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Central bank asset purchases in response to the Covid-19 crisis

Report prepared by a CGFS Working Group co-chaired by
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Preface

Following the global outbreak of the Covid-19 pandemic in early 2020, central banks moved quickly and forcefully to limit the economic and financial fallout from the health crisis. In addition to cutting policy rates, central banks expanded their balance sheets substantially and deployed other unconventional monetary policy tools (UMPTs). Many of these tools had been used after the Great Financial Crisis and, based on this experience, a 2019 report by the Committee on the Global Financial System (CGFS) concluded that UMPTs were a valuable addition to central banks' toolboxes. In 2020, central banks in many advanced small open economies and emerging market economies used UMPTs for the first time, thus providing a richer set of experiences than in the past.

The CGFS formed a Working Group, chaired by Margarita Delgado (Banco de España) and Toni Gravelle (Bank of Canada), to examine experiences with the use of one particular UMPT during the Covid-19 crisis, namely large-scale asset purchases (APs). The Working Group was tasked with examining the effectiveness and side effects of APs aimed at achieving central banks' monetary policy objectives. During the Covid-19 crisis many central banks also deployed other UMPTs, such as yield targets and funding for lending schemes, but the Group's mandate focused on APs. The Group's report complements work by the Markets Committee on market dysfunction and central bank tools, insights from which were published in May 2022.

This report, similarly to the 2019 one, finds that APs were broadly successful in addressing disruptions in monetary policy transmission and providing additional monetary stimulus when the policy rate was constrained by the effective lower bound. While APs had side effects, these were contained during the period of the Covid-19 crisis. The evidence presented in this report focuses largely on the impact of APs on financial conditions in 2020. With the passage of time, richer studies over a longer horizon will allow for more definitive conclusions about APs' macroeconomic impact.

I hope that this report provides policymakers, researchers and market participants with useful insights about the experience with APs. Appendix A of the report is a rich source of information about the use and impact of APs in 18 countries plus the euro area.

Philip Lowe

Chair, Committee on the Global Financial System

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Contents

- Abbreviations.....v
- Executive summary 1
- 1. Introduction..... 2
- 2. Policy responses to the Covid-19 crisis 4
- 3. Transmission of APs: channels and types of effect..... 6
- 4. Features of APs during the Covid-19 crisis 8
 - Rationale and objectives 9
 - Composition..... 10
 - Communication and implementation..... 11
- 5. Effectiveness..... 12
 - Stock effects..... 12
 - Flow effects..... 15
 - Liquidity and term premia 16
 - Credit risk premia..... 17
- 6. Side effects.....20
 - Policy spillovers and capital flows20
 - Suppression of risk premia.....21
 - Distributional effects.....22
 - Scarcity effects.....22
 - Impact on central bank finances24
- 7. Conclusions.....25
- Appendices26
- A APs and their impact: country details.....26
 - Australia26
 - Brazil27
 - Canada.....27
 - Chile29
 - Colombia31

Euro area.....	33
Hungary.....	35
India	37
Indonesia	38
Japan	40
Korea	41
Malaysia	42
Mexico	42
Poland.....	44
Sweden	45
Thailand.....	46
Türkiye	47
United Kingdom.....	49
United States.....	51
B Yield curve dynamics in the euro area during the Covid-19 crisis.....	53
References.....	55
Members of the Working Group.....	59

Abbreviations

Currencies

AUD	Australian dollar	JPY	Japanese yen
BRL	Brazilian real	KRW	Korean won
CAD	Canadian dollar	MXN	Mexican peso
CLP	Chilean peso	MYR	Malaysian ringgit
COP	Colombian peso	PLN	Polish zloty
EUR	euro	SEK	Swedish krona
GBP	pound sterling	THB	Thai baht
HUF	Hungarian forint	TRY	Turkish lira
IDR	Indonesian rupiah	USD	US dollar
INR	Indian rupee		

Countries

AU	Australia	MY	Malaysia
BR	Brazil	NZ	New Zealand
CA	Canada	NO	Norway
CL	Chile	PE	Peru
CO	Colombia	PH	Philippines
CZ	Czech Republic	PK	Pakistan
DK	Denmark	PL	Poland
EA	euro area	QA	Qatar
GB	United Kingdom	RO	Romania
HK	Hong Kong SAR	RU	Russia
HU	Hungary	SE	Sweden
ID	Indonesia	TH	Thailand
IL	Israel	TR	Türkiye
IN	India	TW	Chinese Taipei
JP	Japan	US	United States
KR	Korea	VN	Vietnam
LK	Sri Lanka	ZA	South Africa
MX	Mexico		

Executive summary

In 2020 monetary, fiscal and prudential authorities across the globe took synchronous policy actions to counter the economic and financial consequences of the Covid-19 pandemic. Prominent among these actions were large-scale asset purchases (APs) by central banks. In the wake of the 2007–09 Great Financial Crisis (GFC), APs had been implemented by central banks in a few large advanced economies (AEs). In response to the onset of the Covid-19 crisis these central banks resumed and expanded their purchases. In addition, central banks in many small open economies (SOEs) and emerging market economies (EMEs) conducted APs for the first time.

Central banks' immediate motivation for embarking on APs during the Covid-19 crisis was often to address dysfunction in financial markets, thereby ensuring the smooth transmission of monetary policy. In AEs especially, APs also aimed to achieve central banks' monetary policy objectives when policy rates were constrained by the effective lower bound. Central banks announced programmes to purchase a wide range of assets – including subnational bonds, commercial paper, corporate bonds and asset-backed securities – in addition to central government securities, but in most cases the largest share of purchases was concentrated in government securities. In many AEs, a large part of the net issuance of government debt in 2020–21 was absorbed by central banks.

The cross-country evidence collected for this report suggests that APs had a sizeable positive impact on financial conditions during the Covid-19 crisis. Government bond yields, in particular at longer maturities, declined in response to APs. This in turn contributed to accommodative financing conditions for firms, households and the public sector. APs had an impact through both the gross “flow” of purchases and the total “stock” absorbed by the central bank (or expected to be absorbed). In general, the stock effect had a larger and more persistent impact. However, the flow effect was often stronger during periods of acute market dysfunction and low market liquidity.

The specific impact of APs and relative importance of various channels differed across time and economies. The liquidity channel was particularly important during the early weeks of the Covid-19 crisis, when market conditions were stressed. Credit risk premia also declined in response to central banks' interventions. Especially among large AEs, term premia fell thanks to the absorption of duration risk by the central bank. However, among some SOEs and EMEs, term premia were less sensitive to domestic APs and more responsive to global financial market conditions. The signalling channel, whereby APs were a tool for indicating the stance of future monetary policy, contributed to the impact on financial conditions but was less important than the portfolio rebalancing channel, especially in countries where policy rates remained above the effective lower bound.

While APs have potential side effects, this report concludes that they were not a significant concern during the period of the Covid-19 crisis. The synchronous deterioration in economic and financial conditions across countries meant that capital inflows stimulated by APs in source countries had beneficial effects in recipient countries, for example offsetting, to some extent, capital outflows from EMEs triggered by greater global risk aversion. Furthermore, in most countries a strong economic rebound and surge in inflation prompted central banks to terminate APs within a year or two and to start raising policy rates. The relatively short time period during which Covid-related APs took place made the manifestation of unintended side effects less likely. Where these purchases were part of a prolonged period of accommodative monetary policy, they were more likely to compound the side effects of earlier purchases, but none of the side effects compromised the overall effectiveness of APs.

1. Introduction

This report reviews central banks' experiences with large-scale asset purchases (APs) in response to the Covid-19 crisis that began in early 2020. It focuses on the effectiveness of APs in achieving monetary policy objectives, as opposed to their use for market functioning objectives.

The report discusses market functioning-oriented interventions to the extent that they were instrumental for ensuring a smooth transmission of the central bank's desired policy stance. Interventions explicitly intended to address market dysfunction are reviewed in complementary work by the Markets Committee (Markets Committee (2022)). The Markets Committee finds that APs can be effective at alleviating market dysfunction but are not without costs. It concludes that the key overarching principle for central bank interventions aimed at restoring market functioning is that they should act as backstops. Given the potentially large welfare costs of severe market dysfunction, providing central bank backstops can be optimal when dysfunction emerges. But these actions need to be combined with the appropriate degree of regulation and supervision to limit the distortions to market mechanisms and incentives as well as the risks to central banks and government resources.

During the Covid-19 crisis, in most emerging market economies (EMEs) the motivation for APs was limited to addressing market dysfunction. In advanced economies (AEs), APs launched early during the crisis were motivated principally by market functioning. However, central banks in AEs where policy rates were constrained by the effective lower bound (ELB) later shifted the focus of their government bond purchases to the achievement of their monetary policy objectives. Clearly the two objectives can be complementary. Market dysfunction has the potential to disrupt the implementation and transmission of monetary policy, thereby impacting real activity and price stability. Thus, even if their immediate aim was to address market dysfunction, APs can be seen as a precautionary intervention aimed at macroeconomic objectives in support of conventional monetary policy tools. In other words, APs can be seen as monetary policy reacting to financial shocks to prevent undesired macroeconomic consequences.

This report updates and extends a similar review conducted by the Committee on the Global Financial System (CGFS) in 2019 about the use of unconventional monetary policy tools (UMPTs) in the wake of the Great Financial Crisis (GFC) of 2007–09 (CGFS (2019)). The earlier report analysed a broader range of tools: negative interest rate policies, lending operations and forward guidance, in addition to APs. It concluded with a positive assessment of the experience with these tools. In particular, the report concluded that APs helped both to restore channels for transmitting monetary policy that had been disrupted and to implement an accommodative policy stance when the policy rate had reached its ELB. The 2019 report suggested that clear and prompt interventions were key elements of effective APs, and that only large interventions were likely to generate expansionary effects. At the same time, the report acknowledged that central banks' interventions were more effective when complemented by other economic policies (eg fiscal and macroprudential) – synchronous interventions which were not always undertaken during the GFC. The 2019 report also pointed to the limitations and side effects of APs (and UMPTs in general), such as international spillovers, moral hazard and excessive risk-taking. Nevertheless, it concluded that these side effects did not substantially diminish the overall benefits of unconventional interventions.

Relative to the 2019 report, the present report focuses on a shorter period of time – the two years following the onset of the Covid-19 pandemic – and only on APs.¹ But it examines the experiences of a broader range of countries, including many countries that engaged in APs for the first time in 2020.

¹ For a review of the experience with yield targets during the Covid-19 crisis, see RBA (2022).

The conclusions are similar to the earlier report. APs appear to have been effective in mitigating disruptions to channels for transmitting monetary policy. In economies where the policy rate was at the ELB, APs provided additional policy easing to keep inflation close to its targeted level. Across countries, central banks' balance sheet expansions reduced bond yields by considerable amounts. In contrast to the earlier experience with APs, the Covid-19 crisis saw a synchronous easing of fiscal and monetary policies across the globe, which amplified the macroeconomic effects.

The 2019 CGFS report highlighted several potential side effects of APs. This report concludes that side effects were not a significant concern during the Covid-19 crisis for two main reasons. First, the negative cross-country spillovers of asymmetric unconventional monetary policy interventions, which some EMEs suffered during the GFC, were mitigated, if not eliminated, by the synchronous global policy easing. Second, the rapid economic rebound from the Covid-19 crisis and dramatic change in inflation dynamics led central banks to terminate their balance sheet expansions more quickly than they had after the GFC, which reduced the likelihood that some side effects would become entrenched.

The rest of the report is organised as follows. Section 2 summarises the economic events during the Covid-19 crisis that led to the adoption of APs. Section 3 reviews the channels through which APs are expected to affect financial and economic conditions. Section 4 summarises the features of the latest round of APs. Section 5 gathers the existing evidence on the effectiveness of APs across countries, highlighting differences and commonalities between EMEs, advanced small open economies (SOEs) and large AEs. Section 6 discusses the evidence on side effects and the measures adopted to mitigate them. Section 7 concludes.

As input for the report, central banks from 18 countries plus the euro area provided country-level details about APs and their impact during the Covid-19 crisis, as well as announced exit plans. These details are presented in Appendix A.

2. Policy responses to the Covid-19 crisis

The global outbreak of the Covid-19 pandemic in early 2020 exposed the world economy to a sharp contraction of economic activity and financial instability. Monetary, fiscal and prudential authorities across the globe took synchronous policy actions to limit the economic and financial fallout from the health crisis. Actions by central banks included large – in some cases unprecedented – purchases of public and private sector assets, in addition to policy rate cuts, enhanced forward guidance and expanded lending operations.

In the early phase of the pandemic, authorities responded by announcing containment measures including lockdowns that limited personal mobility and economic activities. In anticipation of a protracted global health and economic crisis, asset prices fell sharply starting in late February 2020 and EME currencies depreciated. A flight to safety morphed into broad-based selling in mid-March, when even the safest and most liquid assets such as government bonds experienced large price declines and funding markets experienced severe strains. The lack of treatments for Covid-19 added to the pessimism and further weighed on economic activity. The economic and financial consequences were immediate and severe: financial conditions tightened sharply in March 2020; a large number of countries saw GDP plunge by several percentage points in the first half of 2020; and inflation dropped rapidly across most countries.

To stabilise the financial system and support economic activity, authorities deployed monetary, prudential and fiscal policies in a concerted way that has few historical precedents (BIS (2020)). Governments in many countries announced large fiscal packages, in many cases despite already stretched public finances, which were in part a legacy of the GFC. Prudential authorities enacted a wide range of measures to support the flow of credit and the resilience of financial institutions. And central banks implemented exceptional measures swiftly and forcefully.²

During economic or financial crises, conventional monetary policy tools – typically consisting of steering short-term interest rates – can lose traction, either because they hit the ELB on interest rates or because the standard channels through which the monetary policy stance is transmitted to the economy are impaired. In these circumstances, unconventional monetary policy tools, such as APs, can be deployed to restore transmission channels and complement policy rate cuts in pursuit of an expansionary policy stance.

The Covid-19 crisis led many central banks to use unconventional tools to address financial market stresses and support economic activity. Especially in Europe and North America, central banks significantly reduced policy rates when possible and expanded their asset purchase and lending programmes. The main objective of these measures in the early phase of the crisis was to restore market functioning and thereby maintain the smooth transmission of the monetary policy stance. For a number of countries, direct monetary policy objectives were also a key motivation. Many EMEs also conducted APs, even though they typically had more room than AEs to lower policy rates, but their focus remained on preserving the smooth transmission of monetary policy. As a consequence, the size of central banks' balance sheets increased rapidly across many countries, in many cases reaching record high levels (Graph 1).

Central banks' announcements of APs and other measures, as well as complementary actions by other authorities, averted a destabilising loop of downward price spirals and fire sales, and resulted in a substantial improvement in liquidity conditions in the early weeks of the Covid-19 crisis. There was also an improvement in financing conditions for firms and households.

Policy stimulus, coupled with the easing of containment measures and the rollout of vaccines starting in late 2020, set the stage for a strong recovery of aggregate demand, albeit one coupled with protracted supply disruptions. The war in Ukraine, which started in February 2022, disrupted the supply of key commodities, which further pushed up food and energy prices. This constellation of factors eventually

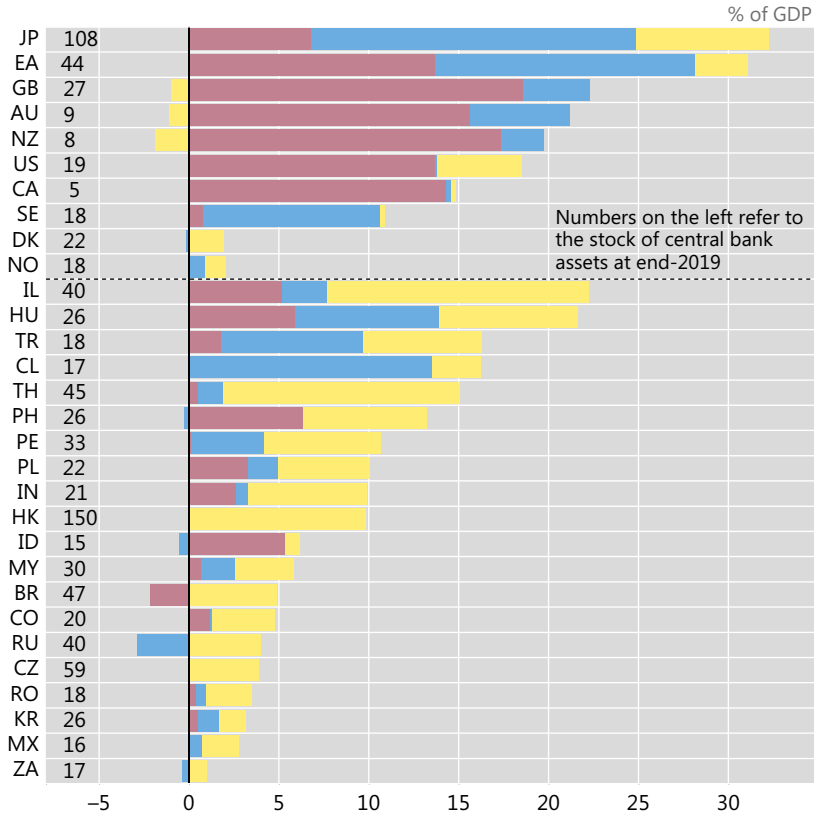
² For details about central banks' monetary policy responses during the Covid-19 crisis, see Cantú et al (2021).

led inflation to overshoot central banks' targets, although longer-term inflation expectations remained anchored. Central banks reacted by tightening their policy stance, including hiking policy rates and winding down APs.

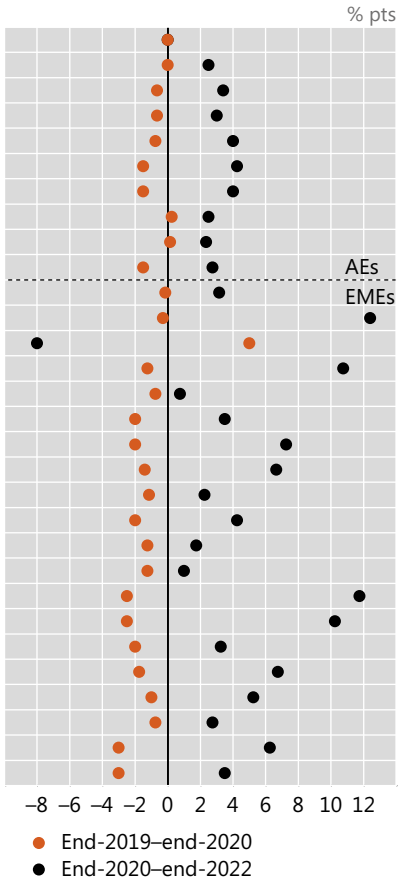
Monetary stimulus during the Covid-19 crisis

Graph 1

A. Change in central bank assets



B. Change in policy rates



End-2019–end-2021: Public assets¹ Private assets² Other assets³

End-2019–end-2020 End-2020–end-2022

¹ Public assets comprise claims on central and local governments. ² Private assets comprise claims on banks, other financial institutions, public non-financial corporations and the private sector. Claims do not take account of guarantees, eg claims on public banks and corporations are classified as private assets even if they are guaranteed by the government. ³ Other assets include foreign exchange and gold reserves and claims not captured by public and private assets.

Sources: Datastream; IMF; national data; CGFS Working Group calculations.

3. Transmission of APs: channels and types of effect

APs involve an increase in a central bank's holdings of bonds and other securities funded by an increase in its liabilities, usually commercial banks' reserve balances. Conceptually, APs affect market yields only to the extent that there is segmentation (or limited arbitrage) across asset classes. If this were not the case, the exchange of central banks' liabilities for other assets held by market participants would have no direct effect on yields (Wallace (1981)).

Segmentation might arise because some types of investor prefer specific assets and maturities. Indeed, investment strategies indicate a certain degree of "preferred habitat", at least in the short run (Yellen (2011), Vayanos and Vila (2021)). Other types of investor seem to be subject to limited risk-bearing capacity. The observed effect of past APs on yields is also indicative of the existence of segmentation (CGFS (2019)).

APs operate through several possible channels. Some affect all asset prices at the same time, albeit to different extents.³ A case in point is the **signalling channel**: an indication of the policy stance that the central bank will follow in the future. Such policy signals affect a broad range of asset prices by influencing expectations about future economic and financial conditions. Through this channel, the mere confirmation of the central bank's willingness to intervene might be sufficient to calm markets and ensure the smooth transmission of monetary policy.

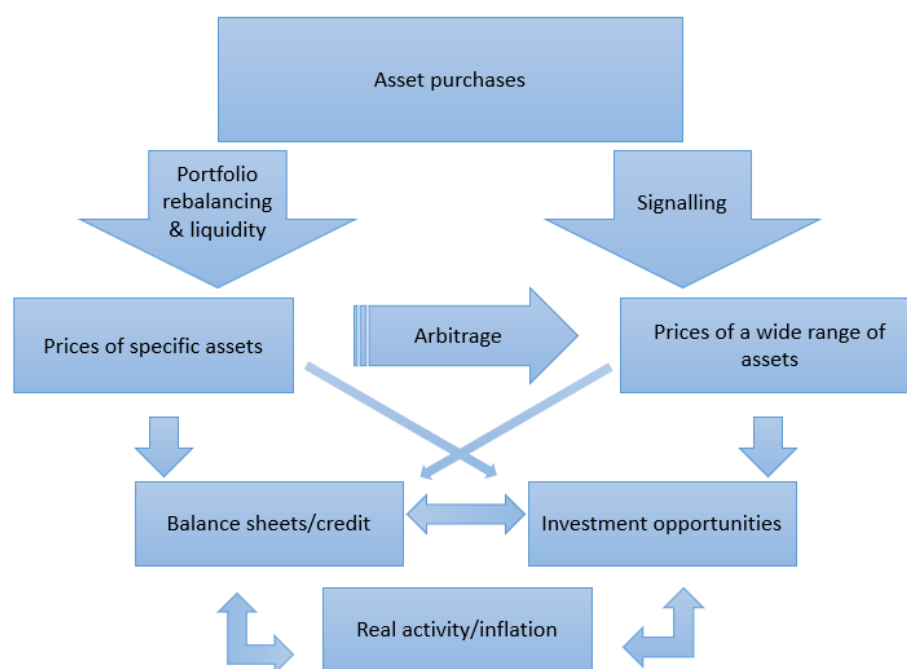
Other channels of APs directly affect a narrower range of asset prices. They affect the price of purchased assets directly and the price of related assets indirectly, through arbitrage. There are two such channels. One is the **liquidity channel**. Central banks' purchases reduce the liquidity premia on bonds by improving market functioning and reducing the risk that bonds might be difficult to sell. This channel can be particularly important in periods of financial market stress.

Another is the **portfolio rebalancing channel**. Central banks' purchases affect the prices of targeted assets directly by altering the duration and credit risk of the private sector's asset holdings. By altering the quantity and composition of risk in private investors' portfolios, the central bank induces an adjustment in investment, which eventually results in changes in other asset prices. Central banks' purchases reduce the private sector's exposure to duration risk – the sensitivity of the price of an asset to variations in interest rates – as central banks exchange lower duration assets (eg central bank reserves) for private holdings of higher duration assets (eg long-term government debt). This operation compresses term premia across maturities, in particular for longer-dated securities. Similarly, APs reduce the private sector's exposure to credit risk as central banks exchange safer assets (eg central bank reserves) for private holdings of riskier assets (eg corporate or subnational government debt).

An increase in asset prices induced by APs through these channels strengthens the balance sheets of financial intermediaries and other borrowers, which stimulates credit and generates investment opportunities. Eventually, the expansion of credit stimulates aggregate demand and improves economic conditions, further strengthening credit and investment in a virtuous cycle, as shown in Graph 2.

Moreover, to the extent that APs cause relative yields across countries and risk premia to adjust, they influence cross-border capital flows. The currencies of countries that embark on APs tend to depreciate relative to those of countries that do not. Whether the exchange rate depreciation stimulates economic activity and inflation depends on a number of factors, including the country's exposure to currency risk (eg foreign currency denomination of debt), and the pass-through of exchange rate changes to import and export prices.

³ Krishnamurthy (2022) identifies two channels of asset purchases: a broad one and a narrow one. The broad channel relates to the effect that APs have on all asset classes, beyond those assets directly targeted. It is similar to the effect of conventional monetary policy tools and can be mainly ascribed to the "signalling" content of asset purchases.



In principle, APs can set in motion the virtuous cycle illustrated in Graph 2 through either the “flow” of purchases or the cumulative “stock” purchased by the central bank. For central banks, the distinction between flow and stock effects is crucial for the correct calibration of the policy stance. If the stock effect is important, simply terminating purchases might not fundamentally alter the policy stance. Because financial markets are forward-looking, stock effects are likely to arise upon announcement (or in anticipation of the announcement) and are likely to last longer. By contrast, flow effects are likely to be relatively limited and short-lived, for example reflecting improvements in liquidity conditions and market functioning during periods of financial stress.

The importance of these different channels – and thus how APs’ effects on financial conditions might evolve over time – depends, for instance, on the degree of market distress and the prevailing state of the economy. For example, the stock effect might wane over time as market conditions improve, even if the assets available to market participants do not change.

In short, APs can affect asset prices broadly and immediately through the signalling channel. Their effects on purchased assets can also spread more slowly to other assets through the liquidity and portfolio rebalancing channels. The increase in asset prices engendered by APs improves balance sheets and stimulates credit, while the fall in the cost of finance stimulates aggregate demand. Improved economic and financial conditions feedback to balance sheets and investment opportunities, triggering an expansionary cycle.

Importantly, the degree of segmentation and the channels through which APs operate change over time and across states of the world. Consequently, the appropriate role of APs in the policy mix is not time- or state-invariant. Market segmentation is more acute during crises. This gives more traction to APs in the targeted segments, yet it limits its short-run effects across asset classes and maturities.

4. Features of APs during the Covid-19 crisis

Whereas prior to the Covid-19 crisis APs had been used mainly by central banks in large AEs, in 2020 central banks in a more diverse set of countries embarked on APs, often for the first time. An important reason for the wider use of APs was the severity of the crisis. In particular, financial markets around the world experienced acute stress in March 2020, which was alleviated by the prompt and exceptional actions of central banks and other authorities.

Across countries there were differences in the specific rationale for adopting APs and the design of purchase programmes, but there were also many similarities (Table 1). Common features included sizeable and flexible purchases, coupled with proactive communication that reflected central banks' willingness to adjust their policies as needed. The main features of APs in different countries are contrasted below; additional details for individual countries are provided in Appendix A.

		Motivation for purchases		Type of assets purchased		Cumulative purchases (in per cent of 2019 GDP)	Average maturity of holdings (in years) ¹
		Market functioning objectives	Monetary policy objectives	Public assets	Private assets		
AEs	Euro area	Yes	Yes	Yes	Yes	19.7%	7.6
	Japan	Yes	Yes	Yes	Yes	70.4%	
	United Kingdom	Yes	Yes	Yes	Yes		13.0
	United States	Yes	Yes	Yes	Yes	21.0%	7.2
SOEs	Australia	Yes	Yes	Yes	No	18.0%	5.9
	Canada	Yes	Yes	Yes	Yes	23.6%	6.2
	Sweden	Yes	Yes	Yes	Yes	13.9%	3.8
EMEs	Brazil ²	Yes	No	Yes	No	0.3%	9.0
	Chile	Yes	No	Yes	Yes		
	Colombia	Yes	No	Yes	Yes		
	Hungary	Yes	Yes	Yes	No		
	India	Yes	Yes	Yes	No	3.0%	8.0 ³
	Indonesia	Yes	Yes	Yes	No		
	Korea	Yes	No	Yes	No	0.9%	4.3
	Malaysia	Yes	No	Yes	No		
	Mexico ⁴	Yes	No	Yes	No	0.1%	15.0
	Poland	Yes	Yes	Yes	No	6.3%	
Thailand	Yes	No	Yes	No	0.9%	5.0	
Türkiye	Yes	No	Yes	No			

¹ Calculated as maturity-weighted sum of central bank's holdings divided by total holding; approximate values, excluding assets without a specific maturity. ² Purchases were conducted by the National Treasury. ³ Purchases under the government securities acquisition programme between April and September 2021, which amounted to 1.1% of 2019 GDP. ⁴ The Bank of Mexico engaged in twist operations, buying long-maturity government debt while selling short-maturity debt. In this table only purchases are recorded.

Rationale and objectives

Across AEs, central banks promptly engaged in APs at the start of the pandemic by launching new programmes, scaling up existing programmes or reactivating past programmes. Most AE central banks engaged in APs with two objectives in mind: first, to address disorderly market conditions that disrupted the transmission of monetary policy, and second to implement an expansionary policy stance when policy rates were constrained by the ELB (Table 1). After their initial announcement in March 2020, programmes were recalibrated on a few occasions in response to the evolution of the health crisis and its economic and financial ramifications. Drawing from the experience accumulated by central banks in coping with the GFC and the resulting economic landscape of low inflation and policy rates close to their ELB, the programmes were designed to be sizeable, broad-based and flexible.

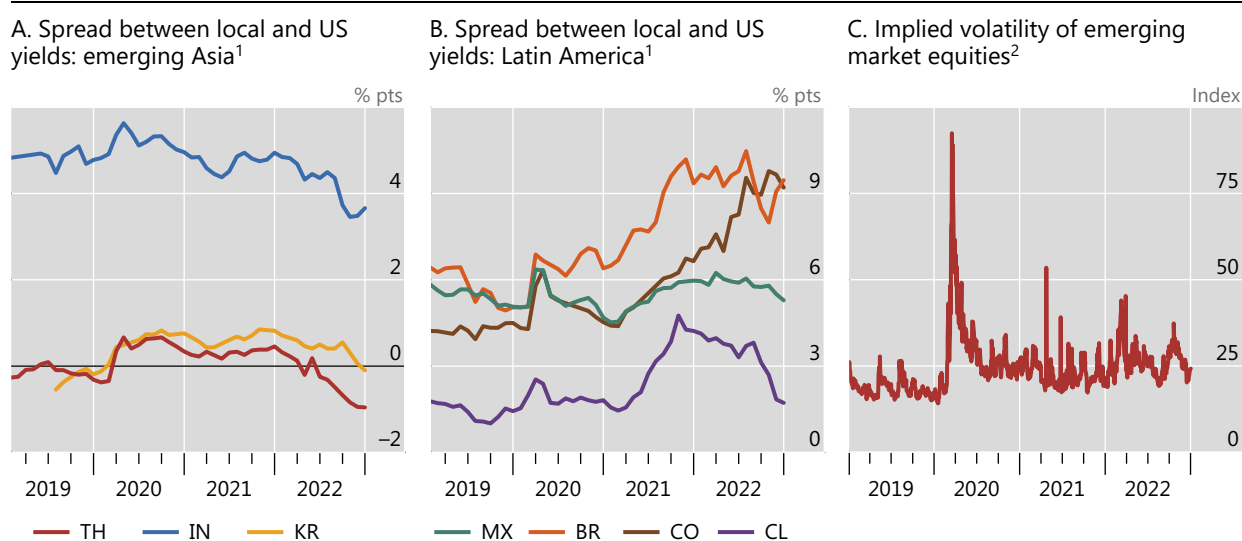
Among EMEs, many central banks used APs exclusively to address market dysfunctions, while some others also used them to support the real economy. Prior to the Covid-19 crisis, many EME central banks had operated with large balance sheets, reflecting large foreign exchange (FX) reserves, and thus had experience adjusting their balance sheets to respond to economic and financial disturbances. Nevertheless, some of them had little experience with larger-scale, emergency APs.

Central banks in many EMEs ventured into APs to restore orderly markets and cushion the tightening of financial conditions. During the initial weeks of the Covid-19 crisis, a general “risk off” sentiment led to a sharp jump in yields and volatility in EMEs (Graph 3). In Brazil, India and Mexico, interventions in domestic government bond markets aimed to reduce excess volatility in various market rates and to contain risk premia (Appendix A). In Colombia too the central bank purchased government and corporate bonds to provide liquidity to the financial system, support market functioning and improve price formation. These interventions were not aimed at directly affecting the level of yields.

In some EMEs, outright purchases were already part of the central bank’s monetary policy tools, but the operations were used more intensively during the Covid-19 crisis. Examples include Hungary, Korea, India, Malaysia and Türkiye. In Hungary, APs were expanded to ensure the efficient transmission of monetary policy. In Malaysia, the central bank operated through the existing AP scheme, and interventions during the Covid-19 crisis were moderate.

Financial conditions in EMEs tightened as Covid-19 spread

Graph 3



¹ 10-year local currency sovereign bond yield minus US Treasury yield. ² CBOE Emerging Markets ETF Volatility Index.

Sources: Federal Reserve Bank of St Louis, FRED; OECD; Bloomberg; CGFS Working Group.

In a few EMEs, central banks coordinated their APs with the government to achieve the broader goal of supporting macroeconomic and price stability. The central bank of Indonesia collaborated with the Ministry of Finance through a special burden-sharing recovery plan. This collaboration involved central bank purchases of government securities in the primary market.

In the case of Chile, the central bank's intervention in early 2020 occurred against the backdrop of social unrest in late 2019 as well as the Covid-19 outbreak. The central bank of Chile purchased banks' bonds and its own bonds in the secondary market. An additional motivation for purchases was the government's decision to allow residents to withdraw some money from their pension funds. The resulting liquidation of assets by pension funds required the absorption of the excess supply of securities to avoid disruptions in financial markets.

Composition

Overall, the largest share of APs consisted of public sector assets. In some countries, for example India, purchases consisted exclusively of government debt. However, in general during the Covid-19 crisis, the range of assets covered by central banks' purchase programmes was wider, and credit quality lower, than in the past.

For monetary policy purposes, purchases of central government bonds were the main channel through which most central banks sought to ease overall financial conditions because government yields typically serve as benchmarks for the private sector's financing costs. Central banks' main motivation for purchasing securities other than government bonds was often to support the liquidity and efficiency of specific segments, owing to the extent of market dysfunction seen in March 2020. Purchases of private sector assets were a way to support the flow of credit and prevent an excessive rise in risk premia.

In some countries, central banks introduced programmes to purchase local public authorities' securities, or eased eligibility requirements. For instance, in the United States, the Federal Reserve (Fed) established a facility to purchase state and municipal debt. The Reserve Bank of Australia (RBA) and Bank of Canada (BoC) also purchased sub-national bonds. The Covid-related APs by the European Central Bank (ECB), under the pandemic emergency purchase programme (PEPP), granted Greek government securities a waiver from the eligibility requirements, which had not been the case for purchases under its pre-pandemic public sector purchase programme (PSPP).

Furthermore, many central banks announced or expanded programmes to purchase private sector assets. Among AE central banks, purchases of commercial paper and corporate bonds were common. Some also purchased exchange-traded funds, asset-backed securities and covered bonds. In the United States, the Fed included agency commercial mortgage-backed securities (MBS) in its purchases for the first time. It also purchased investment grade corporate bonds for the first time and later extended eligibility to subsequently downgraded bonds – so-called "fallen angels". Among EMEs, Chile included bank bonds in its programme, and Colombia high quality corporate bonds. Hungary had a pre-existing programme to purchase corporate and mortgage bonds, but its Covid-related purchases were limited to government and government-guaranteed bonds.

Central banks differed in the maturities purchased. Canada and Sweden's APs targeted a broad range of maturities across the yield curve, while Australia's targeted the three-year bond and the five- to 10-year segment of the curve. In Japan, the central bank temporarily extended the maximum remaining maturity of corporate bonds eligible for purchase from three years to five years. In the euro area, the ECB expanded the eligibility of non-financial commercial paper to include securities with a remaining maturity of at least 28 days, compared with the previous minimum maturity of six months.

In addition to outright operations, central banks in India and Mexico engaged in twist operations, buying long-maturity government debt while selling short-maturity debt. These operations left banks' liquidity positions unchanged. In Brazil, in order to support market functioning, the National Treasury

carried out simultaneous auctions to buy and sell government debt securities, which resulted in net purchases of USD 6 billion.

Communication and implementation

When introducing or expanding APs, central banks emphasised that they were standing ready to take additional measures if necessary and to adjust the pace or size of their purchases depending on market and economic conditions. Such proactive communication by central banks helped to restore market confidence quickly and also enhanced the effectiveness of their APs.⁴

The implementation of APs was also conducted in a flexible manner. AE central banks commonly adjusted the pace of their APs, considering financial market conditions, supply and demand conditions of purchased assets, and the situation of their economies. In the acute phase of the Covid-19 crisis they purchased assets at a materially faster pace than in the past but fine tuned the pace by adjusting the size or frequency of their monetary operations as financial market confidence was restored and their economies started to show signs of recovery.

In the euro area, where APs also sought to resist fragmentation pressures among member countries, purchases under the PEPP were implemented more flexibly than under previous APs. Purchases of government bonds continued to be allocated according to the ECB's capital key, but in contrast to previous APs, the PEPP allowed for temporary deviations from the capital key.⁵

Similarly to AEs, EMEs also adapted their policy instruments to experience gathered over time. In Brazil, for example, the central bank made some changes to its liquidity assistance facilities and its procedures for outright purchases of government debt in the secondary market. In India, the Reserve Bank of India (RBI) announced a government securities acquisition programme with an upfront commitment to purchase a pre-announced amount of government securities in the secondary market to enable a stable and orderly evolution of the yield curve and to help ease financial conditions for the recovery to gain traction.

⁴ For analysis of central banks' communication during the GFC, see Coenen et al (2017).

⁵ The "capital key" is the share of the ECB's capital contributed by each member state. Shares are based on each member's population and GDP.

5. Effectiveness

The empirical evidence summarised below concludes that, during the Covid-19 crisis, APs were effective in loosening financial conditions. Central banks' sizeable APs reduced risk premia and restored channels for the smooth transmission of monetary policy. During the period of acute market stress, segmentation and limited arbitrage capability hampered the spillovers across asset classes. Central banks intervened directly in various market segments, and this flexibility ensured that their purchases had the desired effect on broader financial conditions. Additional details about the effectiveness of APs for individual countries are provided in Appendix A.

Stock effects

Considering that financial markets are forwards-looking and provided that market functioning is not completely impaired, the main impact of APs on asset prices is expected to be realised upon announcement of the policy – the “stock” effect. To the extent that these announcements were unanticipated by market participants, changes in asset prices around the time of the announcement would give unbiased estimates of APs' effects. However, surveys indicate that, during the Covid-19 crisis, market participants anticipated, to various degrees, central bank interventions. Thus small measured declines in yields or spreads on the announcement day might underestimate the larger and possibly non-linear changes that might have been observed without central bank interventions.

With this caveat in mind, event studies find that government bond yields in AEs and EMEs declined sharply in response to the initial announcement of APs. Announcements during the early weeks of the Covid-19 crisis triggered a reversal of the upward trend in yields observed prior to the announcements. In AEs, government bond yields fell by between 10 and 30 basis points in the days following the announcement. In EMEs, long-term bond yields declined by around 10 basis points on average.

Yields declined over several days. In the euro area and the United Kingdom, yields declined by 19 and 16 basis points, respectively, within one day of the initial announcement in March 2020 and 30 basis points over two days (Graphs 4.A and 4.B).⁶ Yields at longer maturities fell by more than at shorter maturities (Graph 4.A). In the United States, 10-year Treasury yields fell by 24 basis points within one day of the Fed's initial announcement, but then increased again for a few days. They started falling decisively after the Fed pledged “unlimited purchases” and scaled up its actual daily purchases substantially (Graph 4.C). In Japan, the central bank's March 2020 announcement that it would actively purchase government bonds and April 2020 announcement that it would conduct further active purchases without setting an upper limit helped to stabilise the 10-year yield at around zero percent, in line with the Bank of Japan's guideline for market operations.

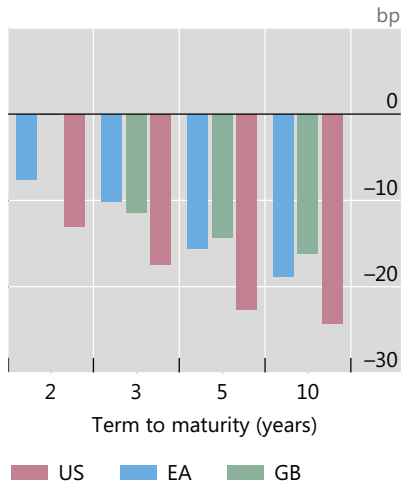
In SOEs too, government bond yields fell across the curve following the announcement of APs, by up to 30 basis points. In Australia and Sweden, the announcement effect was strongest for longer-term bonds, whereas in Canada yield declines were more pronounced at the short end (Graph 5).

⁶ Rostagno et al (2021) find a similar impact after controlling for, inter alia, concomitant macroeconomic releases for the euro area and the United States, and the impact stemming from interest rate policies.

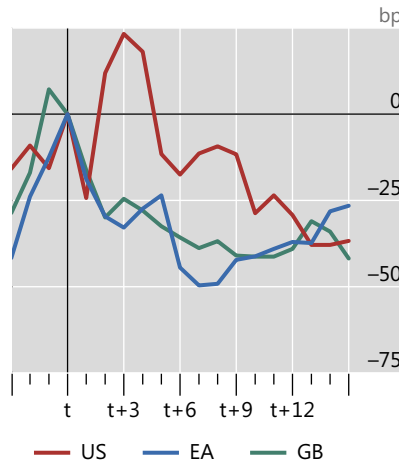
Response of yields to the initial announcement of APs in March 2020: large AEs

Graph 4

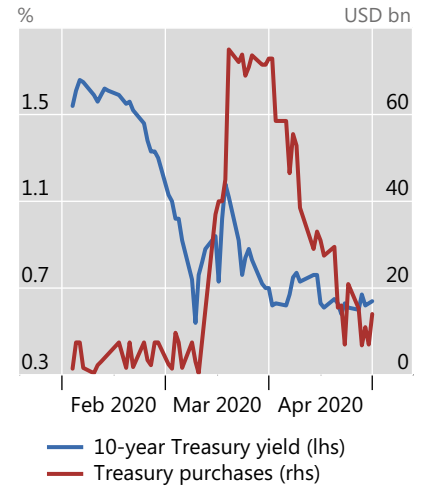
A. One-day change in yields after the initial announcement of APs¹



B. 10-year yields around the initial announcement of APs²



C. 10-year US Treasury yields and daily Treasury purchases by the Fed



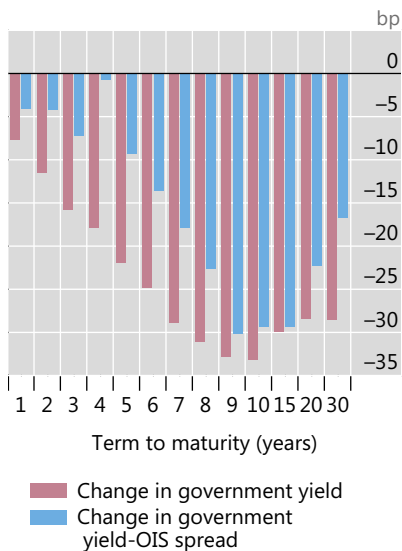
¹ For GB, the change at 2y is -0.00025 . ² For the Federal Reserve, t refers to the date when the scale-up of the Treasury purchase programme was announced. For the ECB, t refers to the date when the start of ECB PEPP purchases was announced. For the BoE, t refers to the date when the start of purchases was announced.

Sources: Board of Governors of the Federal Reserve System; Federal Reserve Bank of St Louis, FRED; CGFS Working Group.

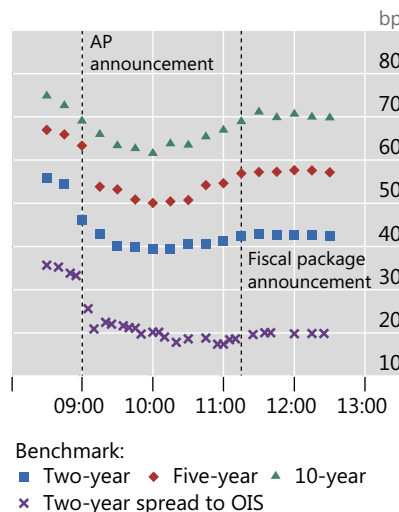
Response of yields to the initial announcement of APs in March 2020: SOEs

Graph 5

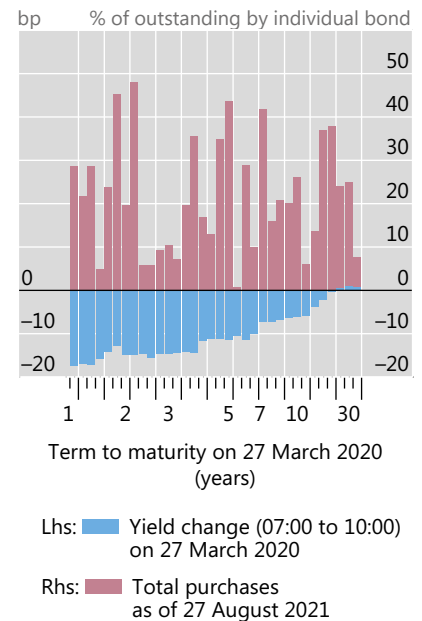
A. In Australia, the announcement of APs lowered yields across the curve, especially at longer maturities



B. In Canada, the announcement of APs had a strong and immediate impact on yields¹...



C. ... with the yields of short- to medium-term bonds falling more than those of long-term bonds



¹ The two-, five- and 10-year benchmarks are calculated as the average yield over 15-minute intervals, while the two-year benchmark spread over the overnight index swap (OIS) rate is calculated as the average spread over five-minute intervals.

Sources: Reserve Bank of Australia; Bank of Canada; Bloomberg; Canadian Depository for Securities Ltd; CGFS Working Group.

In EMEs, yields declined by approximately 10 basis points on the day of the announcement and up to 50 basis points in subsequent days. In Mexico, government debt exchange operations reduced the yield on five-year bonds by around 50 basis points over a 10-day window centred on the announcement of the first swap in April 2020 (see Appendix A). In Brazil, five-year yields declined by around 155 basis points over the same interval. In Thailand, central bank purchases capped the rise in yields and restored market functioning. In India, announcements cumulatively reduced the 10-year yield by around 9 basis points (RBI (2022)). In Indonesia, yields on government debt spiked in March 2020, but then declined following the announcement of APs. While reducing EMEs' yields, APs had statistically insignificant effects on exchange rates (Arslan et al (2020)).

The elasticity of yields with respect to announcements of APs appeared to be in the upper range of pre-Covid estimates, at least for large AEs. Yield changes around policy announcements provide reliable estimates of APs' effects so long as the surprise component of the announcements can be estimated. According to surveys, the Fed's initial announcement was largely unanticipated. Compared with pre-Covid estimates (Graph 6.A), the yield elasticity of this announcement was sizeable, at around 100 basis points for purchases normalised to 10% of GDP. For the euro area, there is more uncertainty about the size of the surprise component. Assuming that the ECB's PEPP announcement was largely unanticipated, the resulting yield elasticity was around 50 basis points for purchases equivalent to 10% of GDP, which is on the high side of pre-Covid estimates.⁷ Estimated elasticities for the United Kingdom are also on the high side relative to the historical experience. For India, the yield elasticity is estimated at around 80 basis points for purchases normalised to 10% of GDP (RBI (2022)).

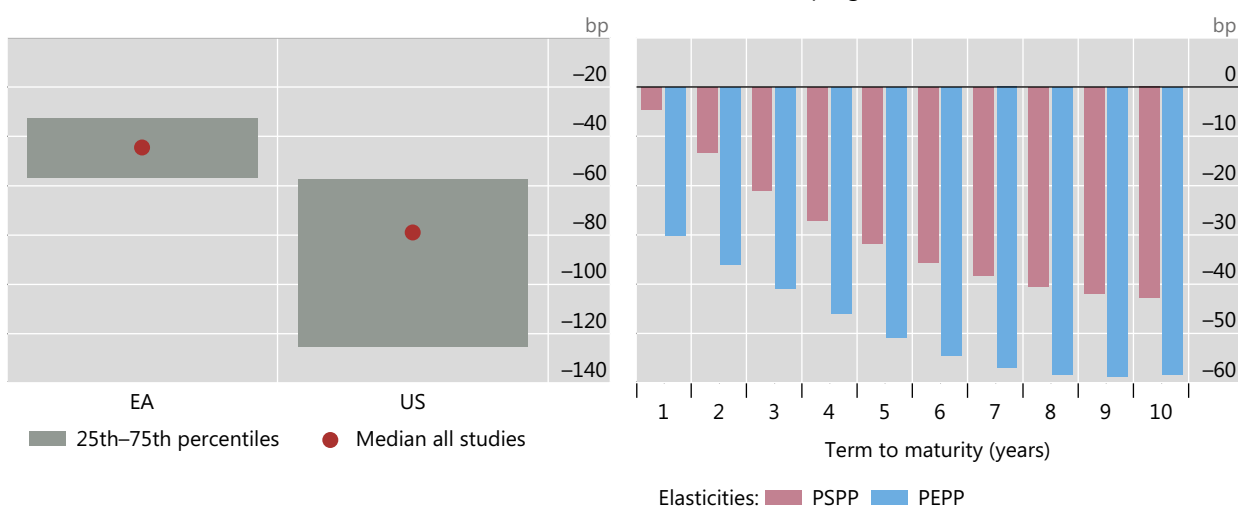
Estimated elasticity of yields to asset purchases in large AEs

Yield elasticities to AP surprises, per 10% of GDP

Graph 6

A. Range of estimates for pre-Covid APs¹

B. Yield elasticities under the ECB's pre-Covid (PSPP) and Covid (PEPP) AP programmes²



¹ Range of estimates derive from the following studies: for the United States, Cahill et al (2013), D'Amico et al (2012), D'Amico and King (2013), Gagnon et al (2011), Kim et al (2020), Krishnamurthy and Vissing-Jorgensen (2011), Li and Wei (2013), Meaning and Zhu (2011) and Swanson (2011); for the euro area, Altavilla et al (2021a), Andrade et al (2016), De Santis (2020), Eser et al (2019), Koijen et al (2021) and Rostagno et al (2021). ² PSPP elasticities are based on Eser et al (2019) informed by the March PEPP envelope. PEPP elasticities are derived from a recalibrated version of Eser et al (2019) so that the model-implied yield reactions to the March PEPP announcement match two-day yield changes observed after 18 March. Elasticities refer to GDP-weighted zero-coupon yields of the largest four euro area countries in response to government bond purchases normalised to 10% of euro area GDP in 2019. No reinvestment assumed.

Sources: European Central Bank; CGFS Working Group.

⁷ For the ECB, surveys suggest that the surprise component ranged from €750 billion (fully unanticipated) to €200 billion. The estimated yield elasticity ranges from 48 to 140 basis points, depending on assumptions about the surprise component.

For the euro area, model-based evidence supports the conclusion that Covid-related APs, through the PEPP, had stronger effects than pre-Covid purchases, through the PSPP. Under the PSPP, an increase in sovereign bond purchases equivalent to 10% of euro area GDP is associated with an average decline in the 10-year yield of around 43 basis points. Under the subsequent PEPP, the decline associated with that volume is larger, at about 58 basis points (Graph 6.B). The higher estimated impact of PEPP on yield premia, compared with PSPP, can be explained by the higher sensitivity of bond yields in times of financial stress and the greater flexibility of PEPP.

Flow effects

Beyond the stock effect associated with APs, sovereign yields in AEs continued to fall in subsequent weeks on the back of the actual implementation of purchases. This persistent decline in sovereign yields was underpinned by APs in two distinct, yet reinforcing, ways. First, flow effects at the time of the actual implementation of the purchases. That is, the flow of purchases reduced associated yields. Second, the flexibility with which purchases were implemented amplified the stock effects by affecting expectations about the total stock of purchased assets, which further contributed to the lowering of yields.

Flow effects were especially strong in large AEs and during the early weeks of the crisis, when market conditions were stressed and liquidity was low. In the United States, the Fed's Treasury purchases appear to have had large effects on asset prices at the time of purchase during the initial phase of the Covid-19 crisis (Vissing-Jorgensen (2021)). Purchases helped curb the yield spike in March 2020 driven by the liquidity needs of mutual funds, foreign official agencies and hedge funds. Similarly, in the euro area flow effects from the PEPP were particularly strong during the stressed market conditions of March 2020 (Bernardini and De Nicola (2020)).⁸ Moreover, these effects were primarily concentrated in more vulnerable countries (Graph 7.A). In the United Kingdom, APs had a substantial impact on asset prices during the stressed conditions of March 2020 and market liquidity improved decisively once purchases began (see Busetto et al (2022) and Appendix A).

However, flow effects were not as strong in SOEs. In some cases they were found to be statistically insignificant and, when results were significant, they were generally small in magnitude. For instance, in Australia purchases lowered the yield on central government securities by 0.5 basis points and state government bonds by 0.2 basis points on the day of purchases, when the analysis grouped shorter-dated and longer-dated bonds together.⁹ A similar analysis for Canada found that a CAD 1 billion government bond purchase caused an average decline in yields of about 0.8 basis points on purchased bonds on the day of a purchase operation. The analysis for Canada also measured the yield impact on eligible bonds that were not actually purchased – it found a yield decline of approximately 0.4 basis points associated with the purchase of CAD 1 billion of other eligible bonds of the same maturity on the day of the operation. Analysis for Sweden showed that the flow effects of purchases were statistically insignificant. In addition, in all three countries, the effects were short-lived, lasting only a few days at most.

The flexibility with which purchases were implemented contributed to APs' overall effect on yields by amplifying the stock effect. For example, purchases conducted at a fast pace provided market participants with additional information about the size and length of the programme – beyond that which had been provided in the announcement. Likewise, the share of riskier assets in purchases led market participants to revise their expectations about the overall extraction of risk entailed by APs. In general, the state-contingent and flexible formulations adopted by central banks in AEs led market participants to revise their expectations about APs over time in response to evolving financial and economic conditions,

⁸ Bernardini and De Nicola (2020) find that actual purchases of sovereign bonds conducted by the Bank of Italy during the first half of 2020 exerted downward pressure on bond yields, especially by reducing sovereign spreads, and contributed to an improvement in market liquidity. These effects were substantially larger during the stressed market conditions of March 2020.

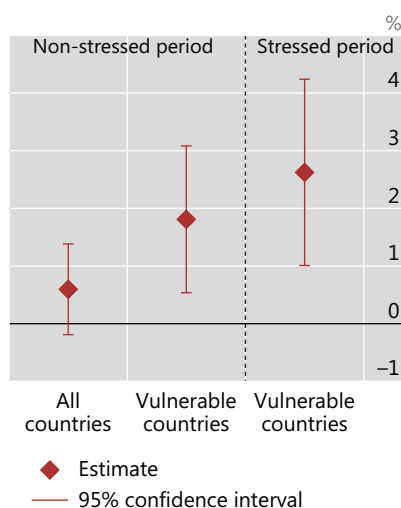
⁹ Effects were found to be insignificant when shorter-dated and longer-dated groupings of bonds were analysed separately. In this specification, the bonds not eligible for purchase were those recently tapped or issued (RBA (2021)).

over and above official communications by central banks. Surveys show that a vast majority of respondents correctly anticipated subsequent central banks' recalibrations. As a result, it has become challenging to identify the effects of those recalibrations on the basis of asset price reactions that followed an initial announcement.

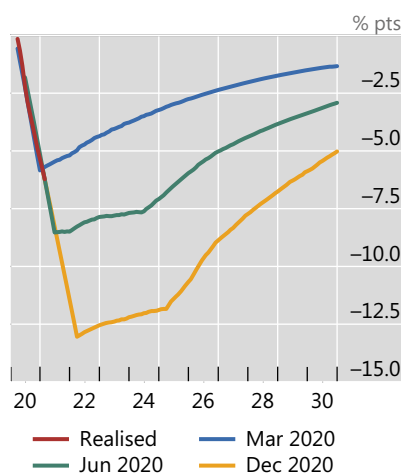
Effects of APs on euro government yields

Graph 7

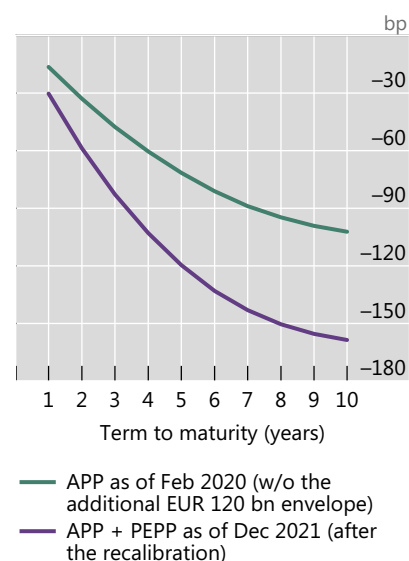
A. "Flow effects" on euro area daily bond returns¹



B. Projected PEPP-induced change in bond free-float by vintage of ECB's recalibration²



C. Impact of additional APs on euro area government term premium³



¹ Impact of 1 percentage point increase in purchases of securities relative to its outstanding amount. The impact estimates derive from regressions of daily bond returns of individual central government securities on ECB purchases of these securities, scaled by their outstanding amounts, and a full set of security and day fixed effects. Purchase volumes are instrumented via the blackout periods embedded in the PSPP and PEPP design, as detailed in De Santis and Holm-Hadulla (2020). ² PEPP-induced change in "bond free float" is computed as Eurosystem's sovereign bond holdings over outstanding sovereign debt (inverted sign), expressed in EUR billions of 10-year equivalents. ³ Impact estimates on zero-coupon GDP-weighted sovereign yields of Germany, Spain, France and Italy are based on the model by Eser et al (2019). The estimates are based on the current and future duration extraction implied by the Eurosystem's APs and PEPP as anticipated in mid-2020, using SHS data for the first quarter of 2020. The green line is predicated on a path for Eurosystem holdings that excludes the PEPP and additional APs undertaken after the Governing Council's decision of March 2020, while the violet line incorporates them and the additional PEPP purchases decided up until the December 2021 Governing Council meeting.

Sources: European Central Bank; CGFS Working Group.

Liquidity and term premia

In principle, APs might be expected to have a larger impact on longer-term yields than short-term ones because they exert downward pressure on term premia through the extraction of duration risk. This seems to have been the case in several countries. APs helped to flatten the yield curve through a compression in term premia, possibly due to a decline in duration risk premia. During the Covid-19 crisis, the sizeable extraction of duration by APs likely had particularly important effects owing to the limited risk-bearing capacity of financial intermediaries at the time and the concomitant expansion in government debt (increase in the supply of duration).

Evidence for the euro area is consistent with a decline in duration risk premia. The ECB's APs reduced the duration-equivalent stock of government debt available in the secondary market by as much as 13% in early 2022 (Graph 7.B). The PEPP-induced duration extraction led to a decline in 10-year euro

area sovereign yields of approximately 65 basis points (Graph 7.C). The effect was more contained for shorter-dated bonds that are less exposed to duration risk.

In some SOEs, however, APs appear to have had a smaller effect on term premia. In Canada, a comparison of intraday yield changes after the announcement of the government bond purchase programme, with the maturity distribution of the BoC's subsequent bond purchases, shows that the announcement effect was uneven across bonds: yields fell more strongly for shorter-duration than for longer-duration bonds (Graph 5.C). The more pronounced effect on shorter-duration bonds may be attributable to market expectations of more purchases in the short end of the curve.¹⁰ The impact is consistent with pre-Covid studies that suggested that quantitative easing is less effective in compressing yields in SOEs than in large economies such as the United States (Kabaca (2016)). Term premia of longer-term bonds in SOEs may be more influenced by global factors, which potentially limits the impact of APs on longer-maturity bonds (Diez de los Rios and Shamloo (2017)).

That said, the duration risk channel was not unimportant in SOEs. Effects associated with the signalling and duration risk channels can be proxied through the response of overnight index swap (OIS) rates, as well as term premia, to the announcement of APs. OIS rates reflect market expectations for the implied path of money market interest rates, and hence central bank policy rates. A decline in the spread between bond yields and OIS rates in response to announcements of APs can be interpreted as a proxy for APs' effects via credit risk and liquidity channels.¹¹ In Sweden, and for short-term bonds in Australia, signalling and duration risk effects appear to have been the main drivers.

Credit risk premia

APs also had a sizeable impact on credit risk premia, especially in the corporate debt market, owing largely to the wide range of assets covered by the programmes. This channel helped to reduce the funding costs faced by private borrowers and thus to ease their access to credit to finance their investment plans. In this way it supported the smooth transmission of the monetary policy stance.

In the United States, the Fed's announcement on 23 March 2020 about the purchase of investment grade bonds appears to have been instrumental in reversing the widening in corporate bond spreads (Graph 8.A). The impact was largest for bonds with shorter maturities and less credit risk, which were directly targeted by the programme. The effects on non-targeted high-yield debt were very limited (Haddad et al (2021)). In a similar vein, corporate bond spreads appear largely unresponsive to the 15 March announcement by the Fed about purchases of Treasuries and mortgage-backed securities. These findings are consistent with theoretical insights and empirical literature suggesting that, at times of heightened market stress, the liquidity channel of APs dominates and transmission to non-targeted assets increases as financial intermediation recovers its strength. Consistent with the portfolio rebalancing channel, the 9 April announcement of the scaling up of US Treasury purchases, in the context of ebbing market distress, appears to have bid up the price of both investment grade and non-targeted high-yield bonds, with broader effects on other asset prices.

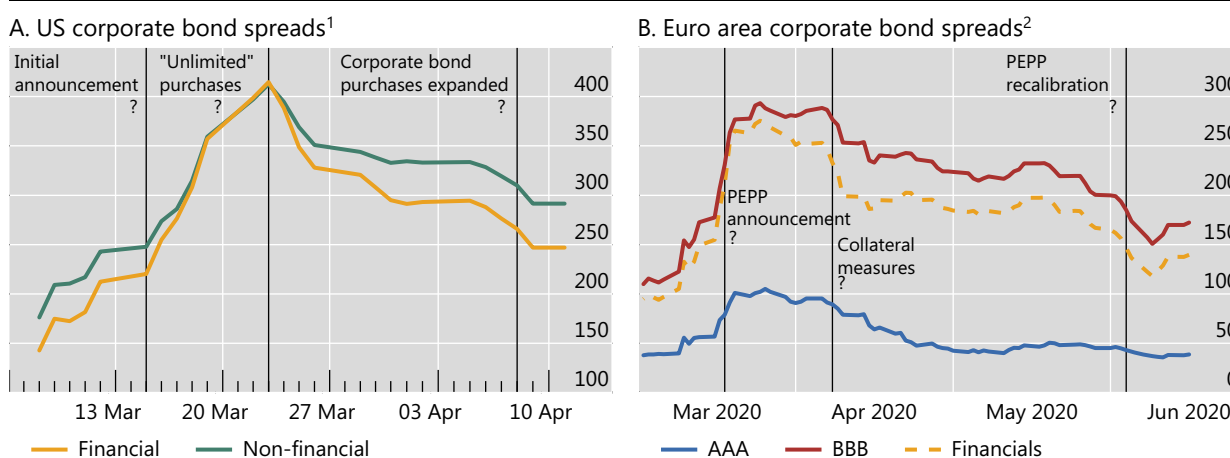
¹⁰ In March 2020, 66% of outstanding Canadian government bonds had maturities of less than five years.

¹¹ Examining how the spread of bond yields change relative to OIS rates (ie using OIS rates as a control variable) is also useful to exclude other macroeconomic or financial market news that might have occurred on the event days that was unrelated to bond purchases. For Canada, see Arora et al (2021).

Corporate spreads tightened after Fed and ECB policy announcements

In basis points

Graph 8



¹ Vertical lines indicate Fed announcements: initial announcement on 13 March 2020; “unlimited” announcement on 23 March 2020; corporate bond purchases expanded on 9 April 2020. ² Vertical lines indicate ECB announcements: PEPP announcement on 17 March 2020; collateral measures on 7 April 2020; PEPP recalibration on 3 June 2020.

Sources: European Central Bank; CGFS Working Group.

In the euro area, the credit risk channel appears to have been relevant for corporations (financial and non-financial) as well as lower-rated sovereigns. First, corporate bond spreads levelled off after the initial PEPP announcement, following the sharp widening recorded in the preceding weeks notably in the lower-rated segments (Graph 8.B). These corporate spreads started to narrow visibly following the ECB’s announcement of collateral easing measures, and the subsequent fall was cemented by the June 2020 PEPP recalibration. Second, yield spreads of lower-rated Italian and Spanish sovereign bonds (relative to high-rated German bunds) fell sharply upon the March 2020 PEPP announcement, including at short segments of the sovereign yield curve. Consistent with the credit risk channel, credit default swaps (CDS) spreads similarly narrowed. A model-based assessment suggests that most of the impact of the PEPP announcement on sovereign yields in lower-rated euro area jurisdictions can be ascribed to the credit risk channel (see Costain et al (2022) and Appendix B).¹² In addition to the effects resulting from the announcement of the PEPP and its subsequent expansion, empirical evidence shows that the implementation of the PEPP purchases played a key role in consolidating the beneficial effects of the programme on sovereign spreads (Bernardini and De Nicola (2020), Bernardini and Conti (2021)).

In the United Kingdom, in early 2020 yields on investment grade UK corporate bonds rose sharply (Busetto et al (2022)). Market dysfunction played an important role in the rise, as there was a significant increase in demand to liquidate bonds and the market’s ability to accommodate that demand appears to have been insufficient. In this environment, there was significant scope for corporate bond purchases to improve liquidity. The surge in UK corporate bond yields slowed down after the Bank of England (BoE) announced, on 19 March, that it intended to purchase at least £10 billion more of sterling corporate bonds at a “significantly faster pace than in 2016”. Yields then fell but it is difficult to separate the impact of the BoE’s announcement on corporate bond purchases from other news. And unlike for gilts, corporate yields did not fall back to their initial level – although that could reflect the persistent economic effect of Covid-19 on the outlook for corporates rather than continued market dysfunction.

In India, the targeted long-term repo operations introduced in late March 2020, which required banks to deploy funds, inter alia, in corporate bonds, commercial papers and non-convertible debentures

¹² These results are also supported by empirical analyses, such as the one carried out by Corradin et al (2021).

issued by corporates, helped to reduce spreads on these instruments over government securities, and thus strengthened monetary transmission.

The reaction of the US corporate debt market entails important elements of novelty compared with past episodes and requires some qualifications (Haddad et al (2021)). First, in the 2020 episode the disruptions in the debt market appeared extremely quickly — in a matter of days rather than months — but also disappeared quickly following a fast and unprecedented response by the Fed. Second, these disruptions were most salient in investment grade bonds in general (corporate, but also municipal bonds and Treasuries), with somewhat less of an effect on high-yield debt. During the 2008 crisis, disruptions were more pronounced in more illiquid lower-rated asset classes. Third, bond spreads decoupled from their corresponding CDS spread for very safe firms like Google or Amazon and recoupled after the Fed's announcement of the primary market corporate credit facility and secondary market corporate credit facility programmes on 23 March 2020. These results do not lend immediate support to a credit risk channel at play. Instead, they are consistent with selling pressure to convert more liquid bonds into cash, and with theories of a safety demand channel (Krishnamurthy and Vissing-Jorgensen (2012)).

Central banks' purchases of long-term government bonds, during a time of rapid fiscal expansion, also shielded intermediaries and investors from additional risk exposure at a time when their risk-bearing capacity was impaired. The fiscal measures adopted by most countries to contain the health and economic costs of the pandemic led to a rapid and sizeable increase in government debt. For example, between end-2019 and end-2021, the stock of outstanding public debt in the four largest euro area economies, expressed in ten-year equivalents, increased by around 23%. It was also thanks to central banks' interventions that fiscal policies operated in a context of favourable financing conditions, thereby exerting effective stimulus on the real economy.

6. Side effects

While APs have clear benefits in terms of helping central banks to achieve their monetary policy objectives, they can also have unintended consequences – or side effects – that offset some of these benefits. Potential side effects include cross-country spillovers, excessive suppression of risk premia, increases in wealth inequality, low bond market liquidity and losses on central bank balance sheets (CGFS (2019)). Some of these side effects are not unique to APs and can arise from other expansionary (fiscal or monetary) policies too.

The CGFS's 2019 report distinguished between two types of side effect: those that diminish the effectiveness of monetary policy, and those that have undesired spillovers either domestically or abroad. To the extent that the first type of side effect is measurable, central banks can calibrate their interventions to take it into account. The second type is more challenging because it might not be easily addressed by the central bank alone. The mandate of the central bank constrains what it can do to mitigate undesired spillovers. That said, awareness of these spillovers helps the central bank to design interventions aimed at achieving its objectives while minimising the side effects.

Based on experience following the GFC, the 2019 report concluded that the side effects were contained and did not compromise the overall effectiveness of central banks' interventions. This report affirms that conclusion. Indeed, there are at least two reasons why the side effects from APs during the Covid-19 crisis were likely smaller than those associated with earlier APs. First, central banks benefited from lessons learned during the previous experience and adjusted their APs accordingly. Second, some side effects are a function of the length of the expansionary stance, as highlighted by concerns about the consequences of low-for-long interest rates (CGFS (2019), Altavilla et al (2021b)). During the Covid-19 crisis, a number of central banks pursued APs for a relatively short period of time, which gave side effects limited time to manifest. For some other central banks, Covid-related APs were an extension of their GFC-related ones, which increased the likelihood that side effects would materialise. However, in these cases the experience so far suggests that APs' side effects were manageable. Moreover, any side effects need to be set against the larger economic gains from undertaking APs.

Policy spillovers and capital flows

An important cross-border spillover attributed to APs is increased private sector leverage, especially in EMEs. The simultaneous increase in liquidity and contraction in yields in AEs resulting from APs led some investors to look for higher returns in EMEs, which boosted capital flows to these economies.¹³ These capital flows engendered expansionary forces (ie lower rates and greater credit) in the recipient economies as well as an appreciation of the local currency.¹⁴ Whether these spillovers are beneficial or detrimental depends on the stage of the business cycle in the recipient economy. Furthermore, in EMEs especially, large capital inflows can increase domestic vulnerabilities (eg high leverage) and thereby make the local economy excessively sensitive to a reversal of capital flows.

There are, however, reasons to think that these types of capital flow dynamics were largely not at play during the Covid-19 crisis. In contrast to the GFC episode, the Covid-19 shock was global. As such, there were fewer investment opportunities in EMEs as well as increased uncertainty, which limited the amount of capital inflows from AEs.

¹³ Curcuru et al (2018) argue that cross-border flows in search of yield are not just the result of APs, as this type of flow also occurs as a result of interest rate policy (ie as a result of conventional monetary policy).

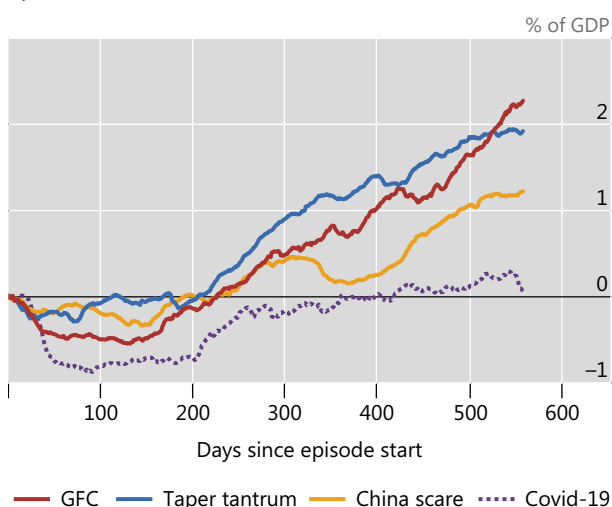
¹⁴ Kabaca and Tuzcuoglu (2022) show that in the case of Canada, US APs induced expansionary conditions despite the appreciation of the Canadian dollar. See also Dedola et al (2021) for a broader perspective on the effects of QE on exchange rates.

During the Covid-19 crisis, capital inflows to EMEs fell significantly and remained weak for a prolonged period (Graph 9.A). The decline was larger and more persistent than during previous periods of turmoil. For example, following the start of the GFC, capital inflows to EMEs fell significantly (especially if bank flows are included) but then increased substantially as AEs' quantitative easing (QE) operations expanded. The Covid-19 crisis generated larger uncertainties for EMEs, whereas AEs rebounded more quickly than had initially been feared. As a corollary to the capital retrenchment from EMEs, the US dollar appreciated significantly, consistent with previous "flight to safety" episodes (Graph 9.B).

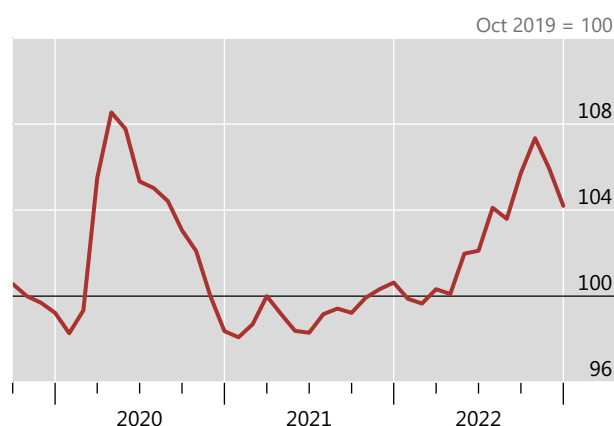
Capital flows to EMEs

Graph 9

A. Cumulative portfolio flows during EME stress episodes¹



B. Nominal EMEs US dollar index²



¹ Episode start dates: GFC = 8 September 2008; taper tantrum = 22 May 2013; China scare = 26 July 2015; Covid-19 = 21 January 2020. Equity flows: BR, ID, IN, KR, LK, PH, PK, QA, TW, VN and ZA; bond flows: HU, ID, IN, KR, PL and ZA. ² An increase represents an appreciation of the US dollar against a basket of currencies from EMEs that are important US trading partners.

Sources: Bloomberg; Board of Governors of the Federal Reserve System; Datastream; CGFS Working Group.

Suppression of risk premia

Another potential side effect of APs is excessive suppression of credit risk or term premia in asset valuations, which in turn affects the efficient allocation of capital. To some extent, the suppression of risk premia is an intended channel through which APs operate. Moreover, it is difficult to identify exactly when the compression of premia becomes excessive.

The potential suppression of risk premia is an issue across all asset classes that are included in APs, but it is likely to be more salient for private sector assets, such as corporate bonds or mortgage-backed securities (and somewhat less for sovereign debt assets, albeit with notable exceptions for some highly indebted economies). APs might also have contributed to the strong rise in house prices in many AEs during the Covid-19 crisis,¹⁵ although changes in housing preferences and the lowering of policy rates to the ELB were arguably more important factors behind the rise (BIS (2021)).

On the one hand, prolonged ultra-accommodative policies can induce financial intermediaries to provide credit to less productive (or unproductive) firms at low costs, thus keeping them alive at the

¹⁵ For example, Canada saw benchmark (ie quality- and size-adjusted) house prices rise by 50% over two years from the start of the pandemic.

expense of more productive firms (the “zombie firms” effect, see Acharya et al (2021)). On the other hand, a large amount of risk created by financial intermediation relates to maturity transformation. It has been argued that the large demand for safe, short-term liquid assets facilitates the financing of riskier, longer-term assets by financial intermediaries (see Greenwood et al (2016)). Excessive maturity transformation can result in fire sales of assets when conditions deteriorate excessively and unexpectedly. By swamping the market with liquid assets (central bank reserves) and absorbing longer-term, riskier assets (government bonds, but also private sector assets), central banks can limit the maturity transformation risk (Woodford (2016)).

As for the Covid-19-related APs, the fact that economic developments have motivated central banks to withdraw accommodative policies earlier should limit the risks of the zombification of the economy, as well as avoiding broader fire sales by financial intermediaries scrambling for liquidity. In particular, a number of central banks terminated corporate bond purchases after a short period of time (eg the BoC in March 2021).

Distributional effects

The boost that APs give to asset prices has heightened debate about their distributional effects. The impact of APs on asset prices, and the benefits that accrue to asset holders, are substantively similar to those arising from a reduction in policy rates. What is important when assessing the distributional effects is whether a particular policy action advantages one group on average (ie over the course of the business cycle) relative to other groups. Moreover, even if some groups benefit directly from the impact of a particular policy on asset prices, others will benefit indirectly through the impact of expansionary policy on job opportunities and wages. The challenge for central banks is to achieve their monetary policy objectives in a way that minimises any undesired side effects.

Central banks’ communications indicate that they are mindful of income and wealth inequality (eg Kuroda (2017), Powell (2020) and Schnabel (2021)). In general, APs are likely to have reduced income inequality through their beneficial effect on economic growth and the labour market, while their effects on wealth inequality are less clear-cut.

Scarcity effects

When central banks buy assets from the private sector, they reduce the available supply of higher quality assets. This can generate substantial fluctuations in repo rates (in which these assets serve as collateral), and this, in turn, can lead to disruptions in the intermediation of repo markets. Another possible consequence of an excessive concentration of bond holdings on central banks’ balance sheets is that markets for these securities can become less liquid and more prone to pricing anomalies (wider, more volatile bid-ask spreads) leading to higher liquidity premia even for assets that are normally highly liquid.

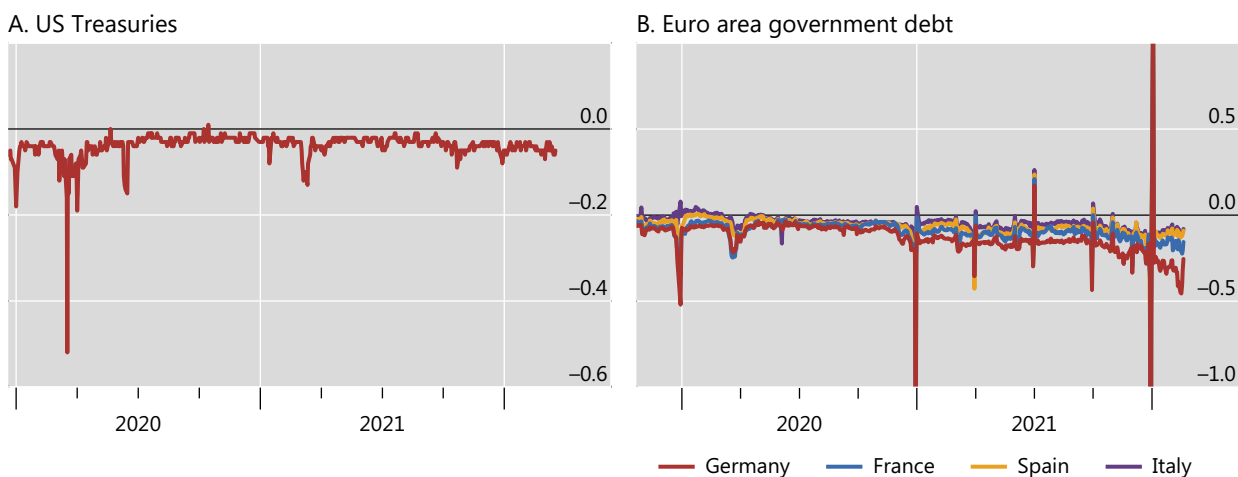
The pre-Covid experience demonstrated that central banks were able to address or mitigate scarcity effects through existing security lending facilities, such as the Fed’s system open market account; through the creation of new facilities, such as the ECB’s securities lending arrangement; or through the introduction of caps on central banks’ holdings of individual securities (Altavilla et al (2021a), CGFS (2019)). Ferrari et al (2017) found evidence that when the ECB launched its first AP programme in 2014, there was an increase in the sovereign-collateral scarcity premium, but this effect was offset once the ECB launched its securities lending arrangement in 2015. In contrast, Arrata et al (2020) found that the ECB’s APs had important and persistent effects on euro area repo rates (and, in particular, how they created scarcity effects) in spite of the recalibrations of the ECB’s securities lending facility; they argue that it was designed as a backstop limited in size, and was not aimed at fully offsetting APs’ effects on the collateral scarcity premium. Carrera de Souza and Hudepohl (2022) also find that security lending did not fully compensate for the downward pressure created by the additional purchases during the Covid-19 crisis.

Liquidity indicators pointed to episodes of scarcity in some markets, but these have not compromised the overall effectiveness of central banks' interventions. APs exacerbated scarcity during the Covid-19 crisis period, although there are not yet many studies looking in detail at scarcity effects from the recent wave of APs. For the United States, the special repo spread (the difference between the special and the general collateral repo rates) was mostly stable between end-2019 and mid-March 2022, with a few short-lived exceptions in March 2020 and March 2021 (Graph 10.A).¹⁶ The March 2020 episode was related to the onset of the Covid-19 pandemic and the financial stress observed at the time. It is unclear what caused the March 2021 episode, but this episode was relatively minor and of short duration.

Scarcity effects of purchases in the United States and euro area

Special repo spread, in percentage points¹

Graph 10



¹ Difference between the non-general (special) collateral repo rate and general collateral repo rate.

Sources: Office of Financial Research; Brokertec; Eurex; MTS; CGFS Working Group.

In the euro area, the special repo spread has visibly fallen further since 2019, especially for German bonds (Graph 10.B). This indicates some degree of increased scarcity. Historically, the spread between a country-specific special repo rate and the general collateral repo rate was significantly more volatile in the euro market than in the US dollar market. In 2021 there were more end-quarter spikes, which are thought to be related to “window dressing” reasons, and potentially to scarcity effects, but these were short-lived.¹⁷ Although it would be premature to conclude that APs during the Covid-19 crisis did not exacerbate scarcity issues in money markets, the euro area data in Graph 10.B suggest that such issues are unlikely to have become materially more problematic than they were during pre-pandemic interventions. Further, the issuance of large amounts of new debt by governments is likely to have helped offset any potential scarcity effects from APs in response to the Covid-19 crisis.

In SOEs, there is some evidence that one of the main reasons for the “leaky floor” experienced by the BoC, ie the overnight rate trading below the target set by the BoC, is scarcity created by the BoC’s purchases. The Canadian experience contrasts with that of Australia, where the cash rate did not trade below the deposit rate despite an increase in the amount of surplus liquidity in short-term money markets

¹⁶ Special collateral (SC) repo are repurchase agreements that use collateral with special characteristics, eg high-quality bonds that are used by intermediaries for other purposes (eg Arrata et al (2020)). In contrast, general collateral (GC) consists of more fungible securities. The rate on SC repos is typically below that of GC repos, ie SC commands a premium. When the central bank purchases high-quality securities, and thus generates some scarcity in SC, the rate on SC repos (the amount that intermediaries are willing to accept to lend cash against special securities) falls further below the rate on GC repos.

¹⁷ “Window dressing” refers to the operations by financial firms carried out close to the end of the regulatory period or ahead of reports to shareholders or clients.

induced by the RBA's APs. The Canadian experience also contrasts with that of Sweden, where banks' overnight funding rates, as for instance measured by the Swedish krona short-term rate (SWESTR), remained close to the Sveriges Riksbank's deposit rate. The main difference between these jurisdictions is that the cash rate targeted by the RBA and SWESTR are unsecured overnight rates, whereas the BoC targeted the overnight repo rate.¹⁸

Impact on central bank finances

APs increase central banks' exposure to financial risks, in particular risks arising from differences in the duration of central banks' assets and liabilities. As interest rates increase, the central bank might post losses. For example, rising interest paid on reserves would cause their net income to fall, possibly leading to losses. However, such losses must be set against the larger economic gains from undertaking APs. Moreover, they do not impair the central bank's ability to conduct monetary policy. Indeed, this transfer of risk from the private to the public sector – the rebalancing of private investors' portfolios – is an intended outcome of APs and, as discussed in Section 5, a crucial channel through which APs affect financial conditions and the real economy.

In principle, a central bank's financial strength is not relevant for its policy effectiveness (Archer and Moser-Boehm (2013), Bell et al (2023), Carstens (2023)). Central banks do not operate under the same rules as private enterprises; they do not exist to make profits, are not subject to insolvency laws and service their liabilities in the currency that they issue. In the past, some central banks have operated with negative equity for a time and still successfully achieved their policy objectives, including in Chile and Israel. Hall and Reis (2015) examined the financial risks for the Fed and the ECB arising from their pre-Covid APs, and while they acknowledged that they were not negligible, they also concluded that they were relatively minimal. Del Negro and Sims (2015) reached a similar conclusion.

Clearly communicating the net benefits of APs to the general public is an important way to pre-empt concerns arising from a weakening of the central bank's balance sheet. For example, gains from a larger balance sheet could be communicated alongside the losses. Losses to the central bank are counterbalanced by the financial gains to the central bank and government during earlier periods of balance sheet expansion and, more importantly, the economic gains emanating from APs. Also, financial losses in the short term might turn into financial gains in the medium term if the yield curve steepens.

A transparent financial framework, with rules governing transfers from the central bank to the government and processes for dealing with episodes of reduced profitability, can also help clarify the unique nature of a central bank's finances in the light of its mandates (Bell et al (2023)). Some central banks have taken steps that they perceive as mitigating concerns about the financial risks that APs might pose to their balance sheets. For example, when their gains were high, several increased their provisions against possible future losses. In Canada, the central bank and government put in place a set of indemnity agreements in 2020 to protect the central bank from possible balance sheet mark-to-market or credit losses arising from the implementation of its AP programme. A similar agreement exists between the UK government and the BoE.

¹⁸ The calculation of the targeted rate by design includes bonds "on special" in addition to general collateral. In addition, there is anecdotal evidence that a certain amount of bonds that are purchased by non-Canadian clients do not get recirculated into the secured lending market. There is evidence that secured rates in Sweden, for instance repo rates with government bonds as collateral, traded below the Sveriges Riksbank's deposit rate.

7. Conclusions

Central banks responded promptly to the onset of the Covid-19 crisis by easing monetary policy and deploying UMPTs, including APs. APs were implemented flexibly, with consideration given to the high degree of uncertainty about economic prospects and the transmission of policy stimulus to the financial system and economy. The available evidence from a broad range of economies shows that APs contributed to a significant easing of financial conditions: yields contracted considerably, and their volatility subsided. The impact was largest at longer maturities and was greater for large AEs than SOEs and EMEs. For some SOEs and EMEs, global financial conditions appear to have had a larger influence on term premia than domestic APs. In addition to the decline in term premia, APs induced a fall in liquidity and credit risk premia in sovereign and corporate bond markets. The overall impact of APs on financial conditions was amplified by the synchronous and extraordinary response of monetary, fiscal and prudential authorities.

APs can have side effects, but two factors helped to mitigate these during the Covid-19 crisis. First, the global scope of the crisis and synchronicity of policy responses contained cross-country spillovers. Second, a strong economic rebound and surge in inflation globally prompted central banks to end APs and tighten policy within a year or two of the start of the crisis.

While the Covid-19 crisis demonstrated the usefulness of APs as a monetary policy tool across a broad range of economies, it also highlighted the challenge of separating APs conducted to address market dysfunction directly from those aimed at macroeconomic objectives in support of conventional monetary policy tools. In AEs, APs launched early during the crisis were often motivated initially by market functioning; however, central banks in AEs where policy rates were constrained by the effective lower bound later shifted the focus of their government bond purchases to the achievement of their monetary policy objectives. Clearly the two objectives can be complementary, especially for APs involving government bonds. Even if their immediate aim was to address market dysfunction, APs can be seen as supporting the transmission of monetary policy and, in turn, as a precautionary intervention to achieve central banks' monetary policy objectives. Yet, central banks sometimes shifted the purpose of their APs without explicitly stating that they were doing so.

Regardless of their intended purpose, APs can have quite similar operational mechanics, and these mechanics can influence market participants' perceptions about their purpose. Managing such perceptions is especially challenging when APs are used to counter market dysfunction at a time when monetary policy is being tightened. The governance, design and communication of interventions can help to demarcate one type of AP from the other.

Appendices

A APs and their impact: country details

Central banks of the respective countries contributed the following summaries about APs and their impact.

Australia

The Reserve Bank of Australia (RBA) purchased government bonds under three programmes with three different aims: (i) to restore market functioning, which ran from March 2020 to May 2020; (ii) to support the yield target on the three-year Australian government bond, which was aimed at easing financial conditions and ran from March 2020 to November 2021; and (iii) a QE-style bond purchase programme, which aimed to ease financial conditions and ran from November 2020 to February 2022.

The RBA purchased only public sector assets, namely Australian government securities (AGS) and bonds issued by Australian state and territorial governments (semi-government securities, or semis). In total the RBA purchased AUD 293 billion of AGS (15% of 2019 GDP) and AUD 68 billion of semis (3% of 2019 GDP). Of this, AUD 51 billion was purchased to restore market functioning (AUD 40 billion of AGS and AUD 11 billion of semis); AUD 29 billion of AGS was purchased to support the yield target; and AUD 281 billion was purchased under the bond purchase programme (AUD 224 billion of AGS and AUD 57 billion of semis).

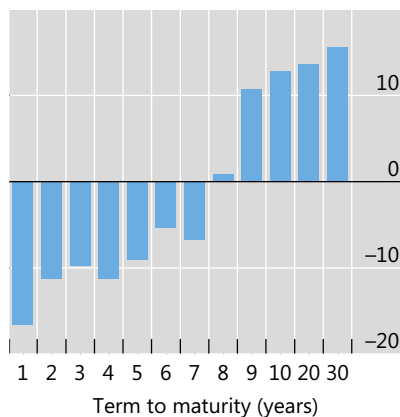
The initial announcement of APs to restore market functioning had a mixed impact across the curve (Graph A1.A). Regression analysis covering the term of the programme suggests that purchasing one percentage point of the free-float of a bond reduced its yield by around one basis point; this equates to an approximately 50 basis point yield impact per 10 percentage points of GDP of bond purchases.

Impact of APs on Australian government bond yields

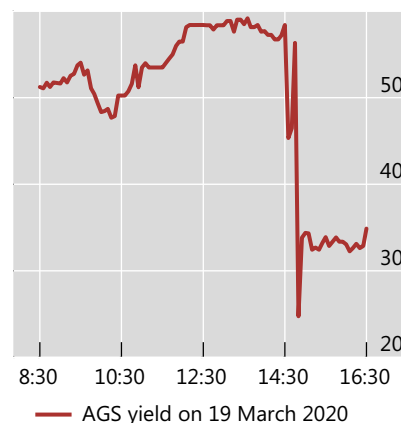
In basis points

Graph A1

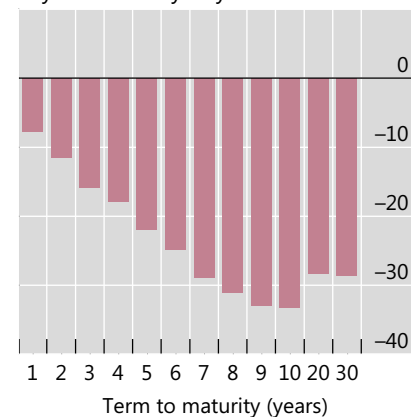
A. Change in Australian government securities yields between 16 and 19 March 2020



B. Yield target introduction and April 2023 AGS yield



C. Cumulative change in Australian government securities yields over key event study days



Sources: Reserve Bank of Australia; Bloomberg; Yieldbroker; CGFS Working Group.

An event study suggests that the bond purchase programme saw 10-year AGS yields fall by around 30 basis points, with this initial impact largely maintained over the course of the programme (Graph A1.C). This amounts to approximately a 25 basis point fall per 10 percentage points of GDP of bonds purchased, using total purchases of AGS over the course of the bond purchase programme. Further purchases did not seem to add to the initial impact.

The RBA has pursued a progressive exit strategy. In November 2021, the Reserve Bank Board announced the termination of the yield target. Further purchases under the bond purchase programme were abandoned with a Board decision in February 2022. At the May 2022 meeting, the Board decided against reinvestment on maturity and against sales of the government bonds that the RBA had purchased. At the same meeting, the Board started to raise the policy rate.

Brazil

In Brazil, the National Treasury conducted simultaneous auctions to buy and sell government debt securities in order to improve market functioning. The objectives were to support liquidity in the secondary market and to provide reference prices for transactions at a time of market stress. From 12 to 25 March 2020, these auctions resulted in net purchases of government debt securities equalling BRL 33.1 billion (USD 6.4 billion). Out of the total amount purchased, 77% were long-term inflation-linked bonds. The remaining purchases were National Treasury bonds (Notas do Tesouro Nacional– Série F, NTN-F) and National Treasury bills (Letras do Tesouro Nacional).

In May 2020, the central bank was authorised by Constitutional Amendment No. 106/2020 to carry out operations in domestic secondary markets for government bonds and private assets, as well as to perform operations in the international market for government bonds, to deal with the effects of the Covid-19 pandemic. The central bank released a regulatory letter establishing procedures for executing operations with corporate bonds, whose importance in the local capital market has steadily increased. Approval of this law had an immediate impact on market prices and liquidity, reducing the need for the central bank to intervene.

Canada

At the Bank of Canada (BoC), APs were motivated by both market functioning and monetary policy objectives. As the Covid-19 pandemic spread across the globe, uncertainty amongst market participants surrounding its impact on economic activity rose rapidly, leading to a large demand for cash over a relatively short period of time in March 2020 (a dash for cash). This put significant stress on fixed income markets. The BoC initially adopted a proactive response to this stress, using pre-established (non-AP) liquidity tools at its disposal in order to ease financial conditions and ensure credit channels remained open in an economy that it judged was likely to be severely impacted by the pandemic.

As functioning in markets continued to rapidly deteriorate throughout March 2020, for the first time in its history, the BoC unveiled a wide range of large-scale AP programmes across various government and non-government securities markets. Each programme had its own size and scope in order to address dysfunction in a specific market. Similar to other programmes, the government bond purchase programme (GBPP) was introduced with a focus on addressing severe market dysfunctions, but it was the only asset purchase programme to subsequently shift its primary objectives. As market functioning in the government of Canada bond market returned closer to normal levels, the primary objective of the GBPP shifted from supporting market functioning to monetary policy objectives. Specifically, with the BoC's policy rate at its effective lower bound, the GBPP became a tool for implementing quantitative easing with dual objectives of supporting the economy and achieving the inflation target.

The elevated uncertainty surrounding the impact of the pandemic on economic activity created an enormous demand for liquidity from practically all sectors of the economy that could not readily be

accommodated by the financial system. As a result, there was a significant deterioration in market functioning across many markets and a relatively large and rapid rise in risk premia. The AP programmes were rolled out to first address this broad deterioration in market functioning. Reflecting the broad market dysfunction in fixed income markets that are critical to the Canadian financial system and economy, AP programmes spanned government (federal and provincial), mortgage and corporate fixed income markets. Each AP programme had its own individual size and scope of assets purchased. Programmes with multiple eligible issuers were set with outright issuer limits, a target relative to some measure (such as each province’s share of Canada’s GDP), or both. AP programmes in the credit markets specified a relatively high minimum credit rating for eligible assets.

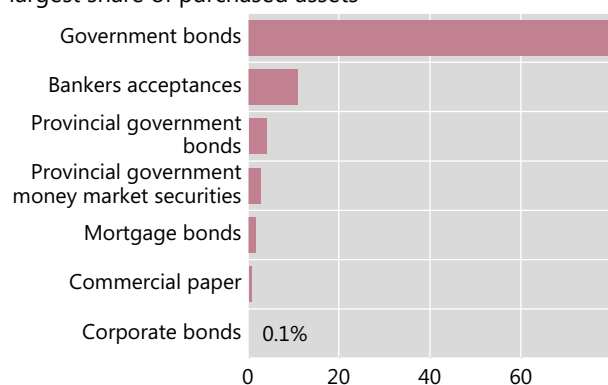
By their end, the BoC’s APs totalled 23.6% of Canada’s 2019 nominal GDP (CAD 1.814 trillion). These purchase programmes were novel for the BoC and the largest in its history – a reflection of the unprecedented nature of the Covid pandemic and crisis. The largest share of purchases consisted of high-quality public sector debt and the majority of assets purchased had a relatively short term to maturity. Government of Canada bonds purchased through the GBPP accounted for the largest share of purchased assets (Graph A2).

Asset purchases by the Bank of Canada

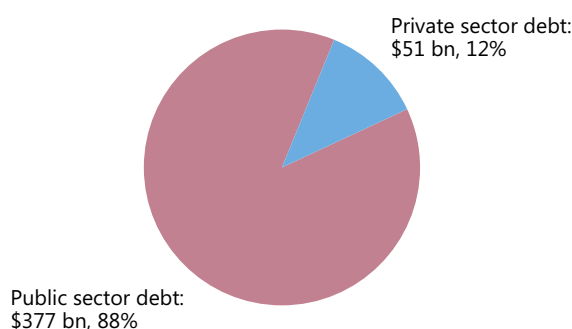
As a percentage of purchased assets

Graph A2

A. Government of Canada bonds accounted for the largest share of purchased assets



B. The largest share of purchases consisted of high-quality public sector debt



Source: Bank of Canada.

APs in Canada were deemed effective in reinstating the functioning of impaired markets, supporting the continued provision of credit to the economy and loosening financial conditions overall. Yet, the magnitudes of each programme’s impact through stock and flow effects on liquidity, term and credit risk premia varied, and are difficult to estimate precisely. In Canada, the stock effect, or announcement effect, of APs on asset prices was positive. In the bankers acceptance (BA) market, a core funding market in Canada, yields declined significantly (by approximately 15 basis points) on the immediate announcement of the bankers acceptance purchase facility (BAPF) programme. Similarly, the announcement of the GBPP reduced GoC bond yields by approximately 10 basis points.

Beyond the announcement effect, yields continued to fall on the back of actual purchases (the flow effect); however in some cases these effects were smaller in magnitude. As more information surrounding the BAPF programme was released, their spread to the risk-free curve declined, and declined more significantly following actual purchases from the BoC. Regarding the GBPP, BoC staff analysis show that CAD 1 billion in government bond purchases caused an average decline in yields of about 0.8 basis points for those bonds purchased on the day of a purchase operation. The analysis also show a decline of about 0.4 basis points in the yield of eligible but not purchased bonds.

Overall, in Canada, following the announcement and implementation of some of the largest AP programmes, declines in yields were more pronounced in the short end of yield curves, suggesting a relatively smaller effect on term premia and perhaps market expectations of more purchases in the short end of the curve. This relatively larger impact on short end yields is consistent with pre-Covid studies that suggested that QE is less effective in compressing yields of longer-term securities in SOEs owing to the greater influence of global factors on term premia in such economies.

Although the BoC's AP programmes of private debt were relatively small, credit premia, viewed simply through credit spreads, largely compressed over the terms of the programmes. For example, Canadian provincial, mortgage and corporate bond spreads all compressed from extremely elevated levels in March 2020 over the course of 12 months following the crisis.

On their announcement, BoC AP programmes either had pre-determined expiry dates, with the caveat that programme parameters could be extended if conditions warranted, or were priced such that, as conditions improved, usage would naturally decline (ie backstop pricing). Over the course of 2020, market functioning improved and thus AP programme utilisation naturally declined. With the exception of the GBPP, programmes initially announced without expiry dates (ie the Canada mortgage bond purchase program (CMBP), BAPF and the provincial money market purchase program (PMMP)) were wound down and terminated within eight months for the same reasons. Other programmes that had been announced with a specific duration of one year were discontinued as planned, at their respective sunset dates.

Total assets outstanding on the BoC's balance sheet from AP programmes continued to grow throughout most of 2021, driven by purchases of government of Canada debt through the GBPP. By early 2021, most other programmes had already expired, and some of the assets purchased with them had matured off the balance sheet.

When sequencing the exit from quantitative easing, the BoC began to tighten only after net purchases were halted, and balance sheet reduction then took place. The pace of purchases gradually reduced during 2021 until October, when the BoC announced an end to quantitative easing and a move into the reinvestment phase. Well into the reinvestment phase, in March 2022 the BoC lifted its policy rate from the ELB. In April 2022, the BoC announced the beginning of quantitative tightening, whereby maturing government of Canada bonds on the BoC's balance sheet would no longer be replaced.

The decision to conduct QT passively was influenced by the duration of purchased assets. In the case of Canada, the assets purchased by the BoC had a relatively short average term to maturity and thus the expected relatively fast material decline in asset holdings was not viewed as requiring additional outright sales to achieve the desired balance sheet decline. As information on the holdings of the BoC was publicly available, the passive approach taken towards QT benefited from a predictable transparent tightening for all market participants, limiting unnecessary volatility in markets and complementing increases in the policy interest rate – the primary monetary policy instrument.

Chile

The case of Chile exhibits certain idiosyncrasies regarding the circumstances of the pandemic. The Covid-19 shock hit the economy after an episode of social unrest in the final quarter of 2019. In response, during March 2020, the Central Bank of Chile (CBC) cut the monetary policy rate to its technical minimum (0.5%). Also, on 16 March 2020, the CBC launched a purchase programme of bank bonds for all participants of the system of open market operations (SOMA) to improve liquidity in local currency. The programme amounted to USD 4 billion, and the pace of purchases was communicated on a monthly basis. This programme was further enhanced on 17 June 2020, when the CBC launched a special purchase programme, including the repurchase of its own bonds (BCU and BCP).¹⁹ For this programme, the purchase

¹⁹ BCU and BCP are central bank inflation-linked debt and debt denominated in Chilean pesos, respectively.

of assets worth up to USD 1.5 billion was announced, with weekly purchases of USD 375 million and monthly updates about the pace of purchases.

The programme had to be modified shortly after when, in July 2020, as a way of providing swift relief to families, a first round of withdrawals from individual mandatory pension funds was approved by the Chilean Congress. A second round was approved in December of the same year, and a third one in May 2021. Overall, the three withdrawals amounted to almost USD 50 billion (equivalent to 20% of 2020 GDP). Each pension fund withdrawal entailed a liquidation of up to USD 20 billion, either in international markets (with a concomitant effect on the exchange rate as foreign currency entered the country) or in domestic markets (where pension funds were large holders of government debt). Also, the time frame given to the pension funds to liquidate these assets was shortened as withdrawals progressed.²⁰

In the event of a disorderly liquidation of pension fund portfolios at short notice, large variations in asset prices and interest rates would have been triggered. The latter posed severe risks to financial stability and this motivated the CBC to intervene. One possibility was for the central bank to absorb those assets by purchasing them from pension funds. However, at the time, by law the CBC was not authorised to buy corporate bonds, stocks or government bonds.²¹ Instead, the CBC was only authorised to buy and sell in the spot market instruments issued by banking institutions. Therefore the CBC scaled up its purchase programme of bank bonds, coupled with simultaneous cash purchase and forward sale operations (at one to three months) in the spot market (the “compra contado venta a plazo” or CCVP programme). On each occasion, the maximum pre-announced amount was USD 10 billion.²² These operations provided pension funds with enough liquidity to carry out payments to affiliates at short notice (in some cases, even earlier than the period established by law). At the same time, by distributing asset sales over a more extended time frame (months instead of a few days), the operations prevented excessive variation in prices.

Pension funds liquidated all of the assets necessary to finance the withdrawals within the time frames of the CCVP, a period during which they carried out purchases with the CBC. As can be seen from Graph A3, when considering initial demand and the renewal of CCVP operations: with respect to the first withdrawal, 100% of the bonds had already been repurchased by December 2020; with respect to the second withdrawal, 100% of the bonds were repurchased by May 2021; and regarding the third withdrawal, the remainder of the outstanding bonds were repurchased by the end of November 2021.

Regarding the repurchase of central bank bonds (BCP and BCU), under the special asset purchase programme initiated on 22 July 2020, from the total of repurchases announced (USD 8 billion), only USD 815 million worth of these bonds were repurchased.

²⁰ For the first withdrawal, pension funds were given 40 business days’ notice to make a deposit to affiliates in two instalments. For the second withdrawal, the period was shortened to 20 business days in two instalments. For the third withdrawal, the period was further shortened to 15 business days in one instalment.

²¹ The possibility of purchasing government bonds was later modified under a constitutional reform in August 2020, which introduced this possibility under exceptional and temporary circumstances.

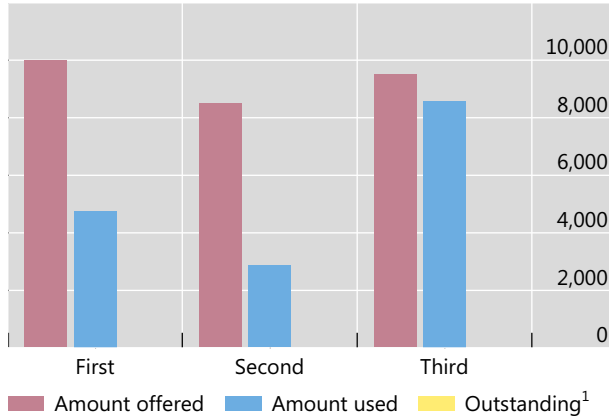
²² For the first withdrawal, the programme was launched on 30 July 2020. For the second withdrawal, another programme was launched on 4 December 2020. Finally, for the third withdrawal, another programme was announced on 29 April 2021.

Bank bond purchases by the central bank of Chile

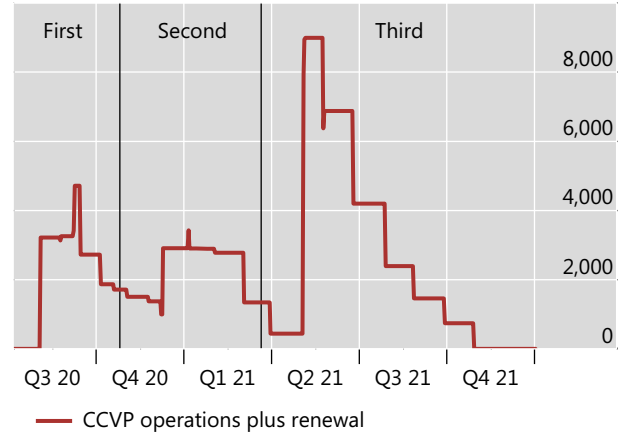
In USD millions

Graph A3

A. CCVP amounts offered and used, July 2020–September 2021



B. CCVP programme over time



First, second and third indicate the three rounds of pension fund withdrawals.

¹ Outstanding amount = 0.

Source: Central Bank of Chile.

Colombia

During the Covid-19 crisis, the Central Bank of Colombia (Banrep) implemented several policies focused on protecting the payments system, stabilising government and corporate debt markets, supporting the foreign exchange market²³ and ensuring that credit continued to flow to the economy.

One of the first decisions made by Banrep at the onset of the crisis was to lower its interest rate to historical lows.²⁴ Regarding the sovereign and corporate debt markets, given the high turbulence observed at the onset of the pandemic and the low liquidity and the distortion of the prices of these assets,²⁵ Banrep decided to: (i) expand the amount, term, eligible institutions (to include trusts, stockbrokers, investment management companies and pension funds) and types of collateral (to include high-quality corporate debt and debt receivables) allowed to participate in the liquidity operations (repurchase agreements) administered by Banrep; and (ii) purchase government and corporate bonds (the latter issued by financial institutions only). Banrep also implemented other measures such as a reduction of the reserve requirement from 11% to 8%, providing additional liquidity of up to COP 10 trillion.

The purchases made by Banrep were intended to provide enough liquidity to the system amidst a spike in uncertainty, support appropriate market functioning and improve robust price formation. Directly impacting the yield levels of these assets was not an aim.

In March and April 2020, Banrep purchased COP 8.7 trillion (0.8% of 2019 GDP) worth of debt securities issued by credit institutions. The eligible bonds had to be rated higher than grade A and have

²³ Banrep did not intervene in the spot market. However, between March 2020 and March 2021, Banrep sold US dollars through non-deliverable forward contracts to offset any potential restrictions across hedging instruments. In March and April 2020, the Bank also entered into 60-day FX swaps to provide short-term US dollar funding.

²⁴ Between March 2020 and September 2020, Banrep lowered its policy rate by 250 bp to 1.75%.

²⁵ In March 2020, the daily average bid-ask spread of COP-denominated government debt stood at 28.5 bp, well above the 2.1 bp average observed during 2019. Likewise, the daily average yield of 10-year COP-denominated government bonds reached a level above 9% during the last days of March 2020, well above the 2019 average (6.5%).

time to maturity of less than three years. This was the first time that Banrep had purchased assets of this type, as part of its policy of expanding the asset classes and collateral included in its balance sheet.

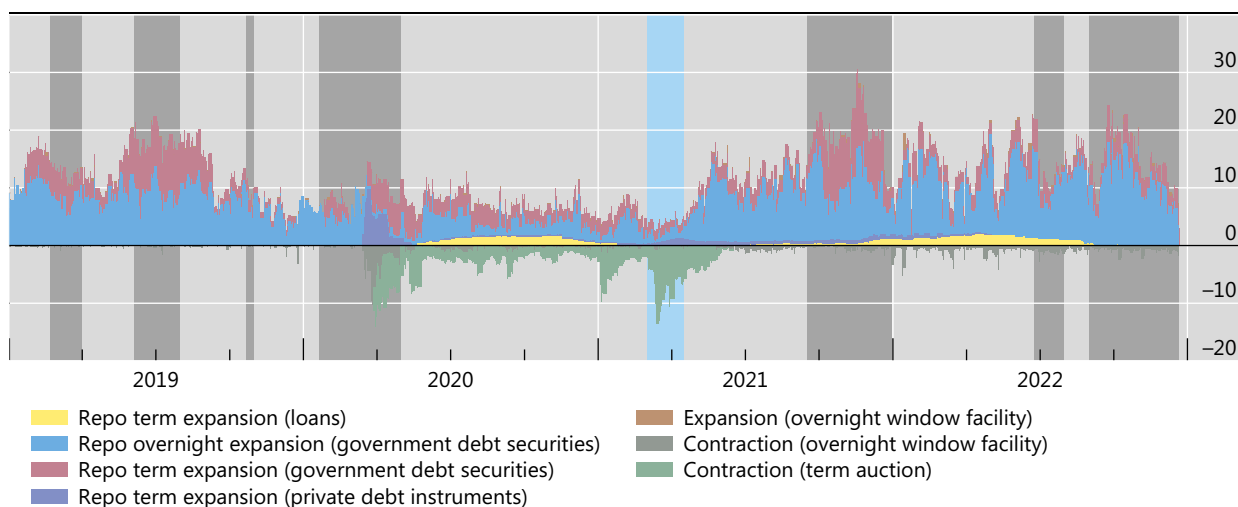
In Colombia, the monetary policy of the Banrep is mainly conducted through operations with government debt (TES). These operations are made at market prices in the secondary market and consider estimates of supply and demand of the monetary base. In that sense, purchases of public debt are a common tool implemented by Banrep to provide structural liquidity to the market, aiming to align the interbank rate with the monetary policy rate. During the pandemic, these operations also helped to support appropriate market functioning (to correct liquidity shortages and improve robust price formation). With the aim of providing enough liquidity in COP and to support market functioning, Banrep announced it would purchase up to COP 4 trillion (0.4% of GDP) of TES between March and April 2020. As market conditions recovered rapidly, purchases were limited to COP 2.8 trillion (0.3% of GDP). Operations were conducted at maturities all along the yield curve.

After the implementation of several liquidity instruments during the pandemic, in March and April 2021, some excess liquidity was drained from the system through TES sales (COP 5.9 trillion, 0.6% of GDP). Later that year, and during 2022, the Bank bought TES worth COP 11 trillion (1% of GDP) and COP 12.1 trillion (1.1% of GDP), respectively, as a mechanism to offset some long-term liquidity needs. These operations were intended to align the interbank rate with the monetary policy rate. Graph A4 shows the monetary policy mechanisms used by the central bank since May 2019.

Balance of transitory liquidity operations by the Central Bank of Colombia

In trillions of COP

Graph A4



The grey shaded areas indicate asset purchases. The light blue shaded area indicates asset sales.

Source: Central Bank of Colombia.

Concomitant with Banrep's interventions in 2020 some important signs of recovery were observed in terms of liquidity conditions and asset prices (Graph A5). After the COP-denominated government debt bid-ask spread increased from less than 5 basis points in February 2020 to levels above 80 basis points in March 2020,²⁶ the intervention by Banrep may have contributed to the rapid improvement in liquidity conditions in subsequent months.²⁷ Bid-ask spreads increased in Colombia in line with what occurred in the government debt markets of regional peers but corrected rapidly thereafter.

²⁶ Alternative measures of liquidity in this market (eg traded volume, depth) showed a similar pattern to bid-ask spreads.

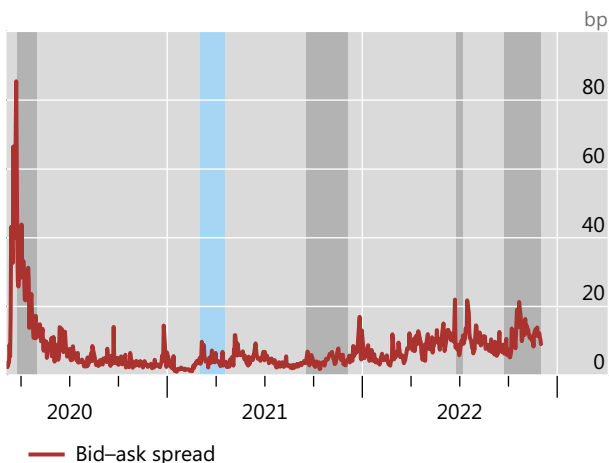
²⁷ No analyses have been performed to date regarding the impact of the purchases made by Banrep on the yields of the sovereign and corporate debt.

Likewise, after a sharp decrease in prices of government and corporate debt securities in March 2020, these assets returned to their original pricing levels alongside the purchases made by Banrep.

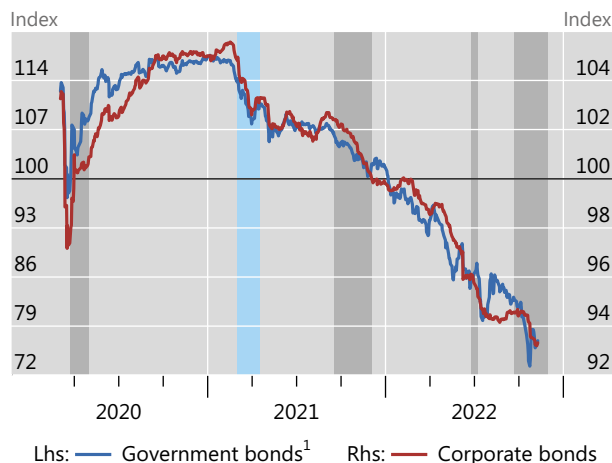
Colombian local currency debt market

Graph A5

A. COP sovereign debt market bid-ask spread



B. Price index of Treasury bonds and corporate debt



The grey shaded areas indicate asset purchases. The light blue shaded areas indicate asset sales.

¹ TES.

Source: Central Bank of Colombia.

Subsequently, in 2021 and 2022 local financial conditions tightened as a result of the external environment (ie tighter monetary policy worldwide, the war in Ukraine and the zero-Covid policy in China) as well as idiosyncratic factors associated with the rising local policy rate, the loss of the country's investment grade sovereign credit rating, some episodes of socio-political unrest in 2021, and political uncertainty regarding legislative and presidential elections in 2022. However, liquidity conditions have shown a better response than those observed in March 2020.

Banrep has not implemented a quantitative easing programme and its purchases in the TES market have pursued a liquidity level that is in line with market requirements. Any adjustments in Banrep's portfolio have been consistent with the objective of keeping the interbank overnight rate aligned with the monetary policy rate.²⁸

Regarding the purchases of corporate debt securities, Banrep has not bought additional assets of this type since April 2020. This measure was intended to be temporary and was communicated as such. However, Banrep still has the possibility of intervening in government or corporate debt markets when it considers it appropriate. Furthermore, some counterparties accepted for liquidity operations during the Covid-19 crisis remain active despite the end of the emergency framework. This is to ensure an adequate response should economic conditions change rapidly. For instance, trust companies, pension funds and open-ended funds remain on the list of authorised counterparties (under certain conditions).

Euro area

In March 2020, the financial distress and economic fallout from the Covid-19 pandemic prompted the European Central Bank (ECB) to launch a dedicated AP programme – the pandemic emergency purchase

²⁸ In 2021, Banrep reduced its balance sheet via sales of TES (aimed to drain liquidity in order to align the interbank rate with the monetary policy rate), and also as a result of the transfer of profits to the Colombian government.

programme (PEPP). The PEPP played a pivotal role in the ECB's monetary policy response and was tailored in terms of objectives, design and implementation to counter the negative pandemic impact.²⁹ While the ECB also continued to carry out its pre-existing asset purchase programme (APP), the associated purchase flows remained limited in size and scope during the pandemic, in particular compared with the PEPP.

The PEPP had two distinct, and yet complementary, objectives. The first was to counter serious risks to the monetary policy transmission mechanism and market functioning amid disruptions seen in mid-March 2020. Indeed, the spreading of the pandemic and the associated containment measures had led to heightened financial markets stress, disorderly liquidity conditions and tensions in lower-rated sovereign bond markets. The resulting financial market fragmentation posed a threat to the smooth transmission of the ECB's monetary policy across all euro area countries. The second complementary objective was to inject additional monetary policy accommodation to support financing conditions and counteract the disinflationary impact of the pandemic, at a time when the room for manoeuvre on policy rates was constrained by the proximity to the effective lower bound on interest rates.

To achieve these objectives, the PEPP's design and implementation featured a distinctly high margin of flexibility in adjusting the pace and composition of purchases to the evolving and uncertain ramifications of the pandemic. Specifically, the PEPP allowed for fluctuations in purchase volumes over time, across asset classes and among jurisdictions. Moreover, the range of assets included in the PEPP was broadened, compared with the APP, by expanding the eligibility criteria.

The underlying motivation was rooted in the evidence on APs carried out during and after the GFC in an economic landscape of disinflationary pressures and low short-term interest rates. In periods of financial distress, APs tend to be effective in releasing balance sheet constraints for investors and intermediaries, reverting the widening of risk premia and protecting monetary policy transmission. At the same time, precisely because of prevailing market segmentation, purchases might entail limited spillovers to non-targeted segments. The flexibility embedded in the PEPP catered for the possibility of targeted purchases across market segments in order to exert the desired effects on broader financing conditions. From this perspective, APs were more effective than interest rate policies, as the prevailing market distress threatened to impair the transmission of near-term risk-free interest rates to broader financial and credit segments.

APs carried out by the ECB during the Covid-19 crisis amounted to around 19.7% of 2019 euro area nominal GDP, and were largely conducted under the PEPP. Specifically, the total intended envelope of the PEPP amounted to €1,850 billion (corresponding to around 15.5% of 2019 euro area nominal GDP), which comprises the initial €750 billion envelope announced on 18 March 2020 and subsequent additional envelopes amounting to €600 billion on 4 June 2020 and €500 billion on 10 December 2020. Cumulative net purchases under the PEPP were carried out until March 2022 and amounted to €1,718 billion, implying 93% usage of the total envelope. PEPP purchases consisted of private and public sector securities, the eligibility criteria for which were expanded relative to the APP. In the first three months of the PEPP, public sector purchases accounted for 80% of overall purchases, reaching around 97% of overall PEPP purchases in March 2022. The share of supranational bonds was approximately 9% of public sector purchases.

The evidence suggests that Covid-related APs have been effective in compressing yields and premia across market segments. A large part of this impact materialised upon announcements ("stock effects"), consistent with established regularities and theoretical insights. The evidence also suggests that the actual implementation of PEPP purchases, with its embedded flexibility, played a non-negligible role in easing financial conditions ("flow effects"), especially at the height of the crisis (see Section 5). The impact has been particularly sizeable for longer-dated and lower-rated bonds through the extraction of duration and credit risk (see Section 5 and Appendix B). Focusing on the impact on sovereign yields, model-based evidence supports the view that Covid-related APs, primarily through the PEPP, had stronger

²⁹ For a comprehensive review of the ECB's experience with the PEPP, covering objectives, implementation and effectiveness, see, eg, ECB (2022).

effects than pre-Covid purchases through the public sector purchase programme (PSPP). Under the PSPP, sovereign bond purchases amounting to 10% of euro area GDP were associated with a decline in the 10-year GDP-weighted sovereign yield of approximately 43 basis points. Under the PEPP, the yield decline associated with the same volume of purchases was larger, at approximately 58 basis points (Graph 6.B).

The ECB discontinued net purchases under the PEPP at the end of March 2022 and terminated net purchases under the APP as of 1 July 2022. Since then, interest rate policy has been the primary instrument for adjusting the monetary policy stance to the evolving economic outlook. Bond holdings remained unchanged until the end of February 2023 as the ECB reinvested in full the principal payments from maturing securities purchased under both programmes. From the beginning of March 2023, the size of the Eurosystem's balance sheet will decline at a measured and predictable pace, in line with the broad principles announced in December 2022 for normalising its monetary policy securities holdings. Specifically, the pace of the APP run-down is calibrated to average €15 billion per month between March 2023 and June 2023; the subsequent pace will be determined over time to ensure it remains consistent with the overall monetary policy strategy and stance, to preserve market functioning, and to maintain firm control over short-term money market conditions. In line with past practice, the remaining reinvestment amounts will be allocated proportionally to the share of redemptions across each constituent programme of the APP. In the case of the PEPP, the ECB intends to fully reinvest maturing securities until at least the end of 2024, and since July 2022 has been applying flexibility in reinvestments to counter risks to the monetary policy transmission mechanism. The ECB clarified that the future roll-off of the PEPP portfolio will be managed to avoid interference with the appropriate monetary policy stance.

Hungary

In recent years, the Magyar Nemzeti Bank (MNB) has supported the economy through its asset purchase programmes. The bond funding for growth (BFG) scheme, the MNB's corporate bond purchase programme, has contributed to the development of the domestic corporate bond market and the diversification of the funding structure. The central bank's mortgage bond purchase programme has helped to improve the functioning of this market segment and to promote the emergence of mortgage loans with longer periods of fixed interest rates and green housing loans in Hungary. However, these programmes were not a direct response to the economic crisis caused by the Covid-19 pandemic, as the central bank had already been using these tools prior to 2020.

As part of its crisis management measures, the MNB's Monetary Council, at its meeting on 28 April 2020, launched the government securities purchase programme. The global market turbulence in spring 2020 caused by the Covid-19 pandemic had an impact on the Hungarian government securities market. Accordingly, the MNB's main objective became the maintenance of price stability. To ensure this, the Bank launched its government securities purchase programme on 4 May as part of its coordinated and targeted measures.

The main objective of the government securities purchase programme was to maintain the efficiency of monetary transmission and the stability of the government securities market. The MNB aimed to create a stable liquidity situation in the government securities market and ensure that interest rate conditions set by the central bank appear on the longer end of the yield curve. Despite rapidly changing global market sentiment and increased demand for government funding, the programme supported the extension of the maturity profile of government debt and the reduction of the slope of the yield curve by reducing long-term yields.

At the start of the programme, the MNB did not set a targeted amount, however, it stated that it would carry out a technical revision at a purchased stock increase of HUF 1,000 billion (EUR 2.83 billion) corresponding to 2.1% of Hungary's GDP in 2019. Following the first revision of the programme, the Council decided on 17 November 2020 to continue purchases due to the increasing risk of a global deterioration of the pandemic situation and to perform the next revision when HUF 2,000 billion is reached.

At the second revision, the Council decided on 27 April 2021 to continue purchases in order to strengthen monetary transmission, and to perform the next revision when HUF 3,000 billion was reached.

On 24 August 2021, the Council decided to gradually withdraw the programme and not to set a revision limit applicable to the entire stock purchased under the programme. Instead, it set a target amount for weekly purchases.

On 14 December 2021, when the Council took the decision to close the government securities purchase programme, the total stock of securities purchased by the central bank under the programme amounted to HUF 3,650 billion, approximately 7.5% of Hungary's 2019 GDP.

The purchases included HUF-denominated, fixed income Hungarian government securities and securities issued with government guarantees. Initially, in the case of each security series, the MNB set the upper limit of the amount that could be purchased at 33% of the market stock. By the Council's decision on 6 October 2020, the amount that could be purchased for each security series increased to 50% of market stock and the scope of securities that could be purchased was slightly expanded – to debt securities issued with a state guarantee. By the Council's decision on 9 March 2021, the MNB's purchases could exceed the 50% share of individual series if this was warranted by the stability and liquidity position of the government securities market. Regarding the maturity profile, the MNB shaped its weekly purchases in a flexible way, taking into consideration market developments but focusing on longer maturities.

The MNB's purchases took place in the secondary market, within the framework of auctions organised by the central bank and at individual secondary market transactions. The central bank carried out purchases by enforcing the principles of market neutrality and equal treatment, and in addition to variable price auctions, bilateral purchases were made at market price. The MNB involved the largest banks in terms of market activity in the programme. Investment funds could also participate.

As a result of the central bank's measures, the HUF government securities market stabilised and long-term government bond yields declined. Compared with the local maximum in March 2020, the 10-year yield significantly decreased. There was also a significant decline in yields in the segment of the yield curve relating to maturities of longer than 10 years. Due to the decrease in long-term yields, the slope of the yield curve also decreased. Purchases were largely concentrated on maturities of 10 years or more than 10 years, and as a result yields decreased more in this segment compared with shorter maturities.

In addition to the decline in nominal yields, government bond spreads also narrowed. The 10-year spread relative to the German yield – considered to be risk-free – reached its local maximum during spring 2020. As a result of the central bank's measures, the spread narrowed significantly. This means that in addition to global factors, country-specific effects also contributed to the decline in HUF yields.

Further, the liquidity situation in the government securities market improved substantially. Following the launch of the programme, market liquidity returned to a level that can be considered the historical average.

By expanding its asset purchase programme, the MNB also contributed to the decline in the yield of securities issued with government guarantees. Following the MNB decision, both the Hungarian Export-Import Bank and the Hungarian Development Bank were able to issue bonds on favourable terms.

On 24 August 2021, the Council decided to gradually withdraw the programme in parallel with a tightening of interest rate conditions which had started in June 2021. It also decided to phase out its other crisis management instruments affecting longer maturities. As a first step, the MNB's purchases decreased from a weekly amount of HUF 60 billion to HUF 50 billion. However, the Council indicated that a stable liquidity position in the government securities market remained crucial from a monetary transmission perspective, therefore, the MNB stood ready to temporarily raise the volume of weekly purchases at any time, if this was needed to maintain market stability. On 21 September 2021, the Council decided to decrease the target amount of the MNB's weekly purchases from HUF 50 billion to HUF 40 billion.

On 14 December 2021 the Monetary Council decided to terminate the government securities purchase programme. The Council underlined that the MNB continues to closely monitor liquidity developments in the government securities market and stands ready to intervene in order to maintain the stability of the market with occasional and targeted purchases if necessary. However, occasional purchases do not indicate a change in the restrictive stance of monetary policy.

India

Following the onset of the Covid-19 pandemic, the Reserve Bank of India (RBI) undertook APs along with reductions in the policy repo rate (and other monetary and regulatory measures) to mitigate the impact of the pandemic on the economy. The increase in uncertainty engendered by the pandemic had triggered a rise in risk premia and yields that could have reduced the effectiveness of the policy rate cuts and would have impeded monetary transmission. In India, the policy repo rate was reduced from 5.15% in February 2020 (before the pandemic) to 4% by May 2020. The banking system had ample surplus liquidity before the pandemic, which was parked with the RBI. Against this backdrop, APs by the RBI were aimed at addressing both the market nervousness (market functioning) as well as to ensure the fuller transmission of monetary policy rate cuts to the real economy (macroeconomic objectives).

In India, APs involved only government bonds, via outright as well as long-term repo operations, and involved only secondary market transactions. The size and design of the purchases was calibrated in response to the evolving macroeconomic and financial conditions and appropriately communicated to the markets. For example, in April 2021, the RBI undertook the government securities acquisition programme (G-SAP), with an upfront commitment to a specific amount of open market operations (OMO) purchases of government securities. Regular OMO purchases, on the other hand, are discretionary. In addition, the RBI undertook twist operations (buying longer-dated government bonds in exchange for shorter-dated bonds, which are largely liquidity-neutral) to stabilise financial markets, compress the term premia and support domestic demand.

Overall, the total liquidity injected through OMOs (including G-SAP) between February 2020 and September 2021 amounted to INR 5.9 trillion (USD 80 billion) corresponding to approximately 3.0% of GDP for 2019–20. This included purchases under G-SAP of INR 2.2 trillion between April and September 2021 (USD 30 billion) corresponding to almost 1.1% of GDP for 2019–20, including both on-the-run (liquid) and off-the-run (illiquid) securities across the maturity spectrum. Around 70% of the purchases under G-SAP were concentrated in the five- to 10-year maturity segment.

Under the twist operations, the RBI purchased longer-dated securities amounting to INR 2.4 trillion (USD 33 billion) corresponding to approximately 1.2% of GDP for 2019–20, while selling shorter-dated securities worth INR 2.3 trillion (USD 31 billion) corresponding to approximately 1.1% of GDP for 2019–20.

APs, other monetary and liquidity measures, concomitant ample surplus liquidity and apposite forward guidance eased financial stress and ensured orderly market conditions, strengthened monetary transmission and supported credit flows. Interest rates and bond yields declined across market segments, and spreads narrowed to pre-Covid levels (Table A1). According to an event study analysis, the G-SAP announcements cumulatively reduced the 10-year bond yield by 9 basis points (RBI (2022)); the implied yield elasticity is thus estimated at around 80 basis points for purchases normalised to 10% of GDP.

Interest rates and spreads in India

Table A1

	Interest rate (per cent)			Spread over corresponding risk-free rate (bp)		
	26 Mar	Mar	Sep	26 Mar	Mar	Sep
	2020	2021	2021	2020	2021	2021
Corporate bonds						
AAA (1-yr)	7.76	4.30	4.17	246	32	35
AAA (3-yr)	8.47	5.56	5.24	276	35	40
AA (3-yr)	9.15	6.31	6.07	344	110	124
BBB-minus (3-yr)	12.29	10.17	9.99	658	496	516
WALR ¹ (fresh loans)	9.22 ²	7.92	7.90			
WALR ¹ (outstanding loans)	10.05 ²	9.10	8.92			

¹ WALR is weighted average lending rate of commercial banks. ² Data refer to February 2020.

Source: Reserve Bank of India.

In October 2021, based on a review of liquidity and macroeconomic conditions, the RBI announced that it would cease APs under the G-SAP – the exit announcement was thus well ahead of major central banks. A number of other liquidity injection measures during 2020 and 2021 had pre-set terminal dates, which allowed an orderly and smooth rollback of liquidity (Das (2022)). In early 2021, the RBI started rebalancing surplus liquidity from its overnight absorption window towards relatively longer-term reverse repos. In April 2022, the RBI announced that it would engage in a gradual and calibrated withdrawal of the surplus liquidity in a non-disruptive manner to a level consistent with the prevailing stance of monetary policy.

With the emergence of inflationary pressures due to the war in Ukraine, monetary policy has, since April 2022, focused on the withdrawal of accommodation to ensure that inflation remains within the target going forward, while supporting growth. The policy repo rate has been increased by 225 basis points between May and December 2022. The cash reserve ratio was increased by 50 basis points in May 2022, consistent with the withdrawal of accommodation stance. The surplus liquidity in the banking system – as reflected in net absorption under RBI's liquidity adjustment facility (LAF) – has moderated from a peak of INR 8.2 trillion (US\$ 111 billion) in September 2021 to INR 0.6 trillion (US\$8 billion) in November 2022.

Indonesia

Facing a multidimensional crisis that required an integrated response, Bank Indonesia (BI) prioritised the achievement of synergies between strengthening monetary expansion and accelerating fiscal stimulus. To support the economic recovery, BI and the Ministry of Finance collaborated on a special burden-sharing recovery plan involving purchases of government securities (Sugat Berharga Negara or SBN) in the primary market.³⁰ The main principles underlying the plan were: (i) prioritising market mechanisms; (ii) considering the measured impact on inflation; (iii) purchasing tradable and marketable securities; and (iv) acting as a buyer of last resort if the market did not have the capacity to absorb the government's auction target. To support the economic recovery, funding of the government budget by BI included funds for the healthcare sector, social protection, government ministries and institutions, and local governments.

Follow-up measures by BI to support the economic recovery included careful monitoring of the global economy and financial market dynamics, as well as Covid-19 transmission and its impact on the

³⁰ It included purchasing securities in auctions as noncompetitive bidder, greenshoe options and private placements.

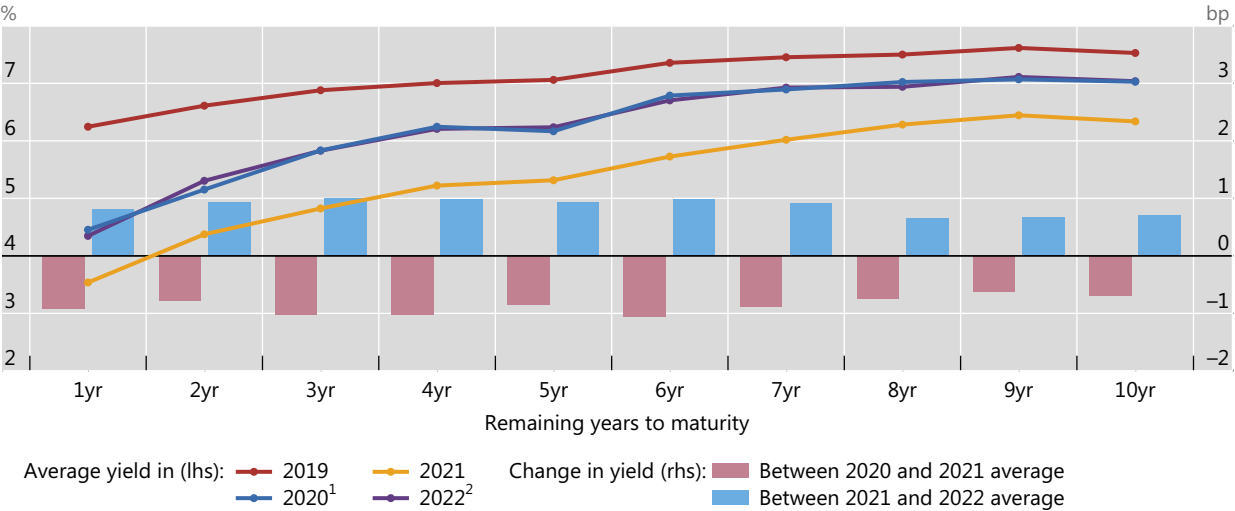
economic outlook. BI regularly recalibrated its policy mix to take into account the impact of existing policies on macroeconomic stability, supported by efforts to strengthen the policymaking process using granular data as part of BI's policy innovation initiative. In addition, BI strengthened coordination with the government and Financial System Stability Committee to maintain macroeconomic and financial system stability while accelerating the economic recovery. Joint decrees by BI and the government contributed to policy synergies that accelerated the economic recovery.

In 2020, a law was enacted to give BI the authority to purchase government securities in the primary market. The law committed BI to ending SBN purchases in the primary market by the end of 2022. To support the economic recovery and finance the health and humanitarian aspects of the response to the Covid-19 pandemic, in 2020 BI purchased SBN in the primary market totalling IDR 473 trillion to fund the government budget. In 2021, BI purchased SBN totalling IDR 358 trillion and in 2022 (as of 15 November) BI purchased SBN totalling IDR 142 trillion.

In 2020–21, BI injected liquidity into the banking sector through QE totalling IDR 874 trillion, equivalent to 5.2% of GDP. This helped SBN yields to decline, especially in 2021. SBN yields for one-year and 10-year tenors jumped from 5.1% and 7.0%, respectively, at the beginning of 2020 to 5.8% and 7.9% at the end of March 2020. In line with the implementation of QE, the SBN yield for one- and 10-year government bonds decreased to 3.7% and 6.4%, respectively, at the end of 2021 (Graph A6).

Indonesian government bond yields

Graph A6



¹ Only includes data from March 2020 onwards. ² Up until 22 Nov 2022.

Sources: Bank Indonesia; Bloomberg.

In 2022, the implementation of QE moderated but still contributed to holding back the increase in SBN yields. In the period through July 2022, SBN yields rose amid increasing uncertainty in global financial markets and following an increase in the yield on 10-year US Treasuries. Further increases in yields were moderated by ongoing QE implementation. At the end of July 2022, one- and 10-year SBN were 4.2% and 7.1%, respectively. From August to late 2022, SBN yields increased significantly, with one- and 10-year tenors increasing to 6.3% and 7.0% as of 16 November 2022. During this period, SBN yields followed BI’s seven-day repo rate and US Treasury yields higher.

In 2022, BI also traded SBN in the secondary market to increase the attractiveness of SBN yields to foreign portfolio investors. This helped to stabilise the exchange rate and reinforce the transmission of the monetary policy stance. BI’s monetary policy in 2022 was directed at maintaining price stability, as well as mitigating the impact of normalisation policies in advanced economies. The normalisation of monetary

policy in Indonesia was carried out in a measured and gradual manner to maintain stability while still supporting the ongoing process of economic recovery.

In January 2022, BI announced that its liquidity policy would be normalised through a gradual increase in the rupiah statutory reserves (GWM), while safeguarding the banking sector's capacity to extend financing to the corporate sector and purchase SBNs to fund the government budget. The minimum requirement for rupiah reserves (GWM) for conventional banks was increased from 3.5% to 5.0% on 1 March 2022, 6.0% on 1 June 2022, 7.5% on 1 July 2022 and 9.0% on 1 September 2022. The reserve requirement for sharia banks and sharia business units was also increased gradually over this period, to 7.5% on 1 September 2022.

BI maintained its policy rate at a low level until there were signs of an increase in core inflation. In August 2022, BI raised its seven-day repo rate for the first time since the Covid-19 crisis, by 25 basis points. This hike was followed by increases of 50 basis points in September, October and November 2022. The decision to raise the policy rate was taken as a front-loaded, pre-emptive and forward-looking measure to lower inflation expectations and to ensure the return of core inflation to the 3.0% +/- 1% target range in the first half of 2023. Simultaneously BI aimed at strengthening exchange rate stabilisation policy in line with the rupiah's fundamental value amidst the strong US dollar and elevated global financial market uncertainty. In line with the law that authorised purchases and the ongoing economic recovery, BI ended its purchases of SBNs in the primary market at the end of 2022.

Japan

In response to the impact of the Covid-19 crisis, the Bank of Japan (BoJ) continued to conduct powerful monetary easing under quantitative and qualitative monetary easing (QQE) with yield curve control (YCC). The BoJ aimed to provide support for financing, mainly of firms, so that they could sustain their businesses, and to maintain stability in financial and capital markets in order to prevent a vicious cycle between turmoil in the markets and deterioration in the real economy. During the Covid-19 crisis, the BoJ purchased a wide range of assets – both public and private – under the QQE with YCC. They included Japanese government bonds (JGBs), T-bills, commercial paper (CP), corporate bonds, exchange-traded funds (ETFs) and Japan real estate investment trusts (J-REITs).

Regarding JGBs, the BoJ purchased necessary amounts without setting an upper limit, with a view to maintaining stability in the bond market and stabilising the entire yield curve at a low level. The BoJ also purchased T-bills as nimbly and actively as necessary. These purchases contributed to the formation of a yield curve that was consistent with the guidelines for market operations for YCC determined at BoJ policy meetings.

Concerning CP and corporate bonds, the BoJ purchased them with an upper limit on the amount outstanding of about 20 trillion yen in total until the end of March 2022. Prior to the Covid-19 crisis, the guideline relating to purchases of CP and corporate bonds was to maintain their amounts outstanding at JPY 2 trillion and JPY 3 trillion, respectively. The BoJ increased these limits temporarily to support financing (mainly of firms) and maintain stability in financial markets in response to the impact of Covid-19. From April 2022 onward, the BoJ has been purchasing these assets at about the same pace as prior to the pandemic so that the amounts outstanding will gradually return to pre-pandemic levels.

ETFs and J-REITs were also purchased as necessary with upper limits of JPY 12 trillion and JPY 180 billion annually, respectively. The annual upper limits for ETF and J-REIT purchases were originally JPY 6 trillion yen and JPY 90 billion, respectively. The BoJ temporarily increased the limits at its policy meeting on 16 March 2020, as part of its response to the impact of the Covid-19 crisis. Later, at the policy meeting on 19 March 2021, it decided to maintain the increased limits even after the Covid-19 crisis.

The BoJ's responses contributed to stabilising financial markets and maintained accommodative financial conditions during the Covid-19 crisis. Specifically, JGB yields stayed at low levels under YCC even

after the outbreak of Covid-19, when liquidity in the JGB market declined temporarily and a subsequent increase in issuance of JGBs intensified upward pressure on yields. The increased purchases of CP and corporate bonds prevented a rise in spreads, and thereby helped to maintain a favourable environment for firms to obtain funding through the issuance of CP and corporate bonds. The flexible purchases of ETFs and J-REITs contributed to containing instability in financial markets.

Korea

In Korea, the aim of APs was to reduce the excess volatility of long-term interest rates. The APs of the Bank of Korea (BoK) were confined to small-scale outright purchases of Treasury bonds in the secondary market. These purchases had previously been used as a policy measure for stabilising the bond market in normal times, rather than for responding to crises such as Covid-19 and the GFC.

Between March 2020 and June 2021, the BoK purchased government bonds totalling KRW 17 trillion (USD 14.7 billion, or 0.9% of 2019 GDP). It purchased bonds on 11 occasions. The amounts purchased were much larger than during the previous three years (KRW 3.5 trillion in 2017, KRW 4.2 trillion in 2018 and KRW 5.7 trillion in 2019). The BoK also created a special purpose vehicle, together with the government, to purchase corporate bonds and commercial paper to support credit markets. Through this vehicle, loans were extended on two occasions, amounting to KRW 3.6 trillion (USD 3.1 billion).

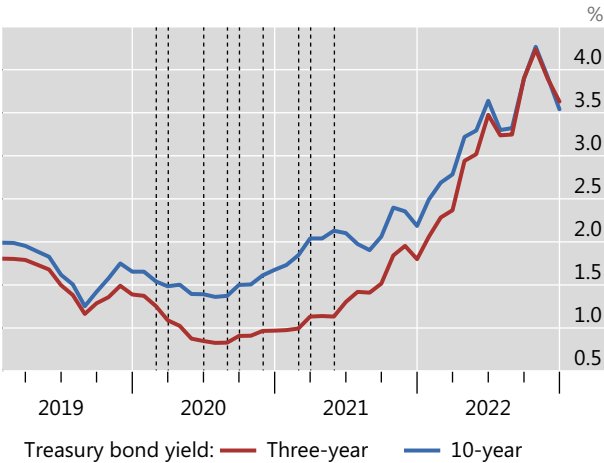
The plan to expand outright purchases of Treasury bonds between March 2020 and June 2021 was announced as a pre-emptive measure against possible increased volatility in market interest rates caused in part by an increase in government bond issuance. As a pre-emptive tool, the measure contributed to lessening the volatility of market interest rates, although the daily decline in yields was not particularly significant (Graph A7.A).

When the BoK began to tighten monetary policy in August 2021, it relied on increases in its base rate (Graph A7.B). Considering the relatively small amount of government bonds purchased by the BoK (around 5% of the BoK’s total assets at the end of 2021), QT was deemed to be unnecessary to support the monetary policy stance.

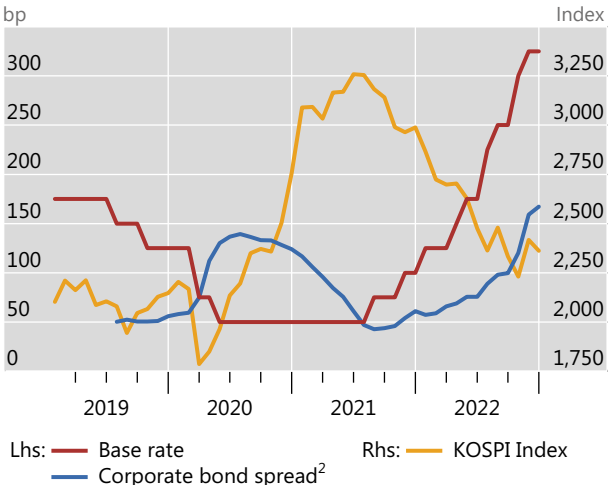
Korean financial markets

Graph A7

A. Government bond yields¹



B. Policy rate, corporate bond spread and equity index



¹ The dashed lines indicate BoK purchases of Treasury bonds. ² Spread between AA-corporate bond yield and 3-year Treasury bond yield. Source: Bank of Korea.

Malaysia

Small-scale APs (of government bonds) have long been part of the instruments for open market operations of the Central Bank of Malaysia (BNM). These are limited to a maximum purchase of 10% of the outstanding amount of any particular security. Such purchases aim to manage liquidity conditions in the banking system. BNM also steps in to purchase government bonds during periods of excessive volatility and illiquidity to ensure orderly functioning of the market. BNM does not announce a predetermined schedule or amount for the purchases as they are intended to be flexible in responding to market dysfunction and are only carried out as and when necessary.

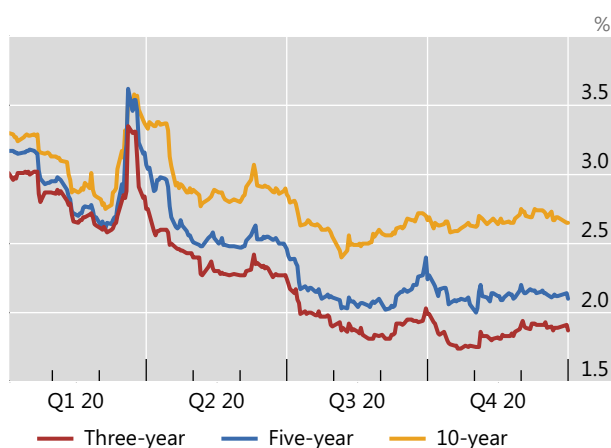
During the Covid-19 pandemic, domestic financial markets came under pressure amidst capital outflows by non-resident investors. BNM stepped in to provide liquidity through purchases of government bonds alongside other instruments such as reverse repo operations and a reduction in the statutory reserve requirement (SRR). These purchases amounted to MYR 9.4 billion (USD 2.1 billion or 0.6% of 2019 GDP) from March to December 2020, bringing the total holdings of government bonds to MYR 11.1 billion (USD 2.5 billion or 0.7% of 2019 GDP) at end-2020. As evidenced by the moderate daily yield movements, these purchases managed to provide sufficient liquidity to the market and facilitate orderly price adjustments (Graph A8.B).

In 2022, BNM commenced monetary policy tightening with 100 basis points of cumulative hikes of the overnight policy rate (OPR). BNM's holdings, while high relative to the historical average, were still insignificant compared with the market size. Given that these are part of normal market operations, no specific communication (or exit plan) is necessary. In terms of balance sheet reduction, BNM typically adopts a passive approach by letting the bonds mature without reinvestment.

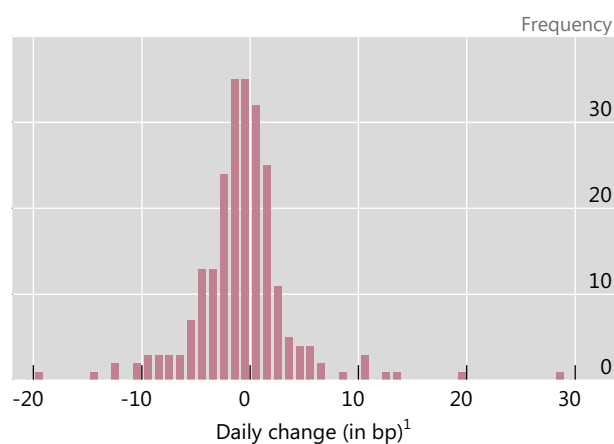
Malaysian government bond market in 2020

Graph A8

A. Malaysian government bond yields



B. Changes in 10-year government bond yields in 2020



¹ Rounded to the nearest basis point.

Source: Central Bank of Malaysia.

Mexico

During the Covid-19 crisis, the Bank of Mexico executed central government debt exchange operations with market functioning objectives. These operations were part of the measures to foster an orderly functioning of financial markets, strengthen the credit channels and provide liquidity for the sound development of the financial system. The main objective of this policy was to avoid major disruptions in

the fixed income market, allowing market participants to reduce their duration risk, while promoting the orderly functioning of the government debt market.

The Bank of Mexico purchased long-term central government debt securities (10 years and longer) in exchange of short-term securities with maturities of up to three years (twist operations). The amount of the programme was up to MXN 100 billion (0.4% of 2019 GDP or USD 4.1 billion), but only MXN 14.98 billion (around 0.1% of 2019 GDP or USD 0.6 billion) was allotted, which shows that the need to hedge interest rate risk through this mechanism was not as large as expected. Although the Bank of Mexico resorted to these interventions only modestly during 2020, the preparedness and availability of such interventions provided certainty for investors affected by interest rate risk in highly volatile scenarios.

The amount of the twist operations was allotted in two auctions. On 29 April 2020, the Bank of Mexico held the first auction of this programme to exchange government securities (Table A2). Consistent with the rules of the programme, the transaction consisted of the exchange of long-term bonds with a maturity of 10 to 30 years for notes and bonds with a maturity of up to three years, for an amount of MXN 4.615 billion (USD 0.2 billion). On 1 July 2020, the central bank implemented the second operation with similar characteristics for an amount of MXN 10.365 billion (USD 0.4 billion).

Swaps of government securities implemented by Bank of Mexico

Table A2

Date of swap	Securities delivered by bidders			Securities received by bidders	
	Type of security	Maturity date	Tenor (days)	Amount allocated (MXN mn)	Type of security (maturity date)
29 Apr 2020	Bonos M	May 2029	3,314	750	Cetes (Apr 2021, Mar 2022) Bonos M (Dec 2021, Jun 2022)
		May 2031	4,042	320	
		Nov 2038	6,772	1,510	
		Nov 2042	8,228	1,735	
		Nov 2047	10,048	300	
1 Jul 2020	Bonos M	May 2029	3,254	1,250	Cetes (Jul 2021, Mar 2022) Bonos M (Dec 2021, Jun 2022)
		May 2031	3,982	360	
		Nov 2034	5,256	2,050	
		Nov 2036	5,984	5,500	
		Nov 2038	6,712	30	
		Nov 2042	8,168	170	
		Nov 2047	9,988	1,005	

Source: Bank of Mexico.

The government debt exchange mechanism led to a decline in long-term government bond yields, thus easing financial conditions. This outcome was largely driven by the portfolio rebalancing channel. The facility saw the yield curve flatten with less distortions in the long end of the curve. Market participants considered these operations to be a positive development and important signalling from the Bank of Mexico to promote the orderly functioning of the fixed income market. Comparing yields between one day before and nine days after the swap operation implemented in April 2020, there was a decrease of more than 90 basis points across all applicable bond yields (Graph A9.B). The intervention in July 2020 also decreased the yields of received securities, but by a smaller magnitude, with reductions between 16 and 28 basis points (Graph A9.B). Even though the full movement in yields cannot be attributed to the debt exchange mechanism, there is no doubt that it helped to achieve better financial conditions.

The Bank of Mexico retained a margin of flexibility with respect to the size and other characteristics of the government debt exchange operations programme. In the statement in which the

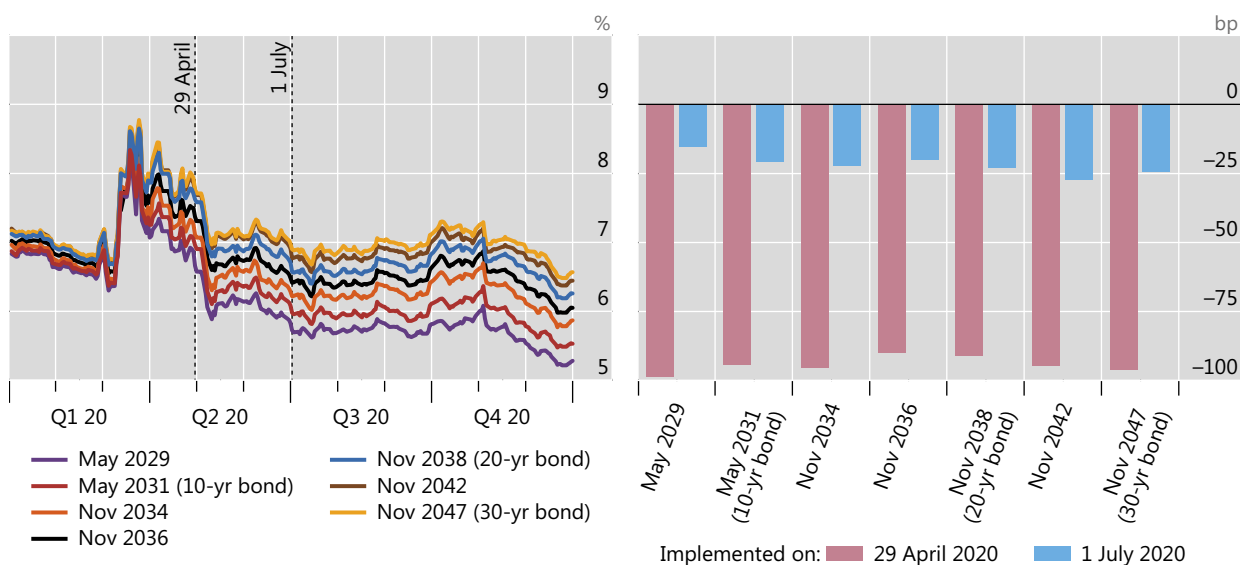
programme was announced, it was established that the characteristics and terms of each swap would be determined in each auction call and that the amount of the programme could be adjusted depending on the conditions prevailing in financial markets. Additionally, in February 2021 the central bank announced that it would retain the ability to carry out these operations when deemed necessary, relaxing the duration of the programme (it had previously been announced that it would terminate in that month).

Mexican bond yields around the time of swap operations in 2020

Graph A9

A. Yields of received securities in swaps of government securities

B. Movements in the yields of selected bonds nine days after swaps on government securities¹



¹ The movement is considered as the reduction of yields between the prior day and the first nine days of the operation.

Sources: Bank of Mexico; Bloomberg.

Poland

Between March 2020 and November 2021 Narodowy Bank Polski (NBP) conducted purchases of Treasury debt securities and debt securities guaranteed by the government in the secondary market under the Structural Open Market Operations (SOMO). The purpose of these operations was: (a) to change the long-term liquidity structure in the banking sector, (b) to ensure liquidity in the secondary markets for the purchased securities, and (c) to strengthen the monetary policy transmission mechanism. SOMO were conducted in a flexible manner; the timing and scale of operations depended on market conditions. SOMO was accompanied by other monetary policy easing measures implemented in response to the outbreak of the Covid-19 pandemic. Between March and May 2020 the NBP lowered its reference rate from 1.5% to 0.1%. Additionally, among others, the required reserve ratio was decreased from 3.5% to 0.5% and discount bill credit aimed at refinancing new loans granted to economic entities by banks was launched. The NBP started to raise its policy rate in October 2021, and APs were concluded in November 2021.

The total amount of debt securities purchased by NBP under the SOMO was PLN 144 billion (6.3% of 2019 GDP; in terms of nominal value). The securities purchased comprised government bonds and securities guaranteed by the government, namely Covid-19 Response Fund bonds issued by Bank Gospodarstwa Krajowego (BGK) and bonds issued by Polish Development Fund (PFR). Purchases were highest during the early phase of the crisis (March-July 2020). In the ensuing months of 2020, the scale of purchases declined substantially (Graph A10.A). In the first half of 2021, NBP again temporarily ramped up its APs amid heightened tensions in the global sovereign bond markets. Later in 2021, only small amounts

of bonds were purchased before SOMO was terminated. Following the termination of purchases, payments from maturing securities purchased under the SOMO were not reinvested.

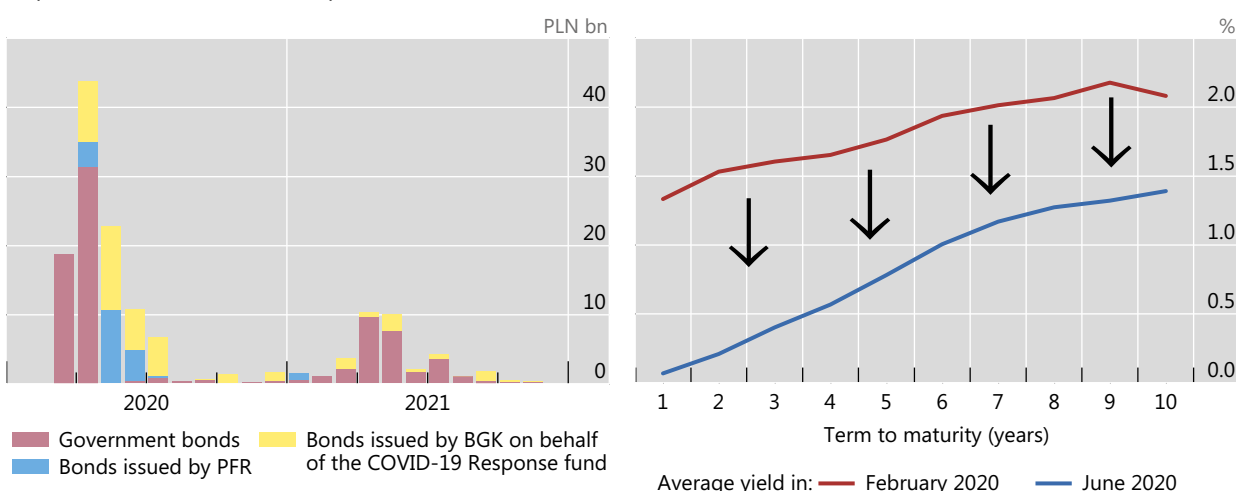
NBP's APs improved liquidity in the secondary bond market and, coupled with other actions by NBP, contributed to a substantial decline in the cost of financing and debt service in the Polish economy. Financing conditions in the market for government and government-guaranteed securities eased significantly (Graph A10.B). This facilitated the government's implementation of measures to counter the crisis. SOMO complemented other monetary and fiscal policy actions aimed at mitigating the negative impact of the pandemic on economic activity and supporting the economic recovery (Hertel et al (2022)).

Poland's asset purchase programme

Graph A10

A. Nominal value of bonds purchased by NBP as part of the Structural Open Market Operations in individual required reserve maintenance periods¹

B. Yield curve for Polish government bonds in February 2020 and June 2020



BGK = Bank Gospodarstwa Krajowego (Polish development bank). PFR = Polski Fundusz Rozwoju (Polish Development Fund).

¹ Nominal value of the bonds calculated according to the dates of the tenders.

Sources: Narodowy Bank Polski; Bloomberg.

Sweden

The Sveriges Riksbank launched APs of SEK 300 billion (USD 31 billion) in March 2020, set to end on 31 December 2020. The objective of the purchases was macroeconomic in nature, namely to keep interest rates low, provide broad support to credit supply and support the Swedish economy during a period with substantial uncertainty. Amid continued uncertainty over the economic outlook and further spread of Covid-19, the AP programme was increased to SEK 500 billion (USD 52 billion) in July 2020 and extended to 30 June 2021, and increased again in November 2020 to SEK 700 billion (USD 73 billion). The programme expired on 31 December 2021.

The Riksbank bought both privately issued and public assets during the pandemic. By 31 December 2021 the Riksbank had purchased SEK 91 billion (USD 9.5 billion) in government bonds, SEK 109 billion (USD 11.3 billion) in municipal bonds, SEK 435 billion (USD 45.2 billion) in covered bonds and SEK 13 billion (USD 1.3 billion) of corporate bonds. By December 2021, the Riksbank no longer held any commercial paper. Purchases of treasury bills resulted in holdings of SEK 20 billion (USD 2.1 billion) on 31 December 2021.

The yield effects of the Riksbank's APs during the pandemic are reported in Table A3, where purchases are normalised to correspond to 10% of annual GDP. When interpreting these results it is important to keep in mind that purchases of covered bonds and municipal bonds accounted for approximately 85% of purchases. The results indicate that Swedish government bond yields fell in relation to German yields by about 14 basis points. Yields on covered bonds/municipal bonds decreased by a further 20 basis points, approximately.

The Riksbank's AP programme to alleviate the effects of the pandemic expired on 31 December 2021. Throughout 2022 the Riksbank continued to purchase assets, but at a pace that implied a decline of asset holdings during the year. At the end of 2022 purchases of additional assets ceased. The assessment, as of November 2022, was that it was appropriate for the Riksbank's asset holdings to continue to decline in the coming years as a part of monetary policy tightening. The Riksbank's asset holdings, due to monetary policy objectives, were approximately SEK 860 billion (USD 89 billion) in mid-November 2022. In November 2022 the Riksbank indicated that asset holdings will gradually decline as individual assets mature. As a result, holdings will more than halve by the end of 2025, declining by almost SEK 490 billion (USD 51 billion). A large part of these maturing assets – around SEK 290 billion (USD 30 billion) – are covered bonds, which have a shorter maturity than government bonds.

Standardised effects of the Sveriges Riksbank's APs during the Covid-19 crisis

Price impact corresponding to purchases equalling 10% of annual 2019 GDP		Table A3
Yield, Swedish government bond	10-year	-1 bp
Yield spread, Sweden – Germany	10-year	-14 bp
Yield spread, covered bonds – swaps	5-year	-21 bp
Yield spread, municipal bonds ¹ – swap	5-year	-22 bp
Nominal effective exchange rate	KIX ²	0.8%
Equity prices	OMXS ³	4.8%

¹ Municipal bonds refer to bonds issued by Kommuninvest I Sverige AB. ² The KIX (krona index) is a weighted average of the currencies in 32 countries that are important for Sweden's international trade. ³ Stockholm stock market index.

Source: Gustafsson (2022); Macrobond.

Thailand

In March and April 2020, the Bank of Thailand (BoT) conducted larger than normal purchases of public debt securities to address market dysfunction. The global dash for cash and large redemptions from fixed income funds triggered a sell-off in Thailand's government bond market. This led to a deterioration in market functioning, as evident in sharp increases in bond yields and widening bid-ask spreads. The BoT conducted government bond purchases to restore market functioning and improve investors' confidence. The operations lasted for three weeks until normal market functioning resumed.

The BoT purchased THB 150 billion (around USD 5 billion) of government and BoT bonds, of up to 15-year maturities. With the objective of supporting market functioning rather than promoting macroeconomic objectives, the BoT only purchased securities as needed according to market conditions. No target size or purchase schedule was planned or announced. In sum, total purchases amounted to 6% of overall March 2020 trading volume (compared with regular bond purchases in 2019 that accounted for around 1% of monthly trading volume).

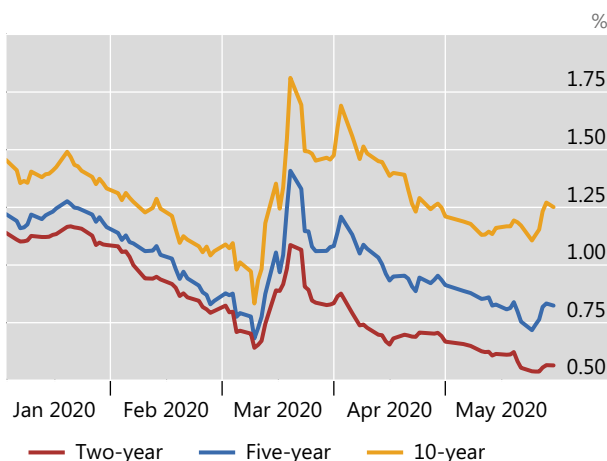
Bond purchases, along with other measures launched at the time such as the mutual fund lending operations, contributed to improvements in bond market conditions. Government bond yields gradually declined from their peaks in April 2020 and bid-ask spreads soon normalised (Graph A11). The BoT has no

plan for active securities sales. The securities purchased have been retained and used as collateral for liquidity management operations.

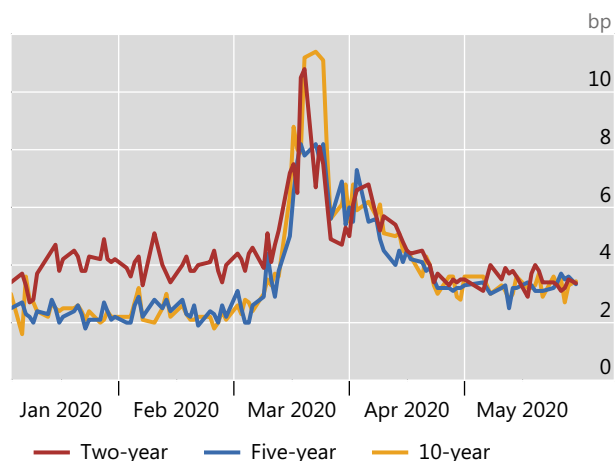
Thai government bond yields and bid-ask spreads in 2020

Graph A11

A. Government bond yields



B. Bid-ask spreads



Sources: Bank of Thailand; Bloomberg; Thai Bond Market Association.

Türkiye

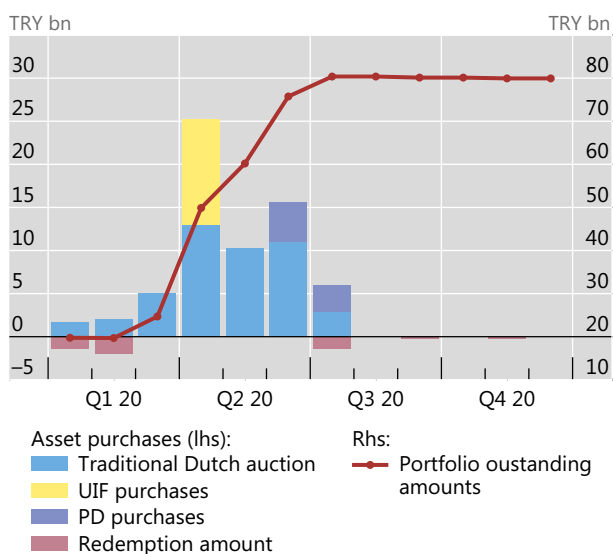
During the Covid-19 crisis and similar to policies implemented by other central banks, the Central Bank of the Republic of Türkiye (CBRT) undertook several measures to maintain the uninterrupted and healthy functioning of financial markets, support the credit channel and contain the adverse implications of the pandemic on the Turkish economy and financial system. The AP programme, introduced within the context of immediate response measures, included only government domestic debt securities (GDDS) and its goals were to maintain market depth, provide banks with flexibility in Turkish lira liquidity management, improve predictability and strengthen the monetary transmission mechanism by boosting the liquidity of GDDS. CBRT took the following additional measures:

- Outright purchases, which had been planned as part of the *Monetary and Exchange Rate Policy for 2020* set out in CBRT (2019), were conducted in a front-loaded manner.
- For a temporary period, the primary dealer (PD) banks were able to sell the GDDS that they had bought from the unemployment insurance fund (UIF) to the CBRT, under terms and limits set by the CBRT. This aimed to support financial stability by containing the likely impacts of increased liquidity needs of the UIF on market functioning. The GDDS purchases were determined to be outside the scope of limits set for the open market operations (OMO) portfolio.
- The maximum ratio of the OMO portfolio nominal size to the CBRT analytical balance sheet total assets, which had previously been set at 5% in the *Monetary and Exchange Rate Policy for 2020*, was increased to 10%.
- To further support the PD system, considering its contributions to the deepening of financial markets and to the effectiveness of the monetary policy transmission mechanism, the facility offered to PD banks to sell GDDS to the CBRT was revised and the limits offered to PD banks for outright sales of GDDS to the CBRT started to be applied independently of repo transaction limits. However, related purchases were subject to a maximum of 10% for the OMO portfolio.

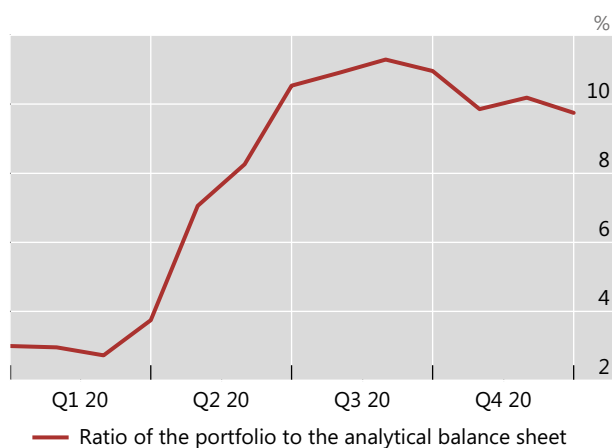
Open market operations by the Central Bank of the Republic of Türkiye

Graph A12

A. Progression of the OMO portfolio in nominal terms



B. OMO portfolio nominal size to the CBRT's total assets



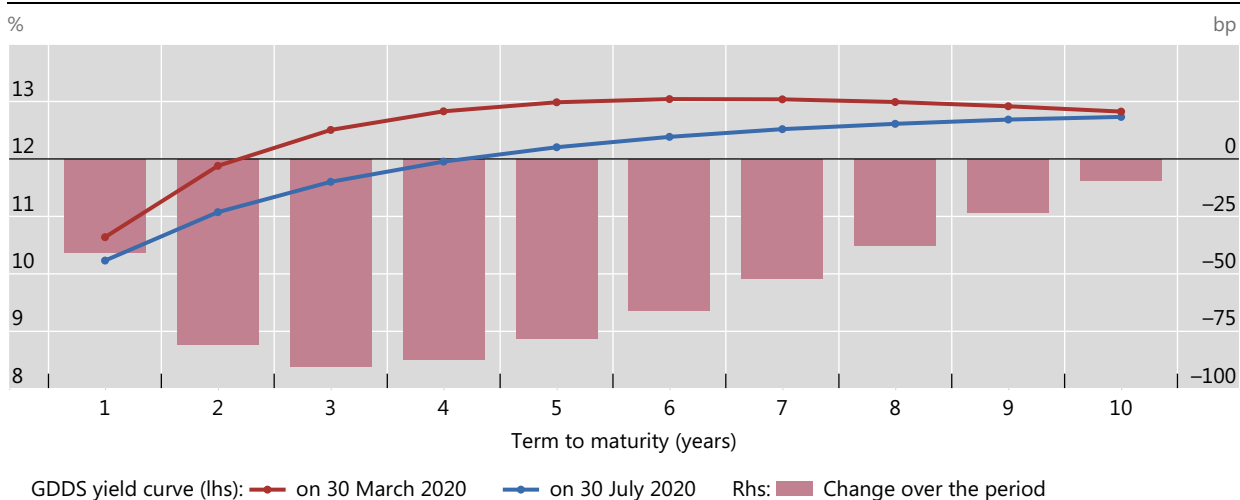
Source: Central Bank of the Republic of Türkiye.

GDDS purchases stopped in July 2020, and the ratio of the OMO portfolio converged to 10% of the total assets of the CBRT's analytical balance sheet by end-2020 (Graph A12.B). GDDS purchases in 2020 equalled approximately 1.8% of nominal 2019 GDP and the OMO portfolio at the end of 2020 reached approximately 2% of nominal 2019 GDP. As announced, no outright purchases were conducted in 2021, and consequently the OMO portfolio declined to TRY 63.8 billion.

From 30 March to 30 July 2020, APs were undertaken in a front-loaded manner. The downward shift in the yield curve partly reflects the effects of these purchases (Graph A13). Various macroeconomic and financial factors also played a role in yield curve moves.

Change in Turkish government yields between the start of front-loaded asset purchases and the end of programme in 2020

Graph A13



Source: Central Bank of the Republic of Türkiye.

United Kingdom

At the start of 2020, the spread of Covid-19 and the measures taken to contain the virus triggered a sharp deterioration in the economic outlook and an increase in economic uncertainty, both globally and in the United Kingdom. This led to an extreme spike in the demand for liquidity – a “dash for cash” – at a time where dealers’ capacity to intermediate in the UK government bond, or gilt, market was constrained (Busetto et al (2022)). In the United Kingdom, the demand to liquidate gilts was driven in part by a need for investors, such as domestic insurance and pension funds, to meet significant margin calls. In normal circumstances, dealers provide liquidity by holding gilt inventories on their balance sheets. In March 2020, the growing imbalance between the demand from clients wishing to sell gilts relative to those wishing to buy required dealers to warehouse unusually high volumes of gilts on their balance sheets, and liquidity provision was insufficient to fully accommodate demand. The combination of these factors resulted in a sharp deterioration of market liquidity. One way this manifested was in an abrupt widening of bid-ask spreads, which is one of the ways dealers are compensated for the risks of holding gilt inventories.

The Bank of England (BoE) responded with APs of unprecedented scale and speed, along with other measures aimed at improving market functioning and mitigating an unwarranted tightening in financial conditions. Other things equal, the deterioration in gilt market conditions and the associated tightening in financial conditions would have further depressed the UK macroeconomy.

On 19 March 2020, the BoE’s Monetary Policy Committee (MPC) announced that it had voted unanimously to increase the stock of purchased assets by £200 billion, and that it would complete the programme as soon as operationally possible, consistent with improved market functioning. During 2020, the MPC increased the envelope of its asset purchase facility (APF) three times, to £895 billion in total. As part of the APF, the MPC committed to increase its stock of purchased corporate bonds to at least £20 billion. The BoE also introduced the Covid corporate financing facility jointly with the government to support liquidity among larger firms.

The evidence suggests this QE programme had a substantial impact on interest rates. Shortly after the initial announcement, gilt yields retraced a significant portion of their earlier surge. Summing the high-frequency reactions to the 19 March MPC announcement and the subsequent BoE notice, 10-year gilt yields fell by 24 basis points – around 40% of the surge in yields over the 10 preceding days. There was no other significant news over this window, so this effect can be attributed to the BoE’s announcements. As it may have taken time for markets to fully absorb the news, these moves could provide a lower bound for the full impact of the announcements. On average, medium- and long-term gilt yields fell by approximately 40 basis points in the two days after the announcements. These elasticities of yields with respect to announcements of APs were in the upper range of pre-Covid estimates.

The evidence also suggests that gilt market liquidity improved after the BoE’s purchases began, suggesting there was a greater role for the market functioning channel compared with previous AP programmes, although other schemes introduced by the BoE at that time to improve market functioning and actions by other central banks are also likely to have contributed. Given the imbalance between the demand to liquidate gilts and the market’s ability to absorb them, there was an unusually large scope for APs to improve market functioning in March 2020. In particular, the presence of a large backstop buyer could reduce the risk of holding gilt inventories and thereby increase dealers’ capacity to accommodate selling pressure from their clients.

One feature of the reaction to the 19 March announcements is that, compared with previous programmes, although long rates fell by more, there was little variation in the reduction in quoted yields across individual short- to medium-term gilts and across quoted yields on individual longer-dated gilts. This could have been a symptom of market dysfunction and uncertainty, making dealers reluctant to discriminate between gilts within broad yield curve segments.

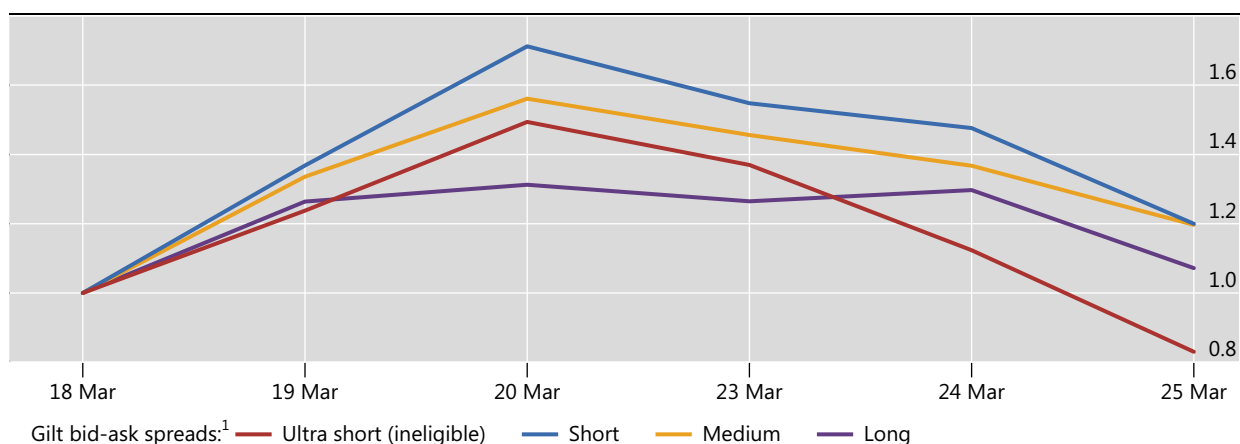
In line with the importance of a market functioning channel, gilt liquidity improved after the BoE's purchases began. The precise timing of the improvement in market liquidity varied across indicators. Measures based on dealer quotes, like bid-ask spreads, did not react strongly on 19 March, but they fell across the maturity spectrum after the BoE began buying assets through its QE auctions (Graph A14). The fact that bid-ask spreads also decreased for very short-term gilts ineligible for BoE purchases is consistent with an improvement in dealers' appetite to provide liquidity after auctions had started.

Meanwhile, transaction-based measures suggest that liquidity improved decisively on 20 March, the first day of QE auctions. It is possible that these measures responded more quickly than bid-ask spreads, for example if the bargaining power of gilt sellers increased due to the impending auctions.

Bid-ask spreads in the gilt market around the announcement of APs in March 2020¹

In basis points

Graph A14



¹ Average intraday bid-ask spread using the best bid and best ask.

Sources: Busetto et al (2022); Bank of England; Tradeweb; CGFS working group.

The surge in UK corporate bond yields slowed down after 19 March, before falling afterwards. Unlike for gilts, corporate yields did not fall back to their initial level – although that could reflect the persistent economic effect of Covid-19 on the outlook for corporates rather than continued market dysfunction. In general, it is difficult to separate out the impact on market liquidity of the BoE's announced gilt and corporate bond purchases from other news, including the parallel extension of Fed and ECB APs and swap lines.

The macroeconomic impact of the March 2020 QE programme is likely to have been material. APs helped to offset a substantial part of the surge in gilt yields during the dash for cash episode. In addition, it is likely that gilt yields would have increased further absent these purchases. But since instances of gilt market dysfunction are rare, it is difficult to quantify this effect, and to estimate how financial conditions and economic activity might have contracted in that counterfactual scenario. That said, the limited historical evidence suggests that episodes of market illiquidity associated with constraints on dealers' capacity to intermediate are associated with adverse macroeconomic outcomes.

In August 2021, the BoE announced its strategy for unwinding APs for monetary policy purposes. Once the BoE's policy rate reached 50 bps, the MPC intended to cease reinvesting maturing gilts (passive balance sheet roll-off). At 100 bps the MPC would consider selling some of the stock of purchased assets (active management). The former condition was met in February 2022, at which point reinvestments ceased, and the MPC also announced a programme of corporate bond sales. The latter condition was met in May 2022, at which point MPC asked BoE staff to work on a strategy for active gilt sales. In August 2022, the MPC announced that it was provisionally minded to commence gilt sales shortly after its September meeting, subject to economic and market conditions being judged appropriate and to a confirmatory vote

at that meeting. At its September 2022 meeting, the MPC agreed that the conditions were appropriate, and voted to begin active gilt sales shortly after that meeting.

On 28 September 2022, following a period of volatility and market illiquidity, the BoE announced a strictly time-limited and targeted financial stability operation to buy long-dated UK government bonds, in order to address market dysfunction and to reduce any risks to financial stability and core funding markets. On 10 and 11 October, the BoE announced additional measures, including undertaking further targeted daily purchase operations for index-linked UK government bonds. In line with what the BoE had announced from the outset of these operations, all bond purchases ceased on 14 October. These financial stability operations were designed to allow liability-driven investment funds affected by the significant repricing of UK financial assets time to reduce their leverage and increase their resilience to future stresses. On 29 November, the BoE began to unwind, in a timely but orderly way, the specific gilt purchases resulting from the financial stability operations conducted between 28 September and 14 October. These sales were completed on 12 January 2023.

Also on 28 September 2022, in light of the dysfunctional market conditions at the time, the BoE postponed the start of its planned gilt sale operations for monetary policy purposes. On 20 October, the BoE announced that, for Q4 2022, gilt sale operations would be distributed evenly across the short and medium maturity sectors only. The first gilt sale operation, of £750 million, took place on 1 November 2022. The first operation in the corporate bond sales programme took place on 27 September. On 11 October, in light of the dysfunctional market conditions at that time, the BoE temporarily paused its corporate bond sales operations for two weeks. Sales restarted on 25 October.

United States

In light of the effects of Covid-19 on the economy and on risks to the outlook, the Fed's Federal Open Market Committee (FOMC) lowered the target range for the federal funds rate by a total of 1.5 percentage points, from a range of 1.05 – 1.75% to 0 – 0.25%, over two meetings in early and mid-March 2020. At its mid-March meeting, along with its decision to lower the target range for the federal funds rate, the FOMC emphasised that it was prepared to use its full range of tools to support the flow of credit to households and businesses, thereby promoting its maximum employment and price stability goals. To support the smooth functioning of markets for Treasury securities and agency mortgage-backed securities (MBS), the FOMC announced that it would increase its holdings of Treasury securities and agency MBS. Later in March, the FOMC announced that it would continue to purchase Treasury securities and agency MBS in the amounts needed to support smooth market functioning and the effective transmission of monetary policy to broader financial conditions. In December 2020, the FOMC further specified that increases in the holdings of Treasury securities and agency MBS in the system open market account would continue at least at this pace until substantial further progress had been made toward its maximum employment and price stability goals.

In response to the Covid-19 pandemic, the Federal Reserve purchased large quantities of Treasury securities and agency MBS, including commercial MBS. As shown in Table A4, the Federal Reserve's holdings of assets increased from \$4,312 billion in March 2020 to \$8,965 billion in April 2022, corresponding to 20.2% and 41.9% of 2019 GDP, respectively. In November 2022, the Federal Reserve's holdings of assets stood at \$8,585 billion, or 40.2% of 2019 GDP. The decline relative to the peak holdings is the result of the reduction in the size of the balance sheet that started in June 2022.

Using evidence from previous literature, as shown in Graph 6 in section 5, the median response of the 10-year Treasury yield to APs equivalent to 10% of GDP was a decline of about 80 basis points. However, the range of estimates is quite broad, with the 25th to 75th percentiles of the range of estimates for the response of 10-year Treasury yield to APs equivalent to 10% of GDP being equal to –57 and –125 basis points, respectively.

Federal Reserve's holdings of assets in response to the Covid-19 crisis

Table A4

	In billions of USD			As a percentage of 2019 GDP		
	March 2020	Peak Amount ¹	November 2022	March 2020	Peak Amount ¹	November 2022
Treasury Coupon Securities	2202	5443	5220	10.3	25.5	24.4
Treasury Bill Securities	321	326	296	1.5	1.5	1.4
MBS ²	1372	2740	2659	6.4	12.8	12.4
CMBS	0	10	9	0.0	0.0	0.0
Total Securities Held Outright	3897	8505	8177	18.2	39.8	38.2
Total Assets	4312	8965	8585	20.2	41.9	40.2

¹ Peak amount dates were May 2022 for Treasury Coupon Securities, August 2022 for Treasury Bill Securities, and April 2022 for MBS, CMBS, Total Securities Held Outright, and Total Assets. ² MBS values do not include commitments.

Sources: Federal Reserve Board, Statistical Release H.4.1, "Factors Affecting Reserve Balances"; Haver Analytics; and staff calculations.

The FOMC views changes in the target range for the federal funds rate as its primary means of adjusting the stance of monetary policy and determines the timing and pace of reducing the size of the Federal Reserve's balance sheet so as to promote its maximum employment and price stability goals. In May 2022, reflecting the need to firm the stance of monetary policy amid elevated inflation and tight labour market conditions, the FOMC announced its plans for significantly reducing the size of the Federal Reserve's balance sheet. The statement outlined the FOMC's intention to reduce the Federal Reserve's securities holdings over time in a predictable manner, primarily by adjusting the amounts reinvested of principal payments received from securities held in the system open market account (SOMA). Specifically, since June 2022, principal payments from securities held in the SOMA have been reinvested to the extent that they exceed monthly caps. For Treasury securities, the cap was initially set at \$30 billion per month and after three months increased to \$60 billion per month. For agency debt and agency MBS, the cap was initially set at \$17.5 billion per month and after three months increased to \$35 billion per month. As shown in Table A4, total securities held outright declined by approximately \$325 billion through November 2022 from their peak amounts.

Once balance sheet runoff has ceased, reserve balances will likely continue to decline at a slower pace – reflecting growth in other Federal Reserve liabilities – until the FOMC judges that reserve balances are at the level required for implementing policy efficiently in an ample regime. At that point, reserve management purchases of securities would likely begin to maintain ample reserves. The FOMC also noted that it is prepared to adjust any of the details of its approach to reducing the size of the balance sheet in the light of economic and financial developments.

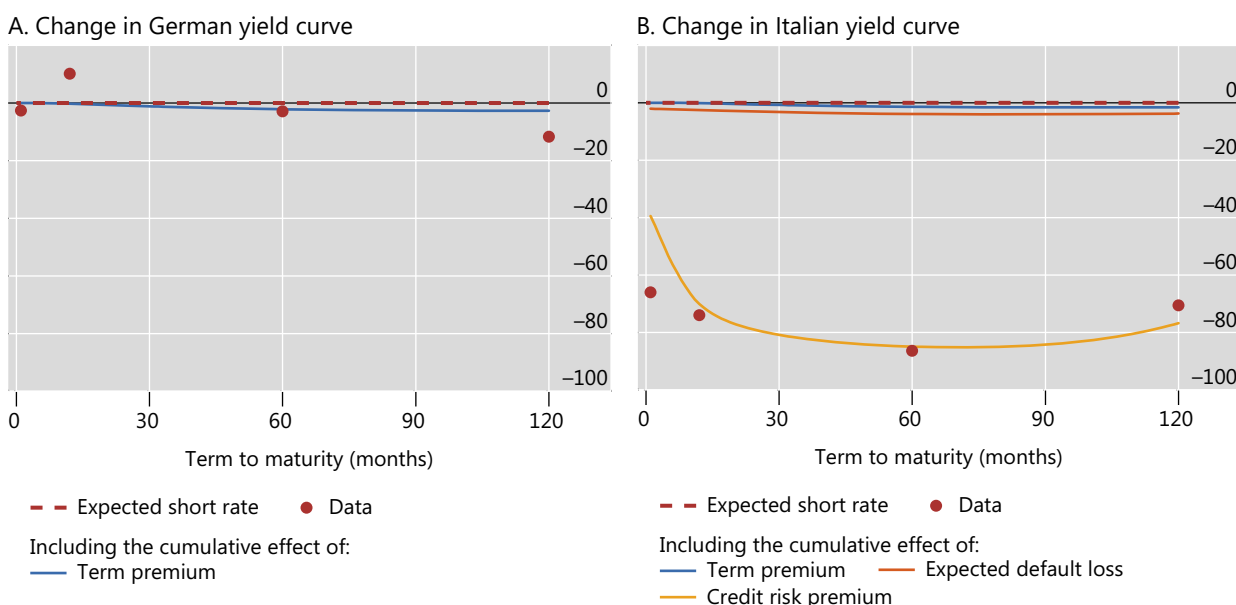
B Yield curve dynamics in the euro area during the Covid-19 crisis

Analysis of APs in large AEs emphasises how they reduced the slope of the yield curve by lowering the term premium. While this may be in line with evidence from economies such as the United States, the United Kingdom or Germany, the Covid-19 crisis has shown that this mechanism does not explain yield curve dynamics in euro area periphery countries such as Italy or Spain. As the dots in Graph B1 show, the ECB's announcement of the PEPP on 18 March 2020 was followed by a small decrease in the slope of the German yield curve (dots in panel A) and a large, roughly parallel downward shift in the Italian yield curve (panel B). This parallel downward shift in the Italian curve – after a similarly parallel upward shift at the onset of the pandemic – cannot be readily explained by “duration risk extraction”, which flattens the yield curve by reducing the term premium but has no impact on the shortest yields.

Decomposition of the impact of PEPP announcement between 18 and 20 March

In basis points

Graph B1



Source: Costain et al (2022).

To better explain euro area yields, Costain et al (2022) extended the influential Vayanos and Vila (2021) term structure model to allow for sovereign default in a monetary union. In the model, sovereign yields can be decomposed into four terms, namely the *expected future interest rates* component and the *term premium*, plus two additional components:

- the *expected default loss*, which is the expected loss due to the possibility of default over the residual life of the bond; and
- the *credit risk premium*, which compensates for the risk in ex post yields due to the possibility of default over the residual life of the bond.

Graph B1 includes a model simulation of the changes in German and Italian yields caused by the PEPP announcement, under the assumption that Italian debt carries default risk, while German debt is non-defaultable, which implies that the last two yield components are exactly zero for German bonds. Consistent with the data, the effects of the PEPP announcement include a small decline in the slope of the German yield curve (solid blue line, panel A) and a large, mostly parallel downward shift of the Italian curve (solid yellow, panel B).

In the structural model, arbitrage links the four yield components, making them empirically comparable. Quantitatively, the estimated model implies that changes in the credit risk premium are the main force driving the impact of APs on euro area peripheral yields. In line with conventional theory, the flattening of the German curve is driven by the term premium, which also declines in Italy. In addition, the PEPP announcement causes a small decrease in the expected default loss on Italian bonds, of roughly three basis points, seen as the distance between the solid-blue and solid-orange lines in panel B of Graph B1. However, the overwhelming majority of the shift in Italian yields, of roughly 80 basis points, is due to a decline in the credit risk premium. Hence, the main transmission channel from APs to euro area peripheral yields could be described as *default risk extraction*, whereby Eurosystem purchases of peripheral sovereign bonds reduce the quantity of defaultable debt that private investors must absorb, inducing a decline in risk premia and a reduction in the fiscal pressure on peripheral governments. These two effects reinforce each other to jointly shrink the credit risk premium.

The default risk extraction channel holds lessons for AP programme design in the euro area. In particular, a flexible design that permits greater purchases at times or in jurisdictions where default risk is greatest will increase the impact of the purchases, both on the yield curve of the sovereign issuer and on the aggregate yield curve of the euro area.

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Central banks of the respective countries contributed the summaries in Appendix A.