Global Liquidity Transmission to Emerging Market Economies, and Their Policy Responses

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Global Liquidity Transmission to Emerging Market Economies, and Their Policy Responses

This paper analyzes the transmission of global liquidity from advanced economies to EMEs. We distill global liquidity (GL) momenta from the macro-financial data of advanced economies through a factor model. Using a panel factor-augmented VAR analysis, we then delve into EMEs’ responses to shocks to each of three types of global liquidity momenta—policy-driven liquidity, market-driven liquidity, and risk averseness. Each GL shock significantly affects EMEs on the real and external fronts. Counterfactual analyses suggest that policy rates are effective in stabilizing the real front, whereas appropriate adjustments in foreign reserves could be conducive to stabilizing the external front.

Keywords: Global liquidity, Policy responses, Panel Factor-Augmented VAR

JEL Classification: F32, F42
I. Introduction

In efforts to ensure international financial system stability and the robust recovery of growth since the global financial crisis (GFC), growing attention is being paid to the role of global liquidity (GL). Changes in global financial conditions have had increasingly larger impacts on not only domestic financial markets but also real economies as global financial markets become more integrated.

Global liquidity has become an integral concept in cross-border monetary transmission. Studies in this area have focused on particular economic variables such as interest rates (Frankel, Schmukler, and Serven, 2002; Edwards, 2010; Kim and Yang, 2009; Giovanni and Shambaugh, 2008; and Valente, 2009), asset prices (Rigobon and Sack, 2004; Bluedorn and Bowdler, 2011; Ehrmann and Fratzcher, 2009; Ammer, Vega, and Wongswan, 2010; and Wongswan, 2009), and inflation (Berger and Harjes, 2009). The policy actions undertaken by the U.S. Federal Reserve (the Fed) after the onset of the GFC are instrumental to gauge the impacts of U.S. monetary policy on emerging-market economies (EMEs) (Glick and Leduc, 2012; and Bauer and Neely, 2014). Compared to existing studies we broaden the scope of cross-border transmission by looking at a wider set of monetary and financial variables as well as real variables to examine the shore and core fronts of EMEs in the face of global liquidity waves.

The ample global liquidity generated by quantitative easing in advanced economies is observed to have flowed into EMEs (see IMF 2010; and Bernanke 2013). The waves of global liquidity have had both positive and negative effects on EMEs. The expanded global liquidity has stimulating effects on output and stock prices in EMEs at the receiving end. Such benign influences, however, are offset by the risks of overheated asset markets and heightened currency appreciation pressures. Against this backdrop, this study investigates how GL affects macroeconomic variables, financial variables, and policies in EMEs.

Global liquidity has multifaceted momenta, since liquidity is generated by both policy and financial markets. These momenta evolve in accordance with market developments such as financial integration, which strengthens the cross-border stream of global liquidity, and financial innovations that intensify the role of endogenous or market-driven liquidity.
Identifying the key drivers of global liquidity is crucial for examining the cross-border spillover effects of global liquidity from a global economy perspective. In this paper, we decompose global liquidity into a policy-driven exogenous momentum, and endogenous market-driven and risk momenta (see Figure 1). We then investigate the impacts on EMEs of GL momenta and seek the policy implications of GL utilizing counterfactual analysis.

Extensive research has been conducted to address a range of issues related to global liquidity—such as its definition and measures, the main drivers of its cycles, its impacts on financial markets and real economy, and its policy implications. D’Agostino and Surico (2007) introduce global liquidity measured by the simple mean of broad money growth in the G7 economies into the prediction of U.S. inflation, and find that, at horizons longer than two years, forecasts based upon global liquidity are more accurate than the alternatives.\textsuperscript{1) } Kim (2001) finds from a vector autoregressive (VAR) model comprising the aggregates of G-6 countries that U.S. expansionary monetary policy delivers booms to the rest of the world through the channel of the world real interest rate. Choi and Lee (2010) also find that ad-

\textsuperscript{1) Darius and Radde (2010) measure GL by adding the international reserves of G-7 countries to the U.S. monetary base and analyze the impacts of GL on asset prices in individual countries. Their findings suggest that GL has a limited impact on domestic housing prices.}
Advanced countries’ expansionary monetary policies persistently boost output growth and inflation in Asian EMEs. The IMF (2010) offers an overview on the matter and evaluates policy options for responding against the surge of capital inflows into capital-receiving economies. Kim (2001) and Choi and Lee (2010) use price measures of the monetary conditions of advanced economies. Recently, Bruno and Shin (2013) have suggested aggregate cross-border lending through the banking sector, i.e. non-core liabilities, as a GL measure. Nonetheless, estimating global liquidity with a single measure, regardless of whether price or quantity, has limitations. Chen et al. (2012) retrieve demand and supply shocks from price and quantity measures of GL, and analyze their impacts on GDP growth in the receiving countries. More recently, Eickmeier, Gambacorta, and Hofmann (2013) have used a factor model to retrieve GL factors from a large set of data including price and quantity measures, and identified them as global monetary policy, global credit demand, and global credit supply.

While it is broadly similar to Eickmeier, Gambacorta, and Hofmann (2013) in drawing out multiple components of global liquidity, our approach has three innovative features. First, we identify the triangular momenta of global liquidity from financial data of the G-5 countries—the U.S., France, Germany, Japan, and the U.K.—rather than by incorporating both advanced and emerging-market economies. We assume that global liquidity comprises three momenta: policy-driven liquidity, market-driven liquidity and risk averseness. Policy-driven liquidity is affected by discretionary policy actions of monetary authorities; and market-driven liquidity is generated within the financial systems of advanced economies and transmitted across borders in the spirit of Bruno and Shin (2013). Risk averseness reflects market participants’ collective willingness to take financial risks including those of price uncertainty and of counterparty solvency. Second, we systematically investigate the impacts of GL momenta on EMEs. We apply a VAR model to data from EMEs, adding GL momenta derived from advanced economies as the exogenous variables. Third, we conduct a counterfactual analysis to explore whether EMEs’ policy decisions on their policy rates and adjustments in foreign reserves leave room for improvement in coping with global liquidity shocks. We evaluate alternative policy mixes by certain metrics based upon their dynamic impacts on key
variables on the real and external fronts.

Our approach enables us to identify distinctive global liquidity shocks and the corresponding reactions of EMEs. To derive the three liquidity momenta, we select nine financial variables in each of the G5 countries, and then apply sign restrictions to characterize the principal components of the total 45 variables as economically meaningful factors. Minimal sign restrictions are imposed to identify these factors: for example, the policy-driven factor is set to decrease the overnight call rate and to increase the monetary base. We then extend the widely-used factor-augmented vector autoregressive (FAVAR) model to incorporate the panel data of 19 EMEs for 1995Q1-2013Q3. This model includes the three factors as exogenous variables.

EMEs’ policy responses to GL shocks are derived from the impulse response analysis based upon the estimated panel FAVAR model. In response to positive GL shocks driven by G5 policies or their financial markets, EMEs appear to reduce policy rates and increase foreign reserves, thus mainly curtailing the shocks’ impacts on their external fronts rather than on their real economies. EMEs’ policy-makers are found to respond more eagerly to policy-driven shocks, which are driven by indicative changes in the policy stance of advanced economies, rather than to market-driven shocks. These shocks give rise to capital inflows into EMEs and currency appreciation pressures, which are absorbed partially through policy rate cuts and foreign reserve accumulation. In response to a heightened risk averseness which accompanies capital outflows, EMEs furnish foreign-currency liquidity (by running down their foreign reserves) and promptly raise policy rates to retain foreign capital.

The remainder of the paper is structured as follows. Section II presents the FAVAR model, and Section III estimates global liquidity momenta from a factor model. Section IV discusses the results of two estimated models, the Core and Shore models. Section V examines alternative policy scenarios for counterfactual analysis. Section VI concludes.
II. Empirical Modeling of Global Liquidity Transmission

To measure the dynamic impacts of the global liquidity momenta originating from advanced economies on key macro-financial variables in EMEs, we adopt a panel FAVAR model by extending the panel VAR models widely used in the literature to study cross-border GL transmission (Kim, 2001; Canova, 2005; Berger and Harjes, 2009; Darius and Radde, 2010; and Chen et al., 2012).

Existing studies have employed global liquidity metrics differing in coverage (country groups; and banking sector vs. overall financial system) and in scope (price vs. quantity measures; and direct vs. indirect measures) to serve their individual research purposes. To evaluate the transmission into EMEs of global liquidity originating from advanced economies, we use both price and quantity data accounting for unconventional monetary policy at the zero lower bound.

To measure GL, recent studies have begun to adopt indirect measures drawn from factor models or VAR models. The need for aggregating large sets of data emerges, because no clear measure suggested by the theoretical work and relevant data are of global coverage. Factor models excel in dealing with large sets of data, which are of low quality or high heterogeneity. Eickmeier, Gambacorta and Hofmann (2013) use a factor model to derive three components of GL while Chen et al. (2012) employ a dynamic factor model to measure the costs of noncore funding, both studies using sign restrictions to identify different GL shocks.

Our empirical modeling of the transmission of global liquidity entails two stages. In the first stage, we derive GL momenta from a static factor model. We employ data from advanced economies in deriving the momenta, an approach consistent with the notion that the liquidity situations of advanced economies are governed by common factors, and also supported by the fact that advanced economies have relatively higher mutual liquidity exposures. In the second stage, we estimate the impacts of the GL momenta on EME macro-financial variables adding the GL momenta as exogenous variables to a VAR model of EMEs. This two-stage approach enables us to use variable sets suitable for the analysis of EMEs’ responses to GL, separately from the variable set used for identifying the GL momenta, and to take advantage of the parsimony of the panel FAVAR system.
In the first stage, we retrieve the global liquidity momenta from a static factor model, employing principal components analysis:

\[ X_t = \Lambda F_t + u_t, \quad (1) \]

where \( X_t \) and \( F_t \) are vectors of financial variables of advanced economies and a three-element vector of global liquidity respectively. Parameter matrix \( \Lambda \) contains factor loadings that relate the global liquidity factors to the financial variables. Vector \( u_t \) comprises the idiosyncratic components from each variable that are not correlated with the global liquidity factors. It has a mean of zero and covariance \( \Psi \).

In the second stage, we add the momenta \( (F_t) \) as exogenous variables to a panel VAR model of EMEs’ variables \( (Y_t) \), incorporating the dynamic factor model of Stock and Watson (2005) into a panel VAR framework. For identification, the common factors \( (F_t) \) are assumed to be independent of individual shocks to EMEs, \( e_t \), in the following VAR model:

\[ Y_t = \sum_{i=1}^{k} A_i Y_{t-i} + \sum_{i=1}^{l} B_i F_{t-i+1} + e_t, \quad (2) \]

\[ F_t = \sum_{i=1}^{m} C_i F_{t-i} + v_t. \quad (3) \]

This model is similar to that in Bernanke, Boivin, and Eliasz (2005), in that factors retrieved from a large set of economic variables are employed in a factor-augmented VAR model (FAVAR). Bernanke, Boivin, and Eliasz (2005) used factors as conditioning information in measuring the impacts of monetary policy shocks on output and prices. In their study, the augmented factors work as proxies for otherwise missing variables, helping resolve the well-known empirical anomaly that monetary tightening leads to inflation—the so-called price puzzle.

2) Alternatively, one can place the GL momenta at the end in recursive identification, as is done by Darius and Radde (2010). This, however, would require a specification by which the endogenous variables interact among themselves. Since such a specification would complicate the matter, while contributing little to the relevant questions of this study, we instead keep our model agnostic on the matter.
In this study, we identify the motivating factors that determine global liquidity. One factor is identified as the monetary policy stance measure of major countries, and the other two factors pertain to liquidity provisions through global financial markets. We hence follow the spirit of Bernanke et al. (2005) in reducing the dimension of the conditioning variables. In addition, our factor-based approach allows us to incorporate into a single framework both the conventional and alternative measures of monetary policy to reflect the fact that major central banks which were constrained by interest-rate lower bounds after the GFC, adopted balance-sheet operations.

### Ⅲ. Driving Global Liquidity Momenta

The factor model uses quarterly data for 1990Q1-2013Q3 from the G5: the U.S., the U.K., France, Germany, and Japan. For each country nine variables—overnight call rates, government bill rates, real exchange rates, lending-rate spread against overnight call rates or policy rates, the monetary base, private domestic credit, international claims, stock prices, and stock market volatility—are used in deriving factors. These variables capture the financial situations of the G5 countries driven by their policy authorities and market participants.

Financial data are processed in three steps. In the first step, following Stock and Watson (2005), outliers are replaced by the medians of previous observations.\(^3\) The second step is filtering out the trend components of the time series. Given that interest rates of advanced economies have displayed a downward trend, a particular level of interest rates, 4 percent for example, may have signaled monetary loosening in the early 1990s but not in the 2000s,\(^4\) and we thus apply the

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3) Outliers are removed since their information content is largely outweighed by the loss of robustness caused by their existence. In this study an observation with a distance more than three times the interquartile range from the median is tagged as an outlier, and replaced by the median of its six previous observations.

4) This trend may partly be attributable to financial innovation. As a supply shock to liquidity provision, it may have induced an expansion in credit and a decline in interest rates, a point made by Chen et al. (2012). Variables other than interest rates are not hampered by such an issue.
Hodrick-Prescott filter to interest rates. The final step is then purging macroeconomic elements in the financial data to single out those that are unwarranted based on domestic fundamentals. Since the liquidity condition should be evaluated against macroeconomic situations, we regress the financial data on GDP growth and producer-price inflation, and then take the residuals from the regressions as the processed data. This is consistent with the literature on monetary transmission such as Romer and Romer (2004). Each variable is weighted by GDP volume, to take into account the differences in size among the G5 economies (see Figure 2).

Figure 2: G5 Key Data

Notes: The thick blue lines show the weighted average of the underlying data from the G5. Each set of data is purged by the macroeconomic series of the corresponding country and then standardized.

5) This step is also taken to render the time series stationary. Alternatively, the original time series might be differenced to obtain stationary series. Considering the global downward trend of interest rates since the 1980s, we use the filtering method to preserve the information contents of the original series.
Table 1: Sign Restrictions on Factor Loading

<table>
<thead>
<tr>
<th>Policy rates</th>
<th>M0</th>
<th>Private Domestic Credit</th>
<th>Lending Rate Spread</th>
<th>T-bill Rate</th>
<th>Stock Price</th>
<th>Stock Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy-driven Liquidity</td>
<td>▼</td>
<td>▲</td>
<td>▲</td>
<td>▼</td>
<td></td>
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</tr>
<tr>
<td>Market-driven Liquidity</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk Averseness</td>
<td></td>
<td>▼</td>
<td></td>
<td>▲</td>
<td></td>
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</tbody>
</table>

Notes: Sign restrictions are applied in pinning down $\Lambda$ in Equation (1). An upward arrow means that a high level of the GL momentum in that row raises the level of the financial variable in that column.

Moments are estimated by the principal component method. We select three principal components as per the criteria of Ahn and Horenstein (2013). Moreover, we believe that these three factors, which explain 49 percent of the variability of the underlying data, sufficiently represent the global liquidity momenta.

The sign restriction approach allows us to postulate causality between the factors and observed variables. Table 1 summarizes the restrictions used in this study: the three momenta—policy-driven liquidity, market-driven liquidity and risk averseness—are assumed to cause the observed variables. Policy-driven liquidity is attributed to the monetary policymakers, while market-driven liquidity is more or less determined by the traditional banking sector. Lastly, the risk averseness momentum aims to measure the risk appetite of investors. Here we use minimal re-

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6) A widely used approach in determining the number of factors, suggested by Bai and Ng (2002), renders five or six as the number of factors close to the upper limit set by that approach. Breitung and Eickmeier (2005), however, argue that Bai and Ng (2002)’s criteria may not be robust. The approach by Bai and Ng (2002) is prone to reporting local factors as well as global factors since multiple data series are used for each country. In contrast, the test based upon eigenvalues proposed by Ahn and Horenstein (2013) seems free from such an issue.

7) Policy-driven liquidity explains 15%, market-driven liquidity 19%, and risk averseness 15% of advanced economies’ variables.

8) Sign restriction is initially attempted in structural VAR models to identify shocks. For a survey of this application, see Fry and Pagan (2011).
restrictions for identification, given the advantages relative to the use of additional restrictions. Employing many restrictions may help identify factors with a high degree of precision, but the outcome is not robust since a single wrong condition may exclude a true solution. With no consensus on valid restrictions having yet been reached in the literature, we opt for robustness.

The identification method of the momenta is in line with the tradition of empirical macroeconomics. The main contribution of the structural vector autoregression lies in the identification of the shock. Once all the relevant information on the shock is concentrated into the covariance matrix of the residuals, what remains to be done is identification through theoretical links between the observed variables and the latent shock. This is the same thing that we do with equation (1). The only difference is that the $X_t$’s do not need to be controlled by their autoregressive components since they are fast-moving financial variables.

To extract policy-driven liquidity, both the price and quantity variables largely associated with aggregate liquidity are assumed to reflect the policy stances of advanced economies. Specifically, lower policy rates are associated with expansions in policy-driven liquidity. A more subtle restriction with respect to the lending-rate spread is based upon the observation that, prior to the exercise of unconventional monetary policy, an expansion in policy-driven liquidity tends to widen that spread by reducing the funding cost of commercial banks through short-term instruments including overnight loans. The monetary base, largely set by monetary authorities, moves along with policy-driven liquidity, and has become to play a prominent role with unconventional monetary policy.

For market-driven liquidity, the main action involves domestic credit because the endogenous generation of liquidity within the banking system tends to foster credit advances to borrowers. An increase in private credit also boosts the stock market. In contrast, the heightened awareness of risk makes banks refrain from lending and tends to increase stock market volatility. Given the set of principal components, there are many possible choices of factors even under a specific set of

9) The validity of these restrictions remains intact even since the federal funds rate was set at 0–25 bps from December 2008, as the bank prime loan rate in the US has remained unchanged at 3.24 percent since January 2009.
sign restrictions. Among these possible candidates we choose the one closest to the median of the candidates, as suggested by Fry and Pagan (2011).

Figure 3 shows the three momenta constructed from the above process. Notably, after the recessions of the advanced economies in the early 2000s, policy-driven liquidity expanded rapidly until the Fed hiked its policy rate from 1 percent in mid-2004 to 5.25 percent in June 2006. The tightening cycle is registered as a decreasing trend in policy-driven liquidity in the first panel. During the tightening cycle, market-generated liquidity continued to expand to its peak in early-2007. Meanwhile, the risk averseness of market participants declined. The confluence of these three liquidity momenta suggests an overall easing in global liquid-

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**Figure 3: Global Liquidity Momenta**

![Graphs showing global liquidity momenta](image)

**Notes:** Three momenta are derived from principal component analysis and identified by the sign restrictions in Table 1. All momenta are standardized. The blue-solid lines depict the medians of all candidates as the corresponding momenta, and the shaded areas represent all candidate factors that pass the sign restrictions. The three red-dashed lines indicate the onset of the 1991 recession, the bust of the dot.com bubble, and the global financial crisis.
ity for prolonged years in the run-up to the global financial crisis. This observation implies that the debacle of the global financial crisis had the catalyzing effects of elevated policy rates and sudden deteriorations in market-driven liquidity, coupled with heightened risk averseness. The resulting sudden declines in GL were countered by the rapid rebound and expansion of policy-driven liquidity from end-2008—consistent with the policy actions undertaken by central banks in advanced economies, especially the U.S. Fed, upon the global financial crisis.

IV. Assessing Transmission to EMEs

The three momenta derived from the observed financial data of advanced economies, denoted by $F_t$, are fed into the dynamics of EMEs’ macro-financial variables as specified equations (2) and (3). The econometric model comprising these equations for the EME panel is estimated by an equation-by-equation least squares method.

4.1 Connecting Global Liquidity Momenta to EMEs

The panel comprises 19 EMEs, and nine variables are used in two sets of estimations for 1995Q1-2013Q3. The nine variables are real GDP growth, CPI inflation, stock price growth, nominal effective exchange rate (NEER) growth, current account balance (as percent of GDP), overnight call rates, M2 growth, capital inflows (as percent of GDP), and percentage changes in foreign reserves at a quarterly frequency. The lag structure of the model is determined by the information criterion of Hannan and Quinn (1979).

For the impulse-response analysis, we apply a shock of one-standard deviation of each of the three GL momenta and trace the responses of each EME variable.

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10) The 19 EMEs comprise Argentina, Brazil, Chile, Bulgaria, the Czech Republic, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Romania, Russia, South Africa, Thailand, and Turkey.

11) Equation (2) has five lags of autoregressive variables and one lag of exogenous factors, and equation (3) has one autoregressive lag.
The error bands of the responses are constructed using the conventional Bayesian Monte Carlo integration method.\(^{12}\)

We consider two models, hereafter referred to as the Core and Shore models. The Core model incorporates macroeconomic variables such as real GDP growth, CPI inflation, stock price growth, NEER growth, and the current account balance, focusing on the transmission of global liquidity into the macro variables of EMEs. The Shore model focuses on the policy responses of EMEs in the form of adjustments in policy rates and foreign reserves.

### 4.2 Estimating Macroeconomic Responses of EMEs

Figure 4 depicts the impulse responses of the Core model. Each column displays the response of EMEs to a shock to one of the three GL momenta. The size of the shock is the one-standard deviation of the residuals from equation (3), which is at about the 86th percentile of the shock distribution. For the case of policy-driven GL, the years that saw shocks higher than a one-standard deviation are 1993, 2003, 2008, 2009, and 2011. The years 1993 and 2003 coincided with U.S. monetary loosening, and the period after the global financial crisis roughly matches the Fed’s balance sheet expansion.

A positive policy-driven GL shock (the first column) accompanies capital inflows and brings about a boosting effect in EMEs by increasing output growth by 0.7 percentage points at its peak. During the first year after the shock we see an increase in stock price growth by 8 percentage points at its peak and local currency (NEER) appreciation by 1 percentage point at its peak.\(^{13}\) The resulting local currency appreciations and stimulated local demand exert downward pressures on current account balances. Inflation declines in EMEs because the downward inflationary pressures from the pass-through effect of currency appreciation predominate over the upward inflationary pressures stemming from domestic liquidity expansions on

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\(^{13}\) This result is consistent with Sun and Psalida (2011)’s finding that global liquidity, measured by the M2 aggregates of G4 countries, spills over to EMEs through increased inflows to equity, thus raising their equity returns.
the demand side.

The second column of the figure shows the EME responses to a positive market-driven GL shock. This shock could be generated for example by the banking system, if foreign bank branches extend credit to local companies and residents more readily due to more lenient lending standards following policy changes by their head offices in advanced economies. The market-driven liquidity shock also calls for cur-

Figure 4: Macroeconomic Responses of EMEs to GL Shocks

<table>
<thead>
<tr>
<th>EM/Factors</th>
<th>Policy-driven Liquidity</th>
<th>Market-driven Liquidity</th>
<th>Risk Averseness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
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<td>CPI</td>
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<tr>
<td>Stock Prices</td>
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<td>Exchange Rates</td>
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<tr>
<td>Current Account</td>
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</table>

Notes: Real GDP and CPI, respectively, denote real GDP growth and CPI inflation, both annualized. (a) This figure shows the responses of key macro-financial variables to a positive, one-standard-deviation shock to each of the GL momenta. In particular, the size of each GL shock at the onset of the global financial crisis (2008Q3 or 2008Q4) amounts to 4.4, 3.8 and 1.5 standard-deviations of policy-driven, market-driven, and risk averseness GL momenta, respectively. (b) Each cell is the impulse response of the corresponding variable in the row, given the shock to the corresponding liquidity momentum in the column. (c) The shaded areas mark the bands between 16% and 84%, constructed by the Bayesian Monte Carlo integration method.
Currency appreciations and boosts output growth and stock markets in EMEs. Compared to the policy-driven liquidity shock, however, it has much smaller impacts on the growth of output, stock price, and exchange rates—with peak responses ranging from one-fifth to one-half in size. Inflation rises rather persistently, with the effect of stimulated demand outweighing the exchange rate pass-through effect.

Finally, heightened risk averseness has an almost opposite outcome: it weakens EMEs’ growth, stock markets, and local currencies. This finding can be explained by capital outflows and in some situations sudden stops of capital flows. The current accounts of EMEs improve with a brief lag after the shock, possibly owing to weakening domestic absorption and to gains in price competitiveness caused by exchange rate depreciations.

Chen et al. (2012) report a similar result with respect to growth. Although it is not fully articulated, their reported figures suggest that a ‘noncore’ GL demand shock has a negative impact on EME growth but that a noncore GL supply shock has a positive impact, consistent with our findings.14) Their noncore GL demand shock corresponds to a positive shock to risk averseness in this study, and their supply shock to a market-driven or policy-driven liquidity shock. The latter match is not one-to-one, since we divide the supply of GL by its source, either policy or the markets.

Previous studies are in line with our finding that global liquidity expansions boost output and inflation in the recipient EMEs but show some differences in their effects on current account balances.15) Choi and Lee (2010) find that global monetary easing increases output growth and inflation in Asian countries, consistent with our study. In contrast to our finding of a negative effect of GL on EME current accounts, however, they find the global monetary easing before the GFC to

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14) Chen et al. (2012) retrieve demand and supply shocks of noncore GL. They define noncore liquidity as total nonresident deposits in commercial banks and other deposit corporations, plus loans and securities of commercial banks, nonbanks and other financial intermediaries.

15) Bernanke (2013) provides a view on two challenges for EMEs in the face of monetary expansions in advanced economies. First, the appreciations of EME currencies driven by the accommodative monetary policies of advanced economies do not necessarily weaken EMEs’ exports, since the increased demand in advanced economies largely offsets the effect of currency appreciation. Second, heavy and volatile capital inflows to EMEs from advanced economies are not only caused by the latter group’s monetary expansions but also influenced by the growth prospects of receiving countries and investor risk sentiment.
widen the savings-investment gap (current account relative to output) in Asian EMEs, because investment growth is lower (with foreign reserve accumulations) than output growth while the savings-output ratio is largely unaffected.\(^{16}\)

Kim (2001) finds that U.S. monetary expansions have positive impacts on growth and inflation and an initial negative impact, followed by positive effects with lags, on trade balances in G6 countries. We find that EMEs experience negative impacts on their current account balances from the monetary expansions in advanced economies, but the negative impacts remain significant for 20 quarters after the shock. The prolonged impact on EME’s current account balances might be attributable to the relaxed perennial funding shortage of domestic buyers as well as to reduced competitiveness following local currency appreciations.\(^{17}\)

A key distinction between policy- and market-driven liquidity involves whether these shocks cause price inflation in the receiving EMEs. Policy-driven liquidity reduces inflation in the short run while market-driven liquidity has an opposite effect. This observation can be explained in part by the initial appreciations of local currency in response to policy-driven liquidity inflows. Such a prompt response of foreign exchange markets is consistent with brisk market reactions to policy actions undertaken by major central banks. In contrast, policymakers may perceive a shock to market-driven liquidity as a demand shock, and respond indirectly to pressures on domestic liquidity and inflation.

As shown in the figure, liquidity inflows from the global financial markets help EMEs boost their growth and financial markets at the cost of macro-financial stability, which depends upon the policy responses of EMEs to be examined below.

\(^{16}\) Choi and Lee (2010)’s finding may reflect the fact that Asian EMEs experience high demand for their exports (spending sprees) from advanced economies, and that this demand may in turn crowd out local consumption, which was one reason for the increasing current account surpluses in Asian EMEs before the GFC.

\(^{17}\) The monetary transmission that renders EMEs’ borrowing costs cheaper can dominate the external demand from advanced economies, resulting in lingering negative impacts on current account balances in EMEs. Kim (2001) argues that the transmission channel through real interest rates is more critical than the trade channel.
4.3 Estimating Policy Responses of EMEs

We consider the second VAR model to investigate the policy responses of EMEs to GL shocks. As shown in Figure 5, both policy- and market-driven GL shocks accompany increases in capital flows, thereby driving up local currency values, and fueling domestic money growth after a short lag. Conversely, heightened risk averseness calls for largely opposite effects except for domestic money growth. Policy authorities use policy rates and/or foreign reserves to counteract the impacts of GL momenta on their economies.

In response to a policy-driven liquidity shock, EME policy authorities lower policy rates and absorb the incoming liquidity as part of their foreign reserves.\(^{18}\) Despite these policy efforts, local currencies appreciate while stock markets experience a boom attributable to the expansion of foreigners’ equity holdings. M2 growth increases with lower policy rates and/or incomplete sterilization.

EMEs appear to accommodate the overall monetary policy stance of advanced economies. The reconciliation of EMEs’ policy stance with those of advanced economies reflects trade linkages and financial integration. First, if policy decisions of the advanced economies are associated with global business cycles, small open economies closely linked to the global markets through trade channels should assimilate major economies in terms of their policies. Second, most EMEs do not exercise the full autonomy of monetary policy despite their de jure flexible regimes and capital account openness.\(^{19}\) Small open economies may attempt to temper the exchange rate volatility heightened by GL shocks—depending on their policy space dictated by the availability of foreign reserves.

The responses of EME policy toward a market-driven GL shock are less clear. This may reflect that the market-driven GL shock does not have clear timing, magnitude, and scope—unlike a policy-driven GL shock which is usually accompanied

\(^{18}\) Sun and Psalida (2011) find that receiving countries accumulate foreign reserves and bring about a decline in their real interest rates in response to incoming global liquidity.

\(^{19}\) Frankel, Schmukler, and Serven (2002) find that in the 1990s U.S. interest rates were fully transmitted to the rest of world including countries under a flexible regime. Edwards (2010) finds that Latin American countries adjust to changes in the U.S. monetary stance more rapidly than Asian countries, citing capital mobility as a cause.
by public policy announcements on a real-time basis. Without a clear signal, individual EMEs are prone to take a market-driven GL shock as an idiosyncratic incident rather than a shock common to all around the globe. For individual EMEs, the shock may be manifested in the form of increased foreign investment inflows or increased liquidity in the foreign exchange markets. In the face of diverse and possible idiosyncratic shocks, EMEs adjust their policies accordingly.

**Figure 5: Policy Responses of EMEs to GL shocks**

<table>
<thead>
<tr>
<th>EMU Factors</th>
<th>Policy-driven Liquidity</th>
<th>Market-driven Liquidity</th>
<th>Risk Averseness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overnight Call Rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Inflows</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Reserves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exchange Rates</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (a) This figure shows responses of policy and financial variables to a positive, one-standard-deviation shock to each of GL moments. In particular, the size of each GL shock at the onset of the global financial crisis (2008Q4) amounts to 4.4, 3.8 and 1.5 standard-deviations of the policy-driven, market-driven, and risk averseness GL moments, respectively. (b) Each cell is the impulse response of the corresponding variable in the row, given the shock to the corresponding liquidity momentum in the column. (c) Shaded areas mark the band between 16% and 84%, which is constructed by the Bayesian Monte Carlo integration method.
sibly unprecedented movements of liquidity flows, therefore, they may deploy conventional policy measures but not so strongly or persistently as in the case of policy-driven liquidity. EME authorities increase foreign reserves to stabilize foreign exchange markets against a surge in foreign funds inflows; and raise policy rates in response to elevated market pressures on inflation.

A shock to risk averseness draws clear policy responses from EMEs in attempts to dampen its impact. EMEs are likely to raise their policy rates and also release foreign reserves to counteract foreign investment outflows upon heightened risk averseness—an adverse shock to global investors’ sentiment such as a flight to safety.\(^{20}\) M2 growth displays a hump-shape response. The persistent increases in M2 growth reflect domestic liquidity injections to offset the adverse impact of reserve drains (partly through sterilized intervention) as well as flight to safety in domestic financial markets amid elevated market uncertainty.

V. Counterfactual Policy Analysis

This section examines counterfactual scenarios of alternative policy mixes by EMEs based on a model with eight endogenous macro-financial variables, along with the three GL momenta. Most variables from the Core and Shore models other than M2 are included in the model of counterfactual analysis.\(^{21}\) The impulse responses of individual variables are very similar to those from the Core and Shore models. The methodology of this counterfactual analysis is described in Appendix B.

We investigate the impact of counterfactual responses in policy measures—overnight call rates and foreign reserves—on the key variables. Figure 6 shows the responses to a policy-driven GL shock (black lines). In the benchmark scenario that is

---

20) EMEs’ decisions on policy rates could differ depending on their economic fundamentals and policy space. As experienced with the QE tantrum in 2013, some EME countries raised their policy rates in the face of a risk of capital outflows, while others did not.

21) The counterfactual method limits the number of solvable variables to the dimension of exogenous shock. We choose to solve exchange rates, capital flows and stock prices. The rationale for this choice is that the impact on M2 is largely determined by these three variables, and policy rates and foreign reserves, especially when the shock comes from abroad. Policy rates and foreign reserves are set as a part of policy experiments. See Appendix B for details.
based on empirical policy reactions, EMEs’ policymakers respond to the shock by lowering their policy rates and increasing foreign reserves during the first year. In the benchmark scenario, we saw positive output swings, capital inflows accompanying currency appreciations, and lower inflation.

Now we attempt to derive key variable responses under alternative policy scenarios, which involve a different response of policy rates or foreign reserves to a GL shock. With the different policy reactions, EMEs will have different contemporaneous reactions in terms of their fast-moving variables such as exchange rates and stock prices; and the vector autoregressive mechanism dictates the subsequent response afterwards.

Alternative scenarios for policy rates are set so that, given the benchmark level of foreign reserve responses, the policy rate is chosen to stabilize the real front (Core) or external front (Shore) of the economy. Likewise, alternative scenarios in the deployment of foreign reserves are set. We measure the performance of policy choices by the square root of the sum of squared deviations from the steady-state level of target variables—real GDP growth and CPI inflation for Core, and exchange rates and capital inflows for Shore. The performance measure is normalized by the standard deviation of historical data of the target variables.

Figure 6 suggests that, in the face of policy-driven GL shocks, Core-oriented policy based on policy rate adjustments is conducive to macroeconomic stability; and Shore-oriented policy based on foreign reserve adjustments is somewhat conducive to external-sector stability. Core-oriented policy based on policy rate adjustments (red-dashed lines in the left column)—policy rate hikes in an effort to stabilize the real front in response to the policy-driven GL shock—will dampen positive responses in output growth. This policy choice, however, tends to entail higher inflation with a lag, perhaps attributable to a higher perceived-debt-service burden.\(^ {22} \) Monetary tightening weakens the domestic economy and the stock market, rendering equity investment less attractive to foreign investors. Higher interest

\(^{22}\) The outcome on CPI inflation seems to be related to the well-known “price puzzle.” The puzzle may take place due to known causes such as an incomplete information set or inaccurate measure of the monetary policy stance. We complement these two with an EME-specific cause: inflation expectations generated by a higher debt service burden stemming from higher interest rates. Alternatively, the fiscal theory of price level rationalizes this finding. We offer a supporting analysis in Appendix C.
Figure 6: Counterfactual Analysis: EME Policy against a Policy-driven GL Shock

Notes: Real GDP and CPI, respectively, denote real GDP growth and CPI inflation, both annualized. The first column shows counterfactual responses when monetary policy is conducted through call rate changes in response to a policy-driven GL shock by in order to stabilize the real front (Core) or to stabilize the external front (Shore). The red-dashed line represents the Core-oriented policy choice, and the blue-dotted line represents the Shore-oriented policy choice. The second column depicts the counterfactual effects of alternative degrees of policy responses using foreign reserve changes.
rates hinder the domestic absorption, reducing current account deficits or the funding needs of the economy. These two forces seem to dominate additional inflows in domestic bond markets with higher yields, resulting in reduced overall capital inflows.

However, Shore-oriented policy with lower policy rates (blue-dotted lines in the left column) is not so effective in reducing either exchange-rate or capital-flow volatility but stimulates further output growth and reduces inflation as well with a lower perceived debt-service burden, detracting from macroeconomic stability.

Next, adjusting foreign reserves can be effective in tempering only exchange rate volatility on the external front and inflation volatility on the real front (right column, Figure 6). Shore-oriented policy with foreign reserve adjustments, which entails absorbing incoming liquidity through foreign reserve accumulation, helps ameliorate currency appreciation at the cost of higher inflation. A more active accumulation of foreign reserves induces greater capital inflows than the benchmark case, while rendering output growth remain intact and tempering downward inflation pressures through exchange rate pass-through effects. The rationale for this policy can be found in Shore-oriented goals. Core-oriented policy using foreign reserves is effective in stabilizing inflation—to the extent that it countervails exchange rate pass-through effects on inflation—but not output growth. For a market-driven liquidity shock, we have very similar findings to the case of a policy-driven liquidity shock.²³)

The above exercise is confined to (counterfactual) adjustments in just one of the two policy measures. Since we consider two policy measures with two policy mandates, an exhaustive analysis on policy mixes may reveal possible trade-offs between the two policy measures. Table 2 summarizes the impacts of each policy adjustment in terms of macroeconomic and external-sector volatility performance. For macroeconomic stability (Core-oriented policy), the best choice among nine combinations would be a tighter monetary stance and stronger adjustment in for-

²³) For policy rates, the outcome is more or less the same. For foreign reserves, the Core-oriented policy calls for adjustments in foreign reserves to strengthen the currency value in an effort to temper inflationary pressure. Still this Core-oriented policy using foreign reserves does not have any significant impact on real GDP growth.
eign reserves than the benchmark case—reaching the cell of (16, 18). For
ternal-sector stability (Shore-oriented policy), a better choice would be the bench-
mark monetary stance and a stronger adjustment in foreign reserves than the
benchmark case—reaching the cell of (51, 14). Using policy rates to stabilize the
Core sector and foreign reserves to stabilize the Shore sector offers an improve-
ment over the benchmark. A notable lesson from this exercise is that policy rates
could be better used in stabilizing the real front rather than the external front. We
see the underperforming outcomes on the real front when policy rates are ad-
justed to reduce external-sector volatility (last column, Table 2).

Figure 7 suggests that, in the face of risk averseness GL shocks, Core-oriented
policy using policy rates is conducive to macroeconomic stability; and Shore-or-
ented policy based on foreign reserve adjustments is conducive to external-sector
stability. Core-oriented policy rate adjustments (left column) show that easing the
monetary stance ameliorates a slowdown in growth over time and helps reduce in-
flation in the short run (perhaps owing to dampened inflation expectations with a
lower debt-service burden). This milder slowdown in growth is translated into larg-
er current account deficits and reduced outflows of foreign funds.

Table 2: Counterfactual Analysis: Policy Mix Performance against a
Policy-driven GL Shock

<table>
<thead>
<tr>
<th>Foreign Reserves</th>
<th>Policy rates</th>
<th>Core-oriented (122 bps raise)</th>
<th>Benchmark (5 bps cut)</th>
<th>Shore-oriented (6 bps cut)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core-oriented</td>
<td>17, 56</td>
<td>45,43</td>
<td>81,44</td>
<td></td>
</tr>
<tr>
<td>(98 bps increase)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benchmark</td>
<td></td>
<td>21,90</td>
<td>51,80</td>
<td>82,78</td>
</tr>
<tr>
<td>(73 bps increase)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shore-oriented</td>
<td></td>
<td>16,18</td>
<td>51,14</td>
<td>85,26</td>
</tr>
<tr>
<td>(123 bps increase)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This table reports the volatility performance of policy-rate and foreign-reserve mix in
response to the shock of policy-driven global liquidity. The first value in each cell stands for
the real-front performance of the policy mix based on the macroeconomic indicators of
output growth and inflation. The second value represents the external-front performance of the
policy mix based on the external indicators of exchange rates and capital inflows. These numbers are percentiles from the kernel distribution derived from
nine observations of each policy mix. A lower number stands for less volatility in the
target variables.
Figure 7: Counterfactual Analysis: EME Policy against a Risk-Averseness GL Shock

Notes: This figure shows the result of counterfactual analysis of a risk averseness GL shock with different adjustment in the two policy measures. The red-dashed line represents the Core-oriented policy choice, and the blue-dotted line represents the Shore-oriented policy choice. See the notes to Figure 6 for details.
Table 3: Counterfactual Analysis: EME Policy Mix against a Risk-Averseness GL Shock

<table>
<thead>
<tr>
<th>Foreign Reserves</th>
<th>Policy rate</th>
<th>Core-oriented (69bps cut)</th>
<th>Benchmark (2bps cut)</th>
<th>Shore-oriented (100bps raise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core-oriented (103 bps decrease)</td>
<td>11,75</td>
<td>36,82</td>
<td>80,92</td>
<td></td>
</tr>
<tr>
<td>Benchmark (35 bps decrease)</td>
<td>31,51</td>
<td>54,43</td>
<td>86,36</td>
<td></td>
</tr>
<tr>
<td>Shore-oriented (58 bps decrease)</td>
<td>23,22</td>
<td>46,15</td>
<td>83,34</td>
<td></td>
</tr>
</tbody>
</table>

Notes: This table reports the volatility performance of mixes of two policy measures, policy rates and foreign reserves, against a one-standard-deviation shock of risk averseness. See the notes to Table 2.

Under core-oriented policy, lower policy rates shoring up stock markets help foreign funds stay in them. Conversely, Shore-oriented policy rate adjustments—calling for interest rate hikes at the cost of increased volatility on the real front—have some limited impact on exchange rate responses but little impact on capital flow responses on the external front. Using foreign reserve adjustments (right column), Shore-oriented policy is especially effective in reducing exchange rate volatility, while Core-oriented policy helps moderate inflation but is not conducive to stabilizing the external front.

The performance of each policy mix against a risk averseness GL shock is shown in Table 3. Interest rate hikes in a bid to retain foreign funds lead to an improvement on the external front at the cost of a deterioration on the real front. Deploying foreign reserves ameliorates macroeconomic volatility at the cost of external volatility. Better choices than the benchmark case could involve moderately greater deployment of foreign reserves, along with no tightening of the monetary stance—reaching the cell of (23, 22) or (46, 15). The worst policy mix among the nine combinations is interest rate hikes combined with aggressive deployment of foreign reserves, which ends up hampering stability on both the real and external fronts.

Upon heightened risk averseness, interest rate hikes tend to worsen substantially macroeconomic stability, which is likely to outweigh the possible gains in
external-sector stability (last column, Table 3). The direct channel through which policy rates affect exchange rates and capital flows seems to work for external-sector stability but with significant fallout on the real front. The deployment of foreign reserves, if there is enough policy space, could support an improvement over the benchmark case for stability on the real and external fronts.

The results in Tables 2 and 3 suggest a trade-off between macroeconomic stability and external stability. An appropriate deployment of foreign reserves can help EMEs enhance external stability. EMEs’ policymakers appear to choose the benchmark case that sacrifices somewhat macroeconomic stability for external stability, as opposed to Core-oriented policy for macroeconomic stability at some cost to external stability. This may reflect that exercising the alternative policy mix is unwarranted partly because it is costly to sustain reserve accumulation, which crowds out domestic investment (Reinhart and Tashiro, 2013).

VI. Conclusions

This study delves into the cross-border transmission of global liquidity by identifying different global liquidity momenta and linking them to reactions of EMEs. Using various financial series of advanced economies, we distill global liquidity into three momenta; and incorporate them into a panel FAVAR model to investigate their effects through cross-border transmission on EMEs' economies and policy responses. Since it has become a challenge to apply major countries’ policy rates that are close to the zero lower bound during the Great Recession as driving factors, we complement them with other financial and monetary series.

Like structural VAR models which take the covariance matrix of residuals and produce a shock structure through various identification schemes including sign restrictions, this study has identified factors with economic interpretations employing a minimum set of restrictions.

Our empirical findings provide a clearer picture of how global liquidity generated from advanced economies embarks an impact on EMEs. We find that the additional provision of external liquidity to EMEs through either a policy- or market-driven GL shock boosts EMEs in the short run and causes local currencies to
appreciate. Heightened risk averseness pulls foreign liquidity out of EMEs, weakening local currencies and slowing down activities in them.

We also identify the pros and cons of each policy mix which comprises adjustments in both policy rates and foreign reserves for macroeconomic stability and external-sector stability in the face of the ebbs and flows of GL. Assuming that GL momenta are exogenous to EMEs, the counterfactual analysis offers plausible alternative reactions of EMEs. Our findings suggest that EMEs could use policy rates for stabilizing the real front and deploy foreign reserves for stabilizing the external front. Also, our findings on trade-offs among policy mixes suggest that there is no silver bullet in policy mixes to fend off the impact of GL shocks. In a situation under which both policy measures have to be deployed for just one of the two policy goals, the other policy goal is found to be severely compromised while the less effective policy measure has only a limited impact on the primary policy goal. For example, raising interest rates to curb withdrawals of foreign liquidity due to a sudden change in investor’s risk perception may help mitigate pressures on the foreign exchange markets, but higher interest rates reduce aggregate demand and hamper the real economy.
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A. Macro-Financial Data Used in Estimation

The underlying data to retrieve global liquidity momenta are financial data of the U.S., the U.K., Japan, Germany, and France. The price measures of liquidity are overnight call rates, Treasury bill rates, real interest rates measured by overnight call rates subtracted by CPI inflation rates, the lending rate spread (lending rate minus overnight call rate), stock prices, and the volatility of stock prices. The quantity measures of liquidity are the monetary base, private domestic credit, and international claims. The data cover the period from the first quarter of year 1991 to the third quarter of 2013. For the macro-financial series of EMEs, the growth rate from the same quarter of the previous year is used for the following data: private domestic credit, international claims, stock prices, and the monetary base. Overnight call rates, Treasury bill rates, and real interest rates are filtered to remove downward trends.

The data sources of advanced economies are as follows: overnight call rates are from the IFS, Bank of Japan, and Bloomberg; lending rates, government bond rates, domestic credit, and stock prices from the IFS; international claims from BIS; stock price volatility is calculated from the daily stock indices of Bloomberg; real GDP, CPI, and PPI from the IFS; and the monetary base from the IFS, DataStream, Bank of England, and Bank of Japan.

The data sources of EMEs are as follows: real GDP from DataStream; the CPI from CEIC; stock prices from Bloomberg and DataStream; nominal effective exchange rates from BIS; current account balance and foreign reserves from the IFS; overnight call rates and M2 from the IFS and DataStream; capital flows are sums of inbound direct investments, inbound portfolio investments and inbound other investments, which are obtained from the IFS.

B. Method of Counterfactual Analysis

In this study, we consider the relationship between endogenous variables and shocks at the point in time when the shocks arrive. We attempt to recover the relationship by means of the pseudo-inverse from the estimated coefficients on the exogenous variables or factors. Since the relationship does not have sufficient in-
formation to identify the responses, we employ the additional assumption that real GDP growth, CPI inflation, and current account balance (as percent of GDP) do not respond contemporaneously to incoming shocks at a quarterly frequency.

When a global liquidity shock $v_0$ hits the economy, EMEs’ responses are determined by equations (2) and (3), which are reproduced with $t=0$:

\begin{align}
Y_0 &= B_1 F_0, \\
F_0 &= v_0.
\end{align}

Now consider the pseudo-inverse matrix of $B_1$, denoted by $\Phi_1$:

$$\Phi_1 B_1 = I.$$ 

Pre-multiplying both sides of equation (A1) by $\Phi_1$,

$$\Phi_1 Y_0^* = F_0.$$ 

Equation (A3) is now a set of equations given $\Phi_1$ and $F_0$ with unknown $Y_0^*$, which is the outcome used in counterfactual analysis. Since there are 8 unknowns and 3 equations, five additional constraints are necessary to obtain a solution. We assume that the initial responses of real GDP growth, CPI inflation, and the current account balance are zero and set the values of policy variables, policy rates and foreign reserves, according to counterfactual scenarios. With these additional constraints, we solve for the three remaining endogenous variables: stock price growth, exchange rate growth, and capital inflows (as percent of GDP).

The number of solvable variables is limited by the dimension of exogenous shocks, the rank of $\Phi_1$. For this technical reason, we choose the most essential three variables out of four candidates in figuring out the effect of policy adjustments to a global liquidity shock. Our choice is based upon the notion that M2 growth can be largely determined by policy variables and the three variables solved from the constraints.

To obtain impulse responses under a counterfactual scenario, we define $J_t$ as:
Here we apply the determined lag structure, that is, $l = m = 1$. It is clear that $J_0 = Y_0^*$. Some calculation yields the following results for $t \geq 1$:

\[ Y_t^* = \sum_{i=1}^{k} A_i Y_{t-1}^* + J_t, \]  

(A4)

\[ J_t = C_1 J_{t-1}. \]  

(A5)

Iterating equations (A4) and (A5) with respect to $Y_t^*$ and $J_t$ produces the impulse responses of key variables under counterfactual scenarios. Note that $C_1$ is a scalar.

The crucial step of this exercise is retrieving the relationship among endogenous variables in response to the shock. We assume that such relationships are incorporated in parameter $B_t$.

The counterfactual exercises here are valid if the structure of economies at the receiving end of global liquidity shocks remains intact upon such policy changes. If the policy changes are transitory or largely unexpected, the expectations of agents may not drastically adjust, a point made by Bernanke, Gertler, and Watson (2004).

C. Price Responses to a Policy Rate Shock

This section lends support for the argument that the price puzzle observed in the whole sample is mainly attributable to the characteristics of fragile EMEs. As shown in Figure A.1, a policy rate hike sparks inflation in fragile EMEs while it instantaneously weakens prices in resilient EMEs. One explanation for this observation is that the perceived debt-service burden increasing with higher interest rates gives rise to inflation expectations in indebted economies, which is rationalized by some EMEs’ history of monetizing debt.

Not only higher interest payments but also lower prospective growth following an interest rate hike is translated into a heavier real debt burden in the future. Taking these into account, rational households are forward-looking in forming inflationary expectations, especially if a country’s fundamentals such as fiscal and current account balances are vulnerable to adverse shocks.
Figure A.1: Impacts of Policy Rate Shocks: Fragile vs. Resilient EME Groups

Notes: This figure shows the impact of a one-standard-deviation shock on economic variables for 1995Q1-2013Q3. Fragile countries are Argentina, Brazil, Chile, Hungary, India, Indonesia, Russia, South Africa, and Turkey; and resilient countries are the rest of the sample countries. The results reported here are based on the Cholesky ordering of variables for shock identifications: real GDP growth, CPI inflation, current account (as percent of GDP), capital inflows (as percent of GDP), exchange rate growth, stock price growth, foreign reserves (percent increase on a year earlier), and overnight call rates. The key finding that a policy rate hike raises inflation in fragile EMEs remains intact by reasonable changes in the order of variables.
본 연구는 선진국으로부터 신흥국으로의 글로벌 유동성 파급 메커니즘을 분석하였다. **Factor** 모형을 이용하여 선진국의 다양한 거시금융 지표로부터 세 가지 글로벌 유동성 요인 - 정책요인, 시장요인, 위험회피 요인 - 을 식별한 후, 요인부가 패널 자기회귀분석을 이용하여 각 글로벌 유동성 충격에 대한 신흥국 경제의 반응을 추정하였다.

추정 결과, 정책요인과 시장요인에 의한 글로벌 유동성 증가 충격에 대해 신흥국은 실물경제 및 주식시장 부양, 자본유입 증대, 환율장상 및 경상수지 축소 등 대체로 유사한 반응을 보였다. 다만 정책요인 유동성 충격의 경우, 환율, 주가 및 경기에 미치는 영향이 상대적으로 강하며 환율장상의 전가효과로 인플레이션도 낮아지는 모습을 보였다. 위험회피 충격은 글로벌 유동성의 감소를 통해 신흥국의 경기 둔화, 자본유출 및 환율절하를 유발하였으며, 신흥국은 자본유출 압력을 완화하기 위해 정책금리를 인상하여 대응하는 것으로 나타났다.

글로벌 유동성 충격에 대응한 신흥국의 적절한 정책대응을 살펴보기 위해 가상 시나리오 분석을 시행한 결과, 신흥국은 실물경제의 안정을 위해서는 금리정책으로, 대외부문의 안정을 위해서는 외환보호를 신중적으로 활용하면서 대응하는 것이 보다 효과적으로 나타났다.

본 연구의 결과는 글로벌 유동성 변동에 대응하여, 신흥국 정책당국은 각 글로벌 유동성 충격의 성격과 함께 정책대응 여력, 정책 전략의 목표를 고려하여 자국여건에 맞는 정책조합을 모색함으로써 실물 및 대외 부문의 전반적 안정성을 개선할 수 있음을 시사한다.