EXECUTIVE BOARD MEETING

EBS/21/14

March 5, 2021

To: Members of the Executive Board

From: The Secretary

Subject: **April 2021 World Economic Outlook—Analytical Chapter 4 and Online Annex**

Board Action:	Executive Directors' **consideration** (Formal)
Tentative Board Date:	**Thursday, March 25, 2021**
Publication:	Yes, it is intended that the full set of the World Economic Outlook documents will be released to the public at the time of the World Economic Outlook press conference, tentatively scheduled for **Tuesday, April 6, 2021**. The analytical chapters will be made available to the public on the IMF website in advance of the publication of the full document.
Questions:	Ms. Celasun, RES (ext. 34274) Mr. Piazza, RES (ext. 36526)
Additional Information:	The paper will be revised for publication in light of the Executive Board discussion. If Executive Directors have additional comments, they should notify Ms. Celasun and Mr. Piazza by **5:30 p.m. on Friday, March 19, 2021**.

CHAPTER 4

SHIFTING GEARS: MONETARY POLICY SPILLOVERS DURING THE RECOVERY FROM COVID-19

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CHAPTER 4

SHIFTING GEARS: MONETARY POLICY SPILLOVERS DURING THE RECOVERY FROM COVID-19

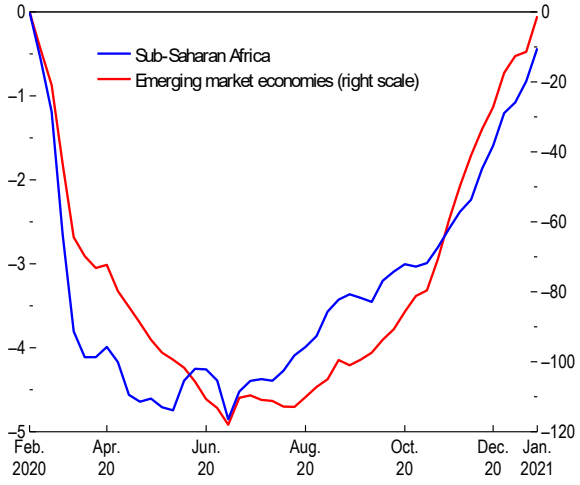
Advanced economies are expected to recover from the COVID-19 crisis faster than most emerging market economies, reflecting their earlier access to vaccinations and greater room to maintain supportive macroeconomic policies. Divergent economic recoveries could complicate the task of emerging market central banks should interest rates in advanced economies begin to rise when conditions in emerging market economies continue to warrant a loose monetary policy stance. The findings in this chapter confirm that monetary policy in advanced economies—especially in the United States—still has a large impact on financial conditions in emerging market economies. Aggressive policy easing by advanced economy central banks early in the pandemic thus provided much relief to financial markets in emerging market economies. Looking ahead to the recovery, clear guidance from advanced economy central banks on future scenarios for policy will be key to avoiding financial disruption to emerging markets. The analysis of the chapter suggests that whereas a monetary policy tightening resulting from a stronger-than-expected US economy tends to be relatively benign for most economies, a surprise tightening, which could reflect a change in the US Federal Reserve's expected reaction function, tends to curb global investor risk appetite and trigger capital outflows from emerging markets. The chapter's analysis also suggests that emerging market economies with lower fiscal vulnerability are more insulated from external financial shocks than others, and countries with more transparent and rules-based monetary and fiscal frameworks enjoy greater monetary policy autonomy.[1]

Introduction

At the end of February 2020, news of the global spread of COVID-19 hit financial markets with devastating force. One month later, global risk aversion had reached an intensity not observed since the peak of the global financial crisis, while capital flows began to cascade out of emerging market and developing economies (Figure 4.1).

Emerging market economies mounted a strongly countercyclical monetary policy response, on the heels of central banks in advanced economies, that cut policy rates wherever possible and introduced an array of asset purchase programs (APPs) to support credit markets (Figure 4.2–4.3).[2] The set of policy tools employed by central banks in

Figure 4.1. Cumulative Portfolio Flows
(Billions of dollars)

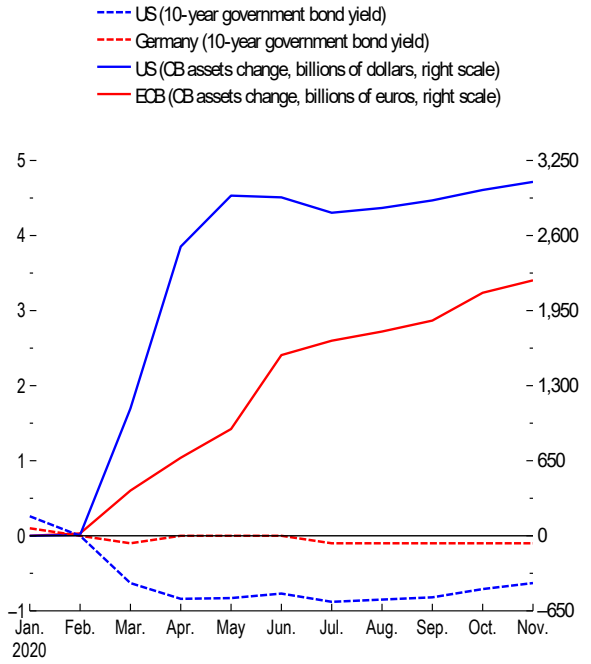


Sources: Bloomberg Finance, L.P.; and EPFR Global.
Note: Cumulative EPFR fund flows for sub-Saharan Africa comprise Ghana, Côte d'Ivoire, Kenya, Namibia, Nigeria, Rwanda, South Africa, and Zambia.

[1] This chapter was prepared by Philipp Engler, Roberto Piazza (team leader) and Galen Sher. It includes contributions from Chiara Fratto, Brendan Harnoys Vannier, Borislava Mircheva, David de Padua, and Hélène Poirson and was prepared with support from Ananta Dua, Chanpheng Fizzarotti, Eric Bang, Daniela Rojas Fernandez, and Ilse Peirtsegaele. The chapter benefited from insightful comments by Christopher Erceg and internal seminar participants. Refet Gürkaynak was a consultant for the project.
[2] This chapter largely focuses on financial conditions in emerging markets, defined as the *World Economic Outlook* Emerging Market and Developing Economy group, excluding countries in the Low Income and Developing Economy group. Only a limited number of countries in the latter group displays significant integration with global financial markets.

Figure 4.2. Monetary Policy in Advanced Economies

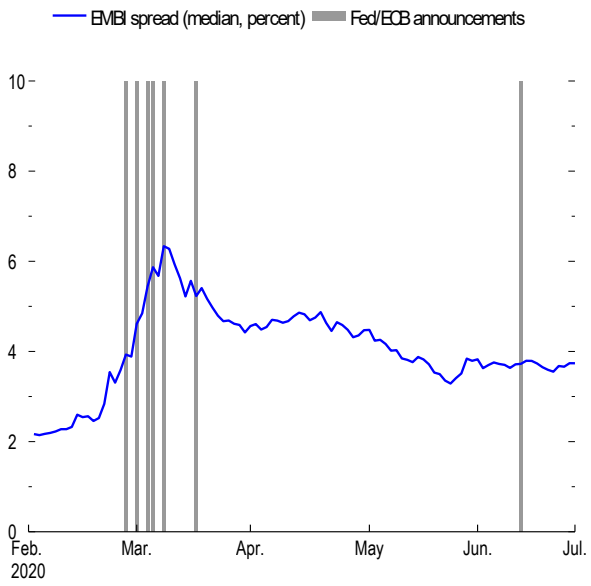
(Percent unless noted otherwise)



Sources: Federal Reserve Bank of St. Louis; and Haver Analytics.
Note: CB = central bank; ECB = European Central Bank.

Figure 4.3. Credit Risk Premiums in Emerging Market Economies

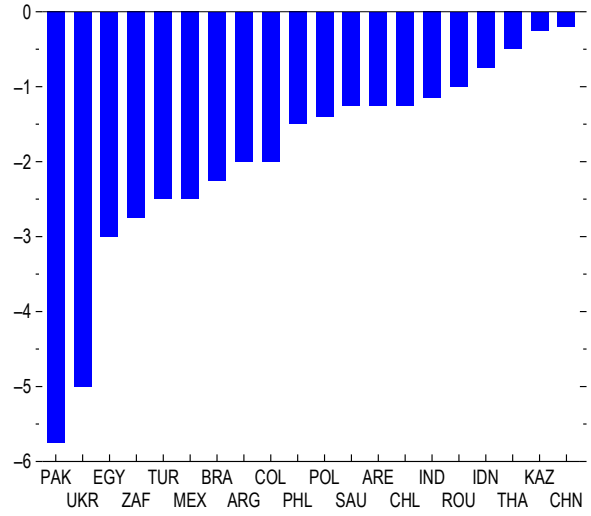
(Median, percent)



Source: Bloomberg Finance, L.P.
Note: ECB = European Central Bank; EMBI = J.P. Morgan Emerging market Bond Index; Fed = Federal Reserve.

Figure 4.4. Policy Rate Cuts in Emerging Market Economies between March and August 2020

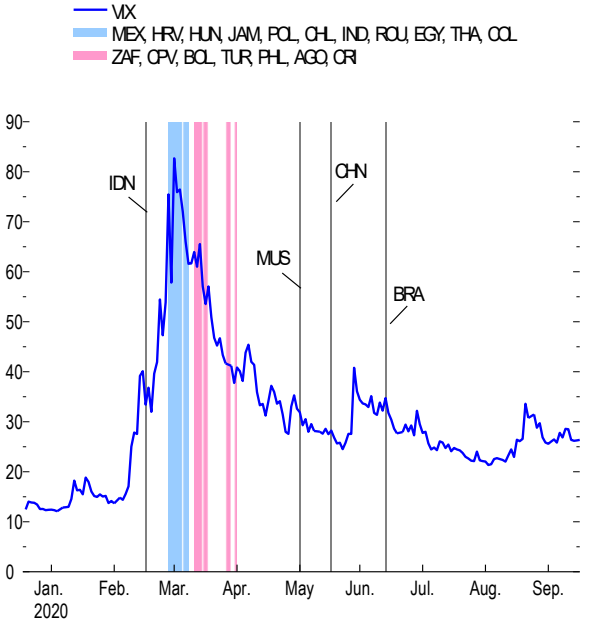
(Percent)



Source: IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

Figure 4.5. Asset Purchase Program Announcement Dates in Emerging Market Economies and the VIX

(Index)



Sources: Haver Analytics; and IMF staff calculations.
Note: VIX = Chicago Board Options Exchange Volatility Index. Data labels in the figure use International Organization for Standardization (ISO) country codes.

emerging markets was notably broad—including not only conventional policy rate cuts but also APPs in several economies (Figure 4.4–4.5).[3] Soon after these strong measures, sovereign default risk premiums in emerging markets began to recede.

Since the announcement of several successful COVID-19 vaccine trials in late 2020, the global economic outlook has improved, but remains vastly differentiated. Given a more backloaded access to vaccinations and less policy space to provide lifelines and support economic activity, many emerging market and developing economies are projected to have a more protracted recovery than major advanced economies. This scenario raises the possibility that policymakers in emerging markets might face different challenges than during the recovery from the global financial crisis, when their countries enjoyed relatively strong growth.

During a multispeed economic recovery many emerging markets might struggle to provide sizable fiscal policy support for a prolonged period, given their more constrained policy space (Vegh and Vuletin 2012)—and even more so following last year's sharp increase in public debt. Constrained fiscal policy, in turn, would heighten the role of monetary policy. This prompts the question of how much autonomy policy makers in emerging markets would have in keeping monetary policy rates low at a time when improved economic conditions may lead central banks in advanced economies to begin increasing interest rates. On this point, a commonly held view is that, even with a flexible exchange rate, emerging markets have little monetary policy autonomy against a powerful global financial cycle that is strongly influenced by monetary policy in advanced economies (Rey 2015).[4]

Several arguments temper the concerns about monetary policy in emerging markets during the global economic recovery. First, flexible exchange rates offer imperfect but still significant insulation from the global financial cycle (Obstfeld, Ostry, and Qureshi 2017), whose impact on capital flows may not be so dramatic after all (Cerutti, Claessens, and Rose 2019). Second, the commitment of central banks in advanced economies to maintain ample monetary accommodation until the recovery is well under way reduces the possibility of an early tightening in global financial conditions.[5] The commitment is exemplified in the United States by the Federal Reserve Board's new flexible inflation targeting framework. Third, aggressive monetary policy easing by emerging markets during the COVID-19 pandemic may indicate that these countries have gained further autonomy in setting their policies in line with domestic needs.

To provide a framework for thinking about the monetary policy challenges confronting emerging markets during the recovery, this chapter addresses the following questions:

- How do *monetary policy surprises* in advanced economies shape *financial conditions* in emerging markets? How has this influence changed over time, and how does it vary across countries?

[3] Fiscal expansions were also instrumental in containing the fallout from the crisis, but they are not examined here. While focused on monetary policy, this chapter explores various instances where fiscal policy matters for a country's sensitivity to international monetary policy spillovers and for the domestic monetary policy response to the pandemic.
[4] One consideration that can stop central banks in emerging markets from countering the global financial cycle is a "fear of floating" (Calvo and Reinhart 2002). In addition, financial frictions in emerging markets may limit the pass-through of monetary policy to domestic financial conditions (Kalemli-Ozcan 2019).
[5] The main measures of financial conditions in emerging markets presented in the chapter include yields on sovereign bonds denominated in local currency, spreads on dollar-denominated sovereign bonds, nominal exchange rates vis-à-vis the dollar and investment funds inflows.

- How does *economic news* in advanced economies affect *financial conditions* in emerging markets?
- Which *characteristics* of emerging markets are associated with greater ability to ease monetary policy at the onset of the pandemic? Are APPs *effective* in easing financial conditions in emerging markets?

The chapter includes two key streams of analysis. The first is a set of event studies that examines how monetary policy shifts in advanced economies affect financial conditions in emerging market and developing economies, leveraging two types of situations: (1) when a monetary policy announcement in advanced economies surprises markets because it does not appear directly attributed to observed changes in economic conditions—these surprises include a change in how central banks interpret data or react to it. And (2) when new information on the state of advanced economies changes market expectations of future monetary policy. The second stream of analysis looks at factors that could predict which emerging markets were able to provide greater monetary policy easing during the pandemic, focusing on both conventional policy rate cuts and APPs. The main findings of the chapter are:

- Monetary policy actions by the Federal Reserve have a significant influence on financial conditions in emerging markets, whereas spillovers from policies of the European Central Bank (ECB) are smaller and regional. As observed in the 2013 "taper tantrum" episode, signals of *unexpected* policy tightening in the United States raise emerging market yields, cause portfolio outflows, and depreciate emerging market currencies. The intensity of these effects is heterogenous over time and across countries: it seems to be stronger now than before the global financial crisis, and stronger for countries that are seen as riskier investments. This suggests that perceptions of risk (*risk channel*) are important in the transmission of the spillover. Notably, the change in domestic yields comes almost entirely from a change in the term premium, with an only marginal contribution from revised expectations of policy rates in emerging markets. Monetary easing by the Federal Reserve helped reduce yields in emerging markets by more than 100 basis points during the pandemic, and the announcement of central bank US dollar swap lines was effective in calming markets.
- The release of good news about the US economy, even as it is accompanied by expectations of tighter US monetary policy, is relatively benign for financial conditions in emerging markets. Following positive news about US employment, capital appears to flow into emerging markets, the Chicago Board Options Exchange Volatility Index (VIX) and risk premiums on emerging market dollar denominated bonds fall, while yields on emerging market domestic bonds tend to rise. This could be attributed in part to a positive *risk channel* (greater global risk appetite) and in part to a positive *trade channel*, where positive growth news in the United States is also associated with improved growth prospects in emerging markets, leading to higher expected monetary policy rates in emerging markets. Surprise increases in US inflation also lead to an increase in US nominal yields, but do not seem to impact financial conditions in emerging markets. Finally, positive news about the development of vaccines against COVID-19 in advanced economies has been particularly beneficial for emerging markets as their domestic yields did not increase, nor did their currencies depreciate.

- Domestic monetary and fiscal frameworks help predict the extent to which emerging markets were able to provide more monetary policy accommodation during the pandemic. Countries with more flexible exchange rates, more transparent central banks, and rule-based fiscal and monetary policy frameworks cut their policy rates by more and were also more likely to announce an APP—controlling for the state of the economy. Countries with the most constrained fiscal position had instead a smaller likelihood of an APP. In general, APPs appear to have been effective in calming domestic financial conditions.

Given the uniqueness of the present episode, any attempt to use past experience to extrapolate lessons for the future must be taken with caution. With this warning in mind, the findings of the chapter suggest that a multispeed global recovery, with growth picking up earlier in advanced economies, may not on its own lead to a premature tightening of global financial conditions in emerging markets. Assuming that inflation does not rise above target in a sustained manner, a quicker-than-expected resolution of the pandemic in advanced economies may drive strong capital inflows to emerging markets and frontier economies, especially if interest rates in advanced economies remain low. In this event, emerging markets could employ a variety of policy tools to curb the buildup of domestic financial risks (IMF 2020b).

If, with the recovery taking hold, central banks in advanced economies were instead to suddenly signal greater concern for inflation risks, then a surprise tightening of global financial conditions similar to the 2013 "taper tantrum" might occur. To reduce this risk, central banks in advanced economies need to continue providing markets with clear communication and guidance about their policies, including on new policy frameworks. In emerging markets, actions to improve confidence about the sustainability of medium-term debt can help reduce the sensitivity of domestic financial conditions to spillovers. Strengthening fiscal and monetary frameworks would also help create room for a more forceful countercyclical monetary policy.

Spillovers on Emerging Market Financial Conditions

This section uses event studies to answer two questions: How do financial conditions in emerging markets change following a *surprise monetary policy* announcement in advanced economies? How do financial conditions in emerging markets change following *surprises about the state of the economy* in advanced economies?[6] The two questions are complementary. The first considers changes in financial conditions that can be entirely traced to the spillover effect of an *unexpected* monetary policy announcement by central banks in advanced economies. The second considers changes in financial conditions that instead can be entirely attributed to news about economic conditions in advanced economies and to the attending implications for, among others, the *expected* reaction of monetary policy in advanced economies. This would be the case, for instance, of positive news about payrolls or the development of COVID-19 vaccines.

Regardless of the type of shock considered, spillovers from advanced economies on financial conditions in emerging markets operate through a variety of channels. The chapter gives prominence to two. The first is a "risk channel", where surprise monetary policy changes in

[6] In both exercises, the sample covers 60 emerging market economies, but country coverage is smaller for some indicators. For example, only 21 emerging market economies have data on government bond yields. The sample of low-income countries contains exchange rate data for 23 economies, but government bond yields for only 5 of them.

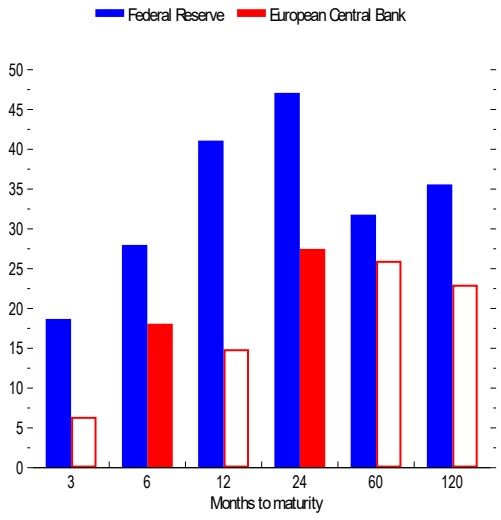
advanced economies affect perceptions of risk and thus financial conditions in emerging markets. The second is a "trade channel," where economic news in advanced economies changes economic conditions and investment opportunities in emerging markets. Monetary policy in emerging markets reacts to both types of changes, as discussed in the next section.

Spillovers from Monetary Policy Surprises in Advanced Economies

Analytical Framework

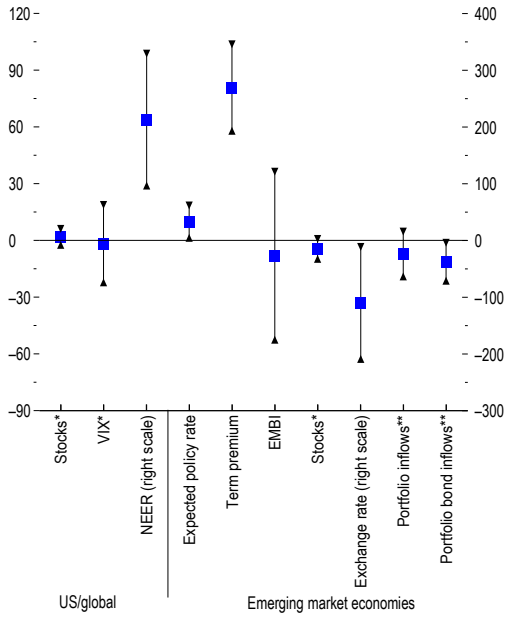
Monetary policy surprises in the United States and the euro area are defined as changes in the respective two-year government bond yields in a window of time around each monetary policy announcement. The choice of the two-year maturity follows Gertler and Karadi (2015) and Hanson and Stein (2015) and allows to capture the effects of forward guidance and asset purchases.[7] For the euro area, the two-year yield is constructed as a weighted average of the corresponding yields for Germany, France, Italy, and Spain. In the case of the Federal Reserve, the window covers the full announcement day, while for the ECB, it covers two hours around the ECB Governing Council's press releases and press conferences.[8] Spillovers from Federal

Figure 4.6. Change in Emerging Market Government Bond Yield Curves in Response to Monetary Policy Surprises
(Basis points)



Source: IMF staff calculations.
Note: The figure shows the two-day changes in emerging market local currency government bond yield curves in response to a 100 basis point surprise tightening of US or euro area monetary policy. Solid bars show maturities that are statistically significant; hollow bars show those that are not.

Figure 4.7. Effects of US Monetary Policy Surprises on Selected Variables
*(Basis points; * = percentage points; ** = basis points of annual GDP)*



Source: IMF staff calculations.
Note: The squares show the response of each variable to a 100 basis point surprise monetary policy tightening in the US. The whiskers show 90 percent confidence intervals. An increase in the nominal effective exchange rate (NEER) for the US, or in the nominal exchange rate vis-à-vis the US for the emerging market economies, denotes appreciation. EMBI = J.P. Morgan Emerging Bond Index; VIX = Chicago Board Options Exchange Volatility Index.

[7] For robustness to using yields of different maturity during zero lower bound periods, see Online Annex 4.1.
[8] For the United States, dates of official monetary policy statements were provided directly by the Federal Reserve Board. For the European Central Bank, the intraday monetary policy surprises were taken from the online dataset of Altavilla and others (2019) until April 2020, and merged with daily changes in yields for the remaining announcements in 2020. This produces 176 and 217 monetary policy surprises by the Federal Reserve and ECB respectively between 2000 and 2020. For more details on the econometric specification see Online Annex 4.1.

Reserve or ECB monetary policy announcements on emerging markets are measured as changes in various emerging market asset prices and financial indicators during the two-day windows around monetary policy announcements, which allows for differences in time zones.

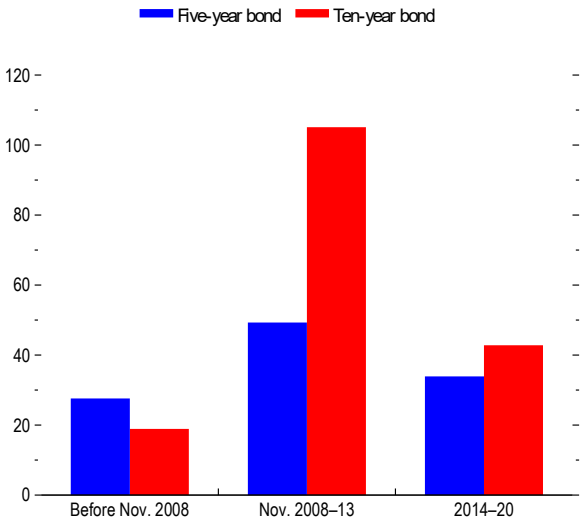
Impact on Emerging Markets

US monetary policy spills over strongly to domestic government bond yields in emerging markets, at all maturities (Figure 4.6). A surprise tightening of 100 basis points by the Federal Reserve translates into a 47 basis point increase in two-year government bond yields in emerging markets.[9] Euro area monetary policy surprises have smaller effects, which are statistically significant only at intermediate maturities or for emerging markets more economically integrated with the euro area.[10]

US monetary policy surprises also have significant effects on exchange rates and capital flows to emerging markets, but the evidence does not show systematic effects on emerging market stock prices and benchmark Emerging Market Bond Index (EMBI) spreads (Figure 4.7). Every 100 basis point tightening of US monetary policy leads to an immediate 1 percentage point depreciation of emerging market currencies against the US dollar and portfolio outflows from emerging markets of 7 basis points of annual GDP.[11] While (trade-weighted) emerging market currencies do depreciate after tightening in the euro area, ECB monetary policy surprises do not seem to affect term premiums, expected future short-term interest rates, stock prices, portfolio flows or bond spreads in the average emerging market. Given the relatively small spillovers from the ECB, the rest of the chapter focuses on spillovers from US monetary policy.

Looking over time, monetary policy spillovers from the United States were especially strong during the period that included the global financial crisis, the euro area crisis, and the 2013 "taper tantrum" (Figure 4.8). Although the sensitivity of emerging market yields fell from 2014 onward,

Figure 4.8. Time Variation in the Sensitivity of Emerging Market Yields to US Monetary Policy Surprises
(Basis points)



Source: IMF staff calculations.
Note: The bars show the effects of a 100 basis point surprise US monetary policy tightening on five- and ten-year emerging market government bond yields during various periods. The 2014–20 bars are not statistically significantly higher than the pre-Nov. 2008 bars.

[9] These estimates are consistent with those of Albagli and others (2019), Bowman and others (2015), Caballero and Kamber (2019), Curcuru and others (2018) and Hoek and others (2020). A separate analysis indicates that US surprise monetary policy easings and tightenings have symmetric effects on emerging markets.
[10] For example, emerging markets with deeper trade links to the euro area experience stronger responses of 3-month, 6-month and 10-year yields than other emerging markets. This suggests that financial conditions in Central and Eastern European economies are more affected by ECB monetary policy.
[11] The chapter focuses on the response of emerging market exchange rates against the US dollar. A large literature highlights the outsized role played by the dollar exchange rate in causing financial shocks in emerging markets (for example, because of liability dollarization) and demand shocks (because of dollar invoicing in international trade). See for instance Calvo and Reinhart (2002) and Gopinath and others (2020).

it seems to have remained higher than it was before the global financial crisis.[12]

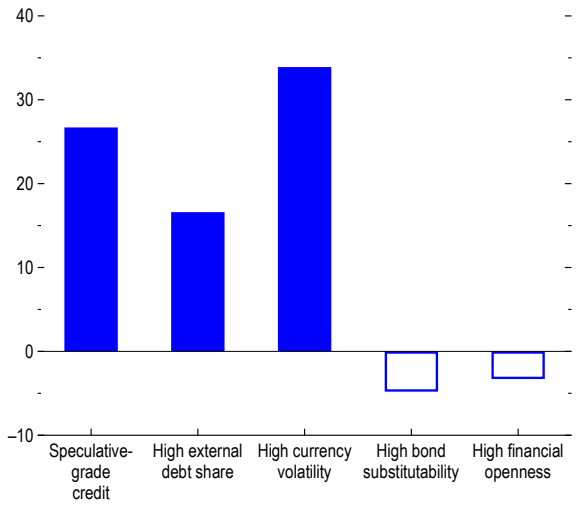
The 'Risk Channel'

It is important to bear in mind that, beyond the average effects discussed above, there is significant heterogeneity in the way financial conditions in emerging markets react to monetary policy changes in advanced countries. Focusing on some features of this heterogenity can provide a partial glimpse into specific channels of transmision of international monetary policy spillovers. As shown in Figure 4.9, economies with a speculative sovereign debt credit rating experience an extra 27 basis point increase in their 10-year bond yield following a surprise 100 basis point US monetary policy tightening. Spillovers are also stronger for countries with a higher proportion of debt held externally or with higher currency volatility. For instance, moving from the 25th percentile in the cross-country distribution of external debt (for example, Armenia) to the 75th percentile (Brazil), raises the sensitivity of 10-year yields by 17 basis points. Similarly, going from a currency volatility at the 25th percentile of economies (for example, Romania) to the 75th percentile (Russia) increases the response of yields by 20 basis points.

The sensitivities of yields to these three indicators can be used to construct a "vulnerability index," which is used in the next part of the chapter that looks at the determinants of monetary policy reactions in emerging markets during the pandemic. Moreveor, all these indicators can be considered proxies for some form of risk. Sovereign default risk, in particular, is influenced by the level and expected path of public debt and therefore provides a mechanism by which fiscal policy directly influences financial conditions in emerging markets and thus, indirectly, the conduct of monetary policy.

That countries with higher perceived sovereign risk experience stronger spillovers suggests that US monetary policy is transmitted to emerging markets through a "risk channel," whereby monetary policy in the US can change the objective riskiness of emerging market assets (for example, by increasing perceived default probabilities) or affect investors' risk aversion (Ahmed and others 2017; Bowman and others 2015; Chen and others 2014; IMF 2014; Kalemli-Ozcan 2019).[13] By contrast, the

Figure 4.9. Spillover Amplifiers from US Monetary Policy Surprises
(Basis points)



Source: IMF staff calculations.
Note: The figure shows how the sensitivity of emerging market ten-year yields to each 100 basis point US monetary policy surprise depends on economy characteristics. "High" refers to the 75th percentile of the distribution of the economy characteristic in the latest available year. Not shown in the figure, the values for investment-grade credit rating, low external debt share, low currency volatility, low bond substitutability, and low financial openness are 0, 0, 14, –2, and 3 respectively. Solid bars show economic characteristics that are statistically significant; hollow bars show those that are not.

[12] Although the sensitivity is higher, the difference is not statistically significant. A further exploration based on shocks on the 10-year US Treasury suggests that this increased sensitivity does not seem to be driven by the adoption of unconventional monetary policy tools by advanced economies.
[13] The conclusion on the possible presence of a *risk channel* is based here only on the observed heterogenous response of bond yields for different classes of sovereign borrowers (Figure 4.9). No evidence of a *risk* channel is instead found based on the behavior of the VIX (Figure (continued)

chapter finds no direct evidence that financial openness or greater correlation between the total return of emerging market sovereign bonds and US Treasuries (a proxy for bond substitutability from the point of view of investors) are associated with a stronger response of domestic yields in emerging markets to US monetary policy shocks (Figure 4.9).[14]

Almost all the change in emerging market domestic yields can be accounted for by the change in term premiums, suggesting that the perceived riskiness of holding emerging market bonds rises after a surprise tightening in US monetary policy and consistent with the finding that countries with higher sovereign risk are more sensitive to spillovers. Markets do expect central banks in emerging market economies to follow a surprise Federal Reserve tightening with tightenings of their own, but only slightly. These conclusions are obtained by relying on dynamic factor models (Adrian, Crump, and Moench 2013) to split the changes in yields on five-year sovereign bonds in emerging markets into one component attributed to changes in the *expected* monetary policy rate in emerging markets and another residual *term premium*. The term premium represents the extra return required by investors to shoulder the greater risk (such as inflation, liquidity, and credit risks) associated with a fixed long-term rate of return (Figure 4.7).

Of course, the yield decomposition into expected monetary policy rates and term premiums must be treated carefully, since it is sensitive to specific model assumptions. Moreover, market expectations of future monetary policy rates may be an imperfect indicator of actual future policy rates, especially over long time periods. Still, the results presented here suggest that whereas overall financial conditions in emerging markets react strongly to changes in US monetary policy, monetary policy in emerging markets does not.

This finding implies a certain degree of monetary policy autonomy in emerging markets, consistent with the findings in IMF (2017). At the same time, the tightening—via risk premiums—of overall financial conditions following a surprise tightening in US policy can be expected to reduce growth in emerging markets. If central banks in emerging markets had full autonomy to adjust their own interest rate policy, then it could be reasonably argued that future monetary policy rates might be expected to fall to offset the rise in domestic yields. The fact that this does not happen (future policy rates are actually expected to go up slightly) may indicate the presence of only partial autonomy.

Spillovers from US Monetary Policy during the Pandemic

As Figure 4.10 shows, the GDP-weighted average of emerging market yields first increased in February 2020, then fell quickly until the end of April, then slowly crawled back toward 4 percent in late 2020. Although, as already noted, monetary policy spillovers are heterogenous across emerging markets, estimates in this chapter can be used to perform some back-of-the-envelope calculations to suggest that, had the Federal Reserve not eased monetary policy in

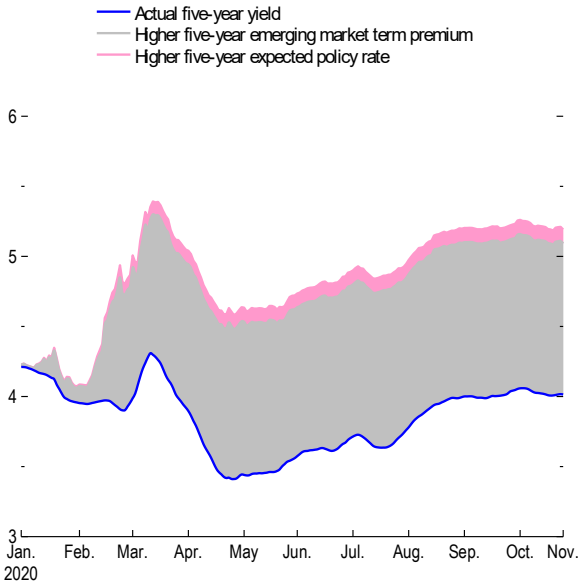
4.7), which is a measure of global risk aversion that many studies (for example, Bekaert and others 2013) but not all (for example, Bekaert and others 2020) find to respond significantly to surprise changes in US monetary policy.

[14] Higher values for these two measures for an emerging market could imply that foreign investors in that emerging markets are more inclined to change their portfolio composition after a US monetary policy announcement, which would indicate the presence of a "portfolio balance channel". The fact that the two regressors are not significant may then suggest the "portfolio balance channel" has a limited role in transmitting monetary policy spillovers from advanced economies. The degree of substitutability of an economy's government bonds with US Treasuries is measured as the correlation between the total returns on its 10-year local currency government bonds, converted to US dollars at market exchange rates, and the total returns on 10-year US Treasuries. Online Annex 4.1 provides more detail.

March, average yields in emerging markets would have been more than 1 percentage point higher. Most of this effect would have come from higher term premiums. Of course, had the Federal Reserve not eased at a time of deep global crisis, the fallout in financial markets would have been severe, so the estimate in Figure 4.10 for the spillover effects of the March 2020 actions likely puts a lower bound on the true effect.

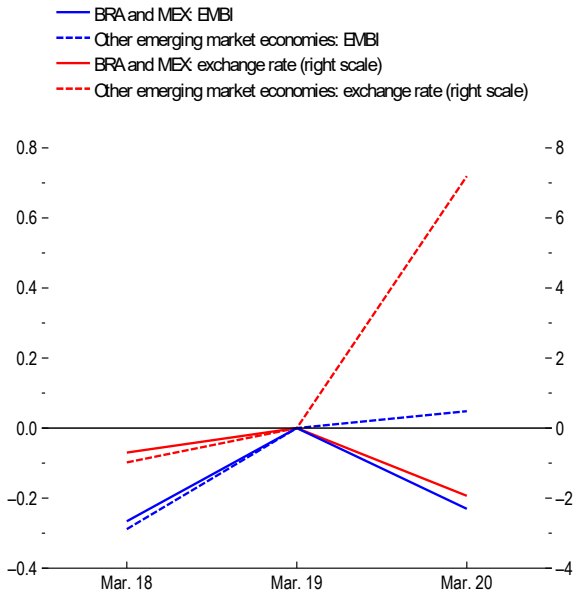
Some monetary policy actions taken by central banks in advanced economies during the pandemic were aimed at affecting financial conditions in foreign markets, including in emerging markets. One such example is the Federal Reserve's announcement on March 19, 2020 of the establishment of temporary US dollar swap line facilities with nine other central banks.[15] Brazil and Mexico were the only emerging markets included, and thus provide an interesting event study to assess the effectiveness of the tool in limiting US dollar funding pressures. Figure 4.11 shows that, following the announcement, spreads on Brazilian and Mexican sovereign debt denominated in US dollars narrowed, while spreads continued to widen in other emerging markets. Similarly, the Brazilian real and Mexican peso appreciated, while the currencies of other emerging markets continued to depreciate. Therefore, it appears that the swap lines announcement was effective in stabilizing financial conditions in these two countries.

Figure 4.10. Counterfactual: Emerging Market Financial Conditions Absent Federal Reserve Easing
(Weighted average, percent a year)



Source: IMF staff calculations.
Note: Five-year denotes government bonds with a five-year maturity.

Figure 4.11. Effects of Swap Line Anouncements for Brazil and Mexico
(Percent; changes after March 19, 2020)



Sources: Bloomberg Finance L.P.; Haver Analytics; and IMF staff calculations.
Note: BRA and MEX denote Brazil and Mexico, respectively. EMBI spreads are in percentage point deviations from those of March 19; exchange rates are in percent changes from those of that date. Increases denote depreciation. EMBI = J.P. Morgan Emerging Market Bond Index.

Spillovers from Economic News in Advanced Economies

Analytical Framework

The methodology here closely follows that used for examining spillovers from monetary policy surprises, but the shocks in advanced

[15] Swap lines can be useful temporary sources of US dollars for the counterparty central banks, which may draw on them to lend US dollars to financial intermediaries while preserving their international reserves. Swap lines may also support investor confidence in liquidity conditions.

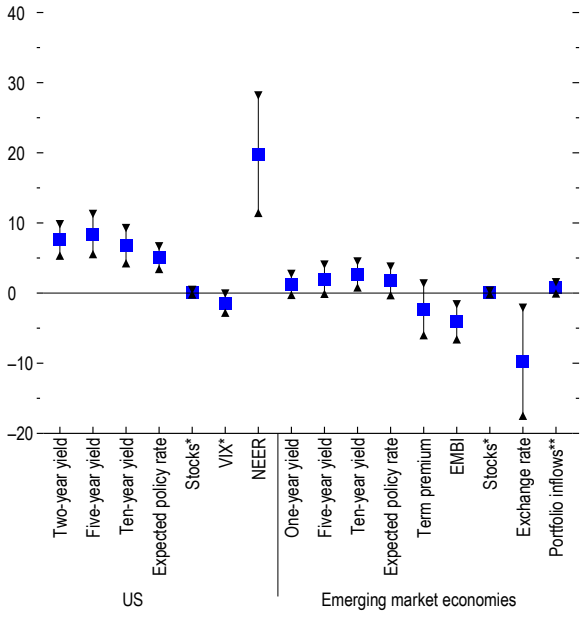
economies that are now considered include *news* about (1) economic activity in the United States, (2) inflation in the United States, and (3) the development of vaccines in advanced economies.

News about economic activity and inflation in the United States is proxied by surprises about nonfarm payroll employment and core consumer-price inflation released from 2000 to 2020.[16] News about the development of vaccines in advanced economies is proxied by whether the stock returns of Moderna and Pfizer-BioNTech are within the top or bottom 10th percentiles of their historical distribution, controlling for their usual comovement with a portfolio of health-care stocks. In this case, the analysis covers April 1 through December 15, 2020, which saw positive news about the development of COVID-19 vaccines, though mostly ones that have stringent cold-chain requirements that make it difficult for them to be delivered in many emerging market and developing economies.

Impact on Advanced Economies and Emerging Markets

Good news about US economic activity lifts longer-term US interest rates (Figure 4.12). The effect is clear at all maturities and, on average over the 20 years considered, is almost entirely down to expectations of higher monetary policy rates (with almost no change in US term premiums). Good economic news about the US economy lowers global uncertainty, measured by the VIX, and leads to a nominal effective appreciation of the dollar. Stock prices are not impacted significantly, likely because expectations of higher monetary policy rates counterbalance the effect on stock prices of better economic prospect for firms.[17]

Figure 4.12. Effects of Positive News about US Economic Activity
*(Basis points; * = percentage points; ** = basis points of annual GDP)*



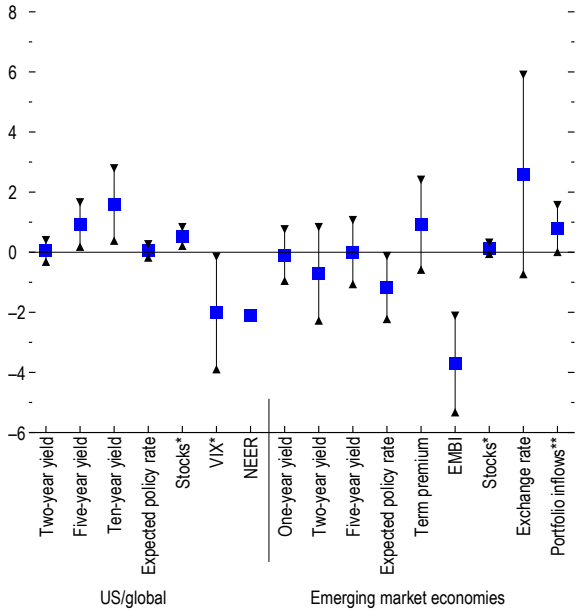
Source: IMF staff calculations.
Note: The squares show estimates of the effect of a two standard deviation surprise in US nonfarm payrolls. The whiskers show 90 percent confidence intervals. Average expected policy rates are calculated at the ten-year maturity for the United States and at the five-year maturity for emerging market economies. An increase in the nominal effective exchange rate (NEER) for the United States, or in the nominal exhange rate vis-à-vis the United States for emerging market economies, denotes appreciation. Portfolio inflows denote bond inflows. EMBI = J.P. Morgan Emerging Market Bond Index; VIX = Chicago Board Options Exchange Volatility Index.

The effect of good news about US economic activity on financial conditions in the average emerging market tends to be benign, in contrast to the impacts of surprise monetary policy changes.[18] Good US economic news still depreciates emerging market currencies on average. However, in parallel with a reduction in the volatility index, emerging market default premiums on dollar-denominated debt (EMBI) now *fall* and portfolio capital *flows into* emerging markets (the effect on capital inflows has a moderate level of statistical confidence with a p-value

[16] Data was provided by the authors of Gurkaynak and others (2020). Moderna and BioNTech are companies involved in the development of two vaccines that, during 2021, are expected to provide advanced economies with a relatively wide vaccination coverage, well beyond that of emerging markets.
[17] For an explanation of the lack of a clear effect on US stock prices see Gurkaynak and others (2020).
[18] This is consistent with previous studies such as IMF (2014) and, more recently, Jasper and others (2020).

of 13 percent). These findings are consistent with a positive *risk channel*, where good economic news in the US reduces the risk aversion of international investors. In addition, domestic bond yields still appear to rise in the average emerging market (although with limited statistical significance), but the increase seems now to entirely reflect expectations of higher monetary policy rates, possibly driven by improved growth expectations. This for instance would be consistent with a positive "trade channel", whose strength should be expected to be heterogeneous across countries, where higher aggregate demand in the advanced economies leads to more demand for tradable goods produced in emerging markets.[19]

Figure 4.13. Effect of Positive News about COVID-19 Vaccines
*(Basis points; * = percentage points; ** = basis points of annual GDP)*



Source: IMF staff calculations.
Note: The squares show estimates of the effect of positive vaccine news. The whiskers show 90 percent confidence intervals. Average expected policy rates are calculated at the ten-year maturity for the US and at the five-year maturity for emerging market economies. An increase in the nominal effective exchange rate (NEER) for the US, or in the nominal exchange rate vis-à-vis the US for emerging market economies, denotes appreciations. Confidence bands on the NEER are wide; they are not shown to save space. EMBI = J.P. Morgan Emerging Market Bond Index; VIX = Chicago Board Options Exchange Volatility Index.

The effect of positive news about COVID-19 vaccines in advanced economies has been positive, thanks in part to the muted response of US interest rates (Figure 4.13). Longer-term US yields have risen on the news, but two-year yields have not reacted, reflecting the Federal Reserve's explicit commitment to maintaining an expansionary monetary policy stance until a firm recovery is under way.[20] Positive vaccine news has lifted corporate earnings expectations and the US stock market, in the context of a muted expected response of monetary policy, and the US dollar has not appreciated.

Domestic bond yields in the average emerging market have not reacted to vaccine news, and there have even been indications of an expected easing in domestic monetary policy. Domestic stock markets have risen, on average. As seen when economic news is positive, the volatility index has fallen and, in parallel, benchmark emerging market bond spreads have shrunk, while capital has flowed *into* emerging markets (and the effect is now statistically significant). The beneficial effects of positive vaccine news on emerging market financial conditions are likely driven by a combination of the aforementioned *risk* and *trade* channels, together with the "low for long" expectation for US interest rates and, possibly, with improved prospects for vaccinations globally.

Finally, the chapter finds that longer-term nominal US yields also rise when US inflation comes in higher than expected, but such surprises do not seem to impact the US dollar,

[19] Additional tests reveal that, after an increase in US employment, spreads on dollar denominated bonds fall more and exchange rates depreciate less in those emerging markets that have stronger trade linkages with the United States. Online Annex 4.1 provides the details.
[20] Even at the 10-year maturity, all the increase in US yields is attributed to rising term premiums, and not to increases in conventional short-term policy rates.

aggregate US stock prices or the VIX. The spillovers from surprise US inflation to interest rates in the average emerging market are minimal,[21] and there is no evidence of effects on the average emerging market's exchange rates, aggregate stock prices or spreads on dollar-denominated debt. The lack of spillovers from US inflation could be consistent with a mixture of US demand and cost-push shocks, which would have opposite implications for growth in other countries. Future research could explore whether the specific source of the US inflation shock matters for spillovers.

Spillovers to Low-Income Countries

Financial conditions in low-income countries generally do not respond as much as conditions in emerging markets do to monetary policy surprises by the Federal Reserve or ECB, or to news about US economic activity or COVID-19 vaccines. There are, however, some exceptions. First, positive vaccine news in 2020 lifted 10-year government bond yields on average in the five low-income countries with data series (Ghana, Kenya, Nigeria, Uganda, Vietnam). Second, positive ECB monetary policy surprises tend to lift 6-month government bond yields on average in the three low-income countries with data (Nigeria, Rwanda, Zambia). Third, the currencies of low-income countries depreciate by about 1.2 percent on average against the US dollar for each 100 basis points of surprise tightening by the Federal Reserve, similar to the response of emerging markets. That said, while the impact of monetary policy on financial conditions of low income countries appears to be smaller than on emerging markets, its effect on commodity prices can still be significant, with overall important repercussions for commodity exporters.

Determinants of Emerging Market Monetary Policy Reactions

APPs and conventional policy rate cuts were two major monetary policy instruments used by emerging markets to counter financial market turmoil and lessen the depth of the recession during the early months of the pandemic.[22] This section uncovers the factors that drove the frequency and intensity of their use. The econometric method seeks to ensure that the drivers explored are not endogenous to the repercussion of the pandemic shock and that appropriate controls are added to the specifications. Still, the identification of causal effects is challenging, and the results are indicative of associations. A separate analysis of the effectiveness of APPs is also presented.

Asset Purchase Programs

Overview and Effectiveness

The COVID-19 crisis saw an unprecedented use of unconventional monetary policy instruments among emerging market and developing economies. APPs were launched in 27 emerging market and developing economies, with most announcing them for the first time—starting with Indonesia on March 2, 2020. Most of the central banks in emerging market and developing economies justified APPs as a means to counter market dysfunction, with only a handful (Ghana, Indonesia, Mauritius) also stating the support of government financing as a

[21] Spillovers from US inflation to emerging market interest rates vary slightly by method, as explained in Online Annex 4.1.
[22] An investigation of the role of macroprudential measures during COVID-19 is beyond the scope of this chapter. For a recent and comprehensive analysis of the effectiveness of macroprudential measures see IMF (2020c).

motivation for the program.[23] The vast majority of countries announced that their purchases were confined to government bonds; only a few also announced purchases of corporate or bank bonds (Brazil, Chile, Hungary, Mauritius) or equities (Egypt).

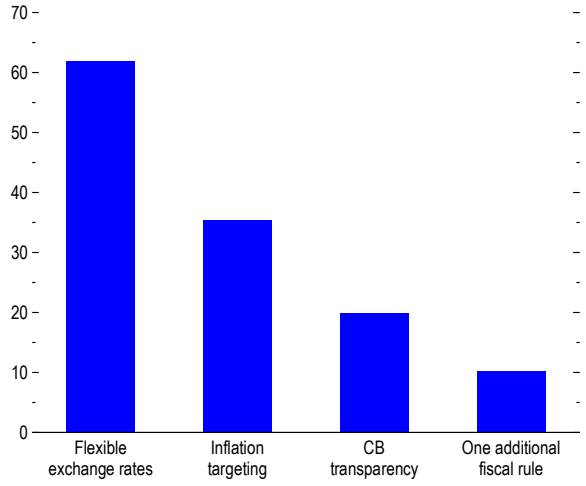
The effectiveness of APPs can be assessed by looking at whether yields on government bonds fell with the launch of the programs. This is an important indicator of success, especially for those APPs whose aim was to reduce interest rate spikes caused by rising liquidity premiums in funding markets. Based on this yardstick, Box 4.1 concludes that APPs by emerging market and developing economies during the pandemic appear to have been effective.

Drivers of APPs

Countries with greater exchange rate flexibility, an inflation targeting framework, greater central bank transparency, a history of a more rules-based fiscal policy framework, and lower sovereign risk were more likely to announce an APP between March and August 2020. The findings are based on logit regressions relating an indicator of whether a country announced an APP to groups of drivers that are each considered separately.[24] Depending on data availability for the different drivers, the sample size varies between 39 and 97 emerging market and developing economies (Online Annex 4.2 provides details).[25]

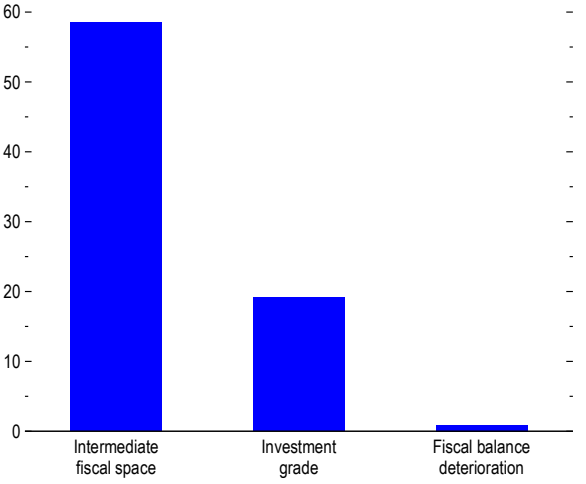
Policy frameworks. Overall, the results indicate that the choice of announcing an APP is highly dependent on the country's monetary and fiscal policy frameworks. Countries with floating or freely floating exchange rate

Figure 4.14. Determinants of Asset Purchase Program Choice during COVID-19: Policy Frameworks
(Change in probability, percentage points)



Sources: Dincer, Eichengreen, and Geraats (2019); IMF (2020b); and IMF staff calculations.
Note: Flexible exchange rates and inflation targeting represent, respectively, floating and free floating exchange rate regimes and inflation-targeting central banks. CB transparency reports the effect of a one standard deviation increase in the transparency index. Coefficients are significant at the 5 percent level. CB = central bank.

Figure 4.15. Determinants of Asset Purchase Program Choice during COVID-19: Fiscal Position
(Change in probability, percentage points)



Sources: Standard & Poor's; and IMF staff calculations.
Note: The fiscal space indicator is calculated by the IMF. Investment-grade ratings are from Standard & Poor's. Fiscal balance deterioration is the change in the 2020 projected fiscal balance between the January 2020 *World Economic Outlook (WEO) Update* and the April 2020 *WEO*, relative to 2019 GDP. Bars are signficant at the 5 percent level; the fiscal balance deterioration bar is not significant.

[23] The data on APPs used in this chapter is from Fratto and others (2021), who also includes a detailed description of APPs during the COVID-19 crisis through 2020. See also Arslan and others (2020) and IMF (2020a).
[24] The list of APPs in emerging market and developing economies during the pandemic is provided in Fratto and others (2021).
[25] A separate analysis looked at whether the probability that a country announced an APP was associated with the strength of the country's trade linkages with other emerging market and developing economies that announced APPs during the pandemic. No evidence of such an effect was found.

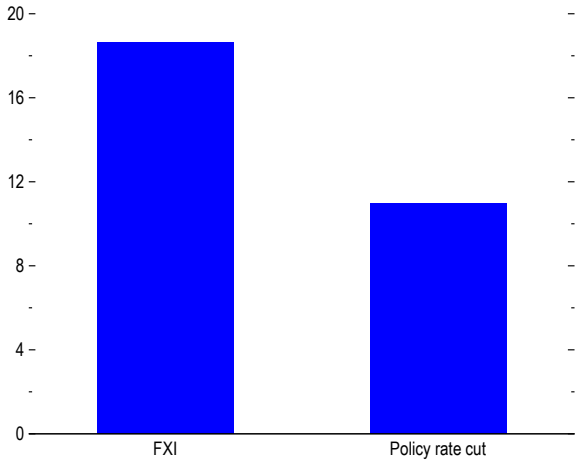
regimes had a 61 percentage-point higher probability of launching an APP than countries with other exchange rate regimes (Figure 4.14), reflecting little scope for expanding the money supply when a financially open economy has an exchange rate target. The presence of a numerical inflation target raises the probability by 35 percentage points, while a one standard deviation increase in an index of central bank transparency (Dinçer and others 2019) raises the probability by 19 percentage points. One extra rule in the fiscal policy framework is associated with a 10 percentage point higher probability.

Fiscal position. Countries with higher sovereign credit ratings (those that were perceived to have less sovereign default risk) were more likely to announce APPs (Figure 4.15). An investment grade rating increases the probability of an APP by 19 percentage points. The amount of "fiscal space" that the government has seems to matter as well. Intermediate levels of fiscal space ("some" or "at risk") increased the probability of an APP by 58 percentage points compared to having, at the two extremes, "substantial" or "no fiscal space".[26] It is possible that countries with "substantial" fiscal space were unlikely to launch an APP because their sovereign bond markets were not disrupted. On the other hand, countries with "no" fiscal space may have resisted activating an APP fearing that markets could interpret it negatively as an attempt at debt monetization (fiscal dominance). The unlikely use of APPs as an indirect means of debt financing is corroborated by the lack of a statistically significant relationship between the activation of an APP and the deterioration in the projected 2020 fiscal balance.

Exposure to financial spillovers. Three proxies are used to measure the exposure. The first is a country-specific "vulnerability index" to monetary policy spillovers from Federal Reserve decisions, as derived in the preceding section of the chapter that deals with the spillover amplifiers from US monetary policy shocks. The second is a measure of financial openness mandated in law, while the third is an indicator of foreign reserves adequacy.[27] None of these proxies is significant in predicting an APP.

Other instruments. APPs are part of a larger set of policy instruments, which include conventional interest cuts (analyzed in detail in the next section) and foreign exchange interventions. A larger policy rate cut increases by 10 percentage points the probability that an APP will be announced, while use of a foreign exchange intervention raises that probability by

Figure 4.16. Determinants of Asset Purchase Program Choice during COVID-19: Other Instruments
(Change in probability, percentage points)

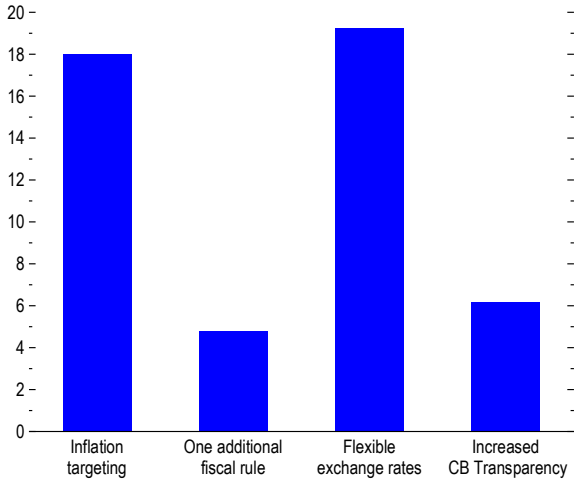


Sources: national authorities; and IMF staff calculations based on national central bank information.
Note: FXI is a dummy for countries that have used foreign exchange interventions to address disorderly market conditions during the COVID-19 crisis. Policy rate cut is based on a one standard deviation increase in the policy rate, as a percentage of its pre-pandemic level. Coefficients are significant at the 5 percent level.

[26] The fiscal space variable is constructed by IMF staff for about 70 countries and published regularly in countries' Article IV Reports.
[27] Financial openness is proxied by the Chinn-Ito index for the year 2018 (see Chinn and Ito 2006 for a description of the index). The reserve adequacy measure is computed by IMF staff and describes reserve holdings relative to the reserve adequacy measure, updated to 2019 (see IMF 2015 for a description).

18 percentage points. The results (Figure 4.16) suggest that emerging market and developing economies use policy rate cuts, APPs, and foreign exchange interventions complementarily. They also use them for different objectives: lowering the domestic risk-free rate, tackling disruptions in the domestic bond market, and resolving disorderly conditions in the market for foreign exchange.[28]

Figure 4.17. Determinants of Policy Rate Cuts during COVID-19: Policy Frameworks
(Changes, percentage points)



Sources: Dincer, Eichengreen, and Geraats (2019); IMF (2020b); and IMF staff calculations.
Note: Flexible exchange rates and inflation targeting represent, respectively, floating and free floating exchange rate regimes and inflation-targeting central banks. CB transparency reports the effect of a one standard deviation increase in the transparency index. Coefficients are significant at the 5 percent level. CB = central bank.

Policy Rate Cuts

Analysis of the "risk channel" suggests that changes in the expected path of monetary policy rates in emerging markets are only marginally influenced by surprise changes in monetary policy rates in advanced economies. This section seeks to explain the differences between countries in how much the policy rate was reduced from March through August 2020.[29] Central banks in countries with greater exchange rate flexibility, an inflation targeting framework, greater central bank transparency, and a more rules-based fiscal policy framework are found to have delivered deeper interest rate reductions. Unlike for APPs, sovereign credit ratings are not correlated with the extent of interest rate cuts.

The econometric specification relates the change in monetary policy rates, expressed as a ratio to the policy rate before the crisis, to four groups of drivers. The first three are the same as those just explored. The fourth intends to capture how the policy rate cut depended on *domestic economic conditions*, the standard driver of policy interest rates.[30]

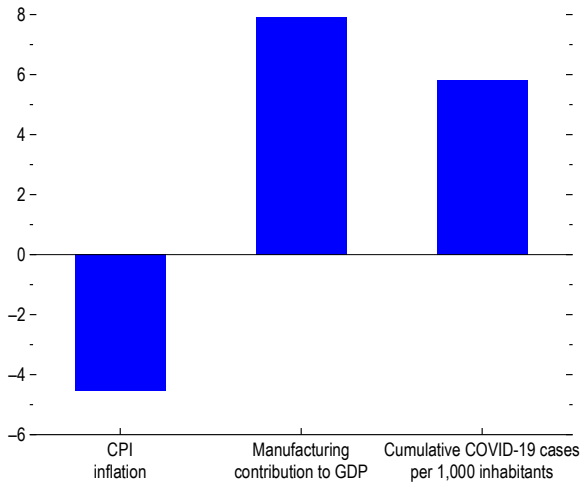
Policy frameworks. The same characteristics of policy frameworks that determine the use of APPs also explain the size of the cut in policy rates (Figure 4.17). In countries with flexible exchange rates and inflation-targeting central banks, the policy rate cut was about 20 percent larger. A one-standard deviation increase in the central bank transparency index raises the policy rate cut by 6 percent and the use of one additional fiscal rule makes it 5 percent larger.

[28] The size of the policy rate cut and the foreign exchange intervention indicator are added simultaneously to the regression. The foreign exchange intervention dummy is based on a collection of such interventions during the COVID-19 crisis by the IMF staff. It is highly correlated with the indicator for floating or free-floating exchange rates, which is added as a control to each regression. This may appear surprising as one would expect that countries with more flexible exchange rates do not rely much on foreign exchange interventions. However, this correlation only reflects the particular construction of the foreign exchange intervention indicator, which captures those interventions aimed specifically at addressing disorderly market conditions (and so have a goal similar to that of APPs). Therefore, the indicator does not include all foreign exchange intervention conducted as part of regular operations to maintain a managed exchange rate regime. For this reason, the regression of Figure 4.16 does not include controls for the exchange rate regime.
[29] For a related analysis on determinants of the policy rate cuts see Gelos, Rawat, and Ye 2020.
[30] The same domestic economic conditions did not determine decisions to use APPs.

Fiscal position. Neither the sovereign debt rating, nor the fiscal space indicator are significant predictors of interest rate cuts. The change in the fiscal balance is also insignificant.

Exposure to financial spillovers. Similar to chapter findings about the exposure to monetary policy spillovers, the indicator of financial openness and the reserve adequacy ratio are not significant drivers of conventional monetary policy cuts. This result is well-aligned with the findings about spillovers from monetary policy surprises and appears to confirm that external monetary and financial conditions are not important drivers of domestic monetary policy rates.

Figure 4.18. Determinants of Policy Rate Cuts during COVID-19: Domestic Conditions
(Changes, percentage points)



Sources: Johns Hopkins University; IMF, *World Economic Outlook;* and World Bank, World Development Indicators.
Note: Manufacturing contribution to GDP and Cumulative COVID-19 cases per 1,000 inhabitants report the effects of a one standard deviation increase in the indicator. Coefficients are significant at the 10 percent level or less. CPI = consumer price index.

Domestic economic conditions. Interest rate cuts were proportionally larger where pre-pandemic inflation was lower, and where the domestic and foreign demand shocks were more negative (Figure 4.18). The policy rate cut was deeper in countries with higher COVID-19 cases by September 1, 2020 (which proxies for the size of negative domestic demand and supply shocks, especially in the service sector). The country's manufacturing share in GDP captures the effect of falling foreign demand on GDP, and is also associated with more conventional easing.

Conclusions

Prospects for a multispeed recovery, with advanced economies recovering more quickly than most other economies, raise concerns about the effects from an asynchronous withdrawal of monetary policy that tightens financial conditions for emerging market and developing economies. These concerns have been amplified by the possibility of a new fiscal stimulus package in the United States, which could lead the Federal Reserve's asset purchases to be scaled back and US interest rates to rise at an earlier-than-expected date.

This chapter finds that changes to interest rates in the United States tend to have important ramifications for financial conditions in emerging market and developing economies. Yet, these effects depend on the circumstances behind the change and the evolution of global risk premiums:

- An unexpected signal of higher future US policy rates that is not driven by changes in economic conditions in the United States unambiguously leads to a tightening of financial conditions in emerging markets. The trigger could arise from markets revising their expectations of how soon or how much the Federal Reserve will react to the evolving information on the economy. This would potentially lead to a shift in global risk appetite, a

reversal of capital flows to emerging markets, deleveraging by global banks, and a depreciation in EM currencies that exposes foreign exchange-related vulnerabilities.

- By contrast, positive news on US economic activity tends to have a relatively benign impact on financial conditions in emerging markets. The volatility index (VIX) and risk premiums on emerging market bonds fall, while capital tends to flow into emerging markets. Positive news from COVID-19 vaccine trials triggered strong effects in the same direction. These findings can be attributed in part to a positive *risk channel*, where favorable economic developments in advanced economies reduce the risk aversion of international investors, and in part to a *trade channel,* which reflects the tendency of better economic news in the United States to imply better growth prospects for emerging markets as well.
- Upside surprises on US inflation also lift expected US rates, but do not appear to systematically impact financial conditions in emerging markets. Although the source of inflation may matter, on average the repercussions for emerging markets seem to be limited.

The analysis suggests that a gradual and well-telegraphed normalization of US interest rates driven by a recovering US economy would likely be manageable for most emerging market economies, though some would be at risk. In fact, many emerging markets (especially those that export a lot to advanced economies) could see a period of strong capital inflows as economic conditions in advanced economies improve, monetary policy accommodation is withdrawn gradually, and global risk appetite remains favorable. A stronger-than-expected inflation recovery in advanced economies could temper global financial risk appetite somewhat, but with likely limited repercussions if inflation expectations remain well-anchored. This is particularly true since the Federal Reserve has clearly communicated that it is targeting a temporary overshooting of its medium-term inflation goal and would not raise interest rates until inflation has risen to 2 percent and is on track to moderately exceed 2 percent for some time. However, some emerging economies with fiscal and external vulnerabilities and a lack of trade ties to advanced economies may find that the global financial tightening outweighs the benefits of stronger external demand. Moreover, the present health and economic crises are different from anything seen in recent decades, making evidence from the past an imperfect guide to the future. Today's high debt levels may accentuate any financial spillovers and efforts to contain the virus may limit the benefits of trade links.

It is not assured that the economic recovery and interest rate normalization in advanced economies will be smooth, and central bank communications will be a critical factor as the recovery progresses. The chapter's findings suggest that a rapid upward revision in expected US monetary policy rates—for example if markets were suddenly to revise down their expectations for the inflation level that the Federal Reserve would tolerate before it tightened monetary policy under its flexible average inflation targeting framework—could lead to rising risk premiums and significant capital outflows from emerging market and developing economies. As such, it will be important for the Federal Reserve to continue to emphasize its policy approach and how it will implement its new monetary policy strategy to anchor expectations about its policy reaction. In general, it will be important for advanced economy central banks to signal early if they judge that

economic conditions are evolving in a way that will warrant scaling back of asset purchases and, eventually, raising policy rates.[31]

Even if global financial risk appetite remains buoyant for some time, emerging market policymakers need to keep in mind that advanced economy central banks will eventually reduce monetary policy accommodation. Even with central banks providing a high degree of transparency and early communication of changes in their policy stance, markets may still misinterpret intentions and financial conditions can shift for reasons that are beyond the control of policymakers. Moreover, as the recovery picks up, risk appetite and term premia may increase, as has happened on the back of expected US fiscal stimulus in the second half of February. Combined with a faster expected normalization of US monetary policy, the decompression of term premia has steepened the US yield curve and has spilled over into higher emerging market bond yields as well, triggering a slowdown in capital flows. This episode foreshadows the bumps that may lie ahead for emerging markets as the global economic recovery progresses and extraordinary policy support is withdrawn.

How can emerging market economies insulate themselves from external financial spillovers? The correlations documented in the chapter suggest that, monetary policy in emerging markets could probably react countercyclically in downside scenarios. However, the strength of the policy easing could be limited and likely heterogenous across countries. For instance, higher public debt might discourage some countries from using APPs with the same intensity as in the earlier phases of the pandemic. Moreover, if public debt and other fiscal concerns were to start weighing on the perceived independence of monetary policy and on its rule-based frameworks, then the ability of central banks to deploy large conventional rate cuts without raising long-term inflation expectations could also be called into question. Maintaining credible fiscal and monetary frameworks is therefore essential for emerging market and developing economies to be able to support domestic activity amid unexpected negative shocks. In addition, taking steps to lengthen maturities on debt and smooth out concentrations in debt service obligations, manage leverage through macro-prudential measures and strong financial supervision, reduce currency mismatches, and ensure an adequate level of international reserves can also help limit the buildup of vulnerabilities (IMF 2020b). A strong international financial architecture, including robust mechanisms for liquidity support for countries, would have a key role to play too.

[31] See Sahay and others 2014 for a stocktaking of lessons from the Taper Tantrum episode.

Box 4.1. Emerging Market Asset Purchase Programs: Rationale and Effectiveness

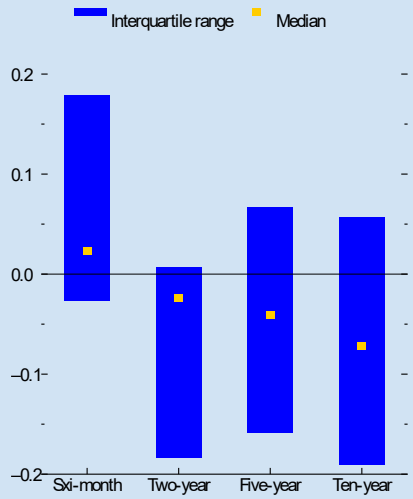
Most Countries Deployed APPs while Short-term Policy Rates Were Still Positive

This partly reflected the reported aim to smooth volatility and provide liquidity to the domestic market. Only in 9 percent of the cases the APPs was reported as aiming to provide monetary stimulus. For 62 percent, market dysfunction and the need to boost confidence was the main concern. Supporting fiscal needs was stated as main objective in 10 percent of the cases, with the rest citing the need to alleviate costs of the COVID-19 pandemic on the population. The exchange rate was one of the objectives in only one case. Purchases of long-dated government bonds (or private sector securities) were sometimes used in combination with policy rate cuts (11 out of 27 cases). The size of APPs, both announced and implemented, was comparable to that in small advanced economies.[1]

Overall, such Unconventional Monetary Policy Measures Lowered Local Bond Yields but Had no Salient Effect on Exchange Rates or External Borrowing Costs

The results of a multiday event study, using a sample of 15 emerging market and developing economies only because of data limitations, point to heterogeneous effects. On average, the estimated effect on domestic bond yields is negative and statistically significant (Figure 4.1.1), slightly stronger than that of conventional monetary policy transmission, and higher in emerging market and developing economies than in advanced economies. The results are broadly consistent with the literature (Arslan and others 2020; Hartley and Rebucci 2020; Sever and others 2020).[2] The estimated effects on the exchange rate are instead inconclusive. Looking at the second-round effects, the announcements have predominantly an insignificant effect on emerging market benchmark bonds. Panel regressions, controlling for policy and global factors, confirm the results.

Figure 4.1.1. Asset Purchase Program Anouncement: Effect on Bond Yields
(Percentage point change)



Source: Fratto and others (2021).

Differences in Implementation and Country Characteristics Can Explain Some of the Heterogeneity in the Effectiveness of APPs

Some country specific factors (central bank credibility, larger monetary policy space, low share of nonresident holdings of government bonds) and implementation modalities (quantity-based programs, smaller announced size, single as opposed to repeated announcements) seemed to increase the impact of APPs on yields. No statistically significant differences were found between purchasing assets on the primary and the secondary market, nor between single announcement and announcements made in coordination with other national authorities. Overall, the results suggest that APPs can be usefully deployed by emerging market and developing economies in response to domestic market stress but may not work in dampening external market pressures more broadly.

The authors of this Box are Chiara Fratto, Brendan Harnoys Vannier, Borislava Mircheva, David de Padua and Hélène Poirson

[1] This box draws on the analysis in Fratto and others (2021) and is based on a data set of APP announcements and implementation during March through August 2020.

[2] Results shown exclude the announcements coinciding with policy rate cuts, in order to avoid capturing spillover effects from conventional monetary policy.

References

Adrian, Tobias, Richard K. Crump, and Emanuel Moench. 2013. "Pricing the Term Structure with Linear Regressions." *Journal of Financial Economics* 110(1): 110-138.

Ahmed, Shaghil, Brahima Coulibaly, and Andrei Zlate. 2017. "International Financial Spillovers to Emerging Market Economies: How Important are Economic Fundamentals?" *Journal of International Money and Finance* 76: 133-152.

Albagli, Elias, Luis Ceballos, Sebastian Claro, and Damian Romero. 2019. "Channels of US Monetary Policy Spillovers to International Bond Markets." *Journal of Financial Economics* 134(2): 447-473.

Altavilla, Carlo, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Giuseppe Ragusa. 2019. "Measuring Euro Area Monetary Policy." *Journal of Monetary Economics* 108: 162-179.

Arslan, Yavuz, Mathias Drehmann, and Boris Hofmann. 2020. "Central Bank Bond Purchases in Emerging Market Economies." BIS Bulletin 20, Bank for International Settlements, Basel.

Bekaert, Geert, Marie Hoerova, Marco Lo Duca. 2013. "Risk, Uncertainty and Monetary Policy." *Journal of Monetary Economics* 60: 771-788.

Bekaert, Geert, Marie Hoerova, Nancy R. Xu. 2020. "Risk, Monetary Policy and Asset Prices in a Global World", Available at SSRN 3599583.

Bowman, David, J. Londono, and H. Sapriza. 2016. "U.S. Unconventional Monetary Policy and Transmission to Emerging Market Economies," *Journal of International Money and Finance* 55: 27–59.

Caballero, Ricardo J., and Gunes Kamber. "On the Global Impact of Risk-Off Shocks and Policy-Put Frameworks." NBER Working Paper 26031, National Bureau of Economic Research, Cambridge, MA.

Calvo, Guillermo A., and Carmen M. Reinhart. 2002. "Fear of floating." *The Quarterly Journal of Economics* 117(2): 379-408.

Cerutti, Eugenio, Stijn Claessens, and Andrew K. Rose. 2019. "How Important is the Global Financial Cycle? Evidence from Capital Flows." *IMF Economic Review* 67: 24–60.

Chen, Jiaqian, Tommaso Mancini Griffoli, and Ratna Sahay. 2014. "Spillovers from United States Monetary Policy on Emerging Markets: Different This Time?" IMF Working Paper 14/240, International Monetary Fund, Washington, DC.

Chinn, Menzie D. and Hiro Ito. 2006. "What Matters for Financial Development? Capital Controls, Institutions, and Interactions." *Journal of Development Economics*, 81(1): 163-192.

Curcuru, Stephanie E., Steven B. Kamin, Canlin Li, and Marius Rodriguez. 2018. "International Spillovers of Monetary Policy: Conventional Policy vs. Quantitative Easing." FRB International Finance Discussion Paper 1234, Federal Reserve Board, Washington, DC.

Dincer, Nergiz, Barry Eichengreen, and Petra Geraats. 2019. "Transparency of Monetary Policy in the Postcrisis World." In *The Oxford Handbook of the Economics of Central Banking*. Oxford University Press.

Fratto, Chiara, Brendan Harnoys Vannier, Borislava Mircheva, David de Padua, and Hélène Poirson. 2021. "Unconventional Monetary Policies in Emerging Markets and Frontier Countries." IMF Working Paper, International Monetary Fund, Washington, DC.

Gelos, Gaston , Umang Rawat, and Hanqing Ye. 2020. "Have Emerging Market- and Developing Economies Escaped the Monetary Policy Procyclicality Trap? Evidence from the COVID-19 Crisis." VoxEU, August 20.

Gertler, Mark, and Peter Karadi. 2015. "Monetary Policy Surprises, Credit Costs, and Economic Activity." *American Economic Journal: Macroeconomics* 7(1): 44-76.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller. 2020. "Dominant Currency Paradigm." *American Economic Review*, vol 110(3): 677-719.

Gurkaynak, Refet S., Burçin Kisacikoğlu, and Jonathan H. Wright. 2020. "Missing Events in Event Studies: Identifying the Effects of Partially Measured News Surprises." *American Economic Review* 110(12): 3871-3912.

Hanson, Samuel G., and Jeremy C. Stein. "Monetary Policy and Long-Term Real Rates." *Journal of Financial Economics* 115(3): 429-448.

Hoek, Jasper, Steven B. Kamin, and Emre Yoldas. 2020. "When is Bad News Good News? US Monetary Policy, Macroeconomic News, and Financial Conditions in Emerging Markets." FRB International Finance Discussion Paper 1269, Federal Reserve Board, Washington, DC.

Hartley, Jonathan S., and Alessandro Rebucci. 2020. "An Event Study of COVID-19 Central Bank Quantitative Easing in Advanced and Emerging Economies." NBER Working Paper 27339, National Bureau of Economic Research, Cambridge, MA.

International Monetary Fund. 2014. Spillover Report, Washington, DC.

International Monetary Fund. 2017. "Are Countries Losing Control of Domestic Financial Conditions?" IMF Global Financial Stability Report, Chapter 3, April, Washington, DC.

International Monetary Fund. 2020a. "Emerging and Frontier Markets – A Greater Set of Policy Options to Restore Stability." IMF Global Financial Stability Report, Chapter 2, October, Washington, DC.

International Monetary Fund. 2020b. "Toward an Integrated Policy Framework", Washington, DC.

International Monetary Fund. 2020c. "Dampening Global Financial Shocks: Can Macroprudential Regulation Help?" IMF World Economic Outlook, Chapter 3, April, Washington, DC.

Kalemli-Özcan, Şebnem. 2019. "US monetary policy and international risk spillovers." NBER Working Paper 26297, National Bureau of Economic Research, Cambridge, MA.

Maurice Obstfeld & Jonathan D. Ostry and Mahvash S. Qureshi, 2019. "A Tie That Binds: Revisiting the Trilemma in Emerging Market Economies." *The Review of Economics and Statistics*, MIT Press 101(2): 279-293.

Rey, Hélène. 2015. "Dilemma not trilemma: the global financial cycle and monetary policy independence." NBER Working Paper 21162, National Bureau of Economic Research, Cambridge, MA.

Sahay, Ratna, Vivek Arora, Athanasios Arvanitis, Hamid Faruqee, Papa N'Diaye, and Tommaso Mancini Griffoli. 2014. "Emerging Markets Volatility: Lessons from the Taper Tantrum". IMF Staff Discussion Note 2014/9.

Sever, Can, Rohit Goel, Dimitris Drakopoulos, and Evan Papageorgiou. 2020. "Effects of Emerging Market Asset Purchase Program Announcements on Financial Markets During the COVID-19 Pandemic." IMF Working Paper 2020/292, International Monetary Fund, Washington, DC.

Végh, Carlos A., and Guillermo Vuletin. 2012. "Overcoming the Fear of Free Falling: Monetary Policy Graduation in Emerging Markets." NBER Working Paper 18175, National Bureau of Economic Research, Cambridge, MA.

CHAPTER 4

ONLINE ANNEX

This Annex provides further detail on the methods, data sources, robustness exercises and extensions applicable to Chapter 4 of the April 2021 World Econoimc Outlook, which is entitled "Shifting Gears: Monetary Policy Spillovers During the Recovery from COVID-19."[1] It is designed to be read jointly with the main text, so it does not repeat information from there. The Annex is structured into two parts. The first part describes the event study analysis and the second describes the determinants of monetary policy actions in EMs.[2]

Annex 4.1. Event Study Analysis

Methods

The chapter estimates the following model of the effects of monetary policy surprises, real news and vaccine news s_t on financial conditions in EMs:

$$y_{c,t+1} - y_{c,t-1} = \alpha_c + \zeta s_t + \theta \tau_t + \gamma x_{c,t} + \mu \tau_t s_t + \eta s_t x_{c,t} + v_{c,t+1}$$

where the dependent variable $y_{c,t}$ represents various financial indicators on day t in EM c, including government bond yields at various maturities, exchange rates, total stock returns, portfolio flows, term premiums and expectations of future short-term monetary policy rates. For models where s_t represents vaccine news, an additional s_t^2 term is included on the right-hand side to capture non-linearities, and the results report the combined effects of a unit increase in both terms. The variable τ_t captures low-frequency time variation in the sensitivity, using linear time trends or indicator variables for sub-periods. The variables $x_{c,t}$ are measures of heterogeneity across EMs in the previous year that could be related to the strength of the spillovers as defined below. Finally, $v_{c,t}$ is an error term. In addition to the model above for financial conditions in EMs, a simplified time series version

$$y_{t+1} - y_{t-1} = \delta + \beta s_t + u_{t+1}$$

is used to model the effects of monetary policy surprises, real news and vaccine news (s_t) on global and US financial indicators (y_t), including US Treasury yields, US expected future policy rates and term premiums, the US dollar nominal effective (trade-weighted) exchange rate and the US stock market volatility index (VIX).

Estimation of parameters $\zeta, \theta, \gamma, \mu, \eta$ uses the within-groups estimator, and given the long time dimension, standard errors that allow for spatial and temporal dependence are used following Driscoll and Kraay (1998). When estimating the average sensitivity (ζ) to monetary surprises or economic/vaccine news (Figures 4.6, 4.7, 4.12 and 4.13 in the main text), time and cross-section effects are dropped before estimation ($\theta, \gamma, \mu, \eta = 0$). When estimating time variation (μ; Figure 4.8 in the main text), cross-section heterogeneity is dropped before estimation ($\gamma, \eta = 0$), and when estimating cross-section heterogeneity (η), time effects are dropped before estimation ($\theta, \mu = 0$; Figure 4.9 in the main text). Parameters δ, β are estimated by least squares with standard errors that allow for heteroskedasticity and autocorrelation as described by Newey and West (1987).

[1] This annex, and the chapter it supplements, is authored by Philipp Engler, Roberto Piazza and Galen Sher.
[2] In this Annex, like in the main text, AE denotes advanced economy and EM denotes emerging market economy, according to World Economic Outlook classifications.

The effects of monetary policy surprises, news about US economic activity, and news about COVID-19 vaccines are estimated on monetary policy announcement days, days of publication of headline US economic indicators and days with news about COVID-19 vaccines, respectively.

In order not to cut off some of the transmission channels of monetary policy and real economic news, the analysis does not control for other factors, which should be uncorrelated with the well-identified monetary policy surprises and real news measures used here.[3]

Data Sources

The following measures are used for news about monetary policy, the real economy or vaccines (s_t):

a. *Monetary policy surprises.* Data on US monetary policy surprises come from the change in Treasury yields on days of FOMC announcements, and these days were provided by the Federal Reserve. The ECB monetary policy surprises are as published by the ECB and as described in Altavilla and others (2019). The bond yield surprises are averaged across Germany, France, Italy and Spain using ECB capital keys as weights. These data end in April 2020, so were expanded to include the changes in bond yields on other announcement days of July 16, September 10 and October 29. However, weighted average eurozone bond yields often abstract from important spreads between yields in eurozone economies that are also arguably a target of euro area monetary policy.[4] Thus, one extension below uses spreads between yields on Italian and German government bonds as a monetary policy instrument, following Rogers and others (2014).

b. *Economic news.* Data on US economic news is the difference between the value of headline US macroeconomic indicators on their publication days and the median market survey expectation just before, as in Gurkaynak and others (2020). The chapter focuses on non-farm payrolls, because they have the largest effects, but GDP, retail sales, durable goods orders and consumer and producer price inflation are also analyzed. As a cross-check, A Bloomberg time series of US non-farm payroll surprises is used, which scales the surprises (in numbers of jobs) by the dispersion of survey responses. As an extension, the US economic surprise index published by Citigroup is also used, from Bloomberg. This index measures the extent to which economic indicators exceed market expectations, weighted according to impacts on exchange rates.[5]

c. *Vaccine news.* The daily stock returns of Moderna and BioNTech, two firms leading the race to develop vaccines against COVID-19, were sensitive to news about the development of vaccines. For example, on July 2, 2020, Moderna's stock fell by 5 percent after a report indicated that the company's stage-3 clinical trial could be delayed by a few weeks, and on November 9, 2020, BioNTech's stocks surged 14 percent after the company and its partner Pfizer announced that, based on preliminary data, their vaccine was a 90 percent effective in preventing infections.[6] Large movements in the stock prices of these two firms were also unlikely to have

[3] Indeed, changes in global factors (log VIX, log commodity prices, and the log total return index on US stocks) and EM monetary policy rates absorb some of the measured monetary policy spillovers, but the results here remain statistically significant.
[4] Weighted average eurozone yields and Italy-Germany spreads move in the same direction on about half of all ECB monetary policy announcement days in the sample.
[5] The interpretation of this index is challenging, because not all its components and weights are public.
[6] On both these days, the MSCI USA Healthcare Index did not change much.

been driven by other aspects of their business because these firms are not large or diversified multinationals. To remove the influence of other economic developments on their stock returns, the residuals are obtained in a regression of these returns on the those of the MSCI USA Healthcare Index. For each of the two firms, the residuals are coded as -1 or 1 if they fall in the bottom or top 10th percentiles of their historical distributions and zero otherwise. The vaccine news index is then computed as the sum of these two coded variables, which means the index takes on integer values between -2 to 2.[7] The interpretation of a unit increase in the index is if one of the two vaccines in development experiences a one-in-ten positive event. Many vaccines were in development in 2020, but their chances of success were correlated due to commonalities in technology.

The sample of 60 EMs is constructed from the IMF's list of 97 EMs by dropping offshore financial centers, countries without their own currency, countries undergoing hyperinflation or crises, countries on the IMF's list of fragile states, countries with population of less than 1 million persons and countries with GDP less than US$ 10 billion in 2019. The resulting economies are Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bahrain, Belarus, Bolivia, Bosnia & Herzegovina, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Dominican Republic, Egypt, Equatorial Guinea, Gabon, Georgia, Guatemala, Hungary, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan, Kuwait, Macedonia, Malaysia, Mauritius, Mexico, Mongolia, Morocco, Namibia, Oman, Pakistan, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russia, Saudi Arabia, Serbia, South Africa, Sri Lanka, Thailand, Trinidad & Tobago, Tunisia, Turkey, Turkmenistan, Ukraine, United Arab Emirates and Uruguay. A similar approach leads to a sample of 23 LICs, containing Bangladesh, Benin, Burkina Faso, Cambodia, Cameroon, Ethiopia, Ghana, Honduras, Kenya, Laos, Moldova, Mozambique, Nepal, Nicaragua, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Uzbekistan, Vietnam and Zambia.

Data for nominal, local-currency government bond yields are obtained from Haver. These come first from official sources if available, otherwise from Tullett Prebon, and otherwise from Reuters. Government bond total return indices and EMBI spreads are from JP Morgan Markets.[8] MSCI total stock return indices and BNP Paribas 5-year EM term premiums (following the method of Adrian and others (2013)) are from Bloomberg. Exchange rates against the US dollar and nominal effective (trade-weighted) exchange rates are from the IMF's Global Data Source database if available, otherwise from offical sources through Haver. The US term premiums and expected future short-term interest rates are as published by the Federal Reserve Bank of New York, also following the method of Adrian and others (2013). Daily portfolio flows are from the Institute of International Finance. Monetary policy rates are from the Bank for International Settlements.

The following measures of heterogeneity in the previous year ($x_{c,t}$) are used:

a. *Credit rating.* An economy is classified as investment grade if its sovereign rating from Moody's was at least Baa3 in the previous year, otherwise it is speculative grade.

[7] However, consistent with analyses of monetary policy surprises and real economic news, models for vaccine news are estimated only on days with vaccine news, so values of zero in the vaccine index are dropped from the sample. There are 62 vaccine news days, with -2 and 2 each occurring on about 10 percent of them, and with -1 and 1 each occurring on about 40 percent of them.

[8] For many economies, data on government bond yields with a 10-year constant maturity are also available from Bloomberg. The results in the main text are robust to using this alternative data source for 10-year yields.

b. *External debt share*. Data on external debt are difficult to obtain across countries. Therefore, the chapter uses the ratio of external debt owed by official sources to government debt, both from the IMF's WEO database.[9]

c. *Currency volatility*. This is the average, across months in the preceding calendar year, of the standard deviation of daily changes in the logarithm of the nominal effective (trade-weighted) exchange rate.

d. *Bond substitutability*. The correlation between the total returns of local currency government bonds is a measure of substitutability from the investor's perspective (Neely 2015). Results are similar whether such returns are expressed in local currency or in US dollars.

e. *Financial openness*. The index of capital account openness used is that of Chinn and Ito (2008).

f. *Financial ties to the US*. Overall financial ties are measured as the simple average of banking, direct investment and portfolio investment ties in the previous calendar year, each of which is measured as total assets and liabilities against the US in percent of the GDP of the given emerging economy. Banking ties are as reported by the US in the BIS' Locational Banking Statistics. Direct and Portfolio investment ties are from the IMF's Coordinated Portfolio and Direct Investment Surveys.

Table A.4.1.1. Interaction Terms (η) for Effects on EM 10-Year Bond Yields and EMBI Spreads of Surprises to US Non-Farm Payrolls and US Monetary Policy.

	Non-farm payrolls			Monetary policy	
	EM 10Y	EMBI	Exch. Rate	EM 5Y	EM 10Y
Fiscal capacity:					
• investment grade *(indicator)*	24	14	10	-42*	-27
• fiscal rule exists *(indicator)*	38**	-2	22	21	15
Risk channel measures:					
• government debt *(percent of GDP)*	-1**	-0.4	1	-0.3	-0.5
• government debt *(log[1+debt/GDP])*	-19*	-7	16	1	-8
• external debt share *(log[1+x])*	7	-0.5	7	17*	17*
• NEER volatility *(percent per day)*	-7	-42**	2	38	80*
Trade channel measures:					
• trade ties to the US *(percent of GDP)*	-1	-1*	-4	0.2	1
Portfolio balance channel measures:					
• substitutability in local currency	-3	81	97	-142	-64
• substitutability in US$	-18	52	507	-38	-22
• financial ties to the US *(percent of GDP)*	-1	1	-256	-2	1
• capital account openness *(index)*	-1	-1	-19*	-2	-2

Notes: Stars denote statistical significance: **=1 percent, *=5 percent, .=10 percent. 2Y, 5Y and 10Y denote the 2-, 5- and 10-year local currency government bond yields respectively. NEER denotes the nominal effective (trade-weighted) exchange rate. Exch. rate denotes the EM's bilateral exchange rate in local currency per US dollar. Non-farm payroll surprises are in millions of jobs and monetary policy surprises are in percentage points (i.e. per 100 basis points change in US2Y). EM10Y and EMBI spreads are in basis points. Substitutability is the correlation in total returns on government bonds between the given economy and the US, and it is constant across time. EM government bond yields are from Haver.

[9] This is a proxy, and may exceed 100 percent in some cases.

Further Detail on Interaction Terms

Table A.4.1.1 shows how the effects of US monetary policy and employment surprises vary across EMs (parameter η), according to EMs' fiscal capacity, riskiness, and trade and financial links to the US. The table confirms that there is some evidence that US monetary policy and employment surprises have stronger financial effects on EMs that are *ex ante* riskier, which suggests that US monetary and employment conditions transmit internationally by affecting investors' perceptions of risks or their risk aversion (a "risk channel"). However, this evidence is only suggestive because not all the tabulated sensitivity parameters are precisely estimated.

By contrast, the evidence does not support the existence of a portfolio balance channel, in that spillovers are no stronger for economies with *ex ante* more open capital accounts, deeper financial ties to the US, or bonds that are more substitutable with US bonds. For monetary policy spillovers, the portfolio balance channel suffers a lack of evidence, but for employment spillovers, the evidence points against the channel. After a surprise rise in non-farm payrolls, EMBI spreads seem to fall slightly less, and domestic currencies seem to depreciate by less, in EMs with deeper financial ties to the US than in other EMs (p-value of 10 percent). Similarly, under a portfolio balance channel, domestic currencies should depreciate by more in EMs with more open capital accounts, but Table A.4.1.1 shows that they in fact depreciate by less.

Table A.4.1.2. Robustness of the Effects of Monetary Policy Surprises.

	Alternative approach			
Finding	Control variables	Huber M-estimation	ZLB period (10-year yield changes)	non-ZLB period (Fed Funds Futures / EONIA)
Positive US monetary policy surprises:				
• appreciate the USD	n.a.	yes	yes	no effect
• do not affect the US VIX	n.a.	yes	yes	yes
• lift EM interest rates	yes	yes	yes	yes
• lift EM term premiums	yes	yes	yes	yes
• depreciate EM currencies against the USD	no effect	yes	yes	no effect
Positive EA monetary policy surprises:				
• lift EM interest rates at some maturities	yes	yes	yes	yes, lifts 6M, but lowers 2Y
• lift EM interest rates less than US surprises	yes, but only at shorter maturities; at longer maturities the effects are similar	yes, but only at longer maturities; at shorter maturities, the effects are similar	yes, but only at shorter maturities; EM10Y reacts more to EA10Y than to	yes

Notes: Huber M-estimation uses bisquare weights. The zero lower bound (ZLB) period for the US is between Nov. 30, 2008 and Sep. 30, 2016 and between Mar. 15, 2020 and Nov. 9, 2020 (the end of the sample). The ZLB period for the euro area is between Jul. 1, 2009 and Jun. 30, 2010 and between Jan. 1, 2012 and Nov. 9, 2020. In the non-ZLB period, the US monetary policy instrument is the 3-month interest rate on federal funds futures. and the euro area instrument is the euro overnight index average (EONIA). 6M and 2Y denote 6-month and 2-year government bond yields.

Robustness Exercises and Extensions

Table A.4.1.2 summarizes the effects of different analytical approaches on the chapter's main findings about the spillovers of monetary policy surprises. The first column shows that, by re-estimating the model using Huber robust regression (like Rogers and others (2014)), the main findings about spillovers from monetary policy surprises are not driven by outliers. Similarly, the main findings barely change when estimated on the zero lower bound period with 10-year government bond yields as the monetary policy instrument. The rightmost column shows the effects of estimating on the period when short-term interest rates were not at the zero-lower bound, with federal funds futures and the euro overnight index average (EONIA) as policy rates. During this non-zero lower bound period, US monetary policy surprises continued to have significant effects on EM interest rates and term premiums but did not have detectable effects on the US dollar or EM exchange rates against the dollar. Also, during the non-zero lower bound period, EONIA surprises lift yields on EM government bonds with 6-month maturity.

The spreads between Italian and German bond yields are informative about risks of fragmentation in the eurozone, which would have significant effects on EM trading partners. Therefore, monetary policy announcements that affect these spreads are significantly associated with measures of risk in EMs, like term premiums, spreads on dollar-denominated debt and stock prices (Figure A.4.1.1). Increases in the Italy—Germany spread seem to drive portfolio flows out of EMs (in the amount of 0.8 basis points of annual GDP, over 2 days, for each 100 bp tightening). Effects on longer-term local currency bond yields are marginally significant.

Table A.4.1.3 summarizes the effects of different analytical approaches on the chapter's main findings about the spillovers of news about the US economy. It shows that, when non-farm payroll surprises beat expectations, this tends to lift US interest rates, lower the US VIX, appreciate the US dollar and lift EM interest rates, and these findings are not driven by outliers (the first column of Table A.4.1.3) or the definition of non-farm payroll surprises (the second column). Two other findings are not as clear-cut.

Table A.4.1.3. Robustness of the Effects of US Economic News.

	Control variables	Huber M-estimation	Bloomberg non-farm payrolls
Positive non-farm payroll surprises:			
• lift longer-term US interest rates	n.a.	yes	yes
• lower the US VIX	n.a.	yes	yes
• appreciate the US dollar	n.a.	yes	yes
• lift EM interest rates	yes	yes	yes
• lift EM expected future short-term interest rates		no effect	no effect
• depreciate EM currencies against the USD	yes	no effect	yes
• lower EMBI spreads	yes	yes	no effect
Positive inflation surprises:			
• have 'essentially' no effect on EM interest rates /1	yes	some effects emerge, but they are sensitive to the weighting function	n.a.
• do not change EM exchange rates against the USD	yes	yes	n.a.

Notes: The results in the main text use a within-groups estimator without control variables and with non-farm payroll surprises from Gurkaynak and others (2020). The first column shows the effect of adding control variables, the second of using Huber M-estimation, and the right column shows the effects of using scaled non-farm payroll surprises (NFP) from Bloomberg. 1/ "Essentially no effect" here means that there may be a statistically significant effect at at most one maturity. We see effects at the 6-month maturity in the baseline specification, but it may be driven by low country coverage and is not confirmed by any effects at nearby maturities.

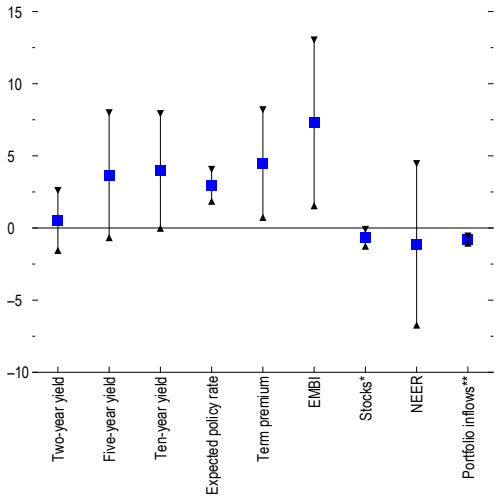
The depreciation of EM currencies after a positive non-farm payroll

surprise could be driven by outliers, and lower EMBI spreads after a positive non-farm payroll surprise could be driven by the definition of such surprises.

The main text concludes that US inflation surprises have very limited effects on EM financial conditions. This finding is based on the within-groups estimator and applies equally to US core CPI and core PPI inflation. While some statistical significance can be found when using a Huber M-estimator with Tukey bisquare weighting (following Rogers and others, 2014), this disappears if the tuning parameter is increased slightly above its conventional level of 4.685 and also disappears if alternative weighting schemes are used (not shown).

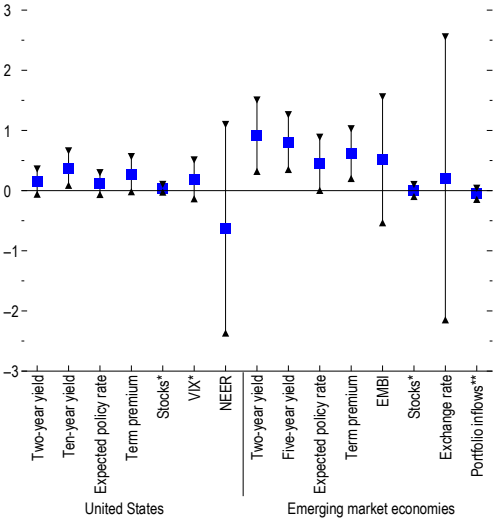
Figure A.4.1.2 shows the effects of US economic news as measured by the Citigroup economic surprise index. Such news tends to lift only longer-term US interest rates and does not clearly affect the US VIX or the value of the US dollar. This index of US news also lifts EM interest rates, but by small amounts.[10] Rising EM interest rates are nearly evenly split between expected future policy rate and term premium components, and the former suggests some expected policy reaction to inflationary pressures from increased US demand. This "trade channel" is similar to the one described in the main text.

Annex Figure 4.1.1. Effects of Increases in the Spread Between Italian and German Yields
*(Basis points; * = percentage points; ** = basis points of annual GDP)*



Source: IMF staff calculations.
Notes: The squares show estimates of the effect of a two standard deviation surprise in the spread between 10-year yields on Italian and German government bonds. The whiskers show 90 percent confidence intervals. The expected future short-term interest rate and term premia, are at the 10-year maturity for the United States and at the 5-year maturity for Emerging market economies. The emerging market nominal effective exchange rate (NEER) is trade-weighted and increases denote appreciations. EMBI = J.P. Morgan Emerging Market Bond Index; VIX = Chicago Board Options Exchange Volatility Index.

Annex Figure 4.1.2. Effects of Positive News about US Economic Activity: Citi Index
*(Basis points; * = percentage points; ** = basis points of annual GDP)*



Source: IMF staff calculations.
Note: The squares show estimates of the effect of a two standard deviation surprise in US economic activity. The whiskers show 90 percent confidence intervals. The expected future short-term interest rate and term premia, are at the 10-year maturity for the United States and at the 5-year maturity for Emerging market economies. Exchange rate increases denote appreciations. The United States nominal effective exchange rate (NEER) is trade-weighted, while the emerging market exchange rate is against the US dollar. EMBI = J.P. Morgan Emerging Market Bond Index; VIX = Chicago Board Options Exchange Volatility Index.

Annex 4.2. Determinants of APP Choice and Policy Rate Cuts

Specification: APPs

This section explains the empirical strategy behind the discussion of the drivers of APP choice and the size of the policy rate cuts among emerging market economies during the Covid-19 crisis in the second part of the main text.

Whether a country used APPs is indicated by a binary dummy variable y that is equal to 1 for countries that used APPs between March and August 2020 and zero otherwise. Vector x contains the drivers explaining the

[10] A 2-standard deviation increase in the Citi index of US economic news on a given day lifts EM interest rates by between ½ and 1 bp.

probability p of launching an APP. The relationship between x and p is described by the logit model

$$\mathrm{p} = \Pr[y = 1|x] = \frac{\exp(x'\beta)}{1 + \exp(x'\beta)}$$

where the term on the right is the logistic cumulative distribution function.[11] The marginal effect of a specific variable x_i on the probability p is equal to

$$\frac{\partial \mathrm{p}_i}{\partial \mathrm{x}_i} = \frac{\exp(x'\beta)}{[1 + \exp(x'\beta)]^2}\beta_i$$

The columns denoted with "APP dummy" in Tables A.4.2.2-A.4.2.5 below show the estimated coefficients β for the various drivers. The parameters β are estimated via maximum likelihood on the cross-section of countries, using the method proposed by Firth (1993) to correct small sample biases.[12] The bars in the charts of the main text show the marginal effects, evaluated at the means of the variables in x.

Specification: Policy Rate Cuts

The determinants of the interest rate cuts are estimated using linear regression models with cross sectional data. To reduce the role of outliers, the chapter uses robust regression which drops or downweighs observations with large residuals.

Estimation Results

All logistic or linear regressions reported in the chapter control for GDP per capita. Moreover, with only three exceptions, all the other regressions also control for the presence of a floating or freely floating exchange rate.

The only three exceptions are the regressions based on the "Inflation Targeting" regressor and on the "CB Transparency" regressor shown in Figure 4.14 in the text of the chapter, and on the

Table A.4.2.1 Pairwise Correlations

Variables	APP dummy	Floating and free floating dummy	Inflation targeting dummy	CB transpa-rency	Number of numerical fiscal rules	FXI	Percent policy rate cut during Covid-19
APP dummy	1.00						
Floating and free floating dummy	0.51	1.00					
Inflation targeting dummy	0.49	0.72	1.00				
CB transparency	0.46	0.60	0.70	1.00			
Number of numerical fiscal rules	0.22	-0.15	0.02	0.15	1.00		
FXI	0.28	0.48	0.47	0.30	-0.03	1.00	
Percent policy rate cut during COVID-19	0.30	0.24	0.31	0.25	0.30	0.22	1.00

t statistics in parentheses, $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

[11] See Cameron and Trivedi (2019) for details.

[12] Since the number of observations is relatively small, collinearities make it difficult to estimate models containing many drivers jointly. But even with separate logistic regressions for individual explanatory variables, maximum likelihood estimates are known to be biased due to a small sample size. This chapter therefore employs the method of Firth (1993) to reduce this bias. The method works by introducing a penalty term in the likelihood that shrinks the parameters toward zero. Without the penalty, traditional maximum likelihood parameters would be biased away from zero.

regression with "FXI" and "Policy rate cut" regressors whose results are displayed in Figure 4.16 in the main text. In all three cases, the exchange rate regime dummy was not used as a control because of its naturally high correlation with the regressors (see Table A.4.2.1; the reason why the FXI indicator is highly correlated with the exchange rate regime is discussed in a footnote in the relevant section of the chapter).

Table A.4.2.2 APPs and Rate Cuts in Emerging Markets: Policy Frameworks

	(1) APP dummy	(2) APP dummy	(3) APP dummy	(4) Percent policy rate cut during COVID-19	(5) Percent policy rate cut during COVID-19	(6) Percent policy rate cut during COVID-19
Real GDP pc, PPP	-0.000007	-0.000001	-0.0000001	-0.000158	0.000436***	0.000631***
	(-0.10)	(-0.06)	(-0.01)	(-0.28)	(2.73)	(3.17)
Floating and Free floating dummy	3.578***			19.24**	5.638	6.338
	(3.10)			(2.53)	(0.83)	(0.86)
Number of numerical rules in place	0.592**			4.789*		
	(2.03)			(1.97)		
Inflation targeting dummy		2.287***			18.19***	
		(4.27)			(2.71)	
Transparency Index			0.396***			2.220*
			(3.38)			(1.79)
Constant	-3.939**	-2.047***	-3.612***	0.239	1.028	-6.971
	(-2.49)	(-3.53)	(-3.42)	(0.02)	(0.26)	(-0.86)
Observations	41	96	72	39	92	70
R^2				0.211	0.249	0.216

t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Columns (1)-(3) in Table A.4.2.2 show the APP logit models and columns (4)-(6) the interest rate regressions for the group of *policy framework* variables.[13] The number of fiscal rules here counts budget balance, debt, expenditure and revenue rules, at the national and supranational level. Note that, since the number of fiscal rules that a country has in place is not very correlated with the flexible exchange rate dummy (Table A.4.2.1), both variables are used contemporaneously in the regression. The coefficients on GDP per capita are not significant in these specifications. Columns (4)-(6) show results for the policy rate

Table A.4.2.3 APPs and Rate Cuts in Emerging Markets: Fiscal Position

	(1) APP dummy	(2) APP dummy	(3) APP dummy	(4) Percent policy rate cut during COVID-19	(5) Percent policy rate cut during COVID-19	(6) Percent policy rate cut during COVID-19
Real GDP pc, PPP	-0.000046	-0.00003	0.000012	0.00037	0.000479***	0.000194
	(-0.88)	(-0.87)	(0.42)	(1.38)	(2.67)	(0.74)
Floating and free floating dummy	2.460***	2.044***	3.049***	7.887	16.43***	12.89
	(2.79)	(3.51)	(3.12)	(1.02)	(2.78)	(1.54)
Fiscal space 'at risk' or 'some'	2.397**			3.257		
	(2.10)			(0.34)		
S&P investment grade dummy		1.296**			(0.648)	
		(1.99)			(-0.11)	
Fiscal balance deterioration			0.0102			-0.156
			(0.88)			(-0.75)
Constant	-2.541*	-1.798***	-2.901**	14.15	3.676	15.57*
	(-1.94)	(-2.76)	(-2.45)	(1.23)	(0.85)	(1.86)
Observations	39	96	45	39	92	43
R^2				0.077	0.16	0.083

t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[13] The tables in this Annex report the estimated coefficients β and not the marginal effect of the regressors, which are instead shown in the figures in the main body of the chapter.

cuts. Here the GDP per capita level is significant at the 1 percent level in models (5) and (6) but loses significance in model (4) (this could be related to the rather small sample size).

Columns (1)-(3) and columns (4)-(6) in Table A.4.2.3 show the role of the *fiscal position* variables "intermediate fiscal space", an "investment grade rating" and of the "deterioration in the fiscal balance". Contrary to the APP regression, in the interest rate regressions none of the variables are statistically significant.

Table A.4.2.4 shows the regression results corresponding to Figure 4.16 in the chapter and Table A.4.2.5 provides the "Taylor rule" estimate for Figure 4.18 in the chapter.

Table A.4.2.4 APPs in Emerging Markets: Other instruments

	(1)
	APP dummy
Real GDP pc, PPP	-0.0000219
	(-0.93)
Percent policy rate cut during COVID-19	0.0254**
	(2.46)
Foreign exchange intervention dummy	1.090**
	(2.01)
Constant	-1.652***
	(-3.13)
Observations	92

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.4.2.5 Policy Rate Cuts in Markets: Domestic Conditions

	(1)
	Percent policy rate cut during COVID-19
Real GDP pc, PPP	0.0000858
	(0.46)
Floating and free floating dummy	15.92***
	(3.30)
COVID cases per 1000 inhab., Sep 1 2020	0.770**
	(2.31)
CPI inflation YOY	-0.665*
	(-1.97)
Manufacturing contribution to GDP	1.073***
	(3.57)
Constant	-3.035
	(-0.56)
Observations	83
R^2	0.344

t statistics in parentheses,

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

References

Altavilla, Carlo, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Giuseppe Ragusa. 2019. "Measuring euro area monetary policy." *Journal of Monetary Economics* 108: 162-179.

Cameron, Adrian C., and Pravin Trivedi. 2005. "Microeconometrics: Methods and Applications." *Cambridge University Press*.

Chinn, Menzie D., and Hiro Ito. 2008. "A new measure of financial openness." *Journal of Comparative Policy Analysis* 10(3): 309-322.

Driscoll, John C., and Aart C. Kraay. 1998. "Consistent covariance matrix estimation with spatially dependent panel data." *Review of Economics and Statistics* 80(4): 549-560.

Firth, D. 1993. "Bias reduction of maximum likelihood estimates." *Biometrika* 80: 27-38.

Gurkaynak, Refet S., Burçin Kisacikoğlu, and Jonathan H. Wright. 2020. "Missing Events in Event Studies: Identifying the Effects of Partially Measured News Surprises." *American Economic Review* 110(12): 3871-3912.

Neely, Christopher J. 2015. "Unconventional monetary policy had large international effects." *Journal of Banking & Finance* 52: 101-111.

Newey, Whitney K., and Kenneth D. West. 1987. "A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica* 55(3): 703-708.

Rogers, John H., Chiara Scotti, and Jonathan H. Wright. 2014. "Evaluating asset-market effects of unconventional monetary policy: a multi-country review." *Economic Policy* 29(80): 749-799.