Divergent EME Responses to Global and Domestic Monetary Policy Shocks

Woon Gyu Choi*, Byongju Lee,
Taesu Kang***, Geun-Young Kim******

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* Senior Economist, IMF Institute, E-mail: wchoi@imf.org.

** Economist, Economic Research Institute, The Bank of Korea, Tel: +82-2-759-5435, E-mail: brian.lee@bok.or.kr.

*** Senior Economist, Research Department, The Bank of Korea, Tel: +82-2-759-4208, E-mail: tskang@bok.or.kr.

**** Head, Research Department, The Bank of Korea, Tel: +82-2-759-5280, E-mail: kgy3104@bok.or.kr.

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Divergent EME Responses to Global and Domestic Monetary Policy Shocks

We assess the effect of tighter monetary policy in the U.S. and emerging market economies (EMEs) on EMEs using a panel factor-augmented VAR model. We find that a U.S. policy rate hike outstrips an equivalent domestic rate hike in its impacts on EMEs. In addition, EMEs show divergent policy responses and their macro-financial responses differ depending upon their economic fundamentals in the face of tighter U.S. policy. In particular, we find that high-inflation than low-inflation EMEs are more susceptible to the shock stemming from a U.S. federal funds rate hike.

Keywords: Global liquidity, Monetary transmission, Divergent responses, Panel factor-augmented VAR

JEL Classification: F32, F42

I. Introduction

The macroeconomic landscape of emerging market economies (EMEs) could be shaped by global business cycles, global liquidity cycles, domestic business cycles, and domestic liquidity cycles. This paper attempts to analyze the influence of global and domestic liquidity cycles, focusing on how U.S. and domestic policy rates affect macroeconomic outcomes and capital inflows in EMEs.

We analyze how growth and inflation in EMEs react to a U.S. federal funds rate hike. Considering that the U.S. policy rate had stayed at the zero lower bound for a significant period after the Global Financial Crisis (GFC), we utilize a factor model to measure the policy stance even with the policy rate at its zero lower bound and derive three liquidity momenta associated with global financial cycles. The derivation and characteristics of these series are covered in Choi, Kang, Kim, and Lee (2014), which identifies the three global liquidity momenta from a VAR with sign restrictions based on macro-financial variables of advanced economies, including the U.S. federal funds rate and monetary base. We apply a factor-augmented vector autoregressive (FAVAR) model to EME panel data.

This approach allows U.S. to control the other elements of global liquidity cycles and idiosyncratic characteristics of each EME. We look into the effects on growth, inflation, capital inflows, stock prices, exchange rates, current account, domestic policy rates and foreign reserves. The empirical approach is also employed to gauge the effects of domestic policy tightening in EMEs.

Capital flows into EMEs are an important transmission channel of global liquidity cycles, as examined by Rey (2015); Broner, Didier, Erce and Schmulker (2013); Alberola, Erce and Serena (2016); Kim and Shin (2015); and Morgan (2011). We analyze four components of capital inflows: bond investments, equity investments, foreign direct investments and other investments.

The second part of this paper explores how divergent EMEs' sensitivities to global liquidity cycles are associated with their economic fundamentals. Previous studies have looked into differences in region, industrial structure or

exchange rate regime to figure out the source of divergent impacts. We group data points of the panel by the level of the relevant variables, such as inflation, real GDP growth, current account or foreign reserves. Then, we evaluate the welfare loss of each group from U.S. monetary tightening and determine the fundamental that most strongly influences the welfare outcome in the event of an external shock. In addition, we carry out a counterfactual exercise to determine whether there exist any welfare gains if the EMEs with vulnerable fundamentals took the domestic shock-absorbing structures of their relatively robust counterparts.

Our three key findings are as follows. First, a U.S. interest rate hike outstrips a domestic interest rate hike on its impacts on EMEs. In particular, a one-percent increase of the federal funds rate reduces the GDP growth of EMEs by a half percent cumulatively for three years, while a one-percent increase in the domestic policy rate of EMEs on average slows down their economies by 0.16 percent. Second, All components of capital inflows to EMEs shrink in response to the U.S. policy rate hike, but only bond investments by foreigners respond significantly to EMEs' own policy rate hike. Third, high-inflation EMEs are more susceptible than low-inflation EMEs in terms of growth and inflation to tighter global liquidity. High-inflation EMEs can achieve some welfare gains if they adopt a domestic economic structure conducive to inflation stability.

The rest of the paper is organized as follows. Section II presents the FAVAR model used in this paper, and Section III illustrates the effects of U.S. and domestic monetary tightening. Section IV investigates the sources of fragility of EMEs, and Section V concludes.

II. Empirical Model

This section briefly explains the empirical model used in this study. The model is introduced in the companion paper, Choi et al. (2014), which offers the characteristics of the model in detail. We assume that there are three global liquidity momenta (F_t), namely, policy-driven liquidity momentum, market-driven

liquidity momentum and risk averseness momentum.

The three global liquidity momenta are retrieved from financial data (X_t) of the G5 (the United States, Germany, France, Japan and the United Kingdom) using a factor model with sign restrictions. For example, policy-driven liquidity momentum is set to increase the U.S. monetary base. The underlying financial time series used in retrieving factors are policy rates, domestic credit, international claims, lending rate spreads, government bond yields, monetary base, real interest rates, stock prices, and stock volatility.

$$X_t = \Lambda F_t + u_t \quad (1)$$

The above equation shows that underlying data X_t are explained by factors F_t and their idiosyncratic disturbances (u_t), of which the covariance is Ψ .

Factors F_t are assumed to be exogenous to EMEs in explaining macroeconomic and financial situation Y_t as expressed in (2). Note that the factors have contemporaneous effects on EMEs.

$$Y_t = \sum_{i=1}^k A_i Y_{t-i} + \sum_{i=1}^l B_i F_{t-i+1} + \varepsilon_t \quad (2)$$

$$F_t = \sum_{i=1}^m C_i F_{t-i} + \nu_t \quad (3)$$

The macroeconomic and financial situation of an EME is described by several variables in Y_t : real GDP growth, inflation in consumer price index (CPI), current account balance, stock prices, nominal effective exchange rate, and capital inflows. Two policy variables, overnight call rates and foreign reserves, are also included. The countries in the EME panel are Argentina, Brazil, Bulgaria, Chile, Czech Republic, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Philippines, Poland, Romania, Russia, South Africa, Thailand, and Turkey.

The sample period runs from the second quarter of 1995 to the third quarter of 2014. Real GDP, CPI, capital inflows, foreign reserves and current account are seasonally adjusted and the trend component of the overnight call

rate is removed by the Hodrick-Prescott filter. Real GDP, inflation, exchange rates and stock prices are measured in the quarter-over-quarter growth rate, and capital inflows, current account and foreign reserves are measured as percentages of the 5-year average of annualized nominal GDP. Components of capital inflows are processed in the same fashion as capital inflows. The sample period goes from the second quarter of 1995 to the third quarter of 2014. Two lags are used for the endogenous variables, and the contemporaneous factor and one-period-lag factor are included in Equation (2). To recover the shock process (ν_t) in global liquidity momenta, an autoregressive structure with lag order one in equation (2) and (3) is chosen on the basis of the Hannan and Quinn (1979) information criterion.

An increase in the U.S. federal funds rate is applied in vector X_t and this in turn feeds into F_t . The accompanying changes in F_t embark the dynamic process of EMEs' domestic economies, which is expressed in equation (2). For the first step, we assume multivariate normality of X_t and F_t , as follows:

$$\begin{pmatrix} X_t \\ F_t \end{pmatrix} = N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \Lambda \Lambda' + \Psi & \Lambda \\ \Lambda' & I \end{pmatrix} \right]. \quad (4)$$

The conditional distribution X_t given F_t is also given by

$$F_t | X_t \sim N \left[\Lambda' (\Lambda \Lambda' + \Psi)^{-1} X_t, I - \Lambda' (\Lambda \Lambda' + \Psi)^{-1} \Lambda \right]. \quad (5)$$

Hence, given the value of X_t , the expected shock is

$$E(F_t | X_t) = \Lambda' (\Lambda \Lambda' + \Psi)^{-1} X_t. \quad (6)$$

While it is not unlikely that a change in the U.S. policy rate would accompany changes in the market-driven factor and risk averseness factor, we concentrate on the effect of the policy-driven factor extracted from global liquidity. Technically, this approach entails measuring a change in the policy-driven liquidity factor while the other two remain fixed. Using the well-known formula of conditional expectations under the assumption of multivariate normal distribution, we obtained the expected value of the policy-driven factor given

the other two factors.

We consider two scenarios of adjustment in X_t . The first scenario supposes a one-percentage-point hike in the federal funds rate, and the second scenario entails a one-percentage-point increase in the U.S. real interest rate in addition to the federal funds rate increase. The second scenario reflects the slow response of U.S. inflation to monetary tightening, as observed in Romer and Romer (2004) and Christiano, Eichenbaum and Evans (1999). The first scenario brings about a shock tantamount to 58 percent of the standard deviation of the policy-driven factor; and the shock of the second scenario corresponds to 87 percent of the standard deviation. We take the second scenario, which incorporates both the real interest rate rise and policy rate hike, as the baseline.

Since we drive factors from the financial and monetary data of five advanced countries, including the U.S., any combination of changes in underlying variables X_t is at our disposal for scenario exercises. We deliberately turn off concomitant changes from other advanced countries in consideration of the growing divergence in macroeconomic situations and corresponding monetary stances among leading advanced countries. We nonetheless keep the normal transmission of U.S. monetary policy to the U.S. price level intact after the GFC. In particular, we do not take into account any inflation pressures stemming from structural drifts (for example, perpetual shifts in productivity growth and demography) that would ultimately alter real interest rates.

III. EME Responses to U.S. and Domestic Monetary Tightening

1. Reactions in growth, inflation and policy

The immediate impact of global liquidity withdrawal is a reversal in net capital flows, which includes a suspension or reversal in capital inflows. Our finding in the first row of Figure 1 confirms this front line impact and accompanying repercussions on exchange rates and stock prices. As the supply of liquidity from foreign sources shrinks in the domestic financial markets, it

Figure 1: EME Responses to a U.S. Federal Funds Rate Hike

Notes: Above are shown EME responses in percentage points (up to 20 quarters) to a one-percentage-point increase in the U.S. federal funds rate and concomitant changes in the U.S. real interest rate. The shaded areas mark the confidence bands between 16% and 84%, constructed by the Bayesian Monte Carlo integration method.

directly decreases aggregate demand as evidenced by weak output and sluggish CPI inflation. The weak GDP growth and low inflation we find here are in contrast with earlier work by Canova (2005) in which Latin American countries are found to experience an increase in GDP within a year after the shock and immediate inflation. He extracts the U.S. macroeconomic and monetary shocks from a VAR model and feeds them into a VAR model of individual Latin American countries. He rationalizes this outcome by means of simultaneous increases of interest rates in Latin American countries, which boost capital inflows. IMF (2013) is a recent study that analyzes the impact of the U.S. monetary shock on other countries. Although its approach to measuring the U.S. policy shock on the output of other countries differs from ours in several aspects, such as the selection of shock-receiving countries (EME vs EME and AD

countries), the measure of output (real GDP vs. industrial production), and data frequency (quarterly vs monthly), we find that its results are largely consistent with ours.

As shown in the third row of Figure 1, domestic authorities' responses with respect to their policy rates and foreign reserves are limited. The response of policy rates—about a 5 bps rise for a 1 percent hike in the U.S. policy rate—is lukewarm and weaker than what is seen in other studies, such as Frankel et al. (2004) and Edwards (2010, 2015). Frankel et al. suggests a full transmission of U.S. interest rates to the rest of world, especially to those countries under fixed exchange rate regimes in the 1990s. In a similar vein, the following studies seek to identify how much countries adjust interest rates in response to changes in the U.S. monetary policy stance. Valente (2009) finds that discretionary policy actions by the FOMC have smaller influences on interest rates in Hong Kong and Singapore than policy changes based upon macroeconomic fundamentals do. Edwards (2010) finds rapid adjustments in Latin American countries but slow adjustments in Asian countries to changes in the U.S. monetary stance, arguing that such differential adjustments are attributable to capital mobility. Kim and Yang (2009) find that Asian countries under flexible regimes significantly adjust their interest rates in response to U.S. monetary policy changes, but their exchange rate responses are muted. They attribute this finding to fear of floating. On the other hand, Lubik and Schorfheide (2006) based upon an estimated DSGE model report a limited transmission of U.S. monetary shocks to Europe. We will revisit this issue when discussing differentiation among EMEs.

We use data beyond the GFC, while most studies on monetary spillovers focus on periods prior to the GFC when the U.S. federal funds rate was not constrained by its zero lower bound. Two developments may have resulted in the low contagion of monetary policy from the U.S. to EMEs. The foremost cause is, of course, the federal funds rate at its zero lower bound. Although the U.S. policy rate stayed at this level for seven years, most EMEs reacted to the waves of global liquidity stemming from the vigorous unconventional monetary policy of the U.S. Federal Reserve. Second, most existing studies on monetary

contagion take the U.S. as the epicenter and largely abstract out the contribution of other advanced countries, while other advanced countries also have contributed to the supply of GL. The synchronization in the supply of global liquidity among advanced countries that was witnessed prior to the GFC is at odd with recent divergences in monetary policy among advanced economies. Our work takes a conservative position in that only the contribution of the U.S. in the supply of global liquidity is put into the exercise while the secondary global liquidity generated from other advanced countries is turned off.

A recent study by Edwards (2015) finds relatively strong spillovers of U.S. monetary policy to emerging markets in Asia and Latin America—33 to 74 bps increases of policy rates in EMEs. He uses data from the 2000-2008 period, during which U.S. monetary tightening was more attributable to U.S. inflation rather than the global business cycle. U.S. policy after the GFC, however, seems to have been concerned about the slow recoveries in domestic output and jobs, and the relatively fast recoveries in EMEs after the crisis may have loosened the cross-border link of monetary stances between the U.S. and emerging markets.¹⁾ Dées et al. (2010) find moderate policy spillovers from the U.S. to 33 sample countries; the median spillover is 2 bps against a U.S. policy rate hike of 22 bps.

The present empirical model also measures the effect of domestic policy rates in EMEs. The main difficulty in assessing the effect of domestic monetary policy in EMEs is controlling for monetary and financial shocks from advanced countries. The three global liquidity momenta play the role of control variables. However, we must accept that the empirical model lacks a link between EMEs and global business cycles. We employ recursive restrictions to identify the domestic monetary shock, placing variables in the following order: CPI inflation, real GDP, current account, capital inflows, foreign reserves, overnight call rates, stock prices, and nominal effective exchange rates. We place

1) While Edwards (2015) deals with a long-run policy contagion from the U.S. to some EMEs, our study focuses on the dynamic responses of EMEs to global liquidity shocks driven by G5 monetary policy. For this purpose, we draw changes in the U.S. policy rate, controlling for U.S. real GDP growth and inflation of producer prices. Edwards' estimation focuses on the long-run contagion, employing an error correction model, while we estimate short-term spillover based upon the VAR approach.

Figure 2. EME Responses to a Domestic Policy Rate Hike

Notes: The figure shows EME responses in percentage points to a one-percentage-point increase in the domestic policy rate, along with those responses shown in Figure 1 for comparison. The shaded areas mark the bands between 16% and 84%, constructed by the Bayesian Monte Carlo integration method.

slow-moving real-sector variables ahead of variables reflecting financial flows. We assume that monetary policymakers in EMEs set their policy rates responsively to innovations in real-sector and financial-flow data. Finally, we allow asset prices and nominal effective exchange rates to react to domestic monetary shocks. We find that it is essential to have the aforementioned sequence over the groups of variables—such as real sector, financial flows, policy measures, and asset prices—to obtain reasonable responses, but that any change in sequence within each group has little impact on the results.

Figure 2 depicts impulse responses to a one-percentage-point increase in the domestic policy rate of EMEs, along with the responses to the U.S. policy rate hike for comparison. Domestic monetary tightening calls for initially moderate

capital inflows, which are followed by a lagged reversal, and domestic currency appreciations in two quarters with lower inflation and current account surplus. Stock prices drop initially but quickly rebound. Output growth, inflation, and current account at their peaks have much smaller responses to the domestic policy rate hike than to the U.S. policy rate hike.

Although output growth and current account show similar response patterns across the two exercises, inflation exhibits different responses. Domestic policy tightening brings about a sluggish reaction in prices, consistent with earlier findings on the effect of U.S. monetary shocks on inflation, such as Romer and Romer (2004) and Christiano, Eichenbaum and Evans (1999), whereas U.S. policy tightening entails an immediate fall in inflation in EMEs. These contrasting reactions may be attributable to different patterns in pricing. In the face of global liquidity tightening, importers can more readily adjust their prices taking into account strategic responses of their domestic competitors and foreign suppliers owing to lower global demand. In contrast, domestic liquidity tightening leads to declines in domestic demand, exerting downward pressures on local prices. Another explanation is that global liquidity tightening may exert downward pressures on energy and commodity prices, which are heavily influenced by global demand and largely priced in U.S. dollars, whereas domestic liquidity tightening affects the domestic prices of items with local currency pricing.

The responses of EME output growth and inflation are largely consistent with findings from estimated New Keynesian open economy models, such as Adolfson et al. (2007 and 2008), except for the timing of responses in output growth and inflation. In our study, output immediately declines upon the domestic as well as U.S. monetary tightening, but inflation reacts slowly to the domestic monetary shock. Our finding that output growth responses precede inflation responses is similar to the major studies based on U.S. data (for example, Christiano et al., 1999, 2005).

EMEs are found to absorb a part of incoming investments in their foreign reserves after domestic monetary tightening. This policy move is likely to limit the effect of the policy rate lift to some degree by curbing domestic currency

appreciation. Policymakers may choose this course of intervention to moderate the impacts of hot money flows on inflation in part through sterilized intervention, which results in foreign reserve accumulation and dampened responses in exchange rates. Alberola et al. (2014) in their panel analysis find foreign reserves in EMEs have stabilizing effects on capital inflows during global financial turmoil, reporting a significant cross term of the EMBI+ spread and international reserves that moderates the first-order effect of the spread in reducing capital inflows to EMEs.

2. Effects on components of capital flows

The previous section finds that global liquidity shrinkage causes overall outflows of foreign investments from EMEs. The IMF categorizes capital flows into portfolio investments, direct investments, and other investments. Portfolio investments are divided further into bond investments and equity investments. Using IMF data, we look into whether the withdrawal of global liquidity has diverse effects across different categories of capital inflows to EMEs.

In response to tighter U.S. monetary policy, all the categories of capital inflows show different degrees of substantively weakened inflows (see dotted lines in Figure 3.²) The most significant change in capital flows takes place in foreigners' investments in domestic bonds. Equity inflows are only marginally affected by the change in GL. Direct investments by foreigners increase initially but soon reverse to significantly negative figures.

The solid lines of Figure 3 depict how a domestic policy rate hike affects foreigners' investments in EMEs. Tighter domestic policy on average has smaller impacts on capital flows than U.S. tighter policy does, and its impacts are significant only for bond inflows. This finding suggests that adjusting policy rates in EMEs to handle capital flows could largely be ineffective.

2) Broner et al. (2013) examine the impacts of banking, currency, and debt crises on capital flow components. They find declines in capital inflows during crises across all the components for upper-middle-income and lower-middle-income countries.

Figure 3: EME Responses of Capital Inflows to Global and Domestic Monetary Policy Shocks

Notes: Above are shown capital inflows as a percent of GDP to EMEs (up to 20 quarters) after a one-percentage-point increase in the U.S. federal funds rate (dotted line) and an increase in the domestic policy rate of the same magnitude (solid line). The shaded areas mark the bands between 16% and 84% for the domestic policy rate increase, constructed by the Bayesian Monte Carlo integration method.

IV. Divergent EME Responses to U.S. Monetary Policy Shocks

1. Do EME responses depend on economic fundamentals?

In the previous section, we have found that the withdrawal of global liquidity causes changes in output growth and inflation in EMEs. The welfare consequences of this development may be different across countries, and we now look into what factors are behind this divergence. There are a number of welfare approximations in terms of key macroeconomic variables, basically extending the approximation for a closed economy proposed by Woodford (2003). These approximations are usually called loss functions, which are

deemed as objective functions of policy authorities. For an open economy, Corsetti et al. (2010) derive approximations that apply to two-country models with various sets of economic structure. A standard approximation for a closed economy comprises the output gap and inflation. The approximations for an open economy could be augmented with additional terms such as inflation of imports, terms of trade, deviations from the law of one price or deviations from exchange rates under perfect risk sharing, depending on assumptions about economic structure regarding financial market completeness and import price setting. We consider four variables to measure the welfare consequences of global liquidity withdrawal: real GDP growth, CPI inflation, exchange rate changes, and capital inflows. We include capital inflows in light of escalating concerns about capital flows in open economies and the necessity for capital flow management to gain monetary independence, notably as in Farhi and Werning (2014). We measure the deviation of each variable from the steady state for a three-year period.³⁾

We employ a grouping approach similar to Lustig and Verdelhan (2007).⁴⁾ An alternative method to investigate the link between country characteristics and certain statistical outcomes is regressing the outcomes on country characteristics as in Miniane et al. (2007). A typical approach is running country-level VARs with limited lags and variables, obtaining statistical outcomes, such as impulse responses, and finally regressing the outcomes on the variables of country characteristics. This approach, however, has three drawbacks: (i) observation inaccuracy owing to limited degrees of freedom; (ii) sample uncertainty in the second-stage regression owing to treating the outcome from the first-stage analysis as a direct observation;⁵⁾ and (iii) evolving

3) This method of measuring deviation for a single variable differs somewhat from the typical measurement of the loss function but retains information on the direction of responses and facilitates comparison with other studies.

4) Lustig and Verdelhan (2007) form portfolios from government bonds of sample countries such that each portfolio includes a group of government bonds with similar levels of interest rate, and bonds are dynamically assigned to each portfolio. Thus, the government bonds of a single country may belong to different portfolios over time. The behavior of low- or high-yield currencies can be directly analyzed through portfolios.

5) Miniane et al. (2007) mitigates the second issue by re-sampling the outcome from the distribution derived from the first-stage VAR.

Figure 4: EME Fundamentals and Welfare-relevant Measures after U.S. Monetary Tightening

Notes: Points in each panel depict the relationship between a measure of fundamentals and a measure of the loss function. In each panel, the x-axis stands for the 3-year average of a fundamental variable and the y-axis for the 3-year accumulation of the impulse response after U.S. monetary tightening. All figures are in percentage points, and real GDP growth (RGDP), CPI inflation (CPI), stock price increase (SP) and nominal exchange rate change (NEER) are presented on a quarter-over-quarter basis and not at an annualized rate. Bars above and below dots mark the bands between 16% and 84%.

country characteristics over time. The grouping method we use is free of all of the above issues.

We divide 19 EMEs per period into four groups according to their characteristics prior to the period. For example, we split 19 EMEs into four groups for the first quarter of 2001 according to their average CPI inflation during the period from 1998 to 2000. We do the same partitioning exercise with respect to other fundamentals such as output growth, exchange rate growth, current account balance, foreign reserve ratio, stock price growth, and capital flow ratio. Among the four groups for each indicator, the first group has

the countries with the lowest values in the indicator. We form a panel from each group and apply the panel FAVAR model, finally measuring a loss function value for each group against the global liquidity shock. Figure 4 reports the most informative combinations among the exercises, and Figures A1 and A2 have the exhaustive sets from the exercise.

We find that CPI inflation has discernable welfare consequences with respect to real growth, CPI inflation and exchange rates from the first column of Figure 4. Countries that experienced high inflation for the previous three years are likely to experience more drastic output loss, higher inflation and larger depreciation than their moderately inflationary counterparts. The most inflationary group will experience a severe real depreciation in the event of global liquidity withdrawal while the least inflationary group will experience moderate real appreciation due to the deflationary effect of liquidity loss and stable exchange rates against the shock.

The real GDP growth rates of EMEs in our samples are more evenly distributed than CPI inflation, as observed by the horizontal distance of points in the first and second column of the figure. A similar pattern of effects on real exchange rates is observed in groups partitioned by real growth rates. Countries that have grown faster than other EMEs experience a larger degree of real depreciation, as shown in the second column of the figure. The loss of growth due to U.S. monetary tightening is least severe for the group with the second highest growth performance prior to the arrival of the shock. The nonlinear pattern shown here may suggest that extremely high growth in an emerging market country may build up vulnerability to external risk.

The third column of the figure pertains to capital inflow responses to tighter U.S. monetary policy. Countries that experienced larger capital inflows, significant gains in stock values, and relative strengthening of their currencies prior to the shock are prone to see capital inflow reductions after the shock. Using country-panel regressions, Broner et al. (2013) find evidence of retrenchment in capital inflows during a three-year period following a country-specific shock in lower- and upper-middle-income countries. Our finding here suggests that retrenchment in capital inflows after a U.S. interest

rate hike depends on the magnitude of inflows prior to the shock.⁶⁾

We do not find a clear dependence of capital flow responses to tighter U.S. monetary policy on the level of foreign reserves (see Figure A2 in Appendix). Alberola et al. (2014) find that the magnitude of decrease in capital inflows into EMEs due to global financial stress (measured by the EMBI+ spread) is low for countries with moderate foreign reserves (as fractions of international liabilities) and high for countries with low or high foreign reserves. Policy authorities can build up foreign reserves to temper the country's vulnerability to sudden stops in capital flows. Provided that the level of foreign reserves is partially effective in curbing sudden stops in capital flows, the non-linear pattern as in the aforementioned study is not necessarily inconsistent with the lack of a clear link between foreign reserves and reduced capital inflows due to U.S. policy tightening.

2. Does the level of inflation matter in transmitting policy shocks?

This subsection explores divergent EME responses stemming from cross-border diversity in inflation and their welfare implications. Since the level of CPI inflation offers a clear demarcation of macroeconomic management among EME countries, we divide 19 EMEs into two groups: high-inflation and low-inflation groups.⁷⁾ The high-inflation group has seen a 14 percentage point increase per annum in their price levels during the sample period, while low-inflation group has experienced only 4 percent inflation on average.

Figure 5 shows that high-inflation countries are more susceptible to a

6) The previous inflows of foreign capital are found to affect the magnitude of foreign investment reversal in response to a U.S. interest rate hike but to have little impacts on growth and inflation. This finding is odd with the concern that financial openness may be related to external vulnerability. There are two possible explanations on the matter. First, financial openness is an endogenous outcome of an economy rather than exogenously determined institutions. In an economy that is capable of manage capital inflows while gaining the benefit of them, policymakers are more likely to initiate or accelerate the process of financial liberation. Second, our measure is about the flows of capital rather than stock and the financial openness of a certain country is better proxied by stock of inbound investments.

7) The high-inflation group comprises Argentina, India, Hungary, Mexico, Indonesia, Russia, Romania, Bulgaria, and Turkey. The low-inflation group includes the rest of the sample countries except for Brazil, which is at the mid-point among EMEs in terms of CPI inflation.

Figure 5: Responses of High-inflation and Low-inflation EME Groups to the U.S. Federal Funds Rate Hike

Notes: The figure summarizes the responses of two EME groups after a one-percent-point increase of the U.S. federal funds rate using a panel FAVAR model for each group. The unit of the y-axis is percentage points. The shaded areas mark the confidence bands between 16% and 84% for the low-inflation group, constructed by the Bayesian Monte Carlo integration method.

one-percentage-point hike in the U.S. federal funds rate in terms of capital flows and policy rates, and consequently foreign reserves, output growth, and inflation. The welfare consequences are in part affected by domestic policy responses, especially changes in policy rates. High-inflation EMEs raise their policy rates in response to tighter U.S. monetary policy in an effort to retain capital inflows or prevent capital outflows, consistent with the argument for policy spillovers. Interestingly, the low-inflation EMEs lower their policy rates after an initial rise, which is possibly conducive to shoring up stock prices and boosting aggregate demand. Despite positive responses in domestic policy rates, capital inflows are unfavorable for the high-inflation group.

Table 1: Divergent Impacts of Global and Domestic Monetary Policy Shocks on EME Groups

		All	High Inflation(H)	Low Inflation(L)	Difference(H-L)
Global Liquidity	Real GDP	-0.49	-0.69	-0.26	-0.43
	CPI	-0.02	0.61	-0.01	0.62
	Current Account	0.44	0.67	0.36	0.31
	Exchange Rates	-0.33	-0.42	-0.39	-0.03
	Overnight Call Rates	0.05	0.17	0.06	0.12
	Foreign Reserves	-0.60	-1.82	-0.29	-1.54
Domestic Liquidity	Real GDP	-0.16	-0.17	-0.21	0.04
	CPI	-0.26	-0.13	-0.62	0.49
	Current Account	0.33	0.24	0.74	-0.50
	Exchange Rates	0.15	0.10	0.33	-0.23
	Foreign Reserves	0.46	-0.12	1.88	-2.00

Notes: The table summarizes impulse responses of EMEs to a one-percent-point increase in the U.S. (global) policy rate and in (domestic) policy rates of EMEs. Real GDP and CPI represent cumulative responses of output growth and CPI inflation in percentage points, respectively, to the corresponding shock. Current Account and Foreign Reserves represent cumulative responses of account balance and foreign reserves, respectively, (both as percentages of nominal GDP) for three years to the corresponding shock. Exchange Rate and Overnight Call Rate are measured by the largest response to the corresponding shock during the first 3 years, both being in percentage points.

In terms of output growth and inflation, low-inflation EMEs absorb the shock with a lesser swing than high-inflation EMEs, as summarized in Table 1. Exchange rates and stock prices exhibit little quantitative differences. The real depreciation of the high-inflation group exceeds that of low-inflation group because the former experiences much higher inflation after the first period than the latter does, while they see similar magnitudes of currency depreciation. As a result, the high-inflation group has more room for mercantile advantage over the low-inflation group, thereby reaping higher rises in the current account.

On the basis of the welfare measures we used in the previous exercise, the output loss of the high-inflation group is larger than that of low-inflation group. Upon tighter U.S. monetary policy, the high-inflation group would have more

Figure 6. Counterfactual Exercise of High-inflation EMEs Taking the Shock-absorbing Process of Low-inflation EMEs

Notes: The figure summarizes a counterfactual exercise by which the high-inflation group takes the shock-absorbing process of the low-inflation group in terms of the dynamic structure of lagged endogenous variables. Shaded areas around the solid lines mark the confidence bands between 16% and 84% of the high-inflation group. The unit of the y-axis is percentage points.

diverse price responses with higher inflation than the low-inflation one would, as implied by the perspective of New Keynesian sticky price models. All of the welfare-relevant measures indicate that the high-inflation group fares much worse than the low-inflation group.

3. Counterfactual exercise: mimicking low-inflation economies?

Broadly speaking, the divergent responses of the two EME groups are attributable to EMEs' differential reactions upon the arrival of the shock and their absorbing processes afterwards. What could be the possible causes of such

divergent responses? We attempt to determine whether the distinction comes from the reaction on the immediate responses of EMEs as expressed in the matrix B 's in equation (2), or the shock-absorbing domestic structure as expressed in the matrix A 's.

We employ a method used by Stock and Watson (2003), specifically, replacing the estimate of A in equation (2) of the high-inflation group with the corresponding estimate of the low-inflation group. The counterfactual and original responses of the high-inflation group are collated in Figure 6. The dashed line of each panel shows how the high-inflation group would absorb the shock if they had domestic economic structures resembling those of the low-inflation group. Note that a global liquidity shock may have diverse initial impacts on the two groups, which are implied by the estimate of B in equation (2). Choi et al. (2014) offer a counterfactual exercise to analyze how alternative policy responses to the arrival of the global liquidity shock affect economic outcomes.

As shown in Figure 6, gains to the high-inflation group from mimicking the low-inflation group dynamics are limited to lower capital outflows, foreign reserve drains, and inflation, along with reduced currency depreciation. The absence of gains in buffering output loss against the shock implies that improving immediate policy responses and other forefront responses, for example through beefing up resilience of the financial sector, would be of the first order importance in curbing the loss from the shock.

It is noteworthy that policymakers in high-inflation groups would not change their policy rate reactions much over time even if they were to have the same economic structure as the low-inflation group, as implied by the comparison between Figures 5 and 6. Improvement in inflation responses despite a marginal deterioration in output growth may nonetheless somewhat warrant arguing that the adoption of the domestic economic structure of the low-inflation group would improve the welfare of the high-inflation group if the weight on inflation is high enough in their welfare metrics.⁸⁾

V. Conclusions

This paper investigates the impacts of U.S. and domestic monetary policy on EMEs and attempts to link the driver of divergent responses to fundamentals. U.S. monetary tightening by a one-percentage-point increase in the federal funds rate reduces the output growth of EMEs on average by a half percentage point. Among EME capital markets, bond markets are expected to be most significantly affected by U.S. monetary policy. In addition, EMEs show divergent policy responses and their macro-financial responses differ depending upon their economic fundamentals in the face of tighter U.S. policy. In particular, we find that high-inflation than low-inflation EMEs are more susceptible to the shock stemming from a U.S. federal funds rate hike.

8) Apart from welfare gains from the improved responses of capital inflows and exchange rates, the gain from moderate inflation may outweigh the loss from output growth. Of course, this argument depends on the weights placed on inflation and output gap in the loss function. For an open economy, the relative weights between output gap and inflation are same as those of a closed economy as in Woodford (2003), although inflation in the loss function usually stands for inflation of domestic goods (see Corsetti, 2010). A typical calibration of parameters results in a low weight placed on the output gap. Even if we use a higher weight on the output gap as argued by Debortoli et al. (2015), the counterfactual outcome is still preferable to the original outcome.

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Appendix

Figure A1: Fundamentals of Emerging Markets and Real GDP Growth and CPI inflation after U.S. Monetary Tightening

Notes: The figure depicts the comprehensive set for Figure 4 with respect to real GDP growth and CPI inflation.

Figure A2: Fundamentals of Emerging Markets and Nominal Appreciation and Capital Inflows after U.S. Monetary Tightening

Notes: The figure depicts the comprehensive set for Figure 4 with respect to nominal exchange rate appreciation (NEER) and capital inflows (CF).

<Abstract in Korean>

해외 및 국내 통화정책 충격이 신흥시장국에 미치는 영향

최윤규 *, 이병주 **, 강태수 ***, 김근영 ****

본 연구는 미국 및 신흥 시장국의 긴축적 통화정책이 신흥국 경제에 미치는 영향을 실증모형을 이용하여 분석하였다. 주요 추정결과는 다음과 같다. 먼저, 미국의 정책금리 인상 충격이 신흥시장국의 금리 인상에 비해 신흥국 경제성장에 더 큰 영향을 주는 것으로 나타났다. 또한, 미국의 금리인상 충격은 신흥국의 경제성장률 및 물가상승률에 유의한 영향을 미치는 가운데, 신흥국의 정책반응과 거시변수에 미치는 영향은 신흥국의 거시여건에 따라 다르게 나타났다. 특히 물가상승률이 높은 신흥국일수록 미국의 긴축정책에 따른 성장률 위축의 여파가 큰 것으로 나타났다.

핵심 주제어: 글로벌 유동성, 금융 전이, 통화정책 충격, 신흥시장국

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* 국제통화기금 Senior Economist (E-mail: wchoi@imf.org)

** 한국은행 경제연구원 국제경제연구실 부연구위원 (전화: 02-759-5435, E-mail: brian.lee@bok.or.kr)

*** 한국은행 조사국 산업고용팀 차장 (전화: 02-759-4208, E-mail: tskang@bok.or.kr)

**** 한국은행 조사국 국제종합팀 팀장 (전화: 02-759-5280, E-mail: kgy3104@bok.or.kr)

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Divergent EME Responses to Global
and Domestic Monetary Policy Shocks

Woon Gyu Choi ·
Byongju Lee ·
Taesu Kang ·
Geun-Young Kim