

SPECIAL FEATURE 1

HOPING FOR THE BEST,
PREPARING FOR THE WORST:

Risks around U.S. Rate Liftoff
and Policy Options

“We face a risk that longer-term interest rates will rise sharply at some point.”
(Ben S. Bernanke, March 1, 2013)¹

“Long-term interest rates are at very low levels, and that would appear to embody low term premiums, which can move, and can move very rapidly...”
(Janet Yellen, May 6, 2015)²

The U.S. Federal Reserve is expected to begin to gradually raise policy interest rates in the near term. Given that it has been anticipated for some time and will take place against the backdrop of an ongoing U.S. recovery and highly accommodative monetary policy by other major central banks, the launch of a series of U.S. rate increases (“liftoff”) is likely to proceed smoothly. The risk remains, however, that the liftoff or subsequent rate increases could lead to abrupt changes in market expectations regarding monetary conditions that could, in turn, prompt a spike in U.S. long-term interest rates, volatility in global financial markets, and a sharp increase in borrowing cost for emerging markets—similar to the way initial discussions of U.S. monetary policy normalization triggered the “taper tantrum” of May–June 2013. If, in response to the liftoff, U.S. long-term bond yields were to jump 100 basis points (as they did during the taper tantrum), capital inflows to emerging markets could decline by 0.8–1.8 percentage points of GDP. The change in external conditions driven by the liftoff or subsequent rate increases could potentially combine with domestic factors to spark a sudden stop in capital inflows in some emerging markets, especially those where vulnerabilities have increased, where there has been uncertainty about policy direction, or where growth prospects have deteriorated significantly. In anticipation of such a risk, emerging markets should prioritize monetary, financial, and fiscal policies that reduce vulnerabilities and strengthen credibility, and structural reform agendas that improve growth prospects.

Introduction

The exceptionally accommodative monetary policy stance of major central banks since the global financial crisis has helped support global liquidity, bolster asset valuations, and reduce risk premia. It has been instrumental in lowering long-term interest rates in the United States and other advanced economies, and has contributed to the increase in capital inflows to emerging market countries as investors search for higher yields. As a result, borrowing conditions in emerging markets have remained particularly favorable.

As the U.S. economy improves, the U.S. Federal Reserve (Fed) is expected to begin to gradually raise policy interest rates in the near term, an event widely referred to as “liftoff.”³ The liftoff and the subse-

quent tightening cycle are expected to proceed smoothly, leading to only modest downward pressures on capital inflows to emerging market countries (Fischer 2015). However, the “taper tantrum” episode of May–June 2013 is a reminder that even an event long anticipated by markets can surprise in its specifics and generate significant financial market volatility and shifts in capital flows.

The potential impact on capital flows to emerging and developing countries depends on both “push” factors (global economic and financial conditions) and “pull” factors (country-specific prospects, vulnerabilities, and policies).⁴

- *Push factors.* As growth prospects improve in advanced countries relative to emerging markets, investment returns are likely to rise and advanced country monetary policies will become

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¹Bernanke (2013b).

²Yellen (2015b).

³In a recent speech, Federal Reserve Chair Janet Yellen (2015c) articulated her position on the timing of the rate hike: “If the economy continues to improve as I expect, I think it will be appropriate at some

point this year to take the initial step to raise the federal funds rate target and begin the process of normalizing monetary policy. To support taking this step, however, I will need to see continued improvement in labor market conditions, and I will need to be reasonably confident that inflation will move back to 2 percent over the medium term.”

⁴Several recent studies have examined the links between capital flows to emerging and developing countries and “pull” and “push” factors, including U.S. monetary policy and global risk aversion (Koepke 2015a).

gradually less accommodative. Although positive growth spillovers from advanced countries would support activity in emerging markets, higher interest rates would likely shift the relative return differential on financial assets in favor of advanced countries.

Pull factors. While emerging markets as a group continue to grow faster than advanced economies, prospects have softened and several emerging market countries face significant vulnerabilities. In some of them, uncertainty about policy direction is elevated and weighing on investor sentiment. These factors increase the likelihood of a sudden market reappraisal of the inherent riskiness of emerging market financial assets.

This Special Feature analyzes the changes in the push and pull factors since the taper tantrum, risks of disruptions around the liftoff, and potential implications for emerging markets and possible policy options. Specifically, it addresses the following questions:

- How have growth prospects and policies in advanced countries changed since the taper tantrum?
- What are the major risks around the liftoff?
- What are possible implications of the liftoff for emerging markets?
- What are the major lessons for emerging markets from the taper tantrum?
- How have growth prospects and vulnerabilities for emerging markets changed since the taper tantrum?
- What policy options are available to prepare for risks around the liftoff?

How Have Growth Prospects and Policies in Advanced Countries Changed since the Taper Tantrum?

Advanced country growth, monetary policy, and broader financial conditions are key global push factors driving capital flows to emerging markets. The economic and policy context in advanced countries has evolved notably since the taper tantrum in May–June 2013 (Figure SF1.1).

- *Lower global interest rates.* Despite a recent pickup, interest rates in major economies are still exceptionally low, and in some cases negative (Box 1.1). The low rates are accompanied by prospects of a significant expansion of balance sheets by the European Central Bank (ECB) and the Bank of Japan. These monetary stimulus measures will continue to shore up global liquidity and help keep interest rates low around the world.
- *Improved activity in advanced economies, including the United States.* Since 2013, growth in advanced countries has picked up markedly, and is projected to reach 2 percent in 2015. In the United States, in particular, labor markets have improved significantly since the taper tantrum (Chapter 1), suggesting that fulfillment of the Fed’s “full employment” mandate does not stand in the way of a nearing liftoff (Yellen 2015c).

Going forward, a rise in U.S. long-term yields could reflect either continued improvements in the U.S. economy or highly anticipated U.S. monetary policy changes, or both. Continued improvements in U.S. activity (a favorable “real shock”), especially if surprising strongly and repeatedly on the upside, could bolster equity valuations and would reduce the need for the current highly accommodative monetary policy stance. In tandem with rising returns on equity, bond yields could rise on market expectations of nearing monetary tightening.

Alternatively, financial markets could be surprised by even a modestly less accommodative stance of monetary policy: it could appear as an accelerated tightening to investors if their views about the U.S. economy differ from the Fed’s (an adverse “monetary shock”). Similarly, if disappointing economic data were to reveal supply-side challenges to potential growth, it could lead to a faster-than-anticipated increase in (actual or expected) inflation. This could in turn warrant faster-than-expected monetary policy tightening.⁵

A structural vector autoregression (VAR) model is employed to disentangle the contribution of such real

⁵There remains considerable uncertainty on supply-side constraints affecting the U.S. economy, including the underlying pace of productivity growth (Gordon 2014; Hall 2014; Fernald and Wang 2015) and labor participation (Aaronson et al. 2014; Council of Economic Advisers 2014), as both have remained unusually low in the post-crisis period. Signs of emerging supply-side constraints could raise inflation expectations, leading market participants to anticipate a faster normalization of policy rates in the short term.

and monetary shocks to movements in the long-term U.S. yields: those associated with changes in U.S. growth prospects (proxied by the S&P 500 index), and those reflecting changes in market perceptions of U.S. monetary conditions (proxied by the 10-year sovereign bond yield). The exercise assumes that an adverse monetary shock (such as perceived accelerated monetary tightening) increases yields and reduces stock prices in the United States, while a favorable real shock (such as one reflecting better growth prospects) increases both yields and stock prices (Matheson and Stavrev 2014; IMF 2014b; see Box SF1.1 for technical details).

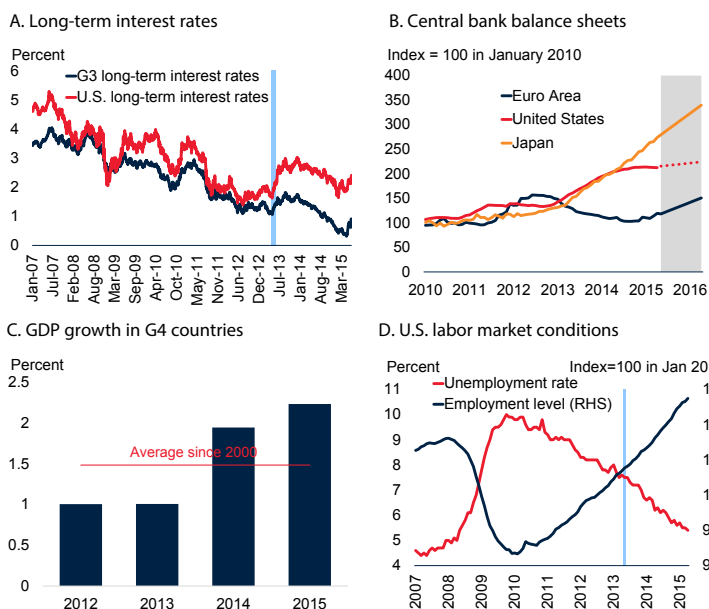
The results suggest that the initial increase in long-term yields after May 2013 largely reflected unfavorable monetary shocks: against the backdrop of concerns about the strength of the U.S. economy, financial markets perceived the taper-talk as signaling an accelerated monetary tightening (Figure SF1.2). In early 2013, economic data releases surprised on the downside and provided little indication that suggested sufficiently strong U.S. growth momentum to warrant rising long-term bond yields. As a result, real shocks contributed little to movements in 10-year U.S. bond yields.

Since the taper tantrum, however, monetary shocks, reflecting both domestic and external factors, have turned increasingly favorable. In late 2014, they began to push yields below May 2013 levels. Despite steadily shrinking Fed asset purchases between December 2013 and October 2014, financial conditions remained highly accommodative. Following ECB President Mario Draghi's speech in Jackson Hole in August 2014, market speculation intensified and was eventually proven right about the use of ECB's quantitative easing. The decline in Euro Area long-term bond yields also spilled over to U.S. long-term bond yields. At the same time, indications of an increasingly robust labor markets contributed to positive real shocks that exerted upward pressure on long-term yields.

If the timing of the liftoff and the subsequent path of policy rates are accurately reflected in market expectations, the normalization of U.S. policy rates amid robust growth prospects for the U.S. economy will be part of a smooth transition for global financial markets. U.S. long term yields will rise only modestly and the U.S. yield curve will flatten slightly, as in some earlier liftoff episodes (Figure

FIGURE SF1.1 Conditions in advanced countries

Long-term interest rates remain at historic lows, especially in the Euro Area, and global financial markets have been bolstered by exceptionally accommodative monetary policies of the European Central Bank and Bank of Japan. The recovery in advanced countries is gathering momentum, benefiting growth in emerging markets. In the United States, labor markets are healing as the recovery is continuing.



Source: Bloomberg, Haver, World Bank.
 A. Average of 10-year government bond yields of G3 countries (Euro Area, Japan, and United Kingdom) weighted by GDP. Blue bar shows the taper tantrum period in May-June 2013. The latest data point is for June 8, 2015.
 B. Grey area shows the forecast period.
 C. Aggregate GDP growth of G4 countries (United States, Euro Area, Japan, and United Kingdom)
 D. Blue bar shows the taper tantrum period in May-June 2013

SF1.3).⁶ Such a fully anticipated normalization of U.S. policy rates should not trigger volatility in global financial markets or sharp reversals in capital flows in emerging markets.

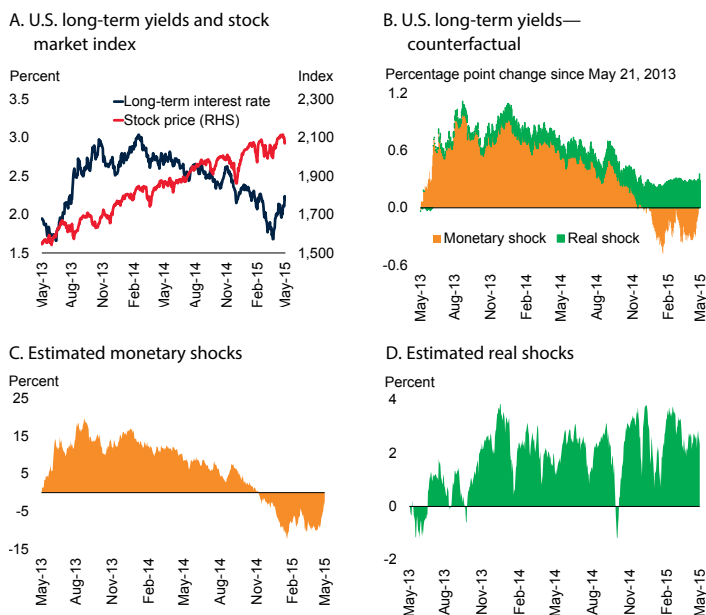
What Are the Major Risks around the Liftoff?

The magnitude of the market reaction during the taper tantrum of May-June 2013 underlines the risks surrounding the liftoff and subsequent rate

⁶In previous tightening episodes, the U.S. yield curve generally flattened and term premia rose only modestly, if at all, during the first year of the first rate increase (Adrian, Crump, and Moench 2013a). The particularly steep 1994 tightening cycle helped stabilize medium-term inflation expectations, reflected also in a narrowing term spread. The 2004 tightening cycle was accompanied by a narrowing term spread (also dubbed the “conundrum”), partly reflecting ample global liquidity and declining medium-term inflation expectations. This tightening episode—which, like the upcoming liftoff, also started at very low U.S. policy interest rates—was the most benign for emerging market currencies and capital flows. In contrast, term spreads initially widened during the tightening cycle that accompanied the particularly strong recovery in 1999.

FIGURE SF1.2 Explaining movements in U.S. bond yields: monetary and real shocks

The sudden rise in U.S. long term yields after May 2013 was mainly due to adverse monetary shocks, as markets interpreted taper talk as signaling accelerated monetary tightening. Since then, favorable financial conditions have been pushing yields down, offsetting upward pressure from strengthening labor markets and activity.



Source: Haver, World Bank estimates.

A. Long-term interest rate is the 10-year U.S. Treasury yield and stock price refers to the S&P 500.

B. Based on estimates from the model, identifying monetary and real shocks using sign restrictions. All shocks except the shock of interest are shut down by setting them to zeros and the model is used to trace out the counterfactual long rate. The exercise is performed separately for monetary and real shocks. The orange (green) counterfactual shows how long rates would have evolved only with the estimated monetary (real) shocks. Numbers shown are in percentage points.

C, D. These are the time series of monetary and real shocks as estimated from the VAR model. Numbers shown are in cumulative percentages. The shock signs are such that whenever positive, they result in an increase in the long rate.

increases that could lie ahead. The 2013 episode was sparked by a statement that became known as “taper talk,” when Fed Chairman Bernanke mentioned the possibility of the Fed slowing its asset purchases “in the next few meetings” on May 22, 2013 (Bernanke 2013b). While financial markets had expected such an action at some point in the future, they were surprised by the mention of an approximate timeframe. Within a couple months of the initial taper talk, U.S. 10-year Treasury yields increased by 100 basis points.

The jump in U.S. yields was quickly followed by a spike in financial market volatility in emerging economies. Specifically, emerging market currencies depreciated, bond spreads rose steeply, foreign portfolio inflows to emerging-market bond and equity funds fell sharply, and liquidity tightened (Figure SF1.4). This forced many emerging markets to tighten monetary policy, intervene in currency markets, and, in some cases, introduce exceptional measures to prevent capi-

tal outflows.⁷ Although U.S. bond yields have since fallen back, long-term bond yields in emerging markets remain above those of early 2013.

U.S. financial markets may currently be vulnerable to a sharp tightening around the liftoff or subsequent tightening cycle. The term premium is exceptionally low, expectations about medium-term interest rate paths diverge between market participants and Federal Open Market Committee (FOMC) members, and market liquidity conditions are fragile.

- *Low term premium.* The term premium in the United States is exceptionally compressed.⁸ The current low U.S. term premium partly reflects modest assessment of inflation risks and strong global demand for U.S. treasuries as safe assets.⁹ This has been reinforced by low interest rates for assets denominated in other reserve currencies, which in part resulted from quantitative easing programs by other major central banks (Bernanke 2015). Inherent in the current low term premium is the risk of a sudden widening, with greater uncertainty potentially leading to a surge in long-term yields (Yellen 2015c).¹⁰
- *Gap between market and FOMC expectations.* Since 2014, expectations for the path of future policy rates among market participants have been considerably (currently more than 100 basis points in 2017 and beyond) below those of

⁷Recent studies—such as Sánchez (2013); Díez (2014); Dahlhaus and Vasishtha (2014); Ikeda, Medvedev, and Rama (2015); and Koepke (2015b)—emphasize the critical role of expectations in determining the scale of macroeconomic adjustments in developing countries in the event of a U.S. interest rate hike. They report that the large macroeconomic adjustments in developing countries during the taper tantrum reflected the fact that the consequences of Fed tapering had not yet been “priced in.” In contrast, the relatively milder movements in developing-country financial markets during the actual taper period (December 2013–October 2014) suggested that markets had already adjusted their expectations accordingly.

⁸Long term interest rates can be decomposed into expectations about the future path of real policy interest rates, inflation expectations, and a term premium. The term premium is therefore the extra return required by investors to hold a longer-term bond instead of re-investing in successive short-term securities. Typically, the term premium is positive.

⁹See Williams (2015), Abrahams et al. (2015), Blanchard, Furceri, and Pescatori (2014), and Caballero and Farhi (2014) for details on these observations.

¹⁰U.S. term premia are highly correlated with macroeconomic and financial uncertainty, reflected in disagreement about future inflation among professional forecasters, consumer confidence, and implied volatility in U.S. Treasury markets (Abrahams et al. 2015). Previous monetary policy surprises and the Federal Reserve’s large-scale asset purchases have been important drivers of U.S. term premia in recent years.

members of the FOMC (Figure SF1.3).¹¹ This implies a risk that market perceptions suddenly adjust upwards. Such a change could, for example, be triggered by a market reassessment of the likelihood of a protracted period of low growth or inflation that would be associated with an extended period of monetary accommodation.

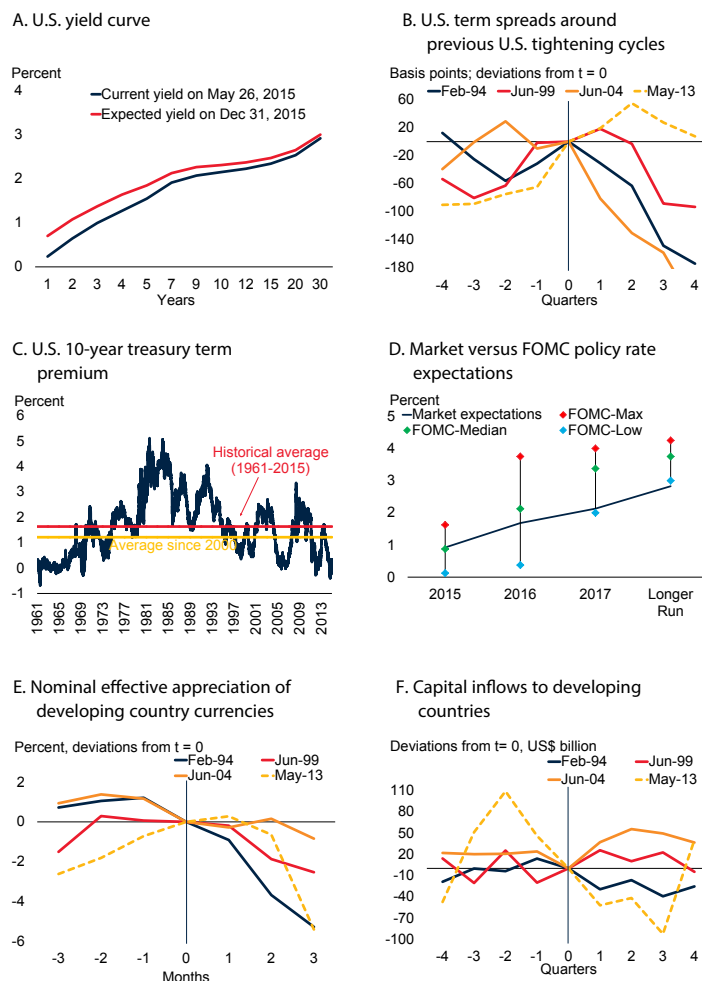
- Fragile market liquidity.** Several factors make liquidity conditions more fragile than before the global financial crisis, even in deep sovereign bond markets in advanced countries. The volume of primary dealer trading—which typically smoothes liquidity over fluctuations in other market participants’ demand and supply—has fallen relative to outstanding treasury bonds (Figure SF1.5). In particular, bank’s dealer inventories and market-making activities have declined as a result of changing business models, diminished bank risk appetite, and tighter regulatory requirements for liquidity and other buffers (IMF 2015; Committee on the Global Financial System 2014). As a result, the role of less-regulated, non-bank market intermediaries has increased since the global financial crisis (Blume and Keim 2012; Fender and Lewrick 2015). Traditionally less volatile, long-term focused institutional investors such as pension and insurance funds may also have become more procyclical in their behavior.¹² While the composition and behavior of private debt holders has changed, their overall share in total debt holdings has also declined from pre-crisis levels as central bank’s holdings of sovereign bonds increased with quantitative easing programs.

¹¹This gap reflects uncertainty about prospects for policy rates over the medium and long run (Williams 2015; Hamilton et al. 2015), with market participants expecting them to remain low for a considerable period of time while FOMC members foresee a gradual rise in coming years, as post-crisis legacies and uncertainties unwind (Yellen 2015a).

¹²During the taper tantrum, market liquidity deteriorated rapidly in U.S. Treasury markets, as primary dealers reduced their inventories at a time when interest rate risks were re-priced more generally (Adrian et al. 2013). Liquidity strains spread rapidly across markets, leading to particularly large adjustments in emerging market asset prices (García-Luna and van Rixtel 2013). Portfolio outflows were concentrated in the most liquid emerging markets (Eichengreen and Gupta 2014) and were largely driven by retail investors. In 2013, institutional investors generally maintained their exposures (World Bank 2014b). However, institutional investors have begun to act less countercyclically and, under acute and persistent market stress, could contribute to a “rush to the exit” (IMF 2014a; Bank of England and Procyclicality Working Group 2014; Opazo, Raddatz and Schmukler 2014; Raddatz and Schmukler 2012). Through their hedging activities, they can also add to exchange rate pressures (IMF 2013).

FIGURE SF1.3 A smooth liftoff in light of past episodes?

If the liftoff proceeds smoothly as expected, the term spread would remain narrow as happened in some past episodes of first rate hikes in a tightening cycle. However, there remains a risk of a spike in long-term interest rates, especially since term premia are well below their historical average and market expectations of future interest rates are below those of members of the Federal Open Market Committee (FOMC).

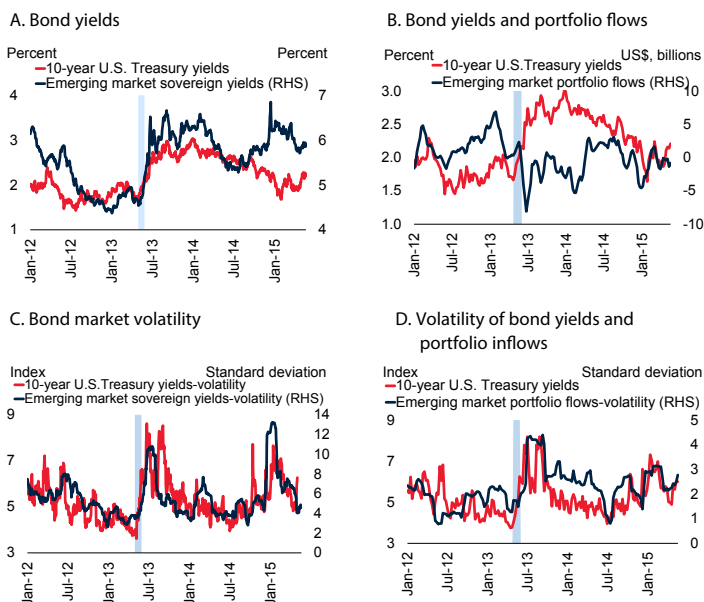


Source: IMF, Haver Analytics, Bloomberg, Federal Reserve Bank of New York, World Bank, U.S. Fed FOMC. B. Term spread denotes the difference between 10-year U.S. Treasury and 6-month T-bill yields, four quarters before until four quarters after the launch of the U.S. tightening cycle (t = 0). C. Term premium estimates are obtained from the model described in Adrian, Crump, and Moench (2013b). This model belongs to the affine class of term structure models which characterize yields as linear functions of a set of pricing factors. E. The x-axis shows the number of quarters before and after t = 0, where t = 0 is February 1994, June 2004, and May 2013. F. Excluding China.

Apart from the possibility of broad-based market volatility, the risks around the liftoff differ in their specifics from those that materialized during the taper tantrum. In particular, taper talk signaled a tightening that directly affected the long end of the yield curve, because it related to Fed purchases of long-term debt securities and, thus, raised the term premium. In contrast, the liftoff would be a policy move at the short end of the yield curve, with only indirect pass-through into long-term yields.

FIGURE SF1.4 U.S. bond yields and capital flows during the taper tantrum

Between 2012 and 2014, emerging market bond yields closely followed U.S. Treasury 10-year yields. The sharp rise in U.S. yields in May-June 2013 was accompanied by a marked fall in capital inflows to developing countries and increased volatility. The volatility in U.S. bond markets coincided with volatility of developing-country bond yields and capital inflows.



Source: Bloomberg, Emerging Portfolio Fund Research, JPMorgan Chase, CBOE, and World Bank.

Note: Blue bars show the taper tantrum period of May-June 2013.

A. Based on JPMorgan EMBIG sovereign bond yield index.

B. 4-week moving average of net inflows to developing-country bond and equity funds.

C. Volatility index for U.S. Treasury yields refers to the expected volatility of the price of 10-year U.S. Treasury note futures (CBOE's TYVIX index). Volatility of developing-country bond yields refers to 30-day rolling standard deviation of JPMorgan EMBIG sovereign bond yield index.

D. Volatility of developing-country portfolio flows refers to 12-week rolling standard deviation of net inflows to developing-country bond and equity funds.

What Are Possible Implications of the Liftoff for Emerging Markets?

The impact of increasing U.S. yields on emerging markets depends on the trigger of the increase. Rising U.S. yields that reflect a strengthening U.S. economy would likely be associated with stronger growth in emerging markets. In contrast, rising U.S. yields that reflect a perception of accelerated monetary tightening would likely be accompanied by deteriorating activity and tightening financial conditions and, hence, with financial market volatility in and capital outflows from emerging markets.

Impact on activity and financial markets. A panel VAR model is employed to examine the diverging impacts of different types of U.S. shocks on activity and financial markets in emerging market economies (see Box SF1.1 for technical details). Activity

indicators (industrial production) and financial market indicators (stock prices, nominal effective exchange rates, long-term bond yields) for emerging markets are regressed on the monetary and real shocks identified in the econometric exercise above.

As expected, the results suggest that a U.S. yield increase resulting from a favorable real shock has a considerably more benign impact on emerging markets than one resulting from an adverse monetary shock (Figure SF1.6). An adverse U.S. monetary shock is associated with falling stock prices, depreciating emerging market currencies, and shrinking industrial production—all consistent with capital outflows. A favorable U.S. real shock, on the other hand, results in rising stock prices and increasing industrial production.

Impact on capital flows. As they did during the taper tantrum, there is a risk that financial market participants consider the eventual liftoff and the subsequent tightening cycle—even if “telegraphed” by the Fed and expected in principle for some time—as an accelerated tightening of monetary conditions. As in the taper tantrum, it could be interpreted by markets as a purely unfavorable monetary shock, sharply raising U.S. long-term yields. This would likely dampen capital flows to emerging markets.

A VAR model of capital flows and financial conditions is used to examine the potential role of rising U.S. bond yields (Lim, Mohapatra, and Stocker 2014). Quarterly capital flows, including foreign direct investment, portfolio, and bank flows, are regressed on global interest rates, financial market volatility, and growth in major advanced and emerging economies (see Box SF1.1 for technical details).

The results indicate that about one-third of quarterly fluctuations in aggregate capital inflows to emerging markets since the early 2000s can be ascribed to changing global financing conditions (Figure SF1.7). Both short-term and long-term interest rate increases in major economies tend to dampen capital flows to emerging markets. In addition, a steepening yield curve is often associated with higher financial market volatility which, in turn, further reduces capital flows to emerging markets.¹³

¹³Higher U.S. term premia and a steepening yield curve are often associated with higher financial market volatility and greater risk aversion (Abrahams et al. 2015; Adrian, Crump, and Moench 2013b; Borio and Zhu 2012; Adrian and Shin 2011; Dell’Ariccia, Laeven and Mar-

If market expectations for medium-term interest rates suddenly adjust upwards around liftoff, U.S. yields could increase abruptly as seen during the taper tantrum. Significant co-movement between long-term interest rates across major advanced countries could contribute to the propagation of the initial shock.¹⁴ Depending on the pass-through to other advanced countries' interest rates, capital flows to emerging markets could slow sharply over the following year. Should U.S. term spreads increase by 100 basis points, the fall in capital flows to emerging markets could be in the range of 0.8–1.8 percentage points of their combined GDP or a decline between 18 and 40 percent in the level of capital flows (Figure SF1.7).

- *Full pass-through.* A 100 basis-point increase in U.S. yields that is accompanied by a similarly sharp increase in yields in the Euro Area, Japan, and the United Kingdom would trigger a sudden increase in market volatility and a temporary drop in capital inflows to emerging markets, with the decline peaking after four quarters at 1.8 percentage points of GDP (corresponding to a 40 percent dip in aggregate capital flows). The magnitude of the effect is in line with the estimated impact of a 100 basis-point real U.S. yield shock found by Adler, Djigbenou, and Sosa (2014) and a 120 basis-point shock in U.S. yields on portfolio flows found by Dahlhaus and Vasishtha (2014).
- *Partial pass-through (as in taper tantrum).* If other major economies' yields adjust in a manner similar to the taper tantrum (when global yields increased by 70 basis points following an increase in U.S. yields of 100 basis points), capital flows could fall by about 30 percent, or 1.3 percentage points of GDP.
- *No pass-through.* Should long-term yields in other major economies remain broadly unaffected, capital flows to emerging markets would fall considerably less, by about 18 percent or

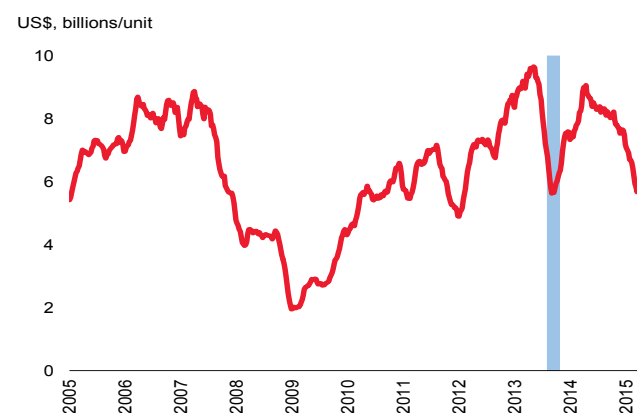
quez 2013). Greater risk aversion and volatility, in turn, reduce capital flows to emerging countries further (Fratzcher 2012; Forbes and Warnock 2012; Bruno and Shin 2015; Lo Duca 2012; Ahmed and Zlate 2013; Bluedorn et al. 2013; Rey 2013).

¹⁴Based on a variance decomposition, Diebold and Yilmaz (2015) suggest that long-term interest rates among non-U.S. major advanced economies co-move (with some lag) with U.S. long-term interest rates. Hunter and Simon (2005) find that bond market returns and volatility in the United States lead those of German and Japanese bond markets.

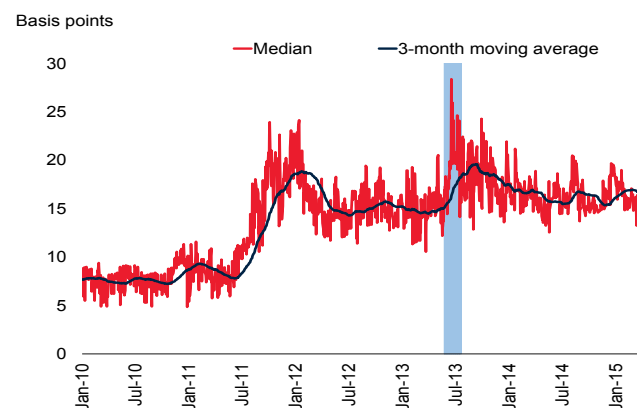
FIGURE SF1.5 Market liquidity

Shocks can trigger sharp volatility especially in illiquid markets. At the height of the Euro Area crisis and during the taper tantrum, liquidity in some emerging bond markets dropped off sharply, driving up bid-ask spreads. With shrinking primary dealer transactions, treasury market liquidity conditions have also become more fragile.

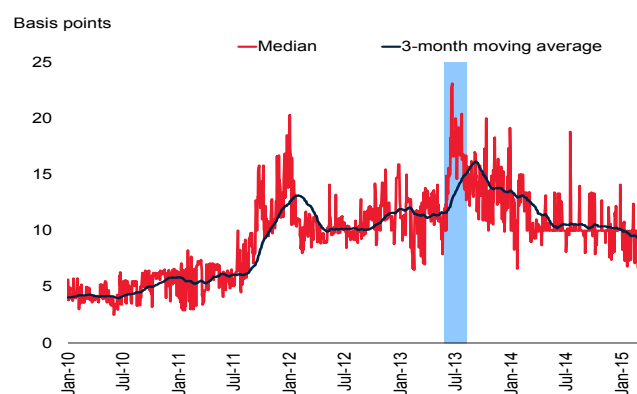
A. Primary dealer treasury transactions



B. Bid-ask spread on emerging market foreign currency bonds



C. Bid-ask spread on emerging market local currency bonds



Source: Federal Reserve Bank of New York, Bloomberg, World Bank.

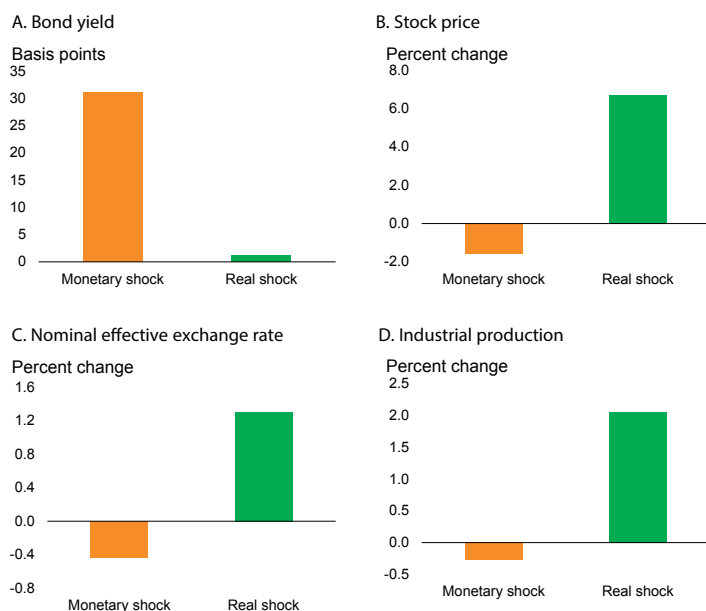
Note: Blue bars show the taper tantrum of May-June 2013.

A. Line shows primary dealer Treasury transactions divided by the Merrill Option Volatility Estimate (MOVE index) (12-week moving average). Merrill Option Volatility Estimate (MOVE) is a yield curve weighted index of the normalized implied volatility on 1-month Treasury options.

B. C. Countries include Brazil, Chile, Colombia, Hungary, Indonesia, the Republic of Korea, Lithuania, Philippines, Poland, Romania, Turkey, and South Africa. Median bid-ask spreads on 10-year government bonds.

FIGURE SF1.6 Implications of monetary and real shocks on activity and financial markets in emerging markets

U.S. bond yield hikes caused by favorable U.S. real shocks have more benign effects on emerging markets than those caused by adverse U.S. monetary shocks. U.S. bond yield jumps associated with real shocks tend to raise equity prices and production in emerging markets, and appreciate their currencies. Those caused by U.S. monetary shocks tend to raise bond yields in emerging markets and depreciate their currencies.



Source: Haver, Bloomberg, World Bank estimates.

Note: Impulse responses after 12 months from a panel VAR model including emerging markets' industrial production, long-term bond yields, stock prices, nominal effective exchange rates and bilateral exchange rates against the U.S. dollar, and inflation, with monetary and real shocks (estimated as in the previous section) as exogenous regressors. All data are monthly or monthly averages of daily data, for January 2013-March 2015 for 19 emerging markets. For comparability, the size of the U.S. real and monetary shocks is normalized such that each shock raises developing-country bond yields by 100 basis points on impact.

A. Bond yields refer to the yields on 10-year (or nearest equivalent) government treasury bonds.

B. Stock price indices are the general price indices from Haver.

C. An increase denotes an appreciation. GDP-weighted average of emerging-market exchange rates.

0.8 percentage point of GDP after a year. Quantitative easing or other monetary policy easing by other major central banks could insulate their markets from pass-through and reduce the impact of rising U.S. bond yields on emerging markets.

The magnitude of the potential decline in capital flows estimated here is both statistically and economically significant, implying considerable challenges for those emerging markets facing more acute vulnerabilities. However, the overall effect for emerging and developing countries remains modest in view of the historical volatility of capital flows. A decline of 40 percent in capital inflows, or 1.8 percentage points of GDP, would be broadly equivalent to a decline of one standard deviation in quarterly flows since the start of the 2000s (compared with the typical definition of a sudden stop in the literature as a two-standard deviation shock).

Under certain conditions, an abrupt increase in U.S. yields could lead to outright sudden stops in capital flows to some emerging markets, which could take a heavy economic toll.¹⁵ The sudden stops in capital flows during the 1990s and 2000s had significant economic costs (Claessens and Kose, 2014; Table SF1.1). For example, about two-thirds of 33 sudden stop episodes through the 1990s and early 2000s were associated with output collapses—contractions in GDP of 4.4 percent from peak to trough (Calvo, Izquierdo, and Talvi 2006).¹⁶ Some sectors are particularly vulnerable to output losses as a result of sudden stops due to their reliance on debt finance, including construction, wholesale and retail trade, transport, and communications (Craighead and Hineline 2013). Compared with the earlier episodes, the impact of sudden stops on emerging market asset prices could be amplified by the increasing role of the non-bank sector and bond financing in channeling liquidity to emerging markets (Shin 2013).

What Are the Major Lessons for Emerging Markets from the Taper Tantrum?

The results above pertain to emerging markets as a group. However, tightening financial conditions would likely put emerging markets with weak growth prospects, policy uncertainty, or lingering vulnerabilities under greater pressure than their less vulnerable peers with better growth prospects and policies.

During the taper tantrum, around 12 percent of emerging market and developing countries experienced sustained declines in capital inflows, especially portfolio inflows (Figure SF1.7). Emerg-

¹⁵Koepke (2015b) reports that Fed tightening cycles coincide with higher incidence of financial crises particularly in the year of the first rate hike, and to a lesser extent in the prior and the following year. Escolano, Kolerus, and Ngouana (2014) find the frequency of emerging market sovereign debt crises increases around episodes of U.S. monetary policy tightening that are associated with widening term spreads.

¹⁶Cardarelli, Elekdag, and Kose (2010), examining 109 episodes of large net private capital inflows to 52 countries over 1987–2007, report that the typical post-inflow impact on GDP growth for episodes that end abruptly is about 3 percentage points lower than during the episode, and about 1 percentage point lower than during the two years before the episode. Claessens et al. (2014) provide a comprehensive review of the literature on financial crises, including sudden stops, in light of recent evidence.

ing market currencies depreciated, bond spreads jumped, foreign portfolio inflows to emerging-market bond and equity funds fell sharply, volatility increased, and liquidity tightened.¹⁷ An extensive literature has identified the following key factors and policy responses characterizing the impact of the taper tantrum (Table SF1.2).

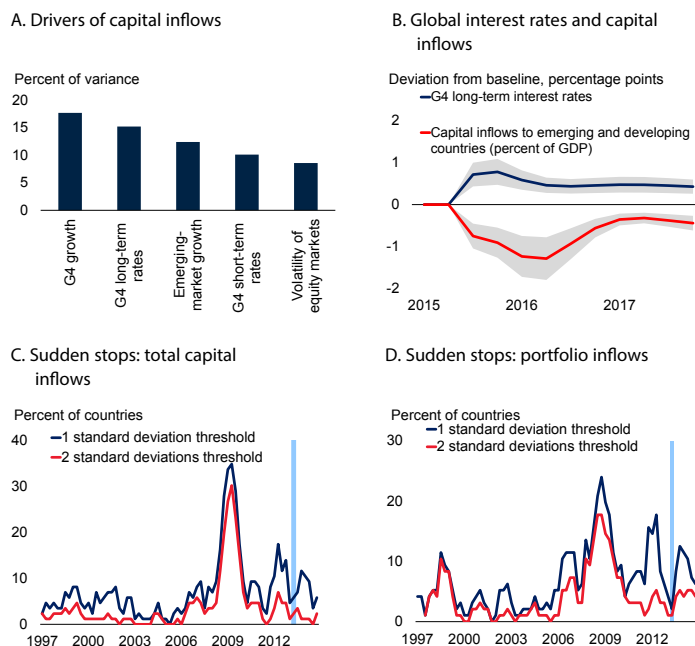
- *Initial impact versus longer-term impact.* The taper talk initially triggered indiscriminate capital outflows from emerging markets. Over time, greater country differentiation emerged as capital flows returned to some countries but not to others (Sahay et al., 2014; Lavigne, Sarker, and Vasishtha 2014).
- *Differentiation depending on country characteristics and policies.* Financial market disruptions during the taper tantrum period were particularly sizable in countries with weaker macroeconomic fundamentals, larger financial markets, and less robust policy responses. Large current account deficits following a period of rapid real appreciation, modest international reserves, and weaker growth prospects were associated with sharper drops in capital inflows and disruptions in financial markets. Larger and more liquid financial markets—including as a result of past capital inflows—also experienced greater exchange rate pressures, foreign reserve losses, and equity price drops.¹⁸ In some countries, these impacts were mitigated by proactive policy responses. Liquidity provision, interest rates hikes, removal of restrictions on capital inflows, and, in some cases, foreign currency intervention helped stem depreciations, stock market declines, and bond yield jumps; fiscal policy announcements appeared to be less effective in mitigating the impact of short-term financial stress (Sahay et al. 2014).

¹⁷Dahlhaus and Vasishtha (2014) document the modest shock to portfolio capital flows to emerging markets during the taper tantrum that, nevertheless, triggered significant financial market adjustment in some emerging markets. Díez (2014) examines the exchange rate adjustment in emerging markets during the taper tantrum. Lim, Mohapatra, and Stocker (2014) calibrate the possible impact of future policy tightening to the taper tantrum.

¹⁸For details about these observations, see Aizenman, Binici, and Hutchison (2014); Chapter 3 of IMF (2014c); Avdijev and Takats (2014); Basu, Eichengreen, and Gupta (2014); Collins and Koepke (2015); Díez (2014); Mishra et al. (2014); Rai and Suchanek (2014) and Eichengreen and Gupta (2014).

FIGURE SF1.7 Surging U.S. yields and capital inflows to emerging and developing countries

Changing global financial conditions—especially U.S. yields—account for a large part of movements in capital flows to emerging market and developing countries. A 100 basis-point rise in U.S. 10-year yields could trigger a drop in capital inflows to developing countries, which could lead to “sudden stops.”



Source: World Bank, Bloomberg.

A. Figure shows the variance decomposition of capital inflows to developing countries after 8 quarters, according to a six-dimensional VAR model estimated over the period 2000Q1 to 2014Q4. The model links aggregate capital inflows to developing countries (including foreign direct investment, portfolio investment and other investment as share of GDP), to quarterly real GDP growth in both developing and G-4 countries (United States, Euro Area, Japan and the United Kingdom), G-4 short-term interest rates (three month money market rates), G-4 10-year government bond yields, and the VIX index of implied volatility of S&P 500 options. To compute the variance decomposition, a structural identification was derived from a Cholesky decomposition on the covariance matrix, using the following order of variables: G-4 GDP growth, developing countries' GDP growth, G-4 short-term rates, G-4 long-term rates, VIX and capital inflows to developing countries. Impulse responses show that a shock in G-4 long-term rates has a peak effect on capital flows after 4 quarters, while the impact remains significant at a 90 percent confidence interval up to 6 quarters.

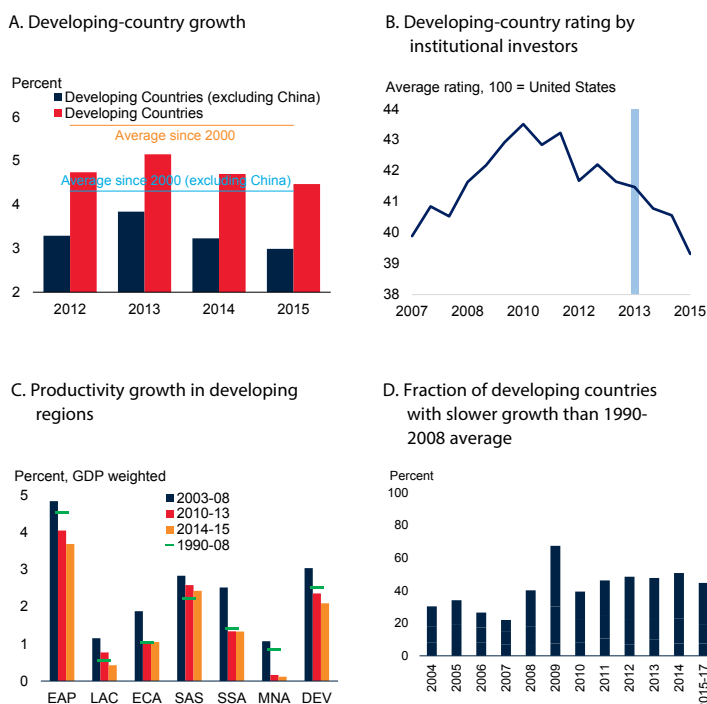
B. The 100 basis point shock on the U.S. term spread was applied to the VAR model assuming a range of pass-through rates to Euro Area, U.K. and Japanese bond yields, from zero to 100 percent. Grey area shows the range of estimated effects on capital inflows depending on pass-through rates (the lower bound corresponds to a zero pass-through rate implying a 40 basis points shock to global bond yields, while the upper bound corresponds to a 100 percent pass-through rates, or a 100 basis points shock to global bond yields). In the median case, global bond yields increase initially by 70 basis point, which corresponds to the observed pass-through rate during the taper tantrum.

C, D. Figures show the fraction of 86 emerging and developing countries that experienced a sudden stop. The methodology used to identify sudden stop episodes at the individual country level is based on Forbes and Warnock (2012), with the threshold being defined as a decline in flows larger than one (or two) standard deviation(s) around a five-year rolling mean. Blue bars show the taper tantrum period of May-June 2013.

- *Differentiation depending on asset classes.* The differentiation by fundamentals, financial market size, and policies was particularly pronounced for certain types of capital outflows. For example, cross-border bank flows to a number of emerging market economies—especially in Latin America—with sizable U.S. dollar-denominated liabilities fell especially sharply during the taper tantrum (Avdijev and Takats 2014; García-Lunaa and van Rixtel 2014). In contrast, FDI flows were broadly stable

FIGURE SF1.8 Growth prospects in emerging and developing economies

Since the taper tantrum in May-June 2013, growth prospects of emerging markets have deteriorated and credit ratings have worsened.



Source: Haver, World Bank estimates.

B. Unweighted average of 120 developing-country institutional investor ratings. Ratings are based on information provided by sovereign-risk analysts at global banks and money management and securities firms. The countries are graded on a scale of zero to 100, with 100 representing the least likelihood of default. Ratings are reported in percent of the United States' score. The blue line shows the taper tantrum period in 2013H2.

C. GDP-weighted annual averages. DEV = developing-country average; EAP = East Asia and Pacific; ECA = Europe and Central Asia; LAC = Latin America and the Caribbean; MNA = Middle East and North Africa; SAR = South Asia; SSA = Sub-Saharan Africa.

D. For each year, the fraction of developing countries in which growth is slower than its historical average for 1990-2008. For 2015-17, the average of three years is shown.

(Basu, Eichengreen, and Gupta 2014), and drops in equity market valuations were more uniform across countries (Mishra et al. 2014; Rai and Suchanek 2014).

Lessons from the taper tantrum episode are consistent with those from the broader literature on sudden stops in capital inflows. Country-specific vulnerabilities not only increase the probability of a sudden stop, but also intensify its severity in terms of currency depreciation, private sector credit contraction, and growth declines, and lengthen the time it takes for growth to revert to its long-term trend (see also Table SF1.1). A greater reliance on FDI and equity flows instead of debt flows and cross-border bank loans may reduce the severity of sudden stop episodes (Levchenko and Mauro 2007).

How Have Growth Prospects and Vulnerabilities in Emerging Markets Changed since the Taper Tantrum?

Country-specific “pull” factors, including macroeconomic fundamentals and policies, play an important role in determining the direction and magnitude of capital flows. Since the taper tantrum, macroeconomic fundamentals in several emerging markets have weakened, and as a result, their credit ratings have on average deteriorated (Figure SF1.8).

Growth prospects have dimmed for emerging markets over the past five years. Specifically, growth in emerging markets has slowed steadily since 2010 and has repeatedly fallen short of expectations, including in 2015. Investment growth in emerging markets has slowed from pre-crisis rates (Chapter 1), and it might be further held back by the upcoming tightening in global financial conditions. Export growth is expected to remain on its weak post-crisis trend (World Bank 2015).

Although, on average, emerging markets' macroeconomic and financial vulnerabilities appear manageable, weak growth could reduce their resilience over time (Figure SF1.9). Government debt levels are, on average, moderate around 45 percent of GDP.¹⁹ Fiscal deficits, while larger than in 2007, amount to about 4 percent of GDP but are expected to narrow in oil-importing countries as a result of declining expenditures on fuel subsidies following last year's significant drop in oil prices. In oil-importing countries, inflation has fallen, allowing central banks in some countries to reduce monetary policy rates to support growth. In contrast, fiscal and monetary policy room has shrunk in oil-exporting countries as oil revenue shortfalls weakened fiscal balances (although, on average, from near-balance) and depreciation pressures reduced reserves (although typically from ample levels) or raised inflation.

¹⁹In frontier markets, however, government debt has increased since the global financial crisis, partly reflecting a rapid increase in bond issuance in global capital markets (although from low levels). In some frontier markets, rising government debt has been accompanied by rapidly growing private sector credit (World Bank 2015).

However, these averages mask considerable differences across countries (Figure SF1.10).²⁰

- While there has been an improvement in current account balances among oil-importing economies, deficits remain elevated for several of them. Foreign reserves have increased, but for some countries only modestly, and came under pressure in some oil-exporting countries in early 2015.
- Inflation has moderated for some oil-importing countries, but is still at or above formal or informal inflation targets in several of them.
- Private debt has edged up despite slower credit growth in some countries. Public debt has increased in some emerging markets and primary balances have deteriorated, particularly among commodity exporters.
- Given the pre-eminent role of the U.S. dollar as the currency denomination of cross-border debt, a dollar appreciation constitutes a tightening of global financial conditions and could heighten risks associated with liability exposures and dollar shortages (Borio 2014).²¹ Foreign currency exposures are elevated, especially in several commodity exporters and frontier and emerging markets that have received large capital inflows since the crisis (Figure SF1.11).

Despite the general lack of major progress, there are individual countries that have succeeded in reducing some of their vulnerabilities. For example, Indian financial markets fell sharply during the taper tantrum, amid macroeconomic conditions that had weakened in prior years and had left it vulnerable to capital outflows (Basu, Eichengreen, and Gupta 2014). The Indian economy has since shown notable improvement, particularly in reducing its high current account deficit and inflation.

For those countries with significant vulnerabilities, financial market volatility around the liftoff or in the subsequent tightening cycle could potentially combine

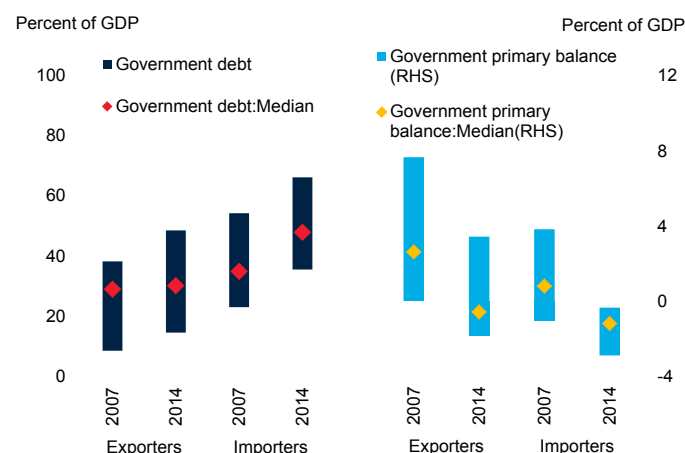
²⁰In addition to individual indicators of emerging market vulnerabilities, a number of aggregate indicators have been developed, such as the index of emerging market vulnerabilities used in the Federal Reserve Board's Monetary Policy Report in February 2014, the heat map index of external vulnerabilities computed by the Institute of International Finance (2015), or Santacreu (2015). While summary indicators are useful to illustrate the evolution of aggregate vulnerabilities over time, they tend to blur differences in sources of vulnerabilities.

²¹Schularick and Taylor (2012) and Bruno and Shin (2013) highlight how currency developments interact with the role of leverage in complex ways in building financial vulnerabilities.

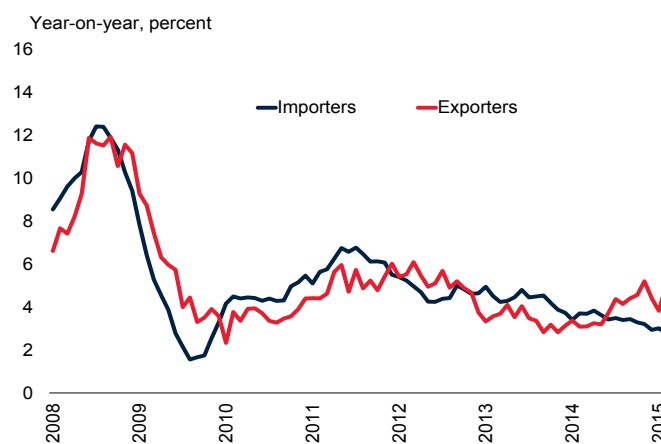
FIGURE SF1.9 Debt, deficits and inflation in emerging markets: Oil exporters vs. oil importers

Fiscal positions in emerging markets have deteriorated since the crisis, but debt and deficits remain, on average, moderate. Inflation has declined in oil-importing countries, partly as a result of low oil prices.

A. General government debt and balance



B. Median inflation



Source: World Bank, International Monetary Fund, Haver Analytics.

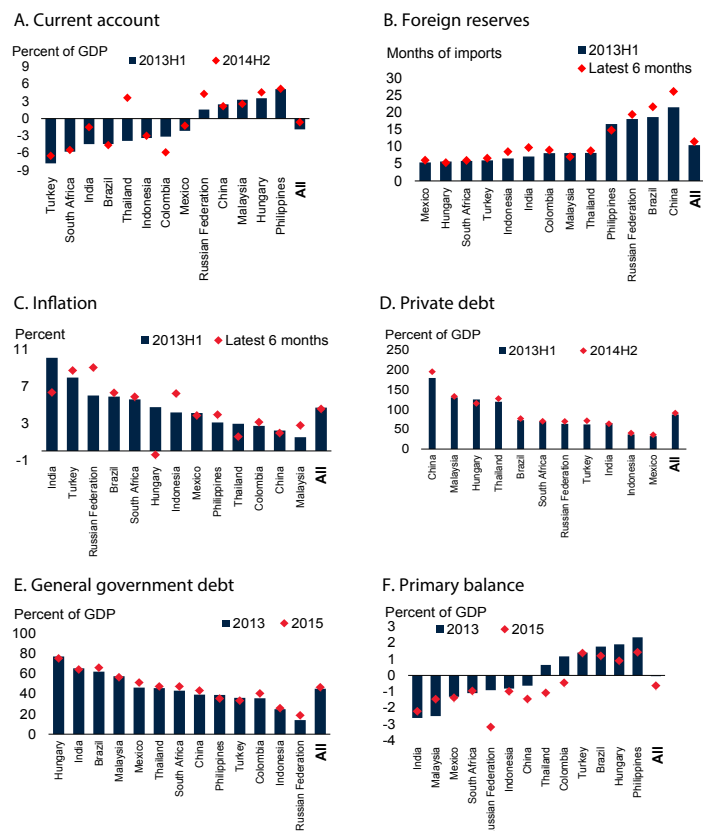
A. Bar illustrates interquartile range for developing countries. Dot shows median for developing countries.

B. For developing countries. Hydrocarbon exporters (as proxy for oil exporters) are Algeria, Angola, Argentina, Azerbaijan, Cameroon, Côte d'Ivoire, Colombia, Chad, Ecuador, Gabon, Indonesia, the Islamic Republic of Iran, Iraq, Kazakhstan, Libya, Malaysia, Mexico, Nigeria, Papua New Guinea, South Africa, Sudan, Turkmenistan, Uzbekistan, República Bolivariana de Venezuela, Vietnam, and the Republic of Yemen.

with other domestic pressures (for example, a large current account deficit, uncertainty about policy direction, or significant deterioration of growth prospects) into a perfect storm that leads to a sudden stop. An abrupt change in risk appetite for emerging market assets could lead to contagion effects affecting capital flows in countries that are highly integrated in international capital markets. Such contagion may take place even if the affected countries have limited domestic vulnerabilities (Calvo and Reinhart 1996; Kaminsky 2008). For example, investor confidence could be dented by uncertainty about policy direction or deteriorating growth

FIGURE SF1.10 Evolution of vulnerabilities in emerging markets since the taper tantrum

Although, on average, current account balances have improved and reserve coverage increased (partly as a result of lower oil prices), there has been wide variation across countries. Private debt and inflation have, on average, increased and fiscal positions have deteriorated.



Source: Bank for International Settlements, Haver Analytics, World Bank, IMF.

A. "All" refers to the un-weighted average among all listed countries.

B. Foreign reserves include gold.

C. Inflation is the 6-month average of the annual average consumer price inflation.

D. Private debt is defined as the sum of private non-financial sector debt and household debt.

F. Primary balance excludes net interest payments.

prospects. This could turn a manageable slowdown in capital inflows as part of a broader emerging market retrenchment around the liftoff into a sudden stop in inflows and translate into a sharp decline in activity. Even countries that are not directly exposed to global financial market shocks could be affected through intraregional spillovers from their larger, financially more integrated neighbors. Whereas within-regional financial exposures often tend to be limited, trade, remittance, and direct investment links are strong in some regions.²²

²²In some cases, official financing could be an additional channel for transmission of fiscal stress (e.g., from República Bolivariana de Venezuela through the PetroCaribe arrangement or from Gulf Cooperation Council countries to countries in the Middle East and North Africa through budget support; IMF 2014b). There can also be strong contagion effects from intraregional volatility of capital flows (Lee, Park, and Byun 2013).

What Policy Options Are Available to Prepare for Risks around Liftoff?

Emerging market policy makers have several options to prepare for the risks associated with the coming tightening cycle. Foremost among them are the adoption of policies that reduce vulnerabilities and the proactive pursuit of structural reform agendas that improve growth prospects.

- Monetary and financial policies.* In several oil-importing countries, inflation is running at or near the top of formal or informal target bands. For central banks in these countries, buttressing monetary policy credibility may be a priority. Elsewhere, for example in oil-exporting countries where growth has softened but inflation has been driven up by depreciation, banks with high foreign currency vulnerabilities or heavy reliance on short-term debt may merit close monitoring or tighter prudential requirements.
- Fiscal policy.* Although emerging market sovereign debt is significantly less than in the early 2000s, fiscal deficits widened rapidly in the aftermath of the global financial crisis and have yet to return to pre-crisis levels. Over the medium-term, several emerging markets need to improve their fiscal positions (World Bank 2015). Many oil-exporting countries are already tightening fiscal policy, even as growth slows. Although this exacerbates growth slowdowns, it will help preserve buffers that could be used if risks around the liftoff materialize. Oil-importing countries that benefit from savings on lower energy subsidies or higher energy taxes could seize the opportunity to build fiscal buffers to regain policy space for effective fiscal stimulus that may be needed in the future.
- Structural reforms.* Given the limited room for fiscal and monetary policy adjustment to reduce vulnerabilities, the proactive pursuit of structural reforms that improve long-term growth prospects are an integral part of preparing for the liftoff. Although the benefits of reforms take time to materialize, decisive moves to implement ambitious reform agendas signal to investors that growth prospects are improving (Kose et al. 2010). In investors' differentiated views, this could make the difference between capital

outflows and inflows. In addition to raising long-term growth, some reforms—especially those requiring investment in infrastructure projects—can support cyclically weak demand.

Should risks around the liftoff materialize, emerging markets need to resort to policy measures to alleviate short-term financial stress. These include, most importantly, exchange rate flexibility, targeted measures to ensure market functioning, and measures to restore confidence. Many of these measures appeared to help countries effectively respond to the taper tantrum (World Bank 2014a).²³

- *Exchange rate flexibility.* In a significant difference to the 1990s, most emerging markets now maintain flexible exchange rate regimes. Allowing exchange rates to adjust will be an important buffer to external shocks in many emerging markets with limited currency mismatches on corporate and household balance sheets and credible macroeconomic policies (Davies et al. 2014).
- *Interest rate increases.* Emerging markets concerned about the balance sheet effects of sizable depreciations may wish to raise monetary policy interest rates to stem depreciations. This has been done, to varying degrees, in past U.S. tightening episodes (Chapter 1). The effectiveness of an interest rate hike in stemming depreciation pressures rests on the credibility of the monetary policy framework (Eichengreen and Rose 2003).
- *Targeted support measures.* If financial stress threatens financial stability, for example because of large foreign currency liabilities, intervention in foreign currency markets through the use of international reserve or swap market operations may be necessary. Liquidity provision in local capital markets may be required to preserve orderly market conditions. The removal of capital inflow restrictions or—as a complement to sound macroeconomic policies, financial supervision and regulation, and strong institutions—the imposition of temporary controls on certain outflows might temper net outflows (IMF 2014d).

FIGURE SF1.11 Foreign currency exposure and corporate debt

Foreign currency exposures in a number of emerging markets remain high, rendering them vulnerable to sharp movements in their currencies. Corporate debt has also increased in many countries.



Source: Bank for International Settlements, Moody's, World Bank.
 A. Foreign currency exposure is measured as the ratio of total foreign currency deposits in the domestic banking system to total deposits in the domestic banking system. Latest available data for 2013.
 B. GDP-weighted average. List of emerging markets includes China, Czech Republic, Hungary, India, Indonesia, Mexico, Poland, South Africa, Thailand, and Turkey.
 C. The 2007 data of South Africa's corporate debt is not available and thus replaced by 2008Q1 data.

- *Measures to restore confidence.* Reforms to improve the credibility of monetary, fiscal, and regulatory policies through changes in the governance of associated policy institutions may

²³A rich literature examines policy responses to financial stress and emphasizes various tradeoffs (Frankel and Wei 2004; Claessens et al. 2014; Forbes and Klein 2015).

help convince investors of a commitment to sustainable macroeconomic and financial policies. Credible commitments to structural reforms could enhance investors' perceptions of long-term growth prospects.

International policy coordination could potentially help limit the risks of financial turmoil around liftoff and, if they materialize, help emerging market countries navigate them, and, in turn, avoid spillbacks to advanced countries (Sahay et al. 2014). Policy coordination could range from heightened efforts by advanced country central banks to engage in clear and effective communication to the internalization by central banks of the spillover effects of their policies, although the latter may be difficult to operationalize (Rajan 2014).²⁴ More broadly speaking, there may be scope for enhanced global and regional safety nets, including through multilateral institutions and regional risk-sharing arrangements, to support emerging markets during periods of financial stress (Carstens 2015).

Conclusion

As the Fed readies for its first policy rate hike after almost a decade, financial conditions are on the cusp of becoming more challenging for emerging market countries. Most likely, the liftoff will proceed smoothly given that the U.S. recovery appears well entrenched and financial markets are being bolstered by highly accommodative monetary policies in other major advanced countries. If the liftoff takes place in line with market expectations, U.S. long-term yields will likely remain well contained, the term premium will remain narrow, and movements in capital flows to emerging countries will be modest.

However, as evidenced during the taper tantrum episode, there is a risk that if market expectations adjust in a disorderly fashion, financial market volatility could spill over to emerging markets. Specifically, low U.S. term premia, diverging views between markets and Fed policy makers about the future path of interest rates, and chang-

ing conditions in market liquidity all heighten risks to U.S. financial markets. If the risks around the liftoff and subsequent tightening steps materialize, U.S. interest rates could increase sharply. This could in turn lead to greater financial market volatility and could significantly reduce capital flows to emerging market countries.

Emerging markets have become more resilient since the early 2000s: fewer have fixed exchange rates; most have sounder fiscal positions and better monetary policy frameworks; and the extent of liability dollarization has declined (Kose and Prasad 2010; Davies et al. 2014). Nevertheless, the taper tantrum is a reminder that emerging market currencies could depreciate sharply, local borrowing costs rise steeply, and balance sheets come under pressure.

During the taper tantrum episode, a jump in U.S. long-term interest rates led, initially, to financial stress across the entire spectrum of emerging market assets. Over time, differentiation among countries increased based on country-specific vulnerabilities, policies, and growth prospects. Since the episode, growth prospects have weakened and vulnerabilities remain in some emerging market countries, heightening the risks of another similar shock. Unless appropriate policy measures are in place, the sudden realization of risks around the liftoff could potentially spark a "perfect storm" in some emerging market economies, in particular those that need to adjust to the prospects of persistently low commodity prices and tighter financial conditions, or that face domestic policy uncertainty against the backdrop of lingering vulnerabilities and weaker growth.

In anticipation of the risks surrounding the liftoff, emerging market countries should prioritize monetary and fiscal policies that reduce vulnerabilities and strengthen policy credibility, and structural policy agendas that improve growth prospects. In the event that risks materialize, exchange rate flexibility could buffer shocks in some countries but may need to be complemented by monetary policy measures and targeted interventions to support orderly market functioning. International policy coordination could reduce the likelihood that these risks materialize and could alleviate their impact on emerging markets. While emerging economies may hope for the best from the eventual liftoff of the U.S. policy rates, they need to prepare for the worst.

²⁴An example of coordination is the introduction of liquidity swap lines by the Fed to other (mostly advanced country) central banks in the 2008–09 global financial crisis (Fischer 2014). Dudley (2014) presents a discussion of the impact of U.S. monetary policies on emerging economies and summary of policy lessons from the taper tantrum.

BOX SF1.1 Econometric analysis of U.S. yields and spillovers

This box briefly describes the main features of the three econometric models used to analyze the role of monetary and real shocks in explaining movements in U.S. yields, the spillovers of such shocks for emerging markets, and the impact of a sudden increase in U.S. yields on capital flows to emerging market and developing countries.

Contribution of monetary and real shocks to U.S. long-term yields

To analyze the drivers of moves in U.S. yields, the first econometric model uses a structural vector autoregression (SVAR) framework with sign restrictions to decompose daily movements in yields during January 2013–March 2015 into two components: one reflecting real U.S. growth shocks and another reflecting U.S. monetary shocks.^a The SVAR follows a similar approach as Matheson and Stavrev (2014) and the International Monetary Fund (2014b) based on three U.S. variables: long-term interest rates, stock prices, and the nominal effective exchange rate.^b For reasons of data availability, other economic data (e.g. inflation expectations) that may also be important drivers of the long-term interest rate are excluded from the model. The sign restrictions assume that an adverse “monetary” shock (such as an unexpected real or perceived policy tightening) increases yields and reduces stock prices in the United States, while a favorable “real” shock (such as reflecting better growth prospects) increases both yields and stock prices.^c The shocks identified using these restrictions naturally reflect market perceptions of monetary policy and growth.

Spillovers from U.S. monetary and real shocks to activity and financial markets

To assess the spillovers from the shocks driving U.S. yields on emerging markets, a panel VAR model is estimated for emerging market country variables, with monetary and real shocks (estimated as in the above

model) as exogenous regressors. The panel VAR includes six variables for emerging markets: long-term bond yields, stock prices, nominal effective exchange rates, bilateral exchange rate with the dollar, industrial production, and inflation. The list of countries is: Argentina, Brazil, Chile, Colombia, the Czech Republic, Israel, Mexico, Poland, South Africa, Turkey, India, Indonesia, the Russian Federation, China, the Republic of Korea, Malaysia, the Philippines, Saudi Arabia, and Thailand.^d All data are monthly or monthly averages of daily data for January 2013–March 2015. Spillovers are then evaluated by tracing out the impulse responses of these variables due to adverse monetary U.S. shocks and favorable U.S. real shocks. The size of the U.S. shocks is normalized such that developing-country bond yields increase by 100 basis points on impact.

Spillovers from U.S. financial conditions to capital flows

The effects of moves in U.S. yields on aggregate capital inflows to emerging markets and developing countries are modeled using a VAR model, based on Lim, Mohapatra, and Stocker (2014). This model links quarterly aggregate capital inflows (including foreign direct investment, portfolio investment, and other investment) to 86 emerging and developing countries (from BPM6 balance of payment data, expressed in percent of gross domestic product [GDP]) to real GDP growth in both emerging market and developing countries and G-4 countries (the United States, the Euro Area, Japan, and the United Kingdom), G-4 short-term interest rates (GDP-weighted average of three month money market rates for G-4 countries), G-4 long-term interest rates (GDP-weighted average of 10-year government bond yields for G-4 countries), and the VIX index of implied volatility of S&P 500 options. This captures the response of capital flows to external shocks, and their propagation through global uncertainty and growth effects. The feedback between global interest rates and investors’ risk appetite is captured by incorporating in the model the VIX index of implied stock market volatility, which is often used as proxy of risk aversion and deleveraging pressures (Adrian and Shin 2010 and 2012), with significant repercussions for capital flows to

^aDaily (rather than monthly) data is used to ensure that U.S. shocks, in particular monetary shocks that reflect Fed announcements, and their near immediate effects on stock prices are well identified.

^bThe nominal effective exchange rate is added on technical grounds, to ensure that the two identified shocks are orthogonal while also ensuring that the sign restrictions are satisfied. The results are broadly in line with Matheson and Stavrev (2014) who leave out a third variable.

^cSign restrictions are imposed on stock prices and yields. Responses of exchange rates are unrestricted and turn out to be statistically insignificant.

^dTo avoid spurious results, the sample is restricted to large emerging markets that are highly integrated into global financial markets.

BOX SF1.1 (continued)

developing countries (Rey 2013; Bruno and Shin 2013; Forbes and Warnock 2012).

To compute impulse responses, the covariance matrix is derived from a Cholesky decomposition. The Cholesky decomposition is based on the following order of variables (from least to most “endogenous”): G-4 GDP growth, emerging markets’ GDP growth, G-4 short-term rates, G-4 long-term rates, VIX, and capital inflows to emerging markets. Overall, the impact of a 25 basis-points (one standard deviation) shock in long-term interest rate across G-4 economies is estimated to reduce aggregate capital flows to emerging and developing countries by 0.45 percent of their combined GDP (10 percent drop in flows), with the effect peaking after 4

quarters and remaining significant at a 90 percent confidence interval up to 6 quarters.

For robustness, a similar VAR model was computed for portfolio flows (balance of payment data), with the impact of an interest rate shock estimated to be of similar magnitude, but peaking earlier and with wider confidence intervals given greater volatility in quarterly portfolio flows. A 100 basis-point shock to the U.S. term spread is applied to the model, assuming a range of pass-through effects on Euro Area, U.K., and Japanese long-term yields (from zero to 100 percent). In the median case, global bond yields increase by 70 basis points on impact, roughly comparable to the pass-through rate observed during the taper tantrum.

TABLE SF1.1 Studies on the effects of sudden stops

Authors	Country/data	Methodology	Objectives and results
Becker and Mauro (2006)	167 countries/annual, 1970–2001	Event study; multivariate probit	<p>“Expected” output cost of sudden stops, based on conditional and unconditional probability of sudden stop.</p> <ul style="list-style-type: none"> • Cost of sudden stops on median output growth is 1.5% per year for emerging markets. • Cost of sudden stops are not significant for developing economies
Bordo, Cavallo and Meissner (2010)	20 emerging markets/annual, 1880–1913	Panel treatment regression	<p>Impact of sudden stops on trend growth and output gap.</p> <ul style="list-style-type: none"> • Sudden stops associated with financial crises widen the output gap, but not trend growth. Growth appears to resume quickly. • Sudden stops not accompanied by financial crises reduce trend growth.
Calderón and Kubota (2013)	99 countries/quarterly, 1975–2010	Event study	<p>Probability of inflow- versus outflow-driven sudden stops and their effects on output and credit.</p> <ul style="list-style-type: none"> • Negative effects of capital outflows-driven shocks are less than those of inflows-driven shocks.
Calvo, Izquierdo and Mejía (2004)	32 developed and emerging economies/quarterly and annual, 1990–2001	Event study; panel probit	<p>Effects of current account reversals on growth and real exchange rate.</p> <ul style="list-style-type: none"> • Sudden stops in emerging markets are accompanied by large real exchange rate devaluations. • However, the same is not the case in developed countries.
Calvo, Izquierdo and Mejía (2008)	110 countries/annual, 1990–2004	Event study; probit panel regressions	<p>Characteristics and probability of systemic sudden stops.</p> <ul style="list-style-type: none"> • They are accompanied by large real exchange rate fluctuations. • They occur in different countries at the same time, suggesting external shocks as causes. • High leverage of tradables absorption and high domestic liability dollarization increases the probability of these events.
Calvo and Reinhart (2000)	Non-empirical policy analysis	Case study; event study	<p>Effects of sudden stops in real economy and policy analysis.</p> <ul style="list-style-type: none"> • Sudden stops cause output losses and real exchange rate devaluation via (a) drop in aggregate demand due to nominal rigidities (Keynesian channel), and (b) an increase in non-performing loans due to decrease in the relative price of non-tradables and a surge in ex-post interest rate faced by domestic producers (Fisherian channel). • (Partial) dollarization and higher short-term flows increase costs by increasing non-performing loans. • Sudden stops likely trigger banking crises (but not necessarily currency crises). • Flexible exchange rates help by avoiding compression in non-tradables prices. • Full dollarization recommended by authors.
Caner, Koehler-Geib and Vincelette (2009)	43 developed and developing countries/annual, 1993–2006s	Panel regression	<p>Effect of sudden stops on GDP growth.</p> <ul style="list-style-type: none"> • Following sudden stops, GDP growth falls by 4-5 percent.
Catao (2007)	16 countries/annual, 1870–1913	Case study; event study; panel regressions	<p>Link between sudden stops and currency crashes.</p> <ul style="list-style-type: none"> • Not all sudden stops triggered depreciations or currency crises. • Interesting results because of the time period, during which countries in sample were pegged to gold and international spreads were much lower than in the past few decades. • Currency crashes were likely not the result of external factors but domestic frictions, like lobbying linked to the export sector.
Cavallo et al. (2015)	63 developing and developed countries/quarterly, 1980–2012	Event-based, time series regression; pooled regression	<p>Changes in GDP and real effective exchange rates in the 10 quarters before and after sudden stop.</p> <ul style="list-style-type: none"> • Differentiation between sudden stops in net inflows, gross inflows, gross outflows, and combinations. • Sudden stops in net flows that coincide with sharp reductions in gross inflows are associated with larger drops in output compared to those that coincide with sharp declines in gross outflows. • The effects of sudden stops on real exchange rates are not robust.

TABLE SF1.1 Studies on the effects of sudden stops (continued)

Authors	Country/data	Methodology	Objectives and results
Cowan and Raddatz (2013)	45 developed and developing countries/annual, 1975–2003	Panel (cross-industry, cross-country) regression	Impact of sudden stops on industrial production. <ul style="list-style-type: none"> • For average industry, industrial production declines 5%. • Production in industries that depend on external finance declines by more, especially in less developed economies. • Contractions are larger in industries with small comparative advantage. • The contraction after sudden stops is largest for industries that produce durable goods, especially in less financially-developed countries. This suggests that financial frictions due to sudden stops affect the observed cyclical behavior of durable goods. • High international reserves reduce production contractions. • Expansionary monetary policy dampens the impact of sudden stops in industry production in emerging and less financially-developed economies.
Edwards (2004)	157 countries/annual, 1970–2001	Simultaneous regression	Probability of current account reversal and effects of current account reversal on growth. <ul style="list-style-type: none"> • Current account reversals are closely related to sudden stops. • Current reversals reduce GDP growth by 1.8–5.1%. • Effects depend on trade openness and exchange rate regime.
Gallego and Tessada (2012)	Brazil, Chile, Colombia, Mexico/annual, 1978–2001	Panel (cross-sector, cross-country) regression	Impact of sudden stops on job creation and destruction. <ul style="list-style-type: none"> • After sudden stops, job creation tends to decrease more in sectors dependent on external finance. • After sudden stops, job destruction is higher in sectors with greater liquidity needs.
Guidotti, Sturzenegger and Villar (2004)	122 countries/annual, 1974–2002	Event study	Impact of sudden stops on GDP deviation from trend depending on current account adjustment. <ul style="list-style-type: none"> • Current account adjustment of more than 2 percentage points of GDP is associated with GDP falling 1.8% below trend. • Current account adjustment of less than 2 percentage points of GDP is associated with GDP falling 0.8% below trend
Hutchison and Noy (2006)	24 emerging markets/annual, 1975–1997	Panel regression	Investigates the effect of crises/sudden stops on GDP growth. <ul style="list-style-type: none"> • It includes currency and sudden stop dummies on growth regressions. • Sudden stops are associated with 6–8% decrease in GDP growth. • The effects are short-lived and disappear after the second year.
Hutchison, Noy, and Wang (2010)	66 emerging developing economies/annual, 1980–2003	Panel regression	Output costs of sudden stops depending on monetary and fiscal policy. <ul style="list-style-type: none"> • Monetary and fiscal policy tightening during sudden stops exacerbates output losses (deviation of output from trend). • Discretionary fiscal policy is associated with lower output costs (deviation in output from trend), whereas expansionary monetary policy has no effect.
Ortiz et al. (2009)	31 emerging markets/quarterly, 1990–2006	Event study; cross-country regression	Costs of systemic sudden stops and fiscal/monetary policy <ul style="list-style-type: none"> • Output falls 7.2% on average from peak to trough. • Significant variation in output change across country-episodes (lowest: –20%; highest: +6.6%) and fiscal and monetary response. • Countries that tightened monetary and fiscal policy during sudden stops experience larger contractions in output.
Rothenberg and Warnock (2011)	24 Emerging Markets/quarterly, 1989–2005	Event study	Impact of sudden stop on GDP growth and its components and quarter-on-quarter exchange rate movements against the U.S. dollar. <ul style="list-style-type: none"> • After a “true sudden stop” (drop in inflows is greater than drop in outflows), GDP growth falls sharply (even below zero in a couple of quarters); the exchange rate depreciates as much as 40%. • After a “sudden flight” (drop in outflows greater than drop in inflows), GDP growth falls (from 5–6% to 2–3%) but does not fall below zero; the exchange rate depreciates around 10%. • Investment and, to a lesser degree, imports are the most affected components of GDP.
Zhao et al. (2014)	85 countries/annual, 1980–2012	Event study; logit regressions	Impact of sudden stops on probability of currency crises. <ul style="list-style-type: none"> • Low trade openness, shallow financial markets and current account imbalances increase the probability that sudden stops will be followed by currency crises.

TABLE SF1.2 Studies on the implications of the taper tantrum

Authors	Country/data	Methodology	Objectives and results
Avdjiev and Takáts (2014)	Both industrial countries and emerging countries/quarterly	Linear regression: event study	<p>Drivers of cross-sectional variation in the slowdown of cross-border bank lending during the taper tantrum.</p> <ul style="list-style-type: none"> • The slowdown of cross-border bank lending during the taper tantrum depended on both the lender's banking system and the conditions of borrower emerging markets. • A rising credit default swap (CDS) spread in lender's banking system during the taper tantrum is associated with a more pronounced slowdown in cross-border bank lending. • A higher current account balance of a borrower emerging market is associated with a milder slowdown in cross-border bank lending during the tapering. • A higher share of cross-border bank lending denominated in U.S. dollars is associated with a more pronounced slowdown in cross-border bank lending.
Aizenman, Binici, and Hutchison (2014)	Emerging markets/daily	Panel regression	<p>Impact of announcements by senior Fed officials on financial markets in emerging economies.</p> <ul style="list-style-type: none"> • Emerging market asset prices respond most to statements from Fed Chairman Bernanke and much less to statements from other Fed officials. • Exchange rates (and, to a lesser extent, equity prices and CDS spreads) of a group of countries with solid macro fundamentals were initially more adversely affected by taper talk than those in the fragile group. This reflected greater financial market development. • However, the cumulative effects of taper talk after a month appear to be quite similar for both robust and fragile emerging markets. • More financially developed emerging economies (according to a classification based on the 2012 value of the World Economic Forum's Financial Development Index, which considers factors related to financial development, intermediation, and access to financial services) were more impacted by taper talk. A plausible interpretation is that more financially developed economies are more exposed, at least in the short term, to external news announcements.
Basu, Eichengreen, and Gupta (2014)	India/daily, weekly, and monthly	Case study; linear regression	<p>Response of Indian financial markets to taper talk.</p> <ul style="list-style-type: none"> • India was adversely impacted because it had received large capital flows in prior years and had large and liquid financial markets that were a convenient target for investors seeking to rebalance away from emerging markets. • India's macroeconomic conditions had weakened in prior years, which rendered the economy vulnerable to capital outflows and limited the policy room for maneuver. • These results suggest putting in place a medium-term policy framework that limits vulnerabilities in advance, while maximizing the policy space for responding to shocks. Elements of such a framework include a sound fiscal balance, sustainable current account deficit, and environment conducive to investment. • India should also continue to encourage stable longer-term capital flows and discourage volatile short-term flows, hold a larger stock of reserves, avoid excessive appreciation of the exchange rate through interventions with the use of reserves and macro prudential policy, and prepare banks and firms to handle greater exchange rate volatility.
Dahlhaus and Vasishtha (2014)	23 emerging countries/weekly and monthly	Vector auto-regression (VAR)	<p>Impact of U.S. monetary policy normalization on portfolio flows to major emerging market economies.</p> <ul style="list-style-type: none"> • A shock corresponding to an increase in spreads of 120 basis points (bps) is associated with a decline in aggregate capital flows to GDP by 0.5% on impact. • The cumulative effect of a policy normalization shock (an increase of 120 bps) on aggregate capital flows is -1.24 percent of GDP after 3 months. • The cumulative effect of a policy normalization shock (an increase of 120 bps) on aggregate capital flows is -1.83 percent of GDP after one year.

TABLE SF1.2 Studies on the implications of the taper tantrum (continued)

Authors	Country/data	Methodology	Objectives and results
Diez (2014)	49 emerging countries/ monthly	Case study; cross-country regression analysis	<p>Emerging markets' financial market responses to taper talk versus actual tapering.</p> <ul style="list-style-type: none"> Emerging markets generally experienced a significantly larger depreciation in nominal exchange rates during the taper talk period in the summer of 2013 than during the actual beginning of the taper period from December 2013 to January 2014. The average depreciation was 3% during the taper talk period, and 1.5% during the beginning of the actual taper period. Moreover, among those countries that experienced noticeable depreciation, the averages were 6.6 % during the taper talk period and 3% during the actual taper period. Current account deficits and real exchange rate appreciation were key factors in explaining the observed cross-country differences in adjustment across the various emerging markets. For seven emerging markets—Brazil, China, India, Indonesia, Russia, South Africa, and Turkey—12 variables are examined for early warning signals of a potential crisis period, defined as a sharp drop in the country's exchange rate and/or a sharp drop in its international reserves. No strong evidence predicting a crisis in the near future is reported.
Eichengreen and Gupta (2014)	53 emerging countries/ monthly	Cross-country linear regression	<p>Which countries were most affected by the taper talk and why.</p> <ul style="list-style-type: none"> Emerging markets that experienced real exchange rate appreciation and widening current account deficits during the prior period of quantitative easing saw the sharpest impact. A more important determinant of the differential impact was the size of country's financial market: countries with larger financial markets experienced more pressure on the exchange rate, foreign reserves, and equity prices. This is interpreted as showing that investors are better able to rebalance their portfolios when the target country has a relatively large and liquid financial market.
García-Luna and van Rixtel (2013)	Emerging countries/ quarterly	Case study; descriptive statistics	<p>Impact of taper talk on cross-border credit for emerging markets.</p> <ul style="list-style-type: none"> Cross-border credit to a large number of emerging market economies with sizable U.S. dollar-denominated liabilities fell in the second quarter of 2013. Latin American countries were most affected. The drop was largest for Brazil (with a ratio of U.S. dollar liabilities to exports of 99%), but was also quite sharp for Chile (50%), Mexico (20%), and Peru (50%). In other regions, cross-border credit to India and Russian Federation contracted as well. In contrast, cross-border credit to Turkey and several emerging Asian economies increased, most notably to Taiwan, China, and Indonesia.
Lavigne, Sarker, and Vasishtha (2014)	Emerging markets/weekly and quarterly	Case study; descriptive statistics	<p>Impact of measures related to U.S. quantitative easing (including taper talk) on capital flows.</p> <ul style="list-style-type: none"> Taper talk in 2013 had a disruptive impact on capital flows to emerging markets; however, after the initial impact subsided, there is some evidence that markets discriminated among countries according to fundamentals.
Lim, Mohapatra, and Stocker (2014)	60 developing countries/ quarterly	Vector autore- gression (VAR)	<p>Gross financial inflows to developing countries between 2000 and 2013, with a particular focus on the potential effects of quantitative easing policies.</p> <ul style="list-style-type: none"> In a scenario of normalization of unconventional monetary policy over the course of 2014–16, simulation results show that capital flows to developing countries could contract by 0.6 percentage point of GDP by the end of 2016.
Meinusch and Tillmann (2015)	United States/ daily (from Twitter)	Vector auto- regression (VAR)	<p>Extent to which changing expectations about the timing of the exit from quantitative easing impact asset prices.</p> <ul style="list-style-type: none"> Shocks to expectations of tapering affect interest rates, exchange rates, and asset prices. Given a positive shock to expectations of early tapering (proxied by a 5% increase of Twitter users foreseeing an early tapering), the long-term interest rate rises 3 bps at impact and peaks at 4 bps after 6 days.
Mishra et al. (2014)	21 emerging markets/daily	Linear regression, event study.	<p>Market reaction to taper talk and its relationship to economic fundamentals and financial structures.</p> <ul style="list-style-type: none"> Countries with stronger economic fundamentals, deeper financial markets, and a tighter macro prudential policy stance in the run-up to the tapering announcements experienced smaller currency depreciations and smaller increases in government bond yields. There was less cross-country differentiation in the response of stock markets based on fundamentals.

TABLE SF1.2 Studies on the implications of the taper tantrum (continued)

Authors	Country/data	Methodology	Objectives and results
Park and Um (2015)	Korea, Rep./daily	High-frequency event-study approach	<p>Effect of U.S. unconventional monetary policy (including tapering) on Korean bond markets.</p> <ul style="list-style-type: none"> • One-day increase of U.S. Treasury yields after the taper announcement were 9 bps for 5-year treasury yields and 6.7 bps for 20-year treasury yields. • Taper talk had no statistically significant impact on the Korea, Rep. bond yields. • Taper talk triggered capital outflows from Korea, Rep. For example, taper talk reduced Korea, Rep.'s foreign net investment by \$193 million.
Rai and Suchanek (2014)	19 emerging countries/ two-day window around Fed announcement dates	Case study; linear regression	<p>Impact of taper talk on financial markets and capital flows for 19 emerging markets.</p> <ul style="list-style-type: none"> • Emerging markets with strong fundamentals (e.g., stronger growth and current account position, lower debt, and higher growth in business confidence and productivity), experienced more favorable responses to Fed communications on tapering. • Initially, countries with less capital account openness experienced more favorable responses to tapering, but this result diminished in subsequent tapering announcements.
Sahay et al. (2014)	Emerging markets/daily, monthly, and quarterly	Case study; descriptive statistics	<p>Policy lessons from taper talk</p> <ul style="list-style-type: none"> • The Fed's monetary policy announcements were strongly correlated with movements in asset prices and capital inflows in emerging markets, with the effects being largest during the phase of unconventional monetary policy (post-2008) and when tapering was first discussed. • On impact, asset prices and capital flows were hit indiscriminately across countries, but over time there was greater differentiation among emerging markets. • Good macroeconomic fundamentals helped dampen market reactions to U.S. monetary policy shocks. Elevated current account deficits, high inflation, weak growth prospects, and relatively low reserves were important factors affecting market reaction. • Where vulnerabilities existed, emerging markets that acted early and decisively generally fared better. • Clear and effective communication by advanced-economy central banks concerning exit from unconventional monetary support is important to reduce the risk of excessive market volatility. The international community has an important role to play to safeguard global financial stability, such as efforts to cooperate with regional financial arrangements, enhance cross-border cooperation between central banks and regulators, and establish stronger global financial safety net, including through adequate IMF resources.

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