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Abstract

The Federal Reserve's path for withdrawal of monetary stimulus and eventually increasing interest rates could have substantial repercussions for capital flows to emerging-market economies (EMEs). This paper examines the potential impact of U.S. monetary policy normalization on portfolio flows to major EMEs by using a vector autoregressive model that explicitly accounts for market expectations of future monetary policy. The "policy normalization shock" is defined as a shock that increases both the yield spread of U.S. long-term bonds and monetary policy expectations while leaving the policy rate per se unchanged. Results indicate that the impact of this shock on portfolio flows as a share of GDP is expected to be economically small. The estimated impact is closely in line with that seen during the end-May to August 2013 episode in response to a comparable rise in the yield spread of U.S. long-term bonds. However, as the events during the summer of 2013 have shown, relatively small changes in portfolio flows can be associated with significant financial turmoil in EMEs. Further, there is also a strong association between the countries that are identified by our model as being the most affected and the ones that saw greater outflows of portfolio capital over May to September 2013.

JEL classification: C32, E52, F33, F42
Bank classification: International topics; Transmission of monetary policy

Résumé

La voie suivie par la Réserve fédérale pour procéder à la réduction de la détente monétaire et, par la suite, à la hausse des taux d'intérêt pourrait avoir des retombées considérables sur les flux de capitaux à destination des économies émergentes. Les auteures ont recours à un modèle vectoriel autorégressif, qui prend explicitement en compte les attentes des marchés relativement à l'évolution de la politique monétaire, pour évaluer les répercussions potentielles de la normalisation de la politique monétaire américaine sur les flux d'investissements de portefeuille vers de grandes économies émergentes. Elles définissent un choc de normalisation qui ne modifie pas le taux directeur, mais a pour conséquence de creuser les écarts de taux sur les obligations à long terme des États-Unis et d'augmenter le niveau des anticipations à l'égard de la politique monétaire. D'après les résultats, l'incidence d'un tel choc sur les flux d'investissements de portefeuille en proportion du PIB devrait être faible du point de vue économique. L'effet estimé correspond de très près à celui observé au cours de la période de la fin mai à août 2013 en réaction à un élargissement comparable de l'écart de taux des obligations à long terme américaines. Cependant, comme l'ont montré les événements de l'été 2013, des variations relativement légères des flux d'investissements de portefeuille peuvent être associées à une importante turbulence financière dans les économies émergentes. En outre, il existe une forte corrélation entre les pays qui, selon le modèle des auteures, sont les plus touchés par la tourmente et ceux qui ont constaté les plus grandes sorties d'investissements de portefeuille de mai à septembre 2013.

Classification JEL : C32, E52, F33, F42
Classification de la Banque : Questions internationales; Transmission de la politique monétaire

1 Introduction

Volatility in global financial markets increased significantly in the summer of 2013 following then-Chairman Ben Bernanke's 22 May congressional testimony hinting that the Federal Reserve (Fed) would start scaling back its large-scale asset purchases (LSAPs).[1] Financial market participants revised their expectations as to when the Fed would begin normalizing monetary policy, bringing forward the dates they expected the Fed to begin tapering its LSAPs as well as the timing of the liftoff in the federal funds rate (Bauer and Rudebusch 2013). These changes in policy expectations likely led to reductions in market participants' tolerance for risk and a reassessment of the returns from investing in emerging-market economies (EMEs). As a result, many EMEs experienced a sharp withdrawal of private capital flows in the second half of 2013 (Figure 1). Despite subsequent attempts by several Fed officials to reassure markets that the timing of the liftoff of the federal funds rate above its zero lower bound (ZLB) was not linked to the pace of tapering of asset purchases by the Fed, the tapering talk triggered an overall reduction in investment in riskier assets, particularly in emerging-market assets.

Going forward, the pressing question for emerging-market policy-makers is how capital flows will respond to the Fed's withdrawal of monetary stimulus and eventual increase in interest rates. To shed some light on this issue, this paper examines the potential impact of U.S. monetary policy normalization on private capital flows to EMEs by using a vector autoregressive (VAR) model that explicitly accounts for market expectations of future monetary policy. To the best of our knowledge, this paper is among the first to incorporate expectations of future U.S. monetary policy in studying the spillovers from unconventional monetary policy (UMP) by the Fed on emerging-market capital flows.

Our paper builds on three main strands of the literature. First, it makes an important contribution to the extant literature on the determinants of capital flows to EMEs that focuses on the role of both country-specific or "pull" factors and global or "push" factors. Our aim, however, is not to revisit the debate on the determinants of capital flows in general, but to focus specifically on the impact of shocks to U.S. monetary policy on portfolio flows to EMEs. The notion that (expansionary) U.S. monetary policy plays a role in driving capital flows to EMEs goes back to the seminal paper by Calvo et al. (1993). Since then, a large volume of papers has examined the role of the Fed's monetary policy stance in explaining movements in capital flows. However, most of this literature uses market interest rates - such as U.S. Treasury yields

[1] For further details on Chairman Bernanke's testimony before the Joint Economic Committee of the U.S. Congress on 22 May 2013, see http://www.federalreserve.gov/newsevents/testimony/bernanke20130522a.htm.

- as a proxy for U.S. monetary policy, instead of focusing on the actual monetary policy stance, i.e., the federal funds rate (see, for example, Fernandez-Arias 1996; Forbes and Warnock 2012; Taylor and Sarno 1997).

Second, and more recently, the impact of UMPs undertaken by the Fed on capital flows to EMEs has been the focus of significant debate among policy-makers. However, only a handful of empirical studies have attempted to explore this issue systematically. Studies in this vein are Ahmed and Zlate (2014), Fratzscher et al. (2013), Lim et al. (2014), and Moore et al. (2013), although, of these, only Lim et al. (2014) examine the effects of tapering on capital flows to EMEs. Our paper makes an important contribution to these two strands of the literature on the role of U.S. monetary policy in driving capital flows by accounting for expectations of future monetary policy, an aspect that has largely gone unexplored. To our knowledge, the only exception so far has been Koepke (2014), who examines how foreign portfolio inflows to EMEs respond to market expectations of monetary policy. Our empirical framework, however, is very different from the one used by Koepke (2014).

Third, several recent papers have argued that the most important news about the Fed in recent years has been information about what it is going to do rather than information about what it just did. Such papers have measured monetary policy surprises as the change in expectations of the federal funds rate on the day of a Fed policy change or announcement itself (for example, Gürkaynak 2005; Hamilton 2008; Kuttner 2001). Drawing upon this literature, we use the federal funds futures contracts at the 36-month horizon as a measure of monetary policy expectations and explicitly include it in the VAR model to analyze the impact of a monetary "policy normalization shock" on capital flows. We define a "policy normalization shock" as a shock that increases both the U.S. long-term yield spread as well as monetary policy expectations, while leaving the policy rate per se unchanged.

Our results indicate that the effect of U.S. monetary policy normalization is economically small. We find that a monetary "policy normalization shock" that increases the U.S. long-term yields by 120 basis points (bps) results in aggregate portfolio capital flows declining by about 1.2% of GDP cumulated over three months. These results are closely in line with the end-May to August 2013 episode when portfolio flows to major EMEs decreased by about 1% of GDP in response to a shock of similar magnitude.[2] While these estimates are small, they can still be of relevance: the experience from summer 2013 has shown that changes in capital flows of a

[2]This figure is based on data on portfolio capital flows from the Emerging Portfolio Fund Research (EPFR) Global database.

similar magnitude were associated with significant financial turmoil in EMEs.

The remainder of the paper is organized as follows. Section 2 describes the different channels through which quantitative easing can affect capital flows to EMEs. Section 3 outlines the empirical methodology and provides a description of the data. Section 4 reports the estimation results, and section 5 discusses the key findings.

2 Capital flows and the Fed: Channels of transmission and lessons from the past

There are three main channels through which quantitative easing (QE) can affect portfolio flows and eventually asset prices, both within the domestic economy and internationally. Fratzscher et al. (2013) and Chen et al. (2013) provide a summary of the main channels of transmission, which are as follows. First, the *portfolio balance channel* operates in the global economy. QE involves the purchases of longer-duration assets, typically long-dated government bonds and mortgage-backed securities. This reduces the supply of such assets to private investors and affects the term premium in long-term interest rates due to imperfect substitutability between securities of different maturities or asset classes. This, in turn, increases the demand for all substitute assets, including emerging-market assets, as investors turn to riskier assets for higher risk-adjusted returns.[3]

Second, QE can also have an impact on cross-border portfolio flows and asset prices via the *signalling channel*. If QE is taken as a commitment by the Federal Reserve to keep future policy rates lower than previously expected, then the risk-neutral component of bond yields may decline.[4] Large interest rate differentials with respect to EMEs will be expected to persist which, in turn, triggers carry trades and capital flows into EMEs.[5] Bauer and Rudebusch (2013) stress the importance of this channel for Fed announcements since 2008, and show that this channel was as important as the portfolio balance channel. Third, QE can also affect portfolio decisions and asset prices by altering the liquidity premia and thus the functioning of markets, i.e., the *liquidity channel*. LSAPs are credited as increased reserves on the balance sheets of private banks. Since such reserves are more easily traded in secondary markets than long-term

[3] A number of studies have highlighted this as the central transmission channel by which QE affects cross-border capital flows (Gagnon et al. 2011; D'Amico and King 2010; Hamilton and Wu 2012). In contrast, some have expressed skepticism about the empirical significance of this channel (for example, Cochrane 2011).

[4] The risk-neutral component of bond yields is defined as the average level of short-term interest rates over the maturity of the bond. In other words, it is the interest rate that would prevail if all investors were risk neutral.

[5] The Fed's actions may also provide new information about the current state of the economy, which in turn can influence portfolio decisions by altering the risk appetite of investors.

securities, there is a decline in the liquidity premium, thus enabling liquidity-constrained banks to extend credit to investors. This results in a decline in borrowing costs and increased overall bank lending, including cross-border lending.

Ex ante it is unclear what the impact on capital flows to EMEs will be when the Fed phases out its asset purchase program and eventually raises interest rates. To shed some light on this issue, we briefly examine how net flows to EMEs behaved during key Fed tightening cycles in the recent past. The evidence, however, is mixed. After the 1990-91 recession, the Fed first increased rates in February 1994. This was largely unanticipated by markets. Over the next twelve months, the Fed raised its policy rate from 3% to 6%. Yields on 10-year Treasury bonds rose by around 150 bps over the same period which, in turn, had significant spillovers on global financial markets. Portfolio flows to EMEs declined sharply after 1994 (Figure 2). In contrast, in the 2000s the Fed gradually increased the policy rate from 1% to 5.25% over 2004-06 by following a pre-announced schedule. The increase in long-term rates was small over this period and had a limited initial impact on global financial markets compared with the 1994-95 episode. Portfolio inflows to EMEs continued to be strong almost until the end of the Fed's tightening cycle (Figure 2).

One of the key lessons learned from these episodes is the importance of communication in managing the impact of monetary tightening on markets.[6] Limitations to forward guidance can lead to uncertainty about the future path of policy rates (IMF 2013). The significant shift in market expectations of the short-term rate following the May and June 2013 tapering announcements by the Fed, despite no change in forward guidance, may have reflected such uncertainty (see Figure 3).

3 Empirical framework

To quantify the impact of U.S. monetary policy normalization on net capital flows to EMEs, we employ the following empirical strategy. First, we extract a common factor from net portfolio flows to EMEs in our sample. Second, we estimate a simple VAR model containing U.S. variables and the estimated capital flow factor. We then identify a monetary "policy normalization shock" in this VAR framework and assess its effects on capital flows to EMEs.

[6] See IMF (2013) for a thorough discussion of the implications of these episodes for exit from UMP.

3.1 Empirical model

Let $\mathbf{W}_t$ denote a vector of N standardized capital flow series that have the following factor model representation:

$$\begin{aligned} \mathbf{W}_t &= \boldsymbol{\chi}_t + \boldsymbol{\xi}_t \\ &= \boldsymbol{\lambda}'\mathbf{F}_t + \boldsymbol{\xi}_t, \end{aligned} \tag{1}$$

where $\boldsymbol{\chi}_t$ is the common component of $\mathbf{W}_t$, which captures the co-movement among the underlying capital flow series, while $\boldsymbol{\xi}_t$ is the idiosyncratic component, which can be interpreted as shocks affecting only individual capital flow series. $\mathbf{F}_t$ is a $r \times 1$ vector of common or static factors, and $\boldsymbol{\lambda}$ is an $r \times N$ matrix of factor loadings. The factors, their loadings and the idiosyncratic errors are not observable, and have to be estimated from the data in practice. We use the method of principal components to extract the first common factor of $\mathbf{W}_t$. We set the number of factors to one, since it is sufficient to explain most of the variation in our sample of capital flow series.[7]

To quantify the impact of U.S. monetary policy on capital flows to EMEs, we estimate a VAR model of the following form:

$$\mathbf{y}_t = \boldsymbol{\alpha} + \mathbf{A}(\mathbf{L})\mathbf{y}_{t-1} + \mathbf{u}_t, \tag{2}$$

where $\mathbf{y}_t$ is a vector of endogenous variables, $\boldsymbol{\alpha}$ a vector of constants, $\mathbf{A}(\mathbf{L})$ a matrix polynomial in the lag operator $\mathbf{L}$, and $\mathbf{u}_t$ a vector of reduced-form residuals, such that $\mathbf{u}_t \sim N(\mathbf{0}, \boldsymbol{\Omega})$. The reduced-form residuals can be related to the underlying structural shocks such that $\mathbf{u}_t = \mathbf{B}_0\boldsymbol{\epsilon}_t$, where $\mathbf{B}_0$ denotes the contemporaneous impact matrix, with $\boldsymbol{\epsilon} \sim N(\mathbf{0}, \mathbf{I})$, and $\boldsymbol{\Omega} = \mathbf{B}_0\mathbf{B}_0'$. We leave $\mathbf{A}(\mathbf{L})$ unrestricted.[8]

The vector of endogenous variables, $\mathbf{y}_t$, comprises seven variables: the federal funds rate, the spread between the U.S. 10-year Treasury yield and the federal funds rate, the federal funds futures contracts at the 36-month horizon, U.S. inflation, U.S. industrial production growth, the level of the implied U.S. stock market volatility index (or VIX), and the common factor of capital flows. The choice of these variables is motivated as follows.

[7] The first common factor explains about 74% of the variation in the capital flow series, on average. See section 4.1 for details.

[8] One could also prevent movements in the capital flow factor from influencing U.S. variables by imposing a zero restriction on the corresponding coefficients of $\mathbf{A}(\mathbf{L})$. Imposing this restriction, however, does not alter our main findings reported below.

The starting point for our model is a standard U.S. monetary policy VAR that includes U.S. CPI inflation, the growth rate of U.S. industrial production, and the federal funds rate (see, for example, Sims 1992; Bernanke et al. 2005). We augment this standard VAR by including the spread between U.S. long-term yields and the federal funds rate. In doing so, we follow Baumeister and Benati (2013) and Gambacorta et al. (2012), among others, since the standard VARs are inadequate for studying the effects of monetary policy shocks when policy is constrained at the ZLB. Further, we also include the implied stock market volatility in the United States as proxied by the VIX.[9] The VIX is widely used in the literature as the key indicator of risk aversion and a general proxy for financial turmoil, economic risk and uncertainty. The literature has also found the VIX to be a significant determinant of capital flows to EMEs (for example, Ahmed and Zlate 2014; Forbes and Warnock 2012; Lim et al. 2014).

We also explicitly include a measure of future monetary policy expectations in the VAR model, drawing upon the growing literature focusing on the identification of monetary policy shocks using financial market data. Our measure of monetary policy expectations is based on the federal funds futures at the 36-month horizon. The argument for using federal funds futures data to identify monetary policy shocks goes back to Rudebusch (1998). More recent papers in this vein are Kuttner (2001), Gürkaynak (2005), Hamilton (2008), and D'Amico and King (2010), among others.[10] The basic premise for including future monetary policy expectations is that forward guidance can be treated as an additional dimension of policy at the ZLB. This is because even when a central bank is unable (or unwilling) to further reduce the current policy rate, it can change what it communicates about how the policy rate is likely to be set in the future (Woodford 2012). Another motivation for including this variable is that ex ante it is not clear whether a Fed monetary policy normalization is reflected in changes in long-term yields or expectations about future monetary policy, or a combination of the two.

Lastly, we include the capital flow factor into the VAR model, which is our key variable of interest. This allows us to calculate the effects of policy normalization on capital flows to individual countries in our sample, as well as on aggregate flows.[11] It is important to note that this paper focuses on assessing the impact of Fed policy normalization on capital flows to

[9] Indices of implied stock market volatility are forward-looking measures of stock index volatility computed based on option prices. These indices measure market expectations of stock market volatility in the next 30 days.

[10] Section 3.3 describes this measure in detail.

[11] We also estimated separate VAR models for individual countries by including the capital flow series for the respective country in each model. However, results for the aggregate and individual-country level effects on capital flows remain similar. The results are available upon request.

EMEs, rather than on explaining possible determinants of capital flows. Therefore, we exclude potential "pull" factors or country-specific macroeconomic variables from the VAR model, since this allows us to isolate the effects of monetary policy normalization without contaminating them with possible feedback from "pull" factors.

We include one lag in the VAR based on the Akaike information criterion and the Bayesian information criterion. We estimate equation (2) using standard Bayesian methods (i.e., Gibbs sampler) described in Koop and Korobilis (2010). Further details about the estimation procedure are provided in Appendix A.

3.2 Identification of a U.S. monetary "policy normalization shock"

We define a "policy normalization shock" as a shock that increases the long-term yield spread and monetary policy expectations (as measured by the federal funds futures rate) while leaving the federal funds rate unchanged. Therefore, the shock is identified by imposing a combination of sign restrictions and a single zero restriction on the contemporaneous impact matrix $\mathbf{B}_0$ underlying equation (2). Table 1 shows the restrictions on the responses of the variables in the VAR. The zero restriction is imposed on impact and the sign restrictions are imposed on impact and for five months.[12] The monetary policy normalization shock has no impact effect on the federal funds rate, while it increases the spread and the federal funds futures rate at the 36-month horizon. The restriction on the federal funds futures rate is motivated by the reaction of markets to former Chairman Bernanke's testimony on 22 May 2013 that signalled the possibility of the Fed tapering its LSAPs by year-end. As the 10-year yield spread and the 36-month futures moved in tandem over the summer of 2013, it is difficult to say whether market participants were reacting to the anticipated tapering of asset purchases by the Fed or to changing expectations about the future evolution of the federal funds rate (see Figure 3). Therefore, to identify a monetary "policy normalization shock," we impose not only the commonly used restrictions to identify a "spread" shock (i.e., QE shock) as in Baumeister and Benati (2013), but also impose a restriction on the sign of the response of expectations about the future federal funds rate.[13]

Further, the shock leads to a lower level of U.S. economic activity and puts downward pressure on U.S. inflation. The responses of the VIX and the capital flow factor are left unconstrained. Finally, impulse-response functions that satisfy the sign and zero restrictions are

[12] Results are robust to imposing restrictions for shorter horizons.

[13] Baumeister and Benati (2013) use the term "pure spread shock" to describe their shock to the spreads on long-term yields.

calculated using the procedure proposed by Baumeister and Benati (2013). They combine the method suggested by Rubio-Ramirez et al. (2010) for imposing sign restrictions with the imposition of a single zero restriction via a deterministic rotation matrix. At each draw of the Gibbs sampler, the impact matrix $\mathbf{B}_0$ is calculated and kept if the corresponding impulse responses satisfy the sign and zero restrictions.

3.3 Data

3.3.1 Capital flows

We use data on net portfolio flows from the Emerging Portfolio Fund Research (EPFR) Global database. The database contains weekly portfolio investment (net) flows by more than 14,000 (mutual and ETF) equity funds and more than 7,000 (mutual and ETF) bond funds, with US$8 trillion of capital under management. Although the database represents less than 20% of the market capitalization in equity and in bonds for most countries, it is regarded as closely matching portfolio flows in the balance of payments data and is being increasingly used in academic research on capital flows (Jotikasthira et al. 2012). In addition, the EPFR data are used widely in the financial industry as a timely, high-frequency indicator of movements in portfolio flows. We use the EPFR data since it is available at higher frequencies than the balance of payments data, allowing us to examine movements in portfolio flows at a monthly frequency. Our sample covers the following 23 emerging markets: Argentina, Brazil, Bulgaria, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine and Venezuela. We use monthly data over the period January 2004 to January 2014.

3.3.2 U.S. and global variables

As mentioned, we use the federal funds future contracts at the 36-month horizon as a measure of expectations about future U.S. monetary policy. Each observation is the expected federal funds rate 36 months later. For example, the observation for May 2013 is based on the futures contract for May 2016. We chose to use expectations of future monetary policy at a long-term horizon since this avoids problems with the ZLB; i.e., expectations of the federal funds rate are essentially set at zero at short-term horizons. The data are taken from Bloomberg and are available for January 2011 onwards for the federal funds futures contracts. We use the Eurodollar futures contracts for the period prior to this. The correlation between the two variables is 0.98 over the period January 2011 to January 2014.

U.S. inflation is measured as the first difference of the log of the consumer price index. U.S. industrial production growth is measured as the first difference of the log of U.S. industrial production. These data, along with the federal funds rate and the 10-year U.S. Treasury yields, are taken from Haver.

4 Results

4.1 Common factor of capital flows to EMEs

We first examine the extent to which capital flows to emerging markets co-move.[14] Figure 4 plots the estimated first principal component for the capital flow series. The common component tracks aggregate net capital flows very well. Moreover, the common component explains about 74% of the variation in country-specific flows, on average, which lends credibility to our approach of including the common factor into the VAR model to obtain the impact of monetary policy normalization shocks on individual countries. It also suggests that common (i.e., global) factors have played a much larger role than idiosyncratic factors in shaping fund flows into emerging-market bonds and equities in recent years. In some cases, however, country-specific factors matter more. For example, the common factor explains only 31% of the variation for Bulgaria and 40% for the Czech Republic (see Table 2).

4.2 The effect of a U.S. monetary "policy normalization shock"

As discussed in the previous section, we identify a "policy normalization shock" as a shock that increases the long-term yield spread and monetary policy expectations while leaving the federal funds rate unchanged. We consider a shock of 120 bps, which is roughly in line with the increase in the yield spread (112 bps) following former Chairman Bernanke's testimony on 22 May 2013.[15] Figure 5 shows the impulse-response functions for this shock. The shock leaves the federal funds rate unchanged on impact as imposed by the zero restriction. At longer horizons, the response of the federal funds rate is insignificant. The spread and monetary policy expectations, as measured by the federal funds futures, increase significantly for about 10 months. The policy normalization shock decreases U.S. inflation and industrial production growth by about 1% and 3% on impact, respectively. Both inflation and industrial production

[14] Recent literature has also documented co-movement of capital flows (for example, Förster et al. 2014; Fratzscher 2012).

[15] The yield spread increased by 112 bps from April to September 2013.

growth return to their pre-shock levels after 15 months. Stock market volatility, as measured by the VIX, increases for about 20 months following the shock, although the response is not significant on impact.

Turning to the response of capital flows, which is the focus of this paper, we find that the policy normalization shock decreases the capital flow factor significantly. Capital flows return to their pre-shock level after 9-10 months following the shock. By combining equations (1) and (2), we obtain the effects on capital flows to individual countries and then sum these effects across countries to obtain the response of aggregate capital flows. In order to assess the economic size of the effects on aggregate as well as country-specific capital flows, we scale these responses by the 2013Q3 GDP for the respective countries. We find that the shock corresponding to an increase in spreads of 120 bps decreases aggregate capital flows to GDP by 0.5% on impact (see the last row of Table 3). After three months, the cumulative decline in aggregate capital flows amounts to 1.2% of GDP. This is broadly in line with the end-May to August 2013 episode, when portfolio flows to major EMEs decreased by about 1% of GDP. One year after the shock, aggregate capital flows decrease by 1.8% of GDP on a cumulative basis.

Table 3 also shows the effects on capital flows to individual countries following the policy normalization shock of 120 bps. The effects vary considerably across countries in terms of magnitude. Hungary, South Africa, Malaysia and Thailand are found to be affected most, with impact effects ranging from -1.0% of GDP to -1.5% of GDP. However, the corresponding effects on Bulgaria, Venezuela and Romania are relatively small, ranging from -0.1% to -0.2% of GDP. The three-month cumulative effects on capital flows range from -0.3% of GDP (Bulgaria and Venezuela) to -4.0% (Hungary). After one year, the cumulative decline in capital flows is as high as 5.8% of GDP in the case of Hungary and 5.7% of GDP in South Africa, while the corresponding figures for Bulgaria, Venezuela and Romania are quite small (between -0.4% and -0.7% of GDP).

To shed some light on possible explanations for the differences in the magnitudes of the effect across countries, we investigate the association between the estimated effects and country characteristics. Motivated by the recent findings in Eichengreen and Gupta (2014), we examine the correlation with capital inflows prior to 2013. Figure 6 shows a scatterplot between the 3-month cumulative effects on capital flows and financial inflows from 2010-12 as a share of GDP. As can be seen, the countries we identify as being potentially most affected are the ones that received greater financial inflows prior to 2013. We also run a simple regression of the estimated effects on the financial inflows from 2010-12 and find the coefficient for financial flows to be statistically significant, with an R-squared of 0.2. Further, we analyze the relation between the estimated effect on capital flows and the capital outflows experienced over end-May to August 2013 following the Bernanke testimony (see Figure 7). Again, there seems to be a strong association between the countries that are identified by the model as being most affected and the ones that saw greater outflows over May to September 2013. Running a regression of the estimated effects on the capital outflows over end-May to August 2013 confirms a statistically significant relation between these variables with an R-squared of 0.82.[16]

4.3 The effect on bond vs. equity flows

In this section, we decompose portfolio flows into bond and equity flows and examine the effects of the policy normalization shock on these flows. In order to do so, we estimate two separate VARs as specified in equation (2): one including the common factor extracted from equity flows as an endogenous variable and the other with the common factor of bond flows. Equity flows are much more volatile compared to bond flows in our sample, with the common factor explaining only 60%, on average, of the variation in flows compared to an average of 83% for bond flows. Looking at the impulse-response functions for a 120 bps policy normalization shock, the bond flows factor shows a bigger drop on impact compared to the equity flows factor in response to the shock (Figures 8 and 9). However, since the magnitude of equity flows is larger than that of bond flows in our sample, the cumulative 3-month response of bond flows as a share of GDP is only slightly bigger (-0.7%) than that of equity flows (-0.5%) (Table 4). These results are consistent with those in Fratzscher et al. (2013) and Lim et al. (2014). The latter paper concludes that bond flows appear to be affected via the portfolio balance channel while equity flows are not which, in turn, yields a bigger response in bond flows.

5 Conclusion

The effects on EMEs of unconventional monetary policies implemented by some advanced economies, as well as the looming exit from these policies, have been a focus of debate among academics and policy-makers. To provide some insights into this issue, this paper uses a VAR model to examine the potential impact of a U.S. monetary "policy normalization shock" on portfolio flows to major EMEs. Results suggest that the impact of such a shock on capital

[16] We also checked whether country fundamentals such as the current account balance and the fiscal deficit can be related to the estimated effects on capital flows. However, we do not find any evidence of a statistically significant relationship in these cases.

flows to EMEs is economically small. Further, the estimated effect is closely in line with that seen in the summer of 2013 following former Fed chairman Bernanke's testimony hinting at the possibility of the Fed scaling back its asset purchase program. However, and as the developments following the testimony have shown, even relatively small changes in capital flows can be associated with significant financial market volatility in EMEs.

It is reasonable to expect episodes of volatility in global financial markets, especially in EMEs, when advanced economies begin to normalize monetary policy. Even if the exit is well managed, some amount of capital flow reversal from EMEs is likely. Higher bond yields will trigger portfolio rebalancing, the effects of which could well be amplified in the presence of market imperfections. Thus, the effects of policy normalization on EMEs will depend on the extent of their vulnerabilities. It is important to keep in mind that our analysis has abstracted from such country-specific or "pull" factors in order to isolate the impact of U.S. monetary policy changes. Potential interactions between the Fed's monetary policy and country-specific macroeconomic factors could exacerbate the impact of a U.S. monetary policy normalization on capital flows.

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Table 1: ***Identification restrictions***

Variable	**Restriction**	
Federal funds rate	0	$(h = 0)$
Spread	$+$	$(h = 0, ..., 5)$
Federal funds futures	$+$	$(h = 0, ..., 5)$
Inflation	-	$(h = 0, ..., 5)$
IP growth	-	$(h = 0, ..., 5)$
VIX	?	
Capital flow factor	?	

Notes: IP denotes industrial production. "?" means that the variable is left unconstrained. h denotes the horizon (in months) of imposed restrictions.

Table 2: ***Variation in capital flows explained by the common component (in percent)***

Argentina	68	Mexico	90
Brazil	72	Peru	89
Bulgaria	31	Philippines	89
Chile	75	Poland	87
China	46	Romania	66
Colombia	76	Russia	76
Czech Republic	40	South Africa	87
Hungary	79	Thailand	81
India	58	Turkey	92
Indonesia	87	Ukraine	82
Korea	73	Venezuela	80
Malaysia	88		
Average	74		

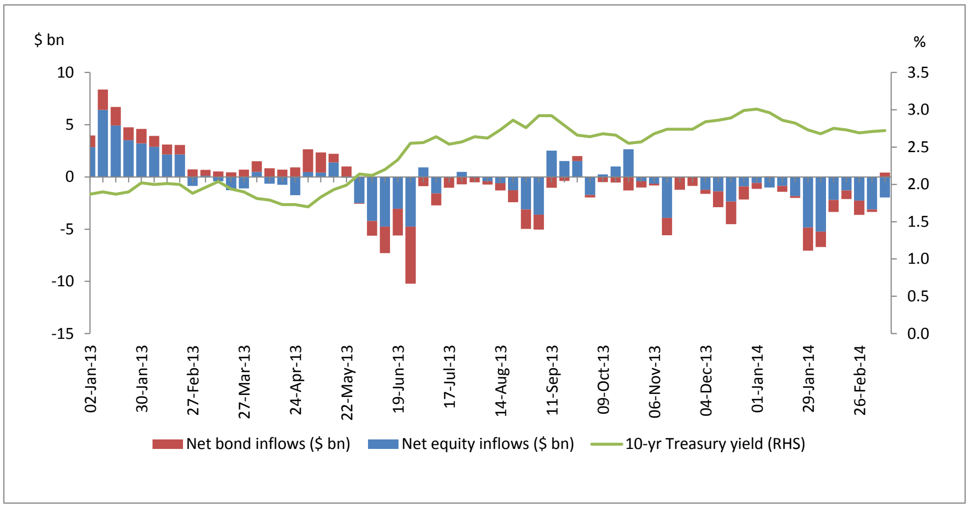
Table 3: ***Effects of a policy normalization shock on individual countries' capital flows (percent of 2013Q3 GDP)***

	Effect					Cumulative Effect		
	h=0	h=1	h=2	h=5	h=11	3-month	6-month	12-month
Argentina	-0.23	-0.23	-0.15	-0.04	0.00	-0.61	-0.82	-0.90
Brazil	-0.85	-0.83	-0.54	-0.16	-0.01	-2.22	-2.97	-3.27
Bulgaria	-0.11	-0.10	-0.07	-0.02	0.00	-0.28	-0.37	-0.41
Chile	-0.57	-0.55	-0.36	-0.11	-0.01	-1.48	-1.99	-2.19
China	-0.20	-0.20	-0.13	-0.04	0.00	-0.54	-0.72	-0.79
Colombia	-0.45	-0.44	-0.29	-0.09	-0.01	-1.17	-1.57	-1.73
Czech Republic	-0.30	-0.30	-0.19	-0.06	0.00	-0.80	-1.07	-1.17
Hungary	-1.51	-1.48	-0.97	-0.29	-0.02	-3.95	-5.30	-5.83
India	-0.46	-0.45	-0.29	-0.09	-0.01	-1.20	-1.61	-1.77
Indonesia	-0.61	-0.60	-0.39	-0.12	-0.01	-1.60	-2.14	-2.36
Korea	-0.91	-0.89	-0.58	-0.17	-0.01	-2.39	-3.20	-3.52
Malaysia	-1.22	-1.19	-0.78	-0.23	-0.02	-3.18	-4.27	-4.70
Mexico	-0.75	-0.74	-0.48	-0.14	-0.01	-1.97	-2.64	-2.91
Peru	-0.90	-0.88	-0.58	-0.17	-0.01	-2.36	-3.16	-3.48
Philippines	-0.80	-0.79	-0.51	-0.15	-0.01	-2.10	-2.82	-3.10
Poland	-0.73	-0.71	-0.46	-0.14	-0.01	-1.90	-2.55	-2.80
Romania	-0.19	-0.18	-0.12	-0.04	0.00	-0.48	-0.65	-0.72
Russia	-0.57	-0.56	-0.37	-0.11	-0.01	-1.50	-2.01	-2.21
South Africa	-1.48	-1.45	-0.95	-0.28	-0.02	-3.88	-5.21	-5.73
Thailand	-1.01	-0.98	-0.64	-0.19	-0.02	-2.64	-3.53	-3.89
Turkey	-0.64	-0.62	-0.41	-0.12	-0.01	-1.67	-2.24	-2.47
Ukraine	-0.48	-0.47	-0.31	-0.09	-0.01	-1.26	-1.69	-1.86
Venezuela	-0.10	-0.10	-0.07	-0.02	0.00	-0.27	-0.37	-0.41
Aggregate	-0.47	-0.46	-0.30	-0.09	-0.01	-1.24	-1.66	-1.83

Table 4: ***Effects of a policy normalization shock on aggregate bond and equity flows (percent of 2013Q3 GDP)***

	Effect					Cumulative Effect		
	h=0	h=1	h=2	h=5	h=11	3-month	6-month	12-month
Aggregate bond flows	-0.25	-0.23	-0.16	-0.06	-0.01	-0.65	-0.91	-1.05
Aggregate equity flows	-0.19	-0.18	-0.09	-0.01	0.002	-0.46	-0.52	-0.55

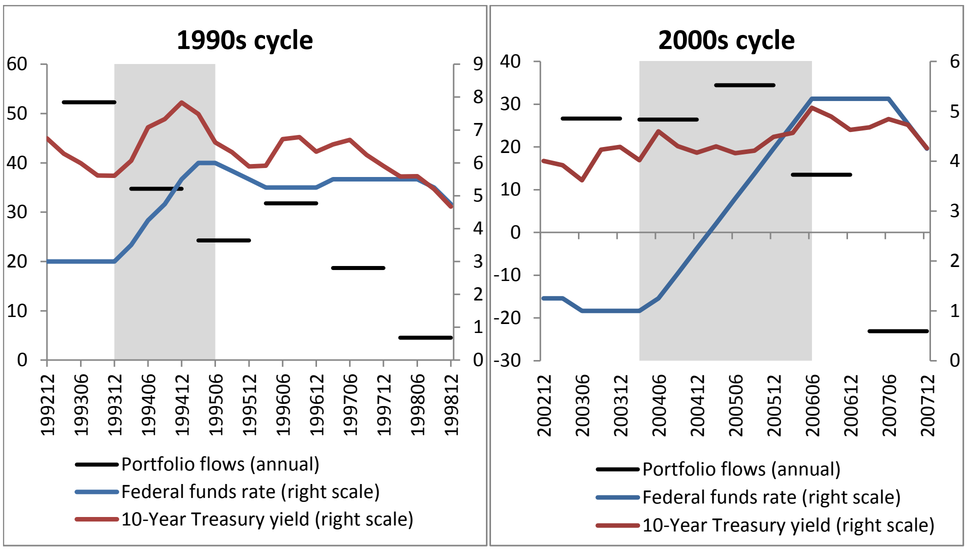
Figure 1: ***Net portfolio flows to EMEs and U.S. Treasury yields (weekly data)***



Sources: EPFR and Haver Analytics

Note: Portfolio flows to EMEs are the sum of inflows to the 23 countries in our sample.

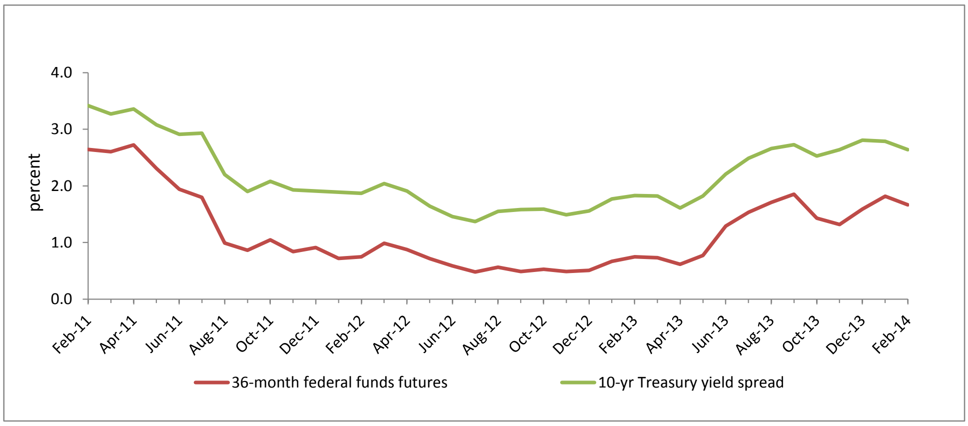
Figure 2: ***Portfolio flows to EMEs during earlier Fed tightening cycles***



Sources: Haver Analytics and Institute of International Finance (IIF)

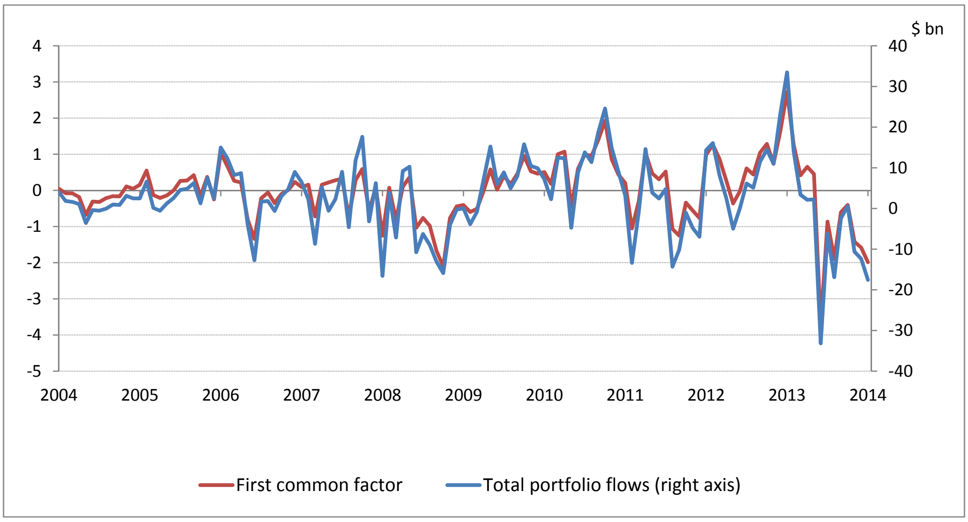
Notes: The federal funds rate and the 10-year Treasury yields are shown at quarterly frequency. The capital flows data are taken from the IIF and are only available at annual frequency for the time period shown in the graph. Portfolio flows represent the sum of flows to all the EMEs in our sample. The gray shaded areas represent the period over which the Federal Reserve raised the federal funds rate.

Figure 3: ***10-year Treasury yield spread vs. market expectations of the federal funds rate***



Sources: Bloomberg, Haver Analytics, and authors' calculations

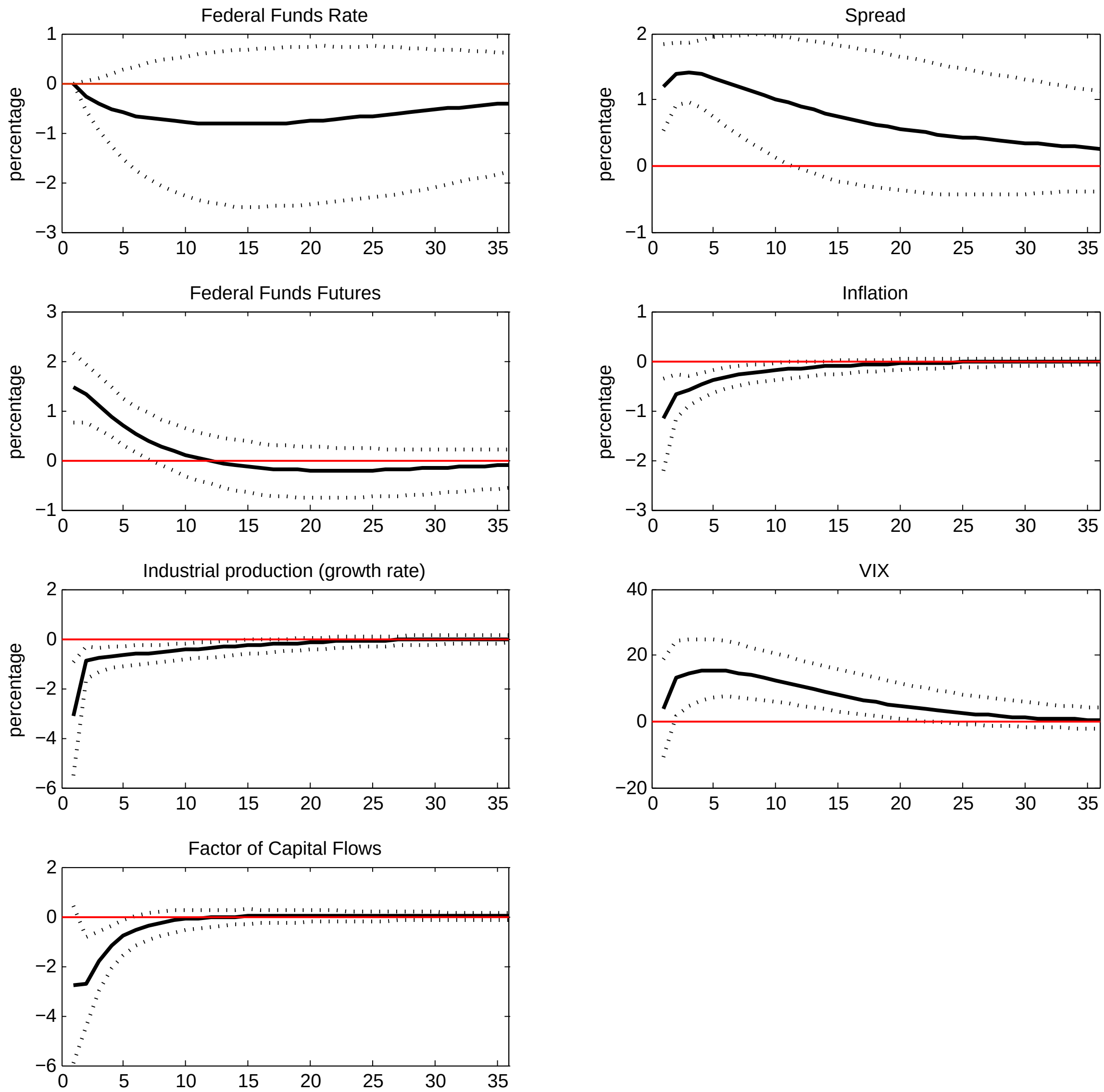
Figure 4: ***Common factor of portfolio flows and aggregate portfolio flows***



Sources: EPFR and authors' calculations

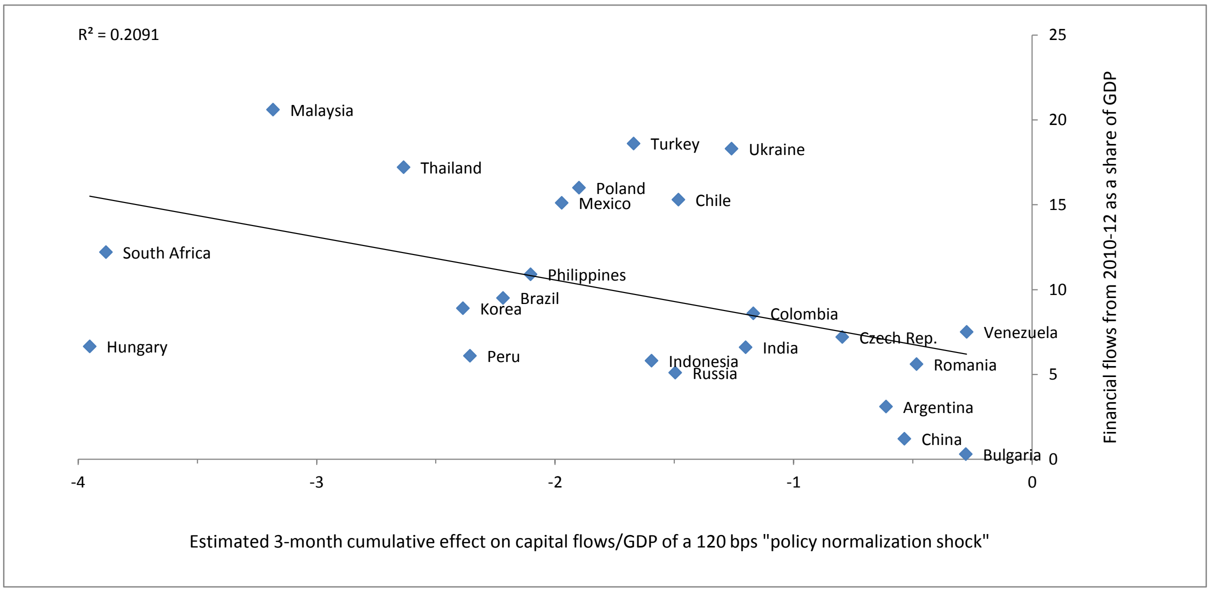
Note: The common factor is the first principal component calculated from our panel of net portfolio flows.

Figure 5: ***Impulse responses to "policy normalization shock" identified by sign restrictions***



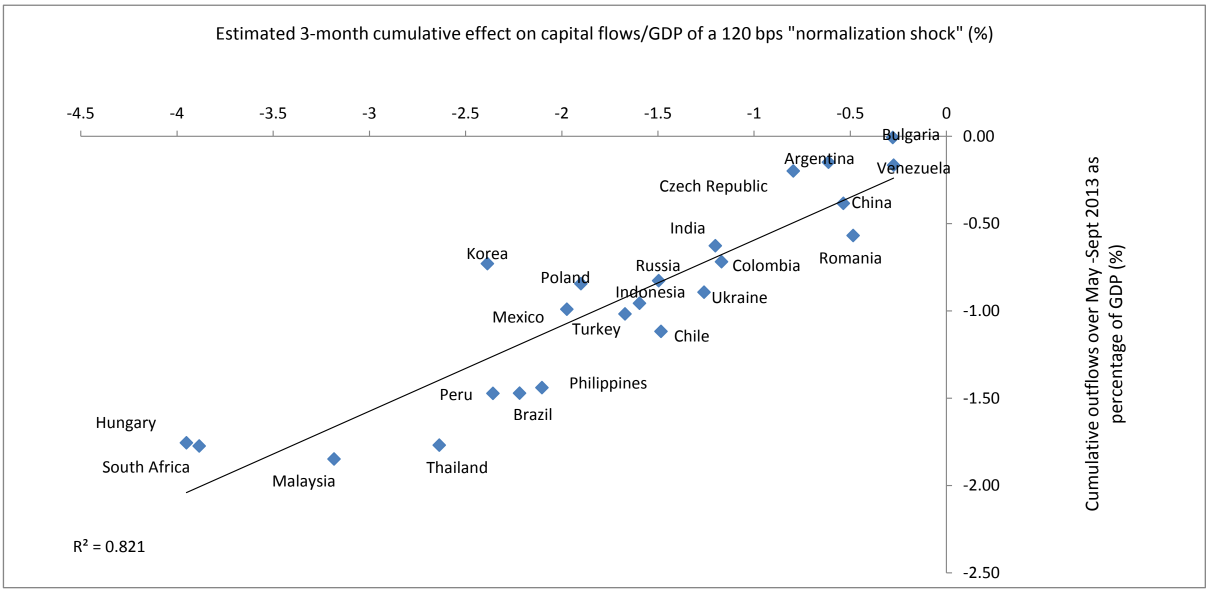
Note: Median (solid line) responses together with 68 percent credible set (dashed lines)

Figure 6: ***Estimated effect on capital flows/GDP vs. financial flows from 2010-12***



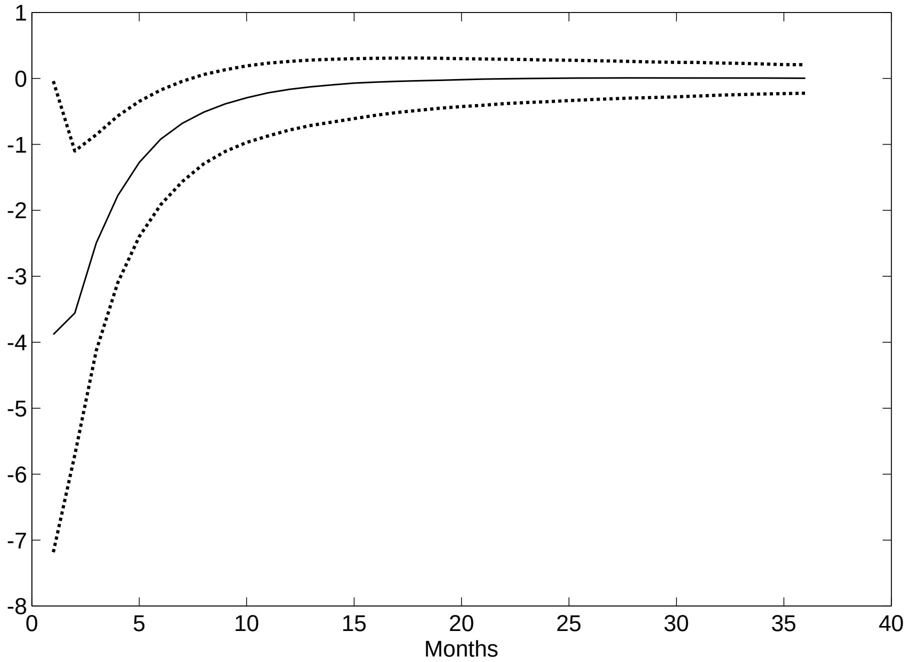
Sources: IMF's International Financial Statistics and *World Economic Outlook*, and authors' calculations
Notes: Financial flows refers to total portfolio inflows. The X-axis shows the estimated 3-month cumulative effect of a 120 bps policy normalization shock on the respective countries, as shown in Table 3.

Figure 7: ***Estimated effect on capital flows/GDP vs. capital outflows over end-May to August 2013***



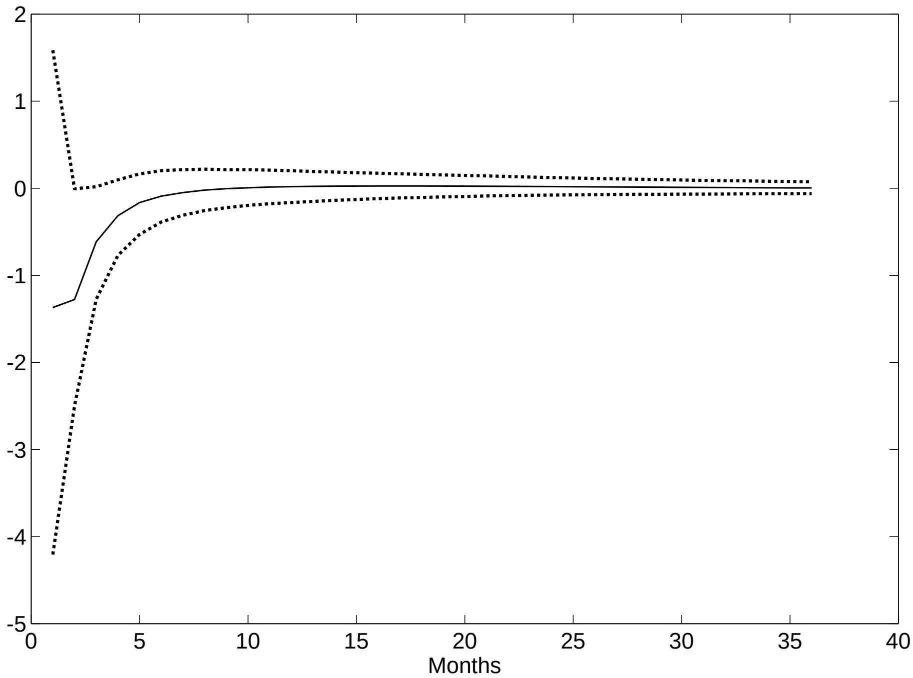
Sources: EPFR and authors' calculations
Note: The X-axis shows the estimated 3-month cumulative effect of a 120 bps policy normalization shock on the respective countries, as shown in Table 3.

Figure 8: ***Impulse responses for common factor of bond flows***



Note: Median (solid line) responses together with 68 percent credible set (dashed lines)

Figure 9: ***Impulse responses for common factor of equity flows***



Note: Median (solid line) responses together with 68 percent credible set (dashed lines)

A Bayesian Estimation Details

Let us define $\mathbf{x}_t = \left(\mathbf{1}, \mathbf{y}'_{t-1}, ..., \mathbf{y}'_{t-p}\right)$ and the $T \times (7p+1)$ matrix $\mathbf{X} = (\mathbf{x}_1, ..., \mathbf{x}_T)$. If $A = (\alpha, A_1, ..., A_p)'$, we can define $\mathbf{a} = vec(\mathbf{A})$, which is a vector stacking all the VAR coefficients and their intercepts. Finally, let $\mathbf{Y}$ and $\mathbf{U}$ be matrices stacking $\mathbf{y}_t$ and $\mathbf{u}_t$ over time, respectively. Then, we can rewrite equation (2) as follows:

$$\mathbf{Y} = \mathbf{X}\mathbf{A} + \mathbf{U}. \tag{3}$$

We estimate equation (3) via Bayesian methods, treating the VAR model's parameters $\mathbf{A}$ and $\mathbf{\Omega}$ as random variables. Estimation by a Gibbs sampler implies alternately sampling these parameters from their respective conditional posterior distributions. We assume an independent Normal-Wishart prior and, thus, the conditional posterior distribution of the coefficients is given by $\mathbf{a}|\mathbf{y}, \mathbf{\Omega} \sim N(\overline{\mathbf{a}}, \overline{\boldsymbol{V}})$, where $\mathbf{a} = vec(\mathbf{A})$, $\mathbf{y} = vec(\mathbf{Y})$, $\mathbf{Z} = \mathbf{I} \otimes \mathbf{X}$, $\mathbf{\Sigma} = \mathbf{\Omega}^{-1} \otimes \mathbf{I}$, $\overline{\mathbf{V}} = (\underline{\mathbf{V}}^{-1} + \mathbf{Z}'\mathbf{\Sigma}\mathbf{Z})^{-1}$, and $\overline{\mathbf{a}} = \overline{\boldsymbol{V}}\left(\underline{\boldsymbol{V}}^{-1}\underline{\mathbf{a}} + \mathbf{Z}'\mathbf{\Sigma}\mathbf{y}\right)$. The conditional posterior of $\mathbf{\Omega}^{-1}$ follows a Wishart distribution, i.e., $\mathbf{\Omega}^{-1}|\mathbf{y}, \mathbf{a} \sim W(\overline{\mathbf{S}}^{-1}, \overline{\boldsymbol{\nu}})$, where $\overline{\nu} = T + \underline{\nu}$ and $\overline{\mathbf{S}} = \underline{\mathbf{S}} + (\mathbf{Y} - \mathbf{X}\mathbf{A})'(\mathbf{Y} - \mathbf{X}\mathbf{A})$. The model is estimated using uninformative priors, i.e., $\underline{\mathbf{a}} = \underline{\mathbf{V}}^{-1} = \underline{\mathbf{S}} = \underline{\nu} = \mathbf{0}$.