.00	-2.41	-3.00	-2.04	-2.52	0.00
16-Oct-13	-1.53	-1.19	2.03	-1.12	-1.01	0.00
30-Oct-13	1.56	2.50	1.54	0.25	0.28	0.00
20-Nov-13	-0.54	1.52	0.91	0.27	0.91	1.00
18-Dec-13	0.58	1.61	0.38	1.82	0.16	0.00
29-Jan-14	1.53	-0.50	0.19	0.74	0.10	0.00
19-Feb-14	1.20	-1.06	-0.19	0.94	0.02	1.00
04-Mar-14	-2.13	-1.09	-0.09	-1.29	-0.46	0.00
19-Mar-14	1.46	-0.26	1.03	0.49	0.21	0.00
09-Apr-14	0.07	0.24	0.61	0.56	-0.09	1.00
30-Apr-14	-0.68	-0.66	-0.21	-0.68	-0.43	0.00
18-Jun-14	-0.84	-1.41	0.35	-0.25	0.11	0.00
30-Jul-14	0.99	1.45	0.02	1.20	0.70	0.00
17-Sep-14	1.60	1.42	0.10	1.01	-0.35	0.00
29-Oct-14	0.21	-2.37	-0.25	-0.37	0.20	0.00
17-Dec-14	-0.69	-2.77	-1.27	-1.78	-0.67	0.00
28-Jan-15	-0.26	1.20	0.91	2.19	0.76	0.00
18-Mar-15	-0.35	1.61	-0.93	-0.34	-0.32	0.00
29-Apr-15	0.39	2.63	-0.25	0.54	0.44	0.00

Statements released at 2pm EST; this is after markets closed (opened) in South Africa and Turkey (and Indonesia)

Shaded dates indicate statements at which economic data were released

Table 3: Bond yield responses to each FOMC meeting since 2013

	10 Year bond					
	South Africa	Brazil*	Indonesia	Turkey	India	minutes
30-Jan-13	-1.93		1.75	0.30	0.80	0.00
20-Mar-13	0.09		0.18	-0.63	0.39	0.00
10-Apr-13	-0.60		-1.57	-1.70	0.20	1.00
01-May-13	-2.14	-1.74	0.86	-2.39	-0.04	0.00
22-May-13	1.98	1.33	2.21	0.89	-2.54	1.00
19-Jun-13	4.05	4.24	4.34	11.50	1.44	0.00
10-Jul-13	-0.30	1.25	-1.38	6.63	-1.13	1.00
31-Jul-13	-0.45	1.90	-5.64	-3.14	-1.79	0.00
18-Sep-13	-2.71	-5.33	-4.01	-8.52	-2.96	0.00
16-Oct-13	-1.74	0.72	-5.66	-3.67	-0.74	0.00
30-Oct-13	3.78	1.47	4.98	3.13	0.78	0.00
20-Nov-13	0.96	3.23	2.56	0.91	0.73	1.00
18-Dec-13	-0.15	1.67	-0.59	3.54	-1.85	0.00
29-Jan-14	1.62	1.91	-0.10	-0.64	0.82	0.00
19-Feb-14	0.41	-1.55	-1.45	2.50	0.22	1.00
04-Mar-14	-1.48	-0.26	-1.60	-0.77	-0.67	0.00
19-Mar-14	0.62	3.07	1.83	2.56	0.16	0.00
09-Apr-14	-0.25	0.56	0.38	-1.21	-1.13	1.00
30-Apr-14	-0.28	0.03	-0.71	-4.04	0.01	0.00
18-Jun-14	-1.08	-1.34	0.54	-3.52	1.03	0.00
30-Jul-14	0.68	1.45	-0.09	3.32	0.78	0.00
17-Sep-14	0.07	2.01	-0.50	2.44	-0.54	0.00
29-Oct-14	0.23	4.66	0.34	-0.17	-0.43	0.00
17-Dec-14	-1.39	0.77	-3.26	-7.28	-0.71	0.00
28-Jan-15	0.28	-0.74	-0.61	3.45	0.09	0.00
18-Mar-15	-1.56	2.41	-1.19	-3.82	-0.35	0.00
29-Apr-15	0.23	1.68	-0.89	1.05	1.25	0.00

Statements released at 2pm EST; this is after markets closed (opened) in South Africa and Turkey (and Indonesia)

Shaded dates indicate statements at which economic data were released

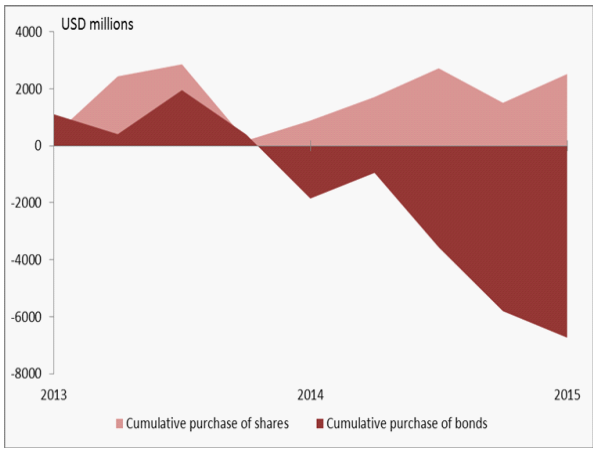
Table 4: Stock market responses to each FOMC meeting since 2013

	Stock prices					
	South Africa	Brazil	Indonesia	Turkey	India	minutes
30-Jan-13	-0.37	-1.07	0.33	-4.13	-0.48	0.00
20-Mar-13	-0.88	-1.39	-0.41	0.11	-1.13	0.00
10-Apr-13	1.57	-0.91	0.50	1.61	1.73	1.00
01-May-13	0.87	-1.05	-0.80	3.05	1.19	0.00
22-May-13	-2.65	0.15	-1.30	0.18	-2.17	1.00
19-Jun-13	-3.83	-2.53	-4.35	-5.50	-2.62	0.00
10-Jul-13	2.21	3.44	4.55	-0.27	1.22	1.00
31-Jul-13	2.62	1.19	0.34	-1.37	-0.16	0.00
18-Sep-13	1.34	1.52	3.39	6.26	4.25	0.00
16-Oct-13	0.49	0.69	-0.02	3.47	-0.64	0.00
30-Oct-13	0.15	-0.52	-1.14	-2.44	1.13	0.00
20-Nov-13	-0.98	-0.65	-1.64	0.08	-3.17	1.00
18-Dec-13	1.17	3.08	1.19	-2.60	0.47	0.00
29-Jan-14	-0.97	-1.25	1.78	-1.33	-0.90	0.00
19-Feb-14	0.20	1.48	0.92	-0.69	-0.47	1.00
04-Mar-14	0.88	-1.07	1.64	3.69	1.58	0.00
19-Mar-14	-1.20	2.44	-2.22	-0.48	-0.42	0.00
09-Apr-14	0.88	-0.11	0.42	-1.08	1.66	1.00
30-Apr-14	0.32	2.20	0.40	3.93	-0.28	0.00
18-Jun-14	0.81	0.62	-0.92	1.33	-1.25	0.00
30-Jul-14	-1.77	-2.26	0.60	-2.45	-0.37	0.00
17-Sep-14	0.74	-1.25	1.51	-1.45	6.40	0.00
29-Oct-14	0.36	0.01	1.15	0.39	1.73	0.00
17-Dec-14	4.44	3.17	1.74	5.10	1.29	0.00
28-Jan-15	0.53	-1.71	-0.27	-2.84	0.37	0.00
18-Mar-15	0.93	1.33	0.27	2.36	-0.93	0.00
29-Apr-15	-1.15	0.75	-2.97	-2.62	-1.41	0.00

Statements released at 2pm EST; this is after markets closed (opened) in South Africa and Turkey (and Indonesia)

Shaded dates indicate statements at which economic data were released

Figure 14: Cumulative non-resident net purchases of South African securities since taper talk



10.3 Financing of current account deficit

Exceptionally expansionary global monetary conditions allowed easy financing of a persistent current account deficit. South Africa is experiencing a sustained reduction in non-resident purchases of government bonds, since tapering (talk and action) – see Figure 14; note however that non-resident net purchase numbers as provided by the JSE need not match cross-border flows over short horizons.[17]

Sustained purchases of equities have not been sufficient to compensate for the effect of cumulative net bond sales. It would be imprudent to assume that portfolio inflows will continue to comfortably finance the external deficit.

The capital flow category which increased substantially since tapering is "other", which includes direct loans – mainly due to a spike in cross-border loans to the banking sector. If un-hedged, this form of financing would lead to currency mismatch in domestic balance sheets, and raises vulnerability to large exchange rate movements. First order vulnerability causes large depreciations; increased (un-hedged) foreign currency liabilities increase vulnerability to large depreciations.

[17] See also "Emerging market portfolio flows reveal fear of the Fed", *Financial Times*, 25 June 2015.

10.4 Data sources

Table 5 lists the various data sources.

Table 5: Data sources

Source	Concept
International Monetary Fund, Balance of Payments Statistics Yearbook and data files, and World Bank and OECD GDP estimates.	Current account balance (BoP, current US$)
International Monetary Fund, International Financial Statistics and data files.	Total reserves minus gold (current US$)
International Monetary Fund, Balance of Payments Statistics Yearbook and data files.	Current account balance (BoP, current US$)
World Bank, International Debt Statistics.	External debt stocks, short-term (DOD, current US$)
World Bank, International Debt Statistics.	External debt stocks (% of exports of goods, services and primary income)
World Bank national accounts data, and OECD National Accounts data files.	GDP (current US$)
IMF Fiscal Monitor	Gross general government debt (%GDP)
International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.	Domestic credit to private sector by banks (% of GDP)
World Bank national accounts data, and OECD National Accounts data files.	Inflation, GDP deflator (annual %)
World Bank national accounts data, and OECD National Accounts data files.	GDP growth (annual %)
Quarterly external debt statistics	Foreign currency denomianted external debt
Bloomberg	Stock market values
Bloomberg	Bond yields
IMF Direction of Trade Statistics	China trade data (imports and exports)
UN Comtrade database	China trade data (non-food commodity imports and exports used in table)
Datastream	India repo rate, inflation rate