EUROPEAN CENTRAL BANK

EUROSYSTEM

John Beirne*
European Central Bank

Apostolos Apostolou
International Monetary Fund

Volatility Spillovers of Fed and ECB Balance Sheet Expansions to Emerging Market Economies

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Disclaimer: The views presented in this study are those of the authors and do not necessarily reflect those of the European Central Bank, the Eurosystem or the International Monetary Fund.

Motivation

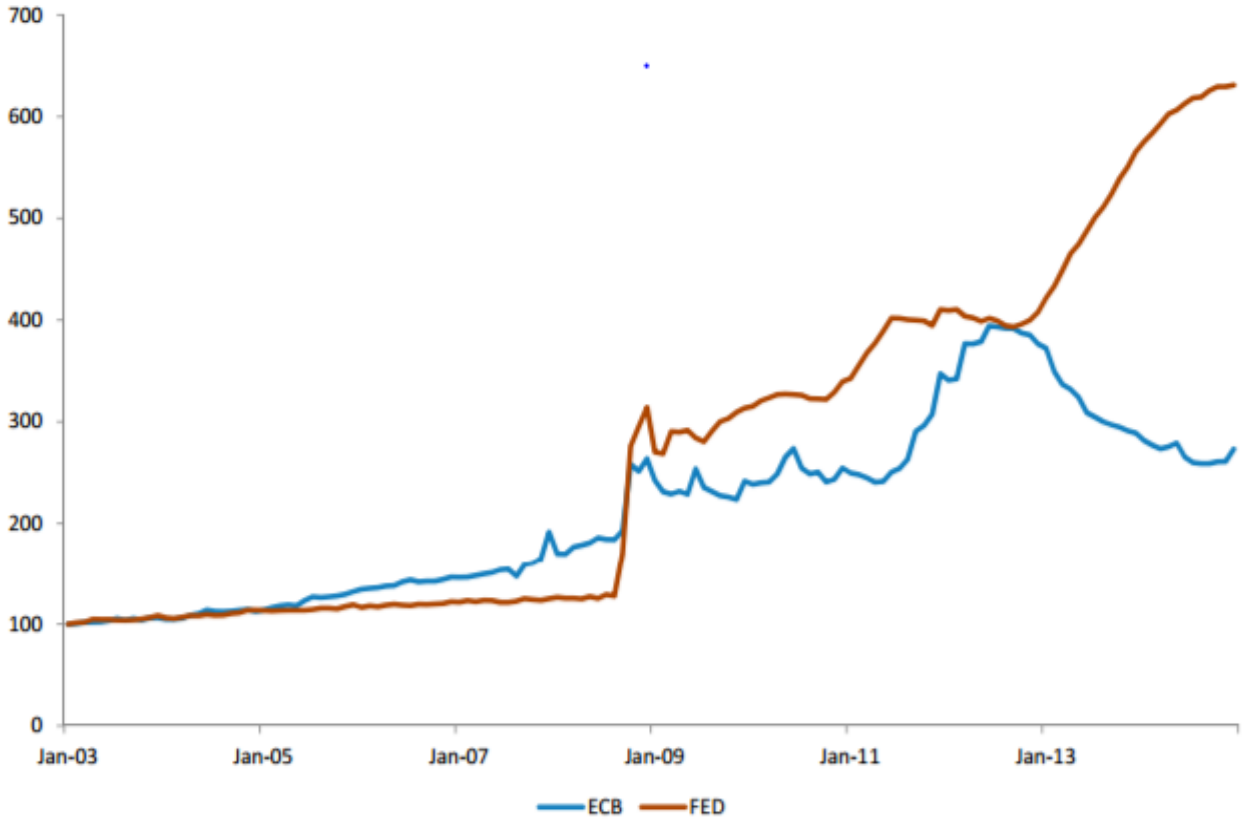
- ‘Taper tantrum’ episode of May 2013 led to a substantial **rise in EME asset market volatility and capital outflows**
- Literature had largely focussed on **level effects** of AE unconventional monetary policy spillovers to financial variables elsewhere.
- **Volatility spillover effects** in real and financial variables in EMEs largely been ignored.
- Volatility matters !!

Motivation

- "*...frankly the ECB has not done anything to increase volatility in the markets. If you think that the ECB has done anything that is comparable to what is happening in the other central banks, we would not agree with this perception...But, certainly, we have observed an increase in global volatility, coming from major monetary policy decisions or announcements of decisions that may be taken in the coming months. However, I do not think that the ECB has in any way been a source of this; I cannot really find any data to support this*".

  - Mario Draghi, June 2013

Fed Reserve and ECB balance sheets



Data:FED and ECB

Why the interest in volatility effects?

- While a global shock triggered the sell-off in May 2013, the country specific performance of equity and bond prices reflected **domestic vulnerabilities**.
  - as volatility and risk aversion rose, investors' started discriminating more across countries by looking at fundamentals.
- EMEs with **large current account deficits** experienced the largest declines in equity prices and the sharpest increases in bond yields.
  - particularly for EMEs whose real exchange appreciated strongly during QE and who had received relatively large capital inflows (e.g. Aizenman, Binici and Hutchison, 2014).
- EMEs with **large and liquid financial markets** felt greater pressure on the exchange rate, foreign reserves, and equities (e.g. Eichengreen and Gupta, 2014).
  - greater scope for portfolio rebalancing and selling without incurring losses.

Summary of main findings

- **EME bond markets are most susceptible** to positive volatility spillover effects from both the Fed and ECB.
- Positive volatility spillover effects to **EME currencies higher in the case of the Fed** by a factor of ten.
- EME stock markets are subject to **negative volatility spillovers**.
- **Limited evidence** of volatility spillovers to the EME real economy.
- **Spillovers have been diminishing** since 2008 in the case of the Fed but not so notably in the case of the ECB.

Related literature

- Fernandez-Villaverde et al (2011) use a DSGE framework to show that rises in **interest rate volatility in EMEs** reduce output, consumption and investment.
  - households change the precautionary holdings of foreign debt.
- Uribe and Yue (2006) show that **interest rate shocks in the US** contribute to volatility in EMEs.
- Bernanke and Reinhart (2004) discuss the policy options for central banks, when the **zero lower bound is reached**:
  - Forward guidance for low interest rates
  - Changing the Central Bank balance sheet composition.
  - Quantitative easing

Related literature

- Hattori, Schrimpf and Sushko (2013) find that the effect of purchases is most pronounced when **combined with an expansion and duration extension** of the Fed's balance sheet.
- Fratzscher, Lo Duca and Straub (2016) – unconventional monetary policy operations by the Fed **spilled over to EME asset markets**. See also Ait-Sahalia et al (2012).
- Diebold and Yilmaz (2009) concentrated on stock market returns, finding **volatility spillovers jumps.**
- Yilmaz (2010) calculates an **equity volatility spillover index** and finds that the interdependence among East Asian equity markets pushed the volatility spillover to the highest levels during the current crisis.

Methodology Step 1

We use a two-step GARCH specification to assess the impact of monetary policies in developed countries, on EMEs. We start with the specification of GARCH(1,1) model for the central bank:

$$r_{cb,t} = \alpha_{cb} + \sqrt{\sigma^2_{cb,t}} z_{cb,t}, \qquad z_{cb,t} \sim \mathcal{N}(0,1) \tag{1}$$

where $r_{cb,t}$ is the percentage change in the central bank's balance sheet at time t. $z_{cb,t}$ is independently and identically distributed as a normal distribution with mean 0 and variance 1. The GARCH variance is defined as:

$$\sigma^2_{cb,t} = \omega_{cb} + \beta_{cb} r^2_{cb,t-1} + \gamma_{cb} \sigma^2_{cb,t-1} \tag{2}$$

where $\omega_{cb} > 0$, $\beta_{cb} \geq 0$, $\gamma_{cb} > 0$ and $\beta_{cb} + \gamma_{cb} < 1$. The innovations from our model are defined as:

$$\varepsilon_{cb,t} = r_{cb,t} - \alpha_{cb} - \sqrt{\sigma^2_{cb,t}} z_{cb,t} \tag{3}$$

Methodology Step 2

In order to model the volatility spillovers from the FED and ECB balance sheet expansions, in the second step we use the innovations from our first GARCH (1,1) regression and add them as an explanatory variable in the second GARCH(1,1) regression for the emerging market variables. The specification is as:[6]

$$r_{em,t} = \alpha_{em} + \phi\varepsilon_{cb,t} + \sqrt{\sigma^2_{em,t}}z_{em,t}, \qquad z_{em,t} \sim \mathcal{N}(0,1) \tag{4}$$

where $r_{em,t}$ is the percentage change in the emerging market variable at time t. $z_{em,t}$ is independently and identically distributed as a normal distribution with mean 0 and variance 1. The GARCH variance is defined as:

$$\sigma^2_{em,t} = \omega_{em} + \beta_{em}r^2_{em,t-1} + \gamma_{em}\sigma^2_{em,t-1} \tag{5}$$

where $\omega_{em} > 0$, $\beta_{em} \geq 0$, $\gamma_{em} > 0$ and $\beta_{em} + \gamma_{em} < 1$.

Then we find the ratio of the volatility of the variables in the developing countries that is explained by the volatility in the developed countries central banks' balance sheet. We calculate this ratio, which holds by construction, as:

$$VR_{cb,t} = \frac{\phi^2\sigma^2_{cb,t}}{\sigma^2_{em,t} + \phi^2\sigma^2_{cb,t}} \tag{6}$$

Data

- Monthly data frequency from 2003M1 to 2014M12 for the following countries:
- Brazil, Russia, India, China, South Africa, Poland, Croatia, Hungary, Czech Republic, Colombia, Chile, Peru and Mexico
- Variables: size of central bank balance sheets for ECB and Fed, EME bilateral exchange rates (vis-à-vis EUR and USD), stock market indices, EMBI spreads, industrial production, CPI
- For ECB: test for spillovers to the BRICS, Poland, Croatia, Czech Republic and Hungary
- For Fed: test for spillovers to the BRICS, Colombia, Chile, Peru and Mexico

Results

Table 1: Volatility spillovers from the FED

	ER	Stock	EMBIG	IP	CPI
Brazil	0.122***	-0.285***	0.461***	-0.02***	0
	(0.0292)	(0.0741)	(0.017701)	(0.0092)	(0.0021)
Russia	-0.069***	-0.212	0.95***	0.079***	0
	(0.0301)	(0.1516)	(0.0262)	(0.0209)	(0.0055)
India	0.089***	-0.214***		0.016	0.003
	(0.0324)	(0.0886)		(0.0256)	(0.0211)
China	-0.003	-0.331	1.141***	-0.002	0.001
	(0.0075)	(0.2277)	(0.009278)	(0.0072)	(0.0059)
South Africa	0.234***	-0.229***	1.325***	0.119***	0.003
	(0.0361)	(0.0855)	(0.0160)	(0.0355)	(0.0049)
Colombia	0.318	-0.265***	0.819***	-0.026	0.001
	(0.0850)	(0.0774)	(0.0181)	(0.0436)	(0.0040)
Chile	0.234***	-0.108***	0.796***	0.025	0.001
	(0.0381)	(0.0425)	(0.0107)	(0.0593)	(0.0041)
Peru	0.026	-0.428***	1.184***	-0.035	0.001
	(0.0366)	(0.0950)	(0.0265)	(0.0486)	(0.0043)
Mexico	0.285***	-0.175***	0.39***	0.001	-0.001
	(0.0133)	(0.0477)	(0.014310)	(0.0095)	(0.0021)

Note: these spillover coefficents refer to the ϕ terms, as per equation (4).
***, **, * denote 1, 5, 10 percent signifance levels respectively.

Results

Table 2: Volatility spillovers from the ECB

	ER	Stock	EMBIG	IP	CPI
Brazil	0.0743	-0.3095***	0.2302	-0.0335***	-0.0012
	(0.0919)	(0.0925)	(0.0365)	(0.0135)	(0.0021)
Russia	0.0527***	-0.0663	0.9231***	0.0094	-0.0009
	(0.0240)	(0.1695)	(0.057021)	(0.0119)	(0.0038)
India	-0.0517	-0.1794*		-0.0231	-0.0056
	(0.0412)	(0.1062)		(0.0506)	(0.0162)
China	-0.0903***	-0.6634***	1.1207***	-0.0006	0.0066
	(0.0289)	(0.1773)	(0.015393)	(0.0084)	(0.0048)
South Africa	0.0261	-0.1824***	1.0183***	-0.0151	-0.0064
	(0.0544)	(0.0791)	(0.0344)	(0.0578)	(0.0041)
Poland	0.0843***	-0.3269***	1.7507***	0.0096	0.0005
	(0.0398)	(0.0825)	(0.0164)	(0.0668)	(0.0024)
Hungary	0.0175	-0.3804***	2.2659***	0.0122	-0.0039
	(0.0222)	(0.0845)	(0.018487)	(0.0373)	(0.0057)
Croatia	-0.005	-0.0976	-0.004	0.027	0.0026
	(0.0080)	(0.0886)	(0.148522)	(0.1293)	(0.0052)
Czech Rep.	0.0352	-0.1698*		-0.0561***	0.0012
	(0.0258)	(0.0998)		(0.0158)	(0.0026)

Note: these spillover coefficents refer to the ϕ terms, as per equation (4).
***, **, * denote 1, 5, 10 percent signifance levels respectively.

Time-varying variance proportions – Federal Reserve

Figure 3: EME Currency Market Volatility - FED Variance Proportion

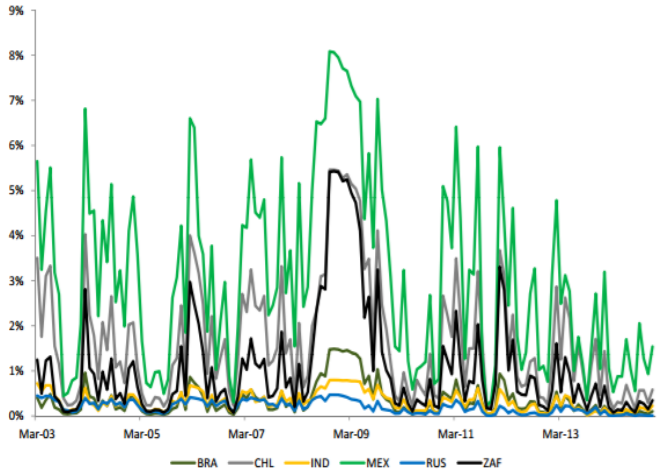


Figure 4: EME Stock Market Volatility - FED Variance Proportion

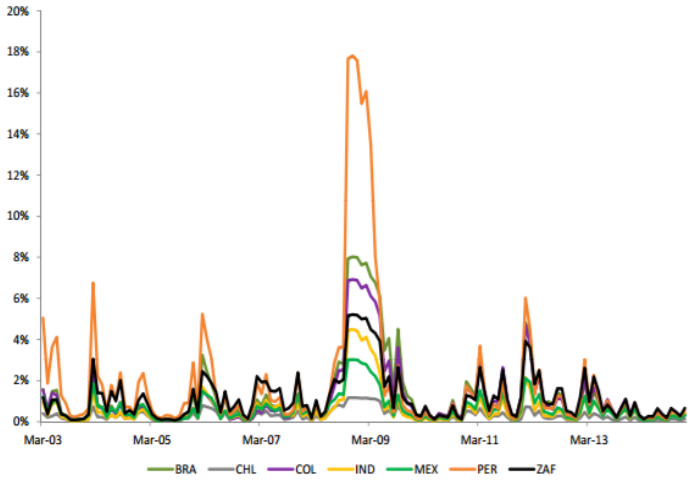


Figure 5: EME Bond Market Volatility - FED Variance Proportion

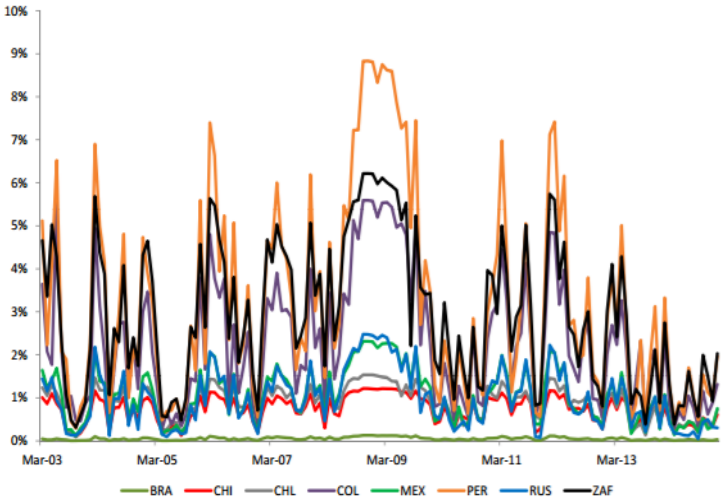
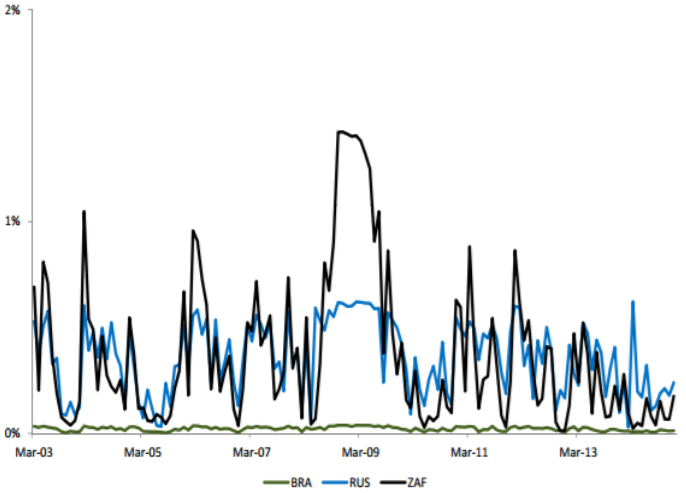


Figure 6: EME Economic Activity Volatility - FED Variance Proportion



Time-varying variance proportions - ECB

Figure 7: EME Currency Market Volatility - ECB Variance Proportion

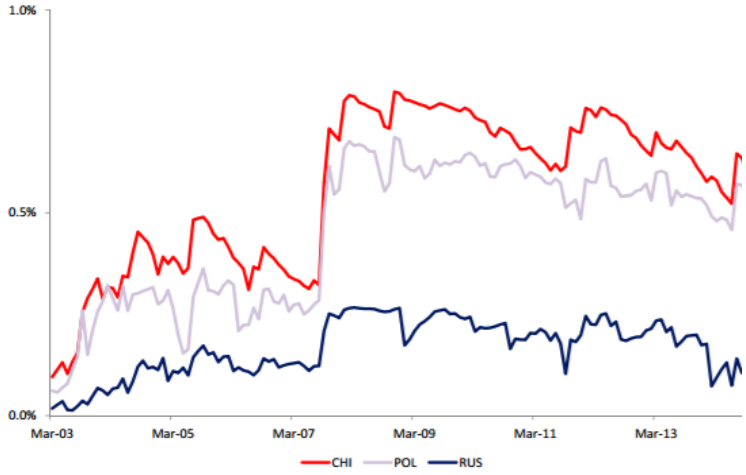


Figure 8: EME Stock Market Volatility - ECB Variance Proportion

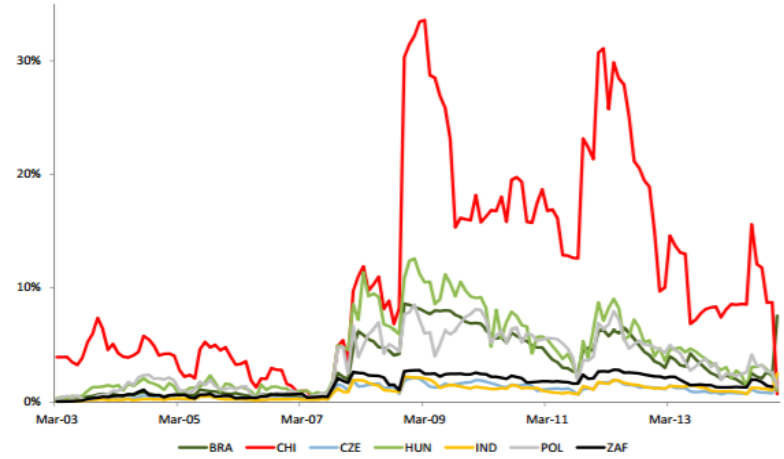


Figure 9: EME Bond Market Volatility - ECB Variance Proportion

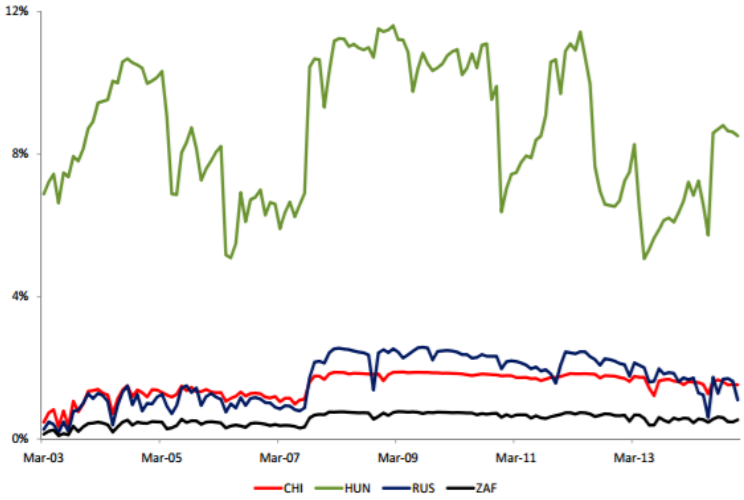
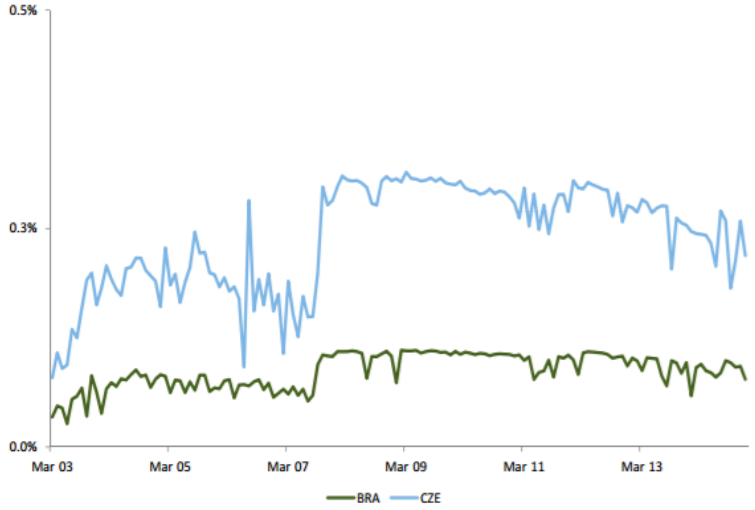


Figure 10: : EME Economic Activity Volatility - ECB Variance Proportion



Conclusions

- EME need to **increase resilience** to volatility spillovers.
- Volatility spillovers to EME bond markets are **proportionally passed through** from changes in the Fed and ECB balance sheets.
- The most affected EMEs have been the ones who have had a **more open capital account**.
- Any exit from unconventional monetary policy should take place in a **transparent and gradual** manner.
- **Targeted macroprudential policy** can be effective in addressing currency mismatches in an environment of heightened exchange rate volatility.