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The Effects of U.S. Unconventional Monetary Policy on Asia Frontier Developing Economies

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Asia and Pacific Department

The Effects of U.S. Unconventional Monetary Policy on Asia Frontier Developing Economies

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Abstract

This paper explores the effect of U.S. unconventional monetary policy (QE2) on a group of frontier developing economies (FDEs) in Asia. This paper finds that spillovers emanating from the U.S. on FDEs in Asia have been small. The relative insulation of emerging Asia from the global financial cycle can likely be attributed to the presence of managed capital accounts coupled with shallow financial markets. Should U.S. monetary policy begin to normalize the direct first-round impact on developing Asia is likely to be small.

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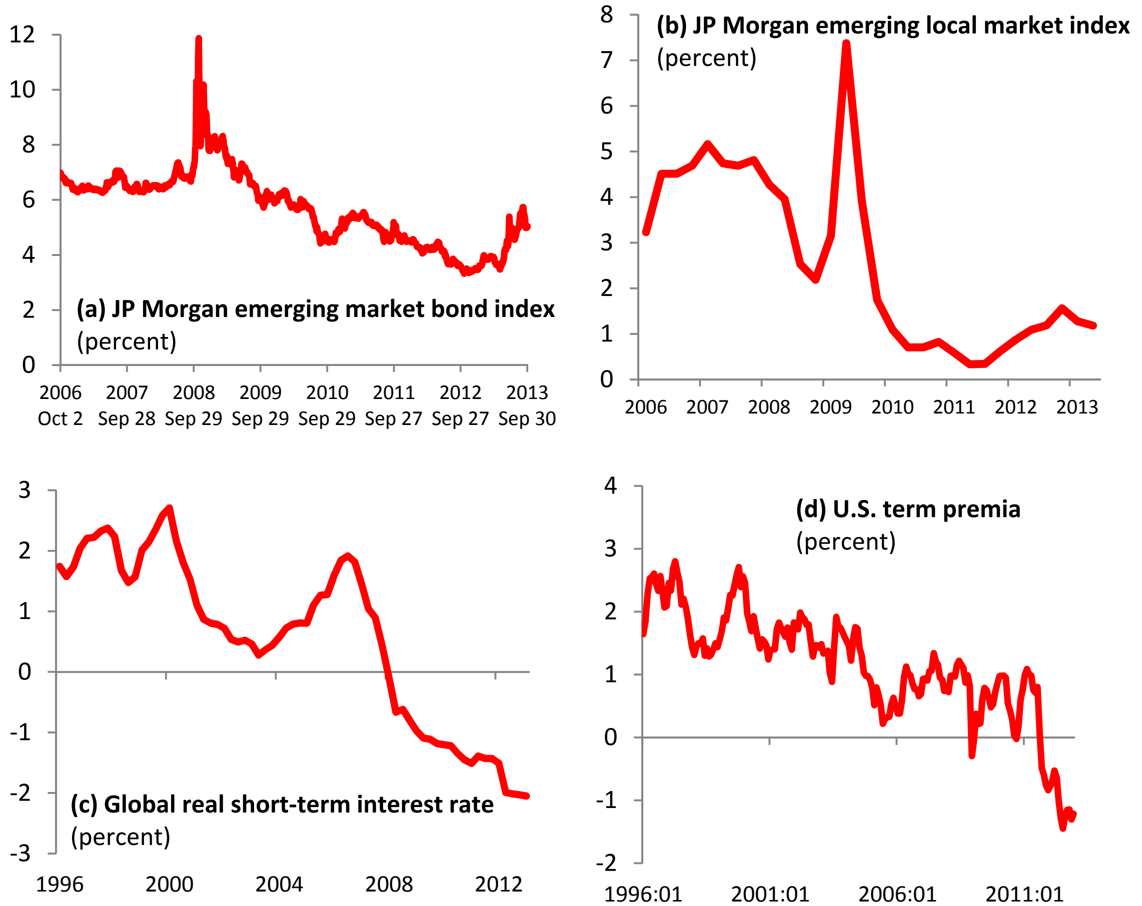
I. Introduction

An unintended consequence of the U.S. large scale asset program (LSAP) that began in early 2009 has been an easing in global monetary conditions. Rising liquidity has led to a decline in global interest rates and risk premia (Figure 1).

Figure 1: Measures of Global Liquidity



Source: Bloomberg and author's calculations.

Monetary policy in the U.S. has been empirically shown to be central in driving a global financial cycle.[2] Existing research shows accommodative U.S. monetary policy transmits to emerging market economies primarily through the bank lending channel, which links dollar liquidity and leverage of global banks. It assumes that when the U.S. dollar risk-free rate of interest falls, the spread between the domestic lending rate and the U.S. dollar funding rate increases. The resulting lower dollar funding cost leads to an acceleration of bank flows and looser credit conditions in recipient economies.

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[2] See, among others, Rey (2013) and Bruno and Shin (2013), Fic (2013), Moore, Nam, Suh and Tepper (2013) , Fratzscher, Lo Duca and Straub (2013) and Chen, Filardo, He and Zhu (2013).

Global capital flows that are driven by U.S. monetary policy could result in monetary conditions that are inappropriate for the cyclical conditions of recipient economies.[3] A boost to domestic demand from easier monetary conditions would complicate domestic policy matters if the economy is already operating above capacity. Rey (2013) has shown gross credit bank flows to be procyclical and volatile, leading to excessive growth in boom times and excessive retrenchment in downturns. Schularick and Taylor (2012) find excessive credit growth to be a good predicator of the onset of a crisis, as surges in credit flows are associated with a rise in leverage through the risk-taking channel.[4] Leverage and investor crowding heighten the consequence of an exit.

While financial markets in emerging markets have deepened over the last decade, they have done so unevenly.[5] Through the promotion of better price discovery, deeper capital markets can prevent prices from overshooting and reduce the price impact of capital flows. Alternatively, a limited capacity to absorb new flows in less developed economies coupled with a tendency to trade on short-term sentiment can cause excessive currency appreciation and unsustainable credit expansion, undermining financial stability. In light of the link between financial deepening and financial stability, highlighted in the IMF Global Financial Stability Report (2014a), less developed economies are potentially more susceptible to a disorderly adjustment should global monetary conditions tighten.

In order to assess the potential challenge in adjusting to a tightening in global financing conditions this paper attempts to quantify the potential impact of U.S. unconventional monetary policy on a group of frontier developing economies (henceforth FDEs) in Asia: Bangladesh, Cambodia, India, Mongolia, Sri Lanka and Vietnam. This paper finds that, with the exception of India, the direct impact of U.S. unconventional monetary policy on frontier developing economies in Asia has been small. Excessively loose U.S. monetary conditions did not lead to a large rise in cross border bank flows to FDEs in Asia. There is little evidence of U.S. monetary shocks spilling over into local funding and foreign exchange markets. The results can partly be explained by the presence of managed capital accounts, which allow for a degree of monetary independence, coupled with shallow financial markets. The direct impact of a tightening in global monetary conditions on most of FDE Asia should U.S. monetary policy begin to normalize is, while not zero, likely to be small. However, as the paper quantifies, the experience of India suggests that as Asia FDEs develop deeper financial markets the impact of the global financial cycle on domestic financial conditions is likely to grow. This would accordingly require strengthening policy frameworks and encouraging greater flexibility to help buffer against external shocks.

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[3] See Calvo, Leiderman and Reinhart (1996).

[4] See Bruno and Shin (2013).

[5] See IMF (2014a).

This paper is organized as follows. Section 2 lays out a simple debt expectations-interest rate model, including the structural identification scheme and data definitions. Sections 3 and 4 discuss the results from the model with Section 5 concluding.

II. Tracing Out the Effects of U.S. Unconventional Monetary Policy

A properly identified structural model should help reduce endogeneity issues that plague reduced-form regressions of capital flows and interest rates.

A. Model linking U.S. Monetary Policy and the Economies of Asia FDEs

This paper uses a panel VAR framework and undertakes an innovation accounting exercise with regards to U.S. monetary policy and its effects on FDEs in Asia.[6] The standard reduced-from VAR model is expressed as

$$y_t = B(L)y_{t-1} + M(L)x_t + u_t \tag{1}$$

the variables contained in the vector of endogenous variables y_t, with x_t a block containing the exogenous variables. This framework is expanded to account for a multi-country setting. A multi-country structural model is expressed as

$$\begin{bmatrix} T_{US,t} \\ w_{i,t} \end{bmatrix} = \begin{bmatrix} B_{11}(L) & 0 \\ B_{21}(L) & B_{22}(L) \end{bmatrix} \begin{bmatrix} T_{US,t-1} \\ w_{i,t-1} \end{bmatrix} + \begin{bmatrix} M_{13}(L) \\ M_{23}^{i}(L) \end{bmatrix} x_t + \begin{bmatrix} \epsilon_{1,\mathrm{t}} \\ \epsilon_{2,\mathrm{t}} \end{bmatrix} \tag{2}$$

where $u_t = \{\epsilon_{1,\mathrm{t}}, \epsilon_{2,\mathrm{t}}\}$ and $u_t \sim (0, I)$. Here $T_{US,t}$ contains the key U.S. macroeconomic variables and $w_{i,t}$ represents the Asia FDE block of country i's variables. It is assumed that the U.S. can affect Asia FDEs in the short- and long-run, while Asia FDEs only affect the U.S. in the short-run. This is consistent with a small economy assumption, and is modeled by setting $B_{12}(1) = 0$.

The panel model is composed of three blocks. The U.S. block contains the following variables

$$T_{US,t} = [y_{US,t}, p_{t,us}, i_{t,US}^{10} - i_{t,US}^{1}, ff_{t,US}, UScredit_{t,US}, Grossflows_{t,US}] \tag{3}$$

The U.S. block includes real output, the price level, the fed funds rate and the term spread measured as the difference between the long- and short-term interest rate. This set of variables is often seen as the minimum requisite for any monetary policy analysis. In order to address the international dimension of monetary policy spillovers, following

[6] The use of a dynamic balanced panel model has potentially advantageous properties. One should a priori expect fluctuations in Asia FDEs to be driven, to some extent, by similar shocks reflecting the fact that these countries have shallow financial markets, managed exchange rates, increasing the likelihood of similar impact. By pooling data together this commonality will translate in repeated observations on either the same source or the same propagation mechanism, providing a more accurate representation of the forces at work.

Bruno and Shin (2013), the model is augmented by adding a measure of cross-border banking sector flows. Rey (2013) has shown monetary conditions in the U.S. to be transmitted world-wide through cross-border gross credit flows. Gross, instead of net, flows are used to assess overall credit conditions, since they are a better indicator of potential of currency and maturity mismatch on balance sheets of financial intermediaries and households, which are known contributors to financial instability.[7] Analogous to Rey (2013), the first measure, $UScredit_{t,US}$, captures U.S. dollar direct cross-border credit, which is measured as the difference in claims on all sectors and the nonbank sector for all BIS reporting countries in all currencies. The second term, $Grossflows_{t,US}$, captures global U.S. dollar flows originating from the U.S, constructed as the sum of U.S. banks direct cross-border credit to the rest-of-the-world non-bank sector.

The Asia block contains the following variables:

$$w_{i,t} = [y_{i,t}, M2_{i,t}, NFA_{i,t}, res/m2_{i,t}, credit_{i,t}, ca_t, reer_{i,t}] \quad (4)$$

The choice of variables is partly determined by data availability. The Asia FDEs block, $w_{i,t}$, is composed of a measure of domestic economic activity ($y_{i,t}$), net foreign asset ($NFA_{i,t}$), net domestic credit ($credit_{i,t}$) and the real exchange rate vis-à-vis the U.S. dollar ($rer_{i,t}$) for each country i. Since quarterly real output growth data is not available for the constituent countries, this paper uses imports to measure changes in domestic economic activity ($y_{i,t}$) and broader shifts in domestic absorption.

At the heart of the transmission mechanism described in Rey (2013) is the ability of banks to leverage up quickly when global financing conditions are favorable. Rajan (2014) puts this down to the direct effect of cross-border banking flows (and indirectly to an appreciating exchange rate and rising asset prices). Unconventionally accommodative U.S. monetary policy should, therefore, spur capital flows into recipient countries, leading to an increase in local leverage, as proxied by NFA and M2, and higher private sector credit growth, which has been demonstrated to be a powerful predictor of financial crises. The dominance of traditional banks and the lack of market based financial intermediaries implies that traditional monetary aggregates, such as M2, which track the size of core liabilities, should provide a useful signal of changes in the size of the aggregate balance sheet of the banking sector. These variables should be able to recover key elements of the bank lending channel. Finally, to account for internal drain associated with capital flight by residents, and augmenting NFA, also included is the foreign

[7] See Borio and Disyatat (2011) and Rey (2013).

reserves-to-M2 ratio ($res/m2_{i,t}$). The ratio is approximately the amount of bank deposits that are sufficiently liquid to leave the country over a short time.[8]

To capture broader global financial market conditions, the model is augmented by an exogenous block. This block includes JP Morgan's Developing Asia Emerging Local Market Index (ELMI), and a measure of uncertainty based on the Chicago Board Options Exchange Market volatility implied index (VIX_t).

$$x_t = [ELMI_t, VIX_t, i_t - \pi_t, i^{3m}_{t+1|t}, i^{10}_{t+1|t}] \tag{5}$$

The model allows for a positive feedback loop between the U.S. Fed Funds rate and VIX, which Rey (2013) has shown to be a strong mechanism in driving capital flows. A global real interest rate, $i_t - \pi_t$ measure is also included to proxy for changes in global liquidity conditions. Finally, in order to more explicitly account for expectations and forward-looking behavior a short- and long-term private sector interest rate expectations extracted from consensus forecasts are also included: $i^{3m}_{t+1|t}$ and $i^{10}_{t+1|t}$. News about future risk shocks can strongly influence financial markets and the real economy today.

B. Identification of U.S. Policy and Nonpolicy Structural Disturbances

Inference concerning the properties of the model cannot be undertaken unless a behavioral system is identified from the reduced form model. In addition to the unconventional monetary policy shock the model follows Benati and Goodhart (2010) and Baumesister and Benati (2013) by identifying two additional shocks: demand non-policy shock and the traditional monetary policy shock. Canova and Paustian (2011) and Baumesister and Benati (2013) highlight the importance of imposing a number of plausible restrictions in order to pin down the shock of central interest.[9] Nonpolicy demand shocks are identified via a positive sign on output, inflation and the fed funds rate, while the term spread is left unrestricted. A flattening of the yield curve following a contractionary monetary policy shock can be motivated by imperfect pass-through along the term structure of interest rates given that short-term interest rates are only temporarily higher.[10]

[8] While the reserves-to-short term debt gives an indication of the vulnerability to external drain, the reserve-to-M2 ratio captures the extent to which the liabilities of the banking system are backed by international reserves. See Kaminsky and Reinhart (1999).

[9] This approach has a number of advantages over existing studies. It allows the econometric model to be relatively more agnostic about the impact of shocks, while simultaneously imposing some structure on the data. The identification scheme leaves open the possibility that the eventual impact of the shock on the variable may violate the theoretical priors. Additionally, as noted in Rafiq and Mallick (2008), because the sign restriction identification strategy identifies shocks using mild restrictions, it matters less which inflation and output measure is used, and so the particular definition used is of secondary importance. This allows for comparable identification schemes to be achieved across countries.

[10] These restrictions are consistent with a multitude of studies including, but not limited to, Peersman (2005), and Rafiq and Mallick (2008).

Table 1: Sign Restrictions Outlining Theoretical Priors

	Type of U.S. shock[1]		
U.S. variable	Standard Monetary Policy	Unconventional Monetary Policy[2]	Nonpolicy Demand
Inflation	–		+
Real output	–		+
Fed funds rate	+	0 basis point floor	+
Term spread	–	100 basis points fall	

[1] In order to ease computational feasibility the two noncore shocks are estimated by assuming that their restrictions hold for around six months. The model refrains from identifying a supply shock due to the relatively short sample (1996:4–2013:2).

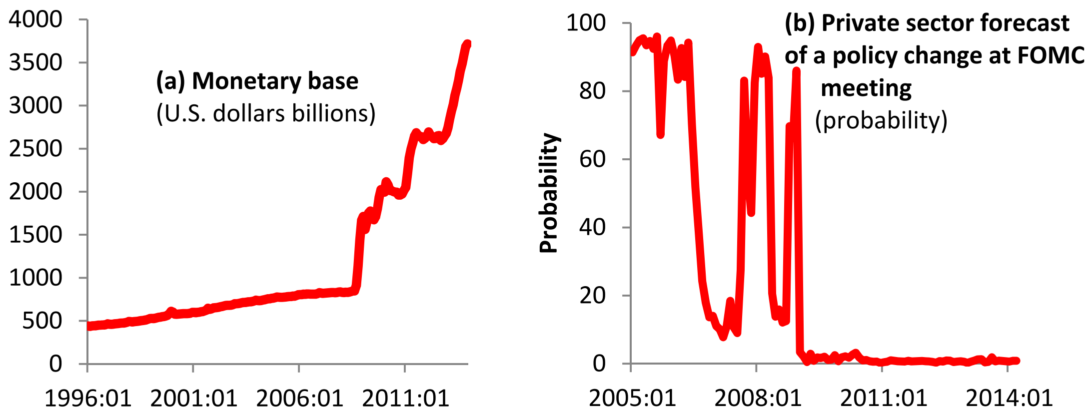
[2] The results remain fundamentally unaltered if a positive sign is imposed on real output and inflation for the unconventional monetary policy shock.

Once the effective zero bound on the short-term nominal interest rate was reached, policymakers resorted to unconventional tools. The Federal Reserve's LSAP involved two pillars from early 2009. The first pillar involved downward pressure on long-term interest rates to compress the yield curve in order to support private borrowing. Figure 2(a) shows a large expansion in the monetary base post-2009. The primary objective of these quantitative measures was to push down long-term rates. A second pillar of the Federal Reserve's unconventional monetary policy program involved forward guidance on the path of short-term interest rates. This essentially amounted to a commitment in keeping the fed funds rate close to zero. Figure 2(b) shows that since 2009 probabilities derived from private sector forecasts regarding a change in the fed funds rate have been zero.

The model here attempts to pin down the effects of the Federal Reserve's unconventional monetary policy by identification of a pure term spread shock, and is dependent on a non-Fed funds rate response, replicating a zero lower bound environment. Table 1 shows that an unconventional monetary policy shock is identified by a 100 basis point decline in the term spread coupled with interest rates pushed up against the zero lower bound. The restrictions are assumed to hold for one year.[11]

[11] D'Amico and King (2013) report long-term rates to have declined by around 100 basis points following the expansion of the Federal Reserve's balance sheet by 600 billion U.S. dollars.

Figure 2: U.S. Monetary Base and Forecasts of Fed Funds Rate



Source: CEIC and Consensus Forecast

This model relies upon the use of quarterly data running from 1996:4 till 2013:2 for estimation purposes. With the exception of the interest rate in the U.S. block and the current account balance in the Asia block, all data are left in log levels and enter the system contemporaneously.[12] Since the model is estimated using levels of the logs of variables the restrictions are imposed on the impulse responses and not on the cumulative responses. Finally, this paper follows Uhlig (2005) in using a weak form prior from which a posterior distribution depends on the maximum likelihood estimator of the VAR model, allowing estimation via a Gibbs sampling procedure.

III. Innovation Accounting of U.S. Shocks on Asia FDEs

The reliability of the results depends upon the ability of the empirical model to accurately capture the underlying structural relationships. This section first explores the response to a conventional U.S. monetary policy and nonpolicy demand shocks. The responses shown are based on posterior medians and 16^{th} and 84^{th} percentile error bands.[13]

A. U.S. Nonpolicy Demand and Monetary Policy Shocks

In the near-term the identified disturbances have the expected effect on real output and inflation.[14] Figure 3 shows that in response to a tightening in U.S. monetary policy short-

[12] This paper does not seek to perform an explicit analysis of the long-run behavior of the economy. In doing the analysis in levels the model allows for implicit co-integrating relationships in the data, while still having consistent estimates of the parameters. See Sims, Stock and Watson (1990).

[13] The *x*-axis is, with the exception of the current account, in percentage terms.

[14] The confidence intervals for the responses widen the further out on the horizon. This is due to the fact that the impulse responses will eventually be dominated by the largest root, which will typically be just a bit larger than one. With a fairly small data set, the largest root is less well-determined, hence, wider confidence bands at relatively medium- term horizons.

term interest rates rise, leading to a contemporaneous humped-shape decline in the term spread. As expected, real output growth and inflation also decline. The findings are in broadly in line with Uhlig (2005). Finally, changes in conventional U.S. monetary policy which lead to higher domestic U.S. interest rates have a short-term depressing effect on bank and non-bank gross capital outflows from the United States.

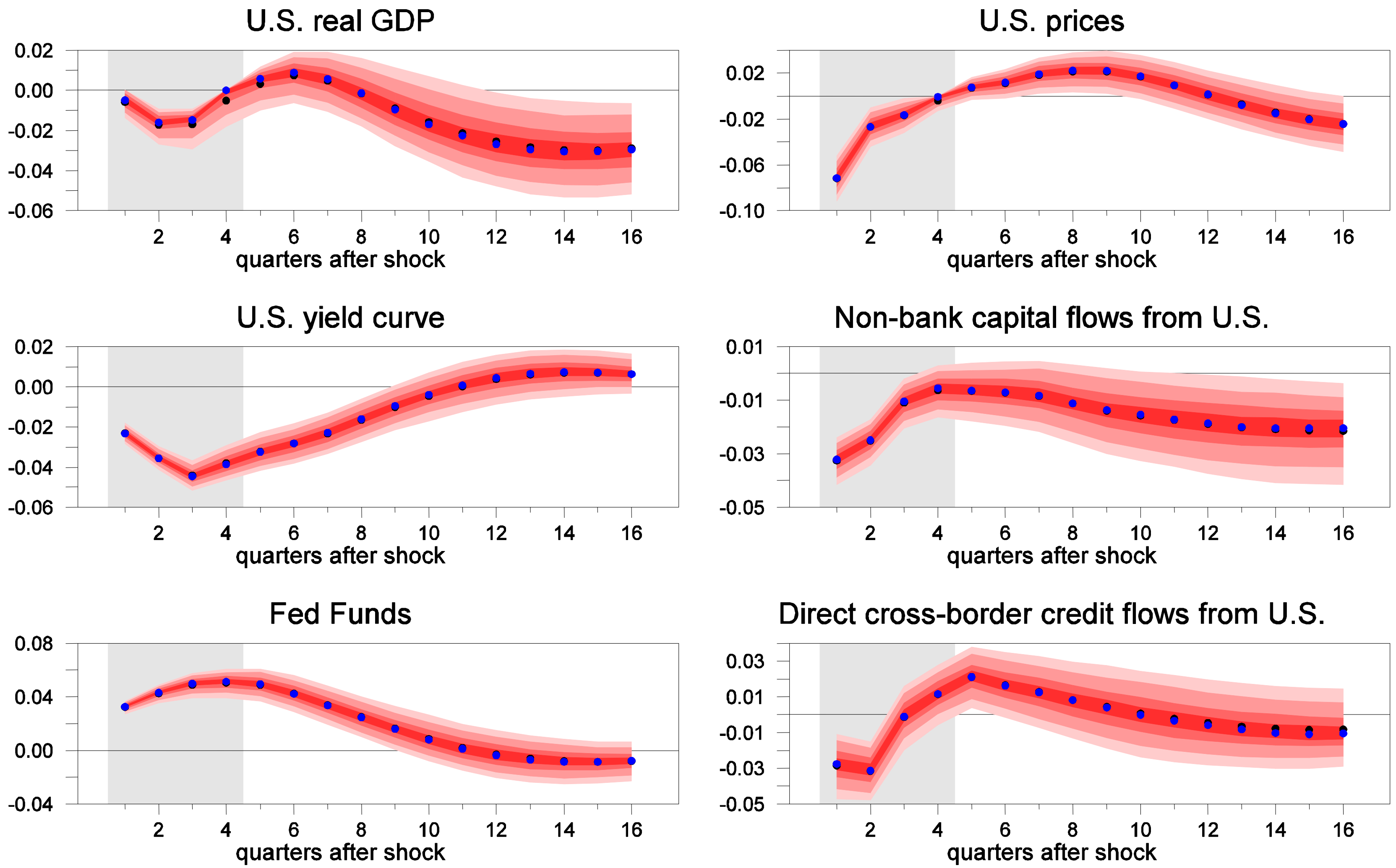
The estimates of a non-policy demand innovation are illustrated in Figure 4. In response to a non-policy demand shock, real output and inflation rise. The effects are more persistent compared with the conventional monetary policy shock. The rise in output and inflation leads to an increase in short-term interest rates, consistent with a tightening in monetary policy resulting from improved economic conditions. In contrast to the conventional U.S. monetary policy shock, a nonpolicy demand shock leads to a rise in gross capital flows from the United States. This finding ties in with Rey (2013), which showed U.S. domestic conditions influence the global financial cycle. The effects wash out after two years.

Figure 5 shows the responses to a U.S. unconventional monetary policy action. The results show that a U.S. unconventional monetary policy shock leads to a 100 basis point compression in the yield curve, while the short-term policy interest rate stays zero for one year (consistent with forward guidance). Real output rises significantly while inflation increases sluggishly, consistent with sticky-prices. The effects of an unconventional monetary policy shock are larger than the standard conventional monetary policy shock. After the initial easing the yield curve steepens consistent with an improved economic outlook and rising inflation. As noted in Baumeister and Benati (2013) the flattening of the yield curve can be motivated by imperfect pass-through along the term structure of interest rates given that short-term interest rates are temporarily higher. The results here are broadly in line with pre-existing research.[15]

The results in Figure 5 also illustrate that unconventional monetary policy produces strong liquidity effects, particularly when compared to conventional monetary policy and non-policy demand shocks. Gross capital flows and direct cross-border credit flows from the United States rise. Credit flow increases more strongly than non-bank flows. After one year, as monetary policy normalizes and the yield curve begins to steepen owing to rising U.S. economic activity, growth in bank and nonbank flows decline. As with the conventional monetary policy shock, these timings illustrate the importance of U.S. monetary policy in altering global monetary conditions.

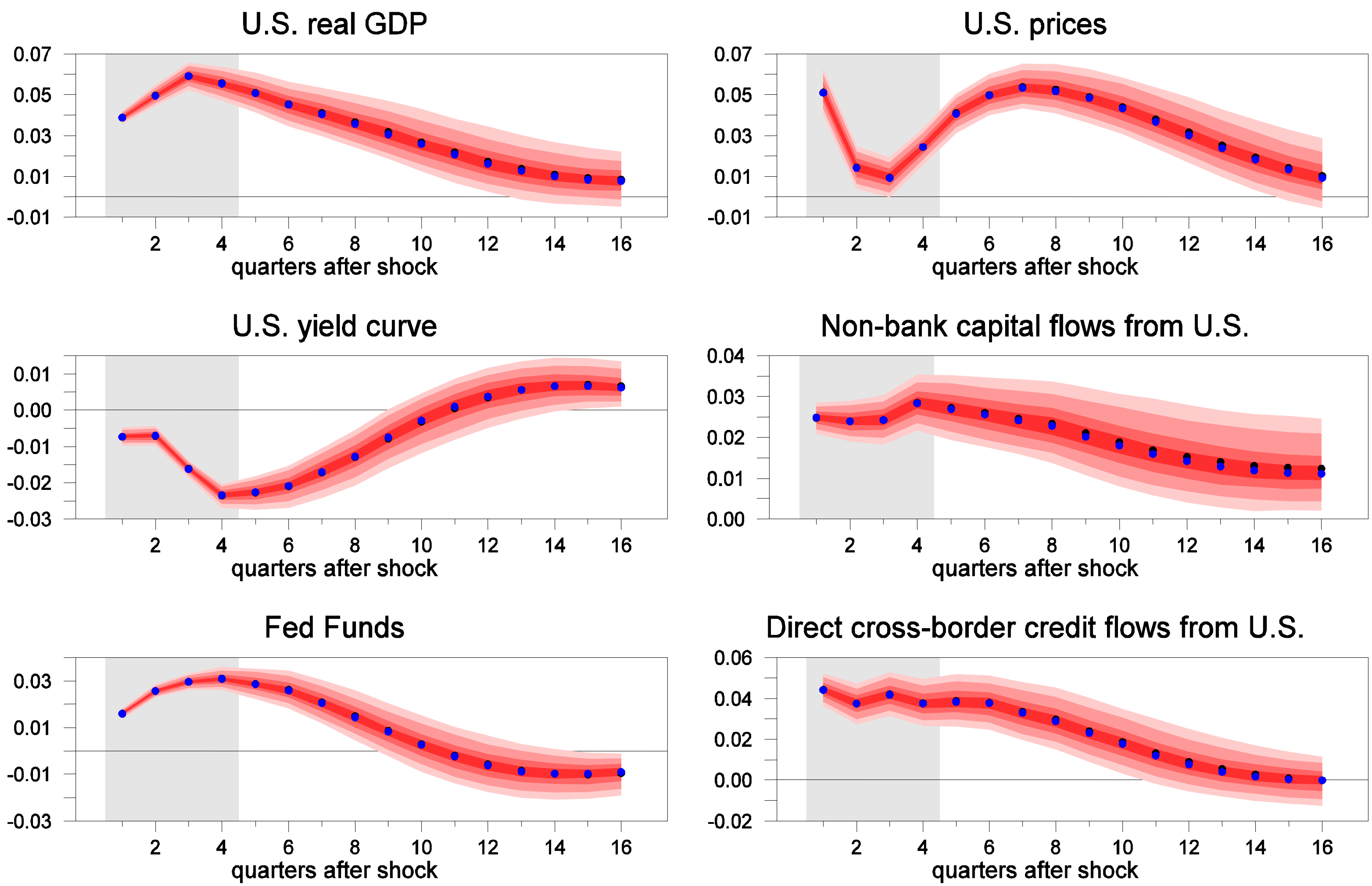
[15] See Gilchirst, Yankov and Zakrajsek (2009), Eickmeier and Hofmann (2012) and Wright (2012).

Figure 3: U.S. Conventional Monetary Policy Shock



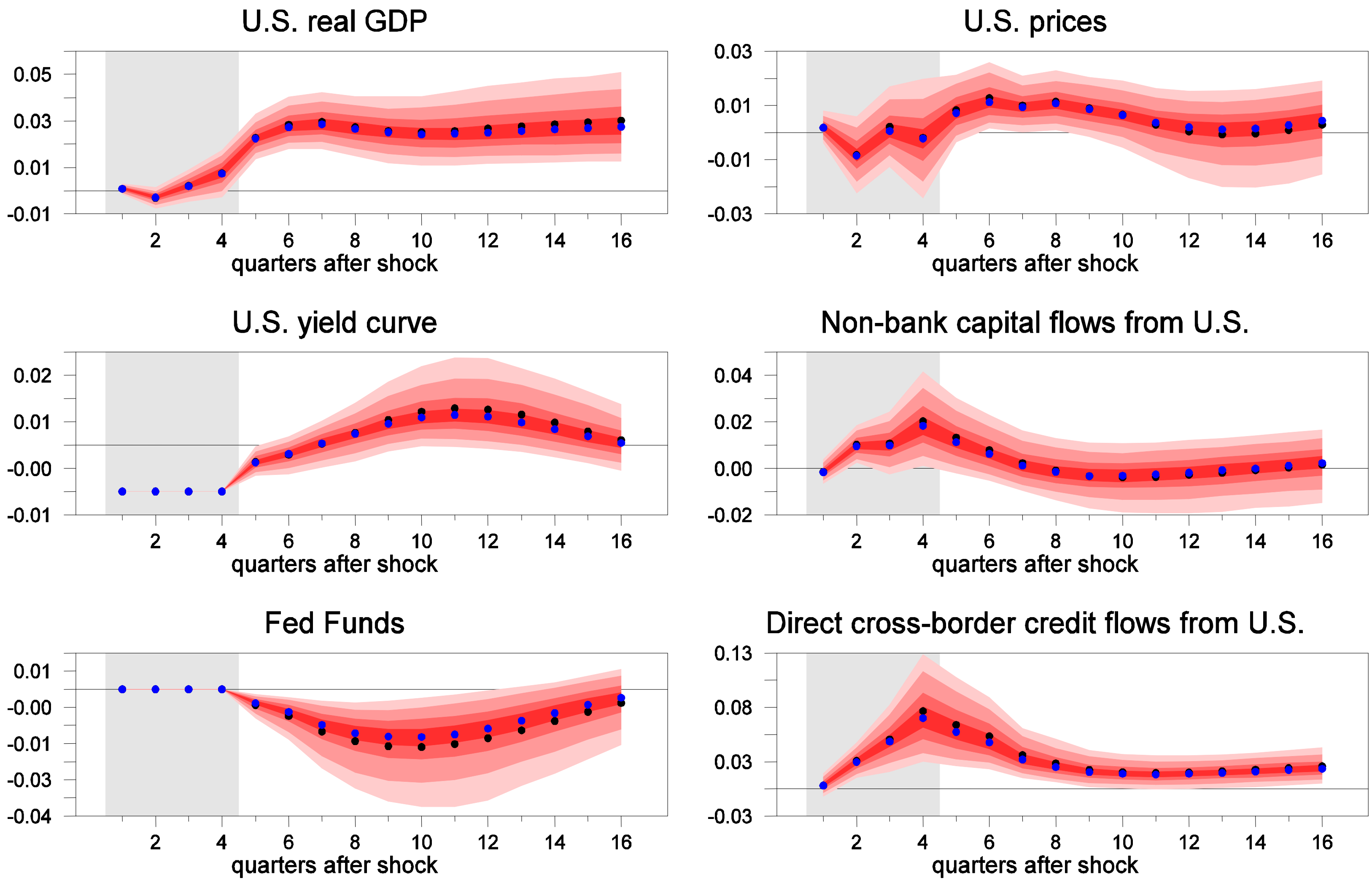
Source: Author's calculations.

Figure 4: U.S. Nonpolicy Demand Shock



Source: Author's calculations.

Figure 5: U.S. Unconventional Monetary Policy Shock



Source: Author's calculations.

The results are line with the idea that zero interest rates, coupled with forward guidance, has a larger effect on cross-border flows through altering incentives on risk taking.[16] Zero interest rates lower the cost of risk taking, while forward guidance significantly reduces and/or eliminates roll over risk on short-term funding positions. This significantly reduces the cost of leverage, creating strong incentives to increase exposures.

B. Tracing Out U.S Shocks on Frontier Developing Economies in Asia

The effects of the U.S. shocks are now traced out on to Asia FDEs to gauge their impact on a broad range of macroeconomic variables.

U.S. unconventional monetary policy and Asia FDEs

The effect of U.S. unconventional monetary policy on private sector credit and broad money growth in FDE Asia is minor. Figure 6 shows there is a very small short-term impact on NFA, which leads to a short-term deterioration in the current account balance. Both responses wash out within a year. The quantitatively small positive impact on foreign reserves-to-M2 ratio implies the constituent countries would have received little in way of liquid capital flows in response to U.S. unconventional monetary policy. Taken together, the responses suggest that the risk-taking and bank-lending channels are not hugely important mechanisms in transmitting an easing in global monetary conditions to FDE Asia. In line with these findings, the estimates also show a short-term positive impact on economic activity, as proxied by imports, consistent with the short-term deterioration in the current account balance. These effects quickly disperse, with no long-run impact.

While most models focus on the financial sector, the real exchange rate could be an important channel in transmitting spillovers from abroad. The model's prediction is ambiguous as to the uncovered interest rate parity, for which empirical support is limited. The estimates for the REER are insignificant in the short-term. It is difficult to fit any definitive theory to the exchange rate responses given the—sometimes large—interventions by the monetary authorities of the constituent countries. Finally, that the effect on the current account balance washes out relatively quickly would suggest that secondary channels via spillovers from trading partner countries affected by U.S. unconventional monetary policy has not been important in transmitting the effects of U.S. policy changes to Asia FDEs.

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[16] Rey (2013) and Rajan (2014) report that cross-border banking flows rise aggressively in times of very accommodative monetary policy. Bruno and Shin (2013) find that an expansionary shock to U.S. monetary policy increases cross-border banking capital through higher leverage of banks.

Historical decomposition of U.S. large scale asset program on developing Asia

In order to investigate the post-financial crisis period to the U.S.' LSAP, this section presents historical decomposition estimates, which represent a special case of counterfactual simulation.[17] Starting with a vector *f*, a scalar term λ and assuming a M matrix such that $F = [\lambda f|M]$ then

$$FF' = \Sigma \Longrightarrow F^{-1} = F'\Sigma^{-1} \tag{6}$$

$$\Longrightarrow F(e)e(1)'F' = F(e)e(1)'F'\Sigma^{-1} = (\lambda f)(\lambda f)'\,\Sigma^{-1}$$

where f is a non-zero vector, λ is a scalar and Σ is the variance-covariance matrix. The counterfactual estimate for variable (i) based on the unconventional monetary policy shock can be attained by

$$\zeta_t^{(i)} = (\lambda f)(\lambda f)'\Sigma^{-1}\varepsilon_t = Paa'P'\Sigma^{-1}\varepsilon_t = Paa'P^{-1}\varepsilon_t \tag{7}$$

If $f = Pa$, this simplifies when the shock is generated as a weighted sum (a) of the columns of the covariance factor Σ. The results are drawn as deviations from the baseline (the deterministic component) post-financial crisis. The estimates are presented in Figure 7.[18]

The first result of note is that there are no clear patterns in the results since 2009. The second result to notice is that magnitudes of the estimates are small. The findings appear to confirm the small impact of U.S. unconventional monetary policy actions on FDEs in Asia since 2009. Although the LSAP program began in 2009, a positive impact on NFA was not seen until 2011 with an eventual peak impact of around two-and-a-half percentage points. A similar pattern is also witnessed for economy activity (imports). The effects on NFA and credit move in phase with one another. However, the results show that the impact of unconventional monetary policy on domestic credit has seldom been positive, as predicted by the banking channel of global monetary spillovers. The non-positive credit response could also reflect a tightening in domestic monetary policy.

The estimates show a small improvement in the current account balance, indicative of the importance of the trade channel. Finally, although the effect is too small to be economically meaningful, U.S. unconventional monetary policy had appreciative effects on the exchange rates of FDEs.

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[17] The historical decomposition is a special case of counterfactual simulation. The observed data can be recreated by adding the base forecast to the sum of contributions of all shocks. If some of those components are omitted, then the estimates would represent data that would have been generated if some linear combinations of the residuals had been zero rather than what was actually observed.

[18] The interpretation goes as follows. Since the model is estimated in log level form the numbers on the *y*-axis will represent the cumulative percentage change from the baseline. An NFA value of one would imply that the cumulated effect of an unconventional monetary policy shock eventually pushes the NFA level up one percent as of that date.

Conventional monetary policy and nonpolicy shocks to Asia FDEs

How does the response to an easing in U.S. monetary policy compare to more conventional macroeconomic shocks? Figure 8 illustrates that a U.S. monetary policy shock induces a negligible change in domestic credit growth, NFA and in the money supply in Asia FDEs. The effect on the overall trade balance is also insignificant. There is little evidence that financial markets force a tightening in domestic monetary conditions following a tightening in global conditions resulting from a rise in the Fed Funds rate. Canova (2005) notes that a contractionary U.S. monetary policy may lead to a tightening in domestic monetary policy in emerging markets in order to ward off a potential rise in default risk, with central banks also adjusting rates to limit exchange rate movements. The results also contrast with Taylor (2013), which argued that the potential for monetary policy spillovers operating through divergent policy interest rates leads to enforced coordination of monetary policy among central banks. Fear of failure to follow suit in lowering rates would undermine investor confidence and other macroeconomic objectives.

Nonpolicy demand shocks, shown in Figure 9, have a more significant short-run impact on FDE Asia than monetary policy innovations. Capital flows increase, signified by the rise in NFA and the foreign reserve-to-M2 ratio. Private domestic credit also rises, leading to an increase in broad money growth. As a result, private consumption and investment are stimulated leading to a rise in import growth. Over the short-term the results are broadly consistent with the view that demand management in systemically important countries has consequences for the rest of the world.[19]

IV. FDE Asia and Global Financial Cycle

Simple analytics extracted from the raw data are consistent with the estimates showing that the effect of a U.S. unconventional monetary policy shocks on Asia FDEs has been, at best, small. Figure 10(a) shows that, with the exception of Cambodia, there was no significant rise in the foreign liabilities of commercial banks since 2009.[20] Private sector credit growth, with the exception of Cambodia, has also been no higher post-2009. Figure 10(c) shows that non-bank portfolio flows into FDEs have been smaller compared to flows into emerging market Asia since the start of the LSAP in the United States. The ratio of foreign reserves to money M2 in Figure 10(f) illustrates no discernible liquid capital inflows beginning 2009. Large capital inflows would precipitate declining risk premia. A negative premium would infer less risk aversion, and overvalued equity markets. Risk aversion measures based on the equity premium for Bangladesh and Sri Lanka, shown in Figure 10(d), has been positive since 2009.

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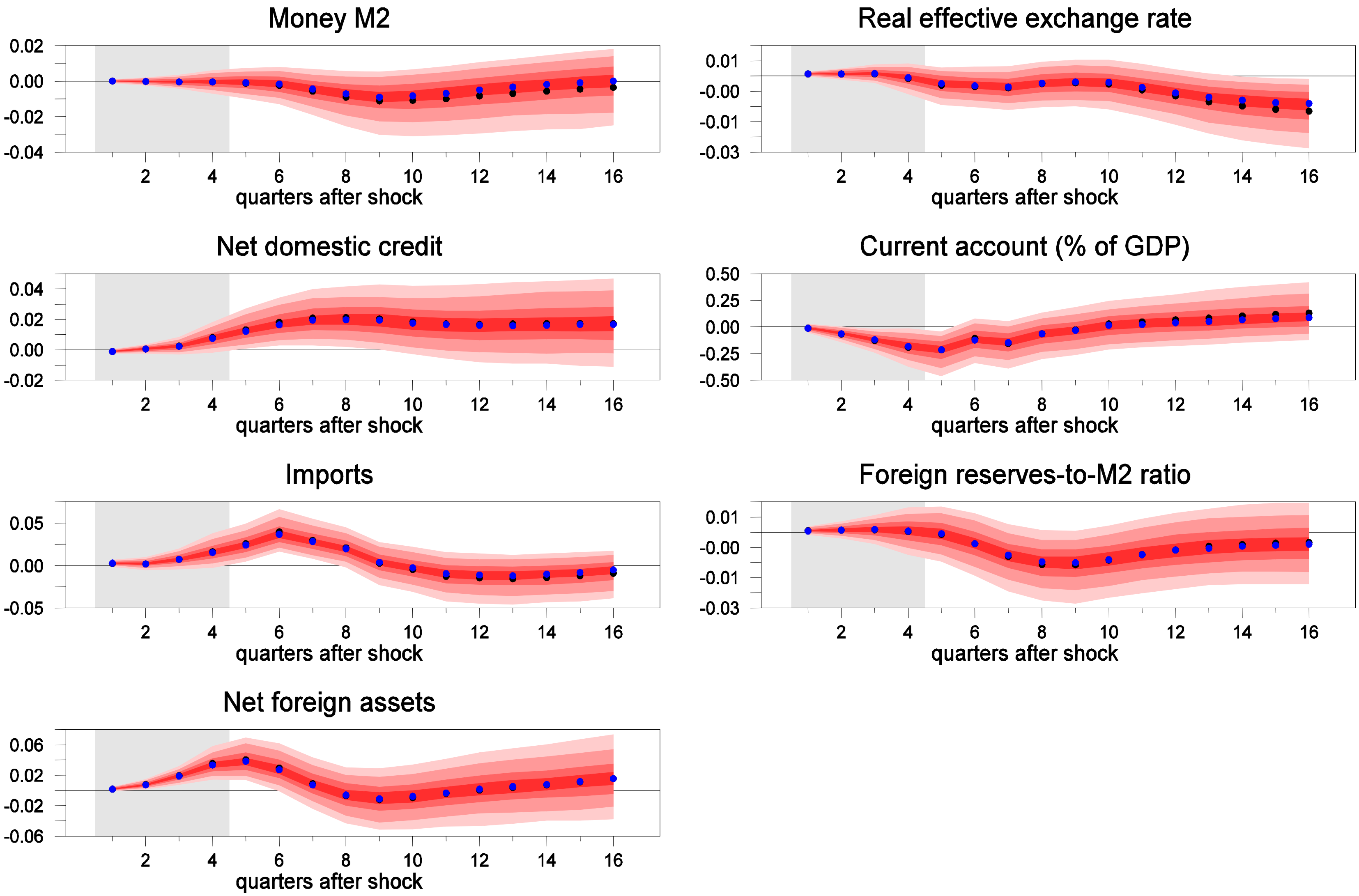
[19] Rey (2013) and Rajan (2014).

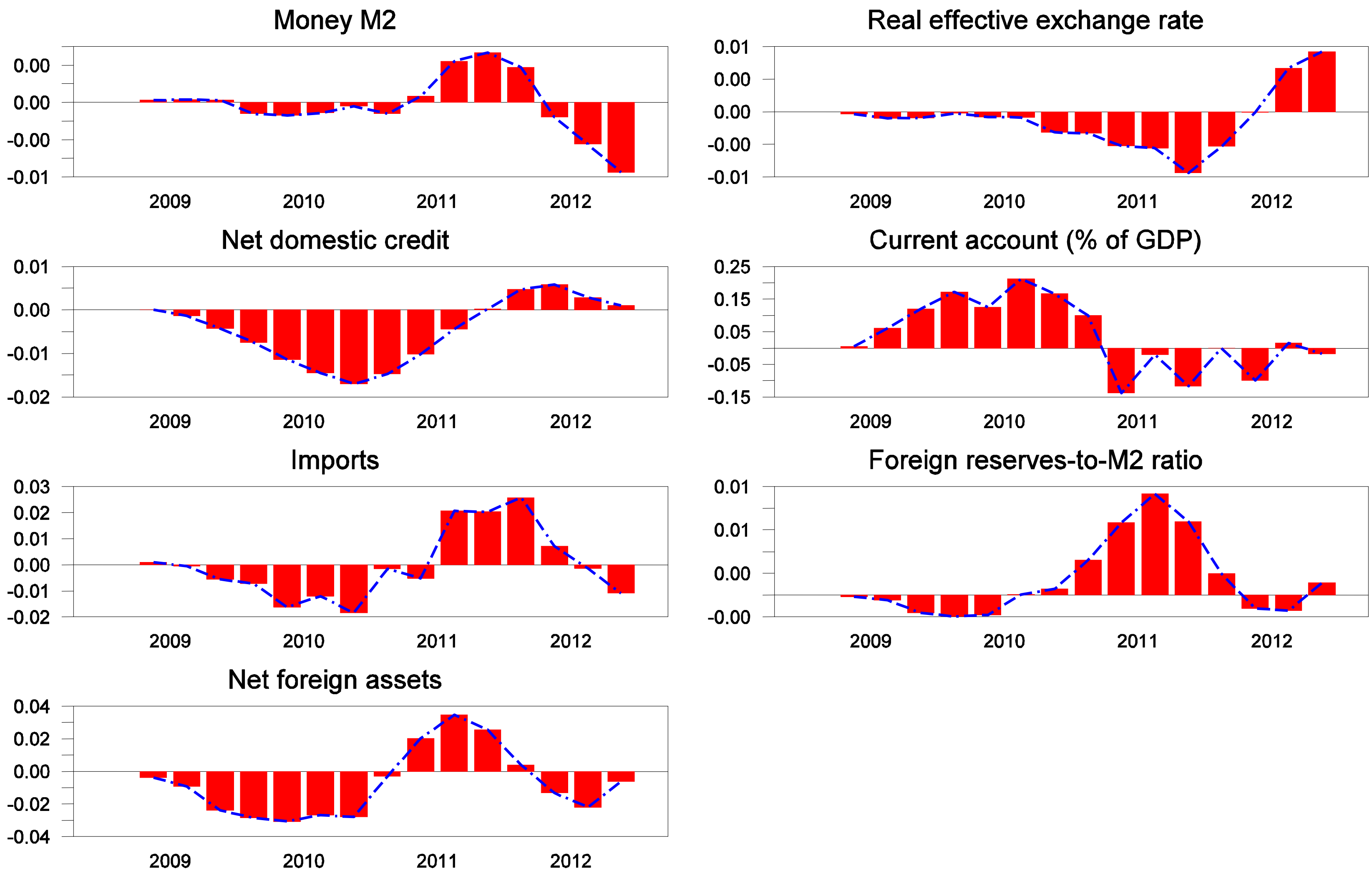
[20] Much of the rise in foreign liabilities for Cambodia reflects a rise in foreign bank subsidiaries setting up operations. Therefore, the flows may be viewed as 'structural', and are less likely to be reversed should global monetary conditions tighten.

Figure 6: Effects of U.S. Unconventional Monetary Policy Shock on Frontier Developing Countries



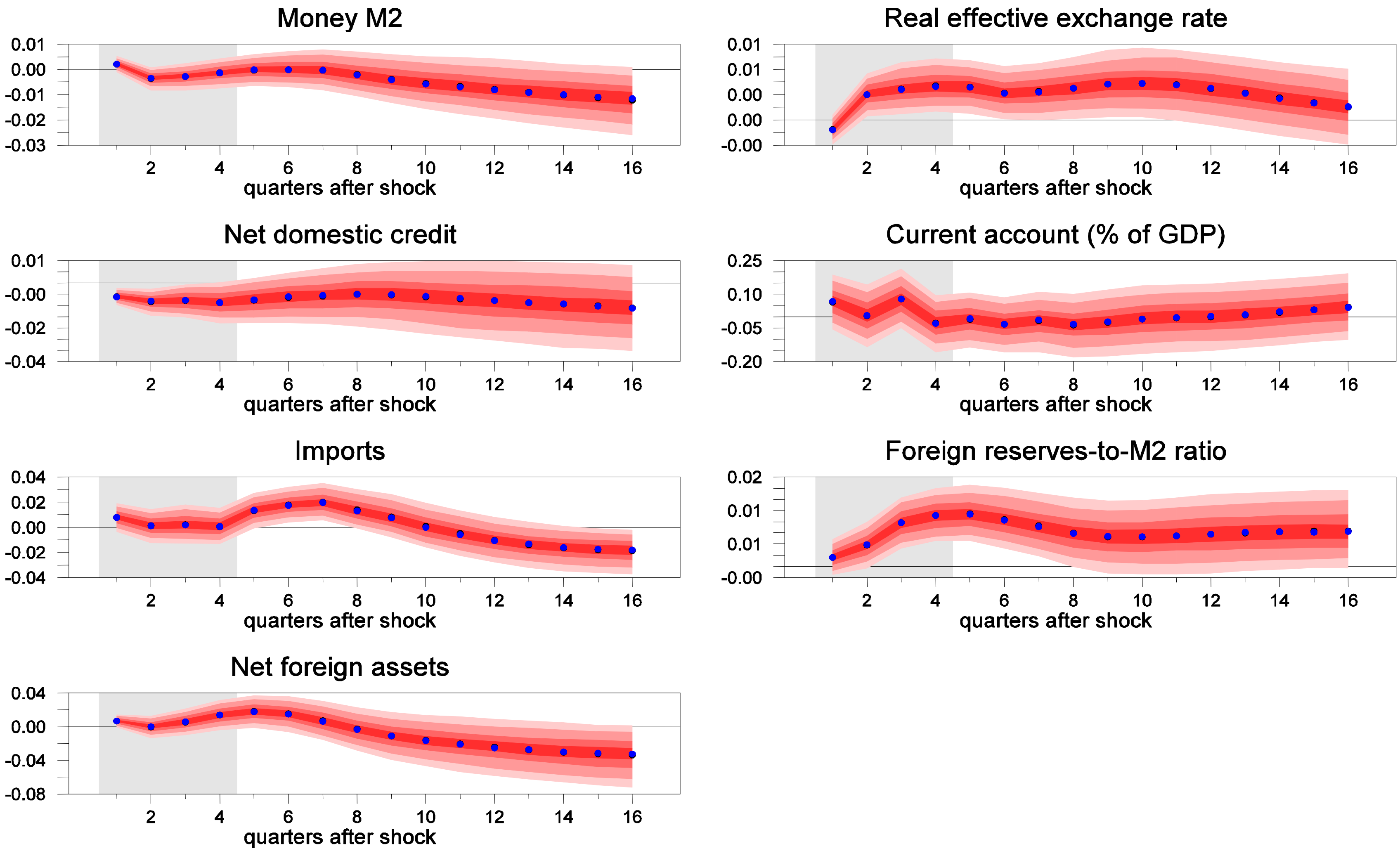
Source: Author’s calculations.

Figure 7: Counterfactual Estimates of U.S. Unconventional Monetary Policy Shocks on Frontier Developing Economies, 2009:2–2012:2



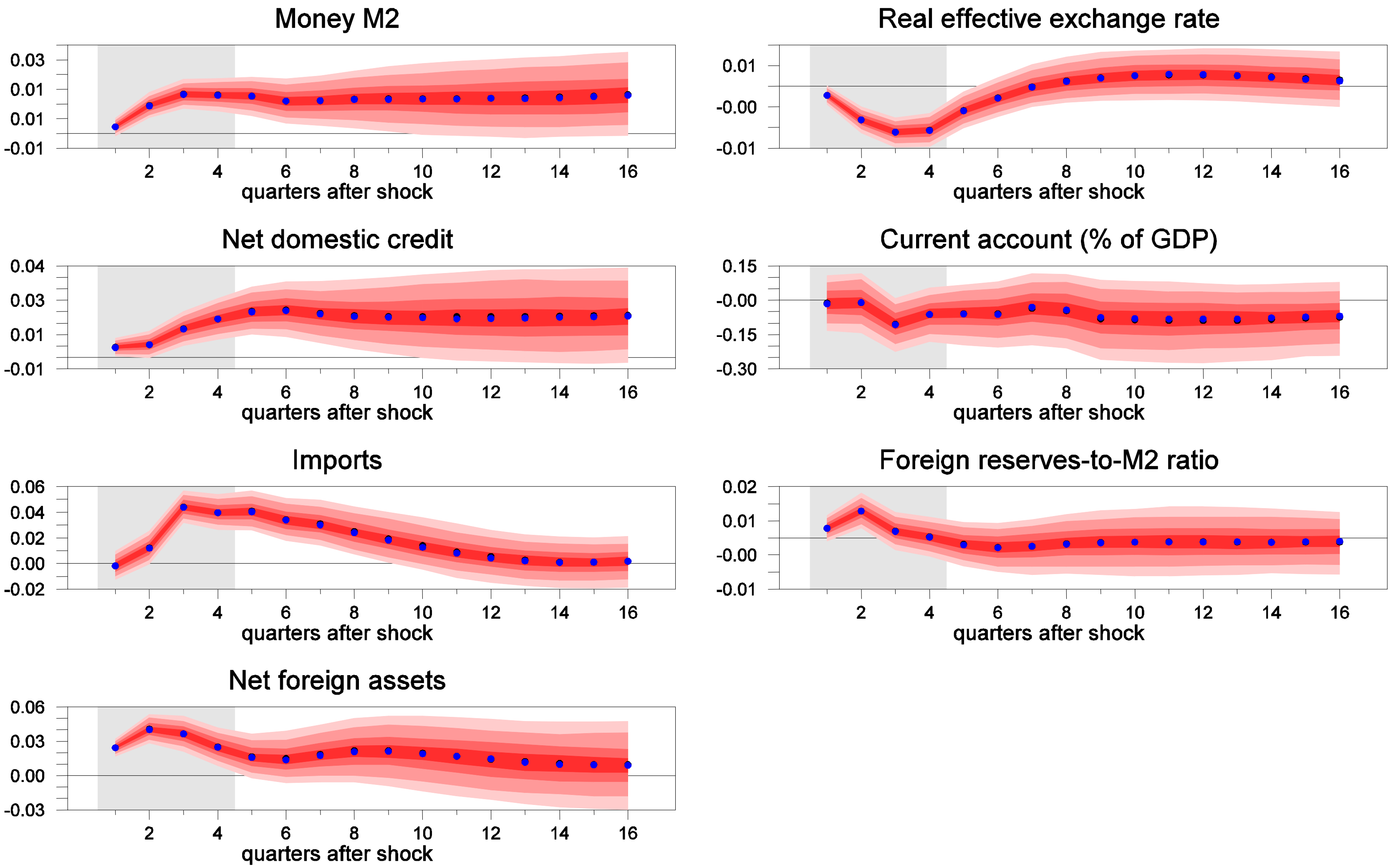
Source: Author's calculations.

Figure 8: Effects of U.S. Conventional Monetary Policy Shock on Frontier Developing Countries



Source: Author’s calculations.

Figure 9: Effects of U.S. Demand Shock on Frontier Developing Countries



Source: Author's calculations.

Finally, Figure 10(e) shows that, while there has been a rise in external debt for some countries, over the course of four years it has not been excessive. Experience across many countries and many decades have shown how rapid financial deepening can create financial stability challenges.[21] IMF (2013, 2014b, 2014c) shows that, for emerging market countries in Asia, the effects of capital flows are mainly transmitted through their impact on bond and equity prices, rather than domestic credit. The shallow financial markets of FDEs would imply a shortage of investible assets.

Figure 11 illustrates trilemma indices derived in Aizenmann, Chinn and Ito (2012). The estimates show that Asia FDEs have managed capital accounts and, as a result, a relatively high degree of monetary policy independence. No country in the sample has a fully flexible exchange rate. Managed capital accounts should dampen the impact of volatile capital flows resulting from an easing in global monetary conditions.

A. The Effects of Unconventional Monetary Policy on India

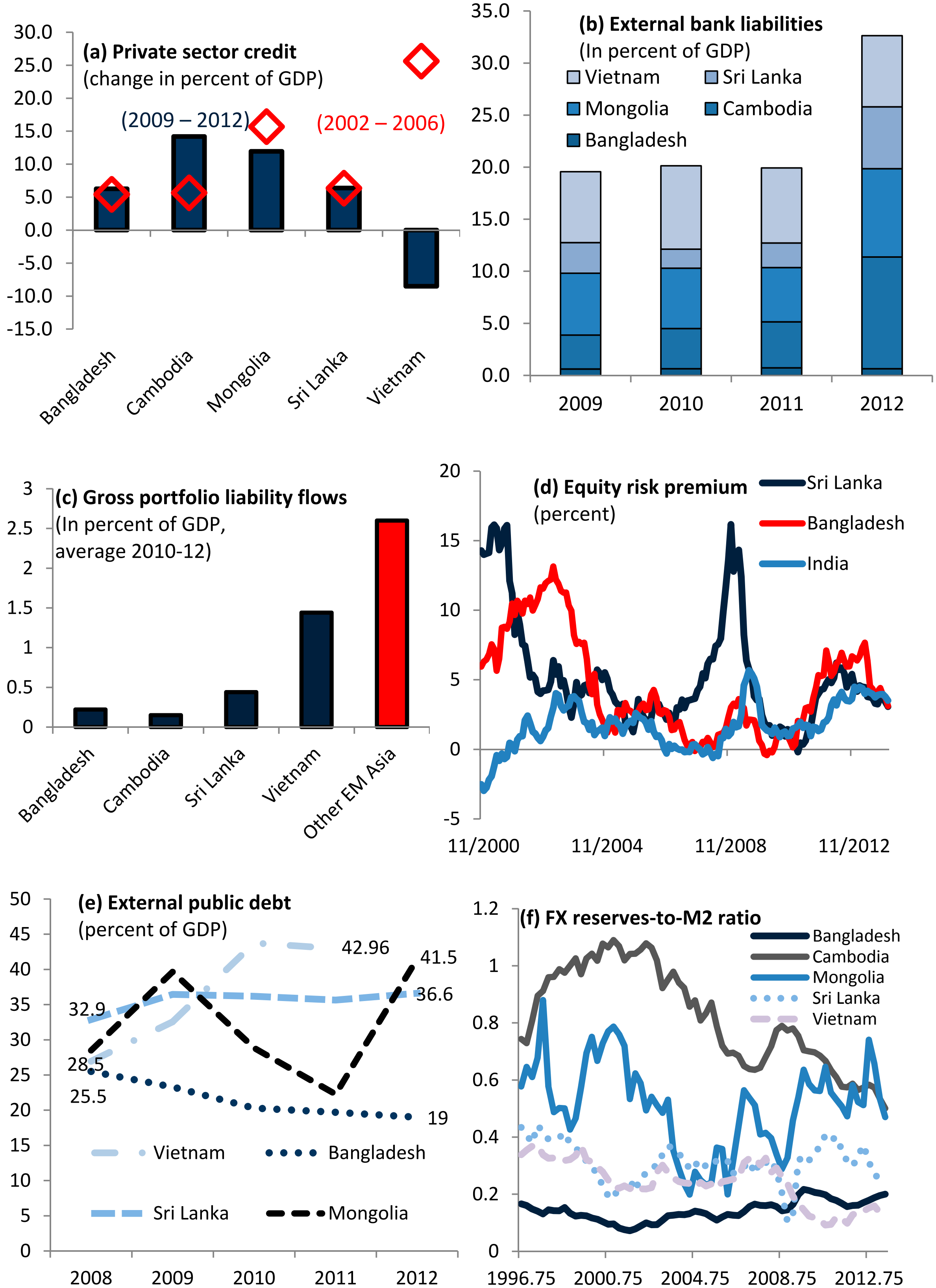
Using a simplified version of the model presented earlier this section examines the effects of U.S. unconventional monetary policy on a large FDE in Asia, India. Like other Asia FDEs, India has a managed capital account. However, India has deeper financial markets with greater corporate and sovereign bond issuance.

Figure 12 shows the response of Indian data to a U.S. unconventional monetary policy shock. With the exception of the current account balance the estimates are statistically significant. The responses show that, with a lag, private sector credit and NFA rise. There is also a compression in the equity risk premium, consistent with stock market inflation and greater risk-taking, while the yield curve steepens as domestic economic conditions improve. Finally, and again with a lag, the impact on real economic activity is positive and statistically significant. The results are in line with IMF (2014c), which showed that a U.S. tapering is likely to have a more pronounced effect on Indian financial markets than on other Asian FDEs.

Figure 13 presents counterfactual estimates for India. The estimates show a clearer pattern of capital inflows. NFA rises consistently from 2009. Unconventional U.S. monetary policy also pushed down the equity risk premium, consistent with asset price inflation and increased liquidity. The yield curve moves in the opposite direction to equity risk premium, in line with improved economic optimism. There is also evidence that U.S. unconventional monetary policy measures helped worsen the current account balance. Evidence for this is strongest during 2010 and 2011.

[21] Rajan (2014) notes countries that have undertaken policies of financial sector liberalization draw in more flows. It is primarily these liquid markets where selling takes place when global monetary conditions tighten. Broner and Ventura (2013) develop a model in which countries with deeper financial markets experience more volatile capital flows through increasing their sensitivity to changes in investor sentiment.

Figure 10: Measures of Capital Flows and Risk Aversion



Sources: Bloomberg, CEIC, and author's calculations.

Figure 11: Trilemma Indices Based on Aizenmann, Chinn, and Ito, 2012

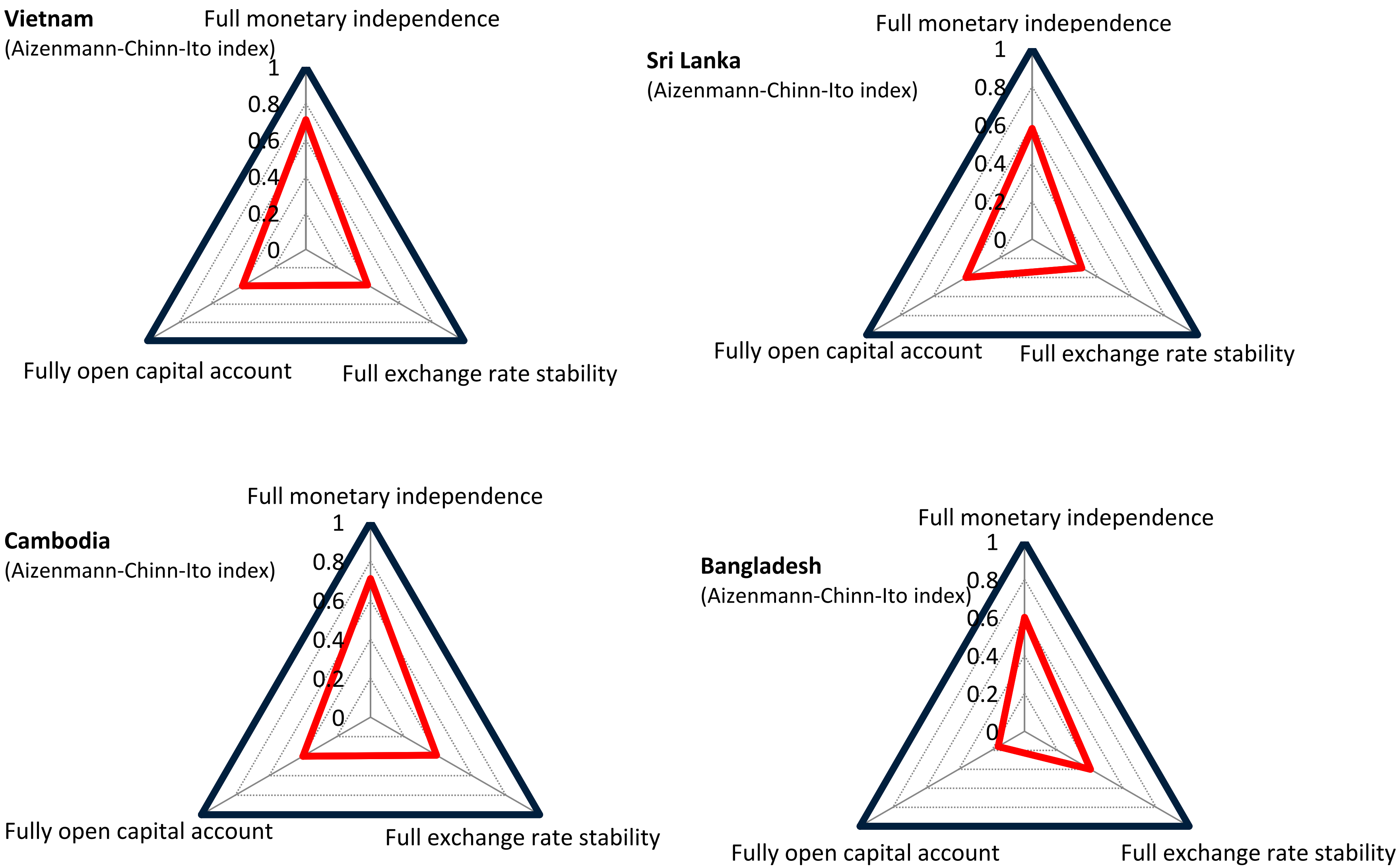
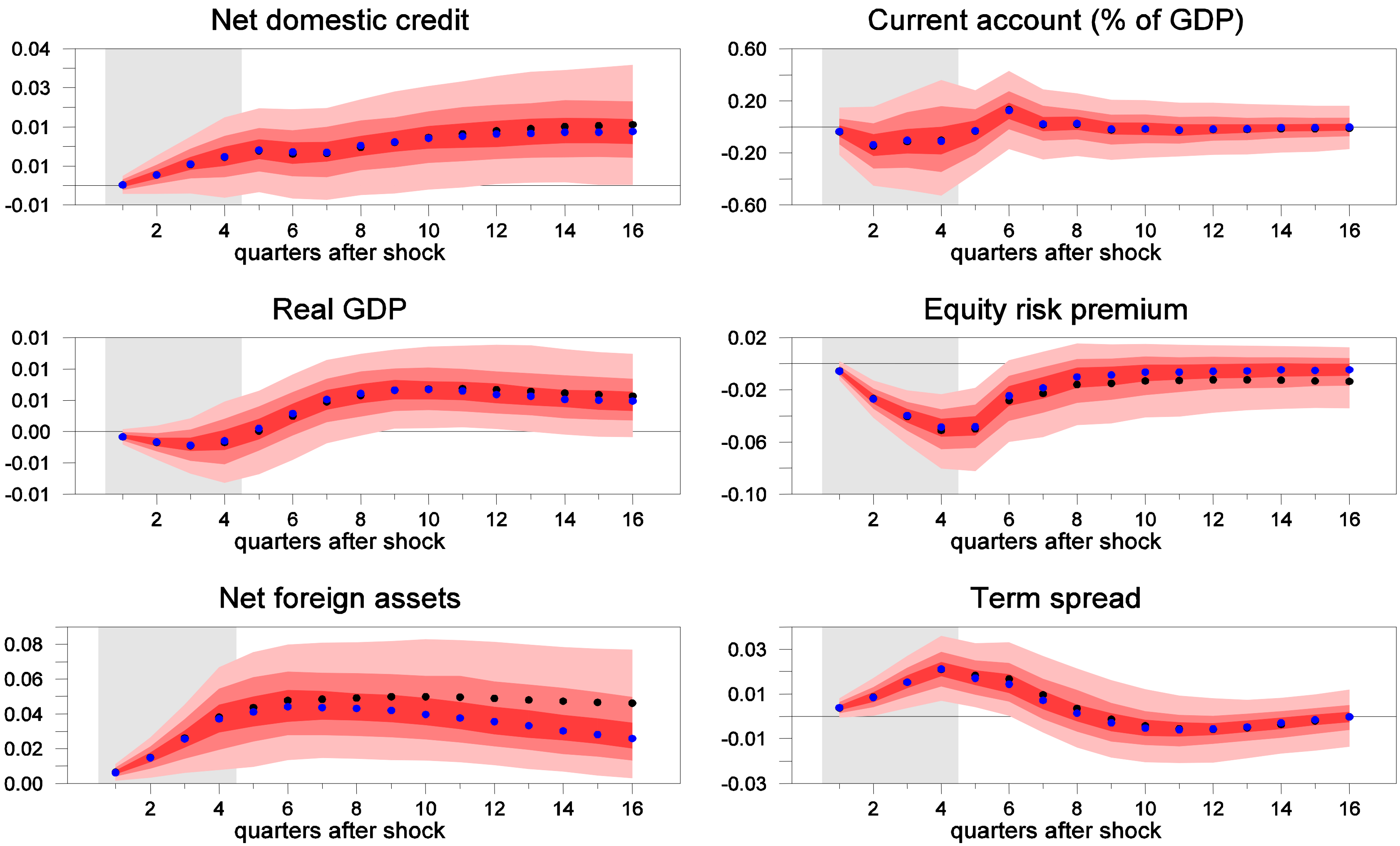
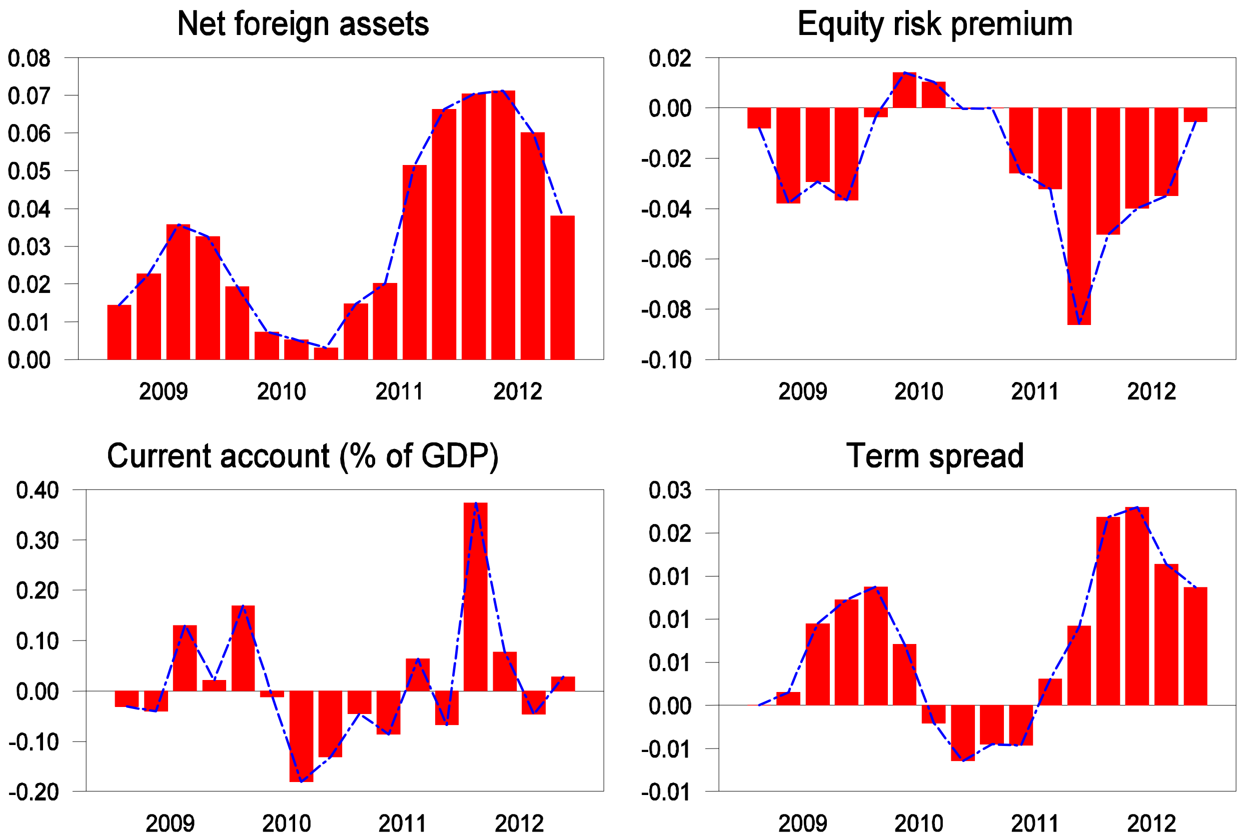


Figure 12: Response of India to U.S. Unconventional Monetary Policy Shock



Source: Author's calculations.

Figure 13: Counterfactual Estimates of U.S. Unconventional Monetary Policy Shock on India, 2009:2–2012:3



Source: Author's calculations.

V. Summary

Subject to all the usual caveats concerning model structure, using a simple economic framework, the paper examines the effects of U.S. policy actions on a group of Asia FDEs. It finds that the impact of unconventional monetary policy on FDE Asia has been relatively minor. Consequently, the direct impact of any Fed tapering on FDEs in Asia is likely to be, at best, small. This assumption implicitly assumes symmetry in the response of countries to unconventional monetary policy and its exit. It is therefore worth noting that the impact of unconventional monetary policy could be different from its exit depending upon whether the exit is orderly or not.

While the quantitative impact of U.S unconventional monetary policy on Asia FDEs may be small, the experience of India implies that as Asia FDEs develop deeper and broader based financial markets they are increasingly likely to be affected by the global financial cycle. This will require a strengthening in policy frameworks and greater monetary flexibility to cope with external shocks.

APPENDIX I: ESTIMATION OF THEORETICAL PRIORS

This appendix illustrates how the model imposes restrictions that back out of the impact of a compression of the yield spread within an environment in which the policy rate remains unchanged for an extended period. To identify these shocks the reduced form model (1) is written in its moving average representation

$$y_t = (I - B(L)L)^{-1}u_t \tag{A.1}$$

The reduced form and the structural shock are linked through $u_t = A\varepsilon_t$, or equivalently $\Omega \equiv E(u_t u_t') = AE(\varepsilon_t \varepsilon_t')A'$, where the matrix A models the contemporaneous interaction between the endogenous variables. The VAR with orthonormal structural shocks is expressed as

$$y_t = (I - B(L)L)^{-1}A\varepsilon_t \tag{A.2}$$

In order to identify the structural shocks via the matrix A a Cholesky factorization on the variance-covariance matrix Ω_t is implemented, such that a lower triangular matrix Z where $ZZ' = \Omega_\mathrm{t}$. This indicates that $u_t = Z\eta_t$ with $E(\eta_t\eta_t') = I$. The following VAR representation is analogous to a recursive VAR

$$y_t = (I - B(L)L)^{-1}Z\eta_t \tag{A.3}$$

However, the vector of orthogonal shocks, η_t, may not contain theoretically consistent shocks because Z is not a valid candidate for A because the Cholesky factorization does not guarantee the sign restrictions in Table 1 are satisfied. In order to recover the A matrix, a $N \times N$ matrix, Q, is drawn, where Q is an orthonormal matrix such that $Q(\theta)'Q(\theta) = Q(\theta)Q(\theta)' = I$.

$$Q(\theta) = \left\{\begin{array}{cc|c} \cos(\theta) & -\sin(\theta) & \\ & & 0_4 \\ \sin(\theta) & \cos(\theta) & \\ \hline \multicolumn{2}{c|}{0_4} & I_4 \end{array}\right\} \tag{A.4}$$

where $0 < \theta < \pi$. Using the rotation matrix $Q(\theta)$ the structural VAR is expressed as

$$y_t = \big(I - B(L)(L)\big)^{-1}ZQ(\theta)'Q(\theta)\eta_t \tag{A.5}$$

where, for suitably chosen θ satisfying the sign restrictions, it is possible to define $A \equiv ZQ(\theta)'$ and $\varepsilon_t \equiv Q(\theta)\eta_t$ such that $u_t = ZQ(\theta)'Q(\theta)\eta_t$. The rotation angle θ is defined as $\theta = tan^{-1}(Z^{1,2}/Z^{1,1})$ and $Z^{i,j}$ denotes the (i,j) element of the candidate impact matrix Z. The shocks are estimated simultananeously.[22] With multiple sign restrictions the shocks are orthogonal by construction.

Following Uhlig (2005), this paper relies upon the use of a penalty function to extract responses consistent with the theoretical priors.

$$f(x) = \begin{cases} x & if\ x \leq 0 \\ 100x & if\ x \geq 0 \end{cases} \quad \text{(A.6)}$$

The penalty function is the sum across the constrained shocks of where, for a given constraint, x is the rescaled (and sign flipped, if the constraint requires positivity) response for that variable and horizon. The second line penalizes (strongly) responses that have the wrong sign, while the first rewards (weakly) those that have the correct sign.

A. Identifying a Term Spread Shock in a Zero Interest Rate Environment

Following Baumeister and Benati (2013) the model here attempts to pin down the effects of the Federal Reserve's unconventional monetary policy by identification of a pure term spread shock that is dependent on a non-Fed funds rate response. A pure spread shock in a constant short-term interest rate environment is estimated by imposing a 'zero' restriction on the fed funds rate. This is achieved by zeroing out all the coefficients in the structural VAR's monetary policy rule. Define $\widetilde{D}_{0,t} \equiv A_t, \widetilde{D}_{1,t} \equiv A_t B_{1,t}, \ldots, \widetilde{D}_{p,t} \equiv A_t B_{p,t}$ and partition $\widetilde{D}_{0,t}, \widetilde{D}_{1,t}, \ldots, \widetilde{D}_{p,t}$ as

$$\widetilde{D}_{0,t} = \begin{bmatrix} \widetilde{D}_{0,t}^{R} \\ \hline \widetilde{D}_{0,t}^{\sim R} \end{bmatrix}, \widetilde{D}_{1,t} = \begin{bmatrix} \widetilde{D}_{1,t}^{R} \\ \hline \widetilde{D}_{1,t}^{\sim R} \end{bmatrix}, \ldots, \widetilde{D}_{p,t} = \begin{bmatrix} \widetilde{D}_{p,t}^{R} \\ \hline \widetilde{D}_{p,t}^{\sim R} \end{bmatrix} \quad \text{(A.7)}$$

Leaving the short-term rate unchanged after the impact period is achieved by zeroing out the relevant elements of the matrices $\widetilde{D}_{0,t}, \widetilde{D}_{1,t}, \ldots, \widetilde{D}_{p,t}$

$$D_{0,t}^{*} = \begin{bmatrix} D_{0,t,11}^{R} \quad 0_{1\times(N-1)} \\ \hline D_{0,t}^{\sim R} \end{bmatrix}, D_{1,t}^{*} = \begin{bmatrix} 0_{1\times N} \\ \hline D_{1,t}^{\sim R} \end{bmatrix}, \ldots, D_{p,t}^{*} = \begin{bmatrix} 0_{1\times N} \\ \hline D_{p,t}^{\sim R} \end{bmatrix} \quad \text{(A.8)}$$

Where $\widetilde{D}_{0,t,11}^{R}$ is the (1,1) element of $\widetilde{B}_0$ at time t. The dynamics of the system after the initial impact is then described by the reduced-form VAR implied by $\widetilde{D}_{0,t}^{*}, \widetilde{D}_{1,t}^{*}, \ldots, \widetilde{D}_{4,t}^{*}$. From the fifth quarter onward the impact of the conventional monetary rule takes hold. The dynamics are driven by $\widetilde{D}_{1,t}, \ldots, \widetilde{D}_{p,t}$ rather than $D_{0,t}^{*}, D_{1,t}^{*}, \ldots, D_{p,t}^{*}$.

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[22] If the procedure is run separately with the different sign restrictions there would be nothing preventing the shocks from being correlated and, depending upon the restrictions used, there may be nothing preventing them from being the same.

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