THE GROWING IMPORTANCE OF FINANCIAL SPILLOVERS FROM EMERGING MARKET ECONOMIES

Summary

Trade and financial integration of emerging market economies into the global economy and financial system has increased significantly over the past two decades. As a result, spillovers of emerging market shocks to equity prices and exchange rates in advanced and emerging market economies have risen substantially and now explain over a third of the variation in asset returns in these countries. Bond market spillovers, however, do not display a corresponding trend, since they continue to be driven largely by global factors.

In recent years, the importance of financial factors in explaining spillovers has grown relative to that of trade linkages. The rise in financial market integration has strengthened spillovers across countries. More than its economic size, the degree of financial integration matters for a country's importance as a receiver and transmitter of spillovers.

Spillovers tend to occur more between countries with similar macro-financial fundamentals. Cross-country spillovers are strongest within sectors. Sectors that are more dependent on external finance are more subject to spillovers, as are firms with lower liquidity and higher borrowing. Purely financial contagion effects remain less significant in the case of China. However, the impact of shocks to economic fundamentals, such as news about China's growth, on equity returns in both emerging market and advanced economies has been rising. China's spillovers to global financial markets will likely increase considerably in the next few years.

Finally, structural changes in financial markets, notably the growth in mutual fund intermediation of capital flows, appear to have increased the importance of the portfolio channel of contagion from emerging markets.

These findings suggest that when assessing macro-financial conditions, policymakers may increasingly need to take into account economic and policy developments in emerging market economies. In particular, as China's role in the global financial system continues to grow, clear and timely communication of its policy decisions, transparency about its policy goals, and strategies consistent with their achievement will be ever more crucial. Finally, given the evident importance of corporate borrowing and mutual fund flows in amplifying spillover of shocks, it will be essential to shape macroprudential surveillance and policies to contain systemic risks arising from these channels.

Introduction

Financial spillovers occur when fluctuations in the price of an asset trigger changes in the prices of other assets. This chapter studies the evolution of such spillovers from emerging market economies to financial markets of other countries. Growing integration of emerging market economies into the global financial system can be expected to raise international financial spillovers—both in its desirable (better incorporation of news) and less desirable (transmission of excess volatility due to financial friction) forms.

Crises in emerging market economies have often had financial repercussions in other countries.[1] The Latin American debt crisis of the 1980s, Mexico's economic crisis of 1994–95, and the east Asian and Russian financial crises of the late 1990s are prominent examples of high macro-financial volatility in emerging market economies that spilled over significantly to other emerging market economies and to advanced economies.

More recently, however, financial market volatility originating in emerging market economies seems to have been widely transmitted outside of crises or near-crises. For example, the suspension of trading after the drop of the Chinese stock market on January 6, 2016, reverberated across major asset markets globally. Similarly, when Chinese equities fell sharply on August 24, 2015, following the announcement of a change in the exchange rate regime of the renminbi, the subsequent plunge in Asian equity markets was significant, and the U.S. and European stock markets were also adversely affected.

Over the past two decades, the share of emerging market economies in global output, trade, and the financial system has risen substantially. Emerging market economies have contributed more than half of global growth over the past 15 years, and their share in global GDP has risen to 38 percent. Integration of these economies into the global trading network has been rapid during this period,

[1]The classification of countries as "advanced" and "emerging market" economies is described in Annex 2.1.

Figure 2.1. Trade between Advanced and Emerging Market Economies
(Billions of U.S. dollars; exports plus imports)
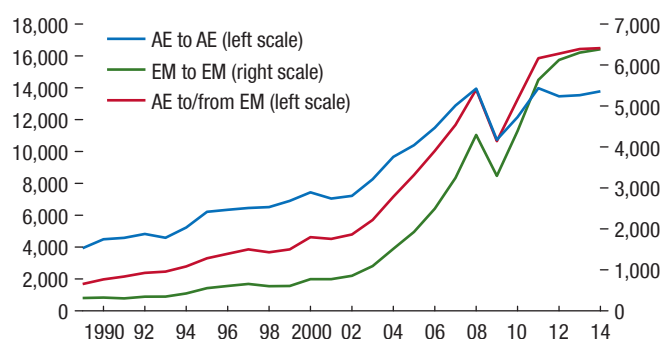
Sources: Haver Analytics; IMF, International Financial Statistics database; and IMF staff calculations.
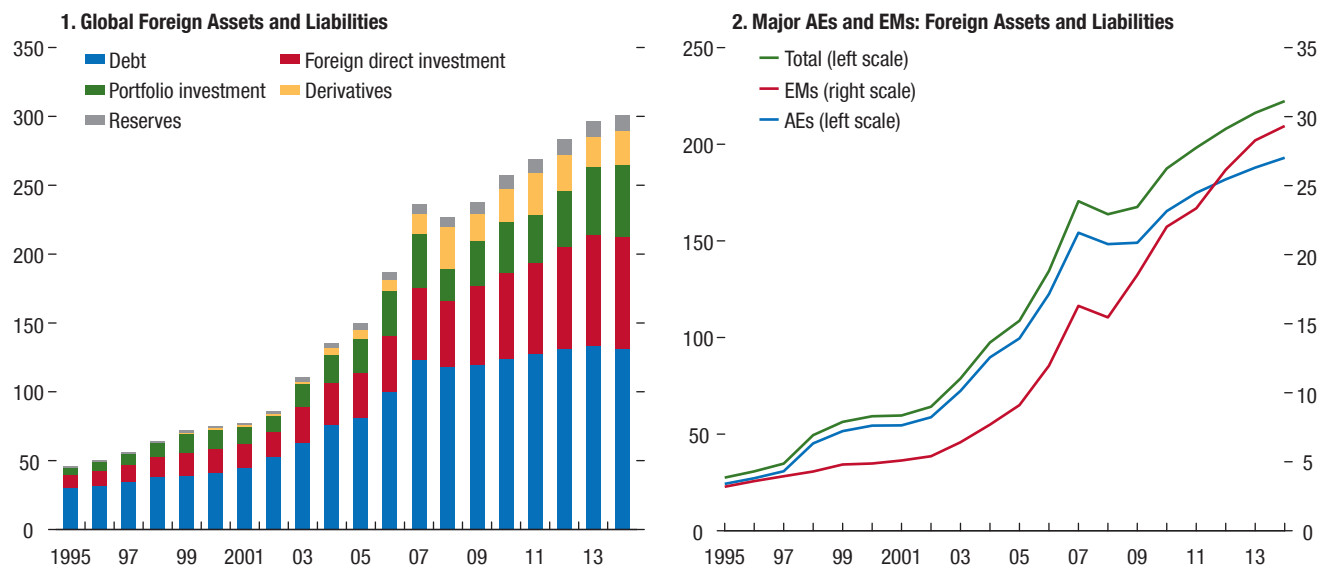Note: AE = advanced economy; EM = emerging market economy.

with trade between advanced and emerging market economies now exceeding trade between advanced economies. Meanwhile, trade between emerging market economies is 20 times what it was in the early 1990s (Figure 2.1). Financial integration has also grown, albeit at a slower pace and from a lower base (Figure 2.2). Advanced economy banks doubled their exposure to emerging market economies during 2005–13, and bond flows to emerging market economies strengthened continuously. Domestic financial market development in emerging market economies has also proceeded accordingly as their share of global equity market capitalization more than doubled relative to two decades ago and their bond market capitalization increased more than seven times. Importantly, a number of de jure and de facto measures point to declining segmentation during this growth in emerging market economies' financial markets. Increased integration of emerging market economies into the global financial system, in addition to risks, has also likely brought these economies significant benefits.

Financial spillovers from emerging market economies are likely to have risen as the channels of transmission have strengthened, magnifying the reverberation of economic shocks and financial friction.

- *Direct and indirect trade linkages of emerging market economies have grown significantly*. Their bilateral trade and participation in trade networks via supply chains have risen (Figure 2.3; IMF 2011). This

Figure 2.2. Global Financial Integration
(Trillions of U.S. dollars)

Sources: External Wealth of Nations Mark II database; Lane and Milesi-Ferretti 2007; and IMF staff calculations.
Note: Both panels depict total gross foreign assets and liabilities. AE = advanced economy; EM = emerging market economy.

has important implications for how news about emerging markets' economic performance affects financial markets elsewhere. For example, stock prices of firms with exports to, or subsidiaries in, these emerging market economies will be affected by changes in the prices of those economies' assets, insofar as these changes reflect updated expectations of demand for these firms' products (IMF 2014b, 2015).
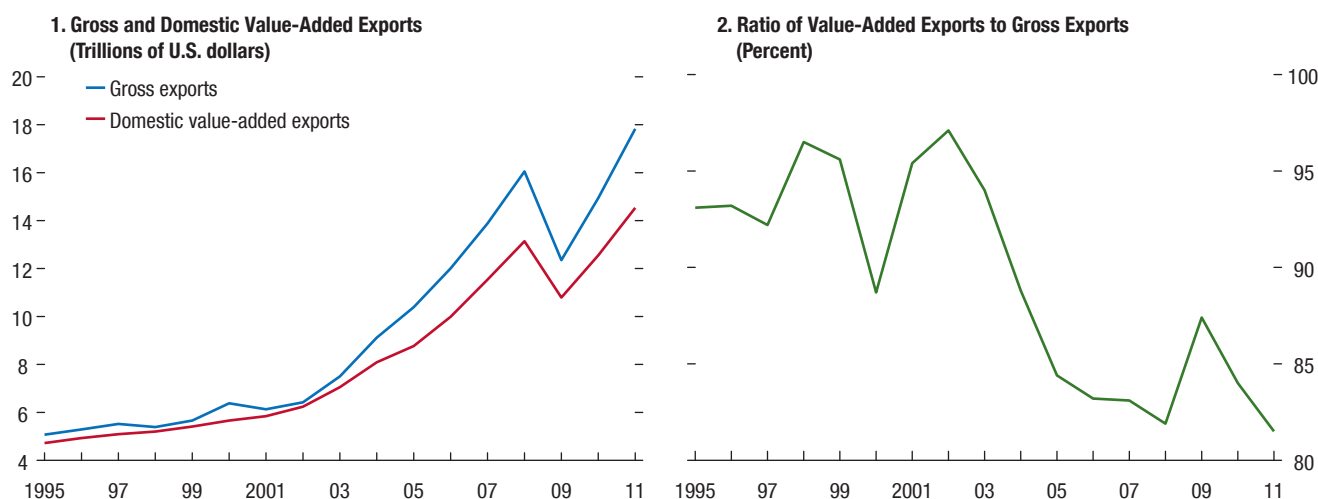
- *Financial mechanisms are likely to have grown as well.* The presence of financial friction may enable or strengthen the cross-border transmission of asset price shocks, even in the absence of direct or indirect trade and economic linkages between countries. This is exemplified by the *portfolio channel of contagion,* through which fund managers can propagate shocks internationally when they rebalance asset holdings across countries in response to losses or gains. The importance of this type of channel is likely to have grown as a result of the increasing presence of advanced economy investors in emerging market economies and vice versa. Similarly, banks that suffer losses in their emerging market operations may be forced to cut lending to other countries.

It is, therefore, natural to hypothesize that emerging markets now transmit shocks in normal times as well as in crisis periods. The continuous increase in correlations in asset prices over the past two decades is suggestive in this regard (see the April 2014 *Global Financial Stability Report*).

In this context, this chapter addresses the following questions:
- How have financial spillovers from emerging market economies evolved during the past two decades? To what degree does news about the real economy in major emerging market economies affect financial markets elsewhere, and how has the strength of this impact changed?
- What are the relative roles played by financial market integration, trade, and direct financial linkages? In which sectors are financial spillovers most prevalent?

The chapter proceeds in four stages. It first defines financial market spillovers and the way they relate to correlation in market returns, common shocks, and contagion. Second, it decomposes the variation in a country's returns in key markets into contributions from domestic and foreign market shocks. These

Figure 2.3. Global Gross Exports and Domestic Value-Added Exports

1. Gross and Domestic Value-Added Exports
   (Trillions of U.S. dollars)

— Gross exports
— Domestic value-added exports

2. Ratio of Value-Added Exports to Gross Exports
   (Percent)

Sources: Duval and others 2016; Organisation for Economic Co-operation and Development–World Trade Organization Trade in Value-Added database; and IMF staff calculations.
Note: Standard gross exports and value-added exports are shown in panel 1, and the ratio of value added to gross exports (VAX ratio) is shown in panel 2. Although both gross and value-added exports are trending upward, their difference (foreign value added in exports) has also been rising. Likewise, the declining VAX ratio highlights the decline in domestic value added (Johnson and Noguera 2014). As inputs pass through these global supply chains, they typically cross borders multiple times, which implies that commonly used gross trade data can be misleading. Using value-added measures of exports mitigates this bias and helps illustrate the growing prominence of global supply chains.

evolving spillovers are subsequently explained as a function of changing trade and financial linkages between countries, controlling for other relevant factors. This analysis is conducted not only at an aggregate, cross-country level, but also, innovatively, at the sectoral level using firm-level data. Third, the chapter assesses the changing impact of news about fundamentals in major emerging market economies on market returns. Fourth, the analysis shows how the portfolio channel of contagion is a growing source of emerging market spillovers in equities markets.

These are the main findings:

- Equity and foreign exchange market spillovers from emerging markets have risen significantly over the past two decades. More than a third of the variation in advanced economies' stock market returns and in their exchange rates can now be traced to spillovers from emerging market economies. Bond market spillovers do not display a corresponding trend, because bond flows are driven much more strongly by global factors.
- In recent years, the importance of financial factors has grown relative to that of trade linkages. The increase in financial market integration has strengthened spillovers across countries. More than their

economic size, the degree of financial integration matters for a country's importance as receiver and transmitter of spillovers.

- Spillovers tend to occur more between countries with similar macro-financial fundamentals. Cross-country spillovers are strongest within sectors. Firm-level factors matter: sectors that are more dependent on external finance are more susceptible to spillovers, as are firms with lower liquidity and higher leverage ratios. Corporate borrowing appears to be playing a growing role in spillover transmission.
- Structural changes in global financial markets and capital flows are affecting the nature of financial spillovers from emerging market economies. Although still smaller than spillovers from advanced economies, emerging market spillovers through global mutual funds have risen in recent years in line with the increase in asset allocation to these economies.
- Shocks to economic fundamentals, such as news about China's growth, are increasingly driving equity returns in both emerging market and advanced economies. It is likely that China's spillovers to global financial markets will increase considerably

in the next few years. By contrast, purely financial factors (such as contagion effects stemming from portfolio reshuffling by common investors) remain less significant in the case of China.

These findings have the following policy implications:

- The growth in spillovers from emerging market economies to global equities and foreign exchange markets means that when assessing macro-financial conditions, policymakers may need to increasingly consider these countries' economic and policy developments. Financial "spillbacks" from emerging market economies stemming from advanced economies' policy actions are also likely to become more significant, underscoring the importance of enhanced international macroeconomic and macroprudential policy cooperation.
- Policymakers need more comprehensive and granular data on capital flows and their intermediation by banks, large institutional investors, and investment funds to better assess risks and vulnerabilities and identify potential shock triggers and spillover channels.
- Given evidence that financial deepening can attenuate financial spillover of external shocks, governments should promote the development of a local investor base (April 2014 GFSR, Chapter 2).
- As China's role in the global financial system grows, economic and policy developments in that country will have increasing implications for global financial stability. Clear and timely communication of its policy decisions, transparency about its policy goals, and strategies consistent with achieving them will, therefore, be essential to ensure against volatile market reactions, which may have broader repercussions.
- Given evidence of the rising importance of investment funds in generating cross-country contagion, better surveillance of mutual funds' exposures and their resilience in the face of shocks is warranted. Micro- and macroprudential measures to guard against systemic risk from their activities should be considered (April 2015 GFSR, Chapter 3).
- Similarly, given that high levels of corporate indebtedness play a prominent role not only in originating shocks but also in their transmission, countries must guard against financial stability risks. Guarding

against excessive increases in corporate leverage may require macroprudential measures targeted at both bank- and market-based financing by firms (October 2015 GFSR, Chapter 3).

International Financial Spillovers—Definition and Drivers

International financial market spillovers can be defined as the impact of changes in domestic asset price movements (or their volatility) on asset prices in other economies.[2] The concept excludes comovement across markets that is driven by common factors (say, regional or global shocks that affect many economies similarly). This implies that any empirical analysis faces the challenge of distinguishing such common shocks from truly idiosyncratic ones and establishing directionality.[3]

Financial market spillovers are a broader phenomenon than contagion. Definitions of contagion usually refer to "unusual" comovement of asset prices or their volatility, typically arising during periods of stress (Forbes 2012).[4] Specifically, contagion is usually understood as asset price comovement that cannot be explained by real-economy linkages.[5] Spillovers span shock transmission in this sense of contagion, but are more general. The definition of spillovers is agnostic as to the underlying mechanism and corresponds to directional interdependence across asset markets, including during normal times.

---

[2]An alternative, less standard definition of financial spillovers can encompass the direct impact of country-specific news on financial markets elsewhere, even if this news is not reflected in domestic markets (spillovers to financial markets). For example, the absence of a well-developed domestic stock market may preclude or inhibit the impact of news on market returns within the country, but this news may have an impact on markets elsewhere.

[3]The concept of spillovers used here is more narrow than that frequently used in relation to real-economy spillovers. The macroeconomic consequences of the evolution of financial spillovers is an important issue that is beyond the scope of the current analysis.

[4]For example, contagion is sometimes statistically defined as an increase in unconditional correlation in asset returns following shocks to a given market or country (Forbes and Rigobon 2002). In order for such contagion to be present, correlations must rise even after adjusting for the higher volatility that often accompanies the occurrence of shocks.

[5]For example, Puy (2016) defines contagion as the mechanism through which a set of common investors (mutual funds) expose all countries or assets in their portfolio to foreign funding or asset return shocks. This is one channel of financial market spillover examined in this chapter, but there are others as well.

Cross-country financial market spillovers may reflect the transmission of news about economic fundamentals or contagion arising from financial friction.

- The presence of *direct and indirect trade linkages* plays an important role in the cross-country financial market transmission of shocks to economic fundamentals. For example, stock prices of firms exporting to a country will be affected by news about economic growth in that market. News about economic fundamentals in major emerging market economies can also convey information about the future demand for commodities, affecting asset prices in commodity-exporting countries, regardless of the strength of their bilateral trade with these emerging market economies. As another example, a devaluation of a country's currency will make that country's exports more competitive, which will likely be reflected in a valuation adjustment of competing firms in other economies (Forbes 2002).[6]

- The presence of *common investors or lenders* in two countries can be sufficient to generate spillovers even in the absence of real-economy linkages (Figure 2.4). For example, as noted previously, funds can propagate shocks by portfolio rebalancing in the face of relative performance concerns and fire sales brought on by end-investor withdrawals (see the April 2015 GFSR, Chapter 3; Boyer, Kumagai, and Yuan 2006; Broner, Gelos, and Reinhart 2006; Coval and Stafford 2007; Jotikasthira, Lundblad, and Ramadorai 2012; Kodres and Pritsker 2002; Kyle and Xiong 2001; Raddatz and Schmukler 2012). Constraints in large institutional investors' mandates may cause those investors to drop assets of countries downgraded to below investment grade (April 2014 GFSR, Chapter 3). The inclusion or exclusion of a country in a benchmark index typically has significant effects on flows and asset prices, since many funds follow these indices either mechanically or closely (Raddatz, Schmukler, and Williams 2015). *Herding* (rational or irrational) by international

investors may lead to the propagation of shocks beyond what is warranted by fundamentals (Calvo and Mendoza 2000). The wake-up call effect—investors' reassessment of the fundamentals of a whole region or group of countries in response to trouble in one country—is an additional mechanism of shock transmission in the presence of common investors (Ahnert and Bertsch 2015; Goldstein 1998). Common lenders can also transmit shocks—for example, after suffering losses in one country, banks may cut lending in others to meet capital requirements (Cetorelli and Goldberg 2012). To the extent that these types of financial friction amplify shocks, exacerbate volatility, and move prices away from fundamentals, they can do economic harm, even in the absence of a crisis, since they can lead to higher funding costs for firms and misallocation of resources.

The degree of financial market integration can be expected to be crucial in shaping the prevalence and intensity of spillovers. A high degree of financial integration facilitates the rapid adjustment of asset prices to economic news in other markets (for example, by allowing arbitrage to eliminate mispricing), promoting better resource allocation and growth. At the same time, a higher degree of financial integration also enables the operation of the common investor and lender spillover channels described above, potentially yielding excessive cross-border price reactions. Particularly if persistent, such price swings could have financial stability implications and economic costs. Financial integration has been fostered by the dismantling of legal, institutional, and informational barriers (Bekaert and others 2011).[7]

Shock transmission is also likely amplified or attenuated by a range of country-specific factors. These include the size of financial markets (of both the originating and receiving countries), the cyclical position and economic buffers (of the receiving country and its firms), and institutional and policy characteristics of either country. Often, the degree of similarity in country and sector characteristics

---

[6]Although the efficient markets hypothesis would predict an instantaneous asset price adjustment to news across borders, evidence shows that stock markets do not immediately incorporate all news (see, for example, Lin, Engle, and Ito 2004). Several theoretical explanations have been offered for this phenomenon (Kyle 1985; Fung, Lam, and Lam 2010). See also Dimpfl and Jung 2011.

[7]On the other hand, it has been argued that lack of country-level transparency (Brandão-Marques, Gelos, and Melgar 2013) can make a market more vulnerable to shocks emanating from financial centers (IMF 2015).

Figure 2.4. Example of Shock Transmission through Common Lenders
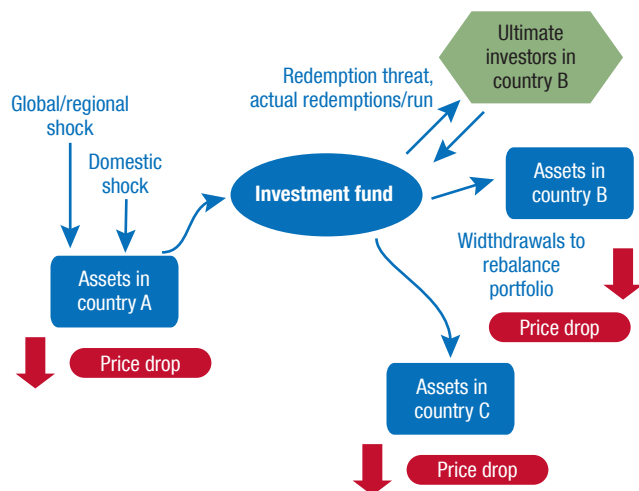
Source: IMF staff.

is associated with higher spillovers—for example, a policy change in a large economy affecting a certain sector may affect companies with similar financing patterns elsewhere, if they compete for international financing sources (see, for example, Antón and Polk 2013). Moreover, under the wake-up call hypothesis discussed earlier, an adverse shock in one country may lead investors to withdraw from similar countries or companies.[8]

In addition to rising financial integration, various accompanying structural changes in international capital markets are likely to have changed the scope and speed of shock transmission from emerging market economies.

- *First, foreign investors (from both advanced and emerging market economies) have become more important players in emerging market economies' debt markets* (Figure 2.5, panel 1). Since the 2007–09 global financial crisis, both international and domestic factors have combined to make emerging market assets, including local currency sovereign bonds and hard currency corporate debt, attractive

---

[8]See Dasgupta, Leon-Gonzalez, and Shortland 2011. Since spillovers entail the transmission of both negative and positive shocks, it is also plausible for more *dissimilar* countries or sectors to experience *more* spillovers. For example, in the case of the wake-up call phenomenon, countries that are very dissimilar from the one experiencing an adverse shock may enjoy positive spillovers (for example, flight to quality during a crisis).

to end-investors. The growing preponderance of bond flows relative to equity flows is significant, because bond flows are more fickle and appear to be more reactive to global financial conditions (IMF 2014b). Institutional investors in emerging market economies have grown and have increasingly sought to diversify their assets (Karolyi, Ng, and Prasad 2015).
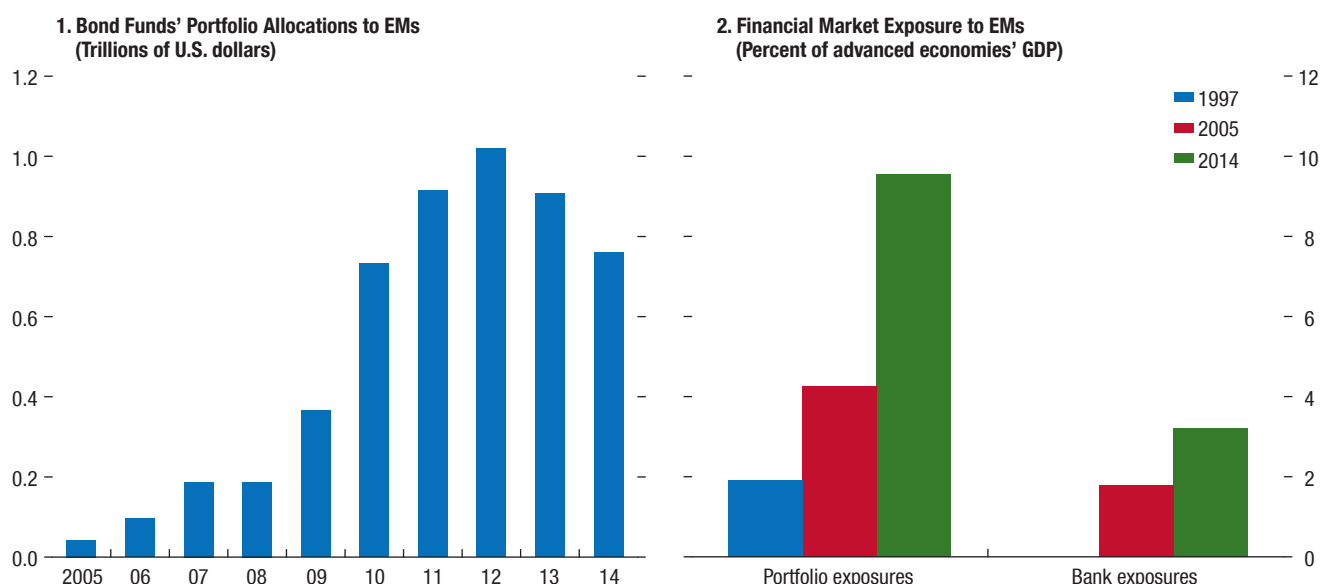
- *Second, the intermediation of global capital flows to emerging market economies has moved from banks to funds* (Figure 2.5, panel 2). Global systemically important banks, traditionally preeminent in this sphere, have lost ground as business models were adjusted following the global financial crisis and regulatory reforms (April 2015 GFSR, Chapter 2). An increasing share of capital to emerging market economies is now intermediated from retail investors through open-end mutual funds. Although cross-border banking flows have traditionally been the most volatile form of capital flows (April 2015 GFSR, Chapter 2), funds are also key transmitters of funding shock spillovers from both end-investor funding withdrawals and losses incurred on investments in other countries.

- *Third, the role of offshore dollar funding markets has grown considerably in recent years.* Close to two-thirds of dollar funding originates outside the United States, increasingly intermediated by investment funds (He and others 2015; McCauley, McGuire, and Sushko 2015). This development is likely to have affected the patterns of financial spillovers.

Spillovers through Financial Markets

How Have Financial Market Spillovers Evolved?

The evolution of spillovers from emerging market economies in equities, foreign exchange, and bond markets is first examined through an econometric model. For the empirical estimation, a financial market spillover from country A to country B is broadly defined as the share of the variation in country B's market return shocks that can be attributed to (contemporaneous or preceding) shocks in country A's market returns. Specifically, following the approach of Diebold and Yilmaz (2014), we estimate a vector autoregression (VAR) of daily asset returns incorporating global control

Figure 2.5. Advanced Economies' Financial Exposures to Emerging Market Economies

1. Bond Funds' Portfolio Allocations to EMs
(Trillions of U.S. dollars)

2. Financial Market Exposure to EMs
(Percent of advanced economies' GDP)

Sources: Bank for International Settlements (BIS), Consolidated Banking Statistics; BIS, Locational Banking Statistics; IMF, Coordinated Portfolio Investment survey; Lipper; and IMF staff calculations.

Note: The sample of countries in panel 1 is larger than that used in subsequent analysis. Please see Annex 2.1 for details on country classifications. Panels show the exposure of economies for which data are available. Panel 1 shows exposures of bond funds domiciled in Austria, France, Germany, offshore financial centers, Spain, Switzerland, United Kingdom, and United States to EMs including Argentina, Bosnia and Herzegovina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Estonia, Ghana, Hungary, India, Indonesia, Jamaica, Korea, Latvia, Malaysia, Mexico, Nigeria, Peru, Philippines, Poland, Qatar, Russia, Serbia, Slovak Republic, Slovenia, South Africa, Thailand, Turkey, Uganda, Ukraine, and Vietnam. In panel 2, AEs are Australia, Canada, Denmark, euro area, Hong Kong SAR, Israel, Japan, Norway, Singapore, Sweden, Switzerland, United Kingdom, and United States; EMs are Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Thailand, and Turkey. AE = advanced economy; EM = emerging market economy.

variables to remove comovement due to common factors.[9,10] Although the method does not identify the causality of spillovers, it relies on historical patterns to identify directionality. Moreover, the results presented below are quite robust and qualitatively unaffected by alternative methods.[11] In particu-

lar, an alternative approach was pursued, based on statistical (Granger) causality—a more stringent criterion that restricts attention to asset price movements in country B that systematically occur *following* shocks in country A. Indices based on this method move in tandem with the spillover patterns documented below.

Cross-country equity and foreign exchange spillovers have risen significantly (Figure 2.6, panel 1). The share of variation in advanced and emerging market economies' equity returns attributable to other countries' equity return variation rose from 50 percent in 1995 to over 80 percent by 2015. For foreign exchange markets, spillovers rose from 50 percent in 1995 to 71 percent in 2015.[12] Further analysis (not

---

[9]Results are reported for a VAR of daily local currency nominal asset returns with a rolling window of 250 trading days, incorporating a lag of one day and a forecast error variance decomposition horizon of 12 trading days. The sample covers 33 major advanced and emerging market economies during 1995–2015. A generalized variance decomposition is used. Annex 2.1 provides a detailed exposition of the data and empirical framework.

[10]A challenge in this context is that major news in emerging market economies may affect global variables, such as global commodity prices. For the benchmark case, we therefore report results controlling only for the Chicago Board Options Exchange Standard & Poor's 500 Implied Volatility Index (VIX), which according to separate analysis does not seem to be influenced by shocks to emerging market economies. Results are robust to controlling for a broader range of global factors (Annex 2.1).

[11]Specifically, as noted in Pesaran and Shin 1998, the approach of Diebold and Yilmaz allows for correlated (nonorthogonalized) shocks but accounts for them via a weighting mechanism based

on the variance-covariance matrix of shocks. Annex 2.1 presents details of the robustness checks. In addition, the following section uses a different method to identify directionality more precisely.

[12]Global bond market spillovers, while significant, do not show the trend increase in spillovers evident in equity and foreign exchange markets. Instead they appear to be cyclical, corresponding to U.S. monetary policy in particular, rising during periods of *search*

Figure 2.6. Spillover Indices for Various Asset Classes and Components
(Percentage points)
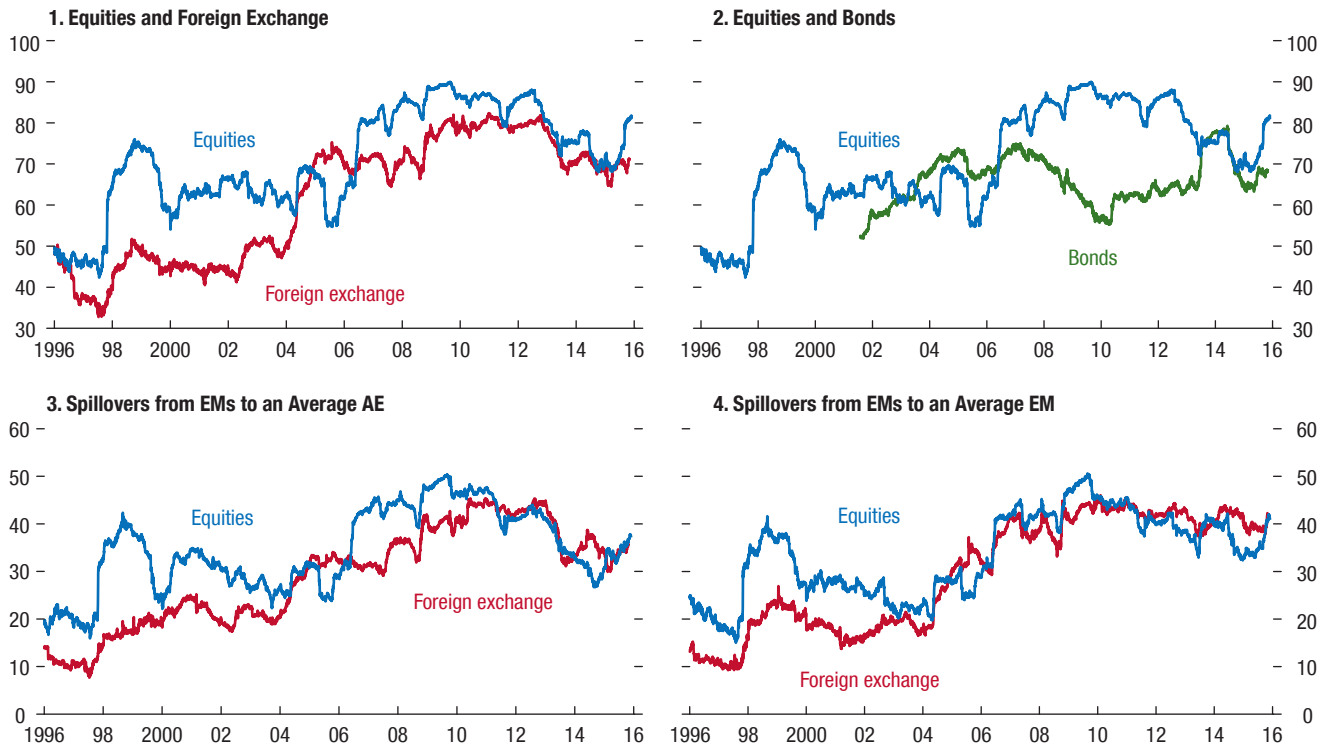
Sources: Bloomberg, L.P.; Thomson Reuters Datastream; and IMF staff calculations.
Note: Average spillovers to AEs (EMs) were obtained by scaling spillovers by the number of AEs (EMs). Financial market spillovers are defined as the fraction of the 12-day-ahead forecast error variance of a country's local currency nominal equity return that can be accounted for by innovations in another country's equity return.
AE = advanced economy; EM = emerging market economy.

shown) reveals that this rise in spillovers stems from a strengthened transmission channel in recent years and not from larger and more frequent emerging market shocks. The pattern for bond markets is less clear, partly because bond prices are significantly influenced by U.S. factors such as the VIX, which is controlled for in these estimations (April 2014 GFSR, Chapter 2). Previous work suggests that financial conditions in advanced economies are significantly more import-ant drivers of bond flows than of equity flows. These factors have been shown to explain as much as half of the variation in bond flows compared with about a fifth of the variation in equity flows (IMF 2014a). Finally, bond spillovers may also be attenuated by the

fact that increased advanced economy exposure to emerging market bonds is a recent phenomenon and has occurred during quantitative easing by central banks in major advanced economies, which may have suppressed bond return variation.

Spillovers from emerging market economies now explain a significant proportion of the variation in advanced and emerging market economies' equity and foreign exchange market returns (Figure 2.6, panels 3 and 4). More than a third of the variation in advanced economies' equity and foreign exchange returns and more than 40 percent of the variation in emerging market economies' equity and foreign exchange returns are attributable to spillovers from emerging market economies.[13]

---

for yield, as during the Great Moderation before the crisis and during the postcrisis quantitative easing until the taper tantrum in 2013 (Figure 2.6, panel 2). Analysis of emerging market economies' bond market spillovers will be taken up in the context of the common investor channel of contagion.

[13]Equity market spillovers in the opposite direction, from advanced to emerging market economies, have grown by a compa-rable amount over the past two decades and now account for over a third of the variation in emerging market equity returns.

Figure 2.7. Spillovers before and after the Global Financial Crisis
(Frequency of bilateral outward equity market spillovers in percentage points)
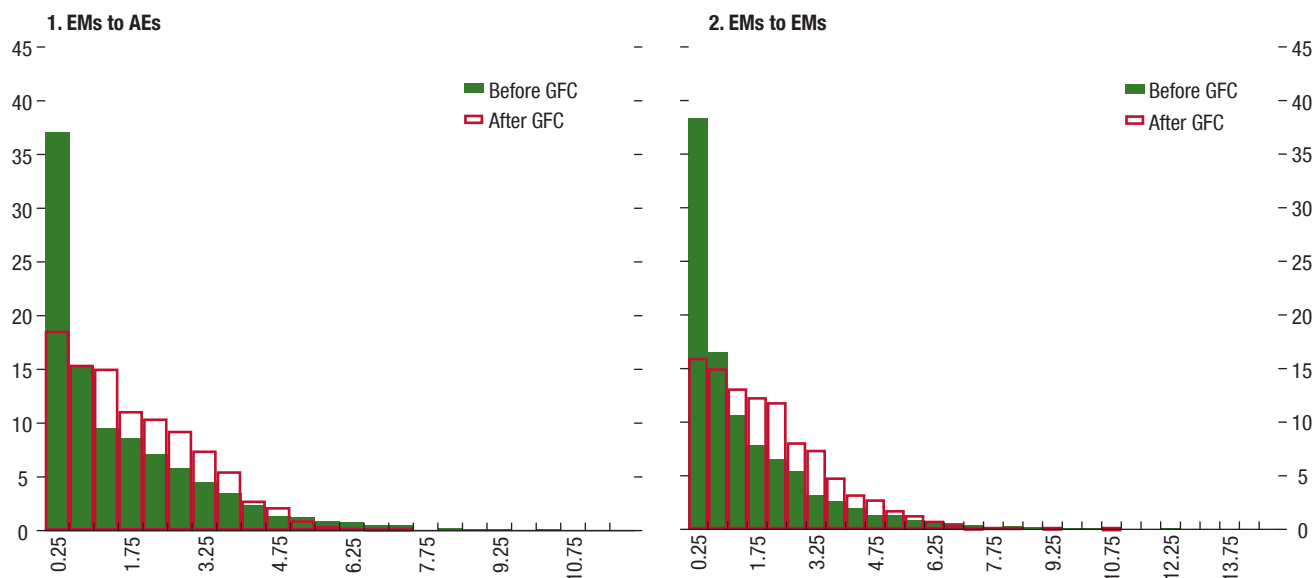
Source: IMF staff calculations.
Note: The figure depicts the relative frequency in percentage points (y-axis) of the intensity of spillovers to other countries' equity returns in percentage points (x-axis). AE = advanced economy; EM = emerging market economy; GFC = global financial crisis.

Financial spillovers from emerging market economies have been significantly stronger since the 2007–09 global financial crisis (Figure 2.7). Average equity return spillovers from emerging market economies to other emerging markets and to advanced economies rose by 28 percent following the crisis—increasing more strongly to emerging market than to advanced economies. Spillovers from some of the largest emerging market economies (Brazil, China, India, Russia, South Africa) have risen by 40 percent. Spillovers from emerging market economies jumped up dramatically between October 2005 and March 2007, stayed elevated through the global financial crisis, and have risen again starting in late 2014 following a dip in between (Figure 2.6). This evolution of financial spillovers from emerging market economies may reflect, in chronological order, increased financial flows between emerging market and advanced economies during 2005–07 followed by the global financial crisis, and soaring advanced economy exposures to emerging market economies through mutual fund flows that have contributed to the recent resurgence of spillovers.[14]

---

[14]As borne out by the statistical analysis of factors driving the evolution of spillovers in a subsequent part of this chapter.

Unsurprisingly, the postcrisis evolution of spillovers mirrors the dynamics of cross-asset price correlations, which have been elevated since 2010, even during periods of low volatility in asset returns (October 2015 GFSR, Chapter 1).

Equity market spillovers are larger from emerging market economies with more integrated financial markets (Figure 2.8). Brazil, Chile, Mexico, Poland, and South Africa transmitted consistently larger equity market spillovers than larger emerging market economies, such as China and India, whose financial markets have been more segmented. The fact that financial spillovers from Chinese A-shares markets have remained low relative to those from other emerging market economies likely reflects the importance of financial integration in shaping spillover intensity.

What Explains the Rise in Emerging Market Financial Spillovers?

To what extent can the growth in financial spillovers from emerging market economies be explained by countries' evolving trade and financial linkages, their institutional and policy characteristics, and the financial health and business models of their firms?

Figure 2.8. Average Equity Spillovers from Selected Emerging Market Economies
(Percentage points)
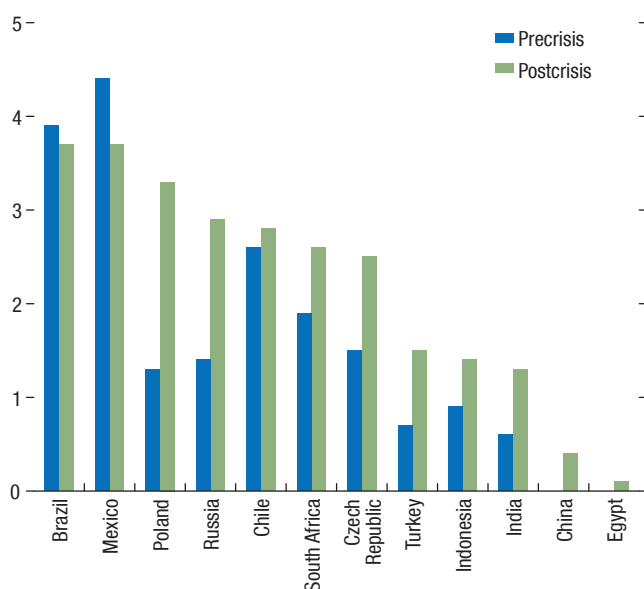
Sources: Bloomberg, L.P.; Thomson Reuters Datastream; and IMF staff calculations.

This section links the changing size and pattern of financial spillovers estimated previously to changing trade and financial integration, country-level factors, and corporate sector financial indicators. Overall, the importance of financial factors has increased relative to that of trade linkages in explaining spillovers.

The analysis examines the role of a variety of country-, sector-, and firm-level factors explaining the strength of financial spillovers. General trade openness and bilateral trade volumes are used to measure trade linkages; foreign direct investment and portfolio flow volumes measure financial linkages.[15] Economic or financial sector characteristics and policy parameters can amplify or attenuate the impact of trade and financial linkages on the intensity of spillovers transmitted or received by countries. To capture factors affecting the degree of segmentation of domestic asset markets from the global financial system (including informational barriers), the analysis considers capital account openness, corporate governance variables, and the transparency of government policies. Countries that have larger financial markets or are home or

[15]Cross-border bank exposures were difficult to incorporate owing to substantially larger gaps in data.
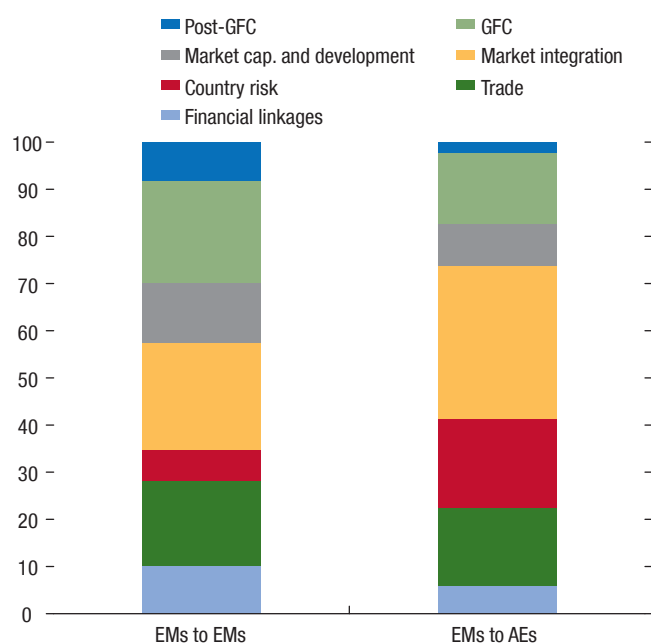
host to more internationally active financial institutions are likely to exert larger spillovers on foreign financial markets. Countries with larger domestic financial markets may also be better able to absorb shocks unrelated to fundamentals (since, for example, local funds may step in if local prices undershoot in response to external developments). This motivates the use of measures of size of both the receiver's and the transmitter's financial systems. Similarities in macro-financial and political risk with the transmitted may play a role in the transmission of shocks, as discussed earlier, and are therefore also considered here. Measures of firms' financial health (profits and cash buffers) and funding strategies (borrowing and dependence on external financing) are also included in the analysis. Given measurement problems and difficulties in disentangling the precise roles of different factors, the results should, however, be taken as indicative and not as precise estimates.

Equity market spillovers at the country level

An analysis of the contribution of different structural and cyclical factors in explaining spillovers reveals the following (Figure 2.9):

- *Trade linkages* explain, on average, between 10 percent and 20 percent of emerging market economies' equity return spillovers. Their significance is higher in the case of commodity-exporting countries. In the postcrisis period, however, their significance in explaining the evolution of spillovers is lower.
- *Increased market integration* has contributed to the growth in equity market spillovers, particularly from emerging market to advanced economies, and explains 30 percent to 40 percent of spillovers.
- The increase in spillovers in the postcrisis period cannot be fully explained by the variables included. The change seems to be more pronounced among emerging market economies. This may be the result of growth of common investor mechanisms, which may not be fully captured in the analysis (and is reflected in the postcrisis dummy in Figure 2.9).
- Countries with more similar *risk profiles* are more likely to experience spillovers from each other, and this factor is of greater importance for spillovers from emerging market to advanced economies, for which it explains about 20 percent of spillovers.

Figure 2.9. Contribution to Variation in Emerging Market Economy Equity Spillovers, 1995–2014
(Percentage points)

Source: IMF staff calculations.
Note: The figure shows the percent contribution of each variable to the overall regression (R^2), using relative weight analysis as described in Nathans, Oswald, and Nimon 2012. AE = advanced economy; Country risk = receiver's International Country Risk Guide rating relative to transmitter; EM = emerging market economy; Financial linkages = receiver's and transmitter's portfolio and foreign direct investment flows; GFC = global financial crisis; Market cap. and development = spillover transmitter's equity market capitalization and financial institution development of spillover receiver, respectively; Market integration = de jure (capital account openness) and de facto (transparency of government policymaking) measures of market segmentation; Trade = transmitter's trade of goods and services with partners. Definition of variables are in Annex Table 2.2.1.

Equity market spillovers at the sectoral level

The analysis of sectoral cross-country spillovers provides a complementary and more granular perspective on equity market spillovers. Specifically, we examine spillovers using firm-level stock market data, grouping companies according to seven broad sectors. Using such disaggregated data at the sectoral level helps better identify the underlying transmission mechanisms.[16]

---

[16]Sector-level data also confer greater cross-sectional variation, which refines the precision of statistical estimates. The analysis considers the interplay between equity return spillovers and trade at the sector level. Both sector- and country-specific fundamentals are accounted for. Sector-level equity subindices are paired with bilateral goods and services exports and imports (trade). Consistent with the aggregate analysis above, foreign direct investment flows are used to proxy financial linkages. Sector-level fundamentals account for differences in solvency (interest coverage ratio), profitability (return

For example, it allows us to measure how much the Chinese industrial sector explains stock price movements of other economies' firms in the oil and gas sectors. By linking spillovers at the sectoral level to sector-level trade flows, the analysis also allows for a more precise identification of the relative importance of the trade channel in explaining the size of spillovers.

Equity market spillovers from emerging market economies are stronger in tradable goods and globally integrated sectors, and have grown over time (Figure 2.10). Spillovers have been consistently higher in sectors such as finance, basic materials (which includes metals and mining), and oil and gas, and have been lower in retail and nontradables-dominated sectors such as consumer goods and services. For instance, the Chinese industrial sector's stock price fluctuations alone account for close to 5 percent of advanced economies' variation in equity prices in the basic materials sector, up from 1½ percent before the global financial crisis (Figure 2.11).

Intrasectoral spillovers are more significant than cross-sectoral spillovers. Intrasector outward spillovers are on average 7 percent higher than cross-sectoral spillovers. This reflects the tendency of shocks to spill over more to similar firms (because of economic and possibly also herding—or wake-up-call-type effects noted earlier). This may particularly reflect the importance of intraindustry trade, even for emerging market economies. For example, emerging market economies are often suppliers of intermediate goods in increasingly complex supply chains, and advanced economies often export machinery to the industrial sector in emerging market economies.

The financial health of firms is an increasingly important factor affecting the magnitude of emerging market economies' equity return spillovers (Figure 2.12). Investor sensitivity to cross-country differences in corporate fundamentals has increased particularly across emerging market economies. Similar firms are more likely to be affected by spillovers. Stock prices of firms with lower liquidity ratios and higher levels of borrowing tend to be more affected by spillovers. More broadly and consistent with the role played by financial constraints, sectors that are more dependent on market financing experience stronger inward spillovers. Such sectors transmit shocks more easily (possibly because they are more vulnerable to changes in financial conditions, and are therefore more volatile) and are also more affected by international shocks. When

---

on equity), liquidity (current ratio), and a sector's dependence on external financing (Rajan and Zingales 1995). The remaining determinants are the same as those used in the aggregate analysis.

Figure 2.10. Emerging Market Economy Outward Equity Spillovers by Sector
(Index)
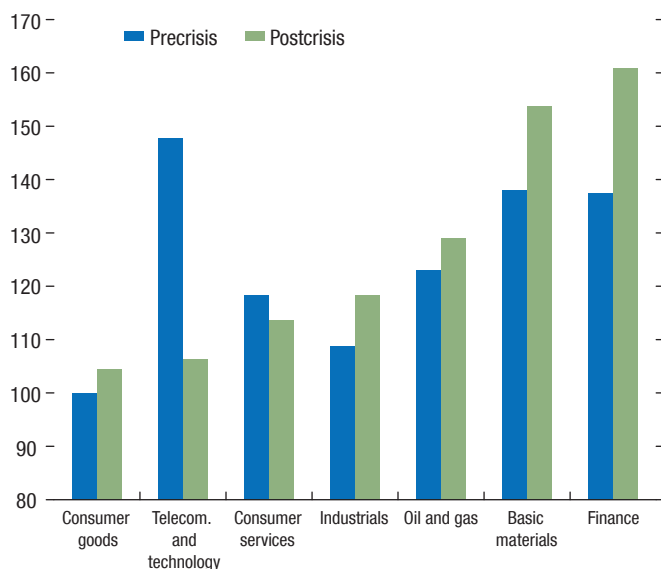
Sources: Bloomberg, L.P.; Thomson Reuters Datastream; and IMF staff calculations.
Note: Spillovers were normalized by the minimum value. Telecom. = telecommunications.

Figure 2.11. Chinese Industrial Sector: Equity Market Spillovers to Advanced Economy Sectors
(Percentage points)

Source: IMF staff calculations.
Note: The figure depicts the annual average precrisis and postcrisis outward equity market return spillovers from the Chinese industrial sector to sectors across all advanced economies. Spillovers measure the fraction of the 12-day-ahead forecast error variance of sector-level equity returns across advanced economies that is attributable to innovations in the equity return in the Chinese industrial sector. Telecom. = telecommunications.
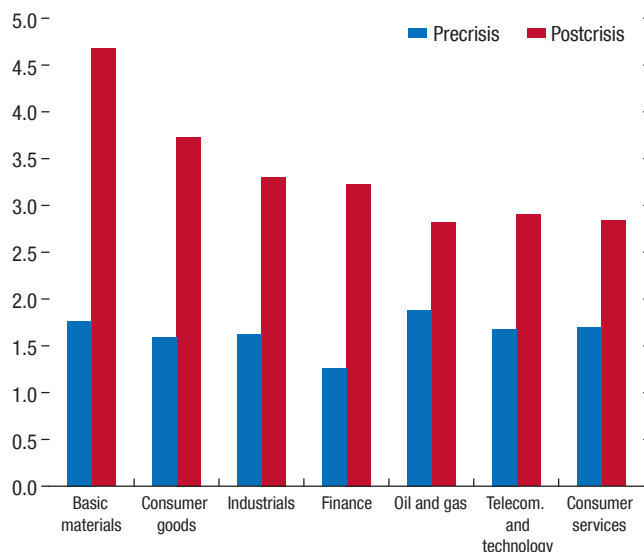
combined with previous analysis (April 2015 GFSR, Chapter 1; October 2015 GFSR, Chapter 3), this underscores the importance of high corporate borrowing—not just as a potentially large originator of shocks, but also as a key channel for their transmission to other advanced and emerging market economies.

Sectoral trade linkages play an important role in underpinning spillovers from emerging market economies to advanced economies. The importance of financial factors has, however, increased relative to trade since the global financial crisis. Similarly, differences in country risk seem to have become less important for spillover transmission to advanced economies.

In recent years, more developed financial systems have helped emerging market economies dampen foreign financial spillovers. A closer look at precrisis and postcrisis patterns of factors underlying the evolution of spillovers suggests that more mature financial sectors, with more developed local institutions, are now attenuating spillovers from other emerging market economies, although this was not the case in the precrisis period.[17]

[17]This is in line with evidence presented in Chapter 2 of the April 2014 GFSR. The postcrisis average of the financial development index for emerging market economies is higher than its precrisis level.

Spillovers to foreign exchange markets

Trade does not play a major role in explaining spillovers in foreign exchange markets (Figure 2.13). Rather, financial market integration, the size of the shock transmitter's financial market, and similarities in country risk are important in explaining spillovers to both advanced and emerging market economies' exchange rates. For emerging market economies, the spillover patterns experienced a significant structural shift following the crisis. Brazil, Mexico, and South Africa are among the largest sources of spillovers to foreign currency markets (Figure 2.14). For example, fluctuations in the Mexican peso explain close to 3 percent of the exchange rate movements of other emerging market economies.

Cross-Border Financial Market Effect of News about Fundamentals

This section presents a complementary examination of the changing nature and importance of financial spillovers by focusing on the implications of growth surprises in major

Figure 2.12. Emerging Market Economy Equity Market Spillovers: Role of Firm-Level Factors
(Percentage points)
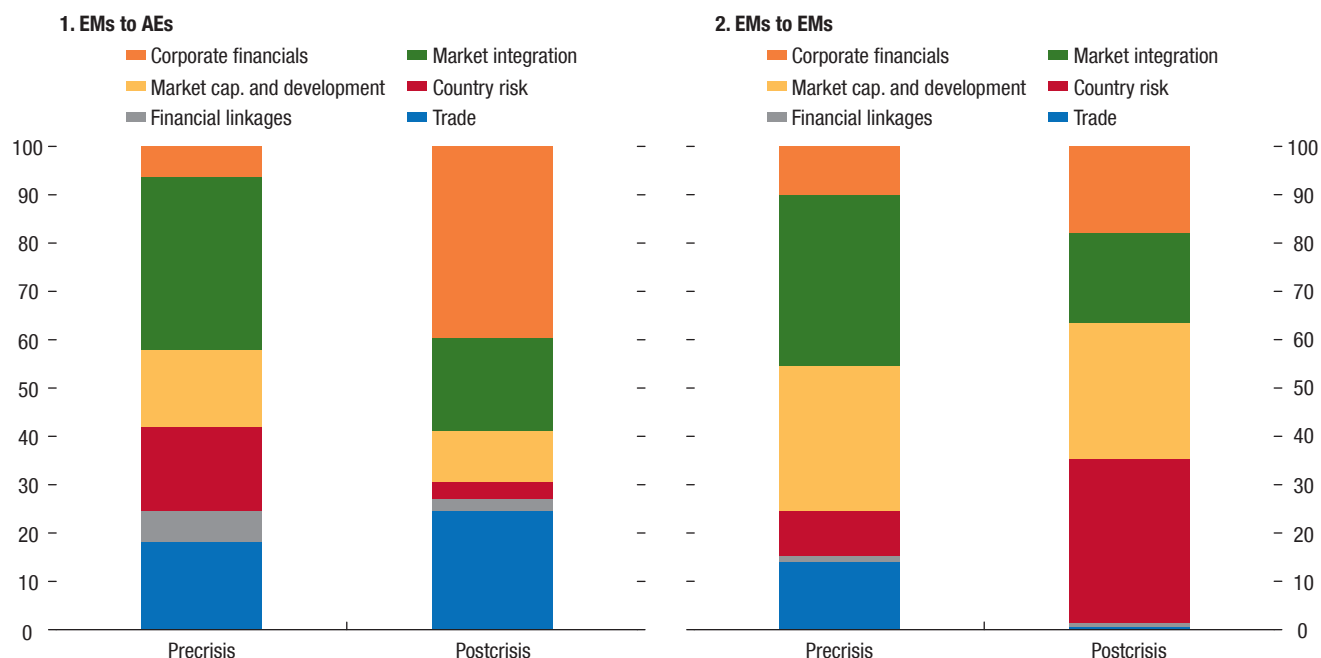
Sources: Bloomberg, L.P.; Thomson Reuters Datastream; IMF, International Financial Statistics and World Economic Outlook databases; United Nations statistics; and IMF staff calculations.
Note: The figure shows the percent contribution of each variable to the overall regression (R^2), using relative weight analysis as described in Nathans, Oswald, and Nimon 2012. Corporate financials include interest coverage ratio (inverse of leverage), current ratio (liquidity), return on equity (profitability), and external financing dependence. They are measured in absolute differences between transmitter and receiver. AE = advanced economy; Country risk = receiver's International Country Risk Guide rating relative to transmitter; EM = emerging market economy; Financial linkages = spillover receiver's foreign direct investment flows; Market cap. and development = respectively, spillover transmitter's equity market capitalization (sector) and financial institution development of the spillover receiver; Market integration = de facto measures (transparency of government policymaking) of market segmentation; Trade = bilateral trade (sector level). Definitions of variables are in Annex Table 2.2.1.

emerging market economies. Overall, although growth surprises in Brazil are increasingly important regionally, those stemming from China have a global as well as regional effect.
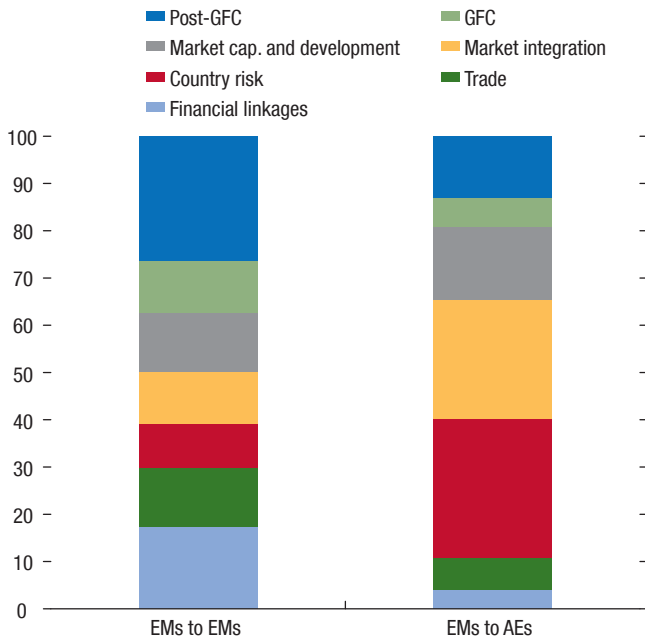
An analysis of *surprises* regarding economic fundamentals allows for a more precise identification of the direction of spillovers. This section assesses the impact of clearly identified news about macroeconomic fundamentals in major emerging market economies on financial markets in other economies, controlling for common global factors. The method serves as a useful complement to the previous analyses, enabling a clear-cut assessment of the cross-border impact of news about fundamentals on financial markets. By design, it excludes spillovers induced purely by financial friction, which may however affect the strength of transmission.

This approach also allows for assessment of spillovers of news that are not well reflected in

less-developed domestic financial markets. Less-developed and segmented markets may not process information efficiently.[18] These considerations are particularly relevant for China over the past two decades, but may also apply to other emerging market economies. Research on Chinese firms that dual-list their stock in the A-shares and B-/H-shares markets has uncovered a very different pattern of variation in returns for identical stocks of the same

---

[18]A combination of heterogeneous expectations and trading restrictions can result in speculative-trading-generated bubbles and excess volatility in segmented markets. Scheinkman and Xiong (2003) present a conceptual framework and an extensive bibliography on this issue. More generally, the presence of heterogeneous expectations and short-sale constraints may result in a time pattern of asset return volatility in the segmented market that does not mirror what may be expected in a market with access to a better range of arbitrage and hedging options.

Figure 2.13. Contribution to Variation in Emerging Market Economy Foreign Exchange Spillovers, 1995–2014
*(Percentage points)*

Source: IMF staff calculations.
Note: The figure shows the percent contribution of each variable to the overall regression (R^2), using relative weight analysis as described in Nathans, Oswald, and Nimon 2012. AE = advanced economy; Country risk = receiver's International Country Risk Guide rating relative to transmitter; EM = emerging market economy; Financial linkages = receiver's and transmitter's portfolio and foreign direct investment flows; GFC = global financial crisis; Market cap. and development = spillover transmitter's equity market capitalization and financial institution development of spillover receiver, respectively; Market integration = de jure (capital account openness) and de facto (transparency of government policymaking) measures of market segmentation; Trade = transmitter's trade of goods and services with partners. Definitions of variables are in Annex Table 2.2.1.

Figure 2.14. Foreign Exchange Spillovers of Selected Emerging Market Economies, 2011–15
(Percentage points)
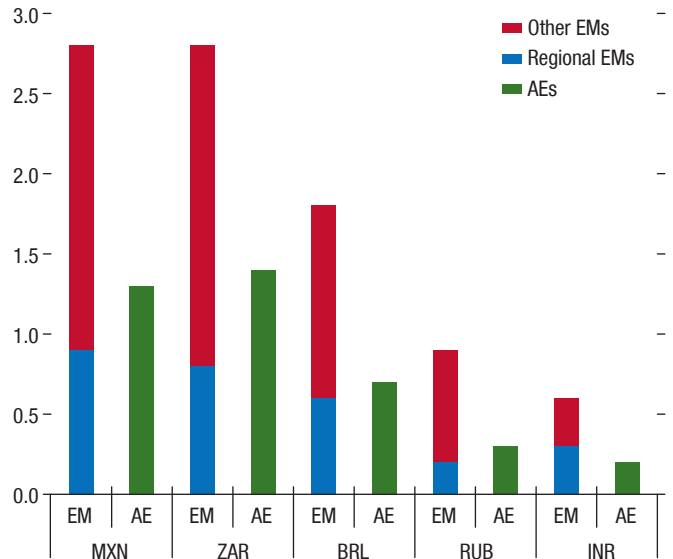
Source: IMF staff calculations.
Note: Regional EMs refer to EMs in emerging Asia, Europe, Latin America, or Middle East and Africa. AE = advanced economy; BRL = Brazilian real; EM = emerging market economy; INR = Indian rupee; MXN = Mexican peso; RUB = Russian ruble; ZAR = South African rand.

firm in the two markets.[19] The Chinese example is a particularly good case for why, in such circumstances, the previous analysis may understate financial market

[19]Chan and Kwok 2005; Fong, Wong, and Yong 2007; Mei, Scheinkman, and Xiong 2009; and Peng, Miao, and Chow 2007 find that the investor bases for these markets are close to mutually exclusive—the A-shares market is dominated by retail and, through the 1990s at least, inexperienced investors, whereas the B-/H-shares markets have been dominated by foreign institutional investors. The A-shares market has been subject to prohibition against short selling, and until 2010 investors did not have access to equity derivatives instruments, so arbitrage and hedging were severely limited. These factors are directly associated with a tendency toward more speculative behavior in the A-shares market, with a wedge between prices of identical shares of dual-listed firms, and with different return volatility patterns. Differential equity return dynamics cannot, in particular, be ascribed to either liquidity differentials (Pastor and Stambaugh 2003) or asset float (Hong, Scheinkman, and Xiong 2006) across the two sets of markets.

spillovers to other countries from shocks to domestic fundamentals.

Growth surprises in China have had an increasing and, in recent years, significant impact on equity markets in other economies (Figure 2.15). A factor model of equity returns was estimated to study the spillover effects of surprises about growth in three major emerging market economies on financial markets in 13 other emerging market economies and 25 advanced economies.[20] The results reveal a strong and steady increase in the impact of growth surprises from China on emerging market and advanced economy equity returns over the past two decades, with the shock impact turning statistically significant shortly after the global financial crisis (see also Shu and others 2015). This stands in contrast to growth surprises from other major emerging market

[20]See Annex 2.3 for a detailed exposition and description of the database. Growth surprises are proxied by news about realized changes in industrial production relative to market expectations. The three major emerging market *shock transmitters* are Brazil, China, and Russia. The selection of the shock recipient markets was based on data availability on market returns at a daily frequency and is consistent with the sample of countries included in the preceding section.

Figure 2.15. Spillover of Growth Surprises in Major Emerging Market Economies
(Percentage points)

Impact of Industrial Production Surprises on Equity Returns across the World
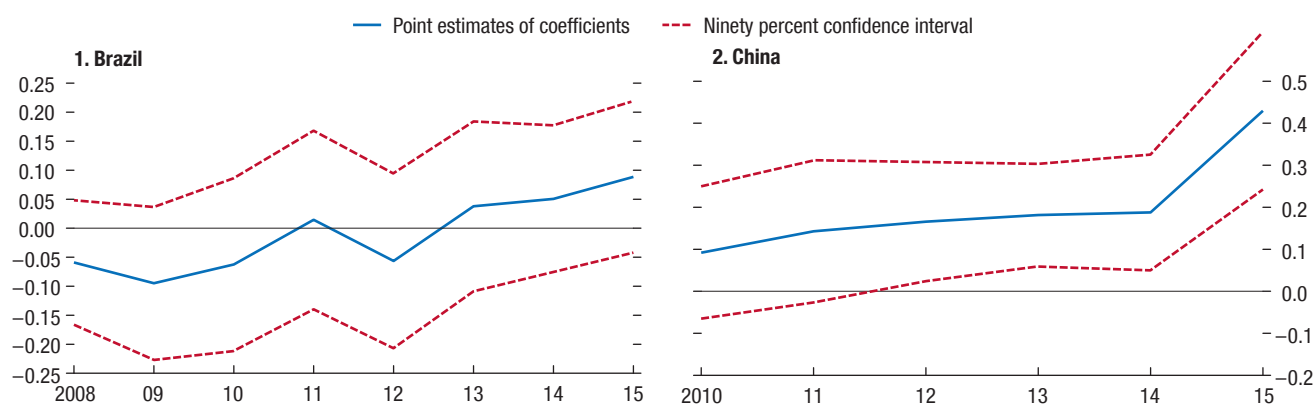
Impact of Industrial Production Surprises on Equity Returns across the Region
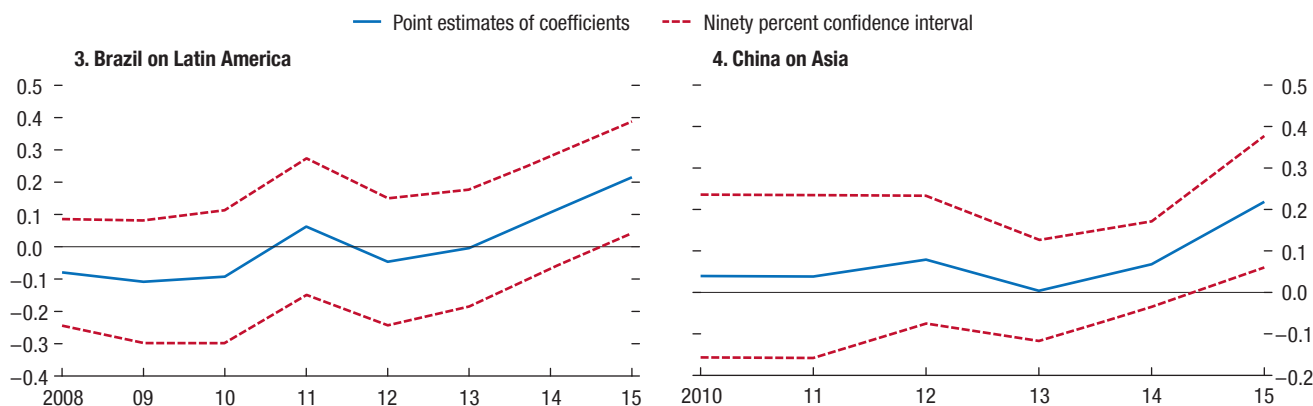
Source: IMF staff calculations.
Note: The figure shows the (averaged across full sample of countries) response of equity prices to a 1 percentage point deviation in industrial production relative to median market forecast. The coefficients are estimated from five-year rolling regressions. The horizontal axis reports the last year of corresponding rolling windows.

economies, which do not share the significant nature of China's impact on global equity prices.

Growth surprises in Brazil and China exert an increasing and significant impact on equity prices in other emerging market economies in their region (Figure 2.15). Brazil's importance for regional financial markets is larger than its global imprint. In China's case, however, the regional impact of growth surprises is smaller than on other emerging market and advanced economies.

The results are likely to underestimate the overall impact of news from emerging market economies but should reflect underlying trends well. First, only a very narrow set of news is considered here; that is, specific macroeconomic growth surprises but not, for example,

firm-level news, policy announcements, or political events. Second, *significant* news from these emerging market economies is likely to affect global factors, a channel that is excluded from the estimation. For example, Roache and Rousset (2015) find that news regarding Chinese industrial production has a significant impact on oil and selected metal prices.

The impact of shocks to China's fundamentals on global financial markets is expected to grow stronger and wider over time (Box 2.1). Beyond the continued growth in importance of the Chinese economy, the size of financial market spillovers is also likely to grow because of the transition to a more market-based financial system and a decline in market segmentation. Moreover, the challenge of engineering a smooth tran-

sition will make global financial markets more sensitive to changes in China's economic and financial conditions and policies. This is consistent with the evidence on the impact of more uncertain Chinese growth prospects on commodity markets and currencies (October 2015 GFSR, Chapter 1). In both equity and bond markets, the inclusion of Chinese securities and indices in emerging market and global benchmark indices will likely have a large global impact. As banking and market linkages rise, the use of the renminbi as a funding currency as well as a reserve currency will grow, which will also increase spillovers through foreign exchange markets.[21]

A Closer Look at the Portfolio Rebalancing Channel of Spillovers

This section examines the role of mutual funds in propagating shocks across countries. It uses microlevel data on fund exposures to quantify financial interdependence across countries through the presence of common investors. These common exposures are a significant contributor to equity return spillovers—much more for spillovers across emerging markets than to advanced economies.

The presence of common investors may be a source of cross-country financial market spillovers. This can occur when losses cause fund managers to become more risk averse and rebalance their portfolios toward those of their peers. In doing so, they will shed assets where they are overexposed relative to their benchmark (Broner, Gelos, and Reinhart 2006). For funds dedicated to investing in emerging market economies, the transmission of shocks can then occur across these emerging market economies; for funds investing in both advanced and emerging market economies, the transmission of shocks can happen between both groups of countries, and in both directions. In this framework, country A will be vulnerable to shocks to country B if it shares with country B funds that are overweight on both A and B (and if the investments of these funds are significant relative to their own domestic market size).[22] This is because if country B's

assets fall in value, it will cause strong losses to funds with heavy investment in country B, driving the funds to reduce their overweight positions across the board, including on country A.

An examination of countries' reliance on investors that are overweight in emerging market economies suggests that *financial interdependence* through the presence of common investors has risen significantly (Figure 2.16). Both emerging market and advanced economies in our sample now rely significantly more (as measured by the share of their equity and bond market capitalization) on globally active equity and bond mutual funds that are overweight on emerging market economies relative to their benchmark weights (see also Box 2.2 for a description of the growth in bilateral cross-border exposures of mutual funds). The common investor channel of spillovers from emerging market economies may, therefore, have risen in importance. It is, however, less important for less financially integrated economies such as China, particularly on the bond market side.

There is evidence that the role of financial interdependence through common investors is a significant contributor to equity return spillovers (Figure 2.17). The empirical approach assesses how much country A's asset returns influence those of country B via trade linkages, relative market size, and financial interdependence through common overweight mutual fund investors.[23] Overall, the role played by financial interdependence both is economically significant and has risen since the global financial crisis, accounting for more than a quarter of the variation in equity returns explained by the model.[24] In particular, financial interdependence via common investors is a statistically significant contributor to financial spillovers from emerging market economies, particularly to advanced economies. The size of this effect on spillovers from advanced to emerging market economies remains, however, about three to four times greater than the other way around. In other words, common investors are still much more likely to transmit shocks from advanced to emerging market economies than vice versa. The role of common investors is weaker,

---

[21]The inclusion of the renminbi in the IMF's special drawing right basket may have already kick-started the process of its growth as a reserve currency.

[22]The underlying reason for this mechanism is that funds typically get evaluated with respect to a benchmark, and tend to suffer redemptions when they underperform. The effect works both ways (for positive as well as for negative shocks) and may explain momentum trading, as documented elsewhere (Raddatz and Schmukler 2012).

[23]The analysis is based on the model of Broner, Gelos, and Reinhart (2006, section 6). See Annex 2.4 for details.

[24]This finding is quite robust to the choice of model specification. While financial interdependence is a statistically significant driver of bond returns in our sample of countries, and its economic significance has doubled since the global financial crisis (Figure 2.17), it grew from a very low base and remains nascent.

Figure 2.16. Financial Interdependence on Emerging Market Economies through Global Funds
(Index value)

Global Equity

1. EMs: Financial Interdependence on Other EMs

2. AEs: Financial Interdependence on EMs

Global Bonds

3. EMs: Financial Interdependence on EMs

4. AEs: Financial Interdependence on EMs
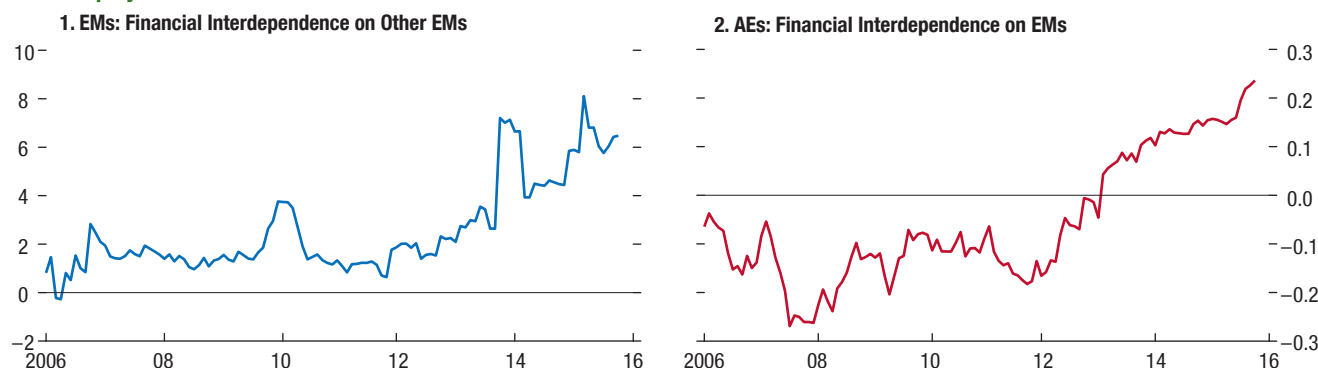
Source: IMF staff calculations.
Note: Financial interdependence is a measure of one country's reliance on investments by funds that have larger-than-averag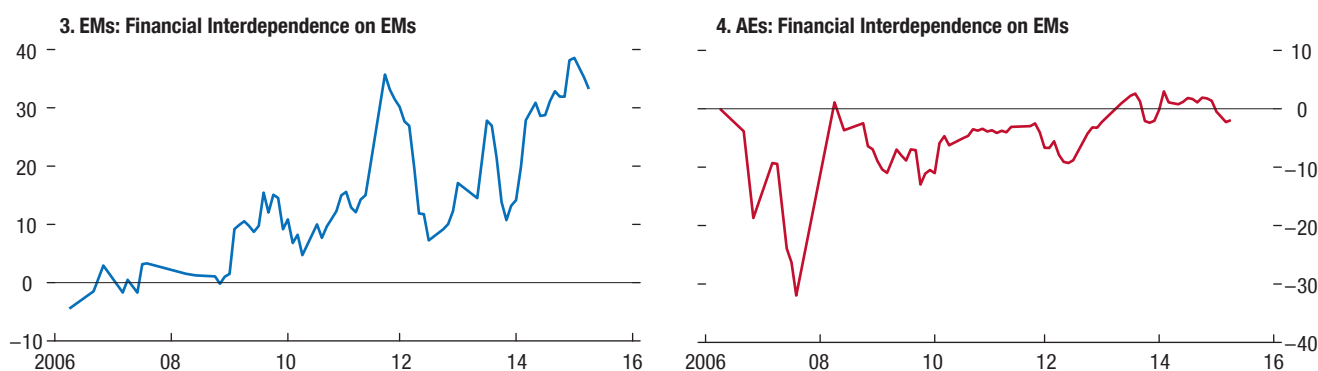e positions in another country. Here, this measure is averaged across country groups. AE = advanced economy; EM = emerging market economy.

however, in explaining spillovers between emerging market economy stock markets.

Conclusions

Financial globalization has made asset markets increasingly interdependent. About 70 percent to 80 percent of equity and foreign exchange returns in both advanced and emerging market economies are by now attributable to international factors. In other words, financial spillovers are the norm, not the exception.

In particular, this chapter has found evidence for a growing role of financial spillovers from emerging market equity and foreign exchange markets. Over a third and 40 percent, respectively, of the variation in advanced and emerging market economies' stock returns and exchange rate fluctuations can now be explained by emerging financial markets. Bond

markets do not display a corresponding trend, mainly because their behavior in recent years has mostly been driven by global factors, and the portfolio channel of contagion through financial interdependence on emerging market economies still remains economically insignificant for bonds. Emerging market economies that are more financially integrated transmit larger spillovers, notwithstanding factors such as economic size and trade volumes. Cross-country spillovers are strongest within economic sectors and are most pronounced among tradable goods and globally integrated sectors.

Financial factors are becoming more important relative to trade linkages in explaining the patterns of spillovers. The increase in financial integration, through a decline in both legal and informational barriers, has contributed to the growth in shock transmission. The role of common investor mechanisms has also increased

Figure 2.17. Contributions to Variation in Bond and Equity Returns in Advanced and Emerging Market Economies
(Percent)
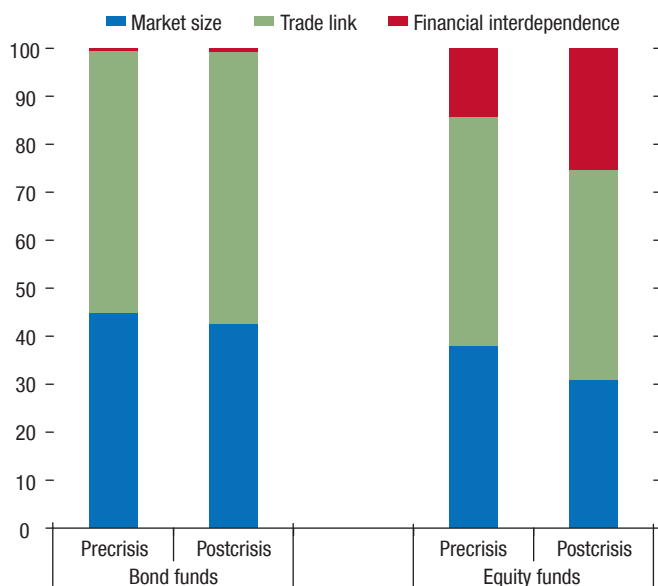
Source: IMF staff calculations.
Note: The figure shows the percent contribution of each variable to the overall regression (R^2), using relative weight analysis as described in Nathans, Oswald, and Nimon (2012). The R^2 values are 0.41 and 0.56 for bonds and 0.29 and 0.54 for equities in the pre- and postcrisis periods, respectively.

in importance because investment funds are intermediating a larger share of capital flows. Stocks of firms with higher leverage and that are more dependent on external financing are more susceptible to spillovers.

News about China's growth has become increasingly influential in driving global equity returns, but the role of purely financial mechanisms remains subdued. News about China also has a measurable impact on global oil and commodity prices. By contrast, purely financial factors (such as contagion effects stemming from the portfolio reshuffling of common investors) remain less significant. China's spillovers to global financial markets can be expected to see a significant further increase in the next few years.

The findings suggest the following policy implications:

- The growth in financial spillovers from emerging market economies means that when assessing macro-financial conditions, policymakers may need to increasingly take into account economic and policy developments in emerging market economies. This also includes the need to pay increased attention to possible financial "spillbacks" from emerging market economies stemming from advanced economies' policy actions. The development also underscores the importance of enhanced international macroeconomic and macroprudential policy cooperation.
- Policymakers need more comprehensive and granular data on capital flows and their intermediation by banks, large institutional investors, and investment funds to better assess risks and vulnerabilities and identify potential shock triggers and spillover channels.
- Given evidence that financial deepening can attenuate financial spillover of external shocks, governments should promote specific forms of financial deepening, for example developing a local investor base (GFSR April 2014, Chapter 2).
- As China's role in the global financial system grows, clear and timely communication of its policy decisions, transparency about its policy goals, and strategies consistent with achieving them will be increasingly important to avoid volatile market reactions with wider reverberations.
- Enhancing surveillance of cross-border financial flows intermediated by asset managers is a priority, as is shaping micro- and macroprudential rules to guard against systemic risks from mutual funds.
- Lastly, it will be important for authorities to deploy appropriate macroprudential measures targeted at bank- and market-based financing to limit excessive increases in corporate leverage that can threaten financial stability (GFSR October 2015, Chapter 3).

Box 2.1. Spillover Channels from China—From Real to Financial Linkages?

The main driver of spillovers from China continues to be news about the country's growth prospects (October 2015 GFSR, Chapter 1). Concerns about weaker Chinese growth and import demand have driven down commodity prices, weighing on exchange rates of emerging market economies with strong trade ties and high commodity dependence. But direct financial linkages have also grown in the past few years, with cross-border bank exposures to China exceeding $1 trillion and Chinese issuers dominating Asia's external dollar bond markets. Financial linkages are expected to grow substantially in strength, and financial market spillovers can be expected to expand accordingly.

Trade Integration Has Proceeded Rapidly, but Financial Integration Has Yet to Catch Up

After many years of rapid economic growth since the 1980s, China has emerged as the largest trading nation and the second largest economy in the world. However, the global financial implications of this growth have been relatively muted owing to capital controls and a complex set of rules constraining trading and investment behavior in domestic markets, which have therefore remained segmented. Still, in recent years, capital controls have become

The author of this box is Hui Miao.

more porous, and capital flows sizable. More recently, Chinese authorities have adopted many financial liberalization measures that have paved the way for the renminbi's inclusion in the IMF's special drawing right basket. China's financial integration with the rest of world is expected to accelerate, and its financial influence abroad will likely catch up with its economic prowess (Bayoumi and Ohnsorge, 2013; He and Luk 2013; He and others 2012; Hooley 2013).

Growth in cross-border banking in the past five years has been striking, and if the recent pace keeps up, China will emerge as a major global banking hub in the medium term. Bank lending is the main channel of financial linkages between China and the rest of the world. During 2010–15, cross-border bank lending to Chinese entities rose more than five times, to more than $1 trillion, and Chinese bank lending abroad increased three times, to about $600 billion (Figure 2.1.1 and April 2015 GFSR, Chapter 2). As Chinese firms continue their overseas expansion, Chinese banks are likely to follow.

The opening up of Chinese bond and equity markets will have major implications for global asset allocation. The Chinese bond market, which has the third largest market capitalization in the world at $6.7 trillion, has been growing at an annual average rate of 22 percent over the past five years (Figure 2.1.2). The bond market was largely closed to foreign

Figure 2.1.1. China: Growth in Cross-Border Banking Claims and Liabilities
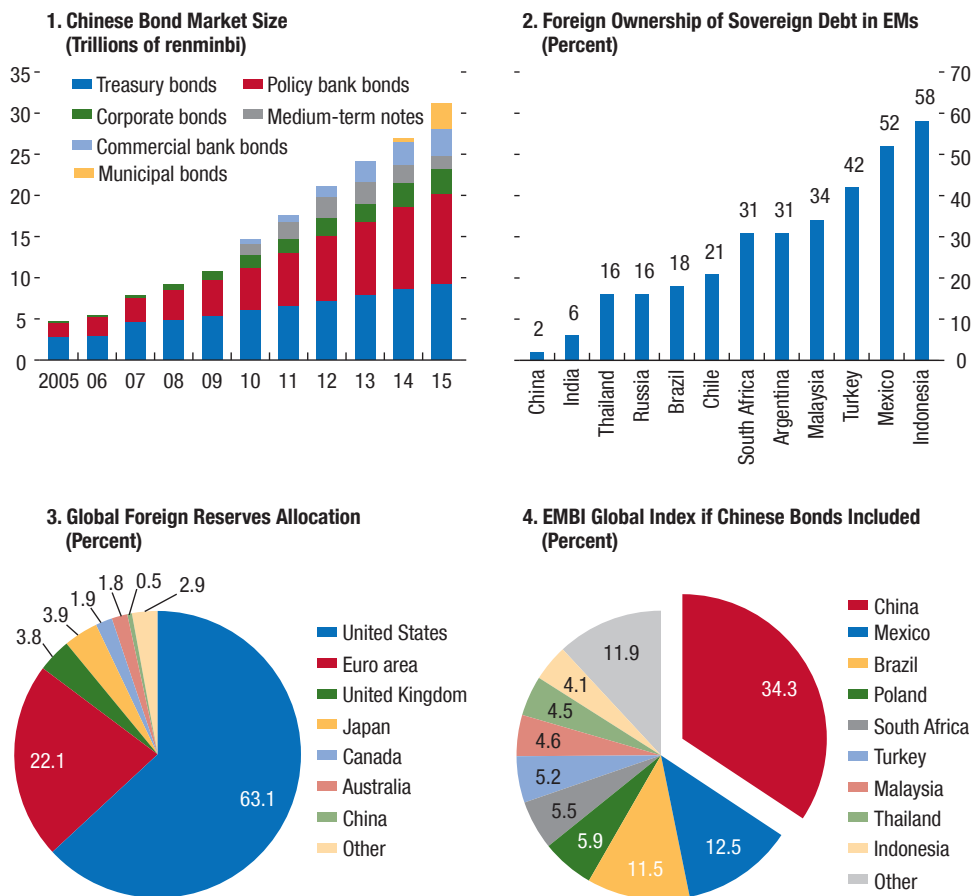*(Billions of U.S. dollars)*
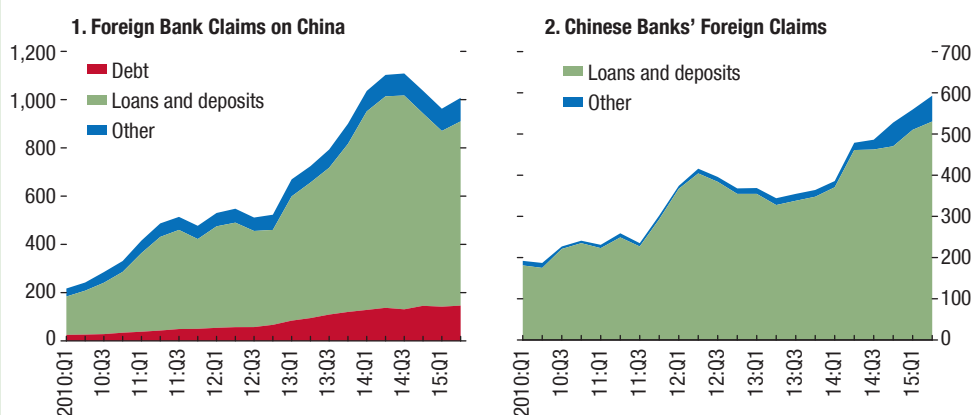
Sources: Bank for International Settlements; and IMF staff calculations.
Note: Loans include those extended by nonfinancial companies owned by banks. In panel 2, the debt data are too small to be shown.

Box 2.1. *(continued)*

investors until 2015, when foreign central banks and sovereign wealth funds were allowed to invest. Foreign central banks can be expected to allocate more reserves to Chinese bonds, and foreign private investment in renminbi bonds is also likely to rise as the bond market opens up further. This can have significant implications for global asset allocation and emerging market economy financial markets. Whereas Chinese bonds are not included in any global index at present, if included, their index weight would be about one-third in the widely followed J.P. Morgan Emerging Markets Bond Index Global. On the equities side, if A-shares were included in a global equity index, their Morgan Stanley Capital International emerging market index weight would be close to 10 percent.

Outward portfolio investment by Chinese residents in global bond and equity markets is also likely to increase significantly. China's gross international investment position is only 107 percent of GDP, significantly less than that of Japan and the United States, reflecting the fact that Chinese households hold limited foreign assets. As the capital account opens up, Chinese households are likely to increase their investment in foreign financial markets, seeking diversification. The pent-up demand for offshore assets by the Chinese private sector is high, and the liberalization of the capital account would imply a significant development for global asset markets. For example, if foreign assets were to reach 10 percent of household savings deposits, this would imply an additional $1 trillion invested overseas.

Figure 2.1.2. Chinese Bond Markets and Global Asset Allocation

1. Chinese Bond Market Size (Trillions of renminbi)

2. Foreign Ownership of Sovereign Debt in EMs (Percent)

3. Global Foreign Reserves Allocation (Percent)

4. EMBI Global Index if Chinese Bonds Included (Percent)

Sources: Bank for International Settlements; and IMF staff calculations.
Note: EM = emerging market economy; EMBI Global = J.P. Morgan Emerging Markets Bond Index Global.

Box 2.2. Bilateral Cross-Border Exposure through Mutual Funds

This box quantifies and analyzes the significance of cross-border exposure in bonds and equities through mutual funds, and contagion effects brought about by investors residing in countries affected by a shock for a sample of advanced and emerging market economies.[1] Although emerging market economies are now more connected to global markets through mutual fund investments, investors residing in these countries are unlikely to transmit shocks to advanced economies.

Cross-border exposure of mutual funds domiciled in a selected group of advanced and emerging market economies has increased significantly over the past 15 years (Table 2.2.1). On average, cross-border holdings by equity mutual funds grew from 4.25 percent of the recipient country's GDP in July 2007 to about 5.9 percent by November 2015. For bond funds, the growth in average exposure has been even more significant, quadrupling over the same period, from 0.35 to 1½ percent of GDP. Although emerging market economies have become more central to the global network of mutual fund flows and exposures, they are still considerably behind advanced economies. In November 2015, emerging market economy assets represented 21 percent and 29 percent, respectively, of cross-border mutual funds' bond and equity assets, but the share owned by emerging market bond and equity mutual fund investors was much lower, at only 4 percent and 2 percent, respectively.

A significant body of research has found that financial intermediaries, particularly mutual funds, can play an important role in the transmission of financial shocks and in explaining the observed excess comovement in asset prices across countries (Gelos 2011; April 2015 GFSR, Chapter 3). In fact, the behavior of end-investors is an important driver of mutual fund behavior (Brandão-Marques, Espinosa-Vega, and Solé forthcoming), often leading to fire-sale transactions (Coval and Stafford 2007). Although mutual fund flows caused by fire sales seem to explain a significant portion of emerging market equity

prices (Jotikasthira, Lundblad, and Ramadorai 2012), few studies have documented emerging market economy spillovers and contagion through the behavior of *investors domiciled in the affected country* as opposed to international investors in third countries (see, however, Brandão-Marques, Espinosa-Vega, and Solé, forthcoming).

To assess the significance of this mechanism, the identified network of bilateral country exposures through mutual funds was subjected to a simulated shock. The starting point is a significant drop in emerging market economies' stock prices (15 percent, on average), possibly as a result of a global shock, such as a fire sale caused by investors from advanced economies. If, in a given step of the simulation, the drop in prices is greater than a threshold defined as the 5th percentile of historical monthly returns, it is assumed that investors residing in the affected market sell 35 percent of their assets abroad and propagate the shock. For equities, the price response of each market to the sell-off is estimated using the average ratio of monthly returns to volume of trade as a price elasticity.[2] The results of the simulation (see Brandão-Marques, Espinosa-Vega, and Solé, forthcoming) suggest that the dynamics of a shock to advanced economies only are similar to those of a shock to both advanced and emerging market economies. Moreover, shocks to emerging market economies do not spill over to advanced economies through *the sales of investors based in emerging market economies* and only do so modestly to other emerging market economies.[3] That is, *spillbacks* through this particular channel are still likely to be low. However, advanced economy investors' sales in advanced and emerging market economies in response to initial losses in emerging market economies may still be a powerful contagion mechanism, as discussed earlier in this chapter.

The authors of this box are Luis Brandão-Marques, Marco Espinosa-Vega, and Juan Solé, with research assistance from Diego Wachs.

[1]The analysis categorizes financial markets following the Morgan Stanley Capital International classification. Advanced economies comprise Austria, Belgium, Finland, France, Germany, Italy, Japan, Netherlands, Spain, Switzerland, United Kingdom, and United States. Emerging market economies comprise Brazil, Chile, China (including Hong Kong SAR), Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Thailand, and Turkey.

[2]The measure of price pressure is similar to Amihud's measure of market illiquidity (Amihud 2002). Since volume data are, in general, not available for bond markets, the simulation assumes that the price response is twice that observed in equity markets, given that these markets are relatively illiquid (October 2015 GFSR, Chapter 2). Although the assumption of a 30 percent drawdown from all advanced economies is extreme but not without precedent, the price elasticities used in the exercise are in general mild, since they do not incorporate the effect of panic sales.

[3]However, a number of factors may increase the likelihood of spillovers from emerging market economies. First, other institutional and retail investors may join the fire sale and amplify the drawdown. Second, price responses may be highly nonlinear, whereas the simulation assumes them to be linear. Finally, the second-round effects may elicit additional responses if they change investors' perceptions about fundamentals or the likelihood of contagion.

Box 2.2. *(continued)*

Table 2.2.1. Geographical Distribution of Cross-Border Exposures

In July 2007, there were already significant cross-border exposures through equity mutual funds … and they continued to increase until November 2015.

Equity Mutual Funds (Percent of recipient country's GDP)					
July 2007	**Advanced Europe**	**Japan**	**United States**	**Large EMs**	**Other EMs**
Advanced Europe	—	0.02	4.16	0.03	0.05
Japan	1.84	—	4.71	0.05	0.04
United States	1.04	0.01	—	0.02	0.03
Large EMs	1.96	0.03	2.58	—	0.06
Other EMs	1.81	0.02	2.88	0.03	—
November 2015	**Advanced Europe**	**Japan**	**United States**	**Large EMs**	**Other EMs**
Advanced Europe	—	0.16	6.66	0.08	0.07
Japan	2.52	—	7.17	0.09	0.04
United States	2.84	0.39	—	0.08	0.05
Large EMs	1.55	0.12	2.63	—	0.04
Other EMs	1.63	0.12	3.30	0.08	—

While for bond funds, exposures were small in 2007… but have become significantly more important at the end of 2015.

Bond Mutual Funds (Percent of recipient country's GDP)					
July 2007	**Advanced Europe**	**Japan**	**United States**	**Large EMs**	**Other EMs**
Advanced Europe	—	0.00	0.14	0.00	0.01
Japan	0.18	—	0.15	0.00	0.01
United States	0.23	0.00	—	0.00	0.01
Large EMs	0.17	0.00	0.14	—	0.01
Other EMs	0.42	0.01	0.27	0.01	—
November 2015	**Advanced Europe**	**Japan**	**United States**	**Large EMs**	**Other EMs**
Advanced Europe	—	0.11	1.10	0.07	0.07
Japan	0.31	—	0.38	0.01	0.01
United States	1.83	0.15	—	0.06	0.05
Large EMs	0.32	0.06	0.23	—	0.01
Other EMs	1.33	0.15	1.12	0.05	—

Sources: EPFR Global; IMF, Coordinated Portfolio Investment Survey; and IMF staff calculations.
Note: The table shows cross-border exposures by mutual funds in percent of the recipient country or region's GDP. Each cell shows, by row, the assets in a given country or region owned by mutual funds domiciled in the country or region displayed in the respective column. Data include direct and indirect exposures (through mutual funds domiciled in offshore financial centers, which are apportioned to each country in the sample using the IMF's Coordinated Portfolio Investment Survey, Equity Investments). A darker shade of red indicates larger exposure. For November 2015, GDP figures refer to 2014. EM = emerging market economy.

Annex 2.1. Estimation of Spillovers and Assessment of the Relative Importance of Spillover Channels

Defining Spillovers

The approach to measuring financial interconnectedness and spillovers follows closely the methodology proposed by Diebold and Yilmaz (2014). A VAR-based econometric framework is estimated in order to capture financial spillovers across advanced and emerging market economies. Within this VAR model, a spillover is defined as the fraction of the H-day-ahead forecast error variance of country j's asset return that can be accounted for by innovations in country i's asset return.

For equity market spillovers, country-specific equity returns refer to the main stock market index returns in local currency.[25] The sample starts in January 1995 and ends in October 2015. Similar to Diebold and Yilmaz (2014), time-varying spillovers are obtained by employing a rolling-window estimation approach. In the baseline model, the rolling window is based on 250 business days, which covers an entire year. The first estimation point refers to the end of December 1995.[26] A similar framework is used for sovereign bond yields, currencies, and equity sector indices.[27] When the set of variables is very large as in the case of cross-country, cross-sector spillover estimation, the VAR model is estimated using shrinkage techniques (such as elastic net, lasso), which allow for the estima-tion of large VARs (Demirer and others 2015; Song and Bickel 2011).

A VAR model amended by several exogenous variables (VARX) can be written as

$$Y_t = \alpha + \sum_{i=1}^{p} \gamma_i Y_{t-i} + \sum_{j=0}^{p} \beta_j X_{t-j} + u_t$$
$$u_t \sim iid(0, \Sigma_u). \qquad (1)$$

The estimation of the VARX model is done recursively, with the number of lags set to one. The set of endog-enous (Y) variables consists of daily log-returns from 33 countries. To circumvent differences in time zones, two-day average returns are used (Forbes and Rigobon 2002). Several control factors are used to account for common/systematic global factors.

Using the framework proposed by Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998), we apply the generalized variance decomposition (GVD) identification framework. GVDs, being order invariant by construction, avoid the ad hoc ordering of structural shocks characteristic of recursive iden-tification. This is a distinct advantage given that the sample of countries is large and heterogeneous and identification schemes such as those based on short- and long-term restrictions (Lütkepohl 2005), sign restrictions, and heteroscedasticity (Rigobon 2003) are neither feasible nor practical (Killian 2013). How-ever, GVDs do not orthogonalize structural shocks, so in general it is not possible to attribute the part of the forecast error variation in an endogenous variable $\{j\}$ that arises from a shock to variable i directly to structural innovations in i as opposed to innova-tions in other variables $\{j'\}$ that are caused by their correlation with structural shocks to i. Our findings are robust to some alternative approaches to frame-works for VAR identification in which equity return spillovers derived under the baseline GVD identifi-cation approach were compared with those estimated by averaging across a very large sample of randomly selected Cholesky orderings. Specifically, spillover indices were estimated using the Cholesky decompo-sition with random variable sequences (Klößner and Wagner 2014). The baseline results were compared with the average, minimum, and maximum spillover index from a set of 10,000 random orders. Although the estimated level of total cross-country equity market spillovers is lower than under the generalized impulse response function framework, all our baseline results hold in this model as well.

---

[25]The set of equity indices includes 13 advanced economies (Aus-tralia, Canada, Denmark, euro area, Hong Kong SAR, Israel, Japan, Norway, Singapore, Sweden, Switzerland, United Kingdom, United States) and 20 emerging market economies (Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Thailand, Turkey). Countries are classified as "advanced" and "emerging market" economies as per the taxonomy of Morgan Stanley Capital International as of 2011.

[26]Results are robust to the following: U.S. dollar; excess and real returns; equity return volatilities; foreign exchange returns, bond yields, and returns; other global factors and their combinations (oil and commodity prices); TED, term, and credit spreads; global interest rates, global (and U.S.) policy and shadow rates, global equity returns, and change in the Chicago Board Options Exchange Standard & Poor's 500 Implied Volatility Index; daily versus weekly frequencies and daily windows of 125 and 750 days; lags of two and five; and horizons of one, two, and five days.

[27]Spillovers are also obtained using sector-level equity indices within the framework described in this annex. There are seven sectors for each country: basic materials, consumer goods, consumer services, financial services, industrials, oil and gas, and telecommuni-cations and technology.

Interconnectedness/Spillover Indices

At each estimation point, the GVD for each variable is further aggregated in a matrix. The non-diagonal elements are referred to as "spillovers." The average sum of nondiagonal elements defines the main spillover index:

$$SI = \frac{100}{N} \sum_{i=1}^{N} \sum_{j \neq i}^{N} d_{ij}. \qquad (2)$$

This index can be further decomposed into four spillover subcomponents: among advanced economies, among emerging market economies, from advanced to emerging market economies, and vice versa. For example, the index of spillovers from emerging market to advanced economies can be written as follows:[28]

$$SI_{EM \rightarrow AE} = \frac{100}{N} \sum_{i=M+1}^{N} \sum_{j=1}^{M} d_{ij} \qquad (3)$$

$$SI_{EM \rightarrow AE} + SI_{AE \rightarrow EM} + SI_{EM \rightarrow EM} + SI_{AE \rightarrow AE} \equiv SI, \qquad (4)$$

in which the sum of the subcomponents equals the main spillover index (SI).

Assessing the relative importance of spillover channels and country characteristics

The relative importance of the drivers of cross-country spillovers across equity and foreign exchange markets is assessed through dynamic panel regression models estimated at an annual frequency spanning the period 1995–2014. The spillover indices obtained at both country and sector levels through the VAR model are used as dependent variables in this exercise.

At the country level, for a pair of spillovers from economy j (transmitter) to i (receiver), at time t, the general specification of the regression model can be written as follows:

$$\begin{aligned} spillovers_{i,jt} = {} & \alpha_1 TRADE\ CHANNEL_{jt} + \beta_1\ FINANCIAL\ CHANNEL_{i \lor jt} \\ & + \delta_1 MACRO_{i \lor jt} + \delta_2 POLICY_{i \lor jt} + \delta_3 INST_{i \lor jt} \\ & + GFC_t + postGFC_t + Other_{i \lor jt}\,, \end{aligned} \qquad (5)$$

in which the dependent variable *spillovers* is the end-of-year-t spillover. *TRADE CHANNEL* denotes the transmitter's total trade in goods and services with all partners in the sample in percent of its domestic

GDP; *FINANCIAL CHANNEL* denotes the portfolio and foreign direct investment flows of the transmitter and receiver with the rest of the world in percent of their respective domestic GDP; *MACRO* refers to the similarity, measured as absolute value of the difference, of the spillover receiving country's composite risk rating (International Country Risk Guide index) relative to the spillover transmitter; *POLICY* includes measures that affect domestic financial market segmentation and include the indices of capital account openness and of the transparency of government policymaking in the receiver and the transmitter; *INST* includes indices of the development of financial institutions of the receiver and of the equity market capitalization of the receiver and transmitter; *GFC* is the time dummy for the global financial crisis (2007–09); and *postGFC* is the dummy for the period from 2010 to 2014. The panel regressions include fixed effects, and the standard errors are clustered at the level of the transmitters and receivers, respectively, as a robustness check.

At the sector level, analysis provides a complementary perspective to that conducted at the country level. Country-level regressors described above are augmented by sector-level bilateral trade and key corporate financial indicators (sector size, solvency, liquidity, profitability, external financial dependence).[29]

Annex 2.2. Description and Definition of Variables

This annex summarizes the data sources and definitions used in this chapter's analysis (Annex Table 2.2.1).

Annex 2.3. Surprise Approach

We use a classical factor model of equity returns to study the spillover of shocks to growth expectations in three major emerging market economies (Brazil, China, Russia) to equity prices in our sample of advanced and other selected emerging market econo-

---

[28]The system of endogenous variables consists of N vectors (e.g., M advanced economies and [N-M] emerging market economies).

[29]Corporate financial indicators are proxied by the following sector metrics: interest coverage ratio (solvency), current ratio (liquidity), return on equity (profitability), Rajan-Zingales (1995; external financing dependence), and total assets (size). Sector averages within each country are used.

Annex Table 2.2.1. Definitions of Variables

Variable	Description	Source
Trade and Financial Linkages		
Transmitter's Trade of Goods and Services with Partners	The sum of exports and imports of goods and services of a spillover-transmitting country with all partner countries in the sample as percent of world GDP	DOTS
Bilateral Trade (sector level)	The sum of exports and imports of goods and services in percent of domestic GDP	UN Comtrade
Receiver's Portfolio and FDI Flows	The sum of portfolio and FDI flow of spillover-receiving country vis-à-vis the world in percent of domestic GDP	IMF, WEO
Transmitter's Portfolio and FDI Flows	The sum of portfolio and FDI flow of spillover-transmitting country vis-à-vis the world in percent of domestic GDP	IMF, WEO
Receiver's FDI Flows	FDI flow of spillover-receiving country vis-à-vis the world in percent of domestic GDP	IMF, WEO
Macroeconomic, Policy, and Institutional Factors		
Country Risk		
Receiver's ICRG Rating Relative to Transmitter	The absolute value of the difference between the ICRG composite risk rating of a receiver and transmitter	PRS Group
Market Capitalization and Development		
Receiver's Financial Institutional Development	Index that summarizes information regarding financial institutions (banks and non-banks), and financial markets across three dimensions: depth, access, and efficiency	Sahay and others, 2015
Transmitter's Stock Market Capitalization	Transmitter's stock market capitalization divided by world GDP	Datastream; IMF, WEO
Receiver's Stock Market Capitalization Relative to Transmitter	Difference in stock market capitalization in percent of world GDP between receiver and transmitter	Datastream; IMF, WEO
Market Integration		
Capital Account Openness Index	The Chinn-Ito index (KAOPEN), which is an index measuring a country's degree of capital account openness and normalized to a number from 0 to 1	http://web.pdx.edu/~ito/ Chinn-Ito_website. htm
Transparency of Government Policymaking	Index of transparency of government policymaking (World Competitiveness Index)	World Economic Forum
Sector Variables		
Return on Equity	Net income divided by total equity, sector average	Worldscope
Interest Coverage Ratio	Earnings before interest, taxes, depreciation and amortization (EBITDA) or earnings before interest and taxes (EBIT) divided by interest expense, sector average	Worldscope
Current Ratio	Current assets to current liabilities, sector average	Worldscope
External Financing Dependence	Rajan and Zingales (1995) index measures dependence on external finance as a firm's capital expenditures minus cash flow from operations divided by capital expenditures, sector average	Worldscope
Size	Total assets, sector average	Worldscope
Global Variables		
VIX	Chicago Board Options Exchange Market Volatility Index	Datastream
Commodity Price Index	S&P Goldman Sachs Commodity Price Index	Datastream
U.S. Term Spread	The difference between short-term (3-month) and long-term (10-year) U.S. interest rates	Datastream
U.S. Credit Spread	The difference in yield between 10-year Treasury note and 10-year BBB corporate bond	Datastream
Global Shadow Rate	Principal component of the shadow rates of United States, euro area, and Japan	RBNZ and authors' calculations
Oil	Crude Oil–West Texas Intermediate Spot	Datastream
Global Stocks	Financial Times Stock Exchange 100 Index	Datastream
News Shocks		
UBS Surprise Indices	UBS Surprise Indices include both growth surprises and inflation surprises; see Annex 2.3 for detailed description	Bloomberg, L.P.
Industrial Production Indices and Forecasts	For each announcement by authorities, Bloomberg records the actual (announced) industrial production growth (year-over-year) as well as its median forecasts by market analysts	Bloomberg, L.P.
Common Investor Variables		
Market Returns	Percentage change in level of country-specific bond (equity) indices	Datastream
Market Size	Market capitalization of country-specific bond (equity) indices interacted with market returns	Datastream
Trade Links	Total trade between partner countries interacted with market returns	DOTS, Datastream
Financial Interdependence	Financial Interdependence Index interacted with market returns	EPFR Global, Datastream

Source: IMF staff.

Note: DOTS = Direction of Trade Statistics; FDI = foreign direct investment; ICRG = International Country Risk Guide; RBNZ = Reserve Bank of New Zealand; WEO = World Economic Outlook database.

mies.[30] The sample period starts between March 2003 (Russia) and April 2005 (China) and ends in November 2015.

Specifically, we expand a classical factor model of equity returns (see, for example, Cuadro-Saez, Fratzscher, and Thimann 2009) by including a set of spillover variables—idiosyncratic country-specific shocks from the three major emerging market economies:

$$r_{i,t} = \alpha_i + \beta_j S^{IP}_{j,t} + \mu G_t + \delta r_{i,t-1} + \varepsilon_{i,t}, \qquad (1)$$

in which $r_{i,t}$ is two-day equity returns in country i at date t, $S^{IP}_{j,t}$ is the difference between the actual announced industrial production growth rate and the median forecast by market analysts in emerging market economy j at date t, G_t is a vector of global factors, and $r_{i,t-1}$ is lagged two-day equity returns. Global factors include world equity returns as measured by the Financial Times Stock Exchange 100, world interest rate as measured by the three-month U.S. Treasury bill rate, global risk aversion as measured by the Chicago Board Options Exchange Standard & Poor's 500 Implied Volatility Index, and crude oil price. Equity returns and oil price are logged for easy interpretation. Because this is an event study analysis, we regress only the specification on announcement dates.[31]

As in Cuadro-Saez, Fratzscher, and Thimann (2009), the estimation uses an ordinary least squares estimator with panel-corrected standard errors.

Annex 2.4. Common Investor Channel for Financial Spillovers from Emerging Market Economies

Data

The fund data come from EPFR Global and consist of observations of cross-country equity and bond portfolio fund investment allocations. Data on country stock market returns and market capitalization were gathered from Thomson Reuters Datastream. All data are at monthly frequency and span the period 2000–15. See note 25 for the country list.

Methodology

A panel regression model with country fixed effects (Broner, Gelos, and Reinhart 2006) was used to measure the impact of investor overlap on portfolio investment recipient countries' stock market dynamics. The specification for this panel regression is[32]

$$r_{c,t} = \alpha_c + \beta_1 \cdot w_{c',t} \cdot r_{c',t} + \beta_2 \cdot t_{c,c',t} \cdot r_{c',t} + \beta_3 \cdot d_{c,c',t-1} \cdot r_{c',t} + \varepsilon_{c,t}, \quad (1)$$

in which, at time t, $r_{c,t}$ is the stock market return for country c, $w_{c,t}$ is the stock market capitalization for country c, and $t_{c,c',t}$ is the share of country c's total trade between country c and country c'. $d_{c,c',t-1}$ is the value of the financial interdependence index at time $t-1$ and denotes country c's reliance on investors who are also exposed to country c'. The model covariates $w_{c',t} \cdot r_{c',t}$ and $t_{c,c',t} \cdot r_{c',t}$ effectively serve as controls for the effect of stock market size and trade linkages.

Several steps were taken to mitigate the influence of outliers. First, we winsorized each regression variable at the 0.005th and 99.5th percentiles to remove the most extreme observations.[33] Then we robustly estimated the coefficients of our model using a modern estimation approach known as SMDM.[34] Model standard errors were transformed using the approach of Croux, Dhaene, and Hoorelbeke (2003) and are robust to the influence of both heteroscedasticity and autocorrelation.

Financial Interdependence Index

The *financial interdependence index* of Broner, Gelos, and Reinhart (2006) is a measure that can be used to assess the extent to which a given set of countries rely

---

[30]An alternate measure of growth and inflation surprises, supplied by UBS, was also analyzed to assess the spillover effects from six major emerging market economies: Brazil, China, Mexico, Russia, South Africa, and Turkey. Whereas results obtained were qualitatively similar to those presented in the chapter, an advantage of the surprise measure described here is that it accounts for the intensity/magnitude of the surprise, which is by construction not captured by the UBS measure.

[31]The coefficient on the emerging market economy shock surprise variable may be interpreted as follows. If the point estimate is 0.2 for S^{IP}_{China}, it means that if the actual industrial production growth rate beats the median forecast by 1 percentage point, the equity markets in other countries would rise by 0.2 percentage point on average.

[32]β_j, for $j \in \{1,2,3\}$, are estimated regression coefficients, a_c is the fixed effect attributable to country c, and $\epsilon_{c,t}$ is the portion of country c's stock market return that is not explained by the model's covariates at time t.

[33]Another motivation for this mild use of winsorization was to clean from the regression data obvious data measurement errors, which were identified by IMF staff and confirmed by EPFR Global database experts.

[34]SMDM estimation differs from ordinary least squares estimation in that it seeks to minimize the iterated reweighted sum of squared differences between observed and predicted values of the dependent variable. This means the SMDM estimation procedure assigns less weight to outlying observations than does ordinary least squares estimation and, consequently, that SMDM estimates are more robust to outliers. See Leone, Minutti-Meza, and Wasley 2014.

on a common set of overexposed investors. This index is defined as follows:

$$d_{c_j,c_k,t} = \sum_i re_{c_j,i,t} \times oe_{i,c_k,t} , \tag{2}$$

in which $d_{cj,ck,t}$ denotes country c_j's reliance on investors overexposed to country c_k at time t.

The subterms $re_{cj,i,t}$ and $oe_{i,ck,t}$ refer to country c_j's relative reliance on investment from fund i and fund i's overexposure to country c_k, at time t. Formally, these are defined as

$$re_{c_j,i,t} = \frac{a_{i,c_j,t}}{\sum_{i'} a_{i',c_j,t}} , \text{ and} \tag{3}$$

$$oe_{i,c_k,t} = b_{i,c_k,t} - \bar{b}_{c_k,t} , \tag{4}$$

which, in turn, rely on the following definitions:

$$\bar{b}_{c_k,t} = \frac{a_{i,c_k,t}}{s_{i,t}} , \text{ and} \tag{5}$$

$$s_{i,t} = \sum_{c_k} a_{i,c_k,t} , \text{ for } i \neq i'. \tag{6}$$

The component terms $\bar{b}_{ck,t}$, $b_{i,ck,t}$, $s_{i,t}$, and $a_{i,ck,t}$ represent, respectively, the average fund investment weight for country c_k, the investment weight of fund i in country c_k, the total value of all assets invested by fund i, and the value of assets invested by fund i in country c_k, all at time t.

References

Ahnert, Tony, and Christoph Bertsch. 2015. "A Wake-Up Call Theory of Financial Contagion." Unpublished manuscript.

Amihud, Yakov. 2002. "Illiquidity and Stock Returns: Cross-Section and Time-Series Effects." *Journal of Finance*, 5 (1): 31–56.

Antón, Miguel, and Christopher Polk. 2013. "Connected Stocks." *Journal of Finance* LXIX (3): 1099–127.

Bayoumi, Tamim, and Franziska Ohnsorge. 2013. "Do Inflows or Outflows Dominate? Global Implications of Capital Account Liberalization in China." Working Paper 13/189, International Monetary Fund, Washington.

Bekaert, Geert, R. Campbell Harvey, Christian T. Lundblad, and Stephan Siegel. 2011. "What Segments Equity Markets." *Review of Financial Studies* 24 (12): 3841–890.

Boyer, Brian H., Tomomi Kumagai, and Kathy Yuan. 2006. "How Do Crises Spread? Evidence from Accessible and Inaccessible Stock Indices." *Journal of Finance* 61 (2): 957–1003.

Brandão-Marques, Luis, Marco Espinosa-Vega, and Juan Solé. Forthcoming. "Cross-Border Spillovers from Mutual Fund Activity." Working Paper, International Monetary Fund, Washington.

Brandão-Marques, Luis, R. Gaston Gelos, and Natalia Melgar. 2013. "Country Transparency and the Global Transmission of Financial Shocks." Working Paper 13/156, International Monetary Fund, Washington.

Broner, Fernando A., R. Gaston Gelos, and Carmen M. Reinhart. 2006. "When in Peril, Retrench: Testing the Portfolio Channel of Contagion." *Journal of International Economics* 69 (1): 203–30.

Calvo, Guillermo, and Enrique Mendoza. 2000. "Rational Contagion and the Globalization of Securities Markets." *Journal of International Economics* 51 (1): 79–113.

Cetorelli, Nicola, and Linda S. Goldberg. 2012. "Global Banks and International Shock Transmission: Evidence from the Crisis." *IMF Economic Review* 59 (1): 41–76.

Chan, Kalok, and Johnny K. H. Kwok. 2005. "Market Segmentation and Share Price Premium: Evidence from Chinese Stock Markets." *Journal of Emerging Market Finance* 4 (1): 43–61.

Coval, Joshua D., and Erik Stafford. 2007. "Asset Fire Sales (and Purchases) in Equity Markets." *Journal of Financial Economics* 86: 479–512.

Croux, Christoph, Geert Dhaene, and Dirk Hoorelbeke. 2003. "Robust Standard Errors for Robust Estimators." Discussion Paper Series 03.16, KU Leuven, CES.

Cuadro-Saez, Lucía, Marcel Fratzscher, and Christian Thimann. 2009. "The Transmission of Emerging Market Shocks to Global Equities Markets." *Journal of Empirical Finance* 16 (1): 2–17.

Dasgupta, Amil, Roberto Leon-Gonzalez, and Anja Shortland. 2011. "Regionality Revisited: An Examination of the Direction of Spread of Currency Crises." *Journal of International Money and Finance* 30: 831–48.

Demirer, Mert, Francis X. Diebold, Laura Liu, and Kamil Yilmaz. 2015. "Estimating Global Bank Network Connect-

edness." Working Paper 15/1512, Koc University-TUSIAD Economic Research Forum.

Diebold, Francis X., and Kamil Yilmaz. 2014. "On the Network Topology of Variance Decompositions: Measuring the Connectedness of Financial Firms." *Journal of Econometrics* 182 (1): 119–34.

Dimpfl, Thomas, and Robert C. Jung. 2011. "Financial Market Spillovers around the Globe." Global Financial Markets Working Paper Series 20–2011, Friedrich-Schiller University.

Duval, Romain, Nan Li, Richa Saraf, and Dulani Seneviratne. 2016. "Value Added Trade and Business Cycle Synchronization." *Journal of International Economics* 99: 251–62.

Fong, Tom, Alfred Wong, and Ivy Yong. 2007. "Share Price Disparity in Chinese Stock Markets." Working Paper 11/2007, Hong Kong Monetary Authority.

Forbes, Kristin J. 2002. "Are Trade Linkages Important Determinants of Country Vulnerability to Crises?" In *Preventing Currency Crises in Emerging Markets*, edited by Sebastian Edwards and Jeffrey Frankel. Chicago: University of Chicago Press.

———. 2012. "The 'Big C': Identifying Contagion." Working Paper 12/18465, National Bureau of Economic Research, Cambridge, Massachusetts.

———, and Roberto Rigobon. 2002. "No Contagion, Only Interdependence: Measuring Stock Market Co-Movements." *Journal of Finance* 57 (5): 2223–261.

Fung, Alexander Kwok-Wah, Kin Lam, and Ka-Ming Lam. 2010. "Do the Prices of Stock Index Futures in Asia Overreact to U.S. Market Returns?" *Journal of Empirical Finance* 17 (3): 428–40.

Gelos, R. Gaston. 2011. "International Mutual Funds, Capital Flow Volatility, and Contagion—A Survey." Working Paper 11/92, International Monetary Fund, Washington.

Goldstein, Morris. 1998. "The Asian Financial Crisis." Policy Brief PB98-1, Peterson Institute for International Economics, Washington.

He, Dong, and Paul Luk. 2013. "A Model of Chinese Capital Account Liberalisation." Working Paper 12/2013, Hong Kong Institute for Monetary Research, Hong Kong.

———, Lillian Cheung, Wenlang Zhang, and Tommy Wu. 2012. "How Would Capital Account Liberalization Affect China's Capital Flows and the Renminbi Real Exchange Rates?" *China and the World Economy* 20 (6): 29–54.

He, Dong, Eric Wong, Andrew Tsang, and Kelvin Ho. 2015. "Asynchronous Monetary Policies and International Dollar Credit." Working Paper 19/2015, Hong Kong Institute for Monetary Research, Hong Kong.

Hong, Harrison, José A. Scheinkman, and Wei Xiong. 2006. "Asset Float and Speculative Bubbles." *Journal of Finance* 61 (3): 1073–117.

Hooley, John. 2013. "Bringing down the Great Wall? Global Implications of Capital Account Liberalisation in China." *Bank of England Quarterly Bulletin.*

International Monetary Fund. 2011. *Changing Patterns of Global Trade*, Policy Paper, Washington.

———. 2014a. *Global Liquidity*, Policy Paper, Washington.

———. 2014b. *Spillover Report*, Washington.

———. 2015. *Spillover Report*, Washington.

Johnson, Robert C., and Guillermo Noguera. 2014. "A Portrait of Trade in Value Added over Four Decades." Working Paper, University of Warwick.

Jotikasthira, Chotibhak, Christian Lundblad, and Tarun Ramadorai. 2012. "Asset Fire Sales and Purchases and the International Transmission of Funding Shocks." *Journal of Finance* 67 (6): 2015–50.

Karolyi, G. Andrew, David T. Ng, and Eswar Prasad. 2015. "The Coming Wave: Where Do Emerging Market Investors Put Their Money?" Working Paper 15/21661, National Bureau of Economic Research, Cambridge, Massachusetts.

Killian, Lutz. 2013. "Structural Vector Autoregressions." Chapter 22 of *Handbook of Research Methods and Applications in Empirical Macroeconomics*, edited by N. Hashimzade and M.A. Thornton, Edward Elgar.

Klößner, Stefan, and Sven Wagner. 2014. "Exploring all VAR Orderings for Calculating Spillovers? Yes, We Can!—A Note on Diebold and Yilmaz (2009)." *Journal of Applied Econometrics* 29 (1): 172–79.

Kodres, Laura, and Matthew Pritsker. 2002. "A Rational Expectations Model of Financial Contagion." *Journal of Finance* 57 (2): 769–99.

Koop, Gary, H. Hashem Pesaran, and Simon M. Potter. 1996. "Impulse Response Analysis in Nonlinear Multivariate Models." *Journal of Econometrics* 74 (1): 119–47.

Kyle, Albert S. 1985. "Continuous Auctions and Insider Trading." *Econometrica* 53 (6): 1315–335.

———, and Wei Xiong. 2001. "Contagion as a Wealth Effect." *Journal of Finance* 56 (4): 1401–440.

Lane, Philip, and Gian-Maria Milesi-Ferretti. 2007. "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004." *Journal of International Economics* 73 (2): 223–50.

Leone, Andrew J., Miguel Minutti-Meza, and Charles E. Wasley. 2014. "Influential Observations and Inference in Accounting Research." Working Paper FR 14/06, Simon Business School, Rochester, New York.

Lin, Wen-Ling, Robert F. Engle, and Takatoshi Ito. 2004. "Do Bulls and Bears Move across Borders? International Transmission of Stock Returns and Volatility as the World Turns." *Review of Financial Studies* 7 (3): 507–38.

Lütkepohl, Helmut. 2005. *New Introduction to Multiple Time Series Analysis*. New York: Springer.

McCauley, Robert N., Patrick McGuire, and Vladyslav Sushko. 2015. "Global Dollar Credit: Links to U.S. Monetary Policy and Leverage." Working Paper 15/483, Bank for International Settlements, Basel.

Mei, Jianping, José A. Scheinkman, and Wei Xiong. 2009. "Speculative Trading and Stock Prices: Evidence from Chinese A-B Share Premia." *Annals of Economics and Finance* 10: 225–55.

Nathans, Laura L., Frederick L. Oswald, and Kim Nimon. 2012. "Interpreting Multiple Linear Regression: A Guidebook of Variable Importance." *Practical Assessment, Research & Evaluation* 17 (9): 1–19.

Pastor, Lubos, and Richard Stambaugh. 2003. "Liquidity Risk and Expected Stock Returns." *Journal of Political Economy* 111: 642–85.

Peng, Wensheng, Hui Miao, and Nathan Chow. 2007. "Price Convergence between Dual-Listed A and H Shares." *China Economic Issues* 6/07.

Pesaran, H. Hashem, and Yongcheol Shin. 1998. "Generalized Impulse Response Analysis in Linear Multivariate Models." *Economics Letters* 58: 17–29.

Puy, Damian. 2016. "Mutual Funds Flows and the Geography of Contagion." *Journal of International Money and Finance* 60: 73–93.

Raddatz, Claudio, and Sergio L. Schmukler. 2012. "On the International Transmission of Shocks: Micro-Evidence from Mutual Fund Portfolios." *Journal of International Economics* 88: 357–74.

———, and Tomás Williams. 2015. "International Asset Allocations and Capital Flows: The Benchmark Effect." Working Paper 04/2015, Hong Kong Institute for Monetary Research, Hong Kong.

Rajan, Raghuram, and Luigi Zingales. 1995. "What Do We Know about Capital Structure? Some Evidence from International Data." *Journal of Finance* 50 (5): 1421–460.

Rigobon, Roberto. 2003. "Identification through Heteroskedasticity." *Review of Economics and Statistics* 85: 777–92.

Roache, Shaun K., and Marina Rousset. 2015. "China: Credit, Collateral and Commodity Prices." Working Paper 15/27, Hong Kong Institute for Monetary Research, Hong Kong.

Sahay, Ratna, Martin Čihák, Papa N'Diaye, Adolfo Barajas, Ran Bi, Diana Ayala, Yuan Gao, Annette Kyobe, Lam Nguyen, Christian Saborowski, Katsiaryna Svirydzenka, and Seyed Reza Yousefi. 2015. "Rethinking Financial Deepening: Stability and Growth in Emerging Markets." Staff Discussion Note 08/2015, International Monetary Fund, Washington.

Scheinkman, José A., and Wei Xiong. 2003. "Overconfidence and Speculative Bubbles." *Journal of Political Economy* 111: 1183–219.

Shu, Chang, Dong He, Honglin Wang, and Jinyue Dong. 2015. "The Influence of Chinese and U.S. Financial Markets on Asia-Pacific." In *Cross-Border Financial Linkages: Challenges for Monetary Policy and Financial Stability.* BIS Paper 82. Basel: Bank for International Settlements.

Song, Song, and Peter J. Bickel. 2011. "Large Vector Auto Regressions." Working Paper SFB649DP2011–048, Humboldt University, Collaborative Research Center 649.