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The transmission of US monetary policy shocks to emerging equity markets

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Introduction

The role of U.S. monetary policy in determining global asset prices has been extensively discussed in economic research.[1] The topic has relevance for several parties. Local policy makers need to be aware of the impact of the U.S. monetary policy stance on the business sector to fine-tune their own policies if necessary. For investors, enhanced knowledge about risk factors in their portfolios can lead to more accurate value forecasts and therefore to more informed investment decisions.

The discussion has recently regained new importance. After an extended period of leaving target rates close to the zero-lower bound, the Federal Reserve Bank started a tightening cycle in December 2015 to respond to economic recovery in the U.S. This is expected to have implications for both the global economy and international capital markets.

In this thesis, we will investigate the international spillover effects of U.S. monetary policy to foreign stock markets. Specifically, we will investigate the reaction of stock market indices in 12 emerging market economies to a surprise change in the federal funds target rate. In addition, we will explore explanations for cross-countries asymmetries with a network approach. Return connectedness, financial and real integration of each country with the U.S. will be considered as potential transmission channels of US monetary policy shocks to foreign equity markets. Different from existing research, this approach allows us to highlight different measures of interconnectedness of emerging market countries with the U.S. and amongst themselves in our analysis. Thus, we hope to gain deeper insights into the transmission channels to these countries.

The rest of this paper is organized as follows: Part 1 provides an overview about the relevant background theory for our analysis, followed by a review of existing research findings on monetary policy transmission in Part 2. Part 3 lays out the methodology applied in our research and Part 4 specifies the data and its sources.

[1] See i.e. Cook and Hahn (1989),Thorbecke (1997), Bernanke and Kuttner (2005), Ehrmann and Fratzscher (2009a), Bjørnland and Leitemo (2009), Laeven and Tong (2012), Chortareas and Noikokyris (2017). A more detailed discussion will be provided in the literature review.

Theory

In order to identify the monetary policy transmission channels from the U.S. to foreign capital markets a sound understanding of asset value drivers is needed. The following section therefore presents the most prominent theories on asset valuation.

One of the most widely known and used models of asset valuation is the Discounted Cash Flow (DCF) Model. The concept in its most basic form was first formalized by Irving Fisher (1930) and incorporated in John Burr Williams' 'The theory of Investment Value' from 1938. It is based on the fundamental idea that the value of an asset is determined by the sum of all expected future cashflows, capitalized at a discount factor which captures several factors determining the individual's time preference, such as size and riskiness of the income stream.

$$V = \sum_{t=1}^{T} \frac{CF_t}{(1+r)^t}$$

CF_t represent the cashflows to the company at time t and r represents the discount rate. According to the DCF model, fluctuations observed in asset prices can arise either from a change in expected cashflows or from a change in the discount rate r.

William's work also lay the foundation for Gordon (1959) in his stock valuation model. The Gordon Growth Model states that the price of a stock is determined by the present value of all expected future dividends.

$$V = \frac{D_1}{1+k} + \frac{D_1(1+g)}{(1+k)^2} + \frac{D_1(1+g)^2}{(1+k)^3} + \frac{D_1(1+g)^3}{(1+k)^4} + \cdots + \frac{D_1(1+g)^{n-1}}{(1+k)^n}$$

D_1 is the value of the dividend next period, whereas g represents the dividend growth rate and k the discount rate.

Assuming constant dividend growth and that the stock is hold for an undetermined amout of time, the price calculation simplifies to a growing perpetuity of the dividend next period.

$$V = \frac{D_1}{(k-g)}$$

Thus, the stock price adjusts based on changes in the required market return, as well as in expectations about the size of upcoming dividend/share and about dividend growth.

There are theories exploring causes for asset price changes beyond changes in intrinsic value drivers. These models ascribe stock price fluctuations to a portfolio channel, i.e. they are caused by investors who reallocate their asset holdings in reaction to domestic shocks. Lastrapes (1998) introduced a model for the impact of a monetary policy shock on capital markets. Imposing long-run monetary neutrality, he showed a 'liquidity effect': investors react to excess real money supply by rebalancing their portfolios from bonds into stocks, thus causing shifts in demand and supply, which in turn lead to changes in equity prices.

The portfolio channel also plays a role in so-called Contagion theories, which analyse mechanisms that impact stock prices across markets. Contagion in a broad sense means that shocks to one market induce price changes in other markets. If countries share common macroeconomic risk factors, such as business cycles, commodity prices or trade dependencies, stock price changes may be caused by long-term investors who respond to shocks in one country by readjusting their portfolios' risk profile based on expectations about the risk factors in in other markets (Kodres & Pritsker, 2002).
For countries without common fundamental factors, the cause for cross-market price changes can be a domestic wealth shock, as it motivates short-term traders to liquidate positions in several markets simultaneously (Kyle & Xiong, 2001).

Literature review

In this part of the paper, a literature review of relevant studies is provided. The early literature of U.S. monetary policy transmission to capital markets focused only on the United States. Later, the scope of investigation widened to the international financial markets. Most scientific articles agree on the existence of U.S. monetary policy shocks transmission to equity markets, but they do not agree on reasons why the strength of impact varies among countries. The most discussed determinants of strength are economic and financial integration, exchange rate regime, industry structure and local monetary policy.

Monetary policy and U.S. Capital Markets

Cook and Hahn (1989) investigated the transmission of U.S. monetary policy to U.S. capital markets. They analysed the relationship between short- and long-term interest rates and the Federal funds rate from 1974 through 1979, which was set monthly by the Federal Open Market Committee. The reaction was measured by the following regression, where RFF_t was the midpoint of the target rate and R_t represented the bond rate on the announcement day, $\Delta R_t = b1 + b2\, \Delta RFF_t + u_t$. Cook and Hahn have shown that monetary policy influenced short-term rates more than intermediate or long-term rates. The findings supported the generally believed view that the Fed can influence market rates through the Federal funds rate target (Cook & Hahn, 1989). Using the same event-study approach as Cook and Hahn (1989), Roley and Sellon (1995) found a much weaker relationship between interest rates and Federal funds rate target during the period of 1987 through 1995. They argued that investors became more accurate in anticipating monetary policy changes (Roley & Sellon Jr, 1995).

Kuttner's (2001) event-study was one of the first studies, which differentiated between anticipated and unanticipated policy actions. The study showed that interest rates reacted more to policy surprises than to changes of the Federal funds rate itself. He suggested to use Fed funds futures rates to differentiate between expected and unexpected policy actions. The disadvantage of using future price as proxy is that Fed funds futures are firstly traded in 1989, which makes it impossible to analyse the relationship before 1989. The Fed funds futures prices must be adjusted for the time average effect because they are settled on an average basis. A Federal funds rate change consists of two elements, the unexpected target rate change ($\Delta\tilde{r}_t^u$) and the expected target rate change ($\Delta\tilde{r}_t^e$), $\Delta\tilde{r}_t = \Delta\tilde{r}_t^u + \Delta\tilde{r}_t^e$. Kuttner's regression function was set up the following way, $\Delta R_t = \alpha + \beta_1\, \Delta\tilde{r}_t^e + \beta_2\, \Delta\tilde{r}_t^u + u_t$, where R was the bond yield for different maturities. He has shown that the regression coefficients for the surprise part were large and statistical significant, whereas the coefficients for the expected component were small and statistical insignificant (Kuttner, 2001).

Bernanke and Kuttner (2005) examined the impact of monetary policy changes on U.S. equity returns. Based on Kuttner's paper in 2001, they argued that capital markets are forward looking, which means that monetary policy expectations are already incorporated in the equity prices. Only an unexpected change could impact equity returns on the day of announcement. They found a negative relationship between monetary policy surprises and equity returns. A hypothetical unanticipated decrease of 0.25% in the target rate led to an 1% increase in stock prices. The strength of impact differs among industries. In addition, Kuttner and Bernanke tried to answer the question why do equity prices react to FOMC announcements. The results showed that equity returns responded mostly to anticipated future dividends and anticipated future excess returns, which were affected by monetary policy surprises. High-tech and telecommunications were the most exposed sectors to FOMC announcements (Bernanke & Kuttner, 2005).

An alternative approach to estimate the strength of reaction is a Vector autoregression model. The rise of VAR models was motivated by the fact that U.S. monetary policy could be treated as an endogenous variable. The endogeneity problem was addressed by several authors. There are numerous studies which examined the effect by using a VAR model. VAR models are sometimes difficult to implement and to interpret (Kuttner, 2001). The advantage of an event-study approach is the usage of higher frequency data compared to a VAR model, which is usually based on monthly or quarterly data (Ehrmann & Fratzscher, 2009b).

Thorbecke (1997) applied both, an event-study regression and a VAR model to investigate the transmission of U.S. monetary policy to the U.S. equity market. He found that consistent with theory, U.S. equity returns were influenced positively (negatively) by unexpected U.S. monetary policy expansions (contractions). Furthermore, the strength of reaction depended on the industry and the company size (Thorbecke, 1997).

The Vector Autoregressive study by Rigobon and Sack (2003) found an inverse relationship, the U.S. equity market influenced Fed's monetary policy by affecting the economy. They argued that the stock market did not respond to monetary policy changes (Rigobon & Sack, 2003).

Bjørnland and Leitemo (2009) examined the relationship between the U.S. monetary policy and the S&P 500 by using a Vector Autoregressive model. The findings indicated a strong interdependence between both variables. A 1% increase in the Fed funds rate decreased the U.S. stock prices by 7% to 9%. In addition, an 1% increase in real stock prices triggered an increase of the interest rate by 0.04%. The VAR model was based on monthly observations. (Bjørnland & Leitemo, 2009).

Monetary policy and International Capital Markets

Wongswan (2009) investigated the transmission of U.S. monetary policy shocks to 15 foreign equity indexes from 1998 through 2004, excluding the 17^{th} of September 2001. His study was based on high-frequency data to control for unrelated news. The study results suggested a strong and significant relationship. An unexpected 0.25% cut in the Fed funds rate target led to a 0.5% to 2.5 % increase in foreign equity indexes. Following Gurkaynak, Sack and Swanson's (2005) paper, monetary policy surprises were deconstructed into two components, target and path surprises. Target surprise (TS) was calculated the same way as in Kuttner's (2001) paper. Path surprise (PS) was extracted by using Eurodollar interest rate futures (Gurkaynak, Sack, & Swanson, 2005). A more detailed description can be found in the methodology section. Significantly higher volatility of equity returns on announcement days indicated that foreign indexes responded to FOMC announcements. The results showed that equity indexes reacted mostly to target surprises. The equity indexes in Korea and Hong Kong reacted the most to FOMC announcement surprises. This may be triggered by the fact that the Hong Kong Dollar is pegged to the US Dollar and that the equity index in Korea was highly influenced by the IT and telecommunication sector (Wongswan, 2009). The second part of the Wongswan's (2009) paper focused on answering the question why foreign equity indexes reacted to U.S. monetary policy surprises. Three different reasons were elaborated. Firstly, economic integration with the United States may have impacted the cash flows of foreign companies. Secondly, discount rates may be impacted through financial integration. Thirdly, the relationship could have been influenced by other factors, such as the indexes' industrial composition, the exchange rate regime or the equity market riskiness. A cross-section regression showed that the equity indexes' reactions were more correlated with financial integration proxies. This was an indication that foreign companies were more affected through the discount rate (Wongswan, 2009).

A study by Ehrmann and Fratzscher (2009) focused on the transmission of U.S. monetary shocks to 50 equity markets. They also found that the strength of reaction differed across countries. On average, equity prices decreased by 3.8% in response to an 1% increase of the target rate. What's more, developed stock markets and equity markets of countries with a more volatile exchange rate responded more to U.S. monetary shocks. Moreover, they found that financial integration in terms of foreign financial assets held by domestic people and in terms of domestic financial assets held by foreigners influenced the strength of reaction. In addition, they argued that the degree of global integration was more important for the transmission than the degree of integration with the United States (Ehrmann & Fratzscher, 2009b).

Hausman and Wongswan (2011) did a similar study as Wongswan (2009), but they extended the scope of assets to short- and long-term interest rates, exchanges rates and foreign equity indexes for 49 countries. They found that equity indexes reacted mainly to target surprises, FX rates and long-term rates responded mostly to path surprises and short-term rates reacted to both. In addition, they discovered that a country's exchange rate regime affected the reaction of equity markets and interest rates to FOMC announcements surprises. A country with a less flexible exchange rate responded more to surprises. Furthermore, the number of assets held by U.S. investors was an important factor for the shock transmission. U.S. investors may want to adjust their portfolio allocation after FOMC announcements (Hausman & Wongswan, 2011).

Ammer, Vega and Wongswan (2010) studied the transmission channels of U.S. monetary policy shocks to equity markets at the firm level. They identified two channels of transmission, demand and credit channel. The demand for goods and services was influenced over the demand channel and the company's credit supply was affected through the credit channel. They found that companies, which operated in a cyclic industry and export more goods, responded stronger to FOMC announcements. In addition, their results confirmed those by Hausman and Wongswan (2011) that companies, which operated in countries with a fixed exchange rate to the USD, reacted more to U.S. monetary policy shocks (Ammer, Vega, & Wongswan, 2010).

A recent study by Chortareas and Noikokyris (2017) investigated how local monetary policy influenced the strength of reaction. The findings suggested that countries, which had a similar monetary policy compared to the United States, were less affected by U.S. monetary policy changes. These countries internalised the external shocks over local monetary policy (Chortareas & Noikokyris, 2017).

Methodology

Hausman & Wongswan's event study approach

An event-study approach will be applied to measure the impact of monetary policy surprises during FOMC announcements on emerging equity markets. According to Gurkaynak, Sack and Swanson (2005), monetary policy surprises consist of two dimensions, target (TS) and path surprise (PS). We will use the same regression as Hausman and Wongswan (2011) to measure the effects on a one-day window around FOMC announcements,

$$R_{i,t} = \alpha + \beta_1 * TS_t + \beta_2 * PS_t + \varepsilon_{i,t}.$$

The dependent variable $R_{i,t}$ is the equity index return of country i on day t, TS is the target surprise, PS is the path surprise and Ɛ is a residual term for country i on day t.

The target surprise is the difference between the actual target rate and expectations, which are derived from the Fed funds futures prices (Kuttner, 2001). The Fed funds futures prices are adjusted for the time average effect because they are settled on an average basis. We will use next month unadjusted Fed funds futures if the FOMC announcements take place in the last 7 days of the month. Target surprises are calculated on a 30-min window around FOMC announcements (Hausman & Wongswan, 2011),

$$TS_t = \frac{D}{D-d} * (ff_{t+20} - ff_{t-10}) \,.$$

The path surprise (PS) is defined as the surprise change related to the expected future path. It is extracted by running the following regression,

$$\Delta ed_{t-10,t+20} = \alpha_0 + \alpha_1 TS_t + PS_t \,,$$

where $\Delta ed_{t-10,t+20}$ represents the change in 1-year-ahead Eurodollar interest rate futures, calculated on a 30 minutes time window. The path surprise is the error term (Hausman & Wongswan, 2011).

Diebold & Yilmaz's Network Approach

To explain why emerging markets react differently to U.S. federal interest rate changes we adopt the approach developed by Diebold and Yilmaz (2009), (2012) and (2014) and construct a network of monthly equity index returns for our 12 considered countries and the U.S. For that, a 13-variable vector autoregressive

(VAR) model will be constructed to form measures for connectedness based on variance decompositions. A N-variate VAR(p) model takes on the following form:

$$x_t = \sum_{i=1}^{p} \phi_i x_{t-i} + \epsilon_t$$

where $x_t = (x_{1t}, x_{2t} \dots, x_{Nt})$ is a vector of equity index returns and $\epsilon_t \sim (0, \Sigma)$ is a vector of IID disturbances. For a covariance stationary VAR, the model can be formulated in moving average (MA) representation as

$$x_t = \sum_{i=0}^{\infty} A_i \, \epsilon_{t-i}$$

where A_i are $N \, x \, N$ parameter matrices which follow the recursion $A_i = \phi_1 A_{i-1} + \phi_2 A_{i-2} + \cdots + A_{i-p}$, A_0 is the $N \, x \, N$ identity matrix and $A_i = 0$ for $i < 0$.

Connectedness, measured as the share θ_{ij} of forecast error variations in country i's equity index which are caused by shocks to country j's equity index, is derived from variance decompositions. In the standard VAR model popularized by Sims (1980), variance decompositions are based on Cholesky factorizations, where orthogonalized shocks make the results highly sensible to ordering of variables and can complicate our analysis. To achieve invariance to ordering, a generalized variance decomposition (GVD) framework as used by Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998), will be used to measure connectedness.

Pairwise directional connectedness

In the GVD framework, country $j's$ contribution to country $i's$ H-step-ahead generalized forecast error variance decompositions $\theta_{ij}^{g}(H)$, for H=1,2,… , is

$$\theta_{ij}^{g}(H) = \frac{\sigma_{ii}^{-1} \sum_{h=0}^{H-1} \left(\kappa_i' A_h \Sigma \kappa_j\right)^2}{\sum_{h=0}^{H-1} (\kappa_i' A_h \Sigma A_h' \kappa_i)}$$

Σ is the variance matrix of vector ϵ, σ_{ii} is the standard deviation of the error term ϵ_i and κ_i is a selection vector with one as the i^{th} element and zeros otherwise. These cross-variance shares depict pairwise directional connectedness of equity indices, for $i, j = 1,2, \dots N$, such that $i \neq j$.

$$C_{i \leftarrow j}^{H} = \theta_{ij}^{g}(H)$$

Also, the strength of pairwise directional connectedness differs, thus $C_{i \leftarrow j}^{H} \neq C_{j \leftarrow i}^{H}$. Because shocks are not orthogonalized, the sum of forecast error variance contributions is not automatically equal to one. Therefore, the return connectedness table explained below will be based on a variance decomposition matrix normalized along the row sum:

$$\tilde{\theta}_{ij}^{g}(H) = \frac{\theta_{ij}^{g}(H)}{\sum_{j=1}^{N} \theta_{ij}^{g}(H)}$$

It holds that $\sum_{j=1}^{N} \tilde{\theta}_{ij}^{g}(H) = 1$ and $\sum_{i,j=1}^{N} \tilde{\theta}_{ij}^{g}(H) = N$.

Total Directional Connectedness, 'From' and 'To'

As described by Diebold and Yılmaz (2014), the total directional connectedness to country $i's$ equity index received 'From' others is the fraction of $i's$ H-step forecast error variance arising from shocks to all other countries j

$$C_{i\leftarrow\bullet}^{H} = \sum_{\substack{j=1 \\ j\neq i}}^{N} \tilde{\theta}_{ij}^{g}(H)$$

and total directional connectedness from country $i's$ equity index to all other countries j is

$$C_{\bullet\leftarrow i}^{H} = \sum_{\substack{j=1 \\ j\neq i}}^{N} \tilde{\theta}_{ji}^{g}(H)$$

The connectedness table summarizes the connectedness measures. It contains the $N\ x\ N$ variance decomposition matrix $\Theta^{g} = [\tilde{\theta}_{ij}^{g}(H)]$ whose $N^2 - N$ off-diagonal entries measure pairwise directional connectedness. Θ^{g} is augmented by a column on the right containing N off-diagonal row sums for $C_{i\leftarrow\bullet}$, and a bottom row containing N off-diagonal column sums for $C_{\bullet\leftarrow i}$, connectedness transmitted 'To' others. The focus of our analysis lies in particular on the pairwise directional connectedness between the U.S. and different emerging equity markets, showing how strongly shocks to U.S. markets transmit to other markets.

Since equity return connectedness can be time-varying, both a full-sample and a rolling-window estimation will be conducted. A full-sample estimation will yield static network connectedness, a rolling-window estimation will characterize dynamic network connectedness.

Causes of Connectedness

Based on Diebold and Yilmaz (2015), we run the following regression analysis to test whether real and financial integration with the U.S. can explain return connectedness and thus qualify as monetary policy transmission channels from the U.S. to emerging markets:

$$\ln\left(\frac{C_{i\leftarrow US}}{C_{US\leftarrow i}}\right)_t = \alpha_i + \beta_i * \ln(X_i)_{t-12}$$

$\frac{C_{i\leftarrow US}}{C_{US\leftarrow i}}$ is the ratio between the connectedness 'from' the U.S. to the connectedness 'to' the US for country i at time t. The independent variable is the explanatory proxy considered in our thesis: for real economic integration it is the both the fraction of exports and imports (both to the U.S.) of local GDP and the ratio of exports and imports to the U.S. of country i, for financial integration the share of U.S. investors' equity holdings in country i, both lagged by 12 months.

De Santis & Zimic`s SVAR Approach

A very current way to explore the spillover effects of shocks was developed by Robert de Santis and Srecko Zimic (2017). Their approach is based on an SVAR model and introduces event-study magnitude restrictions as alternative to traditional identification methods such simple sign or zero restrictions and will be considered as alternative to the aforementioned method after a closer feasibility assessment.
A structural VAR model takes on the following form (De Santis & Zimic, 2017b):

$$A_0 y_t = A_1 y_{t-1} + \cdots + A_k y_{t-k} + B\varepsilon_t,$$

where A_0 represents the contemporaneous relation among the endogenous variables and $A_k, k \in [1,2,..,K]$ accounts for the dynamic relations. y_t is a N x 1 vector of endogenous variables and B is a matrix containing the standard errors of the structural shocks. In order to identify structural shocks and to gather structural impulse responses, A_0 has to be identified. Zero and sign restrictions are common assumptions to use in the identification process. However, De Santis and Zimic argue that it is unsure ex-ante whether spillovers create positive or negative correlation. Therefore, they suggest to use event-study magnitude restrictions or absolute magnitude restrictions on the impact matrix (De Santis & Zimic, 2017a, 2017b). The advantage of using event-study magnitude restrictions compared to absolute magnitude restrictions is that the bounds on the impact matrix are narrower. An absolute magnitude restriction implies that a shock has a higher magnitude in the country of origin than in other countries. For example, a downgrade of Portugal should have a higher impact on the Portuguese sovereign bond yield than on other sovereign bond yields (De Santis & Zimic, 2017b). Rather than applying such absolute magnitude restrictions, the event-study based restrictions suggested by De Santis & Zimic impose upper and lower bounds on the effect of shocks to allow for more precise inference from the model. The restrictions are based on the following regression:

$$x_i = a_{i,j} x_j + \varepsilon_i$$

Where x_i, x_j are the changes in daily equity index returns in countries i and j on Federal reserve announcement dates and $\hat{a}_{i,j}$ is the estimated average spillover from country i to country j. The upper and lower bounds defined for the impact matrix are then constructed from the estimated standard errors with a confidence interval of $\hat{a}_{i,j} \mp 4\hat{\sigma}_{a_{i,j}}$.

Data

In this paper we define emerging countries according to the classification of the MSCI Emerging Markets Index which was introduced in 1988. MSCI's classification is based on the following criteria (MSCI, 2012):

- Market accessibility for foreign investors
- Liquidity and size of the stock market
- Economic growth

Nowadays, 24 countries are included in the MSCI EM Index (MSCI, 2017). We identified 12 countries which have been members of the MSCI Emerging Market Index from 1994 until 2016 and were never excluded once of the index since then: Brazil, Chile, Colombia, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Thailand and Turkey (MSCI, 2012) (Bambaci, Chia, & Ho, 2012) (MSCI, 2017).

Stock market prices for these emerging markets indices will be obtained in local currency from Datastream for a period of around 22 years, starting from 1994. In addition, for the period between 1994 and 2004 we extract both the timing of 8 scheduled FOMC meetings per year and the corresponding monetary policy surprises from data provided by Gurkaynak, Sack, & Swanson (2005). For the period from 2004 to 2016, data on FOMC meetings will be obtained from FRASER, whereas the target and path surprises will be calculated from Federal Funds Futures and 1-year ahead Eurodollar interest rate futures.

The fraction of U.S. investors' equity holdings of emerging stock market capitalization used as proxy for financial integration will be calculated from

Treasury International Capital (TIC) data published annually by U.S. Department of the Treasury for the period 1994 to 2001. From 2001 on, annual data from the Coordinated Portfolio Investment Survey (CPIS) compiled by the International Monetary Fund (IMF) will be basis for the calculations. For the real economic integration proxies, we obtain data on yearly exports and imports to the U.S. as fraction of GDP for our sample from the World Integrated Trade Solution (WITS) software and the World Development Indicators (WDI) provided by the World Bank.

Descriptive statistics, 14th of January to the 29th of December 2017

	USA	Mexico	Brazil	Colombia	Peru	Chile	Thailand	Indonesia	Malaysia	Philippines	India	Korea	Turkey
Panel: summary statistics of log return series (weekly)													
Mean	0.0014	0.0023	0.0037	0.0023	0.0023	0.0011	0.0000	0.0017	0.0003	0.0004	0.0017	0.0013	0.0048
Median	0.0024	0.0034	0.0045	0.0017	0.0022	0.0007	0.0004	0.0024	0.0015	0.0014	0.0037	0.0026	0.0052
Minimum	-0.2012	-0.1931	-0.2272	-0.2204	-0.2822	-0.2296	-0.2860	-0.2459	-0.2017	-0.2055	-0.1900	-0.2140	-0.3461
Maximum	0.1153	0.1801	0.2354	0.1594	0.2199	0.1666	0.2391	0.2826	0.2630	0.1676	0.1366	0.1882	0.3327
Std. dev.	0.0234	0.0323	0.0434	0.0328	0.0396	0.0266	0.0421	0.0440	0.0293	0.0331	0.0335	0.0395	0.0562
Skewness	-0.7890	-0.1534	0.1028	-0.2358	-0.1571	-0.5580	0.0757	-0.0515	0.1942	-0.0515	-0.3234	-0.2599	-0.1079
Kurtosis	9.9547	6.9200	7.5408	7.6207	7.5481	9.9567	8.1350	9.4850	14.4154	7.4611	5.6078	6.9415	7.9611
J-Bera	2651***	805.89***	1076.9***	1124.5***	1083.4***	2587.5***	1375.6***	2192.7***	6800.4***	1089.6***	376.3***	823.86***	1285.4***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Q(10)	32.422***	18.062*	35.178***	33.196***	8.8516	15.4280	29.575***	45.987***	42.123***	19.04**	30.381***	25.794***	16.64*
	(0.0003405)	(0.05392)	(0.0001164)	(0.0002525)	(0.5462)	(0.1172)	(0.001005)	(0.0000)	(0.0000)	(0.03976)	(0.0007419)	(0.004028)	(0.08273)
ADF(10)	-10.586***	-11.118***	-10.133***	-11.396***	-10.371***	-11.423***	-10.533***	-12.506***	-10.182***	-10.365***	-10.161***	-10.342***	-11.395***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Notes: Q(10) is the Ljung–Box statistics for serial correlation and ADF(10) is the Augmented Dickey-Fuller test for stationarity .
The values in parentheses are the actual probability values. *, ** and *** indicate the rejection of the null hypothesis of associated statistical tests at the 10%, 5% and 1% levels respective.

Log returns are measured weekly from Friday to Friday. 1251 observations per country.

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