# Financial Market Openness and Monetary Control[♠]

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July 31, 2011

Abstract

How emerging market financial assets respond to local monetary policy shocks has important implications for the asset allocation and risk management strategies of U.S. investors, for local policymakers in liberalized and pre-liberalized economies, and for international financial integration. We examine the claim that emerging market liberalization led to a loss of local monetary control, thereby rendering local monetary policy ineffective in influencing local asset prices and the economy. Using a structural VAR to model the reaction function of local monetary authorities in 25 emerging markets, we find that 18 stock markets respond significantly to local monetary policy shocks. Specifically, a one standard deviation positive shock causes an immediate decline of 2.07% in stock prices. The evidence indicates that local monetary policy generally has no lesser influence on the stocks of investable firms than on the stocks of non-investable firms. Importantly, while foreign monetary policy affects local asset prices there is no evidence that it dominates local policy. For instance, only a fraction of markets that are unresponsive to local monetary policy are simultaneously responsive to foreign monetary policy. Moreover, foreign monetary policy has statistically indistinguishable effects on investable and non-investable stocks, suggesting that liberalization has not created a dichotomous equity market in which non-investable stocks remain segmented.

**Keywords**: structural VAR, SUR, monetary policy, monetary control, investable stocks, non-investable stocks

**JEL codes**: E52, F36, G15.

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Abstract

How emerging market financial assets respond to local monetary policy shocks has important implications for the asset allocation and risk management strategies of U.S. investors, for local policymakers in liberalized and pre-liberalized economies, and for international financial integration. We examine the claim that emerging market liberalization led to a loss of local monetary control, thereby rendering local monetary policy ineffective in influencing local asset prices and the economy. Using a structural VAR to model the reaction function of local monetary authorities in 25 emerging markets, we find that 18 stock markets respond significantly to local monetary policy shocks. Specifically, a one standard deviation positive shock causes an immediate decline of 2.07% in stock prices. The evidence indicates that local monetary policy generally has no lesser influence on the stocks of investable firms than on the stocks of non-investable firms. Importantly, while foreign monetary policy affects local asset prices there is no evidence that it dominates local policy. For instance, only a fraction of markets that are unresponsive to local monetary policy are simultaneously responsive to foreign monetary policy. Moreover, foreign monetary policy has statistically indistinguishable effects on investable and non-investable stocks, suggesting that liberalization has not created a dichotomous equity market in which non-investable stocks remain segmented.

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**Financial Market Openness and Monetary Control**

> "*We need to re-examine the merits of financial liberalization in the light of [the concern that it] lead[s] to a loss of monetary control...* " (Williamson (1998)).
>
> "*A narrower question … is whether the increased openness of the U.S. economy has in some way affected the ability of the Federal Reserve to…foster price stability and maximum sustainable employment. On this issue, some analysts have argued that globalization hinders monetary policy--for example, by reducing the ability of the Federal Reserve to affect U.S. interest rates and asset prices* …" (Bernanke (2007)).

Does emerging market liberalization lead to a loss of local monetary control? While central bankers and monetary authorities are concerned about this potential negative externality, academics have focused almost solely on the significant benefits of liberalization.[1] To date there has been much debate about but an almost total absence of empirical evidence on the potential costs that could negate these gains.[2] One such cost is that liberalization could create the conditions for foreign monetary policy to dominate local monetary policy, rendering local policy ineffective in influencing local asset prices and the local economy.

Understanding this aspect of the liberalization process is important for several reasons. First, liberalization created an investable component of emerging stock markets that offer international diversification benefits to U.S. equity investors (see, e.g., Errunza, Hogan, and Hung (1999)).[3] Because monetary policy can have a substantial impact on asset prices (see, e.g., Thorbecke (1997)), being aware of the responsiveness, or lack thereof, of investable stocks to local monetary policy enhances the implementation of international asset allocation and risk management strategies.

Second, liberalization could create a dichotomous equity market where the investment and financing decisions of investable firms are no longer influenced by local monetary policy. Conversely, local monetary policy may be able to influence only non-investable firms. This would

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[1] These are, an increase in stock prices (Henry (2000a)); a reduction in the cost of capital (Bekaert and Harvey (2000), Chari and Henry (2004), de Jong and de Rune (2005)); an increase in private physical investments (Henry (2000b), Mitton (2006)); and higher economic growth rates (Bekaert, Harvey, and Lundblad (2005), Quinn and Toyoda (2008)).

[2] The above quotes are a reflection of the broader debate. For instance, the World Bank-International Monetary Fund (2005; p.318) states that, "… macroeconomic risks … may be triggered by financial liberalization (e.g., loss of monetary control…following liberalization…)." Nobel laureates Paul Krugman (1998) and Joseph Stiglitz (1999) seem to support this view by advocating strongly for restricting liberalization on the grounds that that would limit the devastating effects of the sudden stoppage of capital inflows and the acceleration of capital outflows, which local monetary authorities are not adequately equipped to deal with. Williamson (1998), on the other hand, thinks that liberalization has not led to a loss of local monetary control.

[3] Investable firms are able to benefit directly from foreign capital and are open to foreign ownership either as depository receipts, through membership in country funds, ETFs, or other tradable portfolios, or direct purchase. Non-investable firms do not have access to foreign equity capital because they are legally restricted from allowing foreign ownership for strategic reasons or because they choose not to as they are too small or illiquid to make foreign ownership practical.

make it difficult for local monetary authorities to correctly gauge the optimal policy modification(s) necessary to alter the behavior of both investable and non-investable firms in order to achieve desired goals for the entire economy.[4] This would be of concern not only in currently liberalized economies, but also in the more than 20 frontier markets that are contemplating whether and how to liberalize. Third, how emerging stock markets as a whole, and particularly the investable and non-investable segments, respond to foreign vis-à-vis local monetary policy is indicative of their degree of international integration, an issue that is still being debated because of its policy relevance.

In this paper we address this widely debated but, heretofore, unanswered question, whether emerging market liberalization leads to a loss of local monetary control. By a "loss of local monetary control" we mean that the monetary authority is unable to influence in an economically meaningful way local asset prices and by extension the broader economy through unanticipated changes in policy interest rates.

In the late 1980's many emerging markets eased restrictions on foreign capital inflows and foreign ownership of local securities in order to become integrated into world financial markets. However, market integration may come at the cost of less monetary control. As Obstfeld, Shambaugh, and Taylor (2005), among others, note, economies attempting to achieve financial market integration while maintaining exchange rate stability and monetary independence (the "impossible trinity") face a "trilemma," where it is possible to achieve two, but not all three of these goals. If the liberalization of emerging markets has led to market integration then, ceteris paribus, local authorities would have lost their independence in setting local policy interest rates. Hence, flexible exchange rates would be required in order to retain monetary control. However, Calvo and Reinhart (2002), Calvo and Mishkin (2003), among others, point out that many developing economies have resisted fully flexible exchange rate regimes, thereby raising the question whether emerging markets have lost local monetary control as a consequence of liberalization.[5]

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[4] If local monetary authorities have lost monetary control and local and foreign business cycles are imperfectly synchronized, then this would hinder local authorities from being able to adequately respond to exigent circumstances in the economy and to achieve sustained economic growth. Evidence of this dilemma surfaced in Argentina in 1999 and 2000, when the peso was pegged to the dollar, as they had to raise local interest rates because of rising interest rates in the United States, even though they were in a recession (Goldstein (2002)).

[5] The issue is the more intriguing because there is now a debate about the "impossible duo" or open economy dilemma within the impossible trinity doctrine (see, e.g., Shambaugh (2004)). While some suggest that it is impossible to retain monetary control in financially open markets, regardless of the exchange rate regime, others contend that monetary control can be retained after liberalization with a fixed exchange rate regime providing that local and foreign assets are not perfect substitutes (see, e.g., Velasco (2001)). As if taking a middle ground in this new debate, some emerging markets maintain flexible but managed exchange rates while trying to retain local monetary control by hoarding foreign currency reserves, but these reserves are sterilized to avoid possible inflationary pressures (Aizenman and Glick (2009)).

We examine whether shocks to country-specific policy interest rates, in the presence of shocks to foreign monetary policy rates, affect local stock prices in a sample of emerging markets. We use asset prices in our tests because the real economic activities of firms (e.g., investment) evolve slowly in response to changes in monetary policy. Thus if we were to use real activities it would it would be difficult to ascertain whether changes in these activities were a result of monetary policy shocks. In contrast, financial markets are forward-looking and are largely informationally efficient, so monetary policy has its most direct and immediate effect on stock and other financial asset prices (see, e.g., Bernanke and Kuttner (2005); see Fig. 1 for a depiction of asset prices as a monetary policy transmission mechanism). Therefore, by using financial asset prices we conduct a more powerful test of the impact of monetary policy.

Using a structural VAR model with non-recursive contemporaneous restrictions we extract monetary policy shocks from the reaction function of local monetary authorities and standard open economy assumptions. We find that for 18 of the 25 countries in our sample a one standard deviation unanticipated increase in local monetary policy interest rates on average results in a significant and immediate 2.07% decline in the country's overall stock market index. Interestingly, the evidence indicates that the unresponsiveness of the remaining seven stock markets to local monetary policy is not entirely due to the dominance of foreign monetary policy because only in two of the markets (Colombia and India) is foreign monetary policy simultaneously significant. This is despite the fact that, overall, foreign monetary policy shocks also elicit an immediate and significant response from 11 equity markets.

One possible concern is that these results could be because local monetary policy shocks only influence the investment and financing decisions of non-investable firms and this is reflected in the response of the overall stock market index. However, this is not the case because we find that local monetary policy affects both investable and non-investable stocks. Interestingly, the impact of local monetary policy shocks on investable stocks is statistically significant and appears economically larger in more markets than the impact on non-investable stocks. This suggests that foreign investor participation in the investable component of the stock market and the consequent increase in informational efficiency lead to greater sensitivity to local monetary policy shocks. We call this an "efficiency" effect. This is counter to the predictions of what may be termed the "integration" effect, whereby local financial assets that are more integrated into the world capital markets are more responsive to foreign, not local, monetary policy shocks. We provide further insight into this result by testing if local monetary policy has a similar impact on investable and non-investable stocks. To achieve this, we overcome the practical limitations to applying the structural VAR simultaneously to both sets of firms by using an autoregressive-moving average with exogenous variables (ARMAX) model that is influenced by the structural VAR to estimate an alternative proxy for monetary policy shocks and then use it in a bivariate seemingly unrelated regression (SUR) model to test cross-equation restrictions. We find that these effects of local monetary policy on the investable and non-investable components of the market are generally statistically indistinguishable. New to the literature, we also find that foreign monetary policy affects not just the most open segment of the emerging markets as could be expected. Instead, foreign monetary policy generally has a statistically similar effect on investable and non-investable stocks. This suggests that liberalization has not created a dichotomous market in which non-investable stocks remain segmented

Taken together, these results indicate that financial market openness has not led to a loss of local monetary control in the liberalized emerging economies. To the contrary, they indicate that local monetary authorities exert economically meaningful influence over their financial markets and, hence, should be able to influence their economies. However, foreign monetary policy does impact emerging market asset prices, suggesting that local authorities do not have full monetary control. This makes it more difficult for emerging market monetary authorities to achieve their policy goals when the objectives of U.S. and local monetary policies differ. The results further indicate that emerging market asset prices provide an efficient transmission channel to the real economy in the post-liberalization period. Besides, even firms that are closed to foreign capital and ownership respond to foreign monetary policy as if they too are investable.

Our paper makes several important contributions. First, it contributes to the literature on the effectiveness of monetary policy in the emerging markets. This is an issue that has grown in stature in recent times given the role of monetary policy response to the 2008 financial crisis. As far as we are aware, this is the first paper that examines whether emerging market monetary policy affects emerging market asset prices and, thus, whether the latter provide a channel through which monetary authorities can influence the broad economy. In recent work, Hausman and Wongswan (2006) and Ehrmann and Fratzscher (2006) find that emerging stock markets react significantly to U.S. monetary policy. Our work complements theirs by showing that their results do not arise solely from investable stocks, as might be expected, but also from non-investable stocks. Our work is distinct from theirs in that we show that local monetary policy is still relevant in many emerging markets and, in particular, to investable and non-investable stocks. In addition, we fill an important gap in the literature, which is whether or not U.S. monetary policy dominates local monetary policy in these economies. We show that U.S. monetary policy does not dominate local monetary policy, even in the returns of the most open segment of the emerging markets. These results resolve a major concern of both practitioners and academics that has not been previously addressed in the academic literature namely, to what extent has financial market openness in the emerging markets led to a loss of local monetary control.

A second, even if purely methodological, contribution to the literature on emerging market monetary policy is that this is the first paper to employ a structural VAR model and a central bank reaction function that is influenced by best practice in the study of monetary policy in the industrialized economies (see, Christiano, Eichenbaum, and Evans (1999)) to identify monetary policy shocks in the emerging markets. This is important given the relative lack of transparency of central banks in the developing economies (e.g., Dincer and Eichengreen (2006)).

Third, we contribute to the literature on financial market integration. Our finding that foreign monetary policy significantly and similarly impacts investable and non-investable stocks indicates that liberalization has not created a dichotomous equity market in which a significant part is integrated and the rest is not. This is consistent with the argument by Alexander, Eun, and Janakiramanan (1987) that cross-listed firms, akin to the investable segment, produce a positive externality effect by indirectly integrating purely domestic firms (the non-investable segment) into the international capital markets. As such, our results support existing evidence that the emerging markets have become highly integrated in international capital markets (see, e.g., Bekaert, Harvey, and Lumsdaine (2002)).

The rest of the paper is organized as follows. In Section I we discuss the means by which stock markets act as a monetary policy transmission channel and in Section II we discuss the data and describe the methodology used to identify monetary policy shocks. In Section III we investigate the impact of local and foreign monetary policies on the aggregate stock market. In Section IV we examine the impact of local and foreign monetary policies on investable and non-investable stocks. Finally, Section V contains the paper's summary and conclusion.

## I. Literature Review

Stock markets are but one of several channels through which monetary policy actions are transmitted to and affect real economic activity. These channels include various components of the money and financial asset markets: the quantity of monetary and credit aggregates, interest rates (and the structural relationships between policy rates and market interest rates), financial asset prices, and exchange rates (Loayza and Schmidt-Hebbel (2002)). Figure 1 is a schematic depiction of the relationships between monetary policy actions and these various channels and, in turn, the way the transmission channels relate to the real economy, the ultimate target of monetary authorities.

Mishkin (1995) points out that there are primarily four ways by which the stock market transmits monetary policy to the real economy. The first is based on Tobin's (1969) *q* theory of investment and works through the effect that increasing share prices have on the cost of capital. When share prices are high, the market value of firms relative to the replacement cost of their stock of capital is also high and new plant and equipment capital is cheap relative to the market value of firms. Firms are therefore able to finance large amounts of investments easily, by issuing new shares that are valued high relative to the cost of the equipment that they are financing, thereby leading to increased investment spending, aggregate demand, and output. Thus, there is a distinct relationship between investment and changes in the aggregate stock market value. To the extent that following an expansionary monetary policy investors shift from bonds into stocks, this change in asset allocation would bid up stock prices, which in turn would increase the value of Tobin's *q*, thereby increasing investment expenditures.

The second channel is based on the life-cycle theory of Modigliani (1971) and operates through the impact of wealth on consumption. An expansionary monetary policy generally leads to an increase in asset prices. This increase raises the value of consumers' wealth and, therefore, leads to an increase in permanent income. In an intertemporal framework, where consumers smooth consumption over time, this leads to higher current and future consumption, thus resulting in an increase in aggregate demand and output.

The third channel is known as the "credit view" and works through the effect that an improved balance sheet has on a firm's investment and consequently is also known as the "balance-sheet channel" (see, e.g., Bernanke and Gertler (1989), Kiyotaki and Moore (1997)). Because of asymmetric information in credit markets, the ability of firms to borrow depends on the collateral they can provide. To the extent that an expansionary monetary policy increases firms' stock prices it increases their net worth and, hence, their collateral value, which in turn increases their ability to obtain larger loans for investment. This leads to a self-reinforcing process where part of the available credit is utilized to purchase additional assets, leading to further price increases.

The fourth channel can also be thought of as a balance-sheet channel with the important difference being that it is the household's (consumer's) balance sheet rather than that of the firm that is of importance (Mishkin (1976)). This channel operates through consumers' desire to spend rather than banks' desire to lend. Consider the case where consumers hold a significant proportion of their wealth in the form of financial assets. If there is an expansionary monetary policy that leads to an increase in asset prices then consumers' wealth increases. If consumers believe that this increased wealth translates to a reduced likelihood of personal financial distress, then they will hold less liquid assets, while increasing their expenditure on durables and housing.

An examination of the particular means by which emerging stock markets transmit monetary policy to the real economy is beyond the scope of this paper. Instead, we focus on whether local monetary policy affects emerging stock market returns in the post-liberalization period and, as such, whether these financial asset markets are a transmission channel for local monetary policy. There is now a large body of evidence that U.S. monetary policy significantly impacts the returns of U.S. stock markets (see, e.g., Rozeff (1974), Geske and Roll (1983), Kaul (1987), Thorbecke (1997), Bjornland and Leitemo (2009), among others). On the other hand, only a few papers examine the impact of monetary policy on international stock markets (see, e.g., Conover, Jensen, and Johnson (1999), Wongswan (2005), Hausman and Wongswan (2006), and Ehrmann and Fratzscher (2006)).

The papers by Hausman and Wongswan (2006) and Ehrmann and Fratzscher (2006) are the ones that are most closely related to our work. Using Federal Open Market Committee (FOMC) announcements as their measure of U.S. monetary policy, they both find that emerging stock markets react significantly to U.S. monetary policy shocks. However, there are important questions not addressed by these papers. First, these studies do not examine the effect of local monetary policy on emerging economies stock prices. Thus, it is not known if local policy has an impact on local stock markets, or if once local monetary policy is controlled for U.S. monetary policy would still have a significant impact on emerging financial asset markets. Second, the ability of firms to borrow and the cost at which they can do so depends not only on the collateral value of the assets on their balance sheet, but also on the supply of investment funds available to firms in the economy. Access to foreign capital might lower the cost of capital for firms and reduce their sensitivity to local monetary policy. In this paper we are able to examine whether the effect of U.S. monetary policy is being driven by the group of firms that are accessible to foreign investors or if non-investable firms are also affected.

## II. Data and Methodology

In this section, we first describe the stock market assets that are the focus of our tests and discuss the data used to obtain local and U.S. monetary policy shocks. Next, we discuss the methodology used to identify these monetary policy shocks.

*A. Test Assets*

The test assets are emerging market stock returns for the entire market, investable stocks, and non-investable stocks. All data are at the monthly interval. The stock market returns are obtained for the following 25 countries: Argentina, Brazil, Chile, Colombia, Czech Republic, Greece, Hungary, India, Israel, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Portugal, Russia, Slovakia, South Africa, Taiwan, Thailand, Turkey, and Venezuela. The data are from the International Finance Corporation's (IFC's) Emerging Market Database (EMDB) and cover the post-liberalization period through 2005. Table 1 lists the first date on which data are available following the liberalization date reported in Bekaert, Harvey, and Lumsdaine (2002). For each emerging market, the EMDB provides a broad value-weighted index of the aggregate local stock market called the Global Index (IFCG) and an Investable Index (IFCI) comprised of firms that are open to foreign investment and are large and liquid enough to attract foreign investors. These index returns are reported in both U.S. dollars and local currency. See Appendix 1 for additional details about the data and dataset construction. EMDB does not calculate an index of non-investable stocks. Hence, we follow Boyer, Kumagai, and Yuan (2006) to compute the returns ($R_{Nt}$) on the non-investable stocks:

$$R_{Nt} = (M_{At-1} \times R_{At} - M_{It-1} \times R_{It})/(M_{At-1} - M_{It-1}). \qquad (1)$$

The market capitalization of the stocks in the aggregate local stock market is represented by $M_A$ and $R_A$ represents their return. $M_I$ and $R_I$ represent, respectively, the market capitalization of and return on the stocks in the Investable Index. Returns on the aggregate local market and the investable index are calculated as 100 times the log first difference of the dividend-adjusted index in local currency at the monthly interval.

Because EMDB has size and liquidity requirements for a firm's stock to be included in the Investable Index, one concern may be that the non-investable designation is merely a proxy for illiquidity. However, across the emerging markets only between 25% and 35% of firms in the smallest size quintiles are non-investable (Bae, Chan, and Ng (2004)). Furthermore, given that we use a value-weighted index of non-investable firms, differences in size and illiquidity will not have a major effect on any differences between the results for investable and non-investable firms.

Summary statistics for the monthly returns (in %) on the aggregate local market and investable indices and non-investable stocks are reported in Table I. There is considerable variation in the mean returns across countries for the three sets of returns. Within countries, the difference in mean return for investable and non-investable stocks is generally economically material. The returns and standard deviations are generally larger than those for U.S. stocks, reflecting the well-known generally higher reward and risk of emerging markets.

*B. Monetary Policy Instruments and Other Variables*

There is still debate about the macroeconomic variable that is the most appropriate measure for conducting empirical tests of monetary policy (see, e.g., Bernanke and Mihov (1998), Kashyap and Stein (2000)). Moreover, in the emerging markets, some of the variables that have become commonplace in the United States, such as interbank futures rates used to measure expected monetary policy (Kuttner (2001)), are not available in these countries over our sample period. However, many emerging markets have adopted market-oriented policies since liberalization and the primary policy tools are now specific short-term interest rates (Kamin, Turner, and Van't dack (1998) and Loayza and Schmidt-Hebbel (2002)).[6]

We use the interbank interest rate and the discount rate, which are available for about half of our sample countries, as our primary policy instruments following the work of Calvo and Reinhart (2002) who investigate the policy targets for markets around the world. If these are not available, then we use either the Treasury bill rate, the money market rate, or, in a single case, the 10-year government bond rate. In the instances where data constraints force us to use a money market interest rate rather than the main policy interest rate, this is unlikely to pose a problem because most central banks target money market interest rates, which respond efficiently to policy-induced interest rate changes and in turn affects other (long-term) interest rates. More broadly, Obstfeld et al. (2005) point out that even if the particular interest rate or interest rates in general are not the primary tool of monetary policy, because monetary policy directly affects interest rates, they should be a good

[6] Unlike in the United States, in many emerging markets there are no regular announcements of the central bank's target policy rate and neither are there specific dates on which (realized) macroeconomic outcomes (e.g., money supply) are made public. The implication is that we are unable to conduct event-study tests.

measure of the stance of monetary policy. Local interest rate changes are winsorized at the 5th and 95th percentiles to dampen the influence of outliers.

We also require a proxy for monetary policy that is foreign to each emerging market. We choose U.S. monetary policy because the United States is by far the largest host market to investable stocks that cross-list abroad or are part of a country fund. In addition, this choice allows for comparison with other studies that examine the impact of foreign monetary policy on the emerging markets (e.g., Hausman and Wongswan (2006) and Ehrmann and Fratzscher (2006)). Bernanke and Blinder (1992), Thorbecke (1997), Campello (2002), and others, have used (unanticipated) changes in Federal funds rate as a proxy for U.S. monetary policy, with the expected changes typically obtained from an econometric forecast, using autoregressive-moving average (ARMA) or vector autoregression (VAR) estimates. We extract U.S. monetary policy shocks from changes in the Fed funds rates by generating the expected changes from contemporaneous and lagged variables in the manner described below. The Fed funds rates are obtained from Datastream.

Additional data are required to model monetary policymakers' expectations so as to more accurately identify monetary policy shocks. These are oil prices in current U.S. dollars, a measure of each emerging market consumer price index, a measure of aggregate output, and each country's exchange rate, where the exchange rate is expressed as U.S.$/local currency. For aggregate output, we typically use an industrial production index, but where unavailable we use either a manufacturing production (Chile, Columbia, Greece, Pakistan, Peru, Philippines, and South Africa) or crude petroleum production (Argentina and Venezuela) index. These data are from the International Financial Statistics database of the International Monetary Fund, except for Taiwan, where the data are from the Ministry of Economic Affairs and the Central Bank of the Republic of China (Taiwan), and Russia and Thailand, where the industrial production index data are from Datastream. The data for oil prices, aggregate output, and CPI are seasonally adjusted.

*C. Methodology*

It is well known that it is unanticipated changes (shocks) in monetary policy that impact financial markets (see, e.g., Thorbecke (1997)). We follow the extant literature to obtain monetary policy shocks by modeling the reaction function of the monetary authority and the structure of the economy under standard open-economy assumptions. To identify the monetary policy shocks we use a structural VAR (SVAR) model with non-recursive contemporaneous restrictions (see, e.g., Christiano et al. (1999), Kim and Roubini (2000)), and assume that monetary policy and the stock market interact with the broader economy in a manner described by the following SVAR(*p*) model:

$$\Phi(L)X_t = \varepsilon_t. \tag{2}$$

$\Phi(L) = \Phi_0 - \Phi_1 L - \Phi_2 L^2 - \ldots - \Phi_p L^p = \Phi_0 - \Phi_L(L)$ is a polynomial in the lag operator *L*, $\Phi_0$ is a matrix of *n*(*n*-1) coefficients on the possibly *n*-1 contemporaneous endogenous variables in each of the *n* equations in the system, $\Phi_L(L)$ is the component of the polynomial in the lag operator containing the coefficients on the lagged variables in each equation in the system, $X_t$ is an *n*x1 data vector of stationary variables, $\varepsilon_t$ is an *n*x1 vector of structural shocks, and $E(\varepsilon_t \varepsilon_t') = \Omega_s$.

Related to the SVAR in equation (2) above is the reduced form VAR model:

$$\Theta(L)X_t = v_t, \tag{3}$$

where $\Theta(L) = I - \Theta_1 L - \Theta_2 L^2 \ldots - \Theta_p L^p = \Phi_0^{-1}\Phi(L)$ is a polynomial in the lag operator *L*, and $E(v_t v_t') = \Sigma_r$. The structural and reduced forms are related as $\Phi(L) = \Phi_0 \Theta(L)$, $\varepsilon_t = \Phi_0 v_t$ and

$$\Sigma_r = \Phi_0^{-1}\Omega_s \Phi_0^{-1'}, \tag{4}$$

which implies that we can obtain estimates of the structural parameters from sample estimates of the variance-covariance matrix of the reduced form residuals. Specifically, since $\Sigma_r$ has *n*(*n*+1)/2 distinct parameters and $\Phi_0^{-1}\Omega_s \Phi_0^{-1'}$ has *n*(*n*-1) plus *n*x*n* parameters in $\Phi_0$ and $\Omega_s$, respectively, to be estimated, we need to impose (2$n^2$-*n*)-*n*(*n*+1)/2 restrictions on the right hand side of (4). We can reduce the number of parameters to be estimated by restricting $\Omega_s$ to be a diagonal matrix, which effectively imposes *n*(*n*-1) restrictions. Therefore, *n*(*n*-1)/2 restrictions have to be imposed on $\Phi_0$ to obtain an exactly identified model. These are short-run restrictions that govern the contemporaneous relationship between the endogenous variables in the system.

In the estimation, the model is a 7-equation system containing: 100 times the log first difference of oil prices in current U.S. dollars (*Oil*); first difference of the annualized U.S. Fed funds rate (*FF*); 100 times log first difference of the local industrial production index (*IP*); local inflation measured as 100 times log first difference of the local consumer price index (*Inf*); first difference of the annualized local monetary policy interest rate (*LMP*); 100 times log first difference of the exchange rate (*FX*) stated as US$/local currency of each country (thus positive changes represent appreciation of the local currency), and real return on the aggregate local market measured as 100 times log first difference of the index deflated by local inflation (*Ret*).

Using the relationship between the structural disturbances and the reduced form residuals, $\varepsilon_t = \Phi_0 \nu_t$, we impose the following identifying restrictions on the contemporaneous structural coefficients, $\Phi_0$, to obtain an overidentified model:

$$\begin{bmatrix} \varepsilon_{oil} \\ \varepsilon_{FF} \\ \varepsilon_{IP} \\ \varepsilon_{Inf} \\ \varepsilon_{LMP} \\ \varepsilon_{FX} \\ \varepsilon_{\mathrm{Re}\,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \phi_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ \phi_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ \phi_{41} & 0 & \phi_{43} & 1 & 0 & 0 & 0 \\ \phi_{51} & 0 & 0 & 0 & 1 & \phi_{56} & 0 \\ \phi_{61} & \phi_{62} & \phi_{63} & \phi_{64} & \phi_{65} & 1 & 0 \\ \phi_{71} & \phi_{72} & \phi_{73} & \phi_{74} & \phi_{75} & \phi_{76} & 1 \end{bmatrix} \begin{bmatrix} \nu_{oil} \\ \nu_{FF} \\ \nu_{IP} \\ \nu_{Inf} \\ \nu_{LMP} \\ \nu_{FX} \\ \nu_{\mathrm{Re}\,t} \end{bmatrix}. \tag{5}$$

The vector $(\varepsilon_{oil}, \varepsilon_{FF}, \varepsilon_{IP}, \varepsilon_{Inf}, \varepsilon_{LMP}, \varepsilon_{FX}, \varepsilon_{\mathrm{Re}\,t})'$ represents the structural shocks and $(\nu_{oil}, \nu_{FF}, \nu_{IP}, \nu_{Inf}, \nu_{LMP}, \nu_{FX}, \nu_{\mathrm{Re}\,t})'$ the unanticipated components (i.e., residuals) of each variable in the reduced form VAR. Note that these restrictions only restrict the contemporaneous relationship between the variables, while the lagged relationships hold as under the reduced form VAR. Thus, for instance, the model of the local stock return is as follows:

$$\begin{aligned} \mathrm{Re}\,t_t &= \phi_{71} \times Oil_t + \phi_{72} \times FF_t + \phi_{73} \times IP_t + \phi_{74} \times Inf_t + \phi_{75} \times LMP_t + \phi_{76} \times FX_t \\ &+ \textstyle\sum_{p=1}^{P} \theta_{oil,p} \times Oil_{t-p} + \sum_{p=1}^{P} \theta_{FF,p} \times FF_{t-p} + \sum_{p=1}^{P} \theta_{IP,p} \times IP_{t-p} + \sum_{p=1}^{P} \theta_{Inf,p} \times Inf_{t-p} \\ &+ \textstyle\sum_{p=1}^{P} \theta_{LMP,p} \times LMP_{t-p} + \sum_{p=1}^{P} \theta_{FX,p} \times FX_{t-p} + \sum_{p=1}^{P} \theta_{\mathrm{Re}t,p} \times \mathrm{Re}\,t_{t-p} + \varepsilon_{\mathrm{Re}t,t} \end{aligned} \tag{6}$$

While the choice of variables and the restrictions are influenced by Kim and Roubini (2000), Bjørnland and Leitemo (2009), we briefly discuss these choices below. We include a variable in the central bank reaction function that is exogenous to local monetary policy–oil price. The inclusion of oil prices is intended to reflect the possibility that local monetary authorities use the readily available oil price index to form expectations about local inflation ahead of the actual release of inflation data. This is consistent with the evidence in the United States (see, e.g., Bernanke and Mihov (1998), and Romer and Romer (2004)) and other industrialized countries (Kim and Roubini (2000)).[7] We do not include contemporaneous changes in U.S. monetary policy in the reaction function of emerging market central banks, but we do allow changes in the Fed funds rate to have a contemporaneous impact on the exchange rate as changes in U.S. monetary policy can influence the value of local

[7] Claessens and Duncan (1993) note that current increases in commodity index values foreshadow strong economic performance in many emerging economies. As such, oil price changes may be informative about inflationary pressures.

currency relative to the U.S. dollar. This is because, as argued by Kim and Roubini (2000), monetary authorities in foreign countries are more likely to be concerned about how U.S. interest rate affects their currency values rather than how it affects the local policy interest rate.

Additionally, we allow monetary policy to respond immediately to changes in the exchange rate as emerging market monetary authorities are expected to be sensitive to changes in the value of their currencies not only because of the recent experiences with currency crises but also because of the general tendency of developing countries to have flexible but managed currencies (see, e.g., Aizenman and Glick (2009)). Although recent evidence indicates that U.S. monetary authorities respond to developments in the stock market (see, e.g., Bjørnland and Leitemo (2009)), there is as yet no evidence that this is the same in the emerging markets.[8]

We do not allow industrial production to respond contemporaneously to financial variables (see, Christiano et al. (1999)). Instead, industrial production reacts contemporaneously to oil price. Oil prices also affect inflation in the immediate period, as does industrial production.

We allow exchange rates to respond contemporaneously to all variables except the stock market. While developments in the stock market can have an impact on the exchange rate, for example through foreign portfolio flows, the existing evidence (see, e.g., Froot, O'Connell, and Seasholes (2001)) indicates that stock returns tend to lead cross-border flows which, even assuming flows have a contemporaneous impact on the exchange rate, would imply that stock returns do not have a contemporaneous effect on the exchange rate. Therefore, we avoid the possible misspecification by not allowing a contemporaneous impact. For the equation of primary interest, the stock market is allowed to respond immediately to all variables (see, Bjørnland and Leitemo (2009)). This is because market participants are forward-looking and are expected to immediately embed into stock prices information about the variables that have implications for future cash flows or discount rate.

To set the lag length for the system of equations for each country we select the lag length that produces white noise (reduced form) errors in each of the endogenous variable.

[8] We avoid this specification for two reasons. First, a senior central banker from Latin America pointed out to one of the authors that, unlike in the United States, monetary policy authorities do not usually consider developments in the stock market in setting monetary policy. -Second, in an earlier draft allowing a contemporaneous stock market impact on monetary policy frequently led to a failure of the model to converge.

## III. Empirical Results

In this section we present empirical results from the SVAR on whether emerging market monetary authorities have monetary control over their economies by examining the impact of local monetary policy shocks on aggregate local market returns across the 25 markets included in our sample.

A. *Do Local Monetary Authorities Have Monetary Control?*

Table II reports the impulse response coefficients of the local stock market to a structural shock in local and U.S. monetary policies. The impulse response coefficients represent the response, measured in percent, of the stock market given a one standard deviation unanticipated increase in local or foreign monetary policy interest rate. Therefore, the impulse responses are comparable across markets. Figure 2 displays the associated impulse responses.

To determine if the impulse responses are statistically significant we present probability bands around the impulses responses following Sims and Zha (1999). Sims and Zha (1999) recommend that when the impulse responses have an asymmetric distribution and the sample size is small it is more appropriate to use probability bands represented as 0.16 and 0.84 fractiles, instead of the usual standard error bands based on an estimate of the variance of the distribution and the assumption of a symmetric distribution. These bands are obtained from Bayesian Monte Carlo integration with 10,000 replications (see Doan (2007)). Monetary policy has a negative and significant effect if both the upper and lower bands are below the zero horizontal line.

There are several interesting results. First, a one standard deviation shock to local monetary policy results in a statistically significant and immediate decline in stock prices in 18 of the 25 countries in the sample. These include most of the larger emerging markets in Latin America, Asia, and Western and Eastern Europe. On average, a one standard deviation shock in policy interest rate leads to large market responses of two or more percent decline in markets such as Turkey (4.8%), Argentina (3.1%), Russia (3.0%), Poland (2.7%), Greece (2.6%), South Africa (2.3%), Venezuela (2.3%), Israel (2.3%), and Brazil (2.0%). Across all 25 countries, the average decline in the stock market following a one standard deviation shock to the target monetary policy rate is approximately 1.55% and a larger 2.07% for the countries in which the monetary policy impact is statistically significant.

To obtain an alternative picture of the economic significance of these results, Table II also reports the standard deviation of the structural shocks to local and U.S. monetary policies for each country. Dividing the impulse responses by the standard deviation of the shocks indicates that a 100 basis point unanticipated change in the local policy interest rate results in an immediate decline of 0.27% in Slovakia to 10.44% in Israel.

Second, the evidence indicates that emerging market stocks are sensitive to foreign monetary policy shocks. Twelve of the 25 stock markets decline immediately and significantly to a tightening of U.S. monetary policy. Among the significant responses, an unexpected one standard deviation increase in the Fed funds rate leads to a decline of about 1.0% in the Indian stock market to a high and significant 3.5% for Colombia. Assessing the responses to a 100 basis point shock, the evidence indicates that the magnitude of these responses are broadly in line with the high end of the sensitivity in the U.S. market (10% for NASDAQ stocks; see Rigobon and Sack (2003)) and the emerging stock markets (Hausman and Wongswan (2006) and Ehrmann and Fratzscher (2006)), although the latter results are based on different methodologies and time periods. However, it should be kept in mind that over a period corresponding to our longest sample period, October 1987 to December 2005, the average monthly change in the effective Fed funds rate is a 1.4 basis point rate cut and the largest monthly change is a 66 basis point cut. Hence, analyzed at the mean, the response of the local stock market to a change in U.S. monetary policy is not economically large.[9] The insensitivity of the Mexican stock returns to U.S. monetary policy is a bit surprising given the economic relationships between the two countries under the North American Free Trade Agreement and the possibly large U.S. ownership of Mexican stocks.

In the context of the paper's main objective, these results have several important implications. They suggest that local monetary authorities in the majority of the emerging markets retain significant monetary control in the post-liberalization period. It should be noted that the above results do not arise simply because local monetary policy is a proxy for U.S. monetary policy, given that we also include U.S. monetary policy in the model. However, consistent with expectations in a post-liberalized world, the results also indicate that local monetary authorities do not wield unchallenged influence over local asset prices, as U.S. monetary policy is also influential.

[9] The monthly effective Fed funds rate used in the paper is the average of daily rates. Suppose in a particular month the FOMC announces a 50 basis point increase in the target Fed funds rate and the effective rate changes likewise. If on the non-announcement days the rates increase by an additional two basis points each business day and remain fixed on non-business days, the average monthly rate change will be only about [(1*50+22*2+8*0)/31] 3.03 basis points. Of this average rate change, only a portion would be unanticipated by the market. Note also that Hausman and Wongswan (2006) and Ehrmann and Fratzscher (2006) use only the surprises in rate changes on FOMC announcement days.

It is interesting to note that stock returns are insensitive to local monetary policy shocks in Colombia, Peru, Jordan, India, Taiwan, the Czech Republic and Portugal, but the markets in Columbia and India are affected by U.S. monetary policy shocks.[10] These results have two important implications. On the one hand, they are prima facie evidence of a complete loss of local monetary control in Columbia and India. What is not clear is whether there are common characteristics among these countries that could cause the lack of response to local monetary policy while being sensitive to foreign monetary policy. If the proxy for capital control intensity, described in Appendix 2, is a reasonable measure of the degree of openness, then from the cross-sectional variation in this measure across these seven markets (ranging from 25 in Colombia to 65 in India) it appears that our findings cannot be attributed to the level of market openness.[11] On the other hand, that only a fraction of the markets which are insensitive to local monetary policy is simultaneously sensitive to foreign monetary policy implies that foreign monetary policy does not dominate local policy. A more conclusive statement on either of these implications requires further analysis, which we provide below when we exam whether foreign monetary policy impacts only the investable component of the stock market or if non-investable stocks are sensitive to local monetary policy shocks.

*B. Robustness Tests*

It is important to ensure that the above results are robust. One concern is whether the sensitivity of local stock prices to local monetary policy is affected by the occurrence of financial crises. It is possible that we observe the above results because both stock prices and monetary policy respond simultaneously to the onset of a crisis. Therefore, we include exogenous, dummy variables in the SVAR model to account for the Mexican and Asian currency crises. These are defined as one during the period December 1994 to December 1995 after the Mexican crisis and zero otherwise and as one during the period June 1997 to June 1998 after the Asian crisis and zero otherwise. The results, reported in Table III (impulse responses are available on request), are robust to the inclusion of these crisis variables. Specifically, of the 25 countries we find that local monetary policy continues to have a significant impact on 17 equity markets.

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[10] U.S. monetary policy shocks have a positive impact on returns in Portugal. We do not investigate the reason for this result.

[11] We leave open the possibility that the insensitivity to local monetary policy is merely a reflection of the choice, on our part, of a poor proxy for monetary policy shocks. This is not highly likely. As noted earlier, market interest rates are the general choice of monetary policy instruments for the emerging markets in the post-liberalization period.

We also examine if nominal stock returns are responsive to local monetary policy shocks (see, e.g., Thorbecke (1997)). Although investors are interested in real returns it is important to examine if the results are broadly similar for nominal returns. If emerging market monetary authorities also target inflation then the impact of monetary policy on real stock returns might be dominated by the impact on inflation. The results, which are available upon request, are qualitatively robust to the use of nominal stock market returns.

## IV. Further Evidence of Monetary Control Using Investable and Non-Investable Stocks

Thus far, the evidence shows that local monetary policy shocks significantly influence stock returns, suggesting that local monetary authorities in emerging markets retain monetary control in the post-liberalization period. In this section, we decompose the aggregate local market return into an investable component and a non-investable component, as described in the Data and Methodology section (Section II) in order to ascertain whether it is the component of the market that is closed to foreign investment that drives our results or the component which is open.

Our first question is the following: Is the influence of local monetary policy on emerging market stock prices due only to the impact of local monetary policy shocks on non-investable stocks? It is possible that local monetary policy influences stock prices of the aggregate emerging market only because of its impact on the fraction of local firms that does not benefit from foreign ownership of their shares, where such ownership occurs through the purchase of shares that are either cross-listed abroad, included in closed-end funds, or sold on the local market. Furthermore, these firms have limited foreign investor recognition and restricted access to foreign capital markets.[12] This implies that non-investable firms are likely to be strongly affected by local monetary policy because their most viable source of external capital is the local capital market.[13]

Their investable counterparts, in contrast, have access to cheaper capital abroad and may be insensitive to local monetary policy. On average over the sample period investable stocks accounted for at least 50% of each country's aggregate market capitalization for three-fourths of the emerging markets (deduced from Appendix 2). This suggests that if local monetary authorities are unable to

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[12] Foerster and Karolyi (1999) show that the increase in returns that occurs when foreign firms cross-list in U.S. stock markets is related to a change in investor recognition of the cross-listed firm.

[13] An alternative argument with the same implication is as follows. Suppose that there is a fixed amount of capital in the local economy and that two sets of firms compete for this capital. Assume that firms with greater growth opportunities that require external funding beyond the capabilities of the emerging economy are usually given preferential access to local capital. If they then become investable and raise capital abroad, then this increases the access to local capital by non-investable firms, making them more sensitive to local monetary policy actions.

influence investable stocks then, as more firms become investable, monetary policy authorities will lose even more influence over the local economy.

We also account for U.S. monetary policy. This is important because U.S. monetary policy could have two important implications for our results so far. First, it is possible that U.S. monetary policy supersedes local monetary policy in the investable component of local stock markets, given that investable firms raise foreign capital or are held by foreign investors and are likely to be sensitive to foreign (U.S.) monetary policy. This would reduce the benefits of liberalization to the extent that emerging market authorities would not be able to use local monetary policy actions that are different from foreign monetary policy to influence the economic behavior of a large and growing section of their local financial markets. Second, accounting for U.S. monetary policy can provide evidence on whether the previously observed influence of U.S. monetary policy in some emerging markets is due solely to its impact on investable stocks. That is, including U.S. monetary policy allows us to answer the question: Does U.S. monetary policy influence non-investable stocks?

In addressing these questions, we provide several additional novel insights into the relationship between emerging market liberalization and local monetary control. To achieve this, we proceed as follows. Using the same SVAR framework as described above, we first replace the market returns with the returns on non-investable stocks and re-estimate the model for each country. Next, we re-estimate the models using returns on investable stocks. We choose this approach over attempting to jointly estimate the investable and non-investable returns in a model containing eight endogenous variables for the reason that the larger system would not be estimable for several countries in our sample. This is because there are too few observations to obtain convergence of the SVAR model including both the investable and non-investable stocks as these components are generally available at a later date than the aggregate market. Even for the current, more parsimonious model, we are unable to obtain results for some countries due to small sample size. [14]

A. *Sensitivity of Non-Investable Stocks to Monetary Policy Shocks*

The impulse responses of non-investable stocks to a one standard deviation monetary policy shock are reported in Table IV and plotted in Figure 3. Accounting for the cases in which we are

[14] Moreover, investable and non-investable stock returns may be co-integrated and, thus, a model containing both would have to consider this possibility. As there is no existing evidence, to the best of our knowledge, as to whether they are co-integrated, we do not wish to run the risk of needlessly complicating and misspecifying this model.

unable to estimate the model (Pakistan, Slovakia, South Africa and Venezuela), the evidence indicates that local monetary policy has a statistically significant influence on non-investable stocks in 10 of the remaining 14 countries where local monetary policy significantly affects aggregate market returns.[15] This is expected for reasons expounded previously. In fact, it would not have been a surprise if non-investable firms from more countries, relative to the 18 in which the aggregate market displays sensitivity, were sensitive to local monetary policy. This is because it is possible that in some markets the investable component of the aggregate market, which we expect, ex ante, is less sensitive to local monetary policy, dominates the non-investable component and, as such, reduces the sensitivity of the aggregate market to local monetary policy shocks.

Non-investable stocks in Chile, Mexico, the Philippines, and Turkey are not influenced by local monetary policy whereas the aggregate market is. This implies that the sensitivity of the aggregate market to local monetary policy is driven by investable stocks in these markets (see below). This result is consistent with the view that investable firms use their entry into foreign capital markets as certification in order to subsequently raise even more local capital and are, therefore, highly sensitive to local monetary policy shocks (Reese and Weisbach (2002)).

The evidence also indicates that U.S. monetary policy has a significant effect on non-investable stocks in Brazil, Thailand, Greece, and Poland and, more interestingly, in Colombia, the Czech Republic, and the Philippines where non-investable stocks are insensitive to local monetary policy. This implies that these markets have become highly internationally integrated in the post-liberalization period (Bekaert and Harvey (1995), Bekaert et al. (2002)) and that liberalization has not created a dichotomous market in which non-investable stocks remain segmented. That non-investable stocks appear to be integrated into world capital markets, may be the result of the positive externality effect that the more open investable component of the market indirectly integrates the non-investable component into the international capital markets, consistent with the argument by Alexander et al. (1987). These results also indicate that the evidence in Ehrmann and Fratzscher (2006) and Hausman and Wongswan (2006) that U.S. monetary policy shocks have a significant impact on emerging market stock returns is not due solely or predominantly to the investable component of these stock markets, as might be expected.

[15] Recall that in Table II monetary policy had no significant impact on aggregate market returns in Colombia, Peru, Jordan, India, Taiwan, the Czech Republic, and Portugal.

*B. Sensitivity of Investable Stocks to Local and U.S. Monetary Policies*

Next, we turn to the results for the investable stocks, reported in Table V and graphed in Figure 4. The evidence is remarkable. We find that in 16 of the 25 markets local monetary policy shocks have a statistically significant and economically large impact on investable stocks. This includes Chile, Mexico, the Philippines, and Turkey as the results for non-investable stocks suggest they would and virtually all markets in which the aggregate market is impacted by local monetary policy. These results are decidedly inconsistent with the view that liberalization has led to a loss of local monetary control. In contrast, they suggest both a substantial level of local monetary control, given that local policy is able to influence this more open segment of the stock market, and that the emerging markets have become highly informationally efficient (Griffin, Kelly, and Nardari (2010)) following liberalization, perhaps as a result of increased participation of foreign investors (Kim and Singal (1998)). As such, these stock markets are an efficient monetary policy transmission mechanism.

As expected, U.S. monetary policy also significantly affects investable stocks, but only in eight markets. This is similar to the number of markets in which non-investable stocks are sensitive to U.S. monetary policy and only about half the number of markets in which investable stocks respond significantly to local monetary policy shock. Taken together, these results lend little support to the claim that liberalization has led to a loss of monetary control. Instead, the evidence suggests that liberalization might have created a positive externality effect that has significantly benefited local monetary authorities. We call this an "efficiency" effect as it appears that foreign participation in the investable component of the stock market and the consequent increase in informational efficiency has led to greater responsiveness to local monetary policy shocks. This is counter to the predictions of what may be termed the "integration" effect whereby local financial assets that are more integrated are more responsive to U.S. monetary policy.

Overall, despite the evidence that foreign monetary policy influences emerging stock markets, local monetary authorities retain significant monetary control during the post-liberalization period in many markets.

*C. Are Investable Stock Returns More Responsive to Local Monetary Policy Shocks?*

The tests of the sensitivity of investable and non-investable stock returns to local monetary policy shocks indicate that investable stocks in a larger number of countries respond significantly to local monetary policy than do non-investable stocks. A glance at the impulse response coefficients also suggests that the response of investable stocks is generally greater in magnitude than that of non-investable stocks. Unfortunately, the SVAR modeling framework does not provide a tractable means of testing if there is a difference in the magnitudes of these responses. Therefore, we take an alternative modeling approach to provide additional insights.

We use an autoregressive-moving average model with exogenous variables (ARMAX) to estimate the monetary policy shocks, where the specification of the ARMAX model is informed by the monetary policy equation in the SVAR model, equation (5). Specifically, we regress the change in the interest rate representing the local monetary policy instrument on the same contemporaneous and lagged endogenous variables used in the earlier SVARs and use the model's residuals $\eta_{LMP,t}$ as the proxy for monetary policy shock:

$$\begin{aligned} LMP_t &= \alpha_0 + \textstyle\sum_{l=0}^{L} \alpha_{oil,l} \times Oil_{t-l} + \sum_{l=1}^{L} \alpha_{FF,l} \times FF_{t-l} + \sum_{l=1}^{L} \alpha_{IP,l} \times IP_{t-l} + \sum_{l=1}^{L} \alpha_{Inf,l} \times Inf_{t-l} \\ &+ \textstyle\sum_{l=1}^{L} \alpha_{LMP,l} \times LMP_{t-l} + \sum_{l=0}^{L} \alpha_{FX,l} \times FX_{t-l} + \sum_{l=1}^{L} \alpha_{\mathrm{Ret},l} \times \mathrm{Ret}_{t-l} + \eta_{LMP,t} \end{aligned} \quad . \tag{7}$$

We then estimate a bivariate seemingly unrelated regression (SUR) of the investable and non-investable stock returns on the proxies for local and U.S. monetary policies:

$$R_{Investable,t} = b_{I0} + b_{I1} \times \eta_{LMP,t} + b_{I2} \times FF_t + \pi_{It} \tag{8i}$$

$$R_{Non-investable,t} = b_{N0} + b_{N1} \times \eta_{LMP,t} + b_{N2} \times FF_t + \pi_{Nt} \tag{8ii}$$

$$E(\pi_{It} \cdot \pi_{Nt}) = \sigma_{IN} \neq 0 \tag{8iii}$$

and test the null hypotheses that the impacts of local monetary policy are the same $H_0 : b_{I1} = b_{N1}$ and that the impacts of U.S. monetary policy are the same: $H_0 : b_{I2} = b_{N2}$. *LMP* is the first difference of the interest rate used to represent the local monetary policy instrument in a particular country.[16] To allow for comparison across countries, we standardize the local monetary policy shock $\eta_{LMP,t}$ in equation (8) by dividing by its standard deviation, creating a variable with a standard deviation of one. Thus the coefficient estimates are interpreted as the response of the dependent variable to a one standard deviation shock. To estimate the monetary policy shocks, equation (7), we use the aggregate market returns as the proxy for the local stock market, *Ret*, (not the investable or non-investable stocks returns) consistent with the SVAR model. For comparison to the existing literature (e.g., Bernanke and Blinder (1992)) we use the first difference of the Federal funds rate as

[16] Given that the regressors are the same in both equations, the SUR coefficients are the same as OLS coefficients, but the SUR facilitates the cross-equation comparison of the effects of local (or U.S.) monetary policy.

the proxy for U.S. monetary policy, *FF*. This variable is not standardized since the coefficient estimate can be consistently interpreted across countries. The rest of the variables are previously described in the Data and Methodology section, Section II. It should be noted that in equation (7) both the changes in oil price and exchange rate changes are allowed to affect local monetary policy contemporaneously. Additionally, the lag lengths vary by country but we use the same number of lags as in the SVAR model of the aggregate market. For the models in equation (8), statistical significance is based on Newey-West autocorrelation- and heteroskedasticity-consistent standard errors with one lag, where the lag length is determined by an analysis of the partial autocorrelation of the dependent variable.

While the proxy for local monetary policy shocks estimated using the ARMAX model in equation (7) is different from that obtained using the more analytically rigorous SVAR model, they share the common feature that both attempt to model the response function of local monetary authorities using the same economic principles. Given that the SUR model is not the paper's main analytical tool but serves only to allow us to provide additional insight, where it is infeasible using the SVAR modeling approach, we think that the benefits of the additional insight outweighs any disadvantages of the simpler SUR model. Before examining if monetary policy has the same effect on investable and non-investable firms, we first report results from an OLS model, Table VI, in which the aggregate market returns are the dependent variable to demonstrate that this proxy for monetary policy does a reasonable job replicating the SVAR results. They indicate qualitatively similar results to the SVAR model for all but six of the 25 countries. Specifically, the OLS model fails to find a significant relationship between local monetary policy and the aggregate market returns in six of the 18 markets for which the SVAR results are significant. However, the two models agree on the significance of local monetary policy in the other 12 markets and on its insignificance in the remaining seven markets of our sample. We get similar results for the estimation of the SUR model in that the sign and significance of the impact of local monetary policy on investable and non-investable stock returns differ in a maximum of six markets from the results using the SVAR model. Hence, there is sufficient commonality between the two modeling approaches to proceed with the goal of comparing the impacts on investable and non-investable firms.

Table VII reports the results from the SUR model for investable and non-investable firms. We find that in all but three markets (Mexico, South Africa, and Korea), the impacts of local monetary policy on investable and non-investable stocks are statistically similar. In Korea and South Africa, non-investable firms are more sensitive to local monetary policy while in Mexico the opposite holds. Thus, the evidence that local monetary policy significantly affects local stock prices does not arise from local policy having a dominant effect on the non-investable component of the stock market, as might be expected. Given that when attempting to influence the real economy, the actions of monetary authorities will have their most direct and immediate effect on the financial markets, the result that local monetary policy generally has a significant and equal effect on investable and non-investable stocks, even after accounting for foreign monetary policy, is conclusive evidence that stock market openness has not led to a loss of emerging market monetary control.

The results also indicate that U.S. monetary policy has a statistically similar impact on investable and non-investable stocks, with the exception of the Thai market where, interestingly, non-investable stocks are more sensitive to U.S. monetary policy. These results support the evidence from the SVAR model that U.S. monetary policy has a significant impact on investable and non-investable stocks in roughly the same number of markets. These results do not lend support to the claim that the openness arising from liberalization led to a loss of local monetary control even though it must be acknowledged that there are externalities to liberalization that cause non-investable stocks to respond to foreign monetary policy as if they too were investable.

## V. Summary and Conclusion

A hotly debated topic among policymakers and academics is that the recent liberalization of financial markets in emerging economies has adversely affected local monetary control. The "impossible trinity" posits that a country cannot achieve high levels of international integration and exchange rate stability while maintaining monetary independence. Thus, following liberalization, the increase in the openness of emerging markets could have resulted in the loss of monetary independence. In order to retain monetary control, emerging market authorities would have had to adopt fully flexible exchange rate regime, a policy choice many emerging economies have resisted.

Using a structural VAR to model the reaction function of emerging market monetary authorities, we examine whether local monetary policy influences stock market prices in the post-liberalization period for a sample of 25 emerging markets. Our results reveal that emerging market authorities have retained significant monetary control following liberalization as local monetary policy shocks have a statistically significant and economically large impact on stock market returns in about 70% of the sample. These results account for U.S. monetary policy and so are not driven by local monetary policy acting as a proxy for U.S. monetary policy. Similar to recent research, we find that U.S. monetary policy impacts emerging financial markets. In fact, in a few of these markets U.S. monetary policy influences local asset prices where local policy does not. However, in general U.S. monetary policy does not dominate local monetary policy.

Not all firms in emerging markets embraced liberalization or met the criteria to liberalize, resulting in a market with two distinct classes of firms: investable, those firms which are able to raise foreign capital and are open to foreign ownership, and non-investable stocks which do not. We take advantage of this unique and important feature of emerging markets to gain further insight. It is possible that the evidence of local monetary control in the post-liberalization period is due solely to the impact of local monetary policy on the non-investable component of the overall market because local monetary policy has no influence on investable stocks. As such, liberalization would have led to a loss of monetary control, albeit not a complete loss. Similarly, the evidence that emerging markets are sensitive to U.S. monetary policy may be because of the investable component of the overall stock market.

We find that local monetary authorities are able to influence their entire market as local monetary policy shocks significantly impact the returns of both investable and non-investable stocks. Furthermore, the impact of local monetary policy on investable and non-investable stock returns is statistically indistinguishable. In these markets, this is strong evidence against the argument that emerging stock market openness leads to a loss of local monetary control.

We also find that U.S. monetary policy has a significant effect on both investable and non-investable stocks in several markets. Overall, these effects are both statistically and economically similar, implying that recent evidence that U.S. monetary policy has a significant impact on the emerging markets is not due solely to the investable component of the emerging stock markets, as might be expected, and does not support the claim that liberalization led to a loss of local monetary control.

In sum, our paper addresses the concern that increased financial market openness in emerging economies results in a loss of local monetary control. We find robust results which indicate that financial market openness does not eliminate local monetary control. Rather, openness makes monetary policy authorities' task more complicated in that liberalization opens markets to the influence of foreign monetary policy, but local authorities retain influence over their own markets whether or not firms are open to foreign investment. These findings are robust to controls for the recent emerging market financial crises, alternative measures of monetary policy and different modeling approaches.

We leave for future work an examination of why some emerging financial markets respond to local monetary policy and others do not. It appears that simple explanations for the lack of response, such as high levels of openness, might not be sufficient because the evidence indicates that local monetary policy has a statistically similar impact on the more open segment of the market as it does on the less open segment. In fact, the results suggest an "efficiency" effect in that informational efficiency increases with financial market openness and this in turn leads to greater responsiveness to local monetary policy. This is in contrast to what would be predicted under what may be called an "integration" effect, whereby openness leads to reduced responsiveness to local monetary policy.

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## Appendix 1
## IFC Selection of Stocks for the Global Index

The IFC selects stocks for the IFCG index depending on trading activities and aim to obtain market coverage of 60 to 75% of total market capitalization. The IFC selects stocks for the Investable Index by first identifying all stocks in the Global Index that foreign investors are legally allowed to own, trade, and repatriate the proceeds from their trades. From these stocks the IFC selects those that, in the year preceding addition to the IFCI index, are at least $50 million in market capitalization, have at least $20 million in trading volume, and trade at least half the trading days that the country's stock market is open.

The emerging markets data require careful scrutiny to eliminate several potential problems. In the first place, there was a misplaced decimal point in some of the EMDB data. For instance, an index value that was obviously, say, 1200.00 appeared as 12 fairly frequently. We applied appropriate numerical filters and graphed the data to ensure that these were corrected. Second, several currencies, such as those of Brazil, Greece, Portugal, Russia, and Turkey, were re-denominated during the sample period. This created a large change in local-currency values, such as the market capitalization, unrelated to the performance of the stock market. For each country, the EMDB provides bilateral exchange rates and a variable called "scale" that indicates when there is such a change. Hence, currencies with a scale different from 1 were immediately identified. Using the scale factor and the new exchange rates we recreated the exchange rate that is consistent with the old series prior to the re-denomination. This "corrected" exchange rate is then used to make adjustments to, say, the market capitalization of the local-currency index. Third, in high-inflation countries like Argentina and Brazil local currency-based values, such as price and total return indices, market capitalization, and money supply were sometimes restated by weighting the value by, say, the inverse of 1,000. These were accounted for before computing returns and other values of interest.

Return data end in December 2005, except the EMDB Investable Index for Colombia, which end in October 2001. Data for Greece (200104) and Portugal (199812) also end prior to 2005, because of their entry to the European Monetary Union. For Portugal, as of November 1997 the IFC reported the numbers of stocks in the Investable and Global Indices as the same, yet there is a material difference in their market values. We assumed that the market values are correct and computed returns for non-investable stocks for the subsequent period.

It may be that how liberalization affects monetary independence is related to the extent to which a country's stock market becomes investable after liberalization. To provide some insight into the degree of openness of the stock markets after liberalization, we calculate the Edison and Warnock (2003) measure of capital control intensity, measured as 100*(1 – (U.S. dollar market capitalization of the investable stocks/U.S. dollar market capitalization of the stocks in the global index)). A maximum capital control of 100 implies that foreign ownership in the country's firms is not allowed, while a measure of zero is obtained when all the firms in the Global Index become accessible to foreign investors (i.e., become investable firms). Summary statistics of the measure are reported in Appendix 2. There is substantial variation in the degree of capital control (lack of openness) across countries, ranging from an average of less than 1 for South Africa to about 75 for Zimbabwe. This is consistent with the findings of Bae, Chan, and Ng (2004)). Judging from the difference between the minimum and maximum values for each individual country, it is clear that there is also significant time variation in the level of capital control. This is not surprising and reflects both a policy of incremental opening of the market to foreign investors and variation in the interest of foreign investors in these securities, consistent with several papers that have shown that these markets experience time-varying integration (e.g., Bekaert and Harvey (1995)).

## Appendix 2
## Summary Statistics of Capital Control Intensity of Emerging Markets

This table reports the average capital control intensity of the emerging markets. The capital control intensity ratio is a measure of the market's segmentation, with a maximum of 100 indicating a highly segmented market and zero a highly integrated market. The ratio is defined as $\text{Capital Control Intensity}_{it} = 100 * (1 - (IMCAPUS_{it} / GMCAPUS_{it}))$, where $IMCAPUS_{it}$ is the market capitalization of country *i*'s IFC Investable Index in U.S. dollars at time *t* and $GMCAPUS_{it}$ is the market capitalization of country *i*'s IFC Global Index in U.S. dollars. The measure is defined similar to that used by Edison and Warnock (2003) and is computed over the period that the IFC reported the Investable Index. The period differs across countries depending on the availability of the data. The beginning of the period over which the IFC reports the Investable Index may be slightly different from the market's official liberalization date.

| Country | No. Obs | Mean | Std dev | Minimum | Maximum |
|---|---|---|---|---|---|
| Argentina | 205 | 6.16 | 6.64 | 0.05 | 28.66 |
| Brazil | 205 | 27.21 | 25.92 | 3.87 | 88.08 |
| Chile | 205 | 36.75 | 36.73 | 0.66 | 85.98 |
| Colombia | 129 | 24.78 | 12.55 | 4.41 | 59.25 |
| Mexico | 205 | 12.56 | 19.23 | 0.26 | 89.29 |
| Venezuela | 142 | 29.08 | 22.61 | 0.42 | 67.25 |
| India | 158 | 64.96 | 15.91 | 32.91 | 79.97 |
| Korea | 168 | 41.66 | 39.43 | 2.54 | 92.51 |
| Malaysia | 205 | 14.12 | 9.29 | 3.27 | 35.20 |
| Pakistan | 128 | 37.26 | 24.98 | 11.29 | 84.59 |
| Philippines | 205 | 51.37 | 4.93 | 35.72 | 65.06 |
| Taiwan | 180 | 62.71 | 27.43 | 1.21 | 96.95 |
| Thailand | 205 | 57.78 | 13.89 | 33.53 | 78.89 |
| South Africa | 153 | 0.89 | 1.32 | 0.00 | 4.63 |
| Zimbabwe | 101 | 74.83 | 9.73 | 58.31 | 88.80 |
| Czech | 141 | 28.63 | 27.84 | 0.00 | 71.54 |
| Hungary | 153 | 11.46 | 15.28 | 0.45 | 54.01 |
| Israel | 105 | 1.19 | 0.91 | 0.26 | 3.37 |
| Greece | 145 | 9.30 | 10.09 | 0.00 | 38.31 |
| Portugal | 121 | 26.55 | 13.13 | 3.95 | 47.28 |
| Turkey | 197 | 2.92 | 6.92 | 0.00 | 67.36 |

## Table I
## Summary Statistics for Emerging Stock Market Returns

This table reports for each country the number of monthly observations, sample mean, and standard deviation of local-currency returns for the aggregate local market (EMDB's Global Index), investable stocks (EMDB's Investable Index), and non-investable firms. The return on non-investable firms is calculated as:

$$R_{Nt} = (M_{At-1} \times R_{At} - M_{It-1} \times R_{It}) / (M_{At-1} - M_{It-1}),$$

where the market capitalization of the stocks in the aggregate local market is represented by $M_A$ and $R_A$ represents their return. $M_I$ and $R_I$ represent, respectively, the market capitalization of and return on the stocks in the investable index. The start date is the first date data are available following the liberalization date (taken from Bekaert, Harvey, and Lumsdaine (2002) where available). Except for Greece (04/01), Slovakia (10/04), and Portugal (12/98), each sample ends in December 2005.

| | Start | Aggregate Local Market | | | Investable | | | Non-investable | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | Obs | Mean | Std | Obs | Mean | Std | Obs | Mean | Std |
| *Central and South America* | | | | | | | | | | |
| Argentina | 10/93 | 147 | 0.8 | 10.9 | 147 | 0.8 | 10.9 | 147 | 1.6 | 15.6 |
| Brazil | 11/94 | 134 | 1.0 | 9.1 | 134 | 1.0 | 9.3 | 134 | 1.4 | 9.0 |
| Chile | 09/94 | 135 | 0.4 | 5.7 | 135 | 0.3 | 5.8 | 135 | 0.5 | 5.1 |
| Colombia | 04/91 | 94 | 0.9 | 10.0 | 94 | 1.1 | 10.1 | 94 | -0.4 | 12.4 |
| Mexico | 07/89 | 198 | 0.9 | 7.6 | 198 | 1.0 | 7.9 | 198 | 0.9 | 10.3 |
| Peru | 02/93 | 155 | 1.2 | 7.6 | 155 | 1.1 | 7.9 | 155 | 1.6 | 8.5 |
| Venezuela | 02/96 | 81 | -0.4 | 12.3 | 69 | -0.5 | 13.0 | 69 | -0.1 | 16.5 |
| *Middle East and Africa* | | | | | | | | | | |
| Israel | 01/97 | 108 | 1.1 | 6.4 | 108 | 1.1 | 6.4 | 108 | 2.1 | 11.4 |
| Jordan | 02/96 | 119 | 1.6 | 5.5 | 69 | 0.2 | 3.6 | 69 | 0.3 | 3.6 |
| S. Africa | 02/97 | 107 | 1.0 | 6.9 | 107 | 1.0 | 6.9 | 55 | 0.6 | 14.2 |
| *Asia* | | | | | | | | | | |
| India | 01/93 | 125 | -0.3 | 7.9 | 125 | -0.3 | 8.1 | 125 | -0.2 | 7.9 |
| Korea | 03/92 | 166 | 0.4 | 10.1 | 166 | 0.5 | 10.2 | 166 | 0.0 | 9.8 |
| Malaysia | 02/89 | 203 | 0.2 | 8.4 | 203 | 0.3 | 8.6 | 203 | 0.4 | 8.1 |
| Pakistan | 07/97 | 102 | 1.3 | 11.7 | 52 | -1.0 | 14.5 | 52 | 0.0 | 11.4 |
| Philippines | 08/91 | 173 | 0.0 | 8.0 | 173 | -0.1 | 8.9 | 173 | 0.0 | 7.6 |
| Taiwan | 03/91 | 178 | 0.1 | 9.0 | 178 | 0.2 | 9.0 | 178 | 0.0 | 9.0 |
| Thailand | 02/91 | 179 | 0.0 | 11.2 | 179 | 0.0 | 11.0 | 179 | 0.0 | 11.5 |
| *Europe* | | | | | | | | | | |
| Czech | 01/94 | 144 | 0.2 | 8.0 | 144 | 0.3 | 9.3 | 119 | -0.7 | 8.8 |
| Greece | 02/88 | 157 | 1.0 | 10.5 | 146 | 1.3 | 11.3 | 129 | 2.4 | 12.3 |
| Hungary | 01/93 | 156 | 0.9 | 9.9 | 156 | 1.1 | 10.7 | 156 | 0.4 | 7.7 |
| Poland | 01/93 | 156 | 1.3 | 13.2 | 156 | 1.3 | 13.2 | 119 | 1.4 | 10.1 |
| Portugal | 09/86 | 146 | 1.0 | 10.5 | 118 | 0.5 | 6.6 | 118 | 0.5 | 6.6 |
| Russia | 02/00 | 71 | 1.7 | 10.5 | 71 | 1.3 | 11.1 | 71 | 2.6 | 11.3 |
| Slovakia | 01/96 | 106 | 0.0 | 7.7 | 56 | -1.6 | 7.8 | 56 | -1.0 | 7.7 |
| Turkey | 10/89 | 195 | 0.3 | 15.8 | 195 | 0.3 | 15.8 | 125 | -8.5 | 64.3 |

## Table II

## Impulse Responses of Aggregate Market Stock Returns to Monetary Policy Shocks

This table reports the first period (contemporaneous) impulse response of local stock market returns to a one standard deviation structural shock in local and U.S. monetary policies and the standard deviation of the structural shocks of local and U.S. monetary policies. The impulse responses are obtained from a structural VAR with seven endogenous variables: 100 times the log first difference of oil prices in current U.S. dollars; first difference of the annualized U.S. Fed funds rate; 100 times log first difference of the local industrial production index; 100 times log first difference of the local consumer price index; first difference of the annualized local monetary policy interest rate; 100 times log first difference of the exchange rate stated as US$/local currency of each country; and real return on the aggregate local stock market measured as 100 times log first difference of EMDB's Global index deflated by local inflation. The model contains a constant as the only exogenous variable. The monetary policy proxy is noted in the second column. DR is the discount rate, GB is a 10-year government bond rate, IB is the interbank rate, MM is the money market rate, and TB is the local government's Treasury bill rate. Monetary policy proxies are winsorized at the 5th and 95th percentiles. A □ indicates that the upper and lower Bayesian probability bands of the contemporaneous ($t$ = 0) impulse response are both below the zero horizontal line indicating that the response to a positive monetary policy shock is statistically significantly different from zero.

| | | Response of Returns to | | Standard Deviation of Structural Residuals | |
|---|---|---|---|---|---|
| Country | Local Monetary Policy Proxy | Local Monetary Policy | U.S. Monetary Policy | Local Monetary Policy | U.S. Monetary Policy |
| *Central and South America* | | | | | |
| Argentina | IB | -3.079□ | 0.189 | 3.55 | 0.143 |
| Brazil | IB | -2.000□ | -1.107□ | 1.97 | 0.119 |
| Chile | IB | -1.628□ | -1.076□ | 0.38 | 0.117 |
| Colombia | DR | -0.600 | -3.510□ | 0.96 | 0.135 |
| Mexico | IB | -0.713□ | -0.945 | 2.33 | 0.143 |
| Peru | DR | 0.118 | -0.285 | 1.46 | 0.136 |
| Venezuela | MM | -2.308□ | -1.949□ | 6.08 | 0.149 |
| *Middle East and Africa* | | | | | |
| Israel | TB | -2.296□ | 0.793 | 0.22 | 0.132 |
| Jordan | DR | -0.068 | -0.351 | 0.14 | 0.122 |
| South Africa | GB | -2.324□ | -1.262□ | 0.32 | 0.127 |
| *Asia* | | | | | |
| India | DR | -0.458 | -1.011□ | 0.12 | 0.143 |
| Korea | MM | -1.142□ | 0.493 | 0.66 | 0.134 |
| Malaysia | TB | -1.944□ | -0.355 | 0.22 | 0.143 |
| Pakistan | MM | -1.753□ | 1.118 | 2.12 | 0.126 |
| Philippines | IB | -1.214□ | -0.673 | 3.18 | 0.137 |
| Taiwan | IB | -0.676 | 0.324 | 0.49 | 0.129 |
| Thailand | IB | -1.290□ | -1.908□ | 1.83 | 0.141 |
| *Europe* | | | | | |
| Czech | IB | 0.712 | -0.685 | 0.89 | 0.125 |
| Greece | TB | -2.641□ | -0.246 | 0.32 | 0.154 |
| Hungary | TB | -1.165□ | -1.674□ | 0.56 | 0.127 |
| Poland | MM | -2.708□ | -1.342□ | 1.23 | 0.128 |
| Portugal | DR | -0.505 | 2.442□ | 0.46 | 0.171 |
| Russia | IB | -2.999□ | 0.549 | 5.79 | 0.115 |
| Slovakia | IB | -1.193□ | -2.056□ | 4.49 | 0.133 |
| Turkey | MM | -4.803□ | -1.489□ | 7.51 | 0.130 |

## Table III
## Impulse Responses of Aggregate Market Stock Returns to Monetary Policy Shocks Accounting for Currency Crises

This table reports the first period (contemporaneous) impulse response of local stock market returns to a one standard deviation structural shock in local and U.S. monetary policies and the standard deviation of the structural shocks of local and U.S. monetary policies. The impulse responses are obtained from a structural VAR with seven endogenous variables: 100 times the log first difference of oil prices in current U.S. dollars; first difference of the annualized U.S. Fed funds rate; 100 times log first difference of the local industrial production index; 100 times log first difference of the local consumer price index; first difference of the annualized local monetary policy interest rate; 100 times log first difference of the exchange rate stated as US$/local currency of each country; and real return on the aggregate local stock market measured as 100 times log first difference of EMDB's Global Index deflated by local inflation. The exogenous variables are a constant and dummy variables to account for the Mexican and Asian currency crises. These are defined as one during the period December 1994 to December 1995 after the Mexican crisis and zero otherwise and as one during the period June 1997 to June 1998 after the Asian crisis and zero otherwise. The monetary policy proxy for each country is described in Table II. Monetary policy proxies are winsorized at the 5th and 95th percentiles. A □ indicates that the upper and lower Bayesian probability bands of the contemporaneous ($t$ = 0) impulse response are both below the zero horizontal line indicating that the response to a positive monetary policy shock is statistically significantly different from zero.

| | Response of Returns to | | Standard Deviation of Structural Residuals | |
|---|---|---|---|---|
| Country | Local Monetary Policy | U.S. Monetary Policy | Local Monetary Policy | U.S. Monetary Policy |
| *Central and South America* | | | | |
| Argentina | -3.039□ | 0.111 | 3.56 | 0.144 |
| Brazil | -2.164□ | -1.028□ | 1.94 | 0.119 |
| Chile | -1.588□ | -1.022□ | 0.38 | 0.114 |
| Colombia | -0.616 | -3.490□ | 0.96 | 0.137 |
| Mexico | -1.637□ | -0.081 | 2.32 | 0.143 |
| Peru | 0.123 | -0.179 | 1.46 | 0.135 |
| Venezuela | -2.296□ | -1.852□ | 6.18 | 0.152 |
| *Middle East and Africa* | | | | |
| Israel | -2.040□ | 1.103□ | 0.24 | 0.130 |
| Jordan | -0.209 | -0.311 | 0.13 | 0.123 |
| South Africa | -2.451□ | -1.103□ | 0.33 | 0.127 |
| *Asia* | | | | |
| India | -0.522 | -1.033□ | 0.11 | 0.143 |
| Korea | -1.301□ | 0.401 | 0.67 | 0.128 |
| Malaysia | -1.929□ | -0.478 | 0.21 | 0.142 |
| Pakistan | -1.355 | 1.404□ | 2.13 | 0.127 |
| Philippines | -1.192□ | -0.327 | 3.15 | 0.136 |
| Taiwan | -0.707 | 0.352 | 0.49 | 0.130 |
| Thailand | -1.290□ | -1.683□ | 1.81 | 0.141 |
| *Europe* | | | | |
| Czech | 0.733 | -1.092□ | 0.88 | 0.127 |
| Greece | -2.455□ | -0.164 | 0.32 | 0.154 |
| Hungary | -1.168□ | -1.626□ | 0.55 | 0.127 |
| Poland | -2.701□ | -1.356□ | 1.24 | 0.128 |
| Portugal | -0.534 | 2.473□ | 0.46 | 0.172 |
| Russia | -3.021□ | 0.631 | 5.93 | 0.117 |
| Slovakia | -1.461□ | -1.750□ | 4.44 | 0.131 |
| Turkey | -4.813□ | -1.511□ | 7.52 | 0.130 |

## Table IV
## Impulse Responses of Non-Investable Stock Returns to Monetary Policy Shocks

This table reports the first period (contemporaneous) impulse response of non-investable stock returns to a one standard deviation structural shock in local and U.S. monetary policies and the standard deviation of the structural shocks of local and U.S. monetary policies. The impulse responses are obtained from a structural VAR with the seven endogenous variables described in Table II plus a constant. The monetary policy proxy for each country is described in Table II. Monetary policy proxies are winsorized at the 5th and 95th percentiles. A □ indicates that the upper and lower Bayesian probability bands of the contemporaneous ($t$ = 0) impulse response are both below the zero horizontal line indicating that the response to a positive monetary policy shock is statistically significantly different from zero.

| | Response of Returns to Local Monetary Policy | Response of Returns to U.S. Monetary Policy | Standard Deviation of Structural Residuals | |
|---|---|---|---|---|
| | | | Local Monetary Policy | US Monetary Policy |
| Country | Coefficient | Coefficient | (%) | (%) |
| *Central and South America* | | | | |
| Argentina | -2.229□ | 0.802 | 3.68 | 0.142 |
| Brazil | -1.844□ | -1.199□ | 1.90 | 0.128 |
| Chile | -0.378 | 0.374 | 0.38 | 0.121 |
| Colombia | -0.454 | -4.740□ | 1.02 | 0.140 |
| Mexico | -0.305 | -0.315 | 2.31 | 0.144 |
| Peru | 0.461 | -0.308 | 1.45 | 0.138 |
| *Middle East and Africa* | | | | |
| Israel | -3.635□ | -0.272 | 0.23 | 0.127 |
| Jordan | 0.146 | -0.147 | 0.15 | 0.145 |
| *Asia* | | | | |
| India | -0.648 | -0.135 | 0.12 | 0.142 |
| Korea | -1.530□ | 0.195 | 0.66 | 0.138 |
| Malaysia | -1.817□ | -0.649 | 0.22 | 0.144 |
| Philippines | -0.945 | -0.905□ | 3.15 | 0.135 |
| Taiwan | -0.662 | 0.258 | 0.49 | 0.129 |
| Thailand | -1.370□ | -2.011□ | 1.83 | 0.141 |
| *Europe* | | | | |
| Czech | -0.239 | -1.159□ | 0.96 | 0.143 |
| Greece | -3.238□ | -1.810□ | 0.34 | 0.141 |
| Hungary | -1.716□ | 0.325 | 0.51 | 0.138 |
| Poland | -1.219□ | -1.609□ | 0.94 | 0.137 |
| Portugal | -0.760 | -0.069 | 0.47 | 0.139 |
| Russia | -2.095□ | 0.936 | 5.85 | 0.117 |
| Turkey | -1.557 | -0.933 | 4.84 | 0.138 |

## Table V
## Impulse Responses of Investable Stock Returns to Monetary Policy Shocks

This table reports the first period (contemporaneous) impulse response of investable stock returns to a one standard deviation structural shock in local and U.S. monetary policies and the standard deviation of the structural shocks of local and U.S. monetary policies. The impulse responses are obtained from a structural VAR with the seven endogenous variables described in Table II plus a constant. The monetary policy proxy for each country is described in Table II. Monetary policy proxies are winsorized at the 5th and 95th percentiles. A □ indicates that the upper and lower Bayesian probability bands of the contemporaneous ($t$ = 0) impulse response are both below the zero horizontal line indicating that the response to a positive monetary policy shock is statistically significantly different from zero.

| | Response of Returns to Local Monetary Policy | Response of Returns to U.S. Monetary Policy | Standard Deviation of Structural Residuals | |
|---|---|---|---|---|
| | | | Local Monetary Policy | U.S. Monetary Policy |
| Country | Coefficient | Coefficient | (%) | (%) |
| *Central and South America* | | | | |
| Argentina | -3.090□ | 0.163 | 3.53 | 0.143 |
| Brazil | -2.326□ | -1.613□ | 1.87 | 0.121 |
| Chile | -1.645□ | -1.074□ | 0.38 | 0.117 |
| Colombia | -0.368 | -3.340□ | 0.95 | 0.135 |
| Mexico | -1.730□ | -0.210 | 2.33 | 0.143 |
| Peru | -0.012 | -0.236 | 1.48 | 0.135 |
| Venezuela | -0.591 | -1.571 | 6.05 | 0.148 |
| *Middle East and Africa* | | | | |
| Israel | -2.293□ | 0.766 | 0.22 | 0.133 |
| Jordan | -0.388 | -0.620□ | 0.14 | 0.137 |
| South Africa | -2.296□ | -1.261□ | 0.32 | 0.127 |
| *Asia* | | | | |
| India | -0.471 | -0.136 | 0.12 | 0.142 |
| Korea | -1.070□ | 0.466 | 0.66 | 0.133 |
| Malaysia | -1.957□ | -0.311 | 0.22 | 0.143 |
| Philippines | -1.584□ | -0.566 | 3.23 | 0.137 |
| Taiwan | -0.654 | 0.353 | 0.49 | 0.129 |
| Thailand | -1.229□ | -1.772□ | 1.83 | 0.141 |
| *Europe* | | | | |
| Czech | 0.738 | -0.644 | 0.89 | 0.121 |
| Greece | -2.779□ | -0.127 | 0.32 | 0.146 |
| Hungary | -1.224□ | -1.630□ | 0.56 | 0.127 |
| Poland | -2.695□ | -1.335□ | 1.24 | 0.128 |
| Portugal | -0.869□ | -0.571 | 0.52 | 0.145 |
| Russia | -3.354□ | 0.743 | 5.81 | 0.114 |
| Turkey | -4.729□ | -1.397 | 7.50 | 0.130 |

## Table VI
## OLS Estimates of the
## Impact of Monetary Policy Shocks on Aggregate Stock Market Returns

This table reports results from regressing real aggregate local market returns on local and U.S. monetary policy shocks. Local monetary policy shocks are residuals obtained from estimating an autoregressive-moving average model with exogenous variables (ARMAX) of the changes in local monetary policy instrument where the regressors are the contemporaneous and lagged endogenous variables in the 7-variable system used in the SVAR model for aggregate local market returns. U.S. monetary policy shocks are represented by changes in the Fed funds rate. The monetary policy instrument for each country is winsorized at the 5th and 95th percentiles and the shocks are standardized with a mean of zero and a standard deviation of one. Statistical significance is based on Newey-West autocorrelation- and heteroskedasticity-consistent standard errors with one lag. *, **, and *** represent significance at the 10, 5, and 1 percent significance levels.

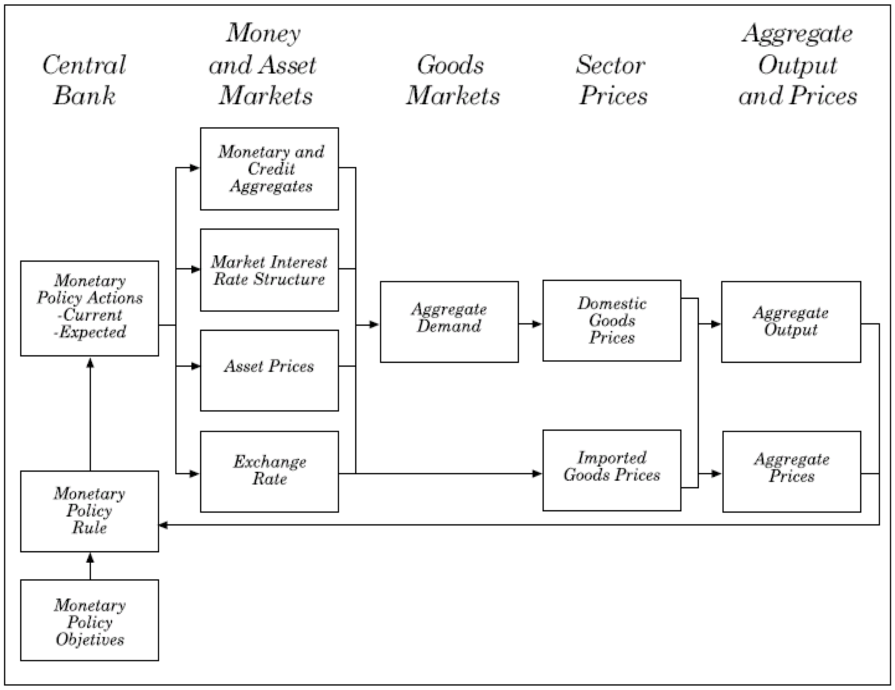
| Country | Constant | Local Monetary Policy | U.S. Monetary Policy | Adj $R^2$ | DW | Obs | F-test |
|---|---|---|---|---|---|---|---|
| *Central and South America* | | | | | | | |
| Argentina | 0.75 | -1.93* | 2.41 | 0.02 | 1.92 | 140 | 0.243 |
| Brazil | 1.42* | -1.72 | 2.37 | 0.02 | 2.22 | 129 | 0.198 |
| Chile | 0.41 | -0.25 | -2.84 | -0.01 | 2.00 | 129 | 0.657 |
| Colombia | 0.42 | -0.93 | -26.19** | 0.19 | 1.15 | 91 | 0.005 |
| Mexico | 0.76 | -1.08* | -4.14 | 0.02 | 1.89 | 191 | 0.060 |
| Peru | 1.05* | 0.21 | -1.23 | -0.01 | 2.01 | 147 | 0.866 |
| Venezuela | -0.88 | -2.15 | 0.16 | 0.00 | 2.26 | 77 | 0.375 |
| *Middle East and Africa* | | | | | | | |
| Israel | 1.01* | -1.64** | 3.72 | 0.06 | 2.02 | 103 | 0.009 |
| Jordan | 1.73** | -0.07 | 0.62 | -0.02 | 1.78 | 113 | 0.970 |
| South Africa | 0.95 | -2.04** | -2.45 | 0.07 | 1.99 | 103 | 0.002 |
| *Asia* | | | | | | | |
| India | -0.27 | -0.52 | -2.48 | -0.01 | 1.93 | 117 | 0.579 |
| Korea | 0.56 | -1.42** | -5.74 | 0.02 | 1.74 | 162 | 0.052 |
| Malaysia | 0.00 | -1.97** | -6.87** | 0.07 | 1.91 | 199 | 0.004 |
| Pakistan | 1.24 | -2.01* | 2.55 | 0.01 | 2.02 | 99 | 0.200 |
| Philippines | -0.04 | -1.02 | -5.78 | 0.03 | 1.72 | 168 | 0.197 |
| Taiwan | 0.11 | -0.17 | -0.99 | -0.01 | 1.90 | 173 | 0.929 |
| Thailand | -0.12 | -1.32* | -10.16** | 0.03 | 2.00 | 174 | 0.029 |
| *Europe* | | | | | | | |
| Czech | 0.30 | 0.60 | -4.36 | 0.01 | 1.73 | 138 | 0.244 |
| Greece | 1.03 | -2.73** | -5.74 | 0.06 | 1.75 | 145 | 0.001 |
| Hungary | 1.10 | -0.96 | -6.49 | 0.01 | 1.98 | 152 | 0.187 |
| Poland | 0.58 | -2.50** | -4.93 | 0.04 | 1.96 | 151 | 0.056 |
| Portugal | 0.72 | -0.23 | 9.01 | 0.02 | 1.49 | 136 | 0.273 |
| Russia | 1.44 | -2.63** | -3.12 | 0.04 | 1.79 | 68 | 0.063 |
| Slovakia | -0.62 | -1.11 | -7.18 | 0.03 | 1.81 | 100 | 0.065 |
| Turkey | -0.01 | -3.77** | 1.00 | 0.05 | 2.06 | 190 | 0.012 |

## Table VII
## SUR Estimates of
## the Impact of Monetary Policy Shocks on Investable and Non-Investable Stock Returns

This table reports results from jointly regressing real investable and non-investable stock returns on local and U.S. monetary policy shocks using an SUR model. Local monetary policy shocks are residuals obtained from estimating an autoregressive-moving average model with exogenous variables (ARMAX) of the changes in local monetary policy instrument where the regressors are the contemporaneous and lagged endogenous variables in the 7-variable system used in the SVAR model for aggregate local market returns. U.S. monetary policy shocks are represented by changes in the Fed funds rate. The monetary policy instrument for each country is winsorized at the 5th and 95th percentiles and the shocks are standardized with a mean of zero and a standard deviation of one. Statistical significance is based on Newey-West autocorrelation- and heteroskedasticity-consistent standard errors with one lag. *, **, and *** represent significance at the 10, 5, and 1 percent significance levels.

| | Investable | | Non-Investable | | Equal Impact On | |
|---|---|---|---|---|---|---|
| Country | Local | U.S. | Local | U.S. | Local | U.S. |
| *Central and South America* | | | | | | |
| Argentina | -1.94* | 2.68 | -1.07 | -0.47 | 0.402 | 0.589 |
| Brazil | -1.59 | 2.38 | -0.90 | 4.62 | 0.176 | 0.289 |
| Chile | -0.25 | -2.87 | 0.55 | 1.25 | 0.242 | 0.137 |
| Colombia | -0.90 | -25.55** | -0.54 | -26.18** | 0.650 | 0.875 |
| Mexico | -1.16* | -4.37 | 0.42 | -3.67 | 0.034 | 0.816 |
| Peru | 0.17 | -1.49 | 0.26 | 0.50 | 0.883 | 0.468 |
| Venezuela | -2.32 | -0.66 | -1.40 | 5.61 | 0.557 | 0.302 |
| *Middle East and Africa* | | | | | | |
| Israel | -1.63** | 3.72 | -2.30* | 4.33 | 0.606 | 0.905 |
| Jordan | 0.16 | -5.34** | 0.05 | -4.43* | 0.539 | 0.160 |
| South Africa | -2.72** | 2.39 | -5.14** | 0.96 | 0.084 | 0.777 |
| *Asia* | | | | | | |
| India | -0.40 | -2.62 | -0.54 | -2.38 | 0.204 | 0.660 |
| Korea | -1.37** | -5.98 | -1.73** | -4.61 | 0.089 | 0.431 |
| Malaysia | -1.97** | -6.57** | -1.90** | -8.41** | 0.835 | 0.167 |
| Pakistan | -1.76 | -1.27 | -2.59** | -3.09 | 0.355 | 0.667 |
| Philippines | -1.23 | -5.14 | -0.84 | -6.31 | 0.214 | 0.363 |
| Taiwan | -0.20 | -0.91 | -0.16 | -1.40 | 0.549 | 0.203 |
| Thailand | -1.31* | -9.23** | -1.34* | -11.38** | 0.887 | 0.087 |
| *Europe* | | | | | | |
| Czech | 0.51 | -8.70** | -0.14 | -8.02** | 0.359 | 0.875 |
| Greece | -2.82** | -5.43 | -2.31** | 2.21 | 0.694 | 0.178 |
| Hungary | -0.90 | -6.38 | -0.71 | -3.62 | 0.828 | 0.446 |
| Poland | -2.79** | 1.40 | -2.01* | -2.21 | 0.347 | 0.340 |
| Portugal | -0.70 | -2.10 | -0.47 | -0.24 | 0.452 | 0.455 |
| Russia | -2.99** | -4.08 | -1.84 | -1.49 | 0.301 | 0.499 |
| Slovakia | -0.82 | -6.23 | -0.19 | -12.81** | 0.481 | 0.229 |
| Turkey | -2.33 | 0.38 | -4.92** | 8.49 | 0.307 | 0.456 |

**Figure 1. Monetary Policy Rule and Transmission Mechanisms**

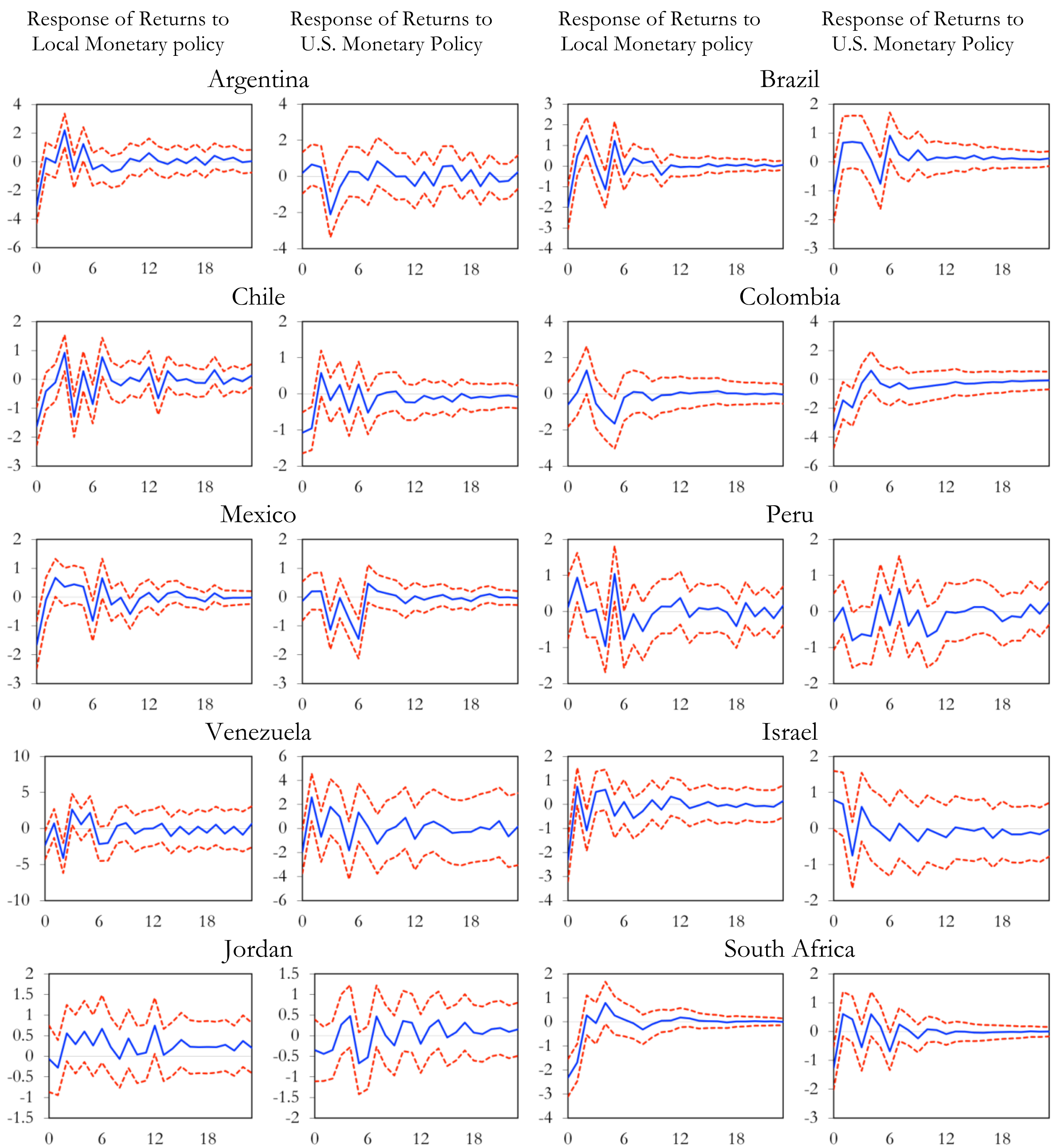


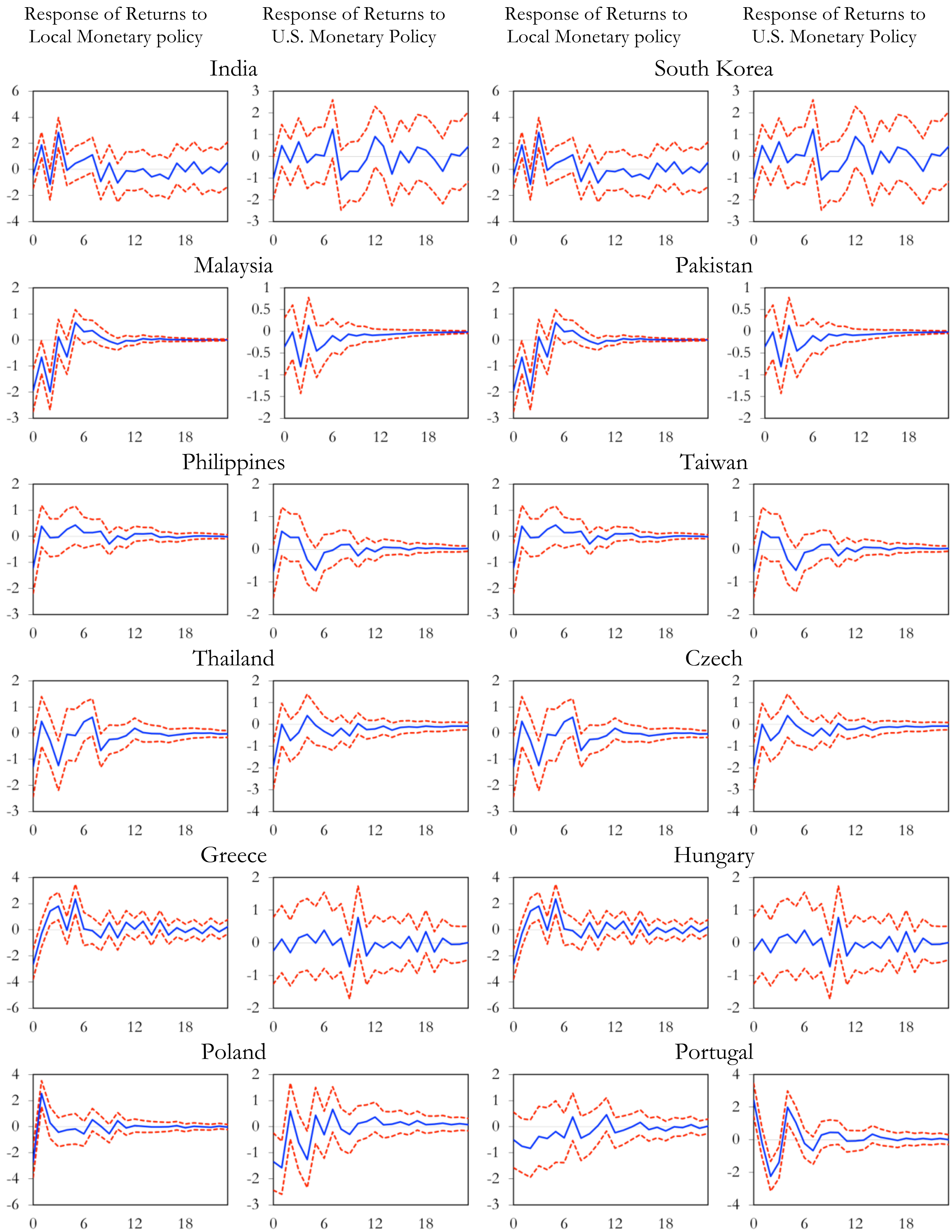

This figure depicts the relationships between monetary policy actions and commonly accepted monetary policy transmission channels.

Source: Loayza and Schmidt-Hebbel (2002)

## Figure 2
## Impulse Responses of Aggregate Local Market Returns to a One Standard Deviation Shock in Local and U.S. Monetary Policies

This figure reports impulse responses of aggregate stock market returns over 24 months in response to a one standard deviation structural shock in local and U.S. monetary policies. The impulse responses are obtained from a structural VAR with the seven endogenous variables described in Table II plus a constant. The left axis is in percent.

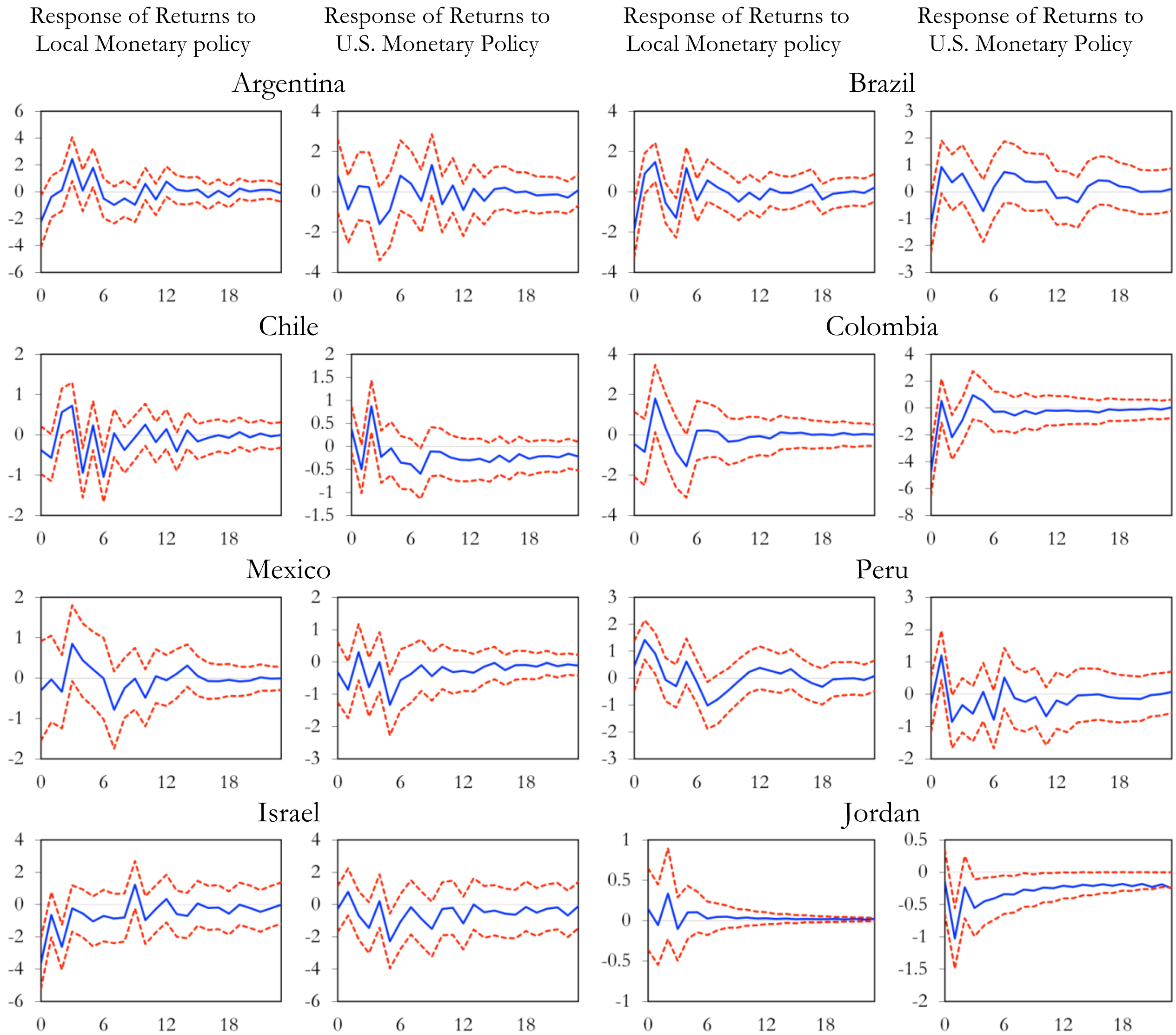


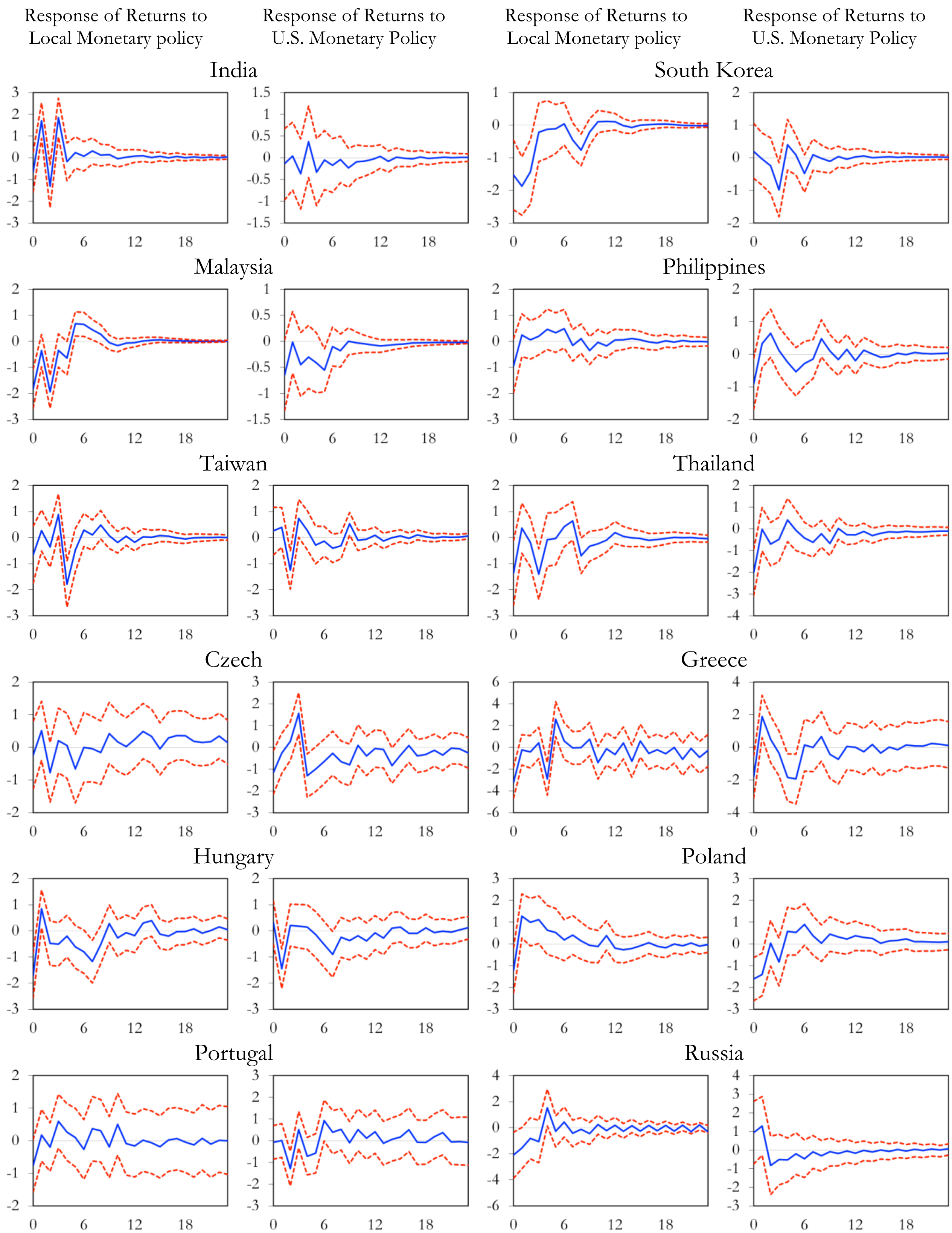

Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
India
South Korea
Malaysia
Pakistan
Philippines
Taiwan
Thailand
Czech
Greece
Hungary
Poland
Portugal


Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Russia
Slovakia
Turkey
0
6
12
18

**Figure 3**
**Impulse Responses of Non-Investable Stock Returns to a One Standard Deviation Structural Shock in Local and U.S. Monetary Policies**

This figure reports impulse responses of non-investable stock returns over 24 months in response to a one standard deviation structural shock in local and U.S. monetary policies. The impulse responses are obtained from a structural VAR with the seven endogenous variables described in Table II plus a constant. The left axis is in percent.

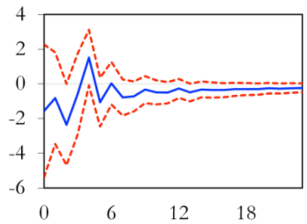


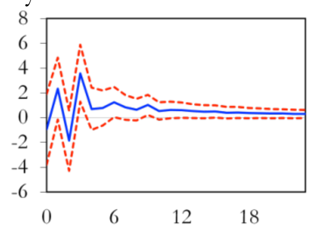

Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
India
South Korea
Malaysia
Philippines
Taiwan
Thailand
Czech
Greece
Hungary
Poland
Portugal
Russia

Response of Returns to Local Monetary policy

Response of Returns to U.S. Monetary Policy

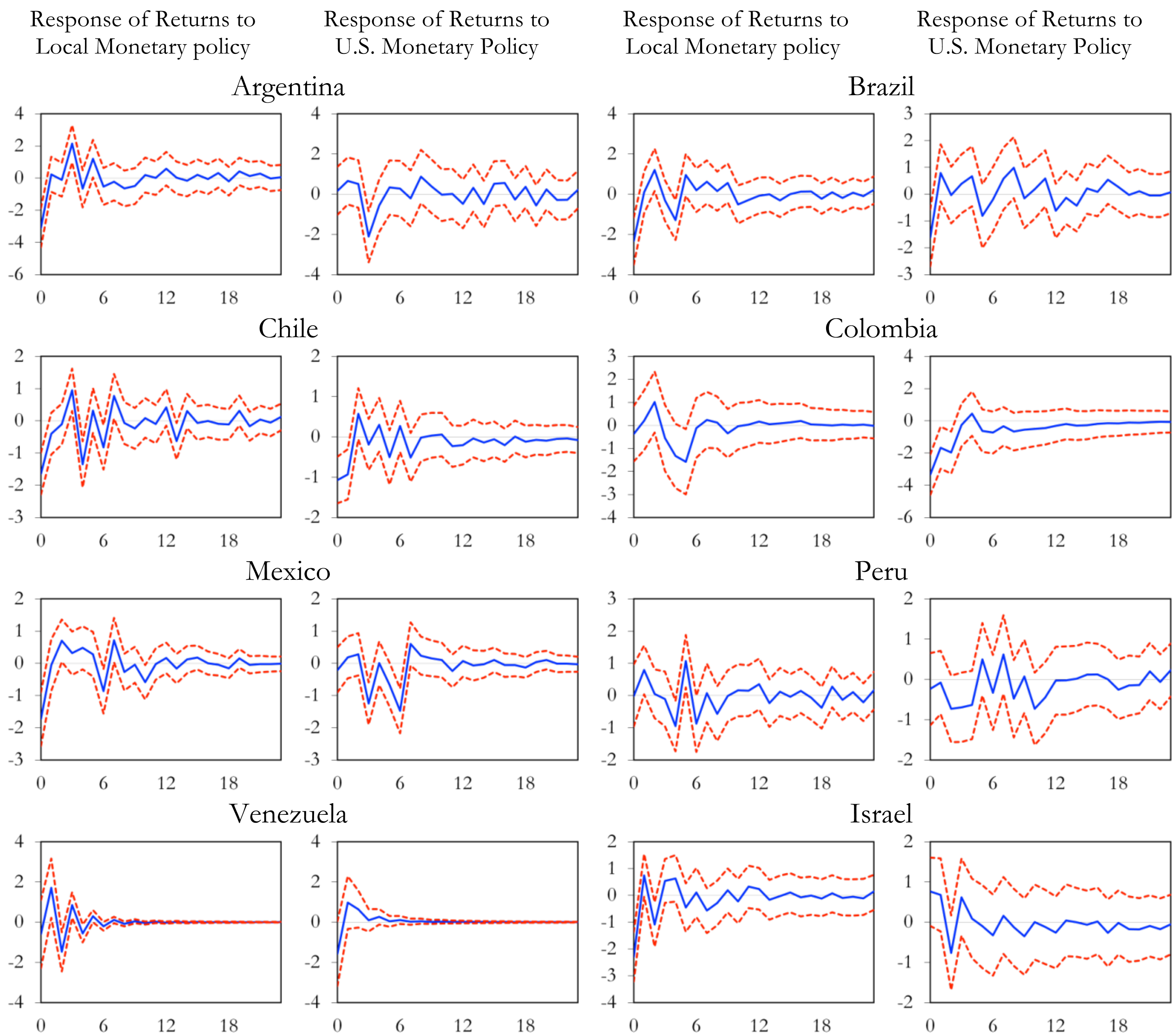
Turkey

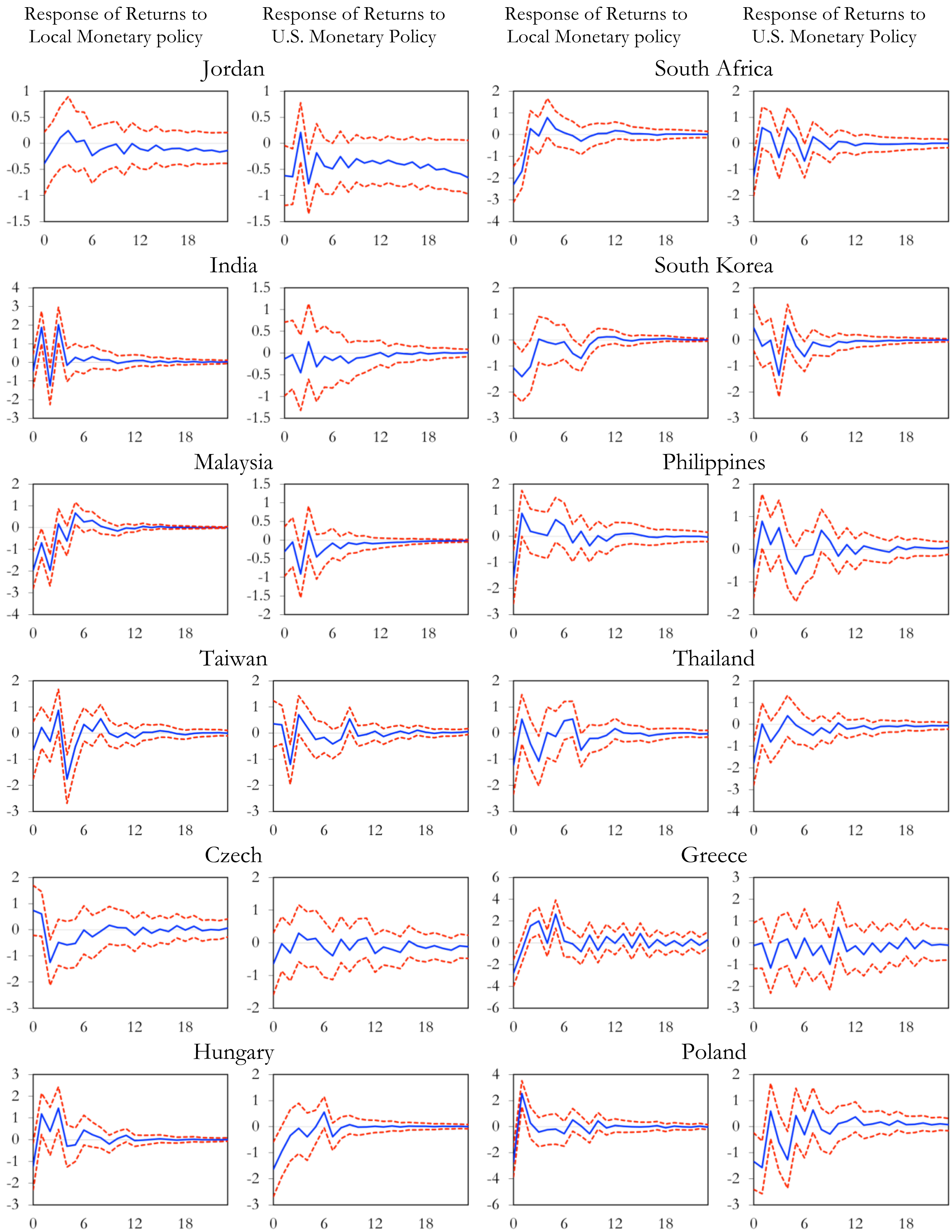


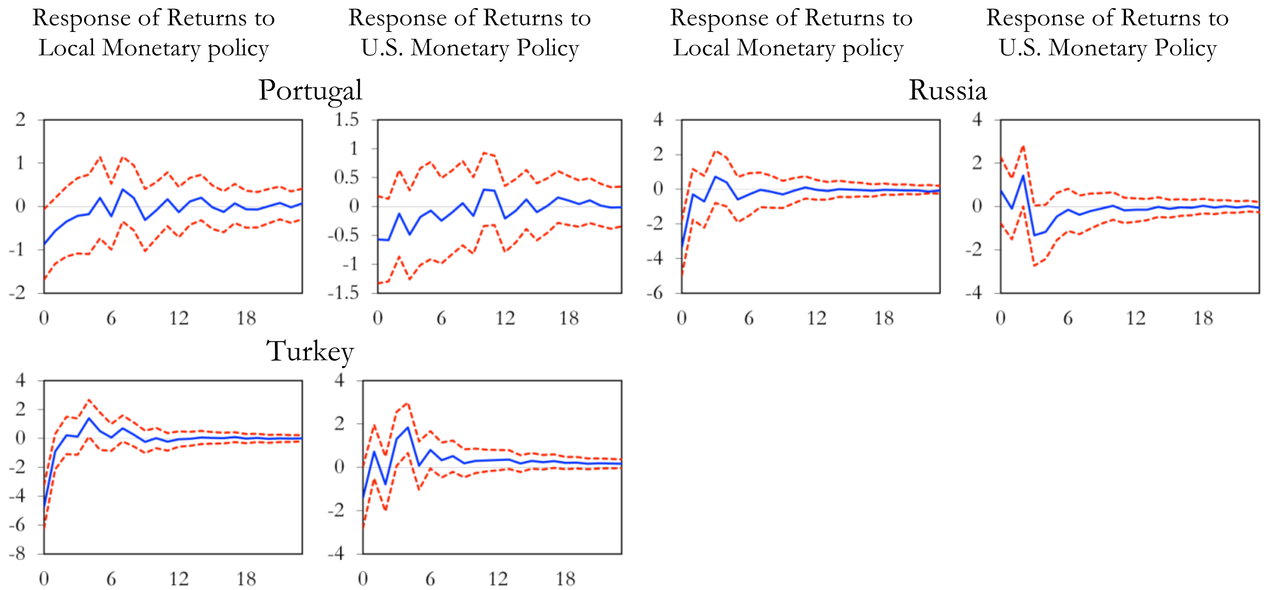



## Figure 4
## Impulse Responses of Investable Stock Returns to a One Standard Deviation Structural Shock in Local and U.S. Monetary Policies

This figure reports impulse responses of investable stock returns over 24 months in response to a one standard deviation structural shock in local and U.S. monetary policies. The impulse responses are obtained from a structural VAR with the seven endogenous variables described in Table II plus a constant. The left axis is in percent.




Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Jordan
South Africa
India
South Korea
Malaysia
Philippines
Taiwan
Thailand
Czech
Greece
Hungary
Poland
0
6
12
18


Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Response of Returns to Local Monetary policy
Response of Returns to U.S. Monetary Policy
Portugal
Russia
Turkey
0
6
12
18