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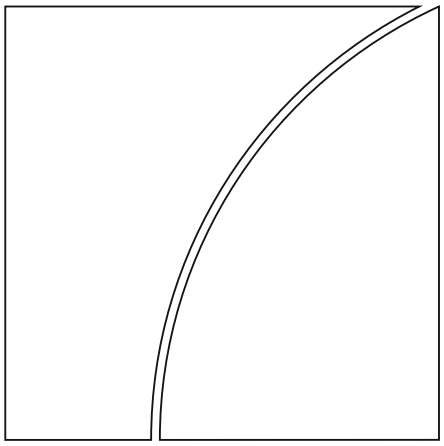

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Non-bank financial institutions and the functioning of government bond markets

by Egemen Eren and Philip Wooldridge

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Keywords: financial intermediation, market liquidity, leverage, hedge funds, principal trading firms, government bonds.

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Non-bank financial institutions and the functioning of government bond markets

Egemen Eren and Philip Wooldridge[1]

Abstract

The structure of market making in government bond markets has shifted from a bank-centric model to a hybrid one in which non-bank financial institutions, notably principal trading firms and hedge funds, play an important role alongside banks. This shift has occurred in several countries and, while farthest advanced in liquid segments, is also evident in less liquid segments. The turmoil in March 2020 highlighted structural vulnerabilities arising from the hybrid model and the procyclical behaviour of some non-bank financial institutions. Proposals for improving the resilience of liquidity in government bond markets aim to reduce demand for liquidity during stress episodes, increase intermediation capacity and improve the efficiency of intermediation.

JEL classification: G15, G23, G28.

Keywords: Financial intermediation, market liquidity, leverage, hedge funds, principal trading firms, government bonds.

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Contents

1. Introduction

The variety of non-bank financial institutions (NBFIs) active in government bond markets, and the roles they perform, have changed substantially in advanced economies (AEs) and emerging market economies (EMEs) over the past decade. The influence of end-investors (eg pension funds, insurance companies, open-ended mutual funds, exchange-traded funds) and arbitrageurs (eg hedge funds) on market dynamics has increased. Moreover, the structure of market making has changed. Bank dealers have reduced the balance sheet space they devote to market making, and technological innovations have increased the speed at which trades can be executed on fully automated platforms. These changes have boosted the participation of new liquidity providers, such as principal trading firms (PTFs).

Amid such changes, liquidity conditions have become increasingly fragile (CGFS (2016)). The market turmoil of March 2020 was an extreme example of stressed conditions in AE and EME government bond markets. It was the most recent of a series of episodes that highlighted the fragility of market liquidity, including gyrations in the Japanese government bond (JGB) futures market in March 2014, the flash rally in the US Treasury market in October 2014, the German bund tantrum in May 2015, and the September 2019 ructions in US repo markets (Annex A).

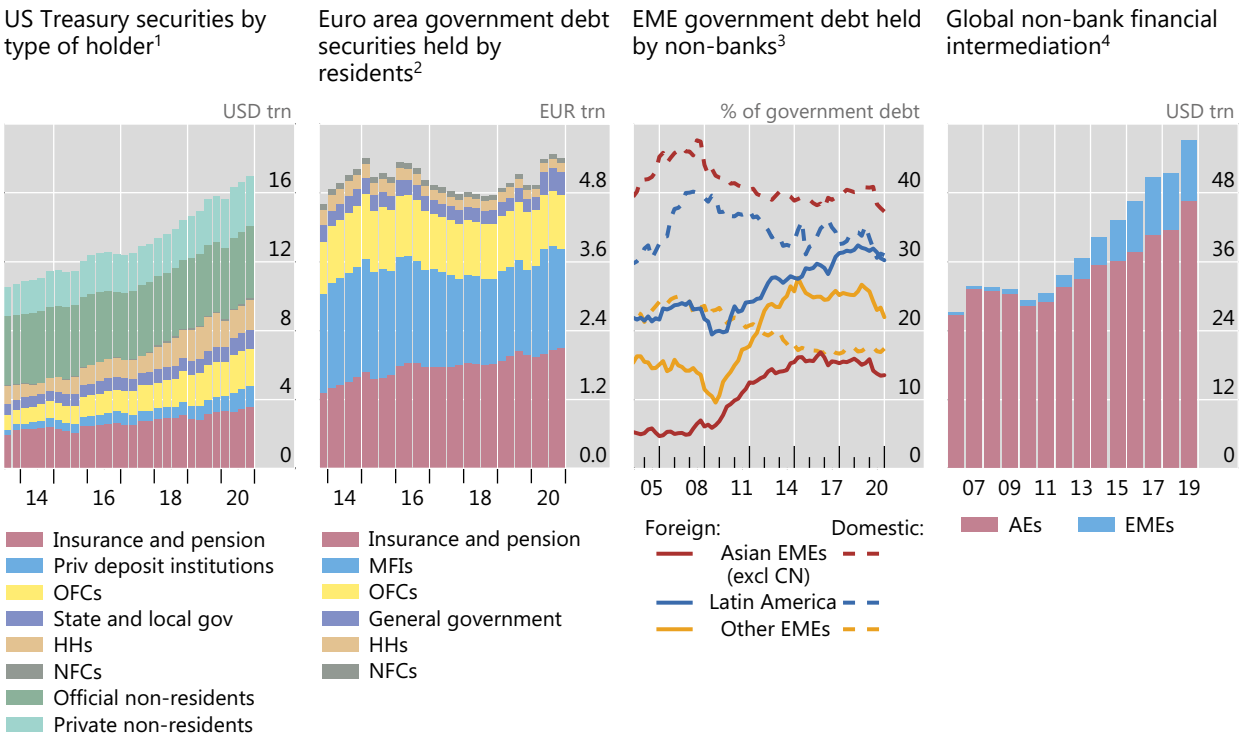
This paper assesses how changes in the composition of market participants and the structure of market making have affected the functioning of government bond markets. It first describes the types and strategies of NBFIs active in government bond markets in different countries. It then explains the channels of stress, amplification and spillovers arising from NBFIs' activities, primarily through the lens of the March 2020 market turmoil. Finally, it outlines proposals that have been made to improve the resilience of liquidity conditions.

2. The role of NBFIs in government bond markets

The footprint of NBFIs, as both end-investors and arbitrageurs, has risen in government bond markets, albeit with differences across jurisdictions. In the United States, domestic NBFIs hold a significant fraction of government bonds. Foreign holdings of US Treasuries are also significant (Graph 1, first panel). While official institutions make up the lion's share of foreign holdings, foreign private institutions' holdings are also large. In the euro area, domestic NBFIs hold a substantial share of outstanding bonds (second panel). Foreign holdings of euro area assets are also large, but the share of the euro in global foreign exchange reserves and some foreign private portfolios has declined in recent years (ECB (2021)). In EMEs, foreign non-banks increased their holdings of government bonds substantially in the first half of the 2010s, but their share has declined in recent years. Domestic non-banks' holdings of EME government debt have also slightly declined recently (third panel).

Rising role of NBFIs in government bond markets

Graph 1



HHs = Households; Insurance and pension = Insurance companies and pension funds; MFIs = Monetary financial institutions; NFCs = Non-financial corporations; OFCs = Other financial corporations; Asian EMEs = ID, IN, MY, PH, and TH; Latin America = AR, BR, CL, CO, MX, PE, and UY; Other EMEs = BG, EG, HU, LT, LV, PL, RO, RU, TR, UA, and ZA.

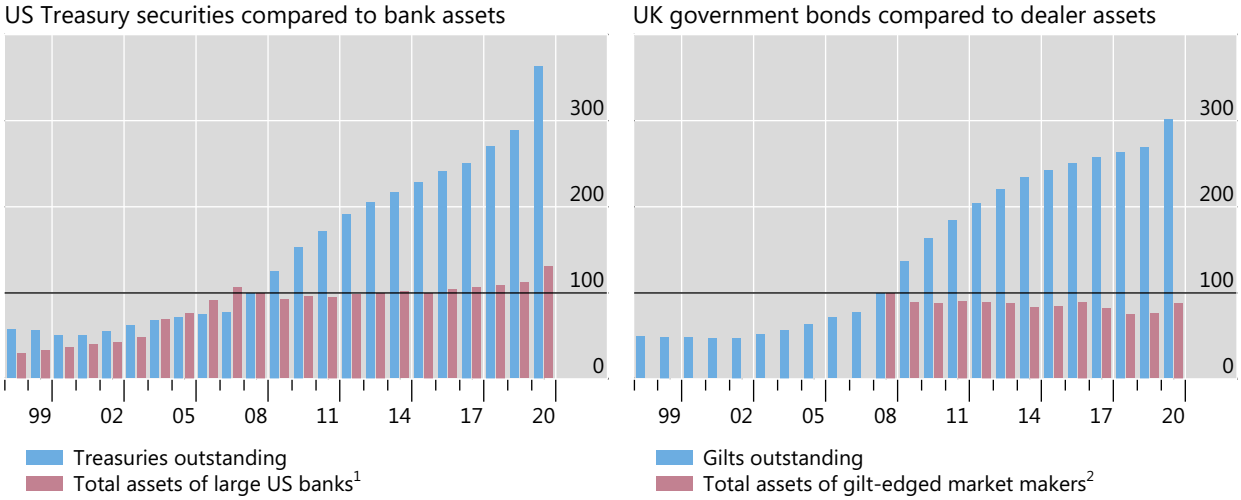
[1] Excludes Federal Reserve holdings. [2] Euro area holders of general government debt securities issued by euro area countries. Excludes central bank holdings. Sum of short- and long-term securities. If value not reported, assumed to be zero. [3] As a share of total general government gross debt. Simple average across each country's individual shares. [4] Narrow measure of non-bank financial entity types that authorities have assessed as being involved in credit intermediation activities that might pose bank-like financial stability risks and/or regulatory arbitrage; based on the 29-Group in the FSB's Global Monitoring Report on Non-Bank Financial Intermediation, net of prudential consolidation into banking groups.

Sources: ECB; Federal Reserve; Arslanalp and Tsuda (2014); IMF, *Sovereign Debt Investor*; FSB, *Global Monitoring Report on Non-Bank Financial Intermediation 2020*; BIS calculations.

The rising participation of NBFIs in government bond markets partly reflects the growing importance of NBFIs in the financial system (Graph 1, fourth panel). In addition, in some markets NBFIs are filling the roles traditionally played by banks. For example, in the United States and United Kingdom, the outstanding stock of government bonds has increased faster than the aggregate size of bank dealers' balance sheets, which points to the increased presence of non-bank players in these markets (Graph 2). The participation of non-bank players is rising in other countries' markets too.

Supply of government bonds increased faster than bank dealers' assets

Amounts outstanding, 2008 = 100 Graph 2



[1] Total assets for the holding companies of Bank of America, Bear Sterns, Citigroup, Goldman Sachs, JPMorgan Chase, Lehman Brothers, Merrill Lynch, Morgan Stanley and Wells Fargo. [2] Based on quarterly averages available from 2008, excluding assets of banking entities authorised to operate in the UK through branches. For 2020, Gilts outstanding as of end-March 2020.

Sources: Duffie (2020); Hauser (2021), updated with latest data.

Different types of NBFIs can be classified into three broad categories: end-investors, arbitrageurs or liquidity providers. Some institutions perform more than one of these roles. The extent of participation by different types of NBFIs depends on – and in turn also influences – the size and liquidity of the market, the risk and return on government bonds, and the presence of arbitrage opportunities. The influence of these different types of NBFIs on government bond markets varies according to their strategies, vulnerabilities and the pro-cyclicality of their activities. In addition to differences in the influence of various types of NBFIs, an important question is how their influence differs from that of banks.

2.1 NBFIs as end-investors

NBFIs that are active in government bond markets as end-investors include pension funds, insurance companies, mutual funds, reserve managers, sovereign wealth funds and exchange traded funds (ETFs). While the investment strategies of each of these investors differ in important ways, they tend to follow long-only strategies and some track benchmark indices.

Pension funds and insurance companies are often major holders of government bonds. They typically have long-dated liabilities and therefore in their domestic currency portfolios are not subject to risks arising from liquidity mismatches. These investors are usually more active at the longer end of the yield curve. Over the past decade, those domiciled in jurisdictions with low interest rates have stepped up their cross-border investment in a search for yield (CGFS (2018), CGFS (2020)). They often use FX swaps to hedge the resulting currency exposures, which makes them vulnerable to disruptions in dollar funding markets.

Some other types of NBFI end-investors, such as open-ended mutual funds, typically promise daily redemptions and operate with a certain degree of liquidity mismatch. These characteristics lead to a first mover advantage in redemptions and make these funds vulnerable to runs. If these funds hold a mix of illiquid assets combined with more liquid government bonds, they might sell more liquid bonds first to raise liquidity in the face of redemptions (Huang et al (2020)). This might generate an externality and add to sales pressures in the aggregate.

Government bond ETFs can be traded intraday and tend to track benchmark indices. They are bought and sold on exchanges and thus are not subject to liquidity risk stemming from redemptions, in contrast to open-ended mutual funds. Market stress can disrupt the relationship between the intraday prices and net asset values of ETFs (Aramonte and Avalos (2020)). A specific feature of bond ETF arbitrage mechanism is the low overlap between the basket of bonds used to create or redeem shares and actual asset holdings. Even though this might undermine arbitrage forces, it allows ETFs to absorb shocks and withstand market stress (Todorov (2021)).

Finally, reserve managers are large holders of government bonds, especially those that are typically considered safe-haven assets. In periods of heightened uncertainty, they might sell these more liquid safe-haven assets to raise precautionary FX liquidity for possible intervention in FX markets. If these sales are synchronous and exacerbate imbalances in order flow, they can contribute to a downward spiral in prices and have knock-on effects on market functioning.

2.2 Hedge funds and similar investment vehicles

Hedge funds and similar investment vehicles (eg leveraged mutual funds) typically operate with more leverage than other NBFIs. They tend to be important players in government bond markets that have well developed repo and derivatives segments, where leverage can be built up. Hedge funds' leveraged holdings serve to warehouse government bonds, and their investment strategies can improve market efficiency and price discovery in normal times. However, strategies that expose hedge funds to rollover risk might contribute to market illiquidity during stress episodes. While their involvement in government bond markets is not new, hedge funds' rapid expansion in recent years is likely to have increased their market impact.

Relative value strategies that combine long and short positions, and thereby minimise market risk, tend to be the most common ones followed by leveraged funds in government bond markets. Strategies that aim to exploit the mean reversion tendency of prices are generally less risky, and thus hedge funds that engage in them typically employ leverage to magnify the returns. Annex B outlines examples of leveraged investors' strategies.

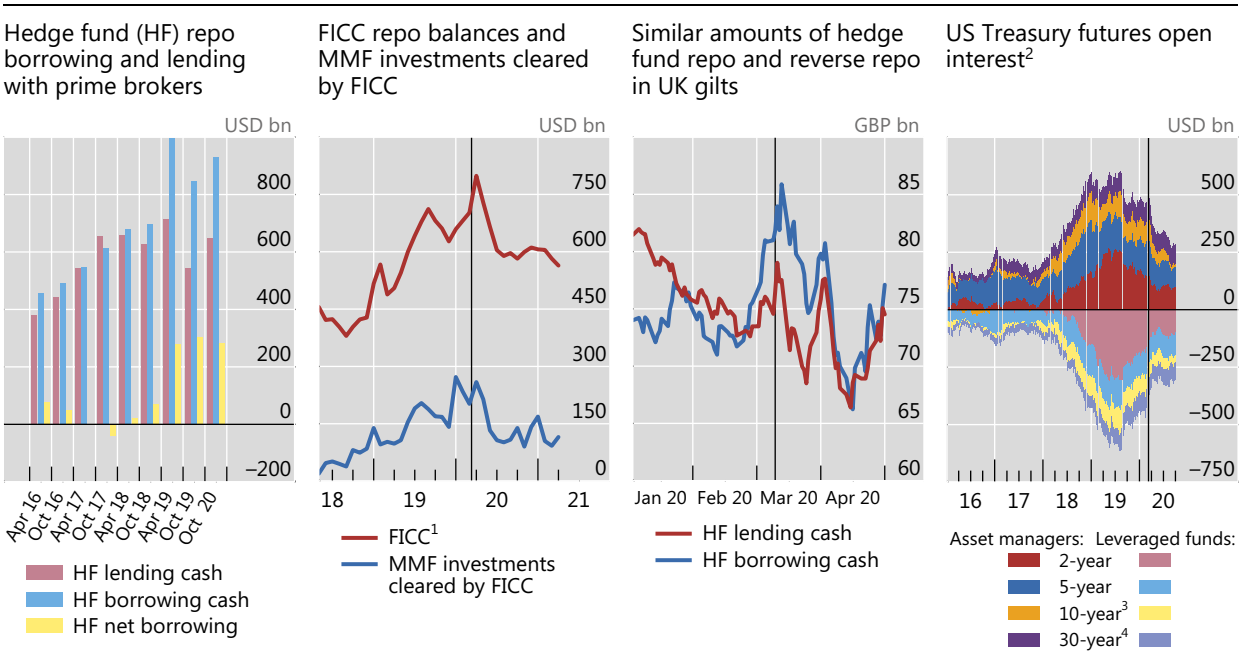
Relative value investors can achieve high levels of leverage due to the perceived safety of these trades and the high collateral value of government bonds.[2] At the same time, since these trades require high leverage to be profitable, they also tend to be more balance sheet intensive, and small price moves in the opposite direction could easily trigger margin calls.

[2] They can often achieve higher leverage through portfolio margining, where margin is required based on the riskiness of the portfolio rather than the long and short positions separately.

To conduct relative value trades, leveraged players obtain funding mainly through prime brokers and repo markets. In recent years, the repo funding obtained by hedge funds from prime brokers has increased (Graph 3, first panel). Hedge funds also obtain repo funding from bank dealers, smaller banks or even money market funds through cleared repo (second panel). To conduct term structure arbitrage trades within the same asset class, it is possible to fund one security using a repo and take a short position in another using a reverse repo. Repo volumes in UK gilt markets are suggestive of this kind of inter-curve relative value strategy, with similar amounts of repo and reverse repo activity by hedge funds (third panel).

Sources of leverage and interlinkages across NBFIs and market segments

Graph 3



Solid vertical lines in the centre-left, centre-right and right-hand panels correspond to 9 March 2020.

[1] Fixed Income Clearing Corporation (FICC); calculated as the volume reported under Secured Overnight Financing Rate minus the volume of the Tri-party general collateral market. Monthly values calculated as average of daily observations [2] Net notional amount of open interest. [3] Includes 10-year Ultra Treasury note futures. [4] Includes Ultra Treasury bond futures.

Sources: Bank of England, *Hedge Fund as Counterparty Survey*; Federal Reserve Bank of New York; Office of Financial Research; US Treasury Department; BIS calculations.

The rising participation of hedge funds in part reflects shifts in the business models of banks. Prior to the Great Financial Crisis (GFC), banks would often execute relative value or other such leveraged trades through their proprietary trading desks. Since the GFC, they have instead provided financing to hedge funds. Through their arbitrage activities, hedge funds partly took over from banks the role of warehousing securities.

Leveraged strategies link together various market participants. These links are illustrated by the mechanics of the cash-futures basis trade for US Treasuries. In the run-up to the March 2020 turmoil, asset managers took long futures positions across the yield curve (Graph 3, fourth panel) due to the lower balance sheet costs of futures positions compared with cash positions. This created a wedge between the prices of similar securities, which pushed up the prices of futures compared with cash bonds, the so-called cash-futures basis. Hedge funds aimed to generate arbitrage-like profits

by taking short positions in Treasury futures across the yield curve (fourth panel) and long positions in similar cash Treasuries, leveraging them with funding from repo markets. In other words, hedge funds provided liquidity to markets by taking the other side of the large futures positions of asset managers and simultaneously buying off-the-run securities. At its peak, the cash-futures basis trade made up as much as half of hedge funds' Treasury positions and around a quarter of dealers' repo lending (Barth and Kahn (2021)).

The March 2020 episode highlighted the trade-off between the benefits of such strategies and the risks arising from the use of leverage to conduct them. In normal times, such basis trades helped maintain a stable relationship between the prices of futures and off-the-run securities. However, the maturity of the short futures positions exceeded the maturity of the repo borrowing, creating a rollover risk (FSOC (2020)).

2.3 Principal trading firms

With the growth of electronic trading and technological innovations, a diverse set of smaller NBFIs known as PTFs have become important liquidity providers in financial markets, including in some government bond markets. PTFs employ automated and often high-frequency trading strategies in electronic trading venues and typically trade on their own account.

The strategies employed by PTFs are well suited to certain markets but not all.[3] By and large, PTFs trade in secondary markets and do not have access to the primary market. Their typical strategy involves high-frequency trading in deep, highly liquid, electronic markets with a central limit order book (CLOB). PTFs' strategies are characterised by the generation of a large number of orders, the holding of positions for very short periods (often for less than a second) and the cancellation of a large share of orders that they generate (Markets Committee (2016)). Such strategies are not well-suited to illiquid markets since PTFs usually aim to offload any inventory quickly. These strategies are also less suitable for markets with "request-for-quote" (RFQ) characteristics, such as the dealer-to-customer segment of cash government bond markets (Brain et al (2018)). That said, some PTFs have a customer-facing business, and their strategies are evolving and getting more complex.[4]

PTFs and bank dealers differ in how they provide liquidity to markets. PTFs trade large volumes intraday, often using intraday leverage obtained from prime brokers and banks. This contrasts with bank dealers, who carry large long or short positions over longer periods, including securities warehoused for their customers. Business models of PTFs typically compete on speed, rather than holding an inventory of illiquid securities and charging customers for immediacy services as bank dealers do. PTFs are generally thinly capitalised compared to bank dealers. They are also subject to less stringent supervisory and regulatory frameworks than broker-dealers and

[3] Even if PTFs are currently not active in some markets, they might start participating as the liquidity and depth of these markets increase. Therefore, markets where PTFs are active market participants could offer lessons for other markets.

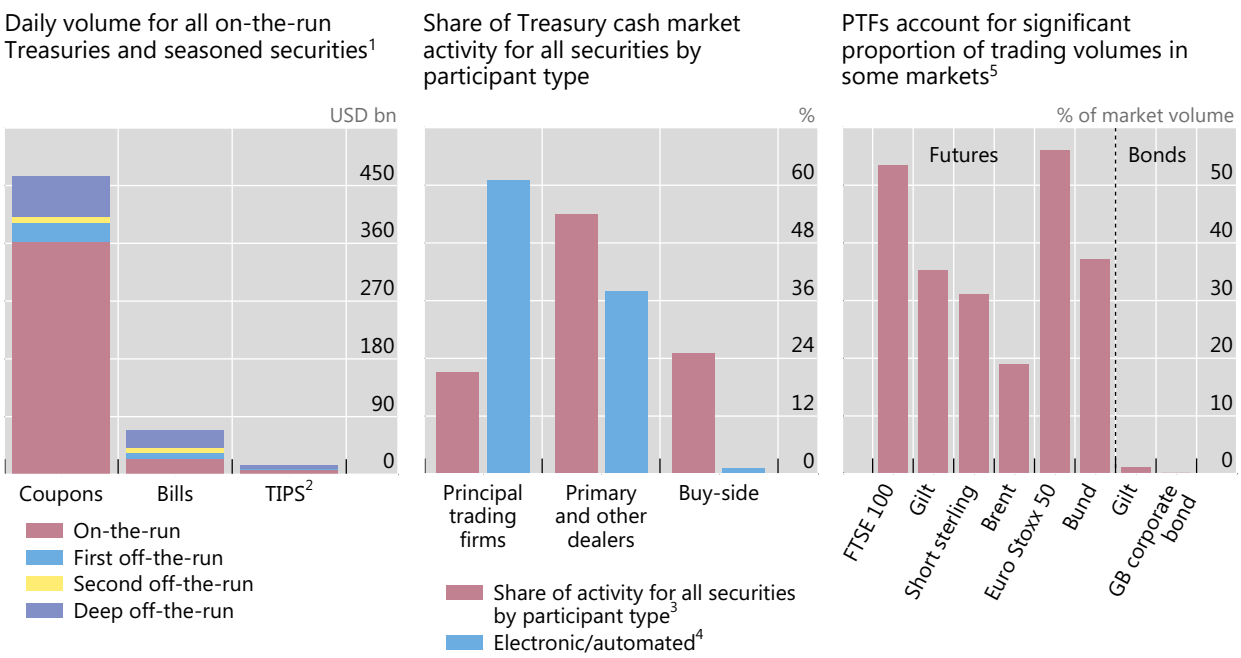
[4] Some PTFs are beginning to stream quotes directly through existing RFQ platforms and offset the trading flow on an anonymous CLOB platform, if needed. However, unlike bank dealers, those PTFs involved in the dealer-to-customer segment do not trade on behalf of customers or provide balance sheet space to warehouse customers' securities.

depository institutions. That said, bank dealers also employ high-frequency and automated strategies, so the differences in business models might shrink over time.

There are significant differences in the activities of PTFs in government bond markets across jurisdictions. These arise from differences in market liquidity and market structure. In US Treasury markets, PTFs are important providers of liquidity in both cash and futures segments. In the cash segment, they are particularly important for on-the-run securities, which account for most trading of US Treasuries (Graph 4, first panel). While PTFs account for around 20% of overall US market trading volume, they are dominant players in electronic/automated markets, where they account for 60% of the trading volume (second panel). In other AE government bond markets, such as Canada, Germany, and the United Kingdom, they are mostly active in the more liquid futures markets, whereas they account for a much smaller share of trading in cash markets (third panel; see also Scheicher (2021)). In the euro area, the fragmented nature of government bond markets, lower electronification rates, ubiquity of slow-paced RFQ platforms and reliance of governments on primary dealer networks represent barriers to entry for NBFIs, including PTFs.

Importance of PTFs differs across different markets

Graph 4



[1] Sample from 1 August 2017 to 31 July 2018. [2] Treasury inflation-protected securities. [3] Shares of trading volume by participant type for the entire cash Treasury market from 1 April to 31 December 2019. [4] Shares of trading volume for nominal coupon securities on Treasury IDB platforms from 1 April to 31 December 2019. [5] Average share of total market volume for October and November 2018. Long gilt futures shown for the period 1 October to 13 November 2018 to avoid futures contract roll.

Sources: Bank of England *Financial Stability Report, July 2019*, Brainard (2018); Harkrader and Puglia (2020a).

The participation of PTFs in government bond markets can benefit market liquidity and overall market functioning. PTFs act as competitors to bank dealers and keep bid-ask spreads tight. They also contribute to the incorporation of information into prices. PTFs lack access to the information contained in customer order flow. Instead, they rely on big data analysis and pattern recognition, and they generate and execute trades very rapidly. Greater PTF involvement might also improve the market

making activities of bank dealers by helping them offset directional positions that remain after matching customer positions (Kirk et al (2014)).

Increased reliance on PTFs for liquidity provision raises several concerns. Unlike PTFs, bank dealers serve customers, are concerned about risks to their reputation and, in some jurisdictions, those designated as primary dealers have an obligation to make markets. PTFs generally do not have comparable long-term interests and so their liquidity provision during stressed market conditions might be more fragile. That said, PTFs in some jurisdictions might also have obligations towards trading venues, such as maintaining bid-ask spreads below a threshold. They might also have reputational concerns if they act as authorised participants for bond ETFs. Moreover, since prime brokers and banks sometimes finance PTFs' intraday positions and provide clearing services, any potential stress at PTFs, prime brokers or banks might have spillover effects (Bank of England (2019)). Finally, market intelligence suggests that PTFs sometimes use information about past patterns and correlations between different markets to predict the direction of very short-term price movements. This might make them more sensitive to a breakdown in correlations between different markets rather than episodes of volatility.

There was a large discrepancy between the behaviour of bank dealers and PTFs during the October 2014 flash rally in the US Treasury market. During the event, bank dealers did not change their quoted depth materially but raised their bid-ask spreads substantially, whereas PTFs held spreads steady but sharply reduced quoted depth (Joint Staff Report (2015); see also Annex A). As a result, published prices by PTFs might not have been very useful for market participants that wished to trade in size.[5]

3. Channels of amplification and spillovers through the lens of the March 2020 market turmoil

A well-functioning market is one that allows timely, efficient market access to participants who wish to buy or sell assets and obtain funding, and that creates price signals that allow for an efficient allocation of resources. Such a market needs to be liquid and resilient to ensure that trading takes place in a timely and efficient manner, even during periods of heightened financial stress (Markets Committee (2019)).

Market dysfunction might arise if these conditions are not met. Unidirectional selling or buying pressures in an illiquid market could lead to stress or the complete drying-up of liquidity even in the absence of leveraged players. Leverage can amplify market illiquidity and stress. If an investor had funded a position in an asset with leverage, price declines could threaten the investor's solvency, leading to a margin call or the fire sale of the asset at the extreme. Fluctuations in leverage due to changes in margins can be a key channel through which NBFIs propagate systemic risks (Aramonte et al (2021)). Without liquidity providers who can absorb sales and stabilise prices, a feedback loop might develop where price declines beget more sales, leading to further price declines (Brunnermeier and Pedersen (2009)).

[5] Liquidity in a market can be judged by several different metrics, such as bid-ask spreads, market depth, price impact or order book replenishment rates. For a discussion of different metrics and their relation to PTF activity, with a focus on the October 2014 flash rally and the March 2020 turmoil, see Joint Staff Report (2015), Fleming and Ruela (2020) and Dobrev and Meldrum (2020).

The role of leverage in amplifying market stress depends on its maturity and degree of procyclicality. The maturity of pension funds' and insurance companies' liabilities tends is longer term and so rarely exacerbates episodes of market illiquidity. Hedge funds and PTFs rely on leverage that is much shorter term, often overnight in the case of hedge funds and intraday for PTFs. This exposes them to significant rollover risks. Consequently, they tend to shrink their balance sheets when funding becomes more expensive or less available, which potentially exacerbates stress by reducing their capacity to provide liquidity and warehouse securities.

Spillovers across different markets and across borders can occur through several channels. First, stress in government bond markets can spill over to other markets because government bonds are often used as a benchmark for other rates in the economy or as collateral. Second, in times of stress or to meet margin calls, investors could first sell more liquid government securities to generate cash, contributing to pressures in government bond markets (Huang et al (2020)). Third, a deterioration in NBFIs' liquidity positions could lead to a general de-risking and sales of cross-border holdings of government bonds (CGFS (2020)). NBFIs' use of FX swaps to hedge currency mismatches in their cross-border investments are another important channel of spillovers. If market stress coincides with a large rollover of FX swaps, widening FX swap basis increases the costs of hedging, as was seen following the outbreak of the Covid-19 crisis (Avdjiev et al (2020)).

3.1 US Treasury market

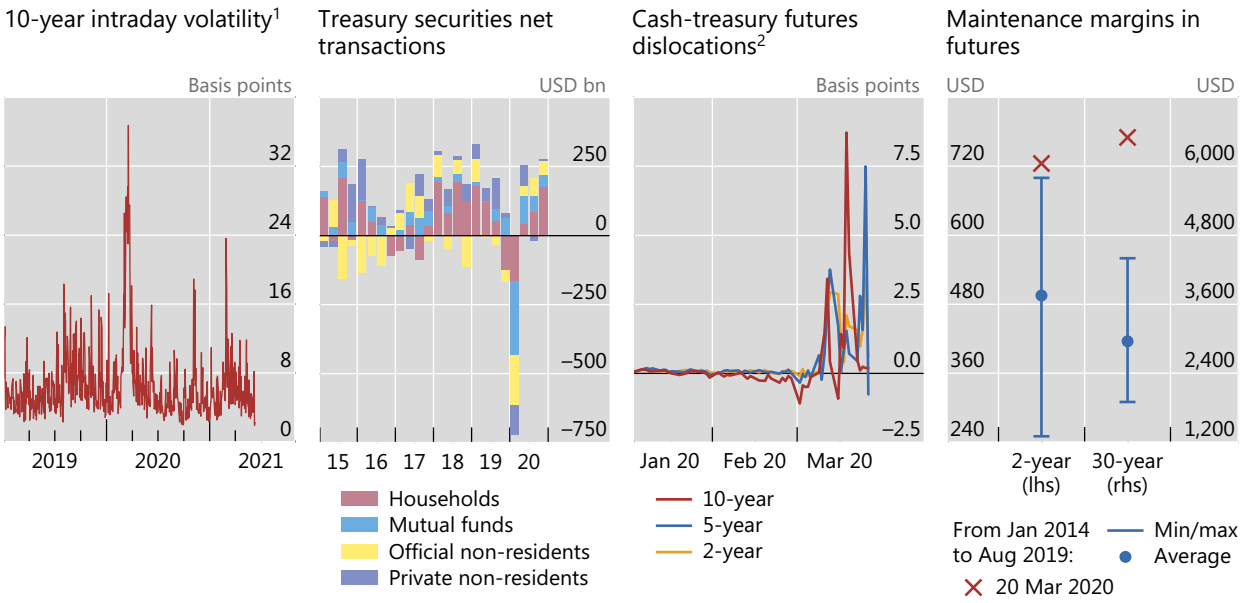
Prior to the March 2020 turmoil, intermediation in the US Treasury market had developed into a hybrid structure, with bank dealers, hedge funds and PTFs all playing a part. Bank dealers had stepped back somewhat from warehousing risk (though still performed this role), increasingly matching buyers and sellers in an agency role due to regulatory changes and capital pressures. PTFs had grown to dominate more liquid parts of the market, while hedge funds effectively fulfilled a warehousing role. Banks remained important providers of leverage to hedge funds and PTFs.

The Covid-19 shock led to one-sided trading flows to dealers because in aggregate all types of investors – leveraged and unleveraged NBFIs alike – sought to increase the liquidity of their portfolios by selling US Treasuries (Graph 5, first and second panels).[6] Uncertainty about fund redemptions induced an unusual "dash for cash" by open-ended mutual funds (Schrimpf et al (2021)). Reserve managers and other official institutions also sold to raise precautionary liquidity. A significant portion of sales by non-US institutions were by private entities domiciled in offshore financial centres, suggestive of sales by hedge funds and similar leveraged investors.

[6] During the "dash-for-cash" in March, many investors sold more liquid assets first, which added to the selling pressure on US Treasuries. This effect was more pronounced for dollar assets than for other currencies (Cesa-Bianchi and Eguren-Martin (2021)). Cash obtained from sales was invested in money market funds that invest in short-term Treasury bills (Eren et al (2020)), resulting in different dynamics across the yield curve.

March 2020 turmoil in US Treasury markets

Graph 5



[1] Calculated as daily high yield minus daily low yield on 10-year generic Treasury notes. [2] Implied repo rates of cheapest-to-deliver bonds in Treasury futures minus the one-month General Collateral market repo rates.

Sources: Federal Reserve; Bloomberg; CME; JP Morgan Chase; BIS calculations.

The procyclical behaviour of bank dealers and NBFIs exacerbated stress in US Treasury markets during March 2020. Declining prices led to pressures on investors with leveraged positions on Treasuries. For example, the implied repo rates of the cheapest-to-deliver bonds in futures contracts rose markedly above general collateral repo rates, indicating strains in relative value trades, such as the cash-futures basis arbitrage (Graph 5, third panel). A downward price spiral led to higher margin requirements (fourth panel), in some cases resulting in the forced unwinding of positions and further sales.

Aggregate sales by hedge funds were similar in magnitude to mutual fund sales, but there was significant heterogeneity among hedge funds depending on their degree of leverage. The long Treasury exposures of hedge funds fell by $242 billion in March 2020 (OFR (2020)). Sales by mutual funds in the first quarter of 2020 were $266 billion (Vissing-Jorgensen (2021)). Most of the US Treasury sales by hedge funds during March 2020 were concentrated in the top decile of hedge funds by leverage. These funds reduced their long US Treasury exposures by $203 billion (OFR (2020)). Margin pressure was greater for hedge funds trading predominantly the cash-futures basis (Kruttli et al (2021)); these funds reduced their US Treasury exposures and repo borrowing the most. However, de-leveraging could have been more pronounced had policymakers not stepped in to provide unprecedented support.

Under normal circumstances, liquidity providers would be able to alleviate market stresses by absorbing sales. However, primary dealers' Treasury inventories were already stretched, especially from 2018 onwards, as they needed to absorb a large amount of issuance (Graph 6, first panel). With rising leverage in the run up to the shock, arguably hedge funds' balance sheets were also stretched. During the market turmoil, bank dealers, PTFs and hedge funds were unable or unwilling to keep pace with the surge in liquidity demand in the US Treasury market amid rising risks

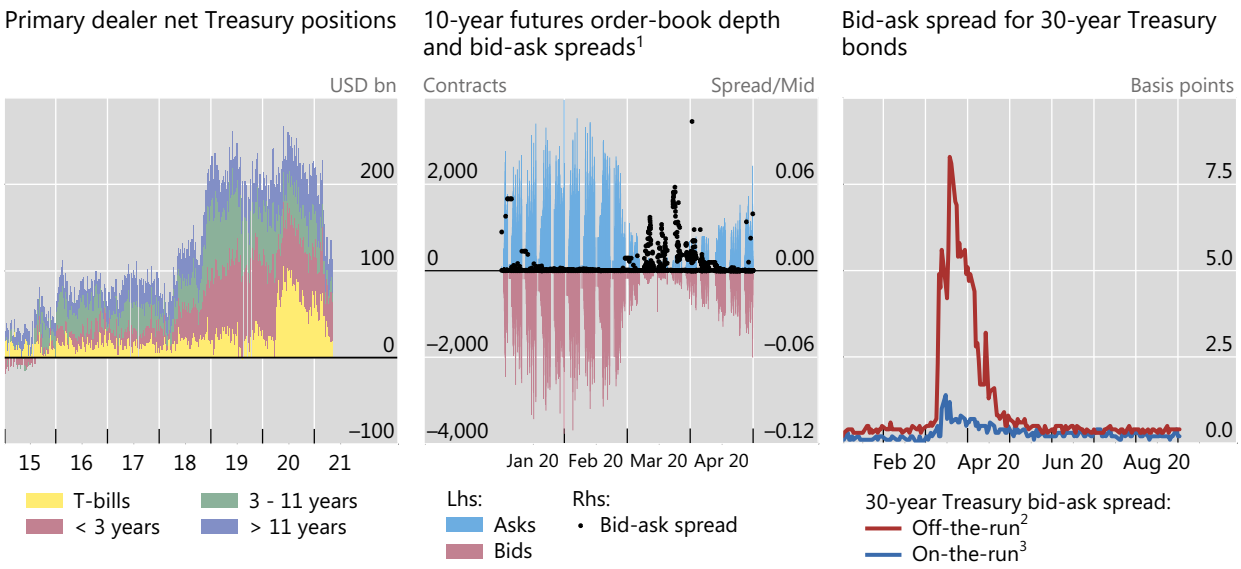
to liquidity provision, resulting in sharp declines in market depth (second panel).[7] For banks the binding constraint was likely internal risk management, hindering the allocation of risk budgets across trading desks in real time, rather than the leverage ratio requirement. Market conditions started to normalise only when the Federal Reserve stepped in and took several measures to support market functioning, including large scale purchases of US Treasury securities (Vissing-Jorgensen (2021)).

Expectations of a pullback in liquidity provision might have become self-fulfilling. In March 2020, dealers might have priced transactions in a risk averse manner and leveraged players might have liquidated their positions earlier given the risk of a pullback in liquidity provision in the market.

Differences in price movements between on-the-run and off-the-run securities provide some additional insights on market liquidity. Volatility occurred in both on-the-run and off-the-run markets; however, the off-the-run market was particularly vulnerable to illiquidity (Graph 6, third panel). This might be due to a combination of factors such as sales by reserve managers or hedge funds being concentrated in off-the-run bonds, combined with the fact that bank dealers' intermediation capacity was limited during the turmoil. Bank dealers tend to have a larger role as market makers for off-the-run securities. Buyers reportedly also experienced difficulties purchasing bonds, particularly deep off-the-run securities, suggesting that intermediation capacity was impaired.

Intermediation capacity and market liquidity during March 2020

Graph 6



[1] Hourly frequency, 1 January–30 April 2020, Chicago Board of Trade. [2] Off-the-run 30-year Treasury on 1 Oct 2019. [3] Generic 30-year Treasury.

Sources: Federal Reserve Bank of New York; Refinitiv; Bloomberg; BIS calculations.

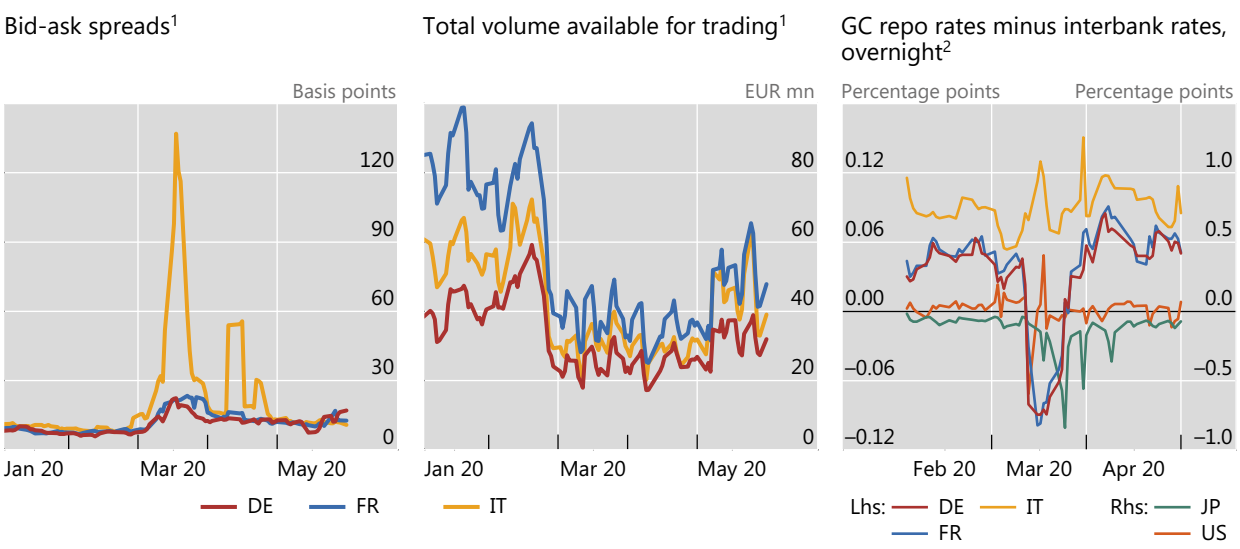
[7] For details and other measures of liquidity such as price impact or order-book replenishment rates during March 2020, see Dobrev and Meldrum (2020) and Harkrader and Puglia (2020b).

3.2 Other AE government bond markets

Market liquidity also deteriorated significantly in other AE government bond markets. Like the United States, the United Kingdom experienced a "flight to safety" followed by an abrupt and extreme "dash for cash" (Czech et al (2021)). Leveraged trading in gilts was less prevalent than in US Treasuries prior to the crisis, and in aggregate hedge funds bought gilts throughout the flight to safety and dash for cash periods. Nevertheless, selling by other NBFIs such as pension funds drove gilt yields up sharply and strained market functioning (Hauser (2020), Hall (2021)).

In the euro area, bid-ask spreads spiked across the board, especially for government bonds of peripheral economies (Graph 7, first panel). At one point bid-ask spreads on Italian bonds exceeded 120 basis points. The volume available for trading moved in lockstep across countries (second panel) and started to fall shortly after the introduction of measures to contain the virus (Moench et al (2021)).

Market liquidity and "dash for collateral" in other AE government bond markets — Graph 7



[1] For 10-year bonds that are eligible for futures contracts [2] For DE, FR and IT the overnight interbank rate is ESTR, for JP it is TONAR and for US it is OBFR.

Sources: Moench et al (2021); Bloomberg; JPMorgan Chase; MTS; BIS calculations.

In Japan, JGB transaction volumes dropped significantly and bid-ask spreads increased sharply (Bank of Japan (2021)), induced by selling pressures from foreign investors including NBFIs. Yields on 10-year JGBs rose temporarily, but the increase was relatively limited compared to other AEs, supported by domestic investors' purchases and the Bank of Japan's unscheduled purchases under its yield curve control policy. In Canada, trading volumes rose amid impaired market liquidity conditions, yet market functioning remained orderly (Fontaine et al (2021)).

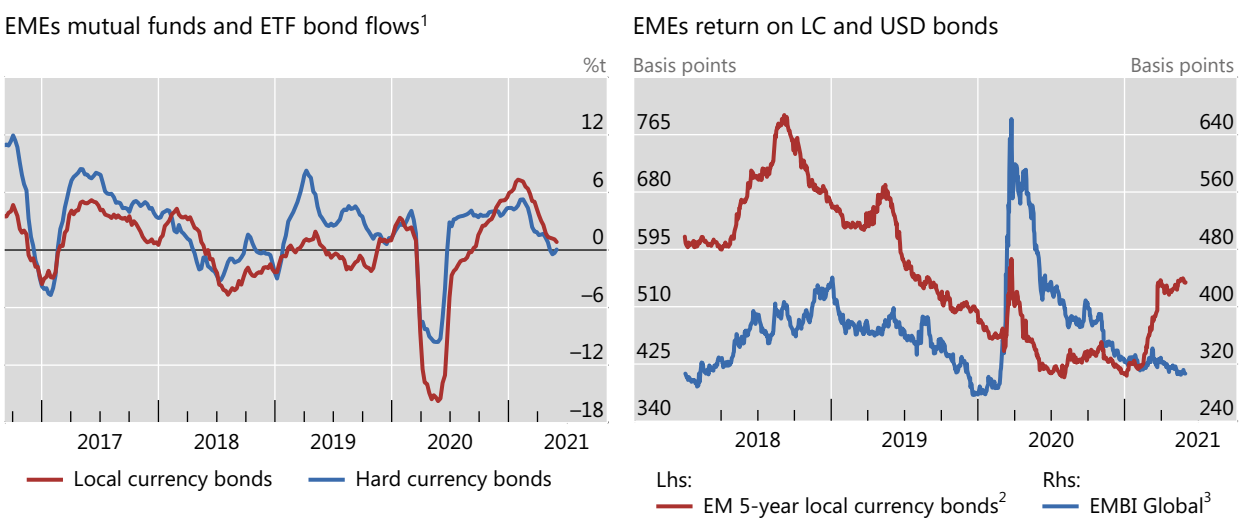
While a "dash for cash" took place in all jurisdictions due to heightened economic uncertainty, collateral scarcity attenuated pressures in those AEs that saw increased demand for government bonds as collateral. There was a sharp decline in the repo rate for government bonds in Japan, Germany and France at the end of March (Graph 7, third panel). That is, borrowers in the repo market were willing to pay a 'specialness premium' to receive Japanese, German or French sovereign bonds as

collateral, resembling a "dash for collateral" in part due to a scarcity of safe government bonds (Moench et al (2021)). Other factors such as lower sales of these bonds by reserve managers, limited participation by leveraged players compared with the US Treasury market, or demand for collateral to pledge for dollar swap lines might have also contributed to differences in experiences across jurisdictions.

3.3. EME government bond markets

EMEs were hit hard during the initial market turmoil. Mutual funds and ETFs investing in EME assets saw large outflows, especially those that invested in local currency government bonds (Graph 8, first panel). Changes in local currency bond yields were muted compared to changes in international bond yields, despite larger outflows from the former (second panel). This difference might be in part because EMEs had room to pursue countercyclical monetary policy during the Covid-19 shock. Furthermore, monetary policy easing in AEs eased initial pressures in EMEs by reducing the tail risks and incentivising private capital to flow back into the EMEs.

EME bond flows and yields — Graph 8



[1] Thirteen week rolling sum of weekly bond flows as a share of total net assets. [2] GDP-weighted average of 5-year government bond yields of BR, CL, CO, HU, ID, KR, MX, MY, PE, PL, TH, TR and ZA. [3] EMBI Global (USD-denominated) stripped spread.

Sources: IMF *World Economic Outlook*; Datastream; EPFR, JPMorgan; BIS calculations.

In EMEs, structural improvements over the past decade arguably strengthened their resilience. Policymakers in many EMEs made efforts to develop local currency government bond markets, while improvements in macroeconomic policies and the resilience of the domestic financial system made local currency debt more attractive to foreign investors (CGFS (2021)). The development of FX spot and derivatives markets has been an integral part of these efforts.

At the same time, a key lesson from the March 2020 episode was that borrowing through local currency bonds did not fully insulate EMEs from global financial shocks. When foreign investors have a large presence in local currency government bond markets, a feedback loop between capital outflows and exchange rate depreciations potentially acts as an amplifier, especially if these investors have currency mismatches on their balance sheets.

EMEs with greater foreign ownership of local currency bonds experienced significantly larger increases in their local currency bond spreads during the initial phases of the Covid-19 crisis (Hofmann et al (2020), Hördahl and Shim (2020)). Indeed, foreign mutual funds exhibited a more pro-cyclical pattern of flows than other investors. During the Covid-19 crisis, dollar appreciation amplified the sell-off of local currency bonds but not dollar-denominated bonds (Bertaut et al (2021)). Such pro-cyclical flows act as an amplifier if sales lead to price declines that, in turn, lead to further redemptions, which was the case during March 2020.

4. Improving the resilience of market liquidity

A range of options has been suggested by policymakers, market participants and academics to improve the resilience of liquidity in government bond markets. One set of options aims to reduce demand for liquidity during stressed market conditions. Another set focuses on increasing intermediation capacity. A third set aims to improve the efficiency of intermediation by reforming the trading and clearing infrastructure. Finally, improved data collection and enhanced transparency could help to strengthen the monitoring of market functioning. More generally, the FSB is leading work to enhance the resilience of non-bank financial intermediation (FSB (2020)).

Some proposals aim to change NBFIs' behaviour during stress episodes by enhancing their ability to manage liquidity shocks and reducing their sensitivity to such shocks. For example, liquidity requirements might improve the ability of NBFIs to withstand liquidity shocks, especially NBFIs that are leveraged or engaged in liquidity transformation.[8] Similarly, arranging for callable capital and maintaining robust tail hedging programmes could improve buffers and make it easier to raise capital during a crisis. Measures to reduce the first-mover advantage in fund redemptions, such as swing pricing, could also increase the resilience of markets (Dunhong et al (2021)).

Leverage limits, stronger collateral requirements or through-the-cycle margining could reduce demand for liquidity during stress episodes by decreasing the likelihood that investors would be forced to unwind their positions. Yet, policies that aim to reduce the risks and costs of de-leveraging during stress times need to be weighed against the potential benefits that leveraged trades bring in normal times, such as market efficiency, better price discovery, and the warehousing of government bonds.

Cross-margining between trading venues could lead to less punitive margin calls in stress times. Cross-margining would reduce gross margin flows in stress and be especially useful for relative value trades combining long and short positions, such as the cash-futures basis. However, experience to date suggests that it can be difficult to operationalise cross-margining.

Another set of proposals focuses on the intermediation capacity in government bond markets. As a result of fiscal stimulus during the Covid-19 crisis, total government debt has increased significantly. This has arguably added to the

[8] Schrimpf et al (2021) show that bond mutual funds with larger cash balances at the onset of the March 2020 turmoil were better able to weather the turmoil without resorting to selling when others were engaged in fire sales. Kruttli et al (2021) show that restrictions on shareholder withdrawals and liquidity buffers also mattered for hedge funds during the March 2020 episode.

challenges that financial intermediaries face to make markets in sufficient size (Duffie (2020), Liang and Parkinson (2020)). Regulations might constrain liquidity provision by bank dealers, which in turn might increase the reliance on non-bank players for market making or warehousing securities. That said, bank regulation has not always been the binding constraint on intermediation activity; capital preservation and profitability also had an important influence.

Other proposals focus on changes to the market infrastructure, such as central clearing, that could make intermediation more efficient. Potential benefits of central clearing in cash or repo markets include a reduction in counterparty risks, fewer settlement failures, a lowering of overall market exposures and the required risk capital, and an improvement in transparency. For example, in US Treasury markets, settlement failures, which are a symptom of market dysfunction and take up balance sheet space, were lower in the centrally cleared segment compared to the bilateral cleared segment during March 2020 (BlackRock (2020)). In addition, centrally cleared repo transactions might facilitate greater netting arrangements (Fleming and Keane (2021)) or increased cross-margining. Central clearing might also instil better margin and valuation discipline and in this way limit leverage.

The benefits of expanding central clearing for government bonds or repos would differ across market segments. Counterparty risks might not be a major concern in high quality government bond markets, while central clearing could deter thinly capitalised participants from trading, reducing market depth. Furthermore, central clearing might impair market access for customers unable to accept the mutualisation of risk (TMPG (2018)). That said, sponsored repo and futures commission merchant models are examples of broad central clearing arrangements without risk mutualisation (ie "agent" models of central clearing). If the central clearing of government bonds is expanded, an important question is whether central banks should become clearing members and how to design loss sharing arrangements.

Other proposals for reforming the market infrastructure include the expansion of all-to-all trading to allow market participants to trade directly with each other rather than through dealers. All-to-all trading is typically predicated on central clearing. Potential benefits include reduced reliance on bank dealers and reduced costs for end-users. Moreover, by facilitating trading by a more diverse set of investors, all-to-all trading might bring a greater variety of strategies and views, which could improve liquidity, including in stress times. On the other hand, all-to-all platforms could lead to a reduction in liquidity on primary trading venues if they lead to a lower volume of CLOBs. So far, the take up of all-to-all trading has been limited and focused on the most liquid market segments, suggesting that dealer intermediation in less liquid segments might be valuable to market participants.

While central clearing and all-to-all trading could make intermediation more efficient, they would not be a panacea. Central clearing would not necessarily stop bid-ask spreads from widening during periods of stress if market participants were more concerned about profitability or capital preservation than about counterparty credit risk. Furthermore, client clearing exposes intermediaries to risk. Finally, all-to-all trading would not improve liquidity if many players were to act in a synchronous fashion by selling during stress episodes.

Enhanced transparency about the activities of NBFIs and trading in government bond markets could also help strengthen the resilience of liquidity. Post-trade transparency would reduce information asymmetries and improve competition between market participants. Enhanced data collections would allow market

participants and policymakers to better monitor leverage and risks in the non-bank financial sector. While building the infrastructure to collect data might be costly, expanded central clearing could improve data coverage and quality without the need for a separate data collection. That said, very detailed data could be hard to analyse, and to the extent that data expose dealer inventories, they might reduce dealers' willingness to intermediate in these markets.

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Annex A: Other episodes of market volatility

While March 2020 was by far the most extreme episode, government bond markets across the world have experienced several episodes of heightened volatility in recent years. A few examples are summarised below. A comparison of these episodes could help draw parallels and identify common factors behind them and thereby point towards ways to improve the resilience of market liquidity in the future.

US Treasury flash rally. On 15 October 2014, the yield on the benchmark 10-year Treasury note declined by 16 basis points and then rebounded within 15 minutes without a clear cause. The event highlighted significant differences in liquidity provision by PTFs during stressed market conditions compared with that by bank dealers, particularly regarding their strategies for containing their exposure to volatility. PTFs continued to provide the majority of order book depth and maintained a tight spread between bid and ask prices, but decisively cut back their limit order quantities. In contrast, bank-dealers widened their bid-ask spreads so that limit orders were only met at a substantial distance from the top of the book. Despite the surge in trading volume during the event window, there was no noticeable change in net positions of PTFs or bank-dealers. Hedge funds were also active during the event, building up short positions in futures markets during the first half of the event window when prices were rising (Joint Staff Report (2015), CGFS (2016)).

Bund tantrum. On 7 May 2015, yields on long-term German government bonds surged 21 basis points intraday, peaking at 80 basis points, but ended the day where they had been at the previous day's close, at 59 basis points. Some commentators argued that the volatility might have been triggered by an unwinding of positions by leveraged directional investors in fixed income derivatives markets in anticipation of the ECB's asset purchase programme. Like during other episodes, strained market liquidity conditions exacerbated the impact of the initial trigger. The cost of immediately executable transactions in the bund market increased in the period around the bund tantrum. Order book depth also showed signs of deterioration over the period. A variety of factors, such as lower inventory holdings by dealers or purchases by the ECB of German government bonds, might have contributed to the reduction of market depth (Riordan and Schrimpf (2015), Markets Committee (2016)).

JGB market volatility. Similar to the US Treasury market event of October 2014, flash events in the JGB futures market on 13 March 2014 were characterised by liquidity evaporation along with a rapid reduction in order book depth, amid a sudden increase in trading volume. However, unlike the US Treasury flash rally, this event did not lead to spillovers to the JGB cash market. A decline in JGB liquidity might have been a temporary phenomenon following the Bank of Japan's expansion of quantitative and qualitative monetary easing and the fall in yields. It might also have reflected factors such as the massive purchases of JGBs by the Bank of Japan, structural market changes and regulatory changes (Markets Committee (2016)).

September 2019 repo ructions. On 17 September 2019, the secured overnight funding rate (SOFR) – the new, repo market-based, US dollar overnight reference rate – more than doubled, and the intraday range jumped to about 700 basis points. MMFs reduced their repo lending due to tax-payment related outflows, especially through sponsored repos, where they indirectly fund repos by hedge funds. Bank dealers were unable or unwilling to provide repo liquidity, in part due to an upcoming large settlement of US Treasury securities. A combination of these factors led to ructions in US repo markets (Avalos et al (2019), Copeland et al (2021)).

Annex B: Examples of investment strategies employed by hedge funds and other leveraged players

Hedge funds and other leveraged players employ a variety of different strategies in government bond markets. The most prevalent ones are relative value strategies, in which they combine long and short positions. Macro strategies and systematic strategies are also commonly used.

There are several different types of relative value strategies. These include *inter-curve strategies* that target differences between government bonds from two different markets; *term structure strategies* that target potential mispricing across the different points along the yield curve in a single government bond market; *balance sheet arbitrage strategies* that target possible mispricing between different market segments within the same asset class, such as cash vs futures or bonds vs swaps; and *intra-curve strategies* that target deviations from a fitted model to the yield curve.

Other strategies include macro strategies and systematic strategies, such as risk parity, CTA/momentum and volatility control. Strategies by macro funds are typically directional positions in government bonds arising from bets on the macroeconomic prospects. Funds using risk parity strategies, which focus on risk allocation rather than capital allocation, employ leverage to enhance the return contribution of government bonds in their overall stock-bond portfolios. So long as bonds perform as a hedge for stocks in a downturn, risk parity funds generate stable returns. However, in times where bonds do not act a hedge, scaling down of leverage by these funds to reduce their exposure to bonds could exacerbate declines in both equity and government bond prices.[9] CTA/momentum funds take both long and short positions, primarily in futures markets. Volatility control funds adjust their portfolios dynamically by increasing the allocations to safer assets, such as fixed income or cash, when volatility rises (Schrimpf et al (2020)).

[9] For a model-based estimation of portfolio shifts experienced by risk parity strategies in March 2020, see Vassallo et al (2020).

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