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WHATEVER-IT-TAKES POLICYMAKING DURING THE PANDEMIC

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Whatever-It-Takes Policymaking during the Pandemic
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ABSTRACT

Central banks across the globe introduced large-scale asset purchase programs to address the unprecedented circumstances experienced during the pandemic. Many of these programs were announced as open-ended to shock-and-awe market participants and restore confidence in financial markets. This paper examines whether these whatever-it-takes announcements had larger effects than announcements with explicit limits on scale. We use a narrative approach to categorize announcements made by twenty-two central banks, and event study, propensity-score-matching, and local projection methods to measure the short-term effects of policy announcements on exchange rates and sovereign bond yields. We find that on average a central bank's first whatever-it-takes announcement lowers 10-year bond yields by an additional 47 basis points relative to size-limited announcements, suggesting that communication of potential policy scale matters. Our results for yields hold for both advanced and emerging economies, while exchange rates go in opposing directions, muting their response when we group all countries together.

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I Introduction

Former ECB President Mario Draghi is credited with resolving the euro crisis based on his promise to do whatever-it-takes to preserve the euro. In September 2022, the Bank of England echoed the phrase in its announcement that it would purchase long-dated UK government bonds on whatever scale necessary to restore orderly conditions in the gilt market. Likewise, during both the global financial crisis and the pandemic, many central banks established facilities to restore market liquidity and support aggregate demand with an explicitly open-ended set of provisions.¹ Would market reactions to these policy announcements have been as strong in the absence of this ramping up in scale and communication strategy? This paper examines this question by testing whether the whatever-it-takes asset purchase policies announced during the pandemic had larger effects than those with explicit limits on scale.

Central banks across the globe introduced extraordinary policies to address the unprecedented circumstances experienced during the global pandemic. This project categorizes these central bank pandemic-related policy announcements as whatever-it-takes or limited in scale, based on the texts of the announcement press releases, post-announcement press-conference statements, and news coverage of the announcements in the financial press. Documenting the accompanying post-announcement news is important, because it often clarifies central bank intentions. In some cases central bank press releases indicate an open-ended commitment, but subsequent statements suggest that there are significant limits to their firepower.² In yet other situations, central banks announce size-limited policies, but the size is so unprecedented that markets consider the announcement as a whatever-it-takes moment.

This paper examines market reactions to pandemic-related monetary policy announcements involving asset purchases by a wide array of central banks over the period March 2020 through December 2021. We ask which announcements had the largest impact and whether the way that policies were communicated to the market mattered. In the midst of the financial and economic turmoil it seems likely that countries were influenced by the types of policies and announcements made by other countries, which we describe as peer-pressure-induced policy. Countries are also influenced by the severity of the impacts of the pandemic on domestic economic conditions, which we describe as desperate-times³ policy. We control for these potential foreign country spillovers and own-country pressures in the

¹Examples of these types of facilities are described in detail in Buiter et al. (2023).

²In some cases central banks may be intentionally fuzzy because fiscal backstop limits are unclear, in other cases central banks themselves may not know how long they will be willing to do whatever-it-takes. Other potential constraints arise if the country prioritizes exchange rate stability or if central bank solvency is in question.

³The expression “desperate times call for desperate measures” is attributed to Hippocrates.

analysis and distinguish the impacts of whatever-it-takes announcements relative to similar, but size-limited, policy announcements. Importantly, we measure the effects of the announcement, not the implementation of the policy. In many cases, the size of the ultimate asset purchases was far lower than what markets anticipated based on asset price reactions at the time of announcement. An extreme example of this comes from Draghi’s now-famous speech in 2012, which resulted in the creation of the Outright Monetary Transaction facility (OMT) that was never tapped.⁴

Our empirical strategy involves using event study, propensity score matching, and local projection methods to measure the short-term effects of pandemic-related central bank policy announcements on exchange rates and sovereign bond yields. We find evidence that expansionary whatever-it-takes policies during the pandemic have stronger effects on asset prices than do size-limited announcements, suggesting that communication of potential policy scale matters. We also find that subsequent whatever-it-takes announcements have little additional impact, suggesting that markets already priced in these policies at the time of the initial announcement. On average a central bank’s first whatever-it-takes announcement lowers 10-year bond yields by an additional 47 basis points relative to size-limited announcements. Our results for yields hold for both advanced and emerging economies, while exchange rates go in opposing directions, muting their response when we group all countries together.

II Background and Literature Review

China was the first country to lockdown cities in January 2020 in order to reduce the spread of Covid-19 transmission. Numerous other countries followed suit, along with issuing travel bans. The World Health Organization declared Covid-19 a global pandemic on 11 March 2020. By the end of March 2020, over half of the world’s population was under some form of stay-at-home mandate. Many businesses were forced to close down, and global economic activity fell sharply. Reactions in the financial markets were immediate and severe: corporate spreads surged, equity prices tumbled, and implied volatilities for a wide range of assets jumped dramatically. Businesses and households around the globe dashed-for-cash

⁴Draghi’s speech where he used the phrase “whatever it takes,” but did not provide any specific policy announcement, was on 26 July 2012. Policy specifics followed in two announcements outlining the terms of the Outright Monetary Transactions (OMT) facility, which allowed the ECB to purchase 1-3 year maturity Eurozone sovereign bonds subject to EFSF/ESM conditionality. The OMT was introduced on 2 August and technical details were released on 6 September. Market reaction to the three 2012 announcements is described in Krishnamurthy et al. (2018), the average yield response across Eurozone countries was between 34 and 63 basis points. No asset purchases were ever made using the OMT, so it is an extreme example of a pure announcement effect.

as confidence in the financial sector plummeted. Governments responded to the crisis with a range of health-related and fiscal policy announcements, with the underlying objective of providing citizens with resources to cushion the impacts of a sudden reduction in economic activity. Likewise, central banks around the globe announced expansionary monetary policies to support aggregate demand and restore the smooth functioning of financial markets.

The Bank of Canada, the European Central Bank, the Bank of Mexico, and the Federal Reserve were the first in a long line of central banks that announced expansions of asset-purchasing facilities to help stabilize financial markets on 12 March 2020.⁵ In most cases, advanced economy central banks had used quantitative easing (QE) measures during and in the aftermath of the global financial crisis in 2008, and had continued to expand their balance sheets in the years prior to the pandemic. The pandemic-related central bank announcements were, as a consequence, not introducing new policy tools; they were instead emphasizing the greatly expanded potential size of the interventions they would be willing to take to counteract the negative impacts of the pandemic on financial markets. In many cases, the announcement was not just that the size of operations would increase, but that they could increase by an open-ended amount.

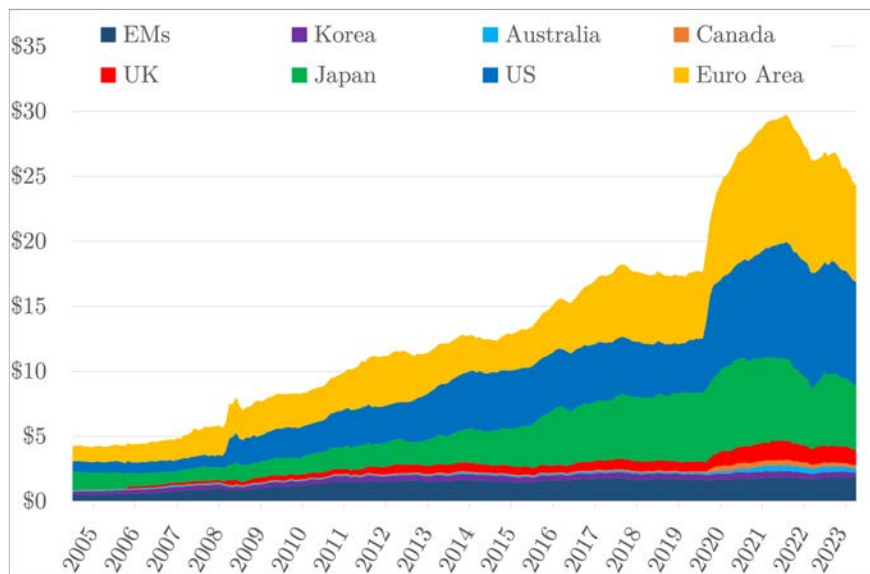
In emerging markets, only the central banks of Hungary and Colombia had pre-existing asset purchasing programs prior to the pandemic, so in the rest of the cases these programs were established for the first time in reaction to the extraordinary circumstances brought about by the pandemic. The central banks of Brazil and Chile needed changes to the legal framework from their legislative branches to allow them to purchase public debt. As was the case for many of the advanced economies, programs in emerging economies included purchases of private sector assets and well as government bonds, public agency assets and provincial and municipal bonds.

Central banks did not just say that they would purchase assets, they did so on an unprecedented scale. Figure 1 shows the dramatic increase in central bank balance sheets during the pandemic. The Bank of Japan's assets as a percent of GDP (103% in 2019) expanded by 21% between 2020 and 2021; the Federal Reserve (by 22%) and the ECB (by 33%) also greatly increased the size of their balance sheets as a result of pandemic-era operations. Emerging market (EM) countries did not expand on the same scale. Among EMs the central banks of Hungary, the Philippines and Poland saw the largest expansion of assets

⁵The Bank of Canada announced the expansion of various programs over multiple days in March 2020. The first time the press release stated purchases would be open-ended was on 27 March, but news reports suggest that it was the first BoC announcement on 12 March that was considered its first whatever-it-takes moment. Arora et al. (2021) only study the announcement on 27 March and find that it reduced Government of Canada bond yields by 10 to 15 basis points.

at around 6% of 2019 GDP over the two year period. Many central banks also expanded the range of assets they were willing to purchase, including corporate bonds, commercial paper and asset-backed securities, though the largest share of purchases were government securities.

Figure 1: Assets on Central Bank Balance Sheets (Trillions of US\$)



Source: Country Central Banks.

Measuring the impacts of monetary policy is always complicated by the fact that economic conditions typically drive policy changes. Central banks do not randomly announce policy changes and this is likely to be especially the case for whatever-it-takes announcements: central banks ‘go big’ in times of crisis. An important reason to emphasize the open-ended size of an intervention is presumably because a similar, but size-limited, intervention might not be large enough to restore confidence.⁶

Most of the whatever-it-takes monetary policy announcements in this time period involved asset purchasing facilities that allowed central banks to expand their balance sheets with a wide array of assets. The first of these announcements by the Federal Reserve on March 15, 2020 stated that the objective was “to support the smooth functioning of markets for Treasury securities and agency mortgage-backed securities that are central to the flow of

⁶Haddad et al. (2023) consider the possibility that all policy announcements have a whatever-it-takes element because market participants view policies as state-contingent, expecting more support in bad states. They suggest that large announcement impacts incorporate a “policy put” that reflects the expectation that additional interventions will be made if economic conditions worsen. Our study tests whether policy announcements that are explicitly limited in size differ from those that are perceived as open-ended, and find evidence that the distinction matters, suggesting that the policy put is not fully priced.

credit to households and businesses,” (Federal Reserve, 2020).⁷ In a related set of actions, the Federal Reserve announced a number of other (size limited) measures expanding access to the discount window, intraday credit, bank capital and liquidity buffers, reserve requirements and dollar liquidity swap line arrangements.⁸ The package of announcements seems to have been designed to shock-and-awe market participants in order to restore confidence in financial markets as well as provide aggregate demand stimulus by resuming quantitative easing (QE).⁹

Monetary policies, including QE policies, can impact asset prices through at least two channels: by changing expectations through the signaling channel; and through liquidity and portfolio balance effects, in models that allow for financial and goods market frictions.¹⁰ Examples of models in which QE can affect interest rates and exchange rates include Woodford (2012), Farhi and Gabaix (2016), Gourinchas et al. (2022) and Greenwood et al. (2020).¹¹ In these models, the signaling channel can operate on expected values of forward looking asset prices at the time of a policy announcement. No actual asset purchases are needed in order for changes in expectations to impact market prices. All that is needed is some form of friction that allows the announcement to provide new market-relevant information. In contrast, the liquidity and portfolio balance channels require actual asset purchases. Central banks can reduce liquidity premia on bonds by reducing the risk that bonds will be difficult to sell. Asset purchases can also impact the prices of specific bonds by changing the quantity and composition of private asset holdings. Asset purchase programs tend to reduce exposure to credit risk as central banks exchange safer assets for private sector holdings of riskier

⁷<https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315a.htm>

⁸Countries that relied heavily on dollar funding were especially hard hit by the global fall in dollar liquidity in March 2020. The Federal Reserve responded to this stress in the dollar market by reopening swap lines with an expanded list of countries and establishing the FIMA Repo Facility for countries without access to swap lines. This allowed central banks to obtain dollars by pledging US Treasuries as collateral. Countries with standing swap lines with the US include: Canada, Euro area, Japan, UK and Switzerland. The expanded list of countries that were given access to swap lines included: Australia, Brazil, Korea, Mexico, Singapore, Sweden, Denmark, New Zealand and Norway.

⁹English et al. (2022) note that along with the unprecedented size of many of the pandemic-era asset-purchase programs, the speed at which these purchases were made is also notable. They provide the example of the Bank of England which purchased bonds in 2020 at almost twice the pace as in the initial phase of QE in 2008.

¹⁰Bhattarai and Neely (2022) provide a comprehensive survey of macro models where QE and other unconventional monetary policies, regardless of size, have no impact, as well as what assumptions are needed for these policies to matter. Likewise, Borio and Zabai (2018) describe the range of unconventional monetary measures that central banks have taken, and what we know about their influence on financial conditions and the macro-economy. These papers, however, do not distinguish whatever-it-takes QE from size-limited QE policies.

¹¹In Dedola et al. (2021) expansionary relative QE shocks exacerbate limits to arbitrage in foreign exchange markets by widening CIP deviations.

assets.

Studies of announcements of size-limited QE measures prior to the pandemic find that they are often associated with significant depreciations of the currency of the announcing central bank and declines in bond yields. The first QE announcement by the Federal Reserve on 25 November 2008 led the dollar to depreciate by approximately 4% (Greenwood et al. 2020) and for average declines in yields of around 40 basis points (Gagnon et al. 2011). The European Central Bank’s size-limited securities market program (SMP) announcement on 10 May 2010 led to an average decline in yields (across the Eurozone countries) of 190 basis points (Krishnamurthy et al. 2018).¹² The Bank of England’s 4 March 2009 size-limited QE announcement led to a 100 basis point decline in the 10-year Gilt yield. Few developing countries used QE prior to the pandemic, so we do not have similar estimates for comparison. Rebucci et al. (2022) examine the pandemic-era QE announcements and find that one-day impact effects were larger for emerging market QE announcements than for advanced countries. They find a statistically significant overall average one-day decline of 23 basis points on 10-year yields, with the largest impact coming from the Romanian announcement on 20 March 2020 that led to a 150 basis points decline.

Dedola et al. (2021) examine the longer term effects of QE on bilateral exchange rates, emphasizing the need to take into account the relative QE actions of the two relevant central banks. They use the announcements of QE measures as instruments for changes in relative central bank balance sheets and find that a typical QE announcement by either the Federal Reserve or the ECB led to a persistent exchange rate depreciation of around 7%. Importantly, in their approach, the focus is on actual relative changes in central bank balance sheets. Whatever-it-takes announcements that do not result in asset purchases, like the original one by Draghi, cannot be examined in their framework.

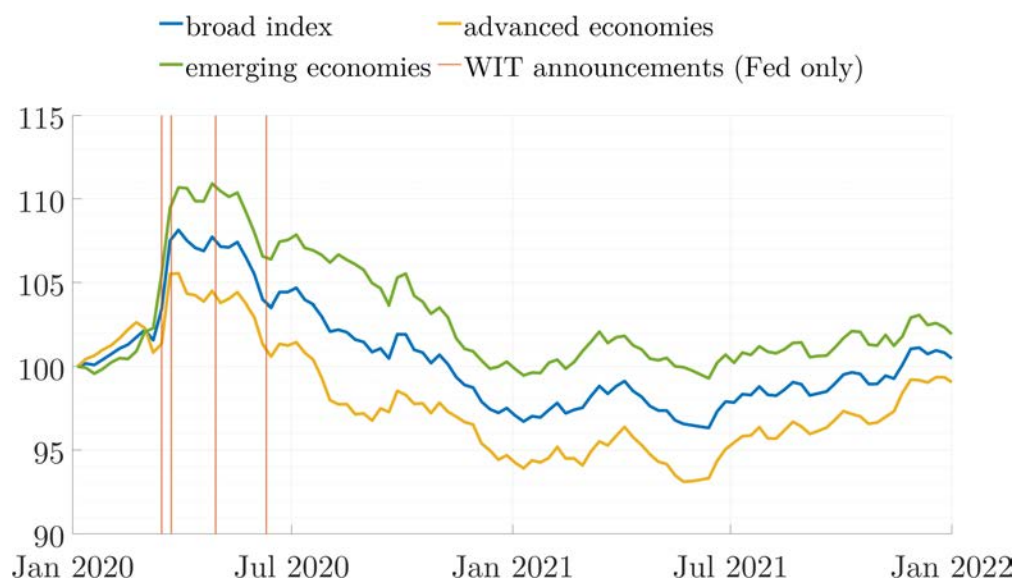
The impact of policy changes during the pandemic was also likely to be influenced by Covid-19 fundamentals. Davis and Zlate (2022) find that Covid-19 infection rates – which differed in timing and intensity across countries – affected the sensitivity of exchange rates and capital flows to the global financial cycle¹³ and explain a larger share of cross country heterogeneity in the early months of the pandemic than traditional macroeconomic fundamentals. During the pandemic, measures of the global financial cycle fell sharply, most

¹²The ECB’s first explicit QE program, the Public Sector Purchase Programme (PSPP), was announced on 22 January 2015. Along with the 2010 SMP, in 2009 and 2011 the ECB announced covered bond purchase programmes, and in 2012 it established the Outright Monetary Transactions programme, but none of these were officially described as QE facilities by the ECB.

¹³The global financial cycle is estimated in Miranda-Agrippino and Rey (2020) as a common component in a wide sample of advanced and emerging market asset prices at a monthly frequency.

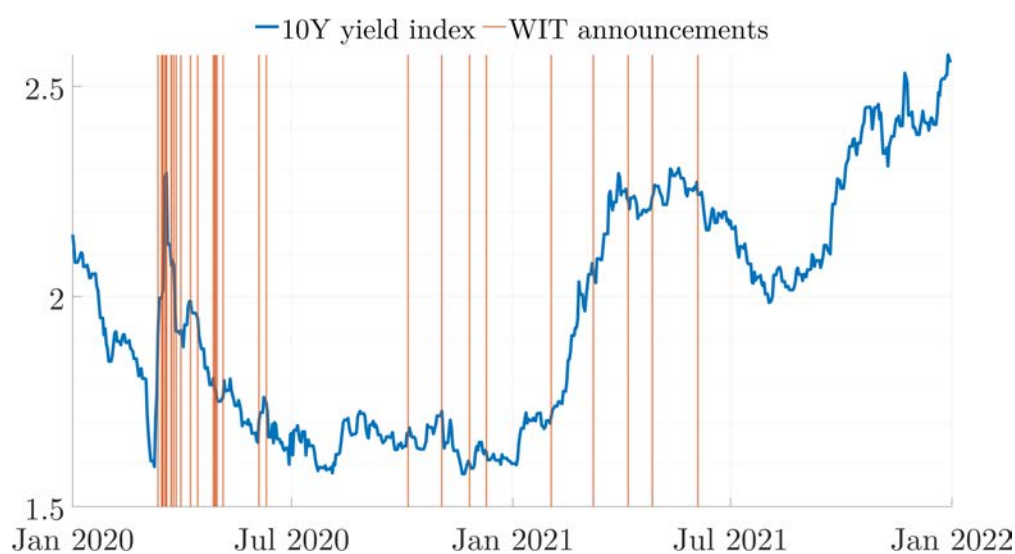
currencies depreciated relative to the U.S. dollar and capital flows fell across the board, but they fell by more for countries and during episodes with larger increases in Covid cases.

Figure 2a: USD exchange rate indices



Source: Federal Reserve Bank of St Louis; announcement data from Cantú et al. (2021), classification as whatever-it-takes (WIT) by authors based on central bank press release and subsequent news coverage.

Figure 2b: Global GDP-weighted 10-year yield index



Source: World Bank (GDP); Bloomberg (yields); announcement data from Cantú et al. (2021), classification as whatever-it-takes (WIT) by authors based on central bank press release and subsequent news coverage.

Figure 2a plots three trade-weighted dollar exchange rate indices: a broad one based on the dollar exchange rate against all major US trading partners, and then two narrower indices based on subsets of the same currencies, separating advanced economies and emerging markets. Vertical lines denote announcements of open-ended sovereign bond purchases made by the Federal Reserve, identified according to our methodology. The plot shows that the dollar appreciated sharply against all currencies in the early days of the pandemic, but the appreciation was steeper with respect to emerging market currencies. The steepest period of dollar appreciation coincided with the bulk of the Fed’s initial whatever-it-takes announcements (along with announcements of a number of other facilities). As investors were dashing for cash, and especially for dollars, in this period, it is hard to disentangle the flight-to-safety dynamics from the concomitant announcement of open-ended asset purchases. It seems likely that the announcements reinforced the dollar’s safe status (a point we will come back to later). Subsequent Fed announcements seem to be associated with both appreciations and depreciations.

Figure 2b plots an index capturing the global behavior of 10-year sovereign bond yields. We construct this as an average of the 10-year sovereign bond yields of the countries in our dataset of central bank announcements, weighted by their 2019 PPP GDP.¹⁴ Vertical red lines mark all whatever-it-takes asset-purchase announcements involving sovereign bonds made by central banks around the world, identified according to our methodology. A quick glance at the plot immediately reveals the spike in global yields at the beginning of March 2020, and a clustering of whatever-it-takes announcements crowding the same weeks. Yields peak on 24 March and then start declining, the day after the Fed unleashed its bazooka¹⁵ involving four asset-purchase facilities in what newspapers named “Jerome Powell’s whatever-it-takes moment”. Notable downward movements in the yield index are punctuated by many other open-ended asset purchases announcements, including another WIT announcement by the Fed on 29 April, Christine Lagarde’s own newspaper-coined whatever-it-takes moment on 4 June, and similar announcements in other countries that came later (for instance, Hungary on 6 October and Australia on 3 November). Of course, it was not just policy that mattered; improvements in the underlying global Covid situation also contributed to lowering yields.

¹⁴We drop Chile, India, and the Philippines, for which local-currency 10Y yields are not available for this period. For the euro area, we include Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal, and Slovakia.

¹⁵The word is an extension of bazoo, a slang term for “mouth” or “boastful talk” (1877), which is probably from Dutch bazuin “trumpet.” The Fed announcement included expanding the QE program to include purchases of commercial MBS, establishing two new facilities (the Primary Market Corporate Credit Facility and the Secondary Market Corporate Credit Facility), reestablishing the Term Asset-Backed Securities Loan Facility (TALF), along with expansions of other facilities.

Yields later surged again in 2021, driven especially by the yields of advanced economies, as the outlook for recovery improved and inflation expectations rose. Whatever-it-takes announcements got sparser during this period and were concentrated in a handful of countries (Australia, Hungary, India, and Japan).

III Categorizing Announcements using Press Releases and Newspaper Reports

The pandemic-era central bank announcements used in our study are collected and described in Cantú et al. (2021). These authors created a database of policy measures together with links to accompanying press statements that provide the timing and details of each announcement. In some cases these press statements are explicit about the size and limited duration of the facility, and in others the language indicates that the central bank is prepared to intervene by as much, and for as long, as needed. In this section, we describe how we categorize the central bank sovereign bond asset-purchase announcements used in our empirical analysis.

Our study aims to distinguish the impacts of open-ended policies from those with explicit limits; therefore, along with using the information provided by each central bank at the time of an announcement in the press-release, as well as statements made in the post-announcement press conferences, we also use the Factiva search engine to understand how the financial media describe the announced policies.¹⁶ There are cases where the press release suggests a size-limited policy announcement, but news reports describe the policy as unprecedented and expansive, often based on subsequent statements made during the post-announcement press conference. It seems likely that central banks purposely invoked constructive ambiguity in some of these cases in order to win over financial markets. This intentional ambiguity required us to take a narrative approach that involved reading both the press releases and the accompanying news reports to ultimately code each announcement as limited or open-ended, rather than rely on an algorithmic method or text analysis.

Two instructive examples of the difficulty of categorizing policies include two of the ECB and Fed’s announcements in March 2020. The European Central Bank’s 18 March 2020

¹⁶We filter the Factiva search on each announcement day to include articles in global and local news sources that include the terms “asset*” and “purchas*” within 3 words, “monetary policy”, “central bank”, and the country’s name or the central bank’s name when it does not contain the country’s name (e.g., the Fed or the Riksbank). Our search window goes from the day of the announcement out one week to ensure that all relevant articles reporting on the announcement are included. Central Bank announcement dates are from Cantú et al. (2021).

announcement of the Pandemic Emergency Purchase Programme (PEPP) included the size and duration of the program (€750 billion until the end of 2020), along with the statement, “The Governing Council will do everything necessary within its mandate. The Governing Council is fully prepared to increase the size of its asset purchase programmes and adjust their composition, by as much as necessary and for as long as needed.”¹⁷ We categorize this announcement as open-ended based on this expansive description of the program, even though an explicit size was also announced. Likewise, the Federal Reserve FOMC press release on 15 March 2020 states that “it will increase its holdings of Treasury securities by at least \$500 billion and its holdings of agency mortgage-backed securities by at least \$200 billion.”¹⁸ At the press conference directly after the FOMC meeting, Chair Powell clarified that the \$500 billion is a floor, but there is no ceiling. This whatever-it-takes clarification was a central feature of the news coverage of the Fed’s announcement and led us to classify it as open-ended.

We code announcements as open-ended in all cases where expansive language is included, potentially downward biasing our results. An example of this is the announcement by the Reserve Bank of Australia on 5 May 2020. In this case, the press release itself is a bit confusing. It states that the RBA “has scaled back the size and frequency of bond purchases, which to date have totaled around \$50 billion. The Bank is prepared to scale-up these purchases again and will do whatever is necessary to ensure bond markets remain functional and to achieve the yield target for 3-year AGS [Australian Government Securities].”¹⁹ The news coverage of this announcement focused on the fact that purchases were scaled back: the potential for reversing course and do “whatever is necessary”, if needed, did not receive as much attention. Nevertheless, because the press-release language includes an open-ended promise we code the announcement as whatever-it-takes. Likewise, the Bank of England’s 19 March 2020 announcement included a limit to how much would be purchased combined with language that they would “do what was necessary,” leading us to classify it as open-ended. In robustness tests we check whether dropping ambiguous announcements matters and find no evidence that these announcements are driving results.

Central banks made 166 asset-purchase announcements over 96 days during the period from March 2020 to December 2021. Of these announcements, 120 (72%) are coded as limited in size. Of the 46 open-ended announcements, 14 make explicit reference to the phrase whatever-it-takes either in the press-release, press-conference, or in the news coverage. Our

¹⁷https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200318_1_3949d6f266.en.html

¹⁸<https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315a.htm>

¹⁹<https://www.rba.gov.au/media-releases/2020/mr-20-13.html>

analysis starts with the full range of central bank asset-purchase announcements, and then focuses just on announcements of sovereign bond purchases (which reduces the total number of announcements to 105 over 73 days). In our full sample of announcements there are 23 dates on which multiple central banks made announcements and 26 dates on which the same central bank made multiple announcements. Our daily analysis is unable to disentangle the impacts of specific announcements on these dates, though we do test whether financial market reactions on dates with multiple announcements are larger than impacts on dates with a single announcement.

Table 1: Central Bank Asset-Purchase Announcements

Country	Date of First Announcement	Number of Announcements	No. Open-ended	% Open-ended
Canada	12/03/20	23	3	13%
Euro Area	12/03/20	13	6	46%
United States	12/03/20	25	11	44%
Mexico	12/03/20	2	0	0%
Japan	13/03/20	11	4	36%
Israel	15/03/20	4	0	0%
Sweden	16/03/20	7	1	14%
Poland	16/03/20	2	2	100%
Chile	16/03/20	9	0	0%
United Kingdom	17/03/20	7	2	29%
India	18/03/20	6	2	33%
Australia	19/03/20	9	6	67%
Korea	19/03/20	7	0	0%
Romania	20/03/20	1	0	0%
Thailand	22/03/20	2	0	0%
Colombia	23/03/20	4	2	50%
New Zealand	23/03/20	5	0	0%
South Africa	25/03/20	1	1	100%
Turkey	31/03/20	2	1	50%
Indonesia	01/04/20	3	0	0%
Hungary	07/04/20	22	5	23%
Philippines	10/04/20	1	0	0%
Total		166	46	28%

Source: Announcement data from Cantú et al. (2021), classification as open-ended by authors based on central bank press release and subsequent news coverage.

Table 1 lists the 22 central banks that announced asset-purchasing programs during the pandemic, the date of their first announcement, the total number of announcements made by each central bank, and the percent of these announcements that we code as open-ended in scale. In our empirical work we compare the exchange rate and bond market reactions to the announcements that are explicitly size-limited to those that are open-ended.²⁰ We also group announcements in four additional ways. First, we narrow the announcements to those involving purchases of sovereign bonds in order to focus on similar policies across countries. Second, we look at advanced economy announcements separately from those made by emerging market countries. In asset pricing models, only shocks, whether exogenous or the surprise component of policy news, should lead to market reactions. Information that is expected will already be priced by markets. In the case of advanced economy pandemic-related asset-purchase announcements, some part of the information is likely to have been expected by markets, based on their actions during the 2008 financial crisis and the wide use of QE in the subsequent years. Few central banks in emerging market countries had previously used QE policies, so their pandemic-related asset-purchase announcements were likely to have been more surprising. Third, we look at the first whatever-it-takes announcement separately from subsequent open-ended announcements, and do the same for the first size-limited announcement. The first announcement at the start of the pandemic is likely to have more of a surprise-factor than succeeding announcements. Bernanke (2020) and Hadad et al. (2023) also find that the initial announcements of QE by the Federal Reserve and the ECB had larger effects on asset prices than did succeeding announcements.²¹ Fourth, we distinguish those announcements that literally use the phrase “whatever-it-takes” in describing the policy either in the press release, the post-announcement press conference, or in the news coverage of the announcement.

Our main set of empirical analyses uses daily data. We use US dollar exchange rates from the Bank for International Settlements online statistics, which in turn are sourced from

²⁰Our robustness tests exclude the announcements that are ambiguous, either because they include limits in the press release, or because the news reports suggest markets are skeptical that the policy is open-ended. Results are qualitatively the same when we exclude all ambiguous announcements at once, as well as one at a time, indicating that none of these announcements are driving the results.

²¹Vissing-Jørgensen (2021) studies the effects of the Federal Reserve March 2020 announcements as well as actual asset purchases on high frequency data from Treasury futures. She finds a causal link from asset purchases, not announcements, to yield declines and suggests that the severe liquidity needs of sectors that were heavy sellers of Treasuries required large actual purchases to stabilize the market. Swanson (2021) also takes a high-frequency (30 min) approach to identify the immediate causal effect of asset-purchase announcements on a broad set of asset prices in the pre-pandemic period and finds impacts that are significant and comparable to those of conventional monetary policy.

Table 2: First Open-ended Sovereign Bond Purchase Program, Announcement Dates by Country

Advanced Economies	Date	Announcement
Bank of Canada	12/03/20	Expansion of Bond Buyback Program
Federal Reserve Board	15/03/20	Asset Purchase Program
Bank of Japan	16/03/20	Government Bond Purchases
European Central Bank	18/03/20	Pandemic Emergency Purchase Program (PEPP)
Bank of England	19/03/20	Government Bond Purchases
Reserve Bank of Australia	19/03/20	Government bond purchases
Sveriges Riksbank	26/11/20	Asset Purchase Program
Emerging Economies		
National Bank of Poland	16/03/20	Treasury Bond Purchases
Central Bank of Colombia	23/03/20	Government Bond Purchases
South African Reserve Bank	25/03/20	Government Security Purchases
Central Bank of the Republic of Turkey	31/03/20	Government Domestic Debt Securities (GDDS)
Hungarian National Bank	28/04/20	Government Security Purchase Program
Central Bank of India	07/04/21	Government Security Purchases

Source: Announcement data from Cantú et al. (2021), classification as open-ended by authors based on central bank press release and subsequent news coverage.

the ECB and the Federal Reserve.²² Exchange rates are measured between 13:15 and 17:00 GMT. For the US, we look at the exchange rate against the euro. All exchange rates are quoted so that an increase corresponds to an appreciation. Local-currency-denominated sovereign bond yields are from Bloomberg, covering maturities between 3 months and 10 years. We focus on results for the 10-year yield in the main text, but results for other maturities are contained in the appendix. Daily Covid-19 cases are from the World Health Organization.²³ The daily Economic Policy Uncertainty (EPU) index is computed by Baker et al. (2016).²⁴ Central bank announcements are from Cantú et al. (2021).²⁵ We provide a robustness test of our daily results by focusing on intraday impacts of ECB announcements using tick-data described in Altavilla et al. (2019).

²²<https://www.bis.org/statistics/xrusd.htm?m=2675>

²³<https://covid19.who.int/data>

²⁴<https://www.policyuncertainty.com/index.html>

²⁵<https://www.bis.org/publ/work934.htm>

IV Event Study Analysis

During the pandemic, governments and central banks announced policy changes to address the negative impacts of business closures and financial market turmoil.²⁶ In some cases, the announcements were explicitly open-ended. In many other cases, announced new facilities included specific size and time limits. Market reactions to these different types of announcements are likely to differ.

If we start with an initial price of an asset, p_0 at time 0, it should reflect the expected value of the asset in the next period, so that: $p_0 = \mathbb{E}[p_1]$. If a size-limited asset-purchase policy is announced at time 0, this tells the market that the central bank will purchase a quantity Q of the asset by a specific date. To keep things simple, let that policy end-date be time 1 and assume that M is the known price impact of a Q -sized purchase of the asset. This suggests that the post-announcement price of the asset at time 1 is $p_1^A = p_1(1 + MQ)$ and at time 0 it is $p_0^A = \mathbb{E}[p_1](1 + MQ)$.²⁷ It is straightforward from this to relate the change in the asset price before and after the announcement, $\frac{p_0^A - p_0}{p_0}$, to MQ .

In the case of an open-ended policy announcement where Q is not defined, the post-announcement price will be based on an expectation of Q . Our setup allows for the possibility that policymakers decline to explicitly define Q so that this market expectation will exceed the Q that would have been announced in normal times. In Haddad et al. (2023), all announcements are modeled as conditional promises, so that markets expect policymakers to scale-up policy by an additional amount Q^* if economic conditions deteriorate in time 1 (which is equivalent to the asset price falling below a cutoff value p^*). The post-announcement price at time 0 in this setting includes the baseline case with a known Q (and M), and an additional term multiplied by MQ^* that includes the expected probability that $p_1 \leq p^*$:

$$P_0^A = \mathbb{E}[p_1] + \mathbb{E}[p_1]MQ + \mathbb{E}[p_1 \cdot \mathbf{1}_{\{p_1 \leq p^*\}}]MQ^* . \quad (1)$$

In our setup, the post-announcement asset price change for announcements that are limited in size and scope should be based on the information policymakers provide about Q and views about M . The size of the post-announcement asset price change after whatever-it-takes announcements are less clear-cut, but we will test whether it exceeds the size of the Q -baseline case. In the case of central bank asset purchases, credibility is likely to be higher

²⁶Bergant and Forbes (2022) examine how countries decide on specific policy packages, looking at a wide array of policies, including fiscal, monetary, foreign exchange intervention and macroprudential regulation. Interestingly, they find that use of one of these types of policies did not affect a country's use of the other policies.

²⁷This notation is the similar to what is used in Haddad et al. (2023).

than it will be for some other government policies, given that central banks have the unique ability to expand their balance sheets when they choose to do so.²⁸

The first step of our analysis is an assessment of the effectiveness of the first whatever-it-takes (we will sometimes abbreviate “whatever it takes” with “WIT” going forward) and the first size-limited announcements. We do this with an event study framework, and specifically with a two-way fixed effect estimator in a staggered dynamic difference-in-differences specification. The choice to focus only on the first announcement is somewhat determined by the event study setup. On the one hand, this methodology is effective for gauging the effect of a single treatment or event, even if it is staggered. On the other hand, however, the shortcoming of the event study approach via this diff-in-diff specification is that it is more appropriate in settings where each group is treated once, and it is not suitable for a situation with repeated treatments, as we have in our case. Indeed, most central banks made several consecutive announcements, and often they were closely timed to each other. As a result, most countries were treated multiple times, and there was no clear “switching off” of the previous treatment before the next one is introduced, so that they effectively overlapped and cumulated, making estimation difficult. For this reason, we limit our event-study analysis only to the first announcement, and we consider this the only treatment experienced by each country. We will expand our analysis to the full set of announcements in the section on the local projections approach to the diff-in-diff analysis.

We begin with an examination of the effects of open-ended sovereign bond purchase announcements on our two outcome variables, exchange rates and yields, around a 15-day window.²⁹ We measure the impact of the first whatever-it-takes and size-limited announcements by the central banks listed in Table 2 on the dollar bilateral rate for non-US announcements and the euro-USD bilateral rate for Federal Reserve announcements as well as own-country

²⁸Central banks have the unique ability to create domestic base money, but they cannot create foreign currency legal tender. This means that countries with fixed exchange rates may be subject to greater constraints on their ability to do whatever-it-takes, for fear of triggering a run on the currency. It is also the case that central bank’s solvency can be at risk if they suffer substantial losses from intervention-related operations, suggesting that balance sheet exposure and restricted access to fiscal support may also influence the credibility of a whatever-it-takes pronouncement.

²⁹Blotevogel et al. (2022) expand the event study specification to include pre-announcement expectations (based on survey data) and post-announcement implementation effects (based on actual asset purchases). In an examination of Euro Area announcements during the pandemic they find large announcement effects, some evidence of pre-announcement expectation effects, and weak implementation effects. These results are in keeping with the larger literature that finds the largest asset pricing effects at the time of announcement.

10-year sovereign yields.³⁰ Our specification for the exchange rate is as follows:

$$100 \cdot \ln FX_{i,t} = \alpha_i + \alpha_t + \sum_{s=-15}^{-2} \beta_s D_{i,t,s} + \sum_{s=0}^{15} \beta_s D_{i,t,s} + \mathbf{X}_{i,t} \boldsymbol{\gamma} + \varepsilon_{i,t} , \quad (2)$$

so that the units of the dependent variable correspond to percentages. The specification is similar for the yields, except the dependent variable is in basis points:

$$y_{i,t} = \alpha_i + \alpha_t + \sum_{s=-15}^{-2} \beta_s D_{i,t,s} + \sum_{s=0}^{15} \beta_s D_{i,t,s} + \mathbf{X}_{i,t} \boldsymbol{\gamma} + \varepsilon_{i,t} . \quad (3)$$

Here, $D_{i,t,s}$ is a dummy variable, equaling 1 if, in period t , country i is s days away from its first whatever-it-takes or limited sovereign bond purchases announcement, and 0 otherwise. We cumulate lags and leads that are farther than 15 days away from the announcement, so that $D_{i,t,-15}$ and $D_{i,t,15}$ are equal to 1 if observation $\{i, t\}$ is 15 or more days earlier or later than the announcement, respectively. Treatment in this context occurs in period 0, and we examine how differences in the outcome variable between treated and untreated countries evolve pre- and post-announcement, relative to their value in the omitted base day, i.e. the day before the announcement. Although in past QE episodes asset prices reacted quickly to central bank announcements, the unusual circumstances of the pandemic may have made it more difficult for markets to process the information revealed in the asset-purchase announcements. This possibility led us to include additional post-announcement days in our estimation window. Importantly, 12 of the 13 first open-ended sovereign bond purchase announcements in our dataset took place in 2020. More specifically, as shown in Table 2, 11 of them occurred between March and April, and only two occurred later. As a result, we estimate the regressions using data from 2020 only, so as not to contaminate the control with observations from 2021 that are very distant from the treatment for most of the countries in our sample.

We include country and time-fixed effects as well as a set of control variables $\mathbf{X}_{i,t}$ that are available on a daily basis. Our regression controls capture global, foreign and domestic factors that may be driving policy announcements. These controls allow us to identify the unpredictable component of the policy announcement. We take into account peer effects

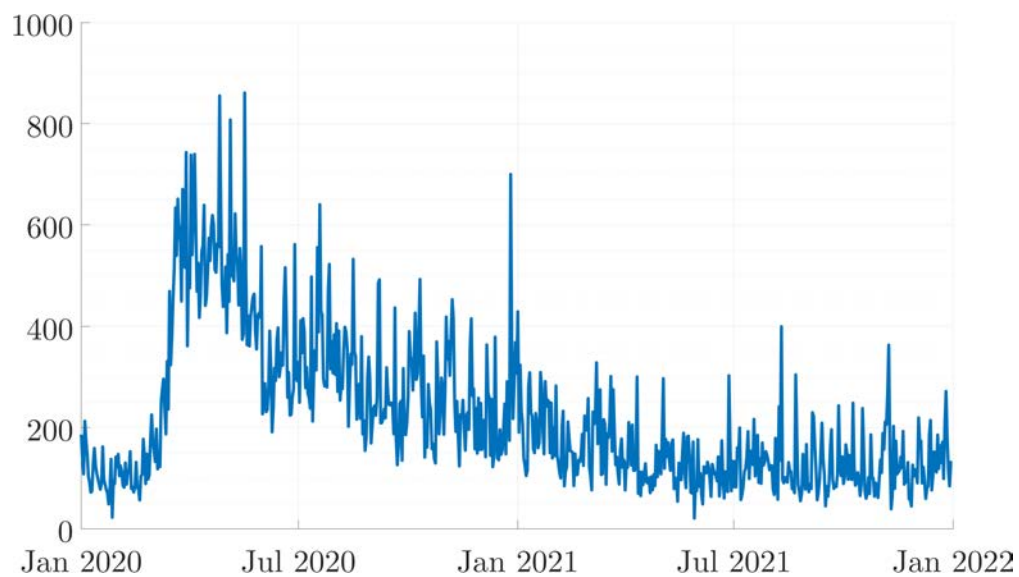
³⁰For the exchange rate, the euro area counts as one country. When looking at yields, we look at individual countries within the currency union: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal, and Slovakia. For each of these countries, we therefore have the ECB announcements on the right-hand side, and the country's own yield on the left-hand side. The control variables are similarly aggregated and disaggregated depending on the specification.

by including prior whatever-it-takes announcements made by other central banks. The cumulative number of own-country Covid-19 cases is also included as an important economic barometer during the pandemic, and we separately include the global number of Covid-19 cases (excluding own-country cases) as an indicator of worldwide economic conditions. Finally, we include the number of own-country prior limited-size policy announcements. The larger the number of prior policy announcements, the more likely economic circumstances have continued to deteriorate, leading to more expansive (desperate-times) policy measures.

Figure 3 presents an overview of the control variables. We begin by plotting the economic policy uncertainty (EPU) index introduced in Baker et al. (2016), which is based on counts of news articles that are related to policy uncertainty, and has been found to be a useful daily predictor of macroeconomic conditions. This is a single time series, so it gets absorbed by the time fixed effects when both are included, but we find either of these controls to be important to take account of the high degree of volatility and uncertainty experienced globally during this period. The Covid cases and cumulative announcements variables have a panel structure given that we include the own-country and rest-of-the-world measures separately. In the plots we provide a global aggregate to show their overall behavior during this period. The first announcements plot shows the steep increase in the number of open-ended announcements in the early days of the pandemic, which coincides with increases in Covid cases and rising uncertainty. Initially the number of WIT announcements grew faster than size-limited ones. In the summer of 2020, the pace of WIT announcements slowed down and eventually plateaued, at the same time the first Covid wave also flattened. Size-limited announcements continued steadily during this period as central banks kept up efforts to sustain the economy. A new wave of open-ended announcements came with the new wave of Covid cases in the fall of 2020. WIT announcements largely ended in the summer of 2021, while size-limited announcements continued through the end of 2021.

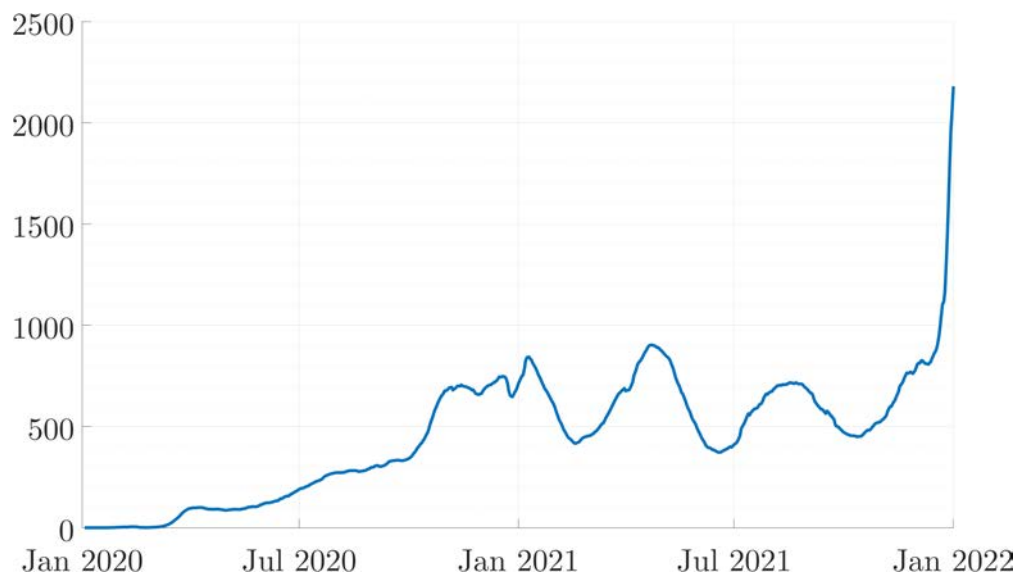
The second announcements figure does not explicitly plot variables that we use as controls, but since we focus on sovereign bond purchases announcements only, it shows how these were different from non-sovereign asset purchases. We call an announcement sovereign if at least one of the asset-purchase programs that were announced that day is directed at sovereign bonds. We call it non-sovereign if no sovereign programs were announced on that day. The yellow line corresponds to the sum of the red and green lines in the previous plot. The plot shows that most of the announcements were directed at purchasing sovereign bonds, rather than other assets such as corporate or municipal bonds. This is especially true between March and July of 2020, where sovereign announcements grow much faster than non-sovereign ones.

Figure 3a: Economic Policy Uncertainty Index



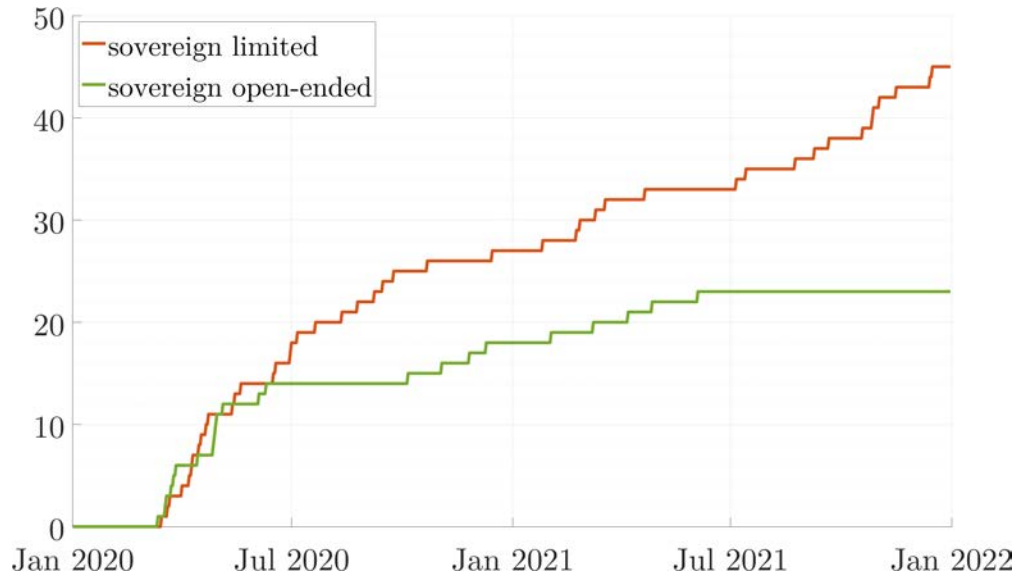
Source: Baker et al. (2016).

Figure 3b: Number of New Covid-19 Cases Globally (thousands), Weekly MA



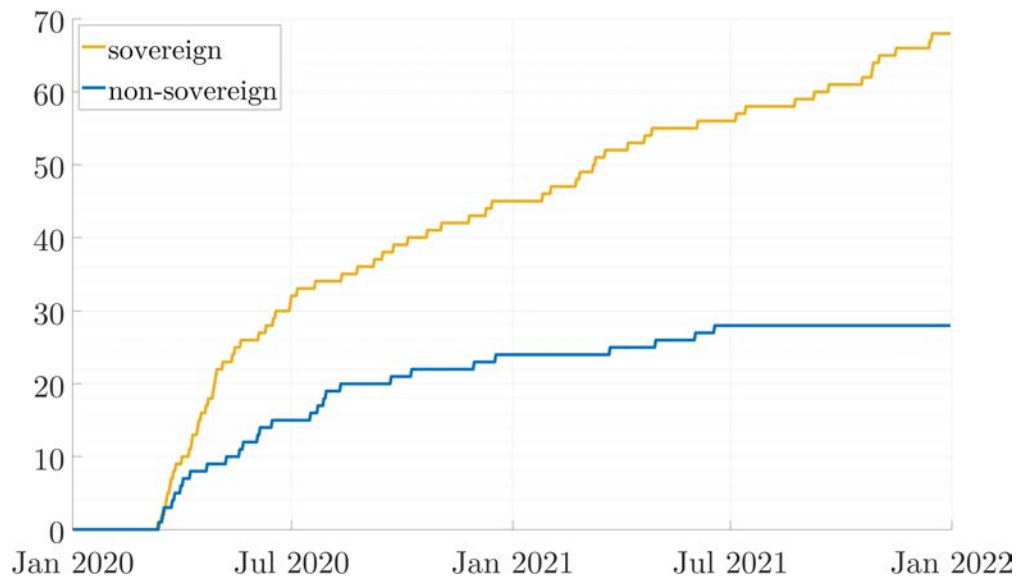
Source: World Health Organization.

Figure 3c: Cumulative Number of Sovereign Bond Purchases Announcements



Source: Announcement data from Cantú et al. (2021), classification as open-ended by authors based on central bank press release and subsequent news coverage.

Figure 3d: Cumulative Number of Asset Purchases Announcements

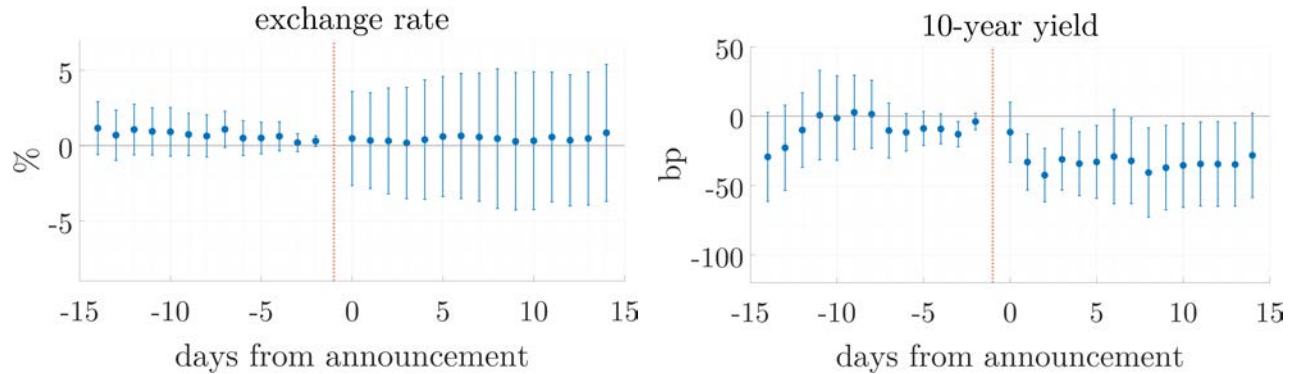


Source: Announcement data from Cantú et al. (2021), classification as sovereign and non-sovereign based on program description and central bank press release.

The event study approach focuses on the coefficients that capture the impact of each country’s policy announcement on the exchange rate and sovereign yields, relative to the day immediately preceding the announcement. In the figures, the x-axis is measured in event time, so that for each central bank, the announcement of a new policy is aligned at time zero. The underlying assumption is that the time-zero event is the announced policy that changed what otherwise would have happened to the exchange rate or the sovereign yield. The y-axis shows the depreciation of the country’s currency value relative to the dollar, or the change in the yield, before and after the announcement.

Figure 4a on the left shows that open-ended announcements had little impact on the exchange rate, although standard errors become considerably larger after the event. The same is true for the first size-limited announcement, where none of the coefficients are significant. One possibility is that these first announcements significantly moved exchange rates, but did so in different directions for different countries, so that the point estimates cancel out, but the standard errors get bigger. We will elaborate further on this point in the next section.

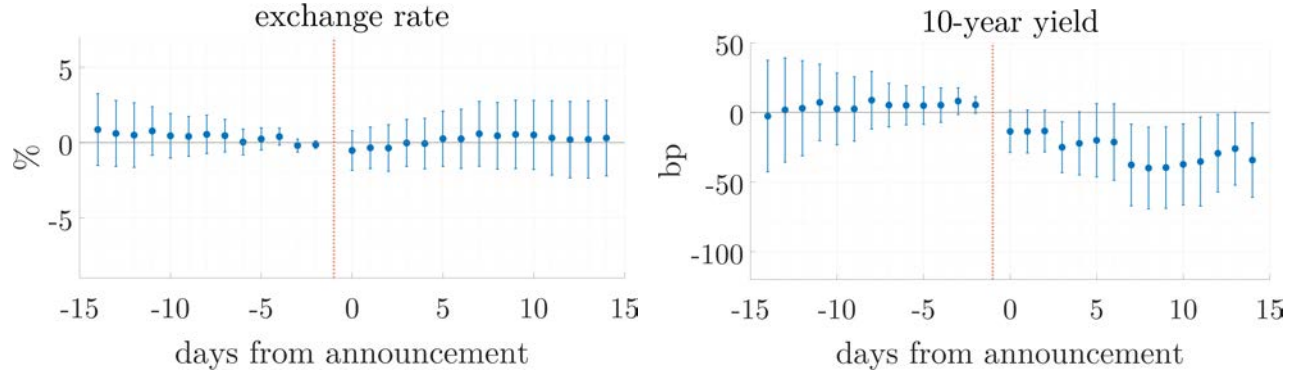
Figure 4a: Event study (WIT)



Notes: Event studies are based on equations 2 and 3. In the charts the x-axis is measured in “event time.” The first whatever-it-takes announcement for the countries listed in Table 2 is the “event”. The y-axis shows depreciation against the dollar in percentages (on the left) or the change in the 10-year sovereign yield in basis points (on the right) relative to the day before the announcement. Dots indicate the coefficient estimates β_s , bars denote 90% confidence intervals. Regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by country.

The story is different for 10-year yields in Figure 4a on the right, where open-ended announcements appear to have strong and rapid effects leading to a persistent decrease of around 40-50 basis points. No pattern of increasing standard errors appears in this case. Our control variables are generally not statistically significant. Figure 4b shows the impact

Figure 4b: Event study (size-limited)



Notes: Event studies are based on equations 2 and 3. In the charts the x-axis is measured in “event time.” The first size-limited announcement for the countries listed in Table 2 is the “event”. The y-axis shows depreciation against the dollar in percentages (on the left) or the change in the 10-year sovereign yield in basis points (on the right) relative to the day before the announcement. Dots indicate the coefficient estimates β_s , bars denote 90% confidence intervals. Regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by country.

of the first size-limited announcement on 10-year yields, which shows little or no effect in the first week, but then the coefficient falls and gets closer to what we find for open-ended announcements. The takeaway from these event study plots seems to be that the first policy announcement impacted market expectations significantly, but only when it comes to yields, not for the exchange rate. This result, however, might hide some heterogeneity, which we will attempt to uncover in the next section, along with a broader comparison of the effectiveness of different policy announcements.

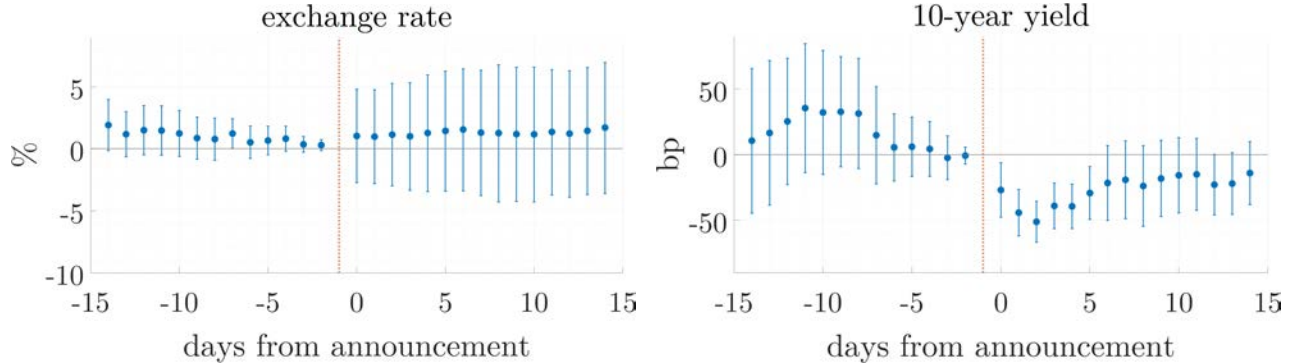
In our event study analysis of WIT announcements, our control sample includes all countries that did not make an open-ended announcement. One concern with this approach is selection bias: it may be that the countries that made WIT announcements differ in important ways from those who did not. In our context, it may be that some countries could not have credibly made open-ended policy promises because they have different monetary policy histories or different levels of financial market development. One way to address this potential selection bias in the control group is to use propensity score matching techniques to narrow our control group to countries that are more similar to each other ex-ante. We base our propensity scores on the behavior of the lagged values of our outcome variables (exchange rates and yields³¹) over 2019. Figure 4c shows that using nearest-neighbor³² propensity score

³¹For yields, in addition to the 10-year yield, which is our main outcome variable, we also include 1-year and 5-year yields.

³²We also used other alternative propensity weighting schemes (including nearest 3 neighbors and radius-

weights (allowing for ties) confirms our results for both exchange rates and yields. For yields, the effect of the announcement is about 50% larger on impact and immediately significant, and remains slightly larger for the next few days, although it then decreases, showing lower persistence relative to our baseline estimates.

Figure 4c: Event study (WIT) with propensity score matching



Notes: Event studies are based on equations 2 and 3, estimated using propensity score weights. In the charts the x-axis is measured in “event time.” The first whatever-it-takes announcement for the countries listed in Table 2 is the “event”. The y-axis shows depreciation against the dollar in percentages (on the left) or the change in the 10-year sovereign yield in basis points (on the right) relative to the day before the announcement. Dots indicate the coefficient estimates β_s , bars denote 90% confidence intervals. Regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by country. The never-treated countries that act as controls (and their propensity score weights) are: Indonesia (0), South Korea (0), Mexico (3), New Zealand (1), Romania (15), and Thailand (3).

V Local Projection Analysis

V.1 Absolute effect of each kind of announcement

The event study and propensity score matching approaches can capture the impact of the announcements (or other forms of treatment) relative to appropriate controls, which in our case are countries and days in which no announcements are made. As long as the announcement is a surprise, and the control days are similar (exhibit parallel trends) to the pre-treatment days, an event study can identify the average announcement effect. In our setting, there are three additional complications: the timing of announcements differs across central banks; there are different types of announcements; and each central bank makes multiple announce-

matching using a range of “caliper” cutoffs) and found that results are comparable with the size of the standard errors not changing significantly.

ments of each type. This suggests that impacts of the announcements may differ due to timing, heterogeneity in underlying policy, and potentially due to gradual learning about the announcements or a cumulation of their effects. In order to take into account these potential staggered, heterogeneous, repeated, and dynamic treatment effects we turn to the local projection methods described in Dube et al. (2023).

A critical issue in our setting is what days can be included in the non-treatment control group. Once a central bank announces a new asset purchasing policy, for how long should we consider the subsequent days to be part of the treatment? Our estimates will potentially be subject to bias if we include control days that are still being affected by an earlier announcement. In the language of event studies, this is described as an ‘unclean comparison’ and will be a source of negative weights bias in the event estimation. Alternatively, if we exclude all subsequent days after an announcement (the clean control condition), this would force us to exclude any subsequent announcements by the same central bank in the analysis and would result in very few eligible days for the control group. In some settings the control days from a distant time period could be used, but in our context we need days during the pandemic in order to be able to match pre-treatment outcome dynamics.

Our setting is one in which the treatment is not always absorbing, as the same central bank can (and often did) make multiple announcements. We would like to examine these subsequent announcements in our analysis. Our approach is therefore to report results using a partially cleaned (15- and 30-day) control group as well as those based on a fully-cleaned control group that excludes all subsequent days after each announcement.³³ In cases where central banks make subsequent announcements prior to the end of the (partial) cleaning period, we include the announcement and start-over with a new cleaning period.

We run the following regression for the exchange rate:

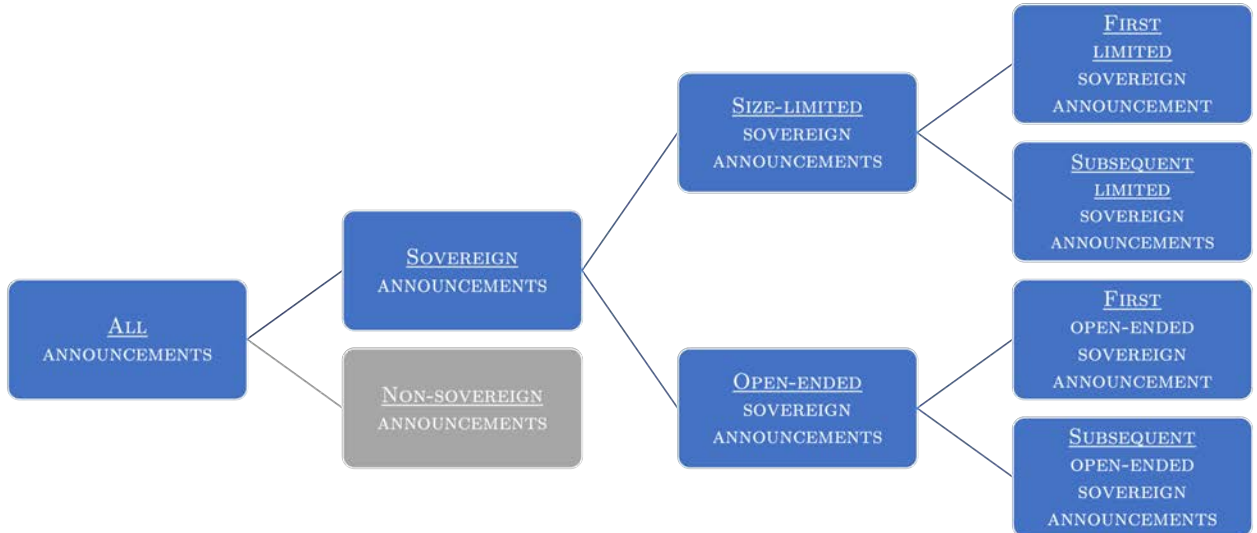
$$100 \cdot \frac{FX_{i,t+h} - FX_{i,t-1}}{FX_{i,t-1}} = \alpha_i + \alpha_t + \beta_h D_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} . \quad (4)$$

We run a similar regression for yields, using differences instead of cumulative percentage changes, and expressing the results in basis points:

$$y_{i,t+h} - y_{i,t-1} = \alpha_i + \alpha_t + \beta_h D_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} . \quad (5)$$

³³Dube et al. (2023) make clear that the only way to rule out negative weights bias is to fully clean controls (in our context exclude all days after an announcement), but at the cost of a reduction in the number of observations (in our case a severe reduction) which can reduce statistical power. They suggest a number of possible modifications of the clean control condition, including a version of the approach we take by limiting the horizon of treatment.

We run the regression for $h = 0, 1, \dots, 15$ days. Here, $D_{i,t}$ is a dummy equal to 1 if the central bank of country i makes an announcement on day t , and 0 otherwise. Differently from the diff-in-diff methodology, the local projections approach is specifically designed to estimate impulse responses to a sequence of shocks, and our asset purchasing announcements resemble repeated, narratively-identified monetary policy shocks more than they do a single and isolated event or treatment. Therefore, we use our local projections approach to break down the effects of different types of announcements. Our empirical analysis starts with an initial assessment of market reactions to all 166 central bank asset-purchase announcements during the pandemic. We then narrow our announcements to those involving purchases of sovereign bonds, and split these announcements into those with size-limits and those we classify as whatever-it-takes. Finally, we look at responses to the first WIT and limited announcement (similar to the event study setup) as well as responses to the subsequent announcements, as outlined in the diagram below. We do not explicitly look at non-sovereign announcements, these are shown in grey in the diagram.



In the local projection approach, covariates help to control for variation in treatment assignment (which in our context is the timing of central bank announcements). As was the case in our event study analysis, we include country and time fixed effects as well as the same set of controls $\mathbf{X}_{i,t}$ that help us identify the surprise component of the policy announcement. These controls are generally not statistically significant for short horizons, but are significant and appropriately signed for longer horizons across our local projection specifications, suggesting they may have contributed to driving yields with some lag, and

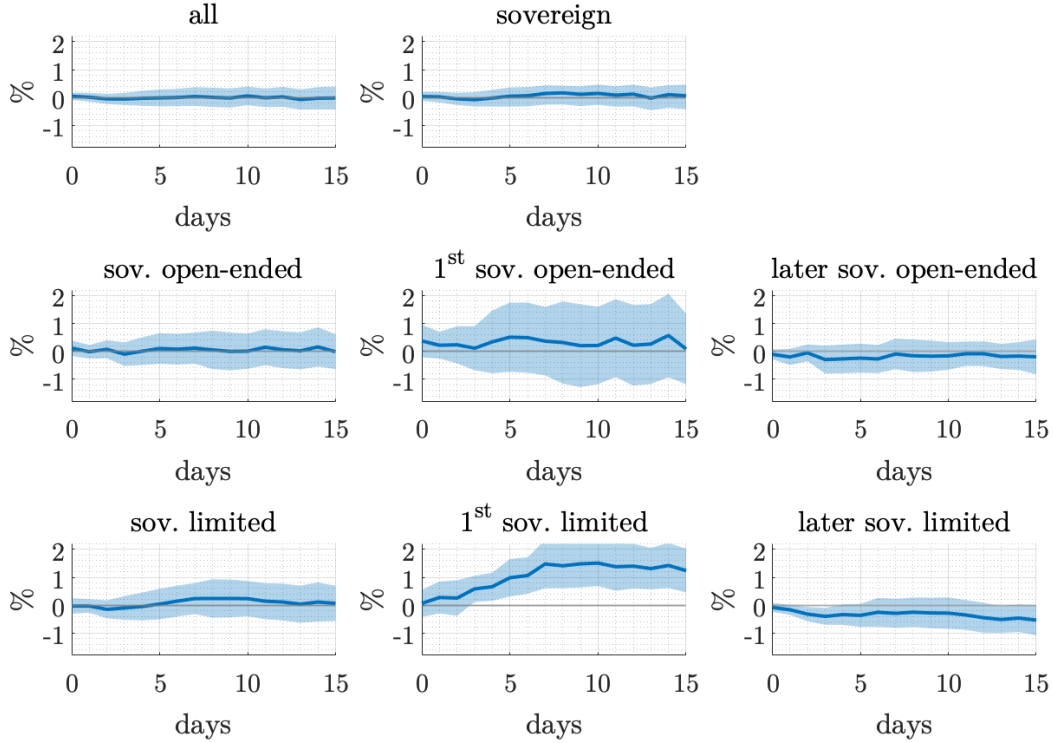
might have influenced central bank decisions to intervene. For robustness, we also verify in the appendix that results are the same irrespective of whether the controls are included or excluded. Standard errors are clustered by date and plotted confidence intervals are at the 90% level. Similar to our findings in the event study section, our local projection analysis, as illustrated in Figure 5a, which plots the β_h coefficients for the exchange rate regressions, shows that exchange rates against the dollar do not seem to respond to asset purchase announcements. The unresponsiveness of the exchange rate remains even after distinguishing between size-limited and WIT announcements, except in the case of the first size-limited announcement, which leads to a significant (though puzzlingly delayed) appreciation.

In order to interpret our local projection results, it is useful to start with the context in the foreign exchange and bond markets during the period under examination. In early 2020, global asset markets had already started to show signs of concern. The US yield curve inverted in late-February 2020, suggesting that investors had begun to worry about a potential crisis, driving short-term security yields up to compensate for the elevated risk. Connected to this, the U.S. dollar briefly lost value relative to a number of other currencies in late February.³⁴ As the potential worldwide severity of the pandemic started to be better understood, we saw a global dash for cash, as investor confidence in financial markets plummeted. The flight to safe cash, and especially dollar cash, reversed the earlier dollar slide; the broad U.S. dollar index appreciated by 7.5% between 6 March and the dollar’s pandemic peak on 24 March. The combination of Federal Reserve swap line announcements on 15 March and 19 March, which reduced a perceived dollar shortage, together with its asset purchase announcements seem to have largely stabilized dollar bilateral rates through mid-May 2020.

The U.S. financial market and monetary policy context is critical to understanding how non-dollar currencies reacted to the asset purchase announcements made by the Federal Reserve and other central banks. The objectives of central bank policy announcements in the early days of the pandemic were twofold: to calm financial markets and provide aggregate demand stimulus. Policies that successfully calm financial markets should appreciate the domestic currency, while expansionary monetary policy (all else equal) should lead to domestic currency depreciation. Of course, during the pandemic all else was not equal. Central banks across the globe were all announcing similar policies at the same time. This meant that foreign exchange markets were responding to the relative strength of central bank policies and attempting to disentangle the effects of counteracting channels.

³⁴This pattern of yield inversion and currency depreciation as a crisis materializes is described in Farhi and Gabaix (2016).

Figure 5a: Response of Exchange Rate to Asset Purchases Announcements



Notes: Local projections are based on equation 4 for each of the classifications of central bank asset purchase announcements (all, sovereign, open-ended, 1st open-ended, subsequent open-ended, limited, 1st limited, subsequent limited). In the charts the x-axis shows the days after the announcement and the y-axis shows the cumulative depreciation against the dollar relative to the day before the announcement, in percentages. Our clean control approach excludes 30 days after each announcement. Solid blue lines are the coefficient estimates β_h , shaded areas are 90% confidence intervals. Regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date.

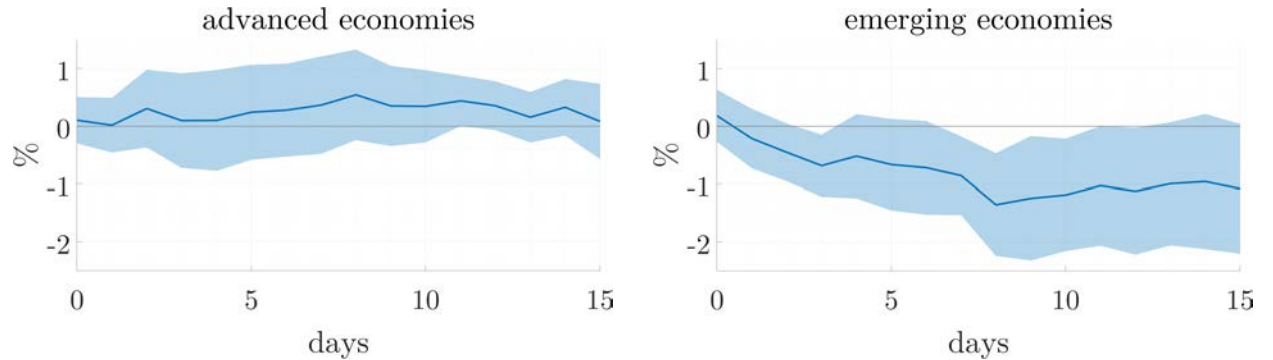
In light of these considerations, it is less surprising that exchange rates against the dollar do not seem to respond to asset purchase announcements. When we further separate the first WIT and size-limited announcements from the following ones, the point estimate is positive (i.e. an appreciation) on impact, but not significant. This lack of response can be attributed to the conflicting mechanisms through which asset purchases likely impacted exchange rates in this period. During the Covid period, the strong flight to safety dynamics likely kept exchange rates of safer countries strong. In this context, asset purchasing policies might actually have a positive effect on the exchange rate, due to their ability to enhance the perceived safety of the country as the central bank commits to doing whatever-it-takes

to support its economy.³⁵

This dual channel suggests distinguishing between advanced and emerging economies: dominance of one channel over the other is likely to differ between these groups. In emerging economies, which do not enjoy a safety status, the traditional channel should be at work, so that asset purchases lead to a depreciation. In advanced economies, by contrast, asset purchases might have boosted their perceived safety relative to other countries, thus making their assets more attractive for investors looking for safety in the midst of a risk-off period.

Figure 5b confirms that splitting our sample to examine advanced and emerging countries separately is important. It shows that open-ended asset purchasing announcements lead to no response, or a small appreciation, in advanced economies, but lead to a significant depreciation against the dollar in emerging economies. Pooling all the countries together masked this heterogeneity. We will come back to this point later.

Figure 5b: Response of Exchange Rate to Open-ended Sovereign Bond Purchases Announcements, Differentiating Between Advanced and Emerging Economies



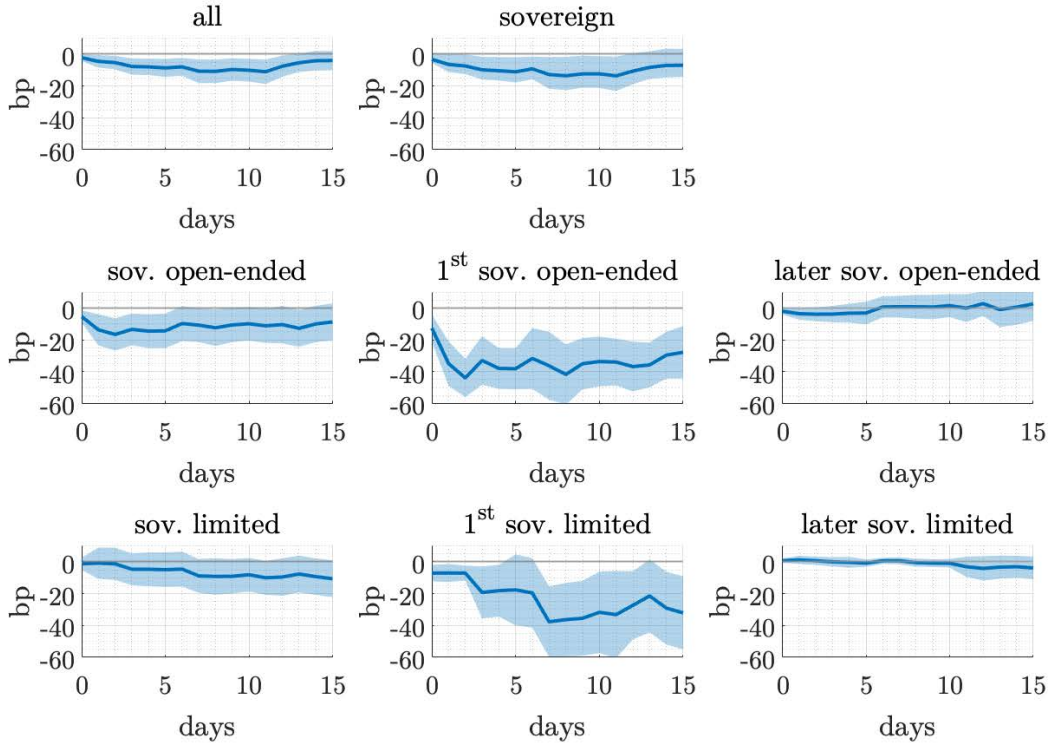
Notes: Local projections are based on equation 4 for open-ended central bank sovereign bond purchase announcements. The sample is split between advanced and emerging economies. In the charts the x-axis shows the days after the announcement and the y-axis shows the cumulative depreciation against the dollar relative to the day before the announcement, in percentages. Our clean control approach excludes 30 days after each announcement. Solid blue lines are the coefficient estimates β_h , shaded areas are 90% confidence intervals. Regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date.

We find yields to be more responsive to announcements than exchange rates. Figure 6 shows the response of 10-year yields to all announcements, and then breaks it down between size-limited and open-ended, and between the first and the subsequent open-ended

³⁵Foschi (2023) provides an examination of flights to safety that explains how perceived safety can change over time.

announcements. Results for the first two days following the announcements are also reported in Table 3. Our estimates suggest that asset purchase announcements change expectations and therefore prices, though the effect is modest, hovering between 5 and 10 basis points over the week following the announcement.

Figure 6a: Response of 10-Year Yield to Asset Purchases Announcements



Notes: Local projections are based on equation 5 for each of the classifications of central bank asset purchase announcements (all, sovereign, open-ended, 1st open-ended, subsequent open-ended, limited, 1st limited, subsequent limited). In the charts the x-axis shows the days after the announcement and the y-axis shows the cumulative change in the 10-year yield relative to the day before the announcement, in basis points. Our clean control approach excludes 30 days after each announcement. Solid blue lines are the coefficient estimates β_h , shaded areas are 90% confidence intervals. Regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date.

Breaking this down shows that there is an underlying heterogeneity in the effectiveness of different announcements: while size-limited announcements have, essentially, no effect, open-ended announcements push yields down by 15 basis points in the first two days and up to 20 basis points after a week. There is evidence of a “first announcement” effect, even with size-limited announcements, but the effect is much larger for first WIT announcements.

The very first whatever-it-takes moment is most effective, lowering yields by 40 basis points, which roughly matches our estimate from the event study section; conversely subsequent WIT announcements have no impact. Consistent with what theory and intuition suggests, the real power of whatever-it-takes policy lies largely in its shock-and-awe effect when it is first announced. After the first WIT announcement, market participants update their expectations, and subsequent announcements seem to only reinforce the original commitment to do whatever is necessary. This may itself be important, as markets might otherwise react negatively if no further announcements are made.

Table 3: Local Projection Coefficients ($h = 1, 2$) for 10-Year Yields

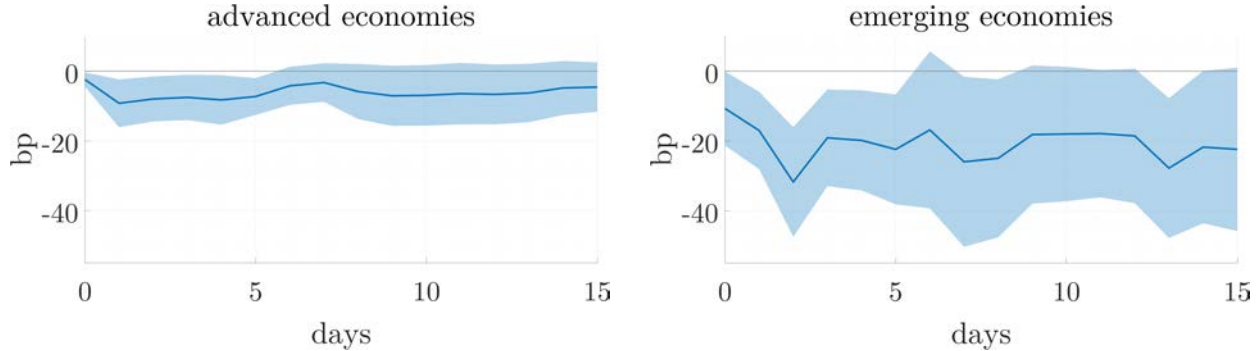
Announcement	1-day after: $y_{i,t+1} - y_{t-1}$, in bp		2-days after: $y_{i,t+2} - y_{t-1}$, in bp	
All	-4.59*	(2.38)	-5.32**	(2.57)
Sovereign	-6.51**	(2.88)	-7.46**	(3.10)
Limited	-0.87	(5.94)	-1.29	(6.17)
1 st limited	-7.05**	(3.44)	-7.09**	(2.85)
Later limited	1.18	(1.57)	0.64	(1.59)
Open-ended	-13.75**	(5.94)	-16.65***	(6.17)
1 st open-ended	-34.93***	(8.51)	-43.94***	(7.33)
Later open-ended	-3.61	(2.28)	-3.95	(2.66)

*Notes: The table shows the estimated coefficients β_h on central bank asset-purchase announcements for each of the six classifications of announcements (all, sovereign, limited, open-ended, 1st open-ended, and subsequent open-ended) over 1-day and 2-days for the 10-year yield local projection regression (equation 5). The regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date and shown in parentheses. *, **, *** indicate significance at 10%, 5% and 1%, respectively.*

Finally, as we did for the exchange rate, we look at open-ended announcements by splitting the sample between advanced and emerging economies. The results are shown in figure 6b. Whatever-it-takes announcements appear particularly powerful in emerging economies, lowering yields by up to 30 basis points. The same does not appear to be true for advanced economies. The results we found for whatever-it-takes announcements in Figure 6a, therefore, appear to be driven by emerging market countries rather than advanced economies. However, this sizable discrepancy in magnitudes between advanced and emerging economies might be related to the differences in volatilities, as yields are higher and more volatile in emerging economies, and thus looking at simple differences might mask how effective the announcements were in advanced economies. We will come back to this point later, when we

consider what happens if yields are standardized by country using their volatility over this period, or if we look at percentage changes in yields instead of simple differences, to account for the lower base level in advanced economies.

Figure 6b: Response of 10-Year Yield to Open-ended Sovereign Bond Purchases Announcements, Differentiating Between Advanced and Emerging Economies



Notes: Local projections are based on equation 4 for open-ended central bank sovereign bond purchase announcements. The sample is split between advanced and emerging economies. In the charts the x-axis shows the days after the announcement and the y-axis shows the cumulative change in the 10-year yield relative to the day before the announcement, in basis points. Our clean control approach excludes 30 days after each announcement. Solid blue lines are the coefficient estimates β_h , shaded areas are 90% confidence intervals. Regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date.

V.2 Relative efficacy of open-ended vs size-limited announcements

Our local projection analysis indicates that WIT announcements during the pandemic had significant impacts on financial markets, especially when we focus on the most surprising of these announcements. The figures show the absolute response of exchange rates and yields to WIT and size-limited announcements separately, but they do not allow us to measure differences in market reaction across announcement types. In order to test whether WIT announcement impacts are different than size-limited announcements, we use the following regression specification for the exchange rate:

$$100 \cdot \frac{FX_{i,t+h} - FX_{i,t-1}}{FX_{i,t-1}} = \alpha_i + \alpha_t + \beta_h WIT_{i,t} + \theta_h ALL_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} . \quad (6)$$

Again, we run a similar regression for yields, using differences instead of cumulative percentage changes, and expressing the results in basis points:

$$y_{i,t+h} - y_{i,t-1} = \alpha_i + \alpha_t + \beta_h WIT_{i,t} + \theta_h ALL_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} . \quad (7)$$

In this specification, the coefficient on $WIT_{i,t}$, β_h , is an estimate of the average change in the dependent variable (the bp change in yields or the percentage change in the exchange rate) in reaction to a WIT announcement relative to the reference group of size-limited announcements. The variable $ALL_{i,t}$ includes the full set of sovereign bond purchase announcements, so that the reference (or omitted) category are the size-limited sovereign bond purchase announcements, and $\mathbf{X}_{i,t}$ includes our control variables.

Table 4a presents our baseline estimates of the impact of WIT announcements relative to size-limited announcements on the one- and two-day post-announcement percentage change in the exchange rate and changes in 3-month, one-year, five-year and ten-year bond yields. Consistent with the message from the event study and local projection analysis, the results show that WIT announcements had statistically significant larger (negative) impacts on yields relative to size-limited announcements, with the largest difference in impact being an additional 16 basis point fall in the two-day 10-year yields. Likewise, similar to our previous results, we do not find a statistically different impact of WIT announcements on exchange rates; neither type of announcement had an impact when we include the full set of sovereign bond announcements in the regression.

The results in Table 4a across yield maturities suggest that the largest relative impacts of WIT announcements are on 10-year bond yields, with much smaller relative effects for 1-year and 3-month yields. The finding that the relative impact is larger over a longer horizon, after the announced asset-purchases would have long stopped, suggests that WIT policy may be affecting long-run expectations. The result may also follow from the underlying volatility distributions across maturities: there was more room for movement in longer maturity bond yields during the pandemic when short-term interest rates in many advanced countries were at the zero-lower-bound. In order to take this difference in underlying yield volatilities into account, we repeat our analysis using the percentage change in yields rather than simple differences. The results using this specification are reported in Table 4b, and are even stronger than those reported in Table 4a for 10-year yields: the relative impact of WIT announcements remains more powerful. The results, however, are no longer significant for the other maturities.

Our next set of tests examine different groupings of WIT announcements (the first one

Table 4a: Local Projection Coefficients ($h = 1, 2$) of Open-ended Relative to Limited Announcements for Exchange Rate and Yields

$h = 1$					
	FX	10Y	5Y	1Y	3M
Baseline (30 days cleaning)	0.06 (0.16)	-13.27** (6.54)	-13.73** (6.77)	-5.76* (3.25)	-5.68 (3.67)
N	12364	14441	14441	14441	13859
$h = 2$					
	FX	10Y	5Y	1Y	3M
Baseline (30 days cleaning)	0.31 (0.25)	-15.87** (7.10)	-15.01* (7.92)	-6.48* (3.52)	-6.94* (3.89)
N	12342	14415	14415	14415	13834

Notes: The table shows the estimated coefficients β_h on open-ended asset-purchase announcements over 1-day and 2-days for the exchange rate (in %) and yield (in bp) local projection regressions (equations 6-7). The regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date and shown in parentheses. *, **, *** indicate significance at 10%, 5% and 1%, respectively.

Table 4b: Local Projection Coefficients ($h = 1, 2$) of Open-ended Relative to Limited Announcements for Yields (% change)

$h = 1$				
	10Y	5Y	1Y	3M
Baseline (30 days cleaning)	-25.51** (11.02)	63.02 (53.68)	-1.08 (7.39)	71.08 (51.78)
N	14441	14441	14441	13859
$h = 2$				
	10Y	5Y	1Y	3M
Baseline (30 days cleaning)	-29.74** (14.55)	66.80 (53.39)	-2.81 (9.28)	53.56 (82.35)
N	14415	14415	14415	13834

Notes: The table shows the estimated coefficients β_h on open-ended asset-purchase announcements over 1-day and 2-days for the yield local projection regressions (equation 7), replacing the dependent variable with a percentage change instead of a simple difference. The regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date and shown in parentheses. *, **, *** indicate significance at 10%, 5% and 1%, respectively.

versus subsequent ones, those that occurred on days when the central bank made other policy announcements versus days with just one asset-purchase policy announcement, those that occurred on days when other central banks also made asset-purchase policy announcements versus days when only one central bank made an announcement, those that literally used the phrase whatever-it-takes in the announcement versus those that made open-ended promises

without using the WIT phrase) relative to size-limited announcements. The regression specification for each of these tests includes two types of WIT announcements ($WIT_{i,t}^1$ and $WIT_{i,t}^2$), with $WIT_{i,t}^1$ always defining the narrower category, the full set of announcements ($ALL_{i,t}$), and our control variables ($\mathbf{X}_{i,t}$). Again, the omitted category of announcements are the size-limited ones. We run, for the exchange rate :

$$100 \cdot \frac{FX_{i,t+h} - FX_{i,t-1}}{FX_{i,t-1}} = \alpha_i + \alpha_t + \beta_h^1 WIT_{i,t}^1 + \beta_h^2 WIT_{i,t}^2 + \theta_h ALL_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} , \quad (8)$$

and, for yields:

$$y_{i,t+h} - y_{i,t-1} = \alpha_i + \alpha_t + \beta_h^1 WIT_{i,t}^1 + \beta_h^2 WIT_{i,t}^2 + \theta_h ALL_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} . \quad (9)$$

In addition, we also re-run regressions 6-7 by splitting the sample between advanced and emerging economies, and between the first months of the pandemic (from March to July 2020) and the later period (from August 2020 to December 2021). We present these results together with those for regressions 8-9 as they all amount to testing different groupings of WIT announcements.

Table 5 reports the estimated coefficient for each of the narrower groupings of WIT announcements on changes in 10-year yields and the percent change in the exchange rate. The top row shows our baseline case with all WIT announcements relative to size-limited ones (previously reported in table 4), and each subsequent set of rows show the additional impact of a narrower grouping of WIT announcements relative to size-limited announcements. These results largely confirm our previous findings, especially for the two-day results. The first WIT announcement lowers yields by an additional 47 basis points relative to size-limited announcements. Likewise, days when multiple central banks made WIT announcements lowered yields by an additional 25 basis points relative to size-limited announcements, whereas on days when only one central bank made a WIT announcement the basis point difference fell to 11.

Interestingly, the days when the same central bank announced multiple policies were not statistically different from days with size-limited announcements, whereas days with just the WIT announcement significantly lowered relative yields by 18 basis points. Another surprising result came when we separated those announcements that literally used the whatever-it-takes phrase. In both these cases the likely explanation is that we had too few announcements that fit our narrower grouping of WIT announcements. As we found earlier, emerging economy WIT announcements lowered relative yields by the largest amount, al-

most 30 basis points, and WIT announcements in the first five months of the pandemic had the largest relative impact.

When looking at the exchange rate, we find at least some evidence, after two days, of the heterogeneity in response that we also found when looking at the absolute effect of WIT announcements: there is evidence of an additional appreciation in advanced economies, while the effect is not significant (though the point estimate is negative) in emerging economies. The opposing directions of the exchange rate responses might suggest that, at least to some extent, the muted response of the exchange rate when taking all countries together is actually due to the underlying heterogeneity in the response between different countries.

VI Robustness

Our analysis so far has found strong evidence that financial markets react to what-ever-it-takes announcements, and that these reactions are statistically significantly stronger than those to size-limited announcements. We also find that grouping the WIT announcements in various ways increases the relative difference in market reaction. In this section we include a number of robustness checks, that examine whether our method of post-announcement “cleaning” matters, whether adding additional controls (specifically a lock-down stringency index which is available daily and across our sample of countries) matters, whether omitting controls matters, and finally whether the way in which we measure changes in our two outcome variables matter.

The results reported in Table 6 suggest that our findings that WIT announcements have larger impacts on bond markets than do to size-limited announcements are robust to a number of changes in our baseline regression specification. In our first set of robustness checks we examine whether reducing or expanding the number of post-announcement days that are excluded from our control group matters. In our original specification we excluded 30 days after each announcement from our control group. The first row in table 6 reports results for specifications that exclude 15 days and the second row reports results based on a specification that drops all subsequent days from our control group after a central bank has made a whatever-it-takes announcement. The results for the specification with 15 days excluded are very similar to those in our baseline specification that excludes 30 days, whereas the β_h coefficient estimates in the specification that assumes all days subsequent to a WIT announcement are part of the treatment are three times larger than their counterparts in the partially-cleaned versions. Similar to our findings using propensity score matching, this suggests that a more narrow definition of our counterfactual leads to larger estimates of the

Table 5: Local Projection Coefficients ($h = 1, 2$) of Open-ended Relative to Limited Announcements for Exchange Rate and Yields, Different Announcement Groupings

	$h = 1$		$h = 2$	
	FX	10Y	FX	10Y
Baseline (30 days cleaning)	0.06 (0.16)	-13.27** (6.54)	0.31 (0.25)	-15.87** (7.10)
N	12364	14441	12342	14415
1 st open-ended	0.35 (0.27)	-37.58*** (9.21)	0.48 (0.41)	-47.17*** (9.65)
Subsequent open-ended	-0.15 (0.22)	-1.01 (2.78)	0.17 (0.26)	-0.62 (3.05)
N	12364	14441	12342	14415
Multiple policies announced	0.20 (0.35)	-7.11 (5.83)	0.32 (0.37)	-6.61 (5.69)
Only sovereign AP announced	0.04 (0.19)	-14.69* (7.72)	0.31 (0.28)	-18.03** (8.45)
N	12364	14441	12342	14415
Other CB announcements	0.42 (0.33)	-20.26 (13.52)	0.36 (0.41)	-25.06* (14.55)
No other CB announcements	-0.09 (0.20)	-9.19* (4.97)	0.28 (0.33)	-10.69* (5.57)
N	12364	14441	12342	14415
Literal “whatever it takes”	0.34 (0.45)	-2.21 (3.18)	0.84* (0.47)	-3.83 (4.11)
Not literal “whatever it takes”	-0.03 (0.21)	-16.94** (8.32)	0.13 (0.32)	-19.94** (9.12)
N	12364	14441	12342	14415
Advanced economies	0.27 (0.32)	-5.93 (3.93)	0.83* (0.47)	-4.82 (3.34)
N	5335	8745	5325	8727
Emerging economies	-0.13 (0.41)	-17.99** (8.17)	-0.42 (0.43)	-29.37*** (10.13)
N	7025	5690	7011	5680
Mar 2020 – Jul 2020	-0.03 (0.21)	-13.29 (8.79)	0.26 (0.35)	-17.03* (9.58)
N	2032	2201	2029	2200
Aug 2020 – Dec 2021	0.20 (0.29)	-2.08 (1.92)	0.46 (0.38)	-2.64 (2.11)
N	10332	12240	10313	12215

Notes: The table shows the estimated coefficients β_h^1 and β_h^2 on open-ended asset-purchase announcements over 1-day and 2-days for the exchange rate (in %) and yield (in bp) local projection regressions (equations 8-9). For the last two blocks of comparisons, the coefficients are the β^h obtained by running 6-7 in subsamples. The regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date and shown in parentheses. *, **, *** indicate significance at 10%, 5% and 1%, respectively.

relative impacts of WIT announcements.

Our next set of robustness checks examine the role of the control variables in our base-line specification. Along with our original set of control variables (country and time fixed effects, prior WIT announcements made by other central banks, the cumulative number of own country Covid-19 cases, the global number of Covid-19 cases excluding own-country cases, and own-country prior size-limited policy announcements) we add a lock-down stringency index to better take into account differences in economic activity across our sample of countries during the pandemic. We also drop all our controls in a second robustness specification. The results reported in table 6 indicate that adding or subtracting controls has no measurable impact on our coefficients of interest.

Table 6: Local Projection Coefficients ($h = 1, 2$) of Open-ended Relative to Limited Announcements for Exchange Rate and Yields, Robustness

	$h = 1$		$h = 2$	
	FX	10Y	FX	10Y
15 days cleaning	0.04 (0.16)	-12.50** (6.16)	0.22 (0.25)	-16.20** (6.99)
N	13492	16484	13470	16456
Permanent cleaning	0.07 (0.38)	-36.18*** (12.04)	0.20 (0.57)	-46.54*** (10.88)
N	6939	4720	6917	4692
Additional control (stringency index)	0.06 (0.16)	-13.24** (6.52)	0.31 (0.25)	-15.83** (7.08)
N	12364	14441	12342	14415
No controls	0.06 (0.16)	-13.45** (6.48)	0.29 (0.25)	-16.01** (7.01)
N	12364	14441	12342	144415

*Notes: The table shows the estimated coefficients β_h^1 and β_h^2 on open-ended asset-purchase announcements over 1-day and 2-days for the exchange rate (in %) and yield (in bp) local projection regressions (equations 6-7). The regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date and shown in parentheses. *, **, *** indicate significance at 10%, 5% and 1%, respectively.*

Next we focus on the measurement of our outcome variables, the percentage change in the exchange rate and the change in sovereign bond yields. Among our sample of countries there is wide variation in the size and volatility of these changes. We attempt to control for this variation in two ways. First, we standardize our outcome variables in our regression specifications using own-volatility over the pandemic, so that $\widehat{FX}_{i,t} = \frac{FX_{i,t}}{\sigma(FX_i)}$ and $\tilde{y}_{i,t} = \frac{y_{i,t}}{\sigma(y_i)}$.

We then run, for the exchange rate,

$$100 \cdot \frac{\widetilde{FX}_{i,t+h} - \widetilde{FX}_{i,t-1}}{\widetilde{FX}_{i,t-1}} = \alpha_i + \alpha_t + \beta_h WIT_{i,t} + \theta_h ALL_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} , \quad (10)$$

and, for yields,

$$\tilde{y}_{i,t+h} - \tilde{y}_{i,t-1} = \alpha_i + \alpha_t + \beta_h WIT_{i,t} + \theta_h ALL_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} . \quad (11)$$

Second, for yields, we also use percentage changes rather than level changes:

$$\frac{y_{i,t+h} - y_{i,t-1}}{y_{i,t-1}} = \alpha_i + \alpha_t + \beta_h WIT_{i,t} + \theta_h ALL_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma}_h + \varepsilon_{i,t} . \quad (12)$$

Table 7 reports the estimated β_h coefficients in regression specifications that include these transformations in our outcome variables. The first set of estimates includes all countries in our sample, and the second two sets of estimates split the sample between advanced and emerging economies. When we standardize our outcome variables we find similar results to those in our baseline specification: WIT announcements have statistically significantly larger impacts on 10-year bond yields relative to size-limited announcements for all countries, advanced economies, and emerging economies, with the largest relative differences appearing in the emerging economies. Further, as we found in our baseline case, there are no significant differences in the impacts of WIT and size-limited announcements on standardized changes in exchange rates. In the second set of estimates, where we measure our 10-year yields in percentage changes, we find that advanced rather than emerging economies are driving the overall results. This transformation of the dependent variable matters; reducing the relative size of yield changes for emerging economies turns out to be consequential and suggests that the differences in results between emerging and advanced economies are less clear cut. These results confirm that the financial market impacts of WIT announcements are significantly larger than sized-limited announcements, but do not allow us to rank the relative strength of this result between advanced and emerging markets.

Another way we take volatility into account is to examine whether specific emerging market countries that experienced extreme movements in yields are driving our results. We do sensitivity tests for outliers by dropping one emerging economy at a time in the regression to see if there is one that makes a big difference. We compare the local projection coefficient on open-ended asset-purchase announcements over 1-day for all emerging economy 10-year yields in table 5 (-17.99) to the same coefficient when we drop Poland (-13.89), Colombia

(-20.21), Turkey (-16.31), Hungary (-25.59), and South Africa (-11.44). In each of these cases the coefficient value and statistical significance is very similar to what we find for the emerging economy group as a whole.

Table 7: Local Projection Coefficients ($h = 1, 2$) of Open-ended Relative to Limited Announcements for Exchange Rate and Yields, Results for Advanced and Emerging Economies for Different Specifications of the Dependent Variable

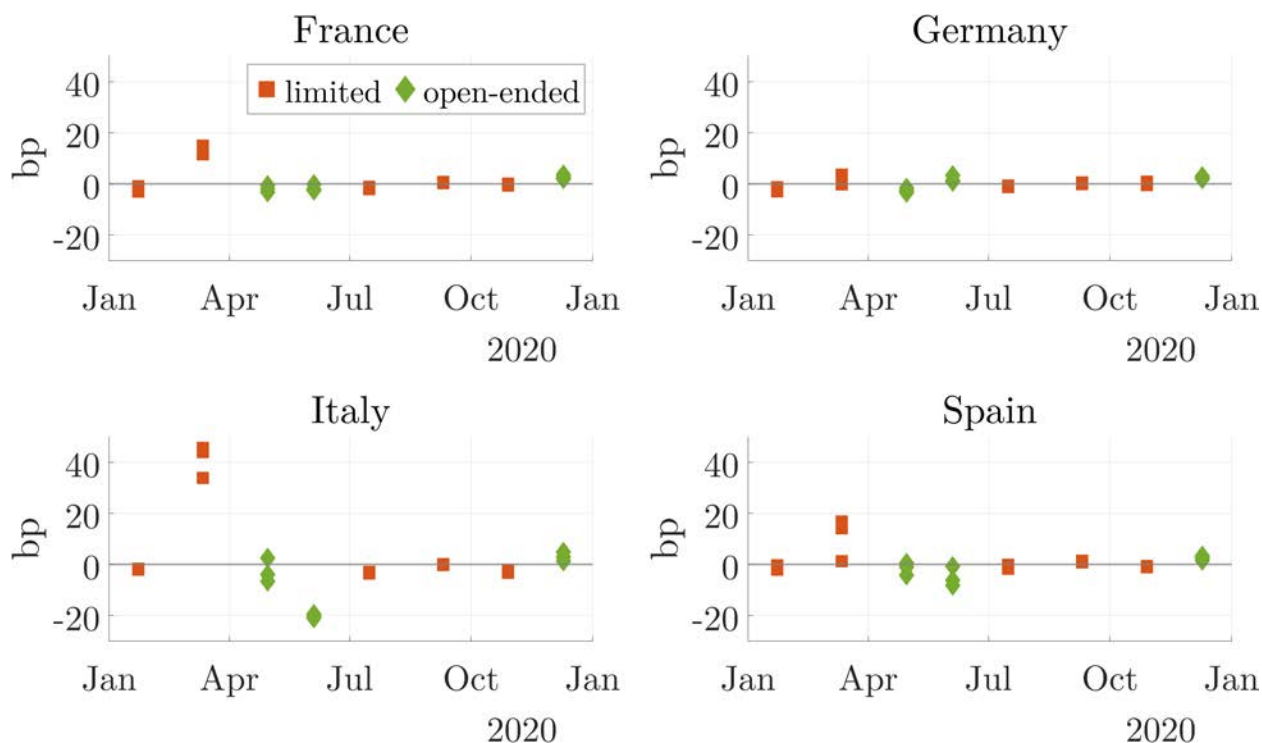
	$h = 1$		$h = 2$	
	FX	10Y	FX	10Y
Standardized Dep. Variable				
All countries	0.04 (0.25)	-148.08*** (52.87)	0.31 (0.33)	-136.17** (56.63)
N	12364	14441	12342	14415
Advanced economies	0.30 (0.47)	-114.04** (57.24)	0.90 (0.58)	-77.04* (42.83)
N	5335	8745	5325	8727
Emerging economies	-0.23 (0.60)	-153.96** (69.99)	-0.45 (0.53)	-161.24*** (51.05)
N	7025	5690	7011	5680
Dep. Variable in BP % Change				
All countries		-25.51** (11.02)		-29.74** (14.55)
N		14441		14415
Advanced economies		-24.30 (15.43)		-37.67 (24.96)
N		8745		8727
Emerging economies		-14.47 (21.33)		-7.58 (29.93)
N		5690		5680

Notes: The table shows the estimated coefficients β_h^1 and β_h^2 on open-ended asset-purchase announcements over 1-day and 2-days for the exchange rate (standardized %) and yield (standardized bp and bp %) local projection regressions (equations 10-12). The regressions include country and time fixed effects and the set of controls $\mathbf{X}_{i,t}$. Standard errors are clustered by date and shown in parentheses. *, **, *** indicate significance at 10%, 5% and 1%, respectively.

Our final robustness check examines whether daily data are appropriate for our analysis. The concern this raises is that our results may be subject to omitted variable bias if other news that occurred on the same day as the announcements were the actual drivers of market reactions. In most cases it seems likely that a central bank announcement, especially one that promises whatever-it-takes actions, will be the critical market-relevant news on a given

day, but as a robustness check we analyze a subset of the announcements over a narrower within-day window.

Figure 7a: Change in 2-,5-, and 10-Year Yields (in bp) around Press Releases for ECB Asset Purchases Announcements



The figures plot the change in yields (in basis points) in the window around press releases by the European Central Bank. Specifically, the changes are computed by comparing the median quote from the window 15:40-15:50 CET, right after the press conference, to the median quote from the window 13:25-13:35 CET, right before the press release. Intraday changes are from Altavilla et al. (2019). Announcements are from Altavilla et al. (2019) and from Cantú et al. (2021), classification as open-ended by authors based on central bank press release and subsequent news coverage.

The Euro Area Monetary Policy Event-Study Database described in Altavilla et al. (2019) provides intraday asset price changes around a two-hour announcement window that starts with quotes immediately prior to ECB announcements and ends with quotes immediately after the end of the press-conference. All ECB Governing Council meeting decisions are announced with a press release at 13:45 Central European Time (CET), this is followed by a press conference starting at 14:30 CET that generally ends at 15:40 CET. The underlying tick data are from Thomson Reuters Tick History database, the data are discretized by using the last quote of each minute and calculating the median price over a ten minute

interval from 13:25-13:35 CET for the pre-press-release quote, 14:00-14:10 CET for the post-press-release quote, 14:15-14:25 for the pre-press-conference quote, and 15:40-15:50 CET for the post-press-conference quote.

As was the case in our daily analysis, the underlying assumption is that the central bank announcements are not responding to asset price changes within the day, so that reverse causality is not a concern. From the results in Figure 7, one announcement appears particularly special: the one on 4 June 2020, after which newspapers wrote that “the ECB is in whatever-it-takes mode”. This is especially apparent when looking at the yields of Italy and, to some extent, Spain. The other two announcements that we categorize as open-ended according to our methodology do not particularly stand out when looking at intraday data. Size-limited announcements, by contrast, are associated with either no movement or with increases in yields. When looking at the euro exchange rate against the dollar, the implications are less clear: the June announcement again stands out, but appreciations are also visible in association with some size-limited announcements.

Figure 7b: Percentage Change in the Euro-Dollar Exchange Rate around Press Releases for ECB Asset Purchases Announcements



The figures plot the percentage change in the exchange rate in the window around press releases by the European Central Bank. Specifically, the changes are computed by comparing the median quote from the window 15:40-15:50 CET, right after the press conference, to the median quote from the window 13:25-13:35 CET, right before the press release. Intraday changes are from Altavilla et al. (2019). Announcements are from Altavilla et al. (2019) and from Cantú et al. (2021), classification as open-ended by authors based on central bank press release and subsequent news coverage.

Unfortunately, the monetary event window dataset does not include the ECB’s first

open-ended announcement on 18 March 2020, which did not follow a regularly scheduled ECB Governing Council meeting. The announcement was made at 6:00 pm CET (just before midday in New York). Vissing-Jorgensen (2021) lists the Federal Reserve announcement times in March and April 2020 (in Table 3). Interestingly, like the ECB, the Fed made its first open-ended policy announcement when most US financial markets were closed, at 5pm on a Sunday. Measuring within-day asset price reactions to these late-in-the-day announcements is unlikely to fully capture market responses in the same way as a scheduled announcement.

Data constraints limit our ability to analyze a larger set of announcements across central banks, but our results for the 8 ECB scheduled announcements suggest a high degree of heterogeneity in the within-day market reactions to both WIT and size-limited announcements. These results suggest that our larger sample of daily reactions include a wide range of impacts, which while providing significant average effects, may overstate the power of WIT announcements for some countries.

VII Conclusion

Central banks across the globe took aggressive action during the pandemic to restore confidence in financial markets and support economies. They both actively intervened and communicated their intervention to markets *ex ante* using announcements. This use of policy announcements to signal resolve and restore confidence was also used by many central banks during the 2008 crisis, and stands in marked contrast to the pre-1990s secrets-of-the-temple approach to monetary policy.³⁶

In this paper we ask whether a subgroup of these monetary policy announcements, those that include a promise to intervene at a whatever-it-takes scale, are more effective than announcements that include size-limits. It is important to note that whatever-it-takes statements embody constructive ambiguity: they are inherently less transparent than announcements with explicit size and duration information. This form of purposeful policy vagueness allows for the possibility that no policy interventions will be taken if the announcement itself is all that it takes. It is also noteworthy that central banks rarely describe the criteria they will use to determine when their whatever-it-takes policy interventions will have accomplished their objective.

Along with the reduced transparency of open-ended operations, there are other downsides to whatever-it-takes policymaking. After a whatever-it-takes announcement is made,

³⁶Geraats (2002) and Blinder et al. (2008) provide excellent discussions of the costs and benefits of central bank transparency.

it may be harder to impress the market again. Our estimates indicate that subsequent open-ended announcements have less impact on asset prices. Whatever-it-takes announcements set a high bar, potentially leading to ever escalating market expectations for large-scale intervention. These types of announcements will also be counter-productive if they inadvertently heighten investors' fears that economic circumstances are even worse than was thought, or that more standard (size limited) policies are not up to the task. Markets may also worry that if central banks go 'too big,' they will have limited their options to address the next shock (Bergant and Forbes, 2023). Finally, whatever-it-takes policies are likely to increase moral hazard. Large-scale asset purchases will inevitably increase incentives for risk taking by financial institutions that hold a high share of eligible securities.³⁷

Peer pressure was likely a factor in the decisions of some central banks to announce whatever-it-takes policies during the pandemic. If other central banks are successfully restoring orderly financial market function with the use of whatever-it-takes policy, it would be difficult not to follow suit. It may also be the case that cross-country spillovers are likely to be less problematic if policy responses are synchronized. The global scope of the crisis also lessened the worry for central banks that markets would interpret their own aggressive actions as a sign that their economy was facing unusual difficulty.

The empirical analysis in this paper underscores the benefits of whatever-it-takes policies. Markets responded positively to these announcements during the pandemic, and this was especially the case for emerging economy central banks. Impacts on yields indicate that these announcements were successful in restoring confidence in financial markets and in reducing uncertainty and financial stress. In the early days of the pandemic there was a risk that the financial market turmoil would intensify, which would have led economies into much deeper recessions. It does not follow that central banks can rely on whatever-it-takes policy in future crises, but it is useful to understand the preemptive role they played in the pandemic.

³⁷Acharya et al. (2019) describe the misallocation of credit that resulted from the announcement impacts of the ECB's OMT on weak European banks.

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Appendix

Table A1: Asset Purchase Announcements by Central Bank and Date

Central Bank	Date	Type of Asset Purchase	Size	Sovereign Open-ended	Sovereign Limited
Reserve Bank of Australia	19/03/20	Government bond purchases	Open-ended	✓	
	05/05/20	Government bond purchases	Open-ended	✓	
	03/11/20	Government bond purchases	Open-ended	✓	
	03/11/20	Government bond purchases	Open-ended	✓	
	03/11/20	Government bond purchases	Open-ended	✓	
	02/02/21	Government bond purchases	Open-ended	✓	
	06/07/21	Government bond purchases	4 billion weekly		✓
	06/07/21	Government bond purchases	4 billion weekly		✓
	02/11/21	Discontinuation of Government bond purchases	Limited		✓
Bank of Canada	12/03/20	Expansion of Bond Buyback Program	Starting with 500 million	✓	
	13/03/20	Bankers' Acceptance Purchase Facility (BAPF)	Limited by min bank credit rating		
	16/03/20	Canada Mortgage Bond Purchase	\$500 billion weekly		
	24/03/20	Provincial Money Market Purchase Program (PMMP)	40-percent purchase limit		
	27/03/20	Commercial Paper Purchase Progeam (CPPP)	Open-ended		
	27/03/20	Government securities purchases	Open-ended	✓	
	15/04/20	Provincial Bond Purchase Program (PBPP)	Up to 50 billion		
	15/04/20	Corporate Bond Purchase Program (CBPP)	Up to 10 billion		
	15/04/20	Treasury Purchases	40-percent purchase limit		✓
	20/05/20	Government securities purchases	Up to 100 million		✓
	03/06/20	Bankers' Acceptance Purchase Facility (BAPF)	Reduce frequency to bi-weekly		
	21/07/20	PMMP Securities Purchase	20-percent purchase limit		✓
	21/07/20	Treasury Purchases	20-percent purchase limit		✓
	21/07/20	Treasury Purchases	20-percent purchase limit		✓
	15/09/20	Provincial Money Market Purchase Program (PMMP)	10-percent purchase limit		
	15/09/20	Treasury Purchases	10-percent purchase limit		✓
	23/03/21	Commercial Paper Purchase Progeam (CPPP)	Limited		
	23/03/21	Provincial Bond Purchase Program (PBPP)	Limited		
	23/03/21	Corporate Bond Purchase Program (CBPP)	Limited		
	21/04/21	Government bond purchases	3 billion		✓
	30/04/21	Securities Repo Operations (SROs)	4,000 million		
	14/07/21	Bank Quantitative Easing Program (QE)	2 billion weekly		✓
	27/10/21	Bank Quantitative Easing Program (QE)	End QE, only replacing maturing bonds		✓
Central Bank of Chile	16/03/20	Bond Purchase Program	US\$4 billion		✓
	19/03/20	Bank Purchase Program	Limited		
	31/03/20	Bank Purchase Program	US\$5.5 billion		
	08/04/20	Bank Purchase Program	US\$8 billion		

	16/06/20	Asset Purchase Program	US\$8 billion	✓
	30/07/20	Cash Purchase Operations Program	US\$10 billion	
	30/07/20	Bank Deposit Purchase Program	US\$8 billion	
	24/09/20	Bank Deposit Purchase Program	US\$6 billion	
	24/09/20	Asset Purchase Program	Limited	✓
Central Bank of Colombia	23/03/20	Government Bond Purchases	Expansion, as large as 2 trillion	✓
	23/03/20	Purchase of Private Titles of Credit Establishments	10 trillion	
	14/04/20	Government Bond Purchases	Expansion, as large as 2 trillion	✓
	15/05/20	Public Debt Swap	1,766 billion	✓
European Central Bank	12/03/20	Asset Purchase Program (APP)	120 billion	✓
	18/03/20	Corporate Sector Purchase Program (CSPP)	Open-ended	
	18/03/20	Pandemic Emergency Purchase Program (PEPP)	Open-ended	✓
	30/04/20	Asset Purchase Program	Open-ended	✓
	30/04/20	Pandemic Emergency Purchase Program (PEPP)	Open-ended	✓
	04/06/20	Pandemic Emergency Purchase Program (PEPP)	Expanded by at least 600 billion euros	✓
	22/09/20	Sustainability-linked bonds Purchases	Limited	
	22/09/20	Sustainability-linked bonds Purchases	Limited	
	10/12/20	Pandemic Emergency Purchase Program (PEPP)	Ongoing commitment, increase of 500 billion	✓
	11/03/21	Pandemic Emergency Purchase Program (PEPP)	Limited	✓
	09/09/21	Pandemic Emergency Purchase Program (PEPP)	Limited	✓
	28/10/21	Pandemic Emergency Purchase Program (PEPP)	Limited	✓
	16/12/21	Pandemic Emergency Purchase Program (PEPP)	Limited	✓
Bank of England	17/03/20	Covid Corporate Financing Facility (CCFF)	Open-ended	
	19/03/20	Government Bond Purchases	Ongoing commitment, increase of 200 billion	✓
	02/04/20	Corporate Bond Purchases	>10 billion	
	19/05/20	Covid Corporate Financing Facility (CCFF)	Limited	
	05/06/20	Corporate Bond Purchase Scheme (CBPS)	Limited	
	18/06/20	Government Bond Purchases	100 billion	✓
	18/06/20	Asset Purchase Facility: Gilt Purchases	Limited	✓
Hungarian National Bank	07/04/20	Government Security Purchase Program	Limited	✓
	07/04/20	Mortgage Bond Purchase Program	Limited	
	07/04/20	Bond Funding for Growth Scheme (BGS)	50 billion	✓
	28/04/20	Government Security Purchase Program	Open-ended	✓
	28/04/20	Mortgage Bond Purchase Program	Open-ended	

	30/04/20	Government Security Purchase Program	Limited	✓
	30/04/20	Bond Funding for Growth Scheme (BGS)	Limited	✓
	21/07/20	Government Security Purchase Program	Limited	✓
	25/08/20	Government Security Purchase Program	Limited	✓
	22/09/20	Bond Funding for Growth Scheme (BGS)	Limited	✓
	06/10/20	Government Security Purchase Program	Open-ended	✓
	26/01/21	Bond Funding for Growth Scheme (BGS)	Limited	✓
	26/01/21	Government Security Purchase Program	Limited	✓
	23/02/21	Government Security Purchase Program	Limited	✓
	09/03/21	Government Security Purchase Program	Open-ended	✓
	27/04/21	Government Security Purchase Program	Open-ended	✓
	24/08/21	Government Security Purchase Program	50 billion weekly	✓
	21/09/21	Government Security Purchase Program	40 billion weekly	✓
	19/10/21	Government Security Purchase Program	Limited	✓
	16/11/21	Government Security Purchase Program	Limited	✓
	14/12/21	Bond Funding for Growth Scheme (BGS)	Limited	✓
	14/12/21	Government Security Purchase Program	Limited	✓
Bank Indonesia	01/04/20	Government Security Purchase	Limited	✓
	18/06/20	Government Security Purchase	Limited	✓
	06/07/20	Government Security Purchase	40 billion	✓
Bank of Israel	15/03/20	Government Bond Purchases	Limited	✓
	23/03/20	Government Bond Purchases	50 billion	✓
	06/07/20	Corporate Bond Purchase Program	15 billion	
	22/10/20	Government Bond Purchases	35 billion	✓
Central Bank of India	18/03/20	Government Security Purchases	10,000 crores	✓
	20/03/20	Government Security Purchases	30,000 crores	✓
	23/04/20	Government Security Sales	10,000 crores	✓
	09/10/20	State Development Loans (SDLs)	Limited	
	07/04/21	Government Security Purchases	Open-ended	✓
	04/06/21	Government Security Purchases	Open-ended	✓
Bank of Japan	13/03/20	Government Bond Purchases	Limited	✓
	16/03/20	Government Bond Purchases	Open-ended	✓
	16/03/20	Corporate Bond Purchases	<2 trillion yen	
	16/03/20	Stock Purchases	<12 trillion yen	
	27/04/20	Government Bond Purchases	Open-ended	✓
	27/04/20	Corporate Bond Purchases	Open-ended	
	22/05/20	Corporate Bond Purchases	Limited	
	18/12/20	Corporate Bond Purchases	<20 trillion yen	

	19/03/21	Stock Purchases	<12 trillion yen	
	19/03/21	Government Bond Purchases	Limited	✓
	18/06/21	Corporate Bond Purchases	Open-ended	
Bank of Korea	19/03/20	Treasury Bond Purchases	1.5 trillion	✓
	09/04/20	Government Bond Purchases	1.5 trillion	✓
	20/05/20	Commercial Paper Purchase Program	10 trillion	
	30/06/20	Government Bond Purchases	1.5 trillion	✓
	17/07/20	Corporate Bond Purchases	8 trillion	
	08/09/20	Government Bond Purchases	5 trillion	✓
	26/02/21	Government Bond Purchases	7 trillion	✓
Bank of Mexico	12/03/20	Government Bond Swaps	40,000 million	✓
	21/04/20	Government Security Swaps	100 billion	✓
Reserve Bank of New Zealand	23/03/20	Large Scale Asset Purchase Program (LSAP)	30 billion	✓
	07/04/20	Large Scale Asset Purchase Program (LSAP)	3 billion	✓
	13/05/20	Large Scale Asset Purchase Program (LSAP)	60 billion	✓
	12/08/20	Large Scale Asset Purchase Program (LSAP)	100 billion	✓
	14/07/21	Large Scale Asset Purchase Program (LSAP)	Limited	✓
Bangko Sentral ng Pilipinas	10/04/20	Government Securities Purchase	1-hour daily window, selected bonds	✓
National Bank of Poland	16/03/20	Treasury Bond Purchases	Open-ended	✓
	08/04/20	Government Securities Purchase	Open-ended	✓
National Bank of Romania	20/03/20	Government Securities Purchase	Limited	✓
Sveriges Riksbank	16/03/20	Government Bond Purchases	300 billion	✓
	20/03/20	Covered Bonds Purchase	10 billion	
	26/03/20	Commercial Paper Purchase	4 billion	
	22/04/20	Municipal Bond-purchasing Program	15 billion	
	08/05/20	Commercial Paper Purchase	32 billion	
	01/07/20	Bond-purchasing Program	200 billion	✓
	26/11/20	Asset Purchase Program	Open-ended	✓
Central Bank of Thailand	22/03/20	Government Bond Purchase Program	>100 billion	✓
	07/04/20	Corporate Bond Stabilization Fund	Limited	
Central Bank of Turkey	31/03/20	Government Domestic Debt Securities (GDDS) Sale	Open-ended	✓
	17/04/20	Government Domestic Debt Securities (GDDS) Sale	Limited	✓
Federal Reserve Board	12/03/20	Treasury Bills Purchase	60 billion	✓
	13/03/20	Treasury Security Purchases	80 billion	✓
	15/03/20	Purchase of Securities	Open-ended	✓
	17/03/20	Commercial Paper Funding Facility (CPFF)	10 billion	
	23/03/20	Purchase of Securities	Open-ended	✓
	23/03/20	Commercial Paper Funding Facility (CPFF)	Open-ended	

	23/03/20	Primary Market Corporate Credit Facility (PMCCF)	Open-ended	
	23/03/20	Secondary Market Corporate Credit Facility (SMCCF)	Open-ended	
	09/04/20	Primary Market Corporate Credit Facility (PMCCF)	Open-ended	
	09/04/20	Secondary Market Corporate Credit Facility (SMCCF)	Open-ended	
	09/04/20	Municipal Liquidity Facility (MLF)	Open-ended	
	27/04/20	Municipal Liquidity Facility (MLF)	Limited	
	29/04/20	Purchase of Securities	Open-ended	✓
	03/06/20	Municipal Liquidity Facility (MLF)	Limited	
	10/06/20	Purchase of Securities	Open-ended	✓
	15/06/20	Secondary Market Corporate Credit Facility (SMCCF)	Open-ended	
	23/07/20	Emergency Lending Facilities	Limited	
	23/07/20	Emergency Lending Facilities	Limited	
	28/07/20	Extension of Lending Facilities	Limited	
	28/07/20	Extension of Lending Facilities	Limited	
	11/08/20	Municipal Liquidity Facility (MLF)	Limited	
	03/11/20	Purchase of Securities	15 billion	✓
	30/11/20	Extension of Lending Facilities	Limited	
	15/12/20	Purchase of Securities	30 billion	✓
	02/06/21	Secondary Market Corporate Credit Facility (SMCCF)	Limited	
South African Reserve Bank	25/03/20	Government Security Purchases	Open-ended	✓

Source: Announcement data from Cantú et al. (2021), classification as open-ended by authors based on central bank press release and subsequent news coverage.