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Global financial conditions and asset markets: Evidence from fragile emerging economies☆

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ABSTRACT

This study examines the effects of global financial conditions on the asset markets of five fragile emerging economies—Brazil, India, Indonesia, South Africa, and Turkey—known as the Fragile Five. We estimate a structural vector autoregressive model with a block exogeneity procedure using high-frequency daily data and Bayesian inference. Our primary findings are as follows. (i) Global financial risk shocks have significant effects on government bond yields, equity prices, CDS spreads, and exchange rates in the Fragile Five. (ii) The effects differ considerably across the fragile countries and the assets. (iii) These country differentiations are strongly related to macroeconomic fundamentals. Finally, (iv) global financial risk shocks have a greater immediate effect on local currency government bond and CDS markets than on FX and stock markets.

1. Introduction

Since the global financial crisis of 2008, fluctuations in global financial conditions have increasingly affected emerging market (EM) asset prices as unconventional monetary policy in the US and other advanced economies has markedly changed the composition of capital flows by affecting international investors' risk appetite. Between the start of the crisis and May 2013, low risk aversion in global financial markets—stemming from accommodative monetary policy in the US—has contributed to substantial capital inflows to EM economies (EMEs). This, in turn, has boosted their equity and bond prices to unacceptable levels and created strong appreciative pressure on their currencies. In this period, the upsurge in capital inflows has depended primarily on strong portfolio flows, notably bond flows, which are substantially sensitive to fluctuations in global financial conditions owing to changes in global risk appetite (IMF, 2014). As a result, foreign ownership in EM local currency (LC) government bond markets has risen sharply, making the asset markets of recipient countries more vulnerable to sudden increases in global risk aversion (Fig. 1).

Indeed, developments in global financial markets after May 2013 apparently indicate how a change of sentiment in markets considerably affects financial markets in EMEs. Between May 21 and December 31, 2013, following expectations of tighter US monetary policy triggered by a speech by Federal Reserve Chairman Ben Bernanke about the tapering of the Fed's asset purchase program, the financial environment in emerging markets changed dramatically. The sharp increase in global risk aversion emanating from these expectations has led to severe turmoil in bond, stock, sovereign credit default swap[1] (CDS), and foreign exchange (FX) markets in EMEs by triggering portfolio outflows (Mishra et al., 2014; Sahay et al., 2014). In this period (the so-called "taper tantrum"), as presented in Fig. 2, EM currencies depreciated severely and equity prices decreased sharply, while sovereign bond yields and CDS spreads increased substantially. During this period of turmoil, a subgroup within the weaker EMEs—labeled the Fragile Five—was affected much more than other EMEs (see Fig. 2), leading global investors to shift their attention to the Fragile Five, namely, Brazil, India, Indonesia, South Africa, and Turkey.

The common movements in capital flows and asset prices across EMEs are driven mainly by two global factors including global risk

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[1] See Longstaff et al. (2011) for further details on sovereign CDS contracts on external debt.

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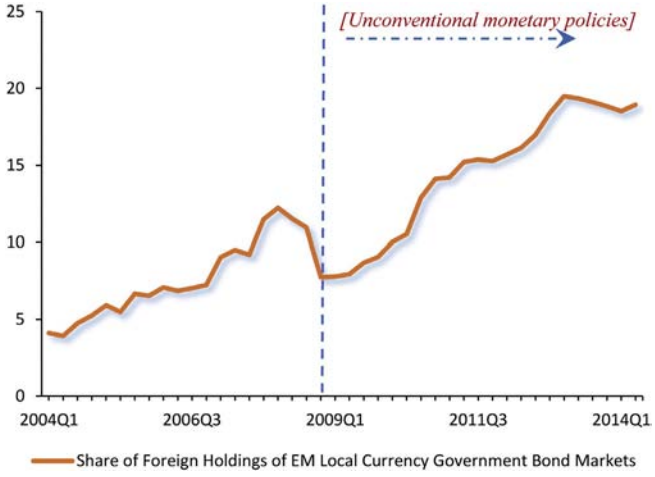

Fig. 1. Foreign participation in EM local currency government bond markets
Source: Arslanalp and Tsuda (2014).

aversion and US monetary policy (Rey, 2013). Since the global financial crisis, a growing body of research reports many empirical findings, which help us understand how both conventional and unconventional US monetary policy is transmitted to financial markets in EMEs. Nevertheless, the empirical evidence on spillover effects from global risk aversion to emerging financial markets is scarce. In this study, we attempt to contribute to the sparse literature by investigating the effect of global financial risk shocks on LC government bond yields, equity prices, sovereign CDS spreads, and foreign exchange rates in the Fragile Five.

The main reasons we concentrate on the Fragile Five are as follows. First, these countries experienced larger asset price declines than other EMs during the recent sharp increase in global risk aversion due to the tapering talks. Second, they have received substantial capital inflows since the global financial crisis.

The contribution of this study to the literature is threefold. First, we examine the transmission of global financial risk shocks to the Fragile Five markets by using a vector autoregressive (VAR) model with block exogeneity restrictions and high-frequency daily data. We find that global financial risk shocks significantly affect the Fragile Five's asset markets, although the magnitude of the effects differs by country and asset class. Second, we analyze whether the heterogeneous responses of the Fragile Five to global financial risk shocks depend on country-specific characteristics, notably macroeconomic fundamentals. We find that macroeconomic fundamentals matter in explaining this cross-country variation. Third, we consider whether the effect of global financial risk shocks on EM asset prices varies by data frequency. To do so, we estimate the VAR model using weekly and monthly data as well as daily data. We find that the sign and significance of the effect do not vary across the data frequency used (daily, weekly, and monthly), but the magnitude of the effect varies significantly.

The present study relates and contributes to four strands of the literature on the recent global financial cycle, characterized by similar patterns of variations in capital flows and asset prices across countries. The first strand, which is closely related to our study, is scarce and focuses mostly on the impact of global risk aversion on sovereign bond yields in EMEs[2]. Earlier studies in this literature (Ciarlone et al., 2009; González-Rozada and Levy-Yeyati, 2008) focus on global risk appetite as a main determinant of EM foreign currency sovereign spreads, while recent studies (Ananchotikul and Zhang, 2014; Ebeke and Lu, 2015; Ebeke and Kyobe, 2015; Jaramillo and Weber, 2013a, 2013b; Miyajima et al., 2014) concentrate on the effect of changes in global risk aversion on EM LC government bond markets. The literature provides some evidence on the spillovers from global risk aversion to EM government bond yields. However, there is little empirical evidence on the spillovers to other EM asset classes in the literature. Moreover, these studies do not extensively examine the factors behind the heterogeneous responses of EM financial markets to global financial risk shocks. Thus, this literature provides little guidance to policy makers in the design of EM policies that increase the resilience of their financial systems to changing global financial conditions.

We extend the literature in two ways. First, our study documents evidence on the effect of fluctuations in global risk aversion on four asset classes in the Fragile Five including LC government bonds, CDS, equities, and FX. Second, our study adds to the literature by revealing evidence of a tight link between the performance of EM financial markets and the strength of their macroeconomic fundamentals.

Our study is related to the second strand of the literature on the spillovers of US monetary policy to foreign financial markets[3], notably to emerging financial markets (Aizenman et al., 2014; Bowman et al., 2015; Chen et al., 2014; Ehrmann and Fratzscher, 2009; Ehrmann et al., 2011; Fratzscher et al., 2013; Gilchrist et al., 2014; Hausman and Wongswan, 2011; Mishra et al., 2014; Miyajima et al., 2014; Moore et al., 2013; Rai and Suchanek, 2014). Most of these studies analyze the international financial spillover effects for different phases of US monetary policy, such as conventional and unconventional monetary policy, while few studies examine whether the spillovers vary across these phases. The literature finds significant financial spillover effects, and emphasizes that the size of these effects differs considerably within EMEs depending on country-specific characteristics (regarding the heterogeneities in the spillovers, see Ahmed et al., 2015). In the current study, we show that global financial risk shocks capture the abovementioned effects of US monetary policy on EM asset prices when such shocks are considered. Therefore, we confirm the argument that two global factors are the main driving forces behind the recent global financial cycle.

Recent related literature documents that US monetary policy shocks are transmitted domestically and internationally to the rest of the world through a risk-taking channel[4], which suggests that US monetary policy affects domestic and foreign financial markets by altering the risk-taking behavior of market participants[5]. Moreover, a recent work by Brana and Prat (2015) highlights the importance of global risk aversion in transmitting fluctuations in global financial conditions to asset prices in EMEs by focusing on global excess liquidity instead of US monetary policy. They find that the effect of global liquidity on equity returns in EMEs depends on international investors' risk aversion. Our study complements the literature by establishing that shifts in global risk appetite substantially hit EM asset prices.

The third strand of the literature focuses on the roles of global and domestic factors in driving capital flows to EMEs. The literature reveals that global risk aversion is one of the most important determinants of capital inflows to EMEs (Ahmed and Zlate, 2014; Forbes and Warnock, 2012; Fratzscher et al., 2012; Ghosh et al., 2012; Koepke, 2014; Nier et al., 2014; World Bank, 2014). The findings of the current study are consistent with this literature.

The fourth strand of the literature is on the transmission of US financial crisis to foreign asset markets. Chudik and Fratszcher (2011)

[2] However, in addition, Akinci (2013) and Josifidis et al. (2014) look at the response to global financial risk shocks of economic activity and monetary policy in EMEs, respectively.

[3] In addition, the effect of US-originated shocks on macroeconomic indicators in the rest of the world has been the focus of a number of recent studies. For instance, Barakchian (2015) examines the transmission of US monetary policy to Canadian macroeconomic variables, while Carmignani (2015) analyzes the impact of US fiscal policy on the macroeconomic performance of Organisation for Economic Co-operation and Development countries.

[4] For the risk-taking channel of monetary policy, see Bekaert et al. (2013); Borio and Zhu (2012); Bruno and Shin (2014), and Rey (2013).

[5] See Bauer and Neely (2014), Fratzscher et al. (2013), and Krishnamurthy and Vissing-Jorgensen (2011) for the other international transmission channels of US unconventional monetary policy, such as signaling, portfolio balance, and liquidity premiums.

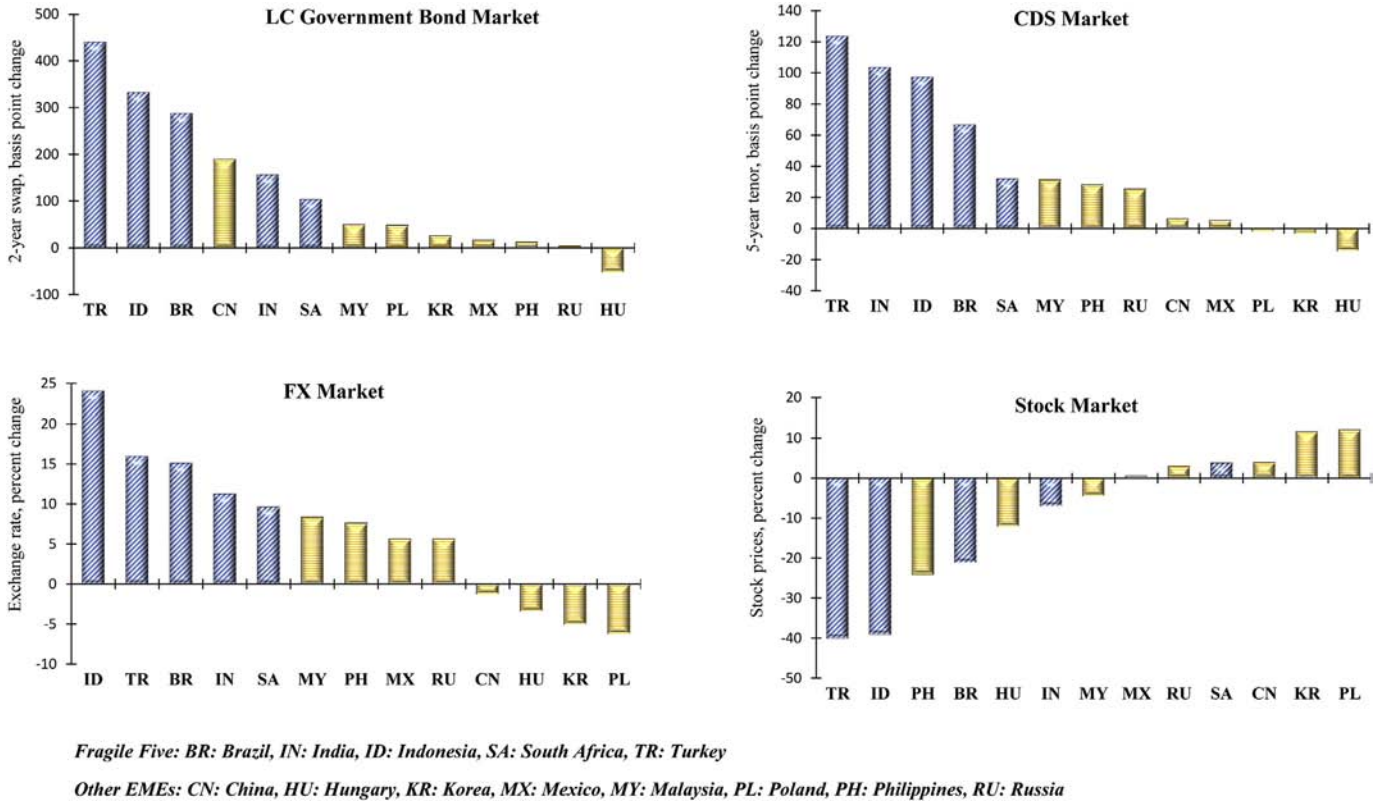

Fig. 2. The response of EM financial markets during the taper tantrum (May 21–December 31, 2013). *The exchange rate is defined as the domestic currency units per unit of US dollar. Thus, a positive change in the exchange rate demonstrates depreciation of the domestic currency.* Source: IMF (2014).

investigate how the financial crisis is transmitted to foreign asset prices, notably to equity prices, by focusing on the role of the tightening in US monetary conditions and collapse in global risk appetite. The authors reveal that deterioration in global risk appetite plays a key role in spreading the US financial crisis to EMEs, while the transmission of the crisis to advanced economies is driven mainly by liquidity shocks. Kim et al. (2015) examine spillover effects of the crisis on asset markets, especially the stock market, in five EM Asian countries. They document evidence of spillovers from the US financial crisis to those countries through the major role of foreign investor's behavior. Finally, Min and Hwang (2012) report similar findings for four OECD countries. The present study complements this literature by documenting strong negative spillover effects from a collapse in global risk appetite to EM financial markets for the period 2006–2015.

Finally, our empirical model and findings are in line with many recent studies that provide theoretical links between global risk aversion, capital inflows, and EM asset prices. Some studies focus on the risk-taking channel of monetary policy to explain these links. In this sense, Bruno and Shin (2015) develop the model by focusing mainly on the functioning of this channel via the banking sector. The model suggests that changes in US monetary policy are transmitted internationally via shifts in global risk aversion, which drive the asset prices in EMEs by affecting leverage of financial intermediaries, bank lending, and thereby, portfolio inflows into their economies. Furthermore, two other studies emphasize the role of risk-averse international investors in explaining the interactions between EM financial markets and global financial conditions. First, Lizarazo (2013) develops a model for small open economies taking into account risk-averse international investors with decreasing absolute risk-aversion preferences, which is consistent with the typical features of investors in EM financial markets. The model provides a possible mechanism to explain the links between investors' characteristics (risk aversion and wealth), capital inflows to EMs, and EM asset prices, notably sovereign risk premiums and bond prices. According to the mechanism, as international investors become more risk averse, EM sovereign CDS prices move higher while capital inflows to EMs and their bond prices decrease. In addition, the model, developed by Borri and Verdelhan (2011), emphasizes that EM sovereign risk premiums and bond prices rely on international investors' time-varying risk aversion.

The rest of this paper is organized as follows. Section 2 introduces the methodological framework and data. Section 3 discusses the empirical results. Finally, Section 4 presents our conclusions.

2. Methodological framework

In this section, we explain the aspects of our empirical strategy. Subsection 2.1 emphasizes the motivation behind the selection of the empirical method and variables. Subsections 2.2 and 2.3 introduce the empirical model and the dataset, respectively.

2.1. Empirical method and variable selection

In order to investigate the effect of global financial risk shocks on asset markets in five EMEs, we employ a VAR model, specifically, a structural VAR (SVAR) model with block exogeneity, which is first used by Cushman and Zha (1997) to identify monetary policy shocks and to examine the response of the Canadian economy to external shocks. Since this pioneering study, a growing number of studies (Gossé and Guillaumin, 2013; Mackowiak, 2007; Osborn and Vehbi, 2015; Sousa, 2014) have adopted a similar model. Most of these have concentrated on examining the effect of external shocks on domestic macroeconomic indicators in small open economies using monthly or quarterly data. Our empirical model is closely related to these studies. However, the main purpose of this study is to investigate the effect of global financial risk shocks on EM asset prices using high-frequency daily data.

The SVAR model with block exogeneity has become a standard empirical instrument for examining the impact of global shocks on emerging countries. The model allows for the division of the dynamic system into two different blocks, usually domestic and external, by excluding the lag coefficients of domestic variables from external block equations based on block exogeneity, which implies that EM countries have small domestic financial markets. As a result, the block exogeneity assumption makes the spurious financial spillover effects disappear and enables us to assess more accurately the effect of the common external financial shocks on domestic asset prices for each emerging country. In addition, the assumption improves the efficiency of the estimation by reducing the number of parameters to estimate. Overall, based on these factors, we adopt the SVAR model with block exogeneity.

The selection of the variables for the SVAR model is based mainly on the international finance theory emphasized in Section 1, which provides the transmission mechanism of global financial conditions to emerging financial markets. That is, global financial shocks are transmitted to EM asset markets by altering private sector (banks and investors) risk-taking and thereby affecting capital inflows to EMEs. In accordance with this mechanism, two global financial variables are included to capture the conditions of global risk aversion and US monetary policy. In the empirical model, the former is represented by a measure of global financial risk, such as the Volatility Index (VIX) and US BAA corporate spread, while the latter is represented by the federal funds target rate. Further, we include four domestic financial variables to measure the effect of global financial conditions on EM asset prices. Accordingly, we consider three core domestic asset classes (bonds, equities, and FX) with a new asset class (sovereign CDS). The new asset class emerges from the lack of an instrument that allows investors to transfer and manage sovereign credit risks. It is used by investors primarily for three main reasons, namely, hedging, speculating, and basis trading (see IMF, 2013). In addition, there is an emerging consensus that sovereign CDS spreads reflect general conditions of domestic asset markets by providing a suitable measure of sovereign default risk.

The external variables, representing conditions in global financial markets, originate from the US financial system. There are various reasons behind the selection of the US financial variables. First, international investors' risk aversion correlates strongly with US monetary conditions. Second, capital inflows to EMs are driven by global risk aversion, measured mostly by indicators in US financial markets, such as the VIX, US BAA corporate spread, and US high yield corporate spread. Third, there is an emerging body of literature documenting that movements in EM asset prices stem primarily from the shocks to the US financial system. Finally, US financial markets drive the recent global financial cycle.

2.2. The SVAR model

We consider the following SVAR model with block exogeneity:

$$\sum_{s=0}^{p}\begin{bmatrix} A_{11}(s) & A_{12}(s) \\ A_{21}(s) & A_{22}(s) \end{bmatrix}\begin{bmatrix} y_{t-s}^{d} \\ y_{t-s}^{e} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^{d} \\ \varepsilon_t^{e} \end{bmatrix} \quad (1)$$

where A_{ij} is a coefficient matrix, $y_t = [y_t^d, y_t^e]'$ is a vector of variables, and $\varepsilon_t = [\varepsilon_t^d, \varepsilon_t^e]'$ is a vector of structural disturbances satisfying $E[\varepsilon_t | y_{t-s}, s>0] = 0$ and $E[\varepsilon_t \varepsilon_t' | y_{t-s}, s>0] = I$. ε_t^d is a vector of structural shocks of domestic origin and ε_t^e is a vector of structural shocks of external origin. y_t^d is a vector of financial variables in the small open economy. y_t^e is a vector of variables external to the small open economy.

The vector of domestic financial variables y_t^d includes 5-year LC government bond yields [gb], 5-year CDS spreads on sovereign bonds [cds], equity prices [equity], and exchange rates [exc]. In addition, the vector of external financial variables y_t^e includes the federal funds target rate [ffr] and a measure of global financial risk [gfr], which is proxied by the volatility index (VIX) in the baseline scenario. Formally, $y_t^d = [gb, cds, equity, exc]$ represents our domestic block and $y_t^e = [ffr, gfr]$ represents our external block. Therefore, for each of the five EMs, our SVAR model includes two external financial variables and four domestic financial variables.

Our identification strategy is based on the following three assumptions[6]:

(i) *The Fragile Five have small domestic financial markets, implying the block exogeneity restriction* $[A_{21}(s) = 0$ *for each* $s = 0, 1, \ldots, p]$.
(ii) *There are significant contemporaneous interactions across the domestic asset markets.*
(iii) *The federal funds target rate affects global financial risk (i.e., the VIX index) contemporaneously, but not vice versa.*

We use a two-step procedure to estimate the SVAR model with block exogeneity (Eq. (1)). First, we estimate the reduced-form VAR by using seemingly unrelated regressions with the first differences of all variables and one lag selected by Schwartz Bayesian criteria. Second, we construct the probability bands for impulse response functions using a Bayesian Markov Chain Monte Carlo (MCMC) algorithm, specifically, a Metropolis-within-Gibbs MCMC algorithm. More details on the construction of impulse response functions with posterior probability bands can be found in the online appendix.

2.3. Dataset

To analyze the response of EM asset prices to global financial risk shocks, we employ daily data from January 2, 2006 to August 31, 2015 (2,521 observations). Using daily data allows us to accurately capture the spillovers of external financial shocks on emerging asset markets because high frequency daily data include more information than lower frequency data. However, lower data frequencies, like those of weekly and monthly, are used in the literature. Considering this, we check our results by re-estimating the model with weekly and monthly data in Subsection 3.4, which focuses on robustness checks.

The dataset includes four domestic assets—government bond yields (5-year and 10-year), sovereign CDS spreads, equity prices, and exchange rates—and three global financial variables—the federal fund target rate, the VIX index, and the US BAA corporate spread. To capture the effect of global financial risk shocks on LC government bond markets, we use 5-year LC government bond yields[7] in the baseline model. In addition, the 10-year LC government bond yields are used for the robustness checks. For the equity markets, we use the primary domestic equity index for each emerging country. For the FX markets, we employ the exchange rate defined as the domestic currency units per unit of US dollar. Therefore, an increase in the exchange rate indicates depreciation of the domestic currency. To analyze the impact of the global financial risk shock on sovereign CDS markets, we use 5-year sovereign CDS spreads denominated in US dollars. Furthermore, the VIX index and US BAA corporate spread are used to proxy global financial risk, while the federal funds target rate proxies US monetary policy. All variables are measured in logarithms except for the federal funds target rate and the bond yields, which are expressed in percentages. The data appendix includes details of the data.

3. Empirical results

In this section, we discuss the empirical results. In Subsection 3.1, we reveal the effect of global financial risk shock on Fragile Five asset prices. In Subsection 3.2, we focus on cross-county variations in the immediate response of the Fragile Five asset prices to global financial risk shock. In

[6] See the online appendix for further details on our identification scheme.
[7] For Brazil, data on the 5-year LC government bond yield is not available before January 2012. Thus, we use the 2-year LC government bond yield instead, as in Moore et al. (2013), who use the 2-year instead of the 10-year ones.

Subsection 3.3, we focus on the role of macroeconomic fundamentals in explaining the cross-country variations. In Subsection 3.4, we check the robustness of our main findings.

3.1. Effects of global financial risk shock on asset prices in the fragile five

Fig. 3 presents the response of domestic and global financial variables to a 1-standard deviation increase in global risk aversion (i.e., a 1-standard deviation increase in the VIX). Global financial risk shock has a significant effect on the asset markets in all Fragile Five countries. The estimated effect on each of the four asset classes can be summarized as follows. First, global financial risk shock (a positive shock to the VIX) increases LC government bond yields in all five emerging countries. The estimated effect is statistically significant in all fragile countries. Second, the effect on sovereign CDS spreads is positive and statistically significant in all countries, which implies that a global financial risk shock leads to deterioration in domestic financial market conditions. Third, the shock has an immediate and significant positive effect on exchange rates; that is, the Fragile Five currencies immediately depreciate following the shock. Fourth, the estimated effect on domestic equity prices is negative and significant in all five emerging countries. This suggests that global financial risk shock reduces equity prices in all Fragile Five countries. Therefore, these findings suggest that fragile emerging economy asset markets are substantially affected by deterioration in global risk sentiment (a positive change in VIX): when market sentiment deteriorates, equity prices fall and local currencies depreciate, while LC government bond yields and sovereign CDS prices increase.

In summary, our findings clearly show that global financial risk shocks have hit the emerging financial markets of the Fragile Five considerably. These findings are consistent with the recent market reaction to a collapse in global risk appetite during the tapering-talk phase (see Sahay et al., 2014). That is, following a sharp rise in global risk aversion observed during this phase, local currencies depreciated, bond yields and country risk premiums increased significantly, and equity prices declined. Our model predicts similar movements in EM asset prices from a global financial risk shock. Furthermore, the results are in line with the findings in Ananchotikul and Zhang (2014) and Chudik and Fratszcher (2011).

3.2. Do effects vary across the fragile five and asset classes?

In order to analyze whether the response of the asset prices to global financial risk shock varies across countries and assets, we present the immediate response of the asset markets for each emerging country in Fig. 4. The figure indicates that the magnitude of the response varies across countries and assets. First, following an increase in global risk aversion (an increase in the VIX), asset markets in Brazil, South Africa, and Turkey come under more pressure than those in India and Indonesia. In other words, the influence of global financial risk shock on asset prices in the former group is more pronounced, but the impact on those in latter group is more subdued. This is consistent with the stylized facts from the recent experience during the tapering-talk phase, indicating that India and Indonesia have experienced less pressure from sharp deterioration in global risk sentiment than the other three fragile countries. Second, global financial risk shock has a greater immediate effect on LC government bond and CDS markets than on FX and stock markets in all fragile emerging countries except India. This strong effect on LC government bond yields can be associated with the recent changes in the composition of capital flows to emerging economies. Unconventional US monetary policy alters the composition of

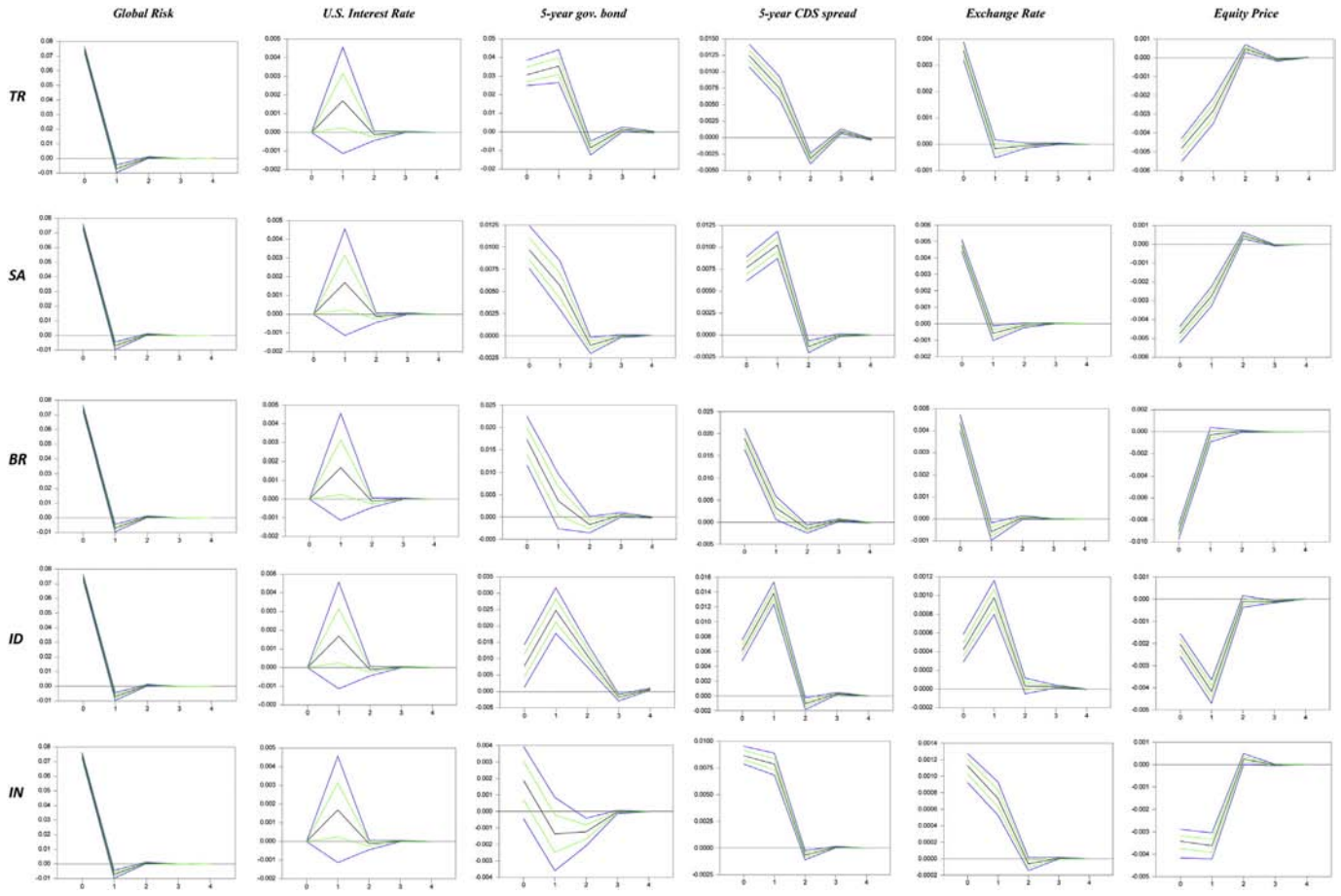

Fig. 3. Impact of global financial risk shocks on asset prices (VIX is used as a proxy for global financial risk).

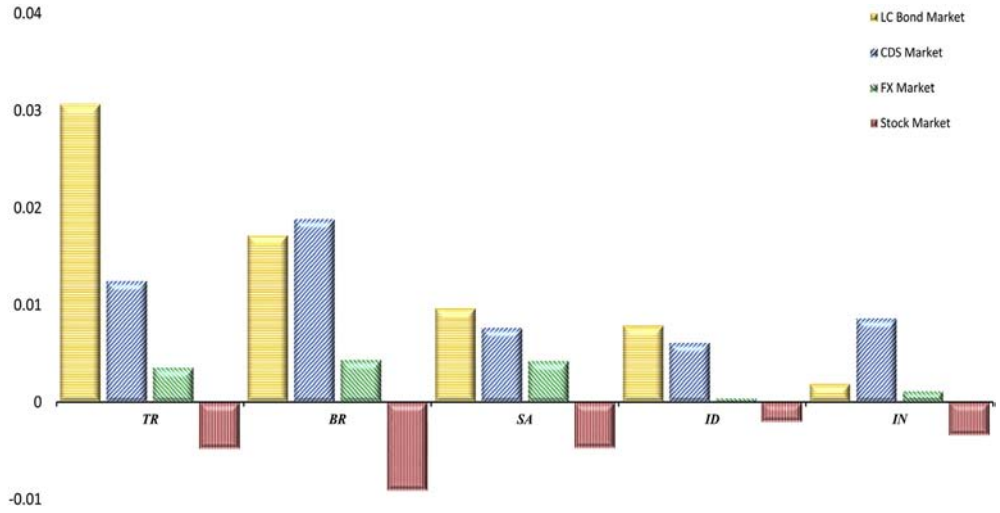

Fig. 4. Immediate effect of global financial risk shocks on different asset markets

capital flows towards more volatile portfolio flows, notably bond flows (Ahmed and Zlate, 2014). Thereby, the share of foreign investors in emerging economies' LC government bond markets has increased substantially (see Fig. 1), causing the bond yields to become more sensitive to global financial shocks. Thus, the high vulnerability of LC bond yields to global financial risk shock is consistent with the recent steady increase in foreign ownership of LC government bond markets (see Figs. 1 and 5). This is in line with the findings documented in the recent literature (see Ananchotikul and Zhang, 2014; Bowman et al., 2015; Hausman and Wongswan, 2011; IMF, 2014). In addition, the magnitude of response of LC government bond yields is closely related to the share of foreign investors in each country's LC government bond markets (see Figs. 4 and 5).

The pass-through effect of global financial risk shock on domestic currencies appears to be smaller in all five EMs. This does not suggest that there is a small, complete effect of global financial risk shocks on those currencies. Rather, it is a result of FX interventions due to the fear of floating. Indeed, recent strong depreciation pressure stemming from the tapering talk clearly indicates that all five emerging countries are prone to fear of floating. During the tapering-talk phase, the Fragile Five implemented monetary policy actions, including policy rate hikes and currency interventions, to reduce the sharp depreciation pressure, which endangered financial and price stability. Therefore, our results indicating a small effect on FX markets are consistent with these actions, and imply that all five countries have inflexible exchange rate regimes and the fear of floating is present in those countries.

In general, the immediate effects of global financial risk shock on the Fragile Five asset prices are dependent on asset class: the shock has a greater immediate effect on LC government bond yields and sovereign CDS spreads. In addition, the effects differ largely within the Fragile Five. The following Subsection 3.3 sheds light on the determinants of this cross-country differentiation.

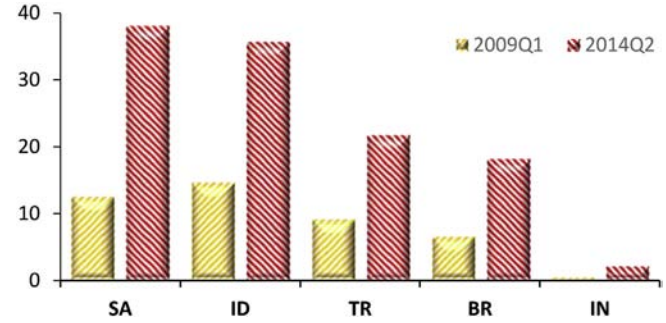

Fig. 5. Foreign holdings of local currency government bonds in the Fragile Five Source: Arslanalp and Tsuda (2014).

3.3. Do country characteristics explain cross-country variations?

The previous Subsection 3.2 reveals an important finding, which suggests that the effect of global financial risk shock on asset prices varies across the Fragile Five. This finding raises a new question: what are the main driving factors behind the heterogeneous responses of the Fragile Five to global financial shocks? An urgent answer to this question is important for EM policymakers amid the ongoing monetary policy normalization in the US. In the present subsection, we attempt to answer this crucial question by considering the recent literature on the international transmission of US monetary policy, indicating that country characteristics—macroeconomic fundamentals and financial structures—are significant drivers of heterogeneous EM responses. To this end, following Bowman et al. (2015) and Hausman and Wongswan (2011), we estimate a monthly panel regression[8]:

$$\Delta Y^{DOM}_{i,t_m} = \gamma_i + (\alpha_1 + \alpha_2 * X_{i,t_m-1}) * \Delta Y^{EXT}_{vix,t_m} + (\beta_1 + \beta_2 * X_{i,t_m-1}) * \Delta Y^{EXT}_{ffr,t_m} + \mathbf{H}_{t_m} + \eta_{i,t_m} \quad (2)$$

where $\Delta Y^{DOM}_{i,t_m}$ represents the monthly changes in either LC government bond yields, CDS prices, equity prices, or exchange rates for each emerging country. X_{i,t_m-1} includes the country-specific variables for each Fragile Five country. Appendix Table B presents details of these indicators. $\Delta Y^{EXT}_{vix,t_m}$ and $\Delta Y^{EXT}_{ffr,t_m}$ indicate the monthly changes in the external financial variables. In other words, the former is the log first difference of the VIX, while the latter is the first difference of the federal funds target rate (ffr). $\mathbf{H}_{t_m}$ represents a set of control variables including an energy price index, US BAA corporate spread, and the log first difference of the S&P 500 index.

The panel-data specification in Eq. (2)[9] allows for the interaction of the external financial variables with country-specific indicators, making it possible to capture the response of each country's asset prices to changes in the external financial variables depending on each country's characteristics. Thus, the specification enables us to analyze whether

[8] The sample period for the monthly panel-data model is January 2006–June 2014 (102 observations).

[9] We conduct the panel unit root test developed by Im et al. (2003) for the variables in Eq. (2). Since the control variables are treated as common for each individual, we investigate their unit root properties by the conventional ADF test and find that they are stationary. In order to save space, the results are not reported here but available upon request.

Table 1
Role of macroeconomic fundamentals in determining the heterogeneous response of the Fragile Five markets.

	Part A: LC bond market		Part B: CDS market		Part C: Equity market		Part D: FX market	
Country-specific variables	Global risk appetite	US interest rate	Global risk appetite	US interest rate	Global risk appetite	US interest rate	Global risk appetite	US interest rate
Financial structure								
Foreign part.	1.157* (0.000)	0.176 (0.685)	0.027 (0.689)	−0.174*** (0.078)	−0.002 (0.906)	0.002 (0.916)	0.009 (0.421)	0.018 (0.633)
Macroeconomic fundamentals								
GDP growth	−0.140*** (0.068)	−0.207** (0.050)	−0.027** (0.041)	−0.002 (0.910)	0.016** (0.025)	0.005 (0.399)	−0.007** (0.002)	−0.006 (0.248)
Credit growth	0.053** (0.018)	−0.044 (0.119)	0.006*** (0.085)	0.008*** (0.087)	−0.002** (0.046)	0.000 (0.915)	0.000 (0.968)	0.001** (0.025)
CA/GDP	0.170** (0.004)	−0.072 (0.303)	0.022** (0.028)	0.023*** (0.066)	−0.005 (0.213)	−0.003 (0.547)	−0.001 (0.535)	−0.002 (0.134)
Debt	0.086** (0.004)	−0.026 (0.623)	0.001 (0.621)	0.021** (0.041)	−0.003** (0.016)	−0.002 (0.622)	0.000 (0.519)	0.000 (0.810)
Reserves	−0.042 (0.308)	−0.008 (0.924)	−0.034* (0.001)	−0.010 (0.552)	−0.001 (0.717)	0.012*** (0.087)	−0.006* (0.000)	0.004 (0.361)
Policy rate	0.135 (0.341)	−0.014 (0.963)	0.046*** (0.099)	0.028 (0.674)	0.002 (0.749)	−0.011 (0.731)	0.000 (0.731)	0.018 (0.167)
Inflation	0.047 (0.341)	−0.044 (0.661)	−0.000 (0.948)	−0.002 (0.887)	0.005*** (0.075)	0.001 (0.852)	−0.003 (0.105)	−0.007* (0.000)
Rate diff.	−0.071 (0.553)	−0.093 (0.722)	−0.060** (0.035)	−0.025 (0.661)	0.006 (0.449)	0.027 (0.347)	−0.001 (0.660)	−0.027* (0.001)

The table depends on the results from the estimation of the following panel regression. Specifically, we present the estimates of two important coefficients, α_2 and β_2 (with corresponding p-values), capturing the response of each emerging country's asset prices to changes in the external financial variables (the VIX and federal funds target rate) depending on each country's indicators, X_{i,t_m-1}.

$$\Delta Y^{DOM}_{i,t_m} = \gamma_i + (\alpha_1 + \alpha_2 * X_{i,t_m-1}) * \Delta Y^{EXT}_{vix,t_m} + (\beta_1 + \beta_2 * X_{i,t_m-1}) * \Delta Y^{EXT}_{ffr,t_m} + \mathbf{H}_{t_m} + \eta_{i,t_m}$$

where X_{i,t_m-1} includes the country-specific indicators. $\Delta Y_{i,t_m}{}^{DOM}$ represents the monthly changes in each domestic asset class for each country i in our sample. Specifically, $\Delta Y_{i,t_m}{}^{DOM}$ represents either the first difference of government bond yields, the log first difference of sovereign CDS prices, the log first difference of equity prices, or the log first difference of exchange rate for each country. $\Delta Y_{vix,t_m}{}^{EXT}$ and $\Delta Y_{ffr,t_m}{}^{EXT}$ show the monthly changes in the external financial variables: the former is the log first difference of the VIX index while the latter is the first difference of the federal funds target rate (ffr). $\mathbf{H}_{t_m}$ includes three control variables, which are an energy price index, US BAA corporate spread, and the log first difference of the S&P 500. P-values based on panel-corrected standard errors are in parentheses.

* $p < 0.001$ indicates coefficients significant at the 1% level.
** $p < 0.05$ indicates coefficients significant at the 5% level.
*** $p < 0.1$ indicates coefficients significant at the 10 % level.

the heterogeneous reactions of domestic asset prices to changes in global financial conditions depend on country-specific characteristics.

One of the important issues in a panel data specification is cross-section correlation. To control for a possible cross sectional dependence of the error terms, we add the control variables and estimate the model with PCSE standard errors. Table 1 presents the results regarding the role of country-specific factors in explaining the cross-country variation in the responsiveness of domestic asset prices[10].

Part A of Table 1 indicates the results for the LC government bond market. The results suggest that the risk-taking channel appears to play a more dominant role in transmitting US monetary policy to emerging LC government bond markets than the interest rate channel. In other words, country-specific factors matter in explaining the cross-country variation in the responsiveness of bond yields to changes in the VIX much more than the US interest rate. In addition, our results indicate that the extent of foreign participation in the LC bond market significantly explains the heterogeneous responses to changes in global risk appetite: Fragile Five countries with higher foreign participation in domestic bond markets are more affected by a collapse in global risk appetite. A recent work by Ebeke and Kyobe (2015) provides similar evidence. Their findings imply that global financial shocks have larger effects on bond yields in EMEs with a higher share of foreign holdings in their LC government bond markets. Finally, we find that country-specific macroeconomic factors recognized as the most important indicators of macroeconomic stability—GDP growth, external debt, current account deficit, and domestic credit growth—are statistically significant in explaining the cross-country variation. This result suggests that fragile countries with lower GDP growth, higher current account deficit, larger external debt, and higher domestic credit growth are more vulnerable to deterioration in global financial conditions.

We obtain similar findings for the CDS, equity, and FX markets. The results indicate that the effect of changes in global risk appetite is more severe in fragile countries with higher foreign participation, but this effect is not significant (see Parts B, C, and D). By contrast, most macroeconomic indicators significantly drive the heterogeneous reactions of three domestic markets to changes in global financial conditions. For instance, the results suggest that emerging countries with weak macroeconomic fundamentals (e.g., low GDP growth, strong domestic credit growth, high policy rate, large current account deficit, huge external debt, and low reserves) experience significant increases in sovereign default risk when external financial conditions deteriorate (see Part B). Likewise, fragile countries with lower GDP growth, higher domestic credit growth, larger external debt, and lower reserves suffer larger drops in equity prices (see Part C), while domestic currencies of those countries suffer more severe depreciation pressure (see Part D). For all three markets, all significant coefficients have the expected sign, except inflation and rate diff.

Overall, our results reveal that the resilience of emerging countries' financial markets against global financial shocks depends crucially on the strength of their macroeconomic fundamentals. In other words,

[10] We use a monthly measure of economic activity—industrial production growth—instead of GDP growth. However, the unreported results indicate that this measure is not significant. Furthermore, we include additional lags of all country-specific variables to investigate the role of these lagged variables. Only two additional lags of foreign participation are statistically significant in explaining the heterogeneous responses of the Fragile Five's asset markets, notably LC government bond markets. Therefore, the panel-data model includes three lags of foreign participation and one lag of other country-specific variables.

the performance of domestic financial markets is closely linked to macroeconomic fundamentals.

3.4. Robustness checks

In this subsection, we briefly review the robustness of our results from both time series (Eq. (1)) and panel data (Eq. (2)) models. The models reveal the following two crucial results: (a) the SVAR model suggests that global financial risk shocks significantly affect asset prices in the Fragile Five while the magnitude of the effects differ by country and asset class; and, (b) the panel data model reveals that macroeconomic fundamentals are important drivers of the cross-country variation. We reach similar results by using (i) a different proxy for global risk aversion, (ii) an alternative variable for EM LC government bond yields, and (iii) different data frequencies including weekly and monthly data in addition to daily data. This subsection explains these robustness checks.

3.4.1. An alternative measure of global risk appetite

To check whether the findings from the time series model are robust to an alternative measure of global financial risk, we estimate our SVAR model (Eq. (1)) by using a different proxy for global risk aversion, namely, the US BAA corporate spreads. Fig. A1 presents the impulse responses with error bands when the new measure is used as a proxy for global financial risk (see the online appendix). The figure indicates that the findings remain unchanged with the new measure of global financial risk, except for India's government bond market, reflecting that the results are very similar to those reported in Fig. 3 when an alternative measure of global financial risk is used. Overall, fragile emerging economies experience severe turbulence in their asset markets following a sharp decrease in global risk appetite, regardless of which measures of global risk appetite are used.

We also check whether the results from the panel data model are robust to a different proxy of global risk by estimating the model (Eq. (2)) with an alternative measure of global risk appetite (the US BAA corporate spread). The results reveal a similar finding: country-specific indicators are main determinants of the heterogeneous reaction. To save space, the results for the robustness test are not reported here but available upon request.

3.4.2. An alternative variable for EM LC government bond yield

We check the results by using 10-year LC government bond yields[11] instead of the 5-year ones to assess whether our results depend on the variable representing the LC government bond market. To this end, the SVAR model is estimated separately for each measure of global financial risk. We report the results in Figs. 6 and A2. The former figure reveals similar results to those in Fig. 4, suggesting that changes in global risk sentiments have a greater immediate impact on LC government bond markets and CDS markets. These results confirm that the magnitude of response of LC government bond yields is related closely with the share of foreign investors in each country's LC government bond market. Panels A and B in Fig. A2 (see the online appendix) show that the impact of global financial risk shock on LC government bond markets is substantial and statistically significant, with the exception of India, irrespective of the alternative proxies of global financial risk and 5-year or 10-year LC government bond yields.

We also estimate the panel data model (Eq. (2)) with 10-year LC government bond yields instead of the 5-year ones. The unreported results reveal that the findings remain unaffected with a different indicator of the LC government bond market, indicating that the country-specific indicators matter in explaining the heterogeneous reaction.

3.4.3. Different data frequencies

A growing body of literature has recently attempted to answer an important question: whether the choice of data frequency affects the results of the empirical work in the financial economic literature. There is an emerging consensus that data frequency matters in examining the links between financial variables. For instance, Narayan and Sharma (2015) analyze the relationship between the forward premium and the exchange rate return by asking whether the link changes depending on different data frequency, like daily, weekly, monthly, and quarterly frequency. The authors find this link is profoundly data-frequency dependent (regarding the importance of data frequency, see also Narayan et al., 2013, 2015; Phan et al., 2015).

Following this recent literature, we examine whether our results depend on the data frequency considered. To this end, we re-estimate the model using two different data frequencies[12], weekly and monthly, which are widely used in the transmission of external financial shocks to foreign financial markets. Figs. A3 and A4 present the results with weekly and monthly data, respectively. These figures reveal a similar pattern obtained with daily data in our empirical results (see Fig. 3). Accordingly, the sign and significance of the estimated effects do not vary across the data frequencies considered (daily, weekly, and monthly). Thus, the results confirm that global financial risk shocks significantly influence asset prices in the Fragile Five.

In addition, we check whether data frequency influences the contemporaneous effect of global financial risk shocks on EM asset prices. Fig. 7 presents the results. We find that the magnitude of the estimated effects varies considerably across daily, weekly, and monthly data but the patterns in our empirical findings remain unchanged with the different data frequencies. That is, in all frequencies, the results suggest that global financial risk shocks have a greater contemporaneous effect on LC government bond and CDS markets than on FX and stock markets.

4. Conclusion

Recent literature has revealed that the global financial cycle is driven mainly by two global factors including US monetary policy and global risk aversion. The effect of US monetary policy shocks on emerging financial markets is well documented in the literature. However, there is little empirical evidence regarding the effects of changes in global risk aversion on asset markets in emerging countries. This study aims to fill this gap in the literature by documenting evidence on the impact of global financial risk shock on asset markets for the Fragile Five.

Our findings reveal strong evidence that global financial risk shocks have significant effects on asset prices in the five fragile emerging countries. We find that these effects vary across asset classes. Deterioration in global risk appetite creates more severe turbulence in LC government bond and CDS markets than other domestic asset markets, which is consistent with the increasing role of foreign investors in domestic government bond markets. Furthermore, our results show that the size of the response of domestic asset prices to global financial risk shocks differs largely within the Fragile Five. These differentiations are associated with the share of foreign holdings in domestic government bond markets and macroeconomic fundamentals. Fragile emerging countries with a large foreign presence in their markets, lower GDP growth, higher domestic credit growth, larger external debt, and higher current account deficits experience more significant turmoil in their asset markets when global financial conditions deteriorate. In addition, we find

[11] Owing to the lack of the historical data for the 10-year LC government bond yields, we use the 3-year and 2-year LC government bond yields for Brazil and Turkey, respectively. The sample period is January 2, 2006–August 31, 2015 (2521 observations) for all countries except South Africa, in which the period starts from September 1, 2006 (2347 observations).

[12] The sample period for the weekly data is January 2, 2006–August 31, 2015 (505 observations), while the period for the monthly data is January 2006–August 2015 (116 observations). The weekly and monthly VAR models are estimated using one lag selected by Schwartz Bayesian criteria.

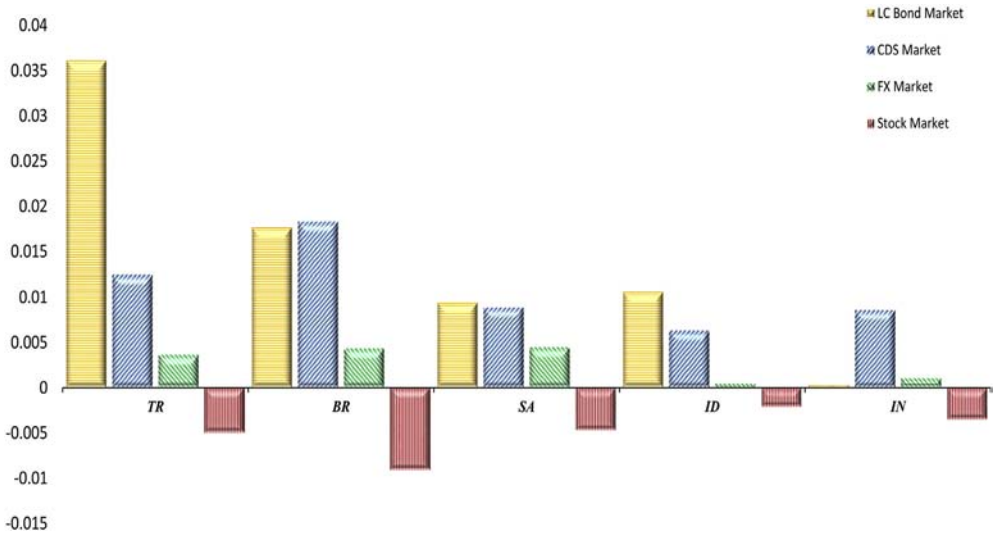

Fig. 6. Immediate effect of global financial risk shocks on different asset markets (local currency government bond markets are represented by the 10-year government bond yield).

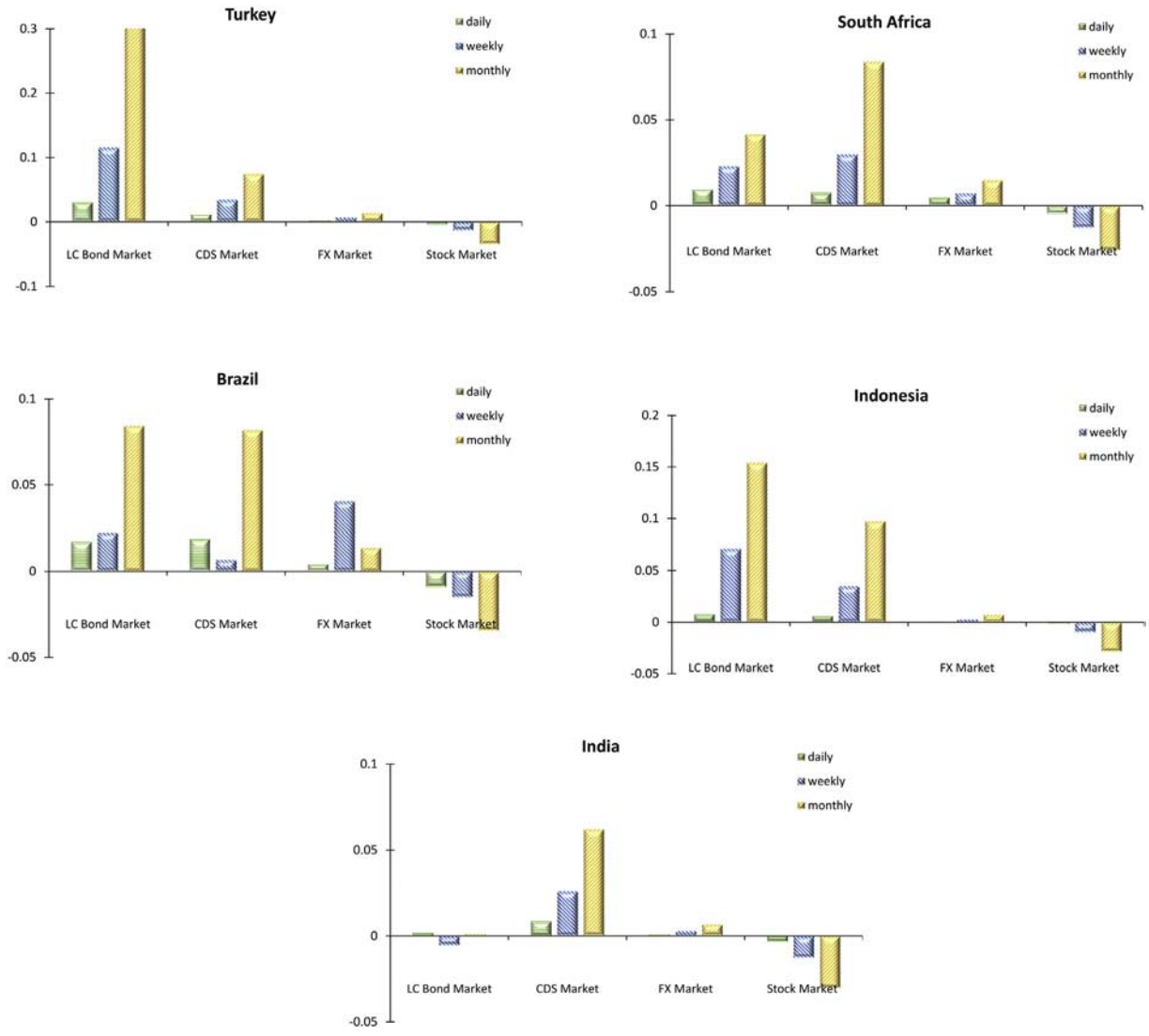

Fig. 7. Immediate effect of global financial risk shocks on different asset markets in different data frequencies.

that there is no severe pressure on currencies in the Fragile Five when risk appetite in global financial markets declines. This does not imply an overall effect of global financial risk shocks on these currencies, but rather, the presence of the fear of floating in these countries.

Overall, the current study contributes to recent debates about the ongoing disruptive effects of tightening global financial conditions on EM financial asset prices. Our results clearly show that the strength of the EMEs' macroeconomic fundamentals matters for reducing the vulnerability of their financial systems to changing global financial conditions. In this context, the present study suggests that EMEs, especially the Fragile Five, should strengthen their macroeconomic fundamentals in mitigating the disruptive effects of the upcoming tightening cycle on EM asset prices.

Future research may extend our analysis by focusing mainly on the threshold effect of global financial conditions on EM asset prices. Our work reveals significant financial spillover effects, leaving an important open question for future research as to whether the spillover effects vary overtime. Specifically, it would be valuable to investigate whether the impact of a collapse in global risk appetite on EM asset prices depends on the stance of global monetary policy.

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Appendix A

Table A
Data sources and definitions.

Country/Financial Variables			*Turkey [TR]*	*Brazil [BR]*	*South Africa [SA]*	*India [IN]*	*Indonesia [ID]*
Domestic Block	*Local Currency Bond Market*	***5-year Government Bond Yield [Primary]***	*TR 5Y T-Bond [DataStream]*	*BR 2Y TSY LTN [DataStream]*	*ZA 5Y Bond [DataStream]*	*IN 5Y GoI Security [DataStream]*	*ID 5Y Gov. Bond [DataStream]*
		10-year Government Bond Yield [Secondary]	*TR 2Y T-Bond [DataStream]*	*BR 3Y TSY NTNF [DataStream]*	*ZA 10Y Bond [DataStream]*	*IN 10Y GoI Security [DataStream]*	*ID 10Y Gov. Bond [DataStream]*
	CDS Market	***5-year Sovereign CDS Spread***	*TR 5Y USD SNRFOR [DataStream]*	*BR 5Y USD SNRFOR [DataStream]*	*ZA 5Y USD SNRFOR [DataStream]*	*IN 5Y USD SNRFOR [DataStream]*	*ID 5Y USD SNRFOR [DataStream]*
	Equity Market	***Equity Price***	*TR BIST 100 [DataStream]*	*BR Bovespa [DataStream]*	*ZA Top 40 [DataStream]*	*IN S&P Sensex [DataStream]*	*ID JKSE [DataStream]*
	FX Market	***Exchange Rate***	*Turkish Lira / US Dollar [DataStream]*	*Brazilian Real/US Dollar [DataStream]*	*South African Rand / US Dollar [DataStream]*	*Indian Rupee / US Dollar [DataStream]*	*Indonesian Rupiah / US Dollar [DataStream]*
External Block	*Global Financial Risk*	***Primary Measure***	*The Chicago Board Options Exchange Market Volatility Index* ***(VIX index)*** *[DataStream]*				
		Secondary Measure	***The US BAA corporate spread*** *(difference between US BAA corporate bond and 20-year Treasury bond) [St. Louis Fed. Fred. FRED Database]*				
	Global Interest Rate	***US Interest Rate***	*The Federal Funds Target Rate [DataStream]*				

Table B
Macroeconomic indicators.

Country-specific indicators	Source	Definition
Financial structure		
Foreign part.[a]	Arslanalp and Tsuda (2014)	Foreign participation in local-currency sovereign bond market
Macroeconomic fundamentals		
GDP growth[a]	OECD	Real GDP growth
Credit growth[a]	BIS	Credit to private sector growth
Policy rate	DataStream	Three-month money market interest rates
Debt[a]	Joint External Debt Hub Database (BIS-IMF-OECD-WB)	Gross external debt to GDP ratio
Reserves[a]	IFS	Total reserves to GDP ratio
CA/GDP[a]	DataStream	Current account to GDP deficit
Inflation	IFS	Change in CPI
Rate diff.	DataStream	Local minus U.S. three-month interest rate differential

[a] The variables are not available at the monthly frequency, but only at the quarterly frequency. Thus, the frequency was changed from quarterly to monthly using an interpolation.

Appendix B. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.econmod.2016.04.018.

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