

Holistic Review of the March Market Turmoil

17 November 2020



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Executive summary

The financial market turmoil in March, brought about by the COVID-19 shock, tested the resilience of the global financial system. In contrast to the 2008 financial crisis, the shock originated outside the financial system. The pandemic and government containment measures led to a sudden sharp pullback in real economic activity and placed the financial system under strain. Some parts of the system, particularly banks and financial market infrastructures, were able to absorb rather than amplify the macroeconomic shock, supported by the post-crisis reforms. However, key funding markets experienced acute stress and public authorities needed to take a wide range of measures to support the supply of credit to the real economy.

Global economic and financial developments prior to the pandemic had made the financial system more susceptible to shocks. The outlook for growth and corporate earnings had begun to weaken; real interest rates had been on a downward trajectory; while corporate indebtedness was high and rising. A search for yield led a number of investors away from high quality cash-like assets down the credit curve. Favourable external financing conditions – strong global risk appetite and a drop in US Treasury yields – supported cross-border lending and debt portfolio flows to emerging market economies (EMEs), and encouraged greater reliance on dollar-denominated borrowing by firms in those countries.

Structural changes in the financial system over the past decade have also increased the reliance on market-based intermediation to finance growing levels of debt. The G20 regulatory reforms and market-driven adjustments in the aftermath of the 2008 financial crisis have resulted in credit risk being increasingly intermediated and held outside the banking sector. Interconnectedness has also increased and taken new forms in some areas. With the overall growth of non-bank financial intermediation (NBFIs), market liquidity has become more central to financial resilience. At the same time, market-making capacity by banks may have become more constrained, while the provision of liquidity by some new entities and in electronic markets is potentially less robust.

The breadth and dynamics of the economic shock and related liquidity stress in March were unprecedented. As in previous cases, the shock caused a fundamental repricing of risk and a heightened demand for safe assets. However, the stress also led to large and persistent imbalances in the demand for, and supply of, liquidity needed to support intermediation. On the demand side, non-financial corporates attempted to tap capital markets; demand for US dollar liquidity increased from foreign borrowers; non-government money market funds (MMFs) experienced significant outflows; and some open-ended funds also experienced redemptions. On the supply side, reductions in risk appetite, regulatory constraints and operational challenges may have reduced dealers' capacity to intermediate larger flows in some core funding markets.

Particular activities and mechanisms in the financial system acted as mitigants or propagators of the liquidity stress. Central counterparties remained resilient despite market turbulence, though margin calls may have been larger than expected in some cases, challenging liquidity risk management for some market participants and adding to the overall demand for cash. Some investors in open-ended investment funds may have faced incentives to redeem ahead of others. While stronger bank capital and liquidity positions, built over the past decade as a result of the post-crisis reforms, helped to prevent a sharp rise in counterparty risks, banks may have been unwilling or unable to deploy substantial amounts of balance sheet capacity in an uncertain and

volatile environment. Dealers also faced difficulties absorbing large sales of assets, amplifying turmoil in short-term funding markets. Market dysfunction was exacerbated by the substantial sales of US Treasuries by some leveraged non-bank investors and foreign holders. This combination of large asset sales, together with the limited capacity or willingness of dealers to intermeditate in some markets, became self-reinforcing.

The policy response was speedy, sizeable and sweeping. The unprecedented policy actions by central banks alleviated market stress through different channels: asset purchases; liquidity operations, including for US dollars; and backstop facilities designed to provide targeted liquidity to specific financial entities (e.g. MMFs and primary dealers). Regulatory and supervisory measures as well as fiscal policies complemented these central bank interventions. Securities regulators also took measures to support market functioning. The policy measures succeeded in alleviating market strains to date, with announcement effects appearing to be particularly important in restoring confidence and shaping the expectations of market participants.

Absent central bank intervention, it is highly likely that the stress in the financial system would have worsened significantly. This would have had a major impact on the ability of financial and non-financial firms to raise funds. The need to intervene in such a substantial way has meant that central banks had to take on material financial risk. This could lead to moral hazard issues in the future, to the extent that markets do not fully internalise their own liquidity risk in anticipation of future central bank interventions in times of stress. Moreover, the exceptional measures taken by central banks were not aimed at addressing the underlying vulnerabilities that amplified the stress. The financial system remains vulnerable to another liquidity strain, as the underlying structures and mechanisms that gave rise to the turmoil are still in place.

The March turmoil has underscored the need to strengthen resilience in the NBFIs sector. The episode has highlighted issues associated with particular market activities and mechanisms that may have caused liquidity imbalances and propagated stress. These include: significant outflows from non-government MMFs; similar dynamics, albeit less intense and widespread, in specific types of open-ended funds; redistribution of liquidity from margin calls; the willingness and capacity of dealers to intermeditate in core funding markets; and the drivers of dislocations in key government bond markets, including the role of leverage in amplifying the stress. The turmoil also highlighted the increased importance of interconnectedness – both within the NBFIs sector and with banks – and of system-wide liquidity conditions for the resilience of the financial system.

The efforts of the international regulatory community to reinforce the resilience of the financial system, while preserving its essential functions and benefits, should focus on three main areas. These are: (i) in the short-term, work to examine and, where appropriate, address specific risk factors and markets that contributed to amplification of the shock; (ii) enhancing understanding of systemic risks in NBFIs and the financial system as a whole, including interactions between banks and non-banks and cross-border spill-overs; and (iii) assessing policies to address systemic risks in NBFIs, including the adequacy of policy tools and the concept and desired level of resilience in NBFIs. Efforts to strengthen NBFIs resilience should not compromise the resilience in other parts of the system or the important role that NBFIs plays in financing the real economy.

The FSB will coordinate the international regulatory community's assessment of identified vulnerabilities and the appropriate financial policy response, working closely with standard setting bodies and member authorities. As part of this review, the FSB published a comprehensive NBFIs work programme covering the key issues at a high level (see below).

FSB work programme on NBFIs

The table below summarises the work programme on NBFIs coordinated and overseen by the FSB for 2021 and beyond. The work programme builds on the lessons from the holistic review of the March market turmoil. The overarching objective of the work programme is to enhance the resilience of the NBFIs sector while preserving its benefits.

The NBFIs work programme is organised along three main areas: analytical and policy work on specific issues, system-wide risk assessments, and policies to address systemic risks in NBFIs. It comprises new work in response to lessons from the holistic review of the March market turmoil as well as ongoing or previously planned NBFIs initiatives. This work will be carried out within the FSB as well as by its member standard-setting bodies and international organisations, to ensure that relevant experiences and perspectives are brought to bear.

Topic	Brief description	Timing
1. Analytical and policy work on specific issues		
Money market fund (MMF) resilience	To make policy proposals, in light of the March experience, to enhance MMF resilience including with respect to the underlying short-term funding markets	2021, incl. report to the G20
Liquidity risk and its management in open-ended funds (OEFs)	To examine the availability and effectiveness of liquidity risk management tools for OEFs, including the experience of redemption pressures and use of tools in the March turmoil and their aggregate impact on the market	2021-22
Margining practices	To examine the frameworks and dynamics of margin calls in centrally cleared and uncleared derivatives markets and the liquidity management preparedness of market participants to meet margin calls	2021
Liquidity, structure and resilience of core bond markets	To examine the structure and liquidity provision in core funding markets during stress, including the role of leveraged investors and factors that limit dealer capacity to intermediate	2021-22
2. Systemic risk assessments		
Strengthening the ongoing monitoring of NBFIs risks	To assess NBFIs risks in light of COVID-19 developments and lessons from the March turmoil	Ongoing
Advancing the understanding of systemic risks in NBFIs and the financial system	To deepen the analysis of structural and interconnectedness issues in NBFIs, including the interaction of USD funding pressures and fund outflows in emerging market economies, as input into enhanced risk monitoring and discussions on policies to address systemic risks in NBFIs	Ongoing, incl. stakeholder workshop in 2021
3. Policies to address systemic risks in NBFIs		
Policies to address systemic risks in NBFIs	To examine policies to address systemic risks in NBFIs, including the adequacy of current policy tools and the concept and desired level of resilience in NBFIs	2022

1. Introduction

This report examines the drivers, effects and implications of the financial market turmoil in March. The COVID-19 pandemic placed the global financial system under considerable strain. Some parts of the system, particularly banks and financial market infrastructure, were generally able to absorb rather than amplify the macroeconomic shock, supported by the post-crisis reforms. However, key funding markets experienced acute stress and public authorities needed to take a wide range of measures to support the supply of credit to the real economy by underpinning market liquidity and functioning.¹ The March turmoil has reinforced the need to better understand interconnections and amplification channels in the financial system and to consider the nature of vulnerabilities in non-bank financial intermediation (NBFI) in relation to the liquidity stress and the implications of central bank liquidity support, and draw lessons about overall resilience of the NBFI sector.

The report draws on a broad range of information sources. These include analysis by the FSB and standard-setting bodies; analysis and information provided by FSB members; input from external stakeholders (industry participants, academics, think tanks and trade associations) through a virtual outreach meeting in September; and a review of the wider literature. These sources taken together form the basis for the analysis in the report.

The report draws lessons from the March turmoil and identifies areas for further work. The decisive policy response helped to stabilise financial markets and contain the economic and financial fallout of the pandemic to date. However, there is a need to address the vulnerabilities that became apparent during the turmoil because uncertainty about the economic outlook remains high and the risk of further market dislocations cannot be ruled out. In light of this, the report identifies lessons that form the basis for further work to increase the resilience of NBFI.

The report is structured as follows:

- Section 2 sets the scene by providing an overview of key developments in global financial markets around March. Annex 1 provides a detailed timeline of market events.
- Section 3 puts the March market turmoil into context, by describing the nature of the COVID-19 shock, discussing the role of global economic and financial conditions prevailing in the run-up to COVID-19, and setting out key structural changes in the global financial system since the 2008 financial crisis and their implications for resilience.
- Section 4 analyses how the shock was transmitted through the global financial system, including the role played by different types of intermediaries and mechanisms that may have mitigated or amplified the shock.
- Section 5 reviews policy measures taken to ease the financial market strains and considers their effects, including the mechanisms through which they may have worked. Annex 2 provides additional information on those measures.
- Section 6 concludes by identifying lessons from the events in March, drawing policy implications, and describing areas of further vulnerabilities and policy work.

¹ See the FSB's *COVID-19 pandemic: Financial stability implications and policy measures taken – Report to the G20* (July 2020).

2. Overview of financial market developments around March

This section describes the key financial market developments that took place during the March market turmoil. It starts with a summary of market conditions in January and February, before worries about COVID-19 hit global markets (prelude to the market turmoil). It then describes the two phases of the most severe stress period. In the first phase (flight to safety), which took place from late February to early March, investors sold riskier assets and bought less risky ones, as often happens in periods of stress. In the second, more acute phase (dash for cash), which took place in mid-March, investors sold risky as well as relatively safe assets in an attempt to obtain cash or cash-like instruments. Following the stress, the last phase (easing of market stress) started in late March following speedy, sizeable and sweeping interventions by authorities, and saw markets progressively return to orderly conditions. A detailed timeline of events is in Annex 1.

2.1. Prelude to the market turmoil

At the start of the year, financial markets were buoyed by a relative sense of optimism on the back of supportive monetary policies, reduced trade tensions, and tentative signs of stabilisation in the global economy. Then on 9 January, the World Health Organisation (WHO) reported that Chinese authorities had identified a new virus causing serious respiratory issues in the city of Wuhan. In the following days, the number of people infected with the virus continued to increase and the WHO confirmed evidence of human-to-human transmission on 19 January.

Financial markets took little notice of these developments until late January. On 23 January, Chinese authorities imposed a lockdown in Wuhan ahead of a week of national holidays for the Chinese New Year. Travel restrictions were subsequently imposed in several Chinese provinces, and a growing number of cases was reported in various countries showing that the virus was starting to spread around the world. Global equity markets, especially in Asia, declined on concerns about the virus, but then recovered in response to easing concerns about the spread of the virus in China. In the US and continental Europe, stock markets reached record highs on 19 February, while other indexes were close to all-time highs.

2.2. Flight to safety

Concerns resurfaced soon afterwards, as the number of coronavirus cases in China and elsewhere continued to increase in late February, intensifying investors' fears. On 21 February, Italian authorities announced local lockdowns in the Northern Italian towns experiencing the highest number of cases. At this point, a general "risk-off" sentiment began to spread through markets as investors adjusted their expectations for the possibility of a significant slowdown in economic activity. Volatility rose substantially and suddenly. Global financial markets experienced significant corrections and even countries that had not reported cases were subject to considerable selling pressure (Graph 2.1, left panel). Initial government measures to contain the spread of the virus were introduced at around this time, including travel bans, lockdowns and the closure of schools.

Global sovereign bond yields across the maturity spectrum declined substantially amid portfolio rebalancing and surging demand for safe assets. Amidst the continuous rise in the number of cases in Asia and Europe, perceived safe haven assets such as US Treasuries and German bunds

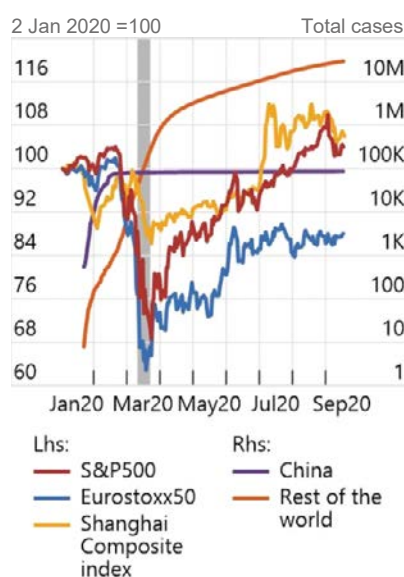
saw very large price increases. As in other major stress events, investor appetite shifted from riskier to safer and more liquid assets. As it did so, some risky assets became difficult to sell and liquidity conditions in these markets became impaired (Graph 2.1).

Funding stress indicators and measures of illiquidity started to increase considerably. Reflecting the uncertainty in financial markets, corporate bond spreads increased quickly and substantially, as did spreads on sovereign bonds of financially weaker countries. Transaction volumes particularly in fast-moving electronic markets (equities, US Treasuries) increased substantially, while liquidity measures began to deteriorate, including in derivatives markets. Flows in funds investing in risky assets, first in equities and then in fixed income, started to moderate and then turned negative by the beginning of March.

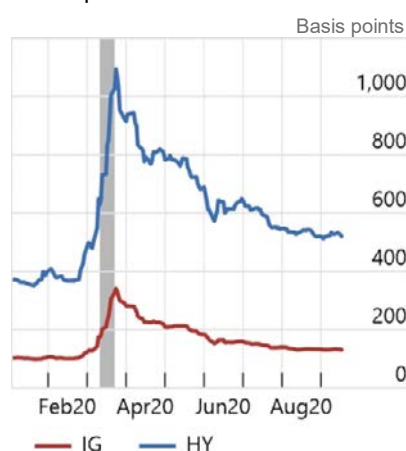
The March episode was characterised by large price movements

Graph 2.1

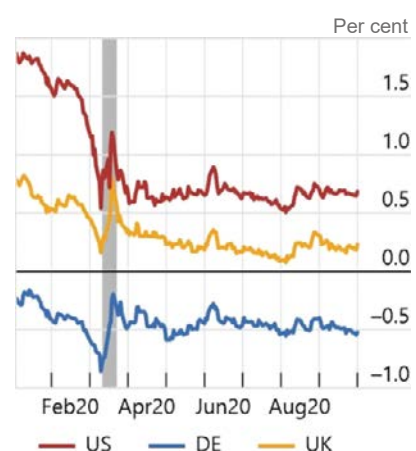
Stock price indices and total number of confirmed COVID cases



Investment grade and high yield bond spreads¹



10-year government bond yields



Shaded area correspond to the period 11-23 March.

¹ Option-adjusted spreads of ICE BofAML Global Corporate Index and ICE BofAML Global High Yield Index.

Sources: Johns Hopkins University; Bloomberg; ICE BofAML Indices.

Worries about oil prices added pressure to financial markets. In early March, the OPEC+ countries failed to reach an agreement on output cuts to maintain stable oil prices in the face of weakening global demand resulting from the spreading of the virus. In response, crude prices dropped significantly and the entire oil futures curve shifted down, putting additional pressure on equity markets. The prospect of a price war among oil producing countries hit certain equity markets particularly hard, with heavy losses in the Middle East, but the effects reverberated in equity markets worldwide.

2.3. Dash for cash

On the back of continued bad news on the health and economic fronts, the flight to safety behaviour morphed into broad-based selling in mid-March, when even the safest and most highly liquid assets such as government bonds experienced large price declines. On 11 March, the WHO officially declared the COVID 19 outbreak a pandemic. At approximately the same time, a

number of countries announced strict containment measures involving lockdowns, border closings and quarantine requirements for people returning from high-risk areas. Continued downward revisions of growth expectations and heightened risk aversion, combined with high uncertainty about the future development of the pandemic led to extreme investor behaviour and sharp market movements (see section 4).

First, there was an extremely high demand for cash and near-cash assets. This ‘dash for cash’ was underpinned by precautionary demand for liquidity in the real economy. Corporates’ and households’ concerns about the loss of a substantial part of their revenues, investor fears about the outlook for the global economy, and cash needs by financial institutions, resulted in the broad-based selling of financial assets - even the safest and most liquid ones. In the financial system, redemptions from investment funds, margin calls resulting from increased volatility and the need of some non-banks to unwind leveraged positions may all have contributed to sudden spikes in the demand for cash (the mechanisms are discussed in detail in section 4).

The commercial paper (CP) and certificate of deposit (CD) segments of money markets started to exhibit signs of severe stress, with outflows from non-government MMFs in the US and EU leading to selling pressures on the assets held by these funds. Equity and bond funds in emerging market economies (EMEs) as well as advanced ones experienced very large outflows as investors liquidated their positions. The selling also started to affect assets that would normally be seen as safe havens, such as US Treasuries and other advanced economy government bonds.² At the same time, government MMFs experienced considerable inflows.

In corporate bond markets, the lack of liquidity also created challenges for fixed income benchmark providers, with some of them postponing their March-end index rebalancing. This aimed at reflecting the lack of liquidity and strained market conditions as well as concerns about the impact of credit rating downgrades that occurred during the period on bond indices.

Second, there was a very sharp tightening of financial conditions, limiting the ability of corporates to obtain market funding. Liquidity conditions continued to deteriorate in many markets (Graph 2.2). Electronic markets saw a substantial increase in volumes accompanied by wider spreads, while dealer-intermediated markets, such as for corporate bonds, saw a significant deterioration in liquidity. Despite the surge in trading activity, trading venues continued to operate in an orderly manner, although high volatility triggered circuit breakers on equity markets multiple times. Very high trading activity resulted in heightened settlement activity and settlement fails rose across asset classes (equities, corporate and government bonds), as market participants faced operational and other challenges in sourcing and delivering securities while most of their employees were working from home.³ Financial and non-financial corporate issuers were also unable to issue more commercial paper due to a shortage of demand, including by MMFs. CP and CD markets shut down for a number of days. The resulting tightening of financing conditions pushed corporates towards selling their investments and further drawing down their existing bank credit lines and revolving credit facilities. This large-scale draw down, taking place partly on a precautionary basis, put pressure on the balance sheets of the providers of those facilities.

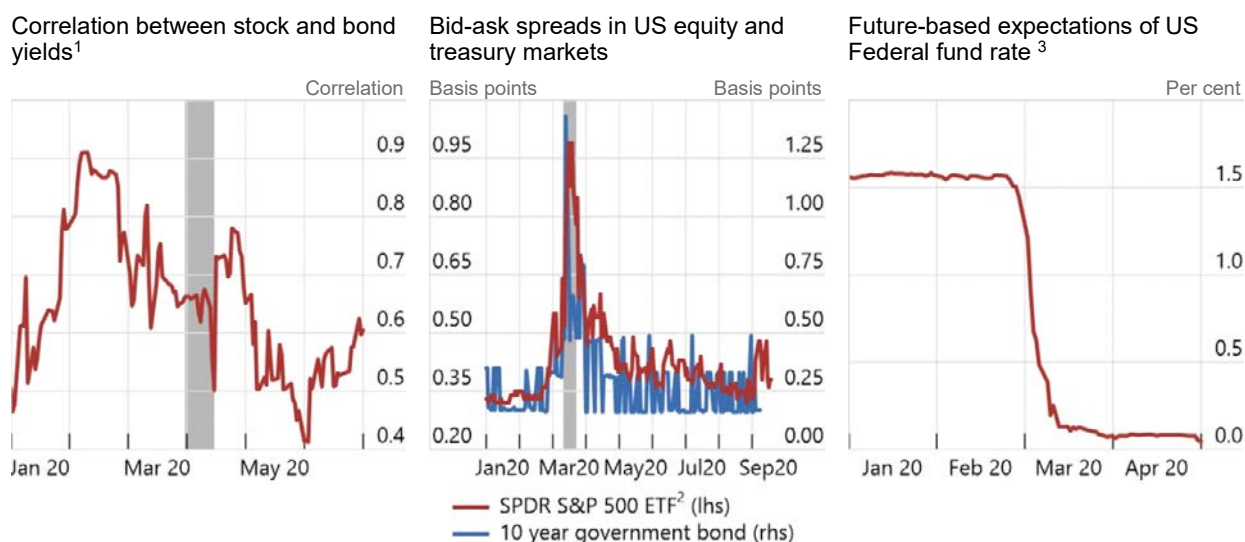
² According to the IMF’s Global Markets Monitor, UST 10-year market depth declined 93% from the February average to its lowest level in history and 30-year market depth dropped 76% from its February average; also the lowest in history.

³ For the EU, see the *ESMA report on Trends, Risk and Vulnerabilities* (September 2020), No.2 2020, p.40.

On 16 March, the S&P 500 lost 12%, the worst one-day drop since 1987 and the VIX reached its all-time peak of 83. Market depth in several asset classes (including US equities and Treasuries) declined to levels seen during the worst period of the 2008 financial crisis. This was accompanied by a large increase in transaction costs in many inter-dealer markets.

Correlations broke down, liquidity deteriorated and expectations of future interest rates collapsed

Graph 2.2



The shaded area in the left hand panel indicates the period 31 March -15 April, which corresponds to the calculation window of moving correlations for the period 11-23 March. Shaded areas in the middle panel and the right hand panel correspond to the period 11-23 March.

¹ Calculated as 20 trading days moving correlations using daily returns of S&P 500 and daily changes in US 10 year government bond yields.

² Average of all bid/ask spreads taken as a percentage of the mid price. US Treasury spreads are calculated based on on the run securities and ETF spreads are calculated a 5-day moving average. ³ Generic 2nd 30 days federal fund futures. Mid yield to maturity.

Sources: Bloomberg; FSB calculations.

Third, longstanding relationships in prices across different markets began to break down, including in the core US Treasuries market. Usually at times of stress equity prices decline while government bond prices increase. But during the dash for cash both types of assets experienced large price declines (Graphs 2.2 and 2.3). Volatility was elevated even for assets (such as government bonds and gold) that are usually stable as investors took benefit of the prior appreciation of these assets to get the needed cash. Furthermore, either uncommon or unusually large differences emerged between the price of assets that usually move in close sync: on-the-run and off-the-run bonds, the net asset value (NAV) of a number of exchange traded funds (ETFs) and their intraday price, and the prices of Treasury bonds and their futures contracts.

Finally, severe strains in offshore dollar funding markets emerged. The US dollar appreciated considerably against other currencies as non-US corporates were unable to roll over funding and sold their dollar-denominated assets. The strain was particularly severe in EMEs, given the growth in dollar denominated debt issuance in recent years (see section 3). Market conditions also forced some non-US central banks to liquidate part of their foreign exchange reserves in order to accommodate the demand for dollars in their jurisdiction. The strains manifested in large dislocations in the USD basis (Graph 2.3, right panel).⁴

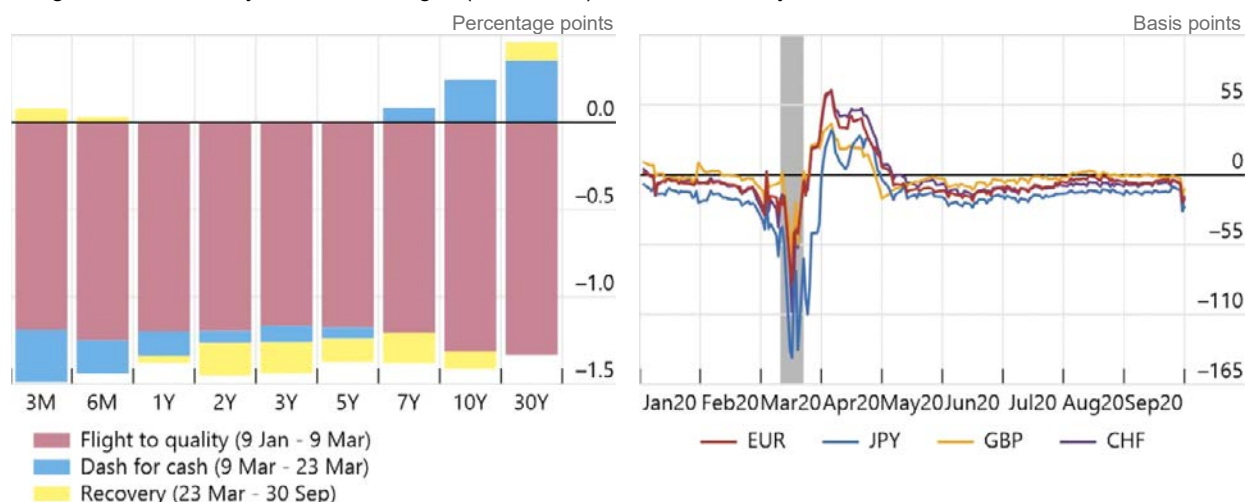
⁴ The basis is the difference between the dollar interest rate in the money market and the implied dollar interest rate from the FX swap market where someone borrows dollars by pledging another currency as collateral.

US Treasury markets experienced very large price movements and strains in the USD offshore funding markets emerged.

Graph 2.3

US government bond yield curve changes (from 9 Jan)

USD currency basis¹



Shaded area in the right hand panel corresponds to the period 11-23 March.

¹ Calculated exploiting the covered interest parity condition as the spread between three-month US dollar Libor and three-month FX swap-implied US dollar rates.

Sources: Bloomberg; FSB calculations.

2.4. Easing of market stress

The dash for cash lasted until the significant interventions and announcements by central banks. These were part of a package of measures that included the provision of relief by some securities regulators and substantial fiscal support by many governments. Central banks' interventions took the form of asset purchases, liquidity facilities, the establishment and expansion of dollar swap lines and the temporary relaxation of regulatory restrictions (see section 5). In addition, fiscal policy provided further stimulus and guarantees that helped ease the market fallout. Global stock markets bottomed out between 18 March (Europe) and 23 March (US, China).

Since then, financial market strains have eased in response to decisive policy actions. By late August, most risky assets had recovered at least three quarters of the losses experienced during the initial stages of the pandemic. US equity indexes were at all time highs, while high yield bonds recovered 80% of the losses. European equities recovered more than two thirds of their losses and oil prices had risen 50% above their lowest point, which in futures market entailed negative prices for the first time in April. Financial conditions eased in domestic and foreign currency funding markets. Credit spreads have narrowed in both investment grade and high yield bonds, while issuance volumes have significantly increased. Investment grade bond issuance by non-financial corporates reached record levels since March, with the largest amount of bonds being issued by industries most exposed to the lockdown measures. The availability of offshore USD liquidity, particularly in EMEs, has also improved following the US Federal Reserve actions, and overall capital outflows from EMEs have receded.

However, the economic and financial outlook remains highly uncertain. Declines in economic activity have been very large. According to the IMF, global GDP growth for 2020 is projected at

-4.4% in 2020,⁵ which is much worse than during the 2008 financial crisis and several percentage points lower than pre-COVID estimates. While some indicators suggest some rebound in activity, the path of recovery and the outlook for sectors most impacted by the pandemic remains highly uncertain. Any change in market sentiment could thus trigger a sharp downward revision of risky asset prices. Non-financial corporates and EME sovereigns experienced a wave of credit rating downgrades in March and April. The pace of downgrades has noticeably decreased since then, on the back of decisive policy action. However, deteriorating credit quality calls for attention to the potential effects a deterioration in the economic outlook. This underlines the need for authorities to take a holistic and system-wide view, consider different players and address the specific structural vulnerabilities in the non-bank financial sector.

3. Origins and backdrop of the March market stress

3.1. The COVID-19 shock

The COVID-19 pandemic was an unprecedented external shock to the financial system. The outbreak and government containment measures caused an adverse simultaneous shock to supply and demand. Quarantines, lockdowns and social distancing curtailed mobility and, combined with heightened uncertainty and job losses, led to lower aggregate demand; while workplace closures and travel restrictions disrupted trade and global supply chains. There was a sudden sharp pullback in real economic activity across a number of sectors – including tourism, transportation, automotive and services – which spread more broadly in tandem with the virus, precipitating the deepest and most broad-based global recession since the Great Depression.

The financial system reacted in anticipation of the severe economic downturn brought about by the shock and governments' containment measures. In contrast to what happened during the 2008 financial crisis, the shock originated outside the financial system. Core parts of the system were able to withstand and absorb the shock, but there were severe disruptions in a number of financial markets. The shock led to an abrupt increase in demand for safe and liquid assets in both the financial and non-financial sectors, which propagated through the system and morphed into a dash for cash. The sudden materialisation of extensive disruptions to economic activity and extreme uncertainty with respect to the consequences and duration of the shock made the pricing of assets particularly difficult and led to a sharp repricing in financial markets. In assessing the impact of the shock, it is relevant to consider global economic and financial developments and structural changes to the financial system in the run-up to the pandemic.

3.2. Global economic and financial backdrop

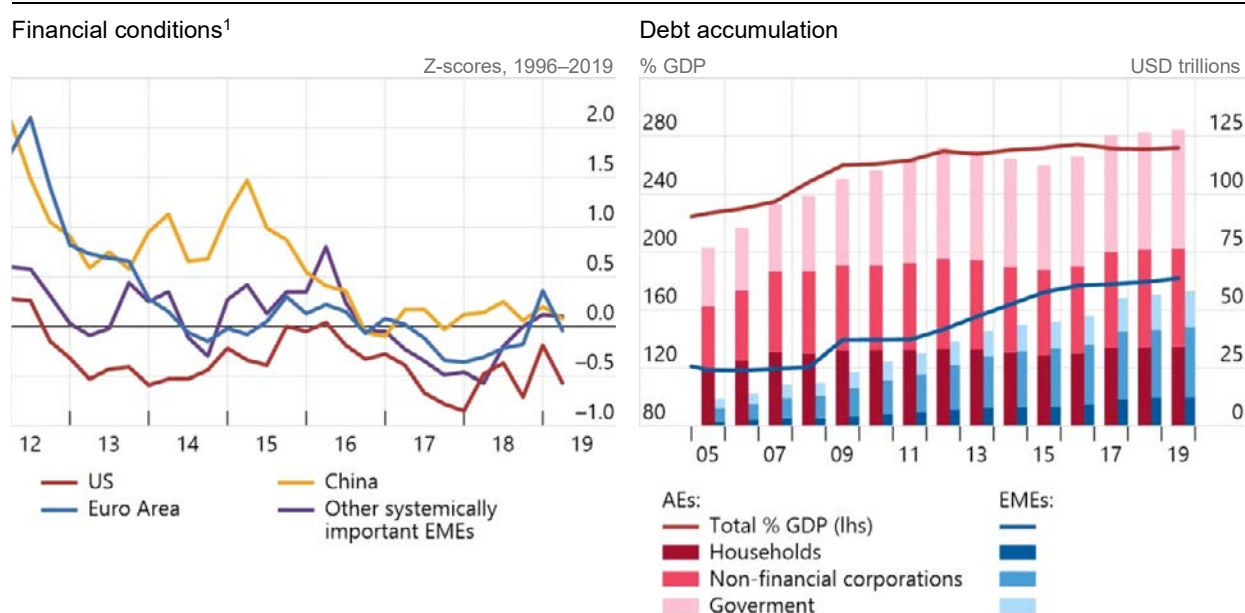
Developments in the lead-up to the pandemic may have contributed to the severity of the reaction in financial markets in March. Following a long global recovery from the 2008 financial crisis, the outlook for growth and corporate earnings had weakened by early 2020 and become more uncertain. Real interest rates have fallen during the past decade, with both authorities and

⁵ See the IMF's *World Economic Outlook, October 2020: A Long and Difficult Ascent*.

market participants predicting a “lower for longer” environment.⁶ This decline in financing costs reduced the debt service burden for borrowers and encouraged further debt accumulation (see Graph 3.1). High levels of corporate indebtedness, declining asset quality and lower credit underwriting standards meant that firms became increasingly exposed to the risk of a material economic downturn or an unexpected rise in interest rates. Investors had therefore become more susceptible to sudden shifts in market sentiment and a tightening of financial conditions in response to shocks.⁷

Easy financial conditions encouraged debt accumulation in recent years

Graph 3.1



¹ Global financial conditions indices. The z-score indicates an observation's distance from the population mean in units of standard deviation. Sources: IMF, GSFR April 2019; Institute for International Finance, Global Debt Monitor.

Certain pre-existing financial vulnerabilities may have amplified financial market reactions to the shock. Relatively easy financial conditions, stretched valuations in some asset classes, compressed risk premia and (more recently) a large amount of sovereign debt with negative yields further encouraged a search for yield. This led a number of investors away from high quality cash-like assets down the credit curve, including in leveraged loans directly and in securitised form through collateralised loan obligations (CLOs).⁸ It may also have increased the popularity of investment strategies reliant on low market volatility, short-term funding and high leverage. Favourable external financing conditions – strong global risk appetite and a drop in US Treasury yields – supported cross-border lending and debt portfolio flows to EMEs, and encouraged greater reliance on dollar-denominated borrowing by firms in those countries.

Some of the concerns about vulnerabilities related to liquidity mismatches and the build-up of leverage in certain types of investment funds. In an environment of low interest rates, growth in asset management was accompanied by increased holdings of higher-yielding but riskier and less liquid assets through open-ended funds that offer daily redemptions to investors. To the

⁶ See the CGFS report on the *Financial stability implications of a prolonged period of low interest rates* (July 2018).

⁷ See the IMF's *Global Financial Stability Report: Lower for Longer* (October 2019).

⁸ See the FSB's *Vulnerabilities associated with leveraged loans and collateralised loan obligations* (December 2019).

extent that such funds do not adequately manage their liquidity risk and experience unanticipated investor redemptions, they may be susceptible to investor runs during a market stress, which could contribute to price dislocations and fire sale spirals. Vulnerabilities may also result from the use of leverage by certain investment vehicles (e.g. hedge funds), either by borrowing or through derivatives. This makes these vehicles more sensitive to changes in asset prices and the availability of short-term funding during stress, which can lead to sudden and sharp unwinding of trades that can propagate risk through linkages with counterparties.⁹

3.3. Structural changes in the global financial system

The COVID-19 shock hit a global financial system that has fundamentally changed over the past decade. A number of factors – including regulatory reforms and market-driven adjustments in the aftermath of the global financial crisis, technological changes, developments in US dollar funding, and the growing role and evolution of non-bank financial intermediation – have affected financial resilience, intermediation patterns, and market functioning.

Post-crisis reforms have contributed to major changes in financial institutions' balance sheets and market structures. Large banks have more capital and liquidity and are less leveraged, thereby enhancing their ability to absorb losses. Several have reduced trading and market-making activities as changes in regulation and risk appetite in light of the crisis have decreased those activities' attractiveness,¹⁰ and curbed their involvement in certain complex activities.¹¹ Over-the-counter (OTC) derivatives reforms replaced much of the complex and opaque web of ties between market participants with simpler and more transparent links between central counterparties (CCPs) and their clearing members, supported by robust risk management (including margining) requirements.¹² And while aspects of structured finance that contributed to the 2008 financial crisis have significantly declined,¹³ implementation of reforms in other NBFIs – including policies to address asset management vulnerabilities – is at an earlier stage.¹⁴

NBFI has overall grown considerably and evolved over the past decade. Non-bank financial entities – comprising investment funds, insurance companies, pension funds and other financial intermediaries – have different structures and are subject to distinct regulatory frameworks within and across jurisdictions. Their asset share has increased to almost half of global financial assets, compared to 42% in 2008, due to both inflows and valuation increases. One factor behind this increase has been the growth of investment funds, whose assets have expanded from roughly US\$21 trillion in 2008 to US\$53 trillion in 2018 (see Graph 3.2). Underlying drivers for this growth include long-term demographic trends leading to asset accumulation; macro-financial factors

⁹ See the FSB's *Policy Recommendations to Address Structural Vulnerabilities from Asset Management Activities* (January 2017) and the Bank of England's *Financial Stability Report* (December 2015, November 2018 and December 2019).

¹⁰ In some markets, a reduction of liquidity in normal times from pre-crisis levels, owing to a better recognition of the costs involved in providing liquidity services, was an expected outcome of the reforms. Prevailing lower yields and a shift in risk appetite following the 2008 financial crisis also contributed to reduced dealer profitability from holding and providing financing for fixed income securities. See the CGFS report on *Fixed income market liquidity* (January 2016).

¹¹ See the CGFS report on *Structural changes in banking after the crisis* (January 2018).

¹² See the FSB's reports on *Incentives to centrally clear over-the-counter (OTC) derivatives* (November 2018) and *Review of OTC derivatives market reform: Effectiveness and broader effects of the reforms* (June 2017).

¹³ These include asset-backed commercial paper programmes, structured investment vehicles and collateralised debt obligations of subprime and other lower quality credits. See the FSB report on *Assessment of shadow banking activities: risks and the adequacy of post-crisis policy tools to address financial stability concerns* (July 2017).

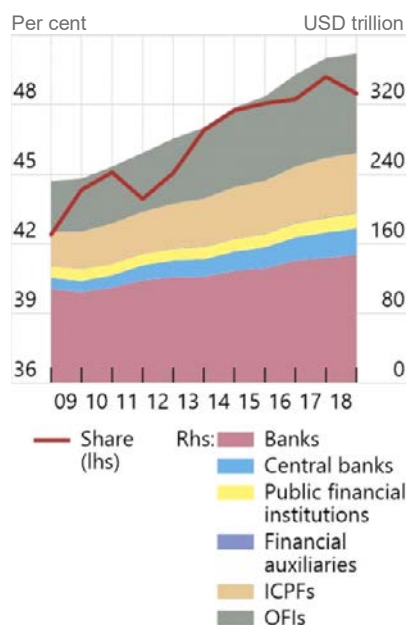
¹⁴ See the FSB's *Implementation and Effects of the G20 Financial Regulatory Reforms: Fifth Annual Report* (October 2019).

such as accommodative monetary policies and the search for yield; and post-crisis reforms, which may have increased the relative cost of bank-based finance.

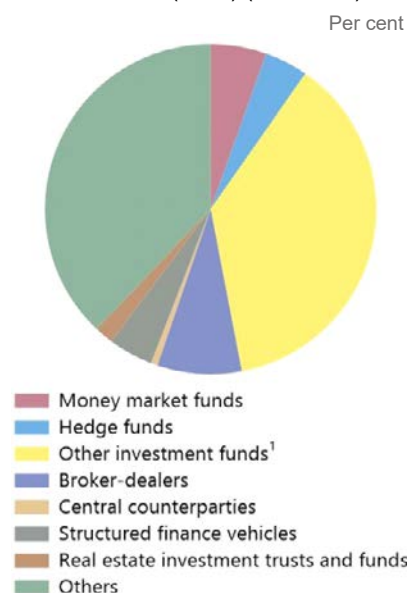
The structure of the NBFi sector changed considerably in recent years

Graph 3.2

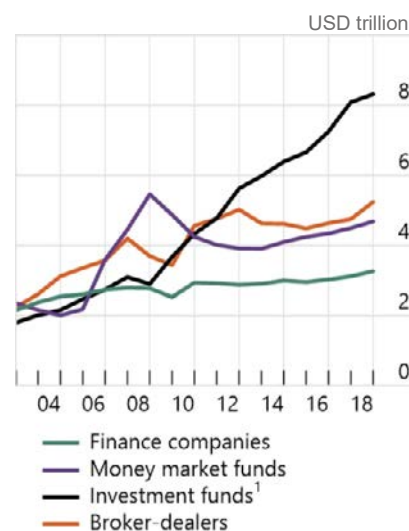
NBFI assets' rising share in total financial assets



Composition of Other Financial Intermediaries (OFIs) (end-2018)



Credit assets² held by selected OFIs sub-sectors



ICPFs = Insurance corporations and Pension funds; OFIs = other financial intermediaries. Data used in the charts above covers 21 jurisdictions and euro area.

¹ Investment funds other than MMFs and hedge funds, including equity funds, fixed-income funds and other investment funds. ² Increases of aggregated data may also reflect improvements in the availability of data over time at a jurisdictional level.

Source: FSB, *Global Monitoring Report on Non-Bank Financial Intermediation 2019* (January 2020).

As a result, the importance of NBFi for the real economy has increased. Business models in, and financial services provided by, that sector have become more diverse. New types of markets (e.g. private debt) and forms of intermediation (e.g. FinTech credit) have sprung up; while investments in credit products (e.g. fixed income ETFs, CLOs) and participation in certain credit segments (e.g. mortgage and consumer finance) by non-banks has grown. Non-bank institutions provide diversified financing and investment opportunities, a broad range of risk management and risk sharing services (e.g. through derivatives hedging and treasury management), and efficient delivery (e.g. through payment, clearing, settlement and electronic trading infrastructures). As a result, these entities – especially asset managers – play a greater role in financing the real economy, as well as in managing the savings of households and corporates.¹⁵

The past decade also saw an evolution in the international US dollar funding landscape.¹⁶ The US dollar dominates international finance as a funding and investment currency, and its widespread use has given rise to a complex and geographically dispersed network of relationships. This has meant that global economic and financial activity is highly dependent on the ability of US dollar funding to flow smoothly and efficiently between users outside the US. In

¹⁵ See the FSB's *Global Monitoring Report on Non-Bank Financial Intermediation 2019* (January 2020).

¹⁶ See the CGFS report on *US dollar funding: an international perspective* (June 2020).

contrast to bank intermediation, market-based financing in US dollars has outpaced the growth of the global economy. Cross-border links between banks and non-bank entities have also increased.¹⁷ Moreover, there has been a shift of global portfolios towards US securities and cross-border USD-denominated lending into EMEs. A consequence of these trends is that non-bank institutions – such as insurers and pension funds – have become more dependent on US dollar funding, while having less recourse to funding sources such as central bank facilities.

Changes in the functioning of financial markets have affected liquidity provision and the speed of transmission of price changes. The proportion of electronic trading has increased substantially in markets with more standardised products (such as stocks and foreign exchange) but also in fixed income (particularly futures and some advanced economy government bonds). This change has allowed more high frequency trading and new players, such as principal trading firms, to enter as liquidity providers in some of these markets (e.g. inter-dealer market for on-the-run US Treasuries).¹⁸ At the same time, the structure of core wholesale OTC funding markets, such as for CP and corporate credit, continues to be characterised by low levels of automated trading and heavy reliance on dealer intermediation – even as the size of those markets has expanded significantly.

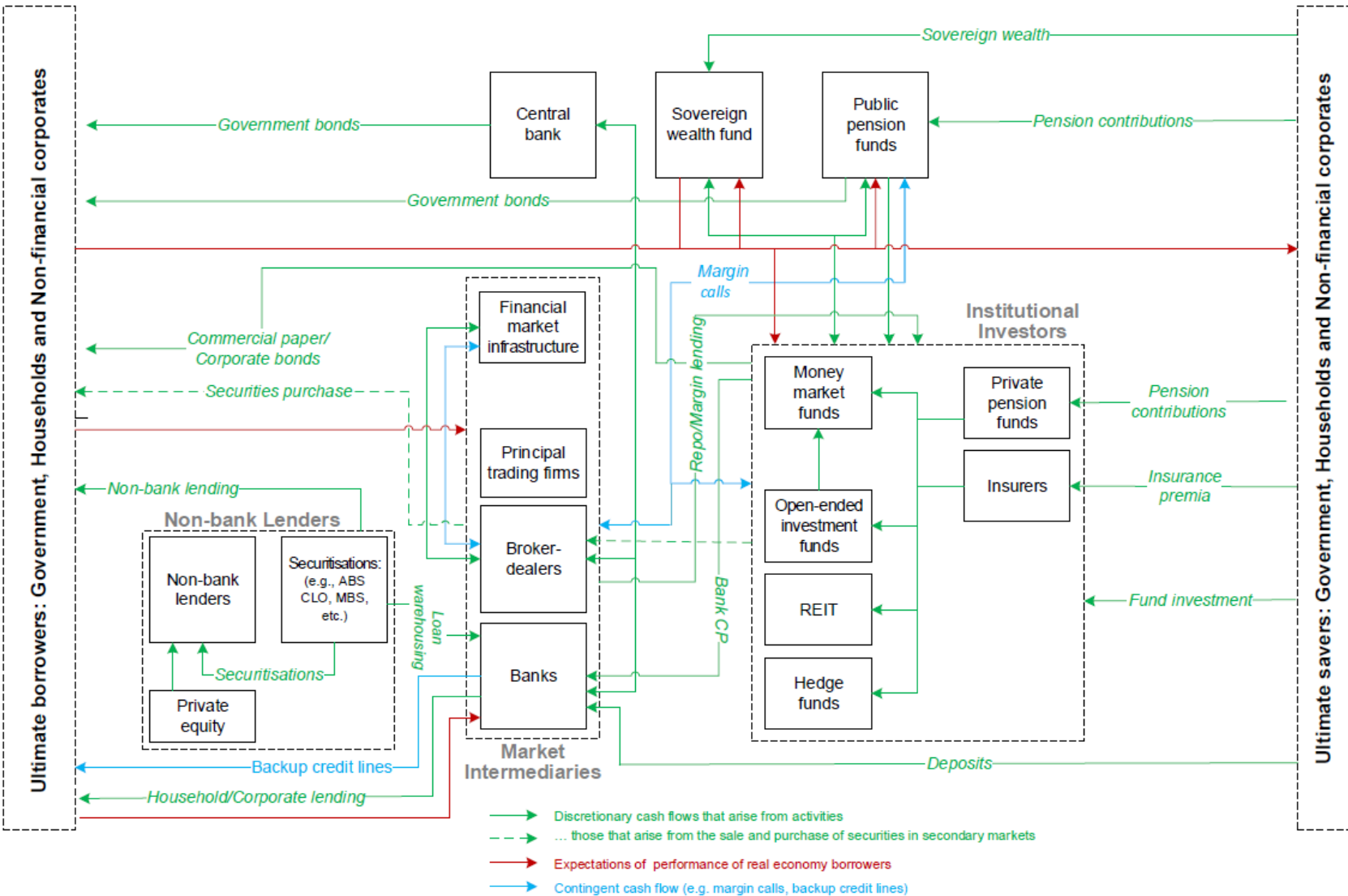
These structural changes have affected the resilience of the global financial system:

- Credit risk is increasingly being intermediated and held outside the banking sector. A greater role of NBFIs implies a shift from the traditional model where banks keep credit risk on their balance sheets to a model where it is borne by investors, and intermediated in financial markets. As a result, financial resilience tends to depend less directly on bank buffers and more on the ability of investors to effectively manage market, credit and liquidity risk in times of stress. This in turn implies greater reliance on market price signals and market liquidity for managing portfolios and the associated risks.
- Interconnectedness has increased and taken new forms in some areas. The diversity and growing involvement of non-bank entities in credit provision has led to more interconnections (see Graph 3.3). Intermediation chains have become longer and more complex, including for cross-border funding in USD by non-banks and non-financial corporates. The growth in central clearing increased the systemic importance of CCPs and their interconnections with market participants, reducing the complex and opaque web of bilateral ties. Increased use of collateralisation, posted as margin or borrowed against in secured funding markets, has increased the reliance on the availability and smooth flow of collateral. These linkages have altered the speed and breadth with which shocks are transmitted through different parts of the financial system.
- Intermediation in the financial system has become more dependent on liquidity. As noted above, the shift in credit intermediation towards markets has increased the need for liquidity to finance and price assets. Greater interconnectedness may facilitate a redistribution of liquidity within the financial system, for example as a result of margin calls. New players have increasingly diversified liquidity provision in some markets,

¹⁷ See Aldasoro et al, *Cross-border links between banks and non-bank financial institutions*, BIS Quarterly Review (September 2020).

¹⁸ See the BIS Markets Committee report on *Electronic trading in fixed income markets* (January 2016).

leading to a mix of entities, activities and infrastructures providing liquidity across the financial system. However, banks continue to play a critical role in providing liquidity in core funding markets, even as they have become less involved in market-making and potentially less able or willing to absorb short-term liquidity imbalances as the size of some financial markets has grown significantly relative to dealer balance sheets.



4. The propagation of the shock

4.1. The impact of the COVID-19 shock on financial markets

The financial system had to cope with large shifts in the demand and supply for market and funding liquidity (see Section 2). While defensive behaviours by various parts of the financial system are individually rational and in keeping with good risk management in the face of increased risks, they resulted in large mismatches between the aggregate supply of and demand for market and funding liquidity that put critical nodes of the financial system under strain. The main factors contributing to these imbalances are discussed in Section 4.2.

Stress was propagated by reductions in the ability and willingness of financial intermediaries to provide liquidity where it was most needed. Recent changes in the structure of the financial system mitigated some of the stress, while others amplified this propagation. These factors are discussed in Section 4.3.

4.2. Factors shifting demand and supply of liquidity

Demand for liquidity

At the onset of the pandemic, faced with uncertainty and prospects of decreased revenues, non-financial corporates attempted to obtain cash in capital markets to keep funding their activities. Corporates tried to raise funding by:

- Tapping short-term funding markets, including through the issuance of commercial paper. However, in the first two weeks of March, issuance of CP fell off sharply and yields increased significantly making funding considerably more expensive. Issuance of CP with an overnight maturity increased in mid-March. This reflected an unwillingness of CP investors to provide funding beyond very short maturities.
- Increasing corporate bond issuance. However, the corporate bond market became illiquid and the cost of issuing bonds increased. Issuance became strained, especially for high-yield corporates. Moreover, issuance in the leveraged loan market halted with no new deals coming on to the market in March. Investment-grade corporate bond issuance also declined considerably.

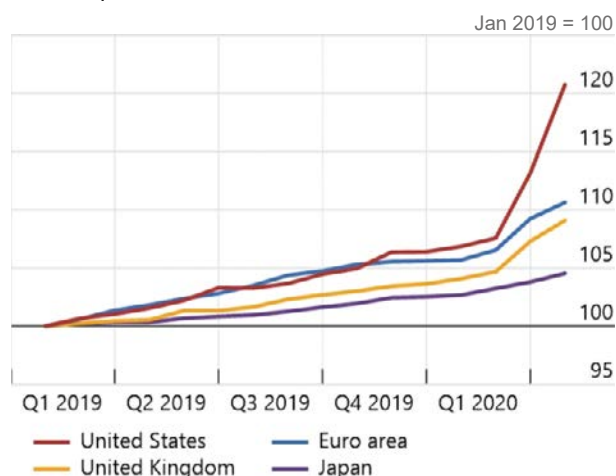
In response, many corporates turned to borrowing from banks, including via their existing credit lines and revolving credit facilities (Graph 4.1). For example, draws on US commercial bank credit lines to firms increased at record weekly rates in March.¹⁹

¹⁹ See JP Morgan, *Large cap banks* (13 April 2020).

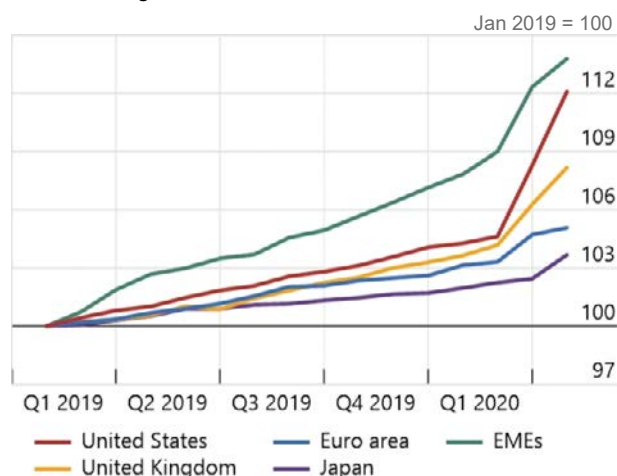
Bank lending and deposits increased in tandem

Graph 4.1

Bank deposits¹



Bank lending to the non-financial sector²



¹ Series used for each jurisdiction (seasonally adjusted); for the United States, Commercial Banks, Deposits; for the Euro area, Money Supply M3 - Deposits, Total; for Japan, Aggregate Bank Deposits and CDS; for the United Kingdom, Retail Deposits and Cash in M4. ² For EMEs, simple average for Brazil, Indonesia, Mexico, Russia, South Africa and Turkey. Series used for each jurisdiction (seasonally adjusted): For Brazil, loans from financial system to nonfinancial corporations and households (total credit outstanding); for European Monetary Union, money supply, loans to other Eurozone residents except government; for Indonesia, commercial and rural banks' claims on private sector (loans); for Mexico, commercial banks' credit to private sector; for Russia, bank lending, corporate and personal loans; for Turkey, bank lending to private sector; for the United Kingdom, monetary financial institutions' sterling net lending to private non-financial corporations and households; for the United States, commercial banks' loans and leases in bank credit.

Sources: national sources; FSB calculations.

Demand for US dollar liquidity increased globally. Non-financial corporates with US dollar denominated debt, which has risen sharply since the 2008 financial crisis especially in EMEs, sought to increase their US dollar cash holdings amid increased economic uncertainty. Obtaining credit in markets was often more challenging than for advanced economies' (AEs) corporates, adding to pressure on banks (through drawdowns of bank credit lines) and domestic asset markets (through asset sales). The appreciation of the US dollar may have resulted in margin calls on hedged positions, potentially further increasing the demand for US dollars.

Increases in volatility triggered margin calls, which contributed to increasing the demand for cash. A discussion of the mechanisms associated with margin calls is in Box 4.2.

Box 4.1: MMF developments during the market turmoil²⁰

The MMF industry is sizeable, with approximately US\$6.9 trillion of assets under management at year-end 2019.²¹ The sector plays an important role in supporting the real economy, both as a liquid and diversified cash management tool for investors, and as a key source of funding for governments and corporates (both financial and non-financial). Post-2008, international standards on MMF regulation were strengthened, notably through valuation, maturity and liquidity risk management requirements.²² The MMF sector is heterogeneous, exhibiting differing characteristics depending on fund type, structure and investor type across jurisdictions. Such differences are important in assessing the effect of COVID-19 related market dislocations.

The March turmoil predominantly affected US- and EU-domiciled MMFs, though the effects varied by MMF type and currency, with significant outflows from those holding non-government debt, along with historic inflows into MMFs invested in government debt during the dash for cash period. Other jurisdictions did not report significant impacts on their MMF sectors.

In the US, there are three types of MMFs: government, prime and tax exempt. The latter two types comprise institutional and retail funds. Different rules apply to different funds: government and retail funds (both prime and tax-exempt) have a stable NAV, while institutional funds have a floating NAV. Non-government funds must be able to introduce liquidity fees and gate redemptions, while government funds have the option, but not the obligation, to introduce these features in their prospectuses. Government funds must invest at least 99.5% of their assets in cash, government securities and fully collateralised repo agreements. Prime funds have both daily and weekly liquidity requirements, while tax-exempt funds only have a weekly liquidity requirement. All funds are required to invest in securities with minimal credit risk.

In Europe, government MMFs are called Public Debt MMFs and are allowed to have a stable, or constant, NAV (PDCNAV). In addition to PDCNAV funds, there are two other types of short-term (i.e. with a maximum maturity of approximately one year) funds: low volatility (LVNAV) funds are allowed to use a rounded NAV of 1.00 if their mark-to-market NAV remains within a tolerance of 20bps, otherwise they need to convert to mark-to-market NAV. Short-term variable NAV funds, on the other hand, always deal on the basis of their mark-to-market NAV. Finally, there are also longer-term VNAV MMFs, which can have a maturity of up to two years. All types of MMFs have minimum daily and weekly liquidity requirements and can introduce liquidity fees and gates.

Government MMFs experienced record inflows during March in the US and the EU, but the picture for non-government MMFs is different. Prime MMFs in the US and USD-denominated MMFs (\$LVNAV) in the EU experienced the most significant redemptions. Following the central bank interventions, all non-government MMFs honoured redemptions and none of them applied fees, gates or suspensions.

In the US, prime MMFs recorded outflows of US\$125 billion in March, representing 11% of their assets, and some faced challenges to maintain their weekly liquidity buffers. However, this figure masks considerable variation. Redemptions from prime MMFs publicly offered to institutional investors during the dash for cash period were considerably higher at approximately 30% of assets under management (AUM), while redemptions from retail prime funds totalled approximately 9% of AUM. Prime institutional MMFs not offered to the public, which are often used by asset management firms to manage their cash, saw even lower redemptions at approximately 6% of AUM. For publicly offered funds, concerns about the potential application of gates or fees – which could result if a fund dropped below the 30% liquidity

²⁰ See the IOSCO *Thematic Note on Money Market Funds during the March-April Episode* (November 2020).

²¹ See https://www.iifa.ca/industry_statistics/index.html.

²² Post-2008, IOSCO developed common international standards for the regulation and management of MMFs – see *IOSCO Final Report on Policy Recommendation for Money Market Funds* (October 2012). These have assisted the development of a global framework for MMF regulation, though domestic frameworks vary across jurisdictions in response to local market structures.

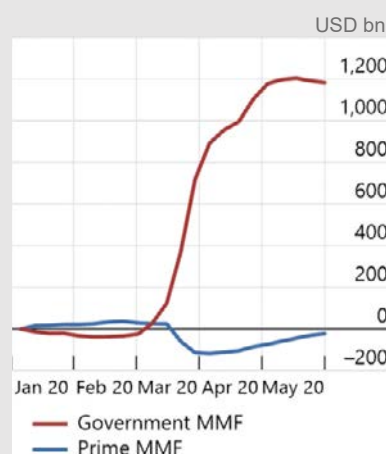
threshold – may have accelerated outflows; as may have been the case as well for \$LVNAV in the EU. These outflows happened at the same time as the underlying funding market (notably the commercial paper market) experienced a sharp drop in liquidity prior to the Federal Reserve’s Money Market Mutual Fund Liquidity Facility announcement on 18 March. Following the announcement, prime MMFs recovered their pre-COVID-19 level of assets under management by end-April.

In Europe, although MMFs experienced outflows overall in March, there is considerable variation across currencies and regulatory fund types. While GBP-denominated funds mainly domiciled in Luxembourg and Ireland initially experienced outflows, these outflows reversed quickly, possibly due to the potential absence of safer alternatives and the investor profiles of such funds. USD-denominated LVNAV funds recorded significant net outflows from mid-March – representing more than 25% of the \$LVNAV assets domiciled in Luxembourg and Ireland; the situation, however, varied across individual funds.²³ A limited number of \$LVNAV resorted to using their weekly liquid assets to meet redemptions. They also sold securities in the secondary market where possible and, where market conditions did not allow for it, they did not reinvest maturing money market instruments. As these funds were not eligible under the Federal Reserve programme, liquidity strains were more enduring for \$LVNAV compared to US Prime MMFs. From the beginning of April, with volatility decreasing and the markets eventually stabilising, outflows tailed-off with net inflows experienced since. As market conditions improved quickly enough on the back of unprecedented public sector response, ultimately no \$LVNAVs were required to convert into floating NAV MMFs as mandated under relevant EU regulation under specified conditions.²⁴

MMFs flows in different jurisdictions

Graph Box 4.1

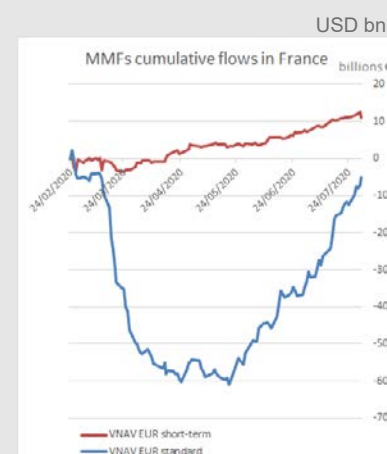
Cumulative MMFs flows in the US



Cumulative flows of USD-denominated MMFs in Luxembourg



Cumulative flows of EUR-denominated MMFs in France



Euro-denominated MMFs in the EU (mostly domiciled in France), also recorded significant outflows from mid-March representing approximately 15% of their assets. To meet redemptions, €VNAV drew down their weekly liquid asset buffers and sold some of their securities on the secondary markets. The ECB’s communication on 12 March, which allowed banks to operate temporarily below the level defined by the Liquidity Coverage Ratio, may have played a role in easing liquidity tensions and market-making constraints in the underlying funding markets. The temporary pandemic emergency purchase programme (PEPP) helped to ease tensions by purchases of non-financial CPs. Assets under management of €VNAVs have recovered to their pre-COVID level from mid-July.

²³ Based on a sample of funds representing 70% of AUM of MMFs domiciled in Luxembourg. Flows in funds domiciled in Ireland followed a similar pattern – see Golden, *The persisting effect of the pandemic on Money Market Funds and money markets*, Central Bank of Ireland Economic Letter 9 (October 2020).

²⁴ Article 33 of the Money Market Fund Regulation (EU) 2017/1131.

Increased demand for less risky and more liquid assets, including those with a shorter maturity, manifested in the selling of certain assets and shifts in the portfolios of some MMFs. While the impact of the COVID-shock differed among jurisdictions (see Box 4.1) two distinct patterns were observed in European and US MMFs:

- There was a surge in redemptions from non-government (prime and tax-exempt) MMFs, i.e. those that invest in short-term CP and CDs. Outflows from US prime MMFs by the end of March amounted to US\$125 billion (roughly 11% of AUM), with the majority of these redemptions in funds that were publicly offered to institutional investors. This contributed to the effective closure of the market for short-term funding and a sharp increase in demand for short-term government debt.
- There was a surge in inflows into government MMFs that invest in short-term government securities.²⁵ Government MMFs, which invest in cash-like short-term debt, saw record inflows in excess of US\$800 billion in March, roughly 30% of their assets under management. These inflows were partly attributable to a reallocation from prime MMFs and other short-term funding market investors, but also driven by disinvestments from other less-liquid asset classes in order to meet demand for cash (see below). Corporates and households also increased their deposits at banks (deposits at US banks increased by around US\$476 billion over the course of March).²⁶

Some open-ended funds also experienced large redemptions, particularly those with a greater mismatch between the frequency with which they offer redemptions and the liquidity of their assets.²⁷ Investors in funds that hold less liquid assets may tend to act procyclically, making larger redemptions in response to fluctuations in the price of funds' underlying assets.²⁸ Outflows from some EME and AEs' equity and corporate bond funds in March reached levels not seen since the 2008 financial crisis, both in terms of absolute amounts and as a percentage of assets under management (Graph 4.2). EME and AE bond funds saw greater outflows despite experiencing lower negative returns on average than equity funds. For example, in mid-March, weekly outflows from bond funds reached record levels (US\$109 billion). For EMEs, portfolio outflows reached a record level of around US\$83 billion in March, as a result of both equity and debt outflows.²⁹

²⁵ Outflows from prime MMFs by the end of March amounted to US\$125 billion, with some prime-MMFs saw their weekly liquid assets (WLAs) falling below the 30% regulatory lower bound. By end-March, government and Treasury MMFs saw inflows in excess of \$800 billion, or about 30% of their assets under management. See Egemen et al, *US dollar funding markets during the Covid-19 crisis – the money market fund turmoil*, BIS Bulletin 14 (May 2020).

²⁶ FDIC data.

²⁷ See Falato et al, *Financial Fragility in the COVID-19 Crisis: The Case of Investment Funds in Corporate Bond Markets*, NBER working paper 27559 (July 2020).

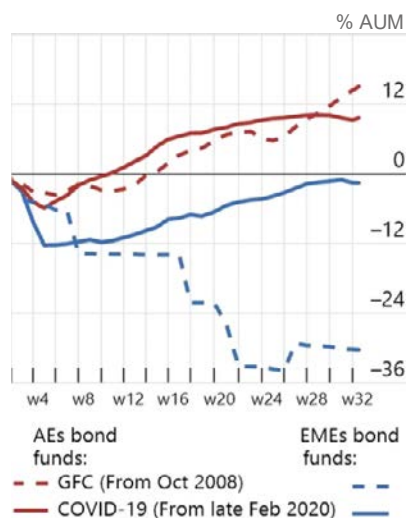
²⁸ See Baranova et al, *Simulating stress across the financial system: resilience of corporate bond markets and the role of investment funds*, Bank of England Financial Stability Paper No 42 (July 2017).

²⁹ See *IIF Capital Flows Tracker – The COVID-19 Cliff* (April 2020).

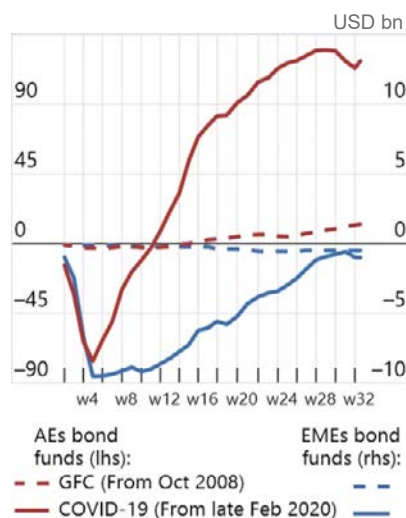
Shifts in investor portfolios led to large redemptions from open-ended investment funds

Graph 4.2

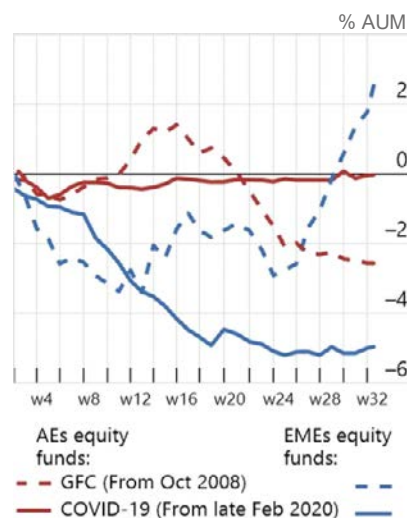
Panel 1: Cumulative flows to corporate bond funds and comparison with the 2008 global financial crisis (GFC)



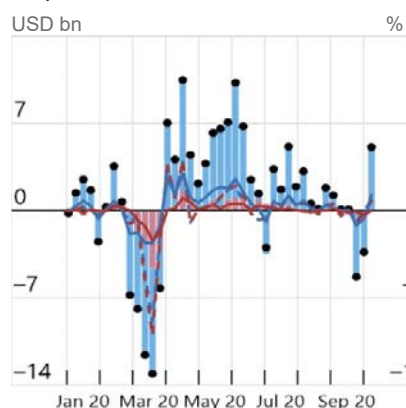
Panel 2: Cumulative flows to corporate bond funds and comparison with the 2008 global financial crisis (GFC)



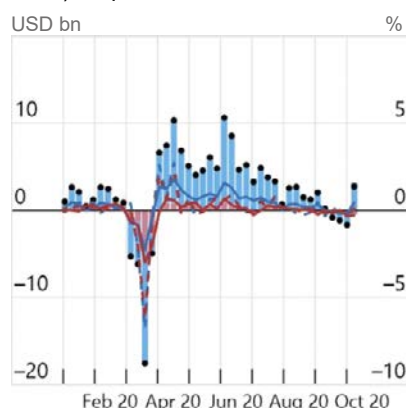
Panel 3: Cumulative flows to equity funds and comparison with the 2008 global financial crisis (GFC)



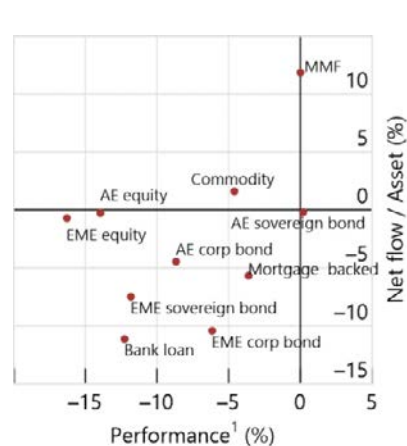
Panel 4: High yield (AE and EME) corporate bond funds



Panel 5: Investment grade (AE and EME) corporate bond funds



Panel 6: Net flow vs Performance in March 2020



Data up to 7 October 2020. AUM = assets under management.

¹ NAV % change is the change in the underlying value of the selected asset class/geographic group

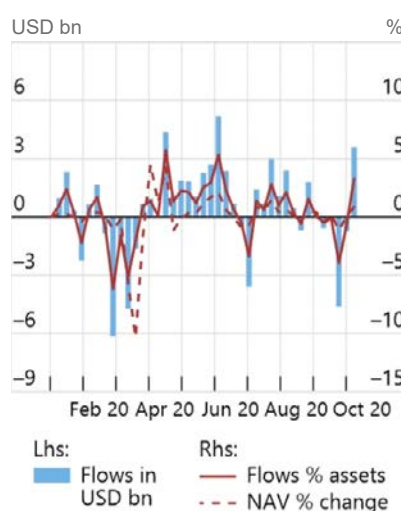
Sources: EPFR; FSB calculations.

ETFs, which offer immediate liquidity because of their trading on secondary markets, became one of the key mechanisms for price discovery during the dash for cash. In particular, there were some large differences between certain fixed income ETF share prices and the estimated value of their assets (Graph 4.3). This suggests that ETF prices contained more up to date information about the underlying asset values than out-of-date cash prices, reflecting more accurately the liquidity and cost of selling those assets. Though ETFs sold fewer bonds than open-ended funds, outflows from ETFs measured as a percentage of AUM were similar or larger during the stress.

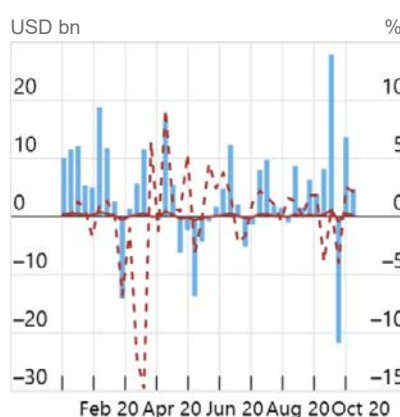
ETFs also experienced outflows, as well as large discrepancies between their market price and NAV

Graph 4.3

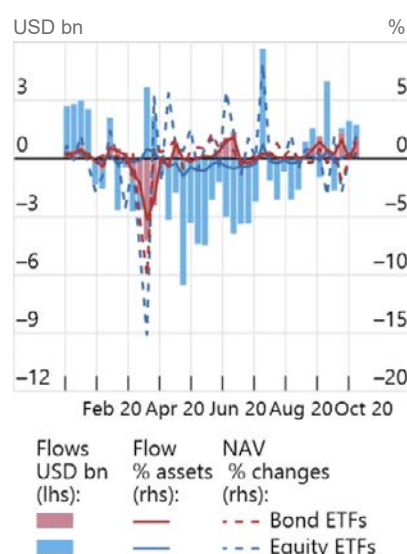
Panel 1: HY (AE and EME) bond ETFs



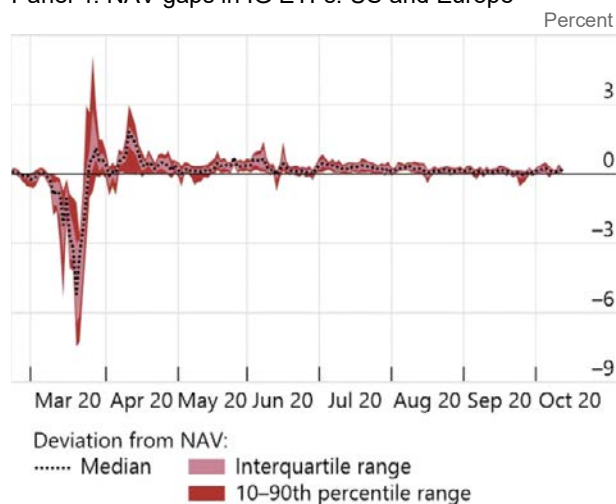
Panel 2: Equity (AE and EME) ETFs



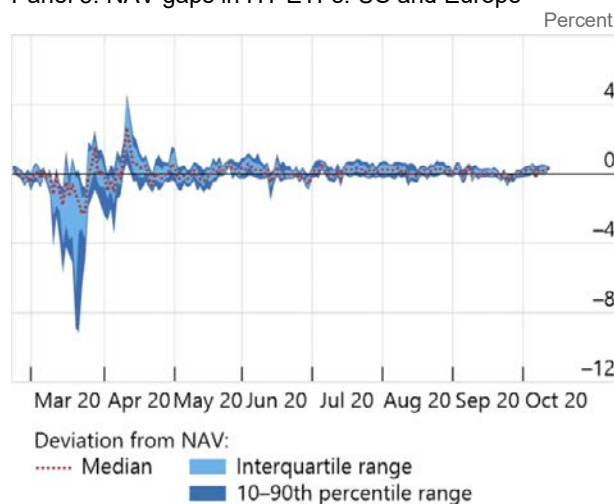
Panel 3: EME ETFs



Panel 4: NAV gaps in IG ETFs: US and Europe



Panel 5: NAV gaps in HY ETFs: US and Europe



Data for panel 1, 2, and 3 are up to 7 October 2020. HY = High yield. IG = Investment grade. NAV = Net Asset Value.

Sources: EPFR; Refinitiv; FSB calculations.

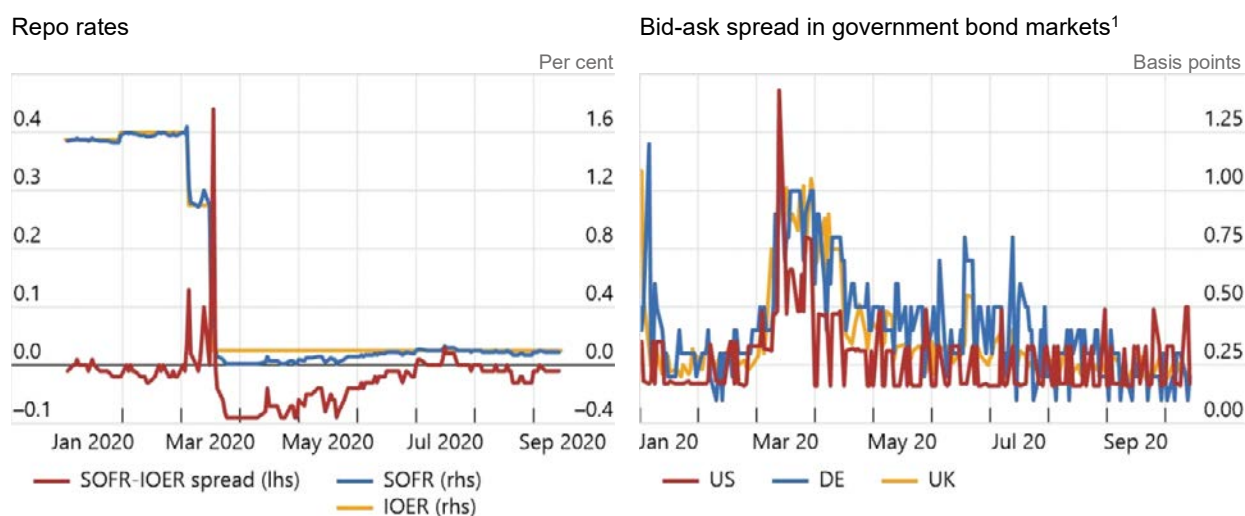
Supply of liquidity

Internal risk management practices and regulatory constraints reduced dealers' ability to intermediate larger flows in some secured funding markets. In normal times, some secured funding (e.g. repo) markets, allow market participants to convert assets (e.g. government and corporate bonds) into cash. In the initial phase of market stress, dealers absorbed sales of government bonds by other market participants in a relatively orderly manner. However, as demand for liquidity increased, sales of such securities overwhelmed dealers' capacity to intermediate in these markets, given constraints on their balance sheets. Increasing risk meant dealers were less willing to meet short-term imbalances in the supply of/demand for cash. Repo rates increased sharply, as a range of market participants struggled – or were forced to pay higher prices – for cash (Graph 4.4).

Dealers also could not fully accommodate substantial increases in volumes in a number of securities markets. As a result, price discovery in some markets – including those for less risky assets that are normally highly liquid, such as government bonds – was impaired. Headline measures of market liquidity, such as bid-offer spreads, widened sharply, in some cases to levels that exceeded those seen during the 2008 financial crisis. The already mentioned large differences between the prices of some ETFs and the value of their assets is consistent with a considerable lack of liquidity in their underlying assets. Reductions in intermediation might also have reflected other pressures on dealers' balance sheets – for example, an increase in their lending to the non-financial sector via the drawdown of committed credit lines.

Reductions in dealer intermediation led to a sharp tick-up in the cost of secured finance, and reductions in securities market liquidity

Graph 4.4



1 10-year. SOFR: Secured Overnight Financing Rate; IOER Interest Rate on Excess Reserves.

Sources: Federal Reserve Bank of St Louis, FRED; Bloomberg; Eikon.

Operational constraints may also have adversely affected the provision of market making and liquidity during the March market volatility. While financial market infrastructures, functioned well and were able to handle record trading volumes (see below), operational challenges may have constrained market-making activity. Particularly during the early days of remote working, some market intermediaries suffered from poor connectivity and problems connecting with colleagues and counterparts. Some firms also reported that their staff were unfamiliar with how to implement processes when working from home, particularly in the early days of remote working. This resulted in a number of payment delays and other operational incidents. It may also have impaired market functioning, to the extent that human traders were unable to step in as some high-speed algorithmic traders substantially reduced their participation in certain markets.

4.3. The propagation of liquidity stress

Mitigants and amplifiers of liquidity strains

CCPs remained resilient despite market turbulence. Increased use of central clearing in derivatives markets reduced aggregate collateral demands by allowing exposures and payment obligations to be netted multilaterally. Nonetheless, extremely high asset price volatility and large trading volumes led to significant increases in initial margin and flows of variation margin.

Margin calls have contributed to the increased demand for cash. Initial margin calls for cleared derivatives experienced large increases in Q1 2020, as a result of the sharp rise in market volatility in March combined with increased transaction volumes and portfolio rebalancing (see Box 4.2 for a discussion of the mechanics of margin calls). Variation margin calls were also sizable during March 2020.³⁰ Data provided through IOSCO's Financial Stability Engagement Group show that most of the increase in initial margins took place between 6 and 13 March, which suggests that margin calls contributed at least in part to the initial dash for cash. While increases in margin are to be expected in volatile markets, some market participants may not have anticipated the size or timing of the increase in margin requirements, and so needed to utilise cash buffers or obtain further funding to meet those margin requirements.³¹

Box 4.2: Margin call mechanics and effects

Margin represents the collateral that one party in a transaction (for instance a hedge fund entering an interest rate swap contract) deposits with or passes to the other party (for example a broker or a clearing house) as protection against past or anticipated future contract losses. There are two types of margin – initial margin (IM) and variation margin (VM) – which have different aims.

Initial margin represents collateral protecting against the risk that the counterparty does not meet its future obligations in the transaction. These margin payments are a regulatory requirement in cleared, and many uncleared, derivatives transactions. To the extent that certain categories of market participants are exempt from these requirements, their counterparties may cover the associated risks in the bid-offer spreads. Initial margin is paid at the inception of a contract, but can vary through its lifecycle, and serves as the first line of defence – if a firm is unable to afford IM, it cannot transact. IM models, designed to ensure that there are sufficient pre-funded resources to cover losses due to counterparty default, are risk-based, and take into consideration both market risk as well as idiosyncratic risks at the instrument and portfolio level. IM therefore traditionally increases when indicators such as volatility or counterparty default risk increase.

Variation margin is exchanged regularly (e.g. daily) throughout the life of a contract in order to cover changes in the market value of the relevant portfolio.

Increased volatility in March resulted in increases in IM, due to changes in IM requirements at a product level, as well as position changes at a portfolio/firm level. In addition, VM payments increased, with larger price moves and consequent mark to market gains and losses being exchanged between counterparties. These dynamics occurred by design across cleared and uncleared derivatives markets as well as various securities markets. Substantial variation was present in changes in initial margins between CCPs between the end of 2019 and March 2020, with some CCPs experiencing increases in excess of 100% as compared to previous quarter.

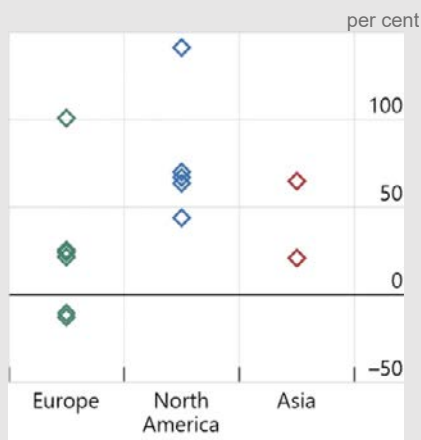
³⁰ See <https://www.clarusft.com/margin-calls-during-covid-19/> and <https://www.bis.org/publ/bisbull13.pdf>.

³¹ CCP margin calls' impact on overall liquidity can be considered by pairing margin call data with clearing members' and clients' available liquid resources, where initial comparisons suggest relatively small overall magnitudes. An initial comparison between the increase in IM posted to CCPs in March relative to banks' available cash (focusing on the US, UK, EU and Japan) shows the former representing 2-3%. An initial comparison of VM calls (focusing on the USD market) on peak days in March against volume of overnight repos – the principal short-term funding source for banks – shows the former representing 3.5%.

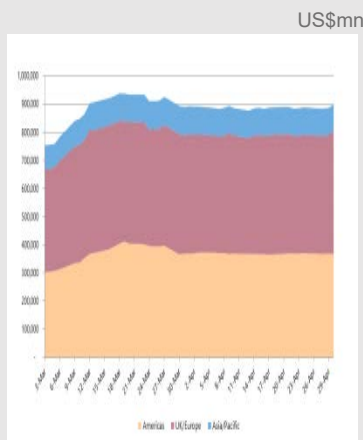
Initial and variation margin changes

Graph Box 4.2

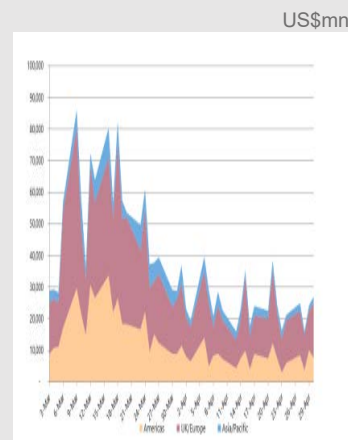
Change in initial margins by CCP q4 2019 - q1 2020



Initial margin 3 March to 30 April (daily)



Variation margin 3 March to 30 April (daily)



Source: CCP disclosures, IOSCO Financial Stability Engagement Group.

IM and VM charts reflect trends within region and globally, but comparative weight between regions not proportional due to sample size.

For cleared derivatives globally, initial margin held at CCPs rose over the course of March 2020 while daily amounts of VM exchanged in March were sizable as markets experienced substantial volatility.

VM and IM can affect market liquidity conditions differently. VM, reflecting price movements of a financial contract or portfolio, transfers mark to market and realised losses from one counterparty to another, thus moving liquidity within the system albeit on a potentially large scale. In aggregate, the demand for liquid assets to meet variation margin calls does not change, with some market participants receiving VM while others paying it. At a less aggregate level, a given market participant may be paying VM on some trades while receiving VM on others. In contrast, because IM reflects anticipated volatility in underlying markets, it is required and held by CCPs from clearing members (and, in turn, clients). Cash IM posted for centrally cleared transactions may be invested by the CCPs with the market. Therefore, liquidity may be – at least partially – recycled back to the market by the CCP.

In March 2020, daily demands due to additional initial margin requirements were notably smaller when compared to the same-day VM calls. One set of IM mitigants in March was designed to reduce margin increases during periods of volatility, commonly known as anti-procyclicality (APC) measures. All major CCPs are required to have, or voluntarily have in place, APC measures of some type to dampen or slow down the changes in IM. Most APC measures entail higher IM when market volatility is low, thereby reducing the extent of the upward adjustment when volatility increases. This may provide market participants some additional time to prepare for further margin calls, should those calls hit them unexpectedly. In the March market turmoil, IM increased sharply after a few days, which suggests that APC tools were able to dampen or slow down the IM increase only for a short time period.

In addition to the relative size of demands, there is often extra flexibility in satisfying IM demands. Where VM calls are almost exclusively satisfied with cash transfers, many different high quality collateral types are acceptable for IM (e.g. high-quality sovereign debt). While CCPs accept certain non-cash assets for IM, anecdotal evidence indicates that firms chose to post cash instead, which raises questions as to whether IM calls added to cash demands and funding markets stress.

Some investors in open-ended investment funds may have faced incentives to redeem ahead of others. Such an incentive may have arisen if investors anticipated that the price of a fund unit did not reflect the true value of its underlying assets, particularly where these were illiquid.³² In mid-March, large differences arose between the prices of certain ETF shares and the value of their underlying assets, including those holding less liquid assets such as corporate bonds (Graph 4.3). To the extent that ETFs are considerably more liquid than their underlying assets, the existence of such a price differential suggests that ETF share prices may have reflected more current market information than the valuation of the underlying assets. By contrast, investors in other open-ended funds may have faced incentives to redeem ahead of others. This is because investors in mutual funds could have redeemed their units at the old (stale) NAV, while the actual value of the underlying assets was more accurately reflected in ETF prices.

The use of liquidity management tools may have successfully reduced redemptions in some cases, but in others it may have contributed to accelerating them. Investment funds use liquidity management tools to manage their liquidity and protect the interests of remaining investors in the face of large redemptions.³³ In Europe, a number of funds used tools such as swing pricing, which seek to reduce incentives faced by investors to redeem ahead of others. Previous studies have shown that alternative or swing pricing rules help funds to retain their investor capital during periods of high market stress.³⁴ Other funds also used ex-post liquidity-management tools such as suspensions, deferral of redemptions and redemption fees.³⁵ In March, as market conditions deteriorated however, the prospect of some of these tools being applied may have contributed to increased redemptions. To meet redemption pressures and margin calls and build cash buffers, open-ended funds sold assets, which may have impacted market dynamics.

Overall, improvements to their capital and liquidity positions over the past decade enabled banks to absorb the shock and prevented a sharp rise in counterparty risks. More resilient balance sheets in the sector (see Section 3) helped to avoid a repeat of events during the 2008 financial crisis, where concerns about banks caused a freeze in funding markets.

Nevertheless, banks may have been unwilling or potentially unable to deploy their balance sheets in a highly uncertain and volatile environment. Banks' private decisions (e.g. positions cutting and compression of ticket sizes) as well as changing behaviour from their clients played an important role. Internal risk controls might have constrained banks' role as market makers. While regulatory requirements proved effective in containing excessive bank leverage, those requirements may have become temporarily binding for some banks given the magnitude of the shock. For example, some banks may have seen a temporal increase in the denominator of the leverage ratio as a result of intermediation in secured funding markets. These constraints might have reduced dealers' incentives to expand their balance sheets by absorbing mismatches between supply and demand in these markets in stress.

³² See Liang, *Corporate Bond Market Dysfunction During COVID-19 and Lessons from the Fed's Response*, Hutchins Center Working Paper # 69 (October 2020).

³³ Since the 2008 financial crisis, regulation has focussed on addressing structural vulnerabilities from asset management activities that could potentially present financial stability risks, including recommendations on liquidity management tools. See the *Policy Recommendations to Address Structural Vulnerabilities from Asset Management Activities* by the FSB (January 2017) and the *Recommendations for Liquidity Risk Management for Collective Investment Schemes* by IOSCO (February 2018).

³⁴ See Jin et al., *Swing pricing and fragility in open-end mutual funds*, FCA Occasional Paper #48 (May 2019).

³⁵ 76 funds in the EU suspended redemptions across several asset classes between March and mid-April; see Fitch, *European mutual fund ratings rise as coronavirus spooks markets* (2020).

Propagation through short-term funding markets

Stress was propagated through the interaction of investors in CP markets (Graph 4.5). Amid increased risk aversion and desire for liquidity, investors became less willing to advance funds in the short-term unsecured market and fund CP with a maturity greater than a few days. Significant redemptions from non-government MMFs, which threatened to deplete the funds' holdings of liquid assets, may have exacerbated strains in the short-term funding market. In the EU, some funds that held a significant portion of CP and other short-term debt adjusted their portfolios by selling less-liquid and riskier assets such as term CP and CD, and shortening the maturity of their unsecured debt. Some funds also attempted to raise funds by requesting issuing banks buy back their CP. Some banks accommodated these requests, others discouraged them with aggressive pricing. A few requests were, in the absence of contractual obligations, denied.³⁶

Dealers also faced difficulties absorbing large sales of assets, amplifying turmoil in short-term funding markets. Dealers' intermediation capacity was limited with the holdings of large amounts of other securities contributing to constrained balance sheets.³⁷ Banks became less willing or able to supply hedging services and faced increased credit drawdowns by corporates, while prime MMFs that traditionally supply dollar funding faced redemptions and were forced to sell assets. Some intermediaries' balance sheets may have been particularly inflexible given the looming March quarter-end. This pullback in the supply of dollars resulted in a sharp increase in funding costs. As a result, activity in CP and CD markets decreased markedly, primary issuance decreased sharply and issuers (both corporate and financial) struggled to roll over funding.

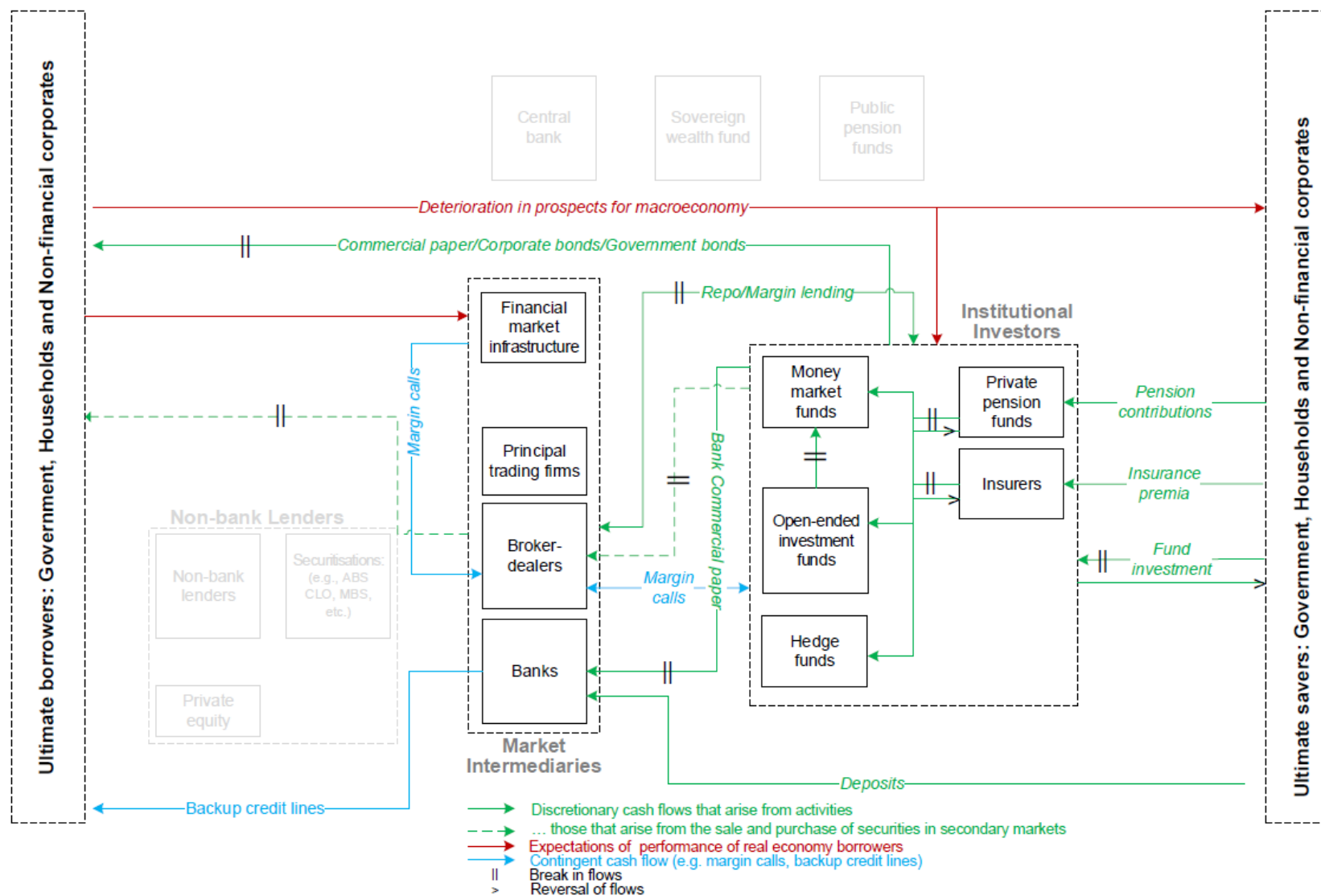
The cost of funding for financial institutions increased, contributing to tighter funding conditions. Short-term funding cost surged as measured by, for example, interest rates on CP, CD and unsecured interbank lending. Bank funding conditions tightened not only because banks received less funding from MMFs, but also because corporate borrowers who were no longer able to obtain short-term funding via MMFs drew down their credit lines with banks, thereby crowding out other forms of bank lending.

Tighter dollar funding conditions affected entities that borrow in US dollars worldwide. Non-government MMFs are important holders of US dollar CP issued by non-US banks and non-financial corporates. Amid outflows from these funds, stresses intensified in the US dollar funding markets – particularly in the case of banks headquartered outside the US.³⁸ Portfolio outflows from US dollar-denominated bonds issued by EME borrowers were significant. At the same time demand for funding (including US dollars) increased amid lower revenues (especially for commodity exporters) and fiscal expansion. These factors contributed to an increase in the US dollar bond yields for EME borrowers – increasing the repayment cost for those without natural hedges. Funding conditions tightened as a result of rising domestic interest rates and depreciating exchange rates.

³⁶ See the special feature on *Recent stress in money market funds has exposed potential risks for the wider financial system* in the ECB's Financial Stability Review (May 2020).

³⁷ See Schrimpf et al, *Leverage and margin spirals in fixed income markets during the Covid-19 crisis*, BIS Bulletin No. 2 (April 2020) and Duffie, *Still the World's Safe Haven? Redesigning the U.S. Treasury Market After the COVID19 Crisis*, Hutchins Center Working Paper #62 (May 2020).

³⁸ See Eren et al, *US dollar funding markets during the Covid-19 crisis – the international dimension*, BIS Bulletin No. 15 (May 2020), and Saleem and Reis (2020), *Central bank swap lines during the Covid-19 pandemic* (April 2020).



Propagation through core government bond markets

Amid increased demand for cash and shorter-maturity assets, investors sold large volumes of longer-dated Treasuries in favour of shorter-dated assets. There were large, though orderly, inflows in to Treasuries up to early March – with yields falling to record lows for all maturities. Government MMFs, investing in Treasury bills received significant inflows, pushing the short-maturity T-bill rates to zero. However, during the dash for cash there were also strong selling pressures in Treasury bonds with longer maturity, and those yields increased temporarily but sharply, especially in less liquid off-the-run Treasuries. The propagation of stress via US Treasury markets is summarised in Graph 4.7.

Market dysfunction was exacerbated by substantial sales of US Treasuries by some leveraged investors.³⁹ Since 2018, these investors had taken increasing leveraged positions in some government bond markets, to seek to arbitrage differences in market price between the value of derivatives, and the cash instruments that they reference (commonly referred to as the “basis trade”) (Graph 4.6).⁴⁰ As a spike in the demand for the most liquid safe assets in mid-March led to a decoupling in the price of US Treasuries relative to futures, these positions became loss making. The increase in US Treasury price volatility also led to margin calls in spot markets for basis trade investors, some of whom encountered difficulties renewing funding for their trades.⁴¹ Large-scale unwinding of these trades, of almost US\$90 billion during March, was likely one of the contributors to a short period of extreme illiquidity in government bond markets.

Selling by foreign holders of government bonds also added to market pressures. For example, foreign holders sold, net of purchases, a record amount of almost US\$300 billion Treasury bonds and bills in March (Graph 4.6). About one-fifth of these sales were by foreign official institutions, including central banks. This may have reflected efforts of EME authorities to raise USD cash to satisfy USD funding needs of non-US financial firms, or to intervene in foreign exchange markets. Large sales came from offshore financial centres, where some leveraged investors are domiciled. In this sense, the build-up of dollar credit abroad may have increased liquidity pressures in the US Treasury market.

Dealers’ capacity to intermediate in other asset classes was also constrained – including corporate bonds – contributing to higher funding costs for corporates. Amid concerns over the economic outlook for corporates, the cost of issuing debt increased markedly and corporate bond funds faced record redemptions. In response to these selling pressures, dealers limited purchases of corporate bonds and shed some of their inventory. The cost of principal trades increased significantly, and the fraction of agency trades (that typically take longer to execute) increased – contributing to further illiquidity in the corporate bond market.⁴² The sharp reduction in market liquidity likely exacerbated asset price declines, and it may have hindered other investors from acting counter-cyclically by stepping in to take advantage of lower bond prices.

³⁹ For a discussion of the role of leveraged investors in US Treasury markets, see Schrimpf et al (ibid) and Barth and Kahn, *Basis Trades and Treasury Market Illiquidity*, OFR Brief Series (July 2020).

⁴⁰ The largest 25 US hedge funds, for example, together accounted for 50% of the hedge fund industry’s borrowing as of 2019Q2, even though they accounted for less than 14 percent of its net assets; see Securities and Exchange Commission Form PF, ‘Reporting Form for investment advisors to private funds and certain commodity pool operators and commodity trading advisors’.

⁴¹ See Schrimpf et al (ibid).

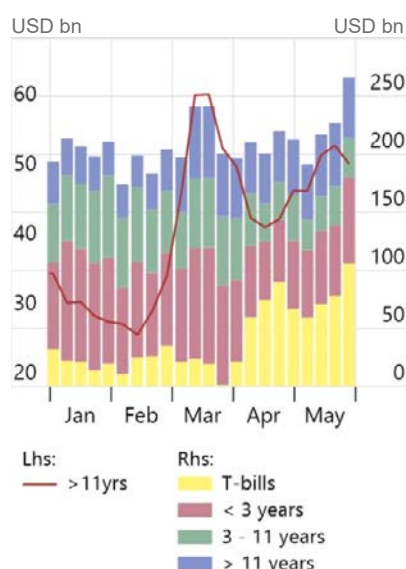
⁴² See Kargar et al, *Corporate Bond Liquidity during the COVID-19 Crisis* (May 2020).

This combination of large asset sales, together with the limited ability/willingness of dealers to intermediate in some markets, became self-reinforcing. Large-scale asset sales, combined with limited dealer intermediation (see above) contributed to increased volatility and illiquidity in certain markets. This prompted margin calls, both in centrally cleared and bilateral markets as well as in spot markets, which contributed to increased demand for liquid assets leading to further assets sales and further volatility. Together with increased risk aversion, this made it more difficult and expensive to secure funding, prompting those market participants who wanted to raise cash to sell securities. Such sales further overwhelmed broker dealers' ability to intermediate in these markets, also contributing to further volatility.

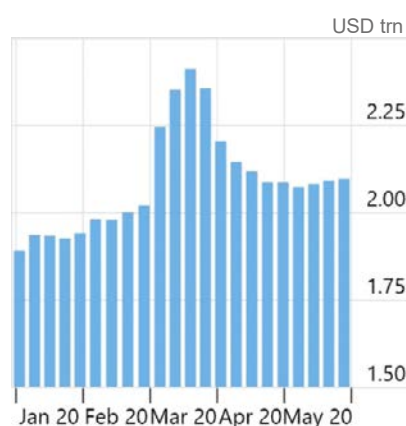
Primary dealers' balance sheet and net US Treasury sales by foreigners

Graph 4.6

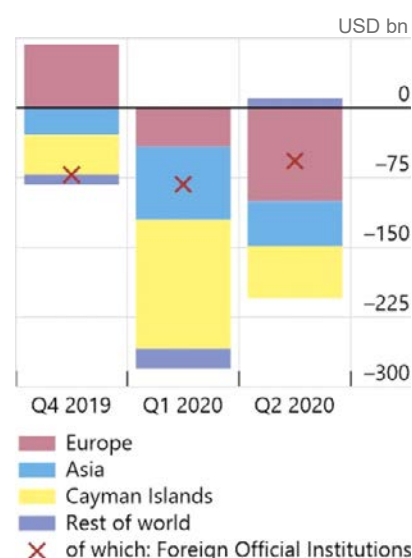
Primary dealer net Treasury positions



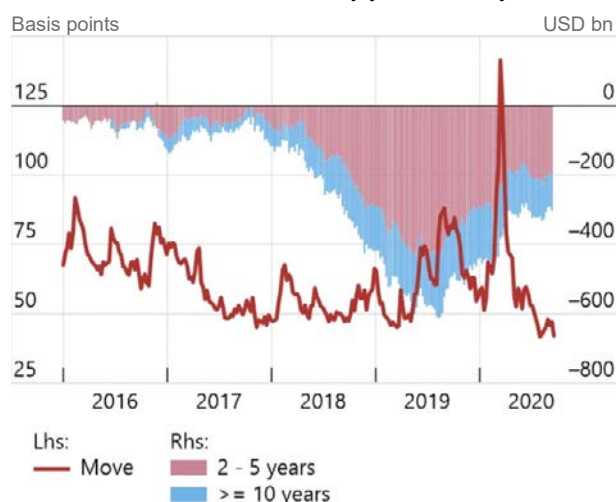
The quantity of financing primary dealers needed to support Treasury inventories¹



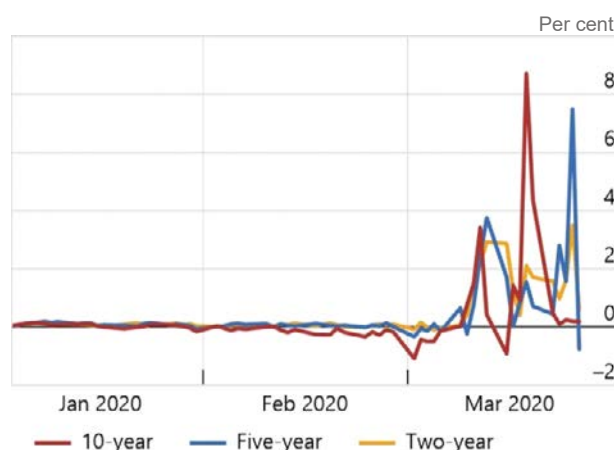
Net purchases of US Treasury bonds by foreign residents



Net speculative positions in Treasury futures markets and MOVE Index of US Treasury yield volatility



Cash Treasury-futures dislocations²



¹ The quantity of Treasury securities financed includes overnight and term, nominal securities as well as Treasury Inflation-Protected Securities, and covers securities with repurchase agreements and securities lending agreements. ² JPMorgan Chase cheapest-to-delivery implied repo rates minus the one-month General Collateral market repo rate.

Sources: Federal Reserve Bank of New York; JPMorgan Chase; Bloomberg; CFTC; US Department of the Treasury; FSB calculations.

Graph 4.7



5. Public sector responses

This section focuses on the policy measures, particularly central bank interventions, taken to ease financial market strains during the March turmoil. Authorities have adopted a broad range of measures in response to COVID-19.⁴³ A number of other measures may have also affected financial market conditions – for example, fiscal packages and credit guarantees helped support the economy and market sentiment – though these policies go beyond the scope of this report.

5.1. Measures taken

The policy response to the dash for cash episode was speedy, sizeable and sweeping to ensure public markets remained open. Following cuts to policy rates in a number of central banks, the intensifying pressures in markets, particularly government bond and short-term money markets, led to the rollout of a wider set of policy measures that provided liquidity support and backstopped specific markets or entities. Ultimately, these measures were aimed at preventing a sharp tightening in financial conditions, halting an intensification of the market shock, avoiding knock-on effects from markets to the economy and ensuring the smooth transmission of monetary policy.

The policy actions were unprecedented and in several cases went beyond those taken during the 2008 financial crisis. Central banks in many countries expanded the assets they were willing to purchase, including by taking credit risk, and increased their balance sheets at an unparalleled scale. Overall, these measures led to a US\$7 trillion increase in G7 central bank assets in just eight months (Graph 5.1). In contrast, G7 central bank assets only rose by about US\$3 trillion in the year following the collapse of Lehman Brothers in 2008. In addition to these actions by central banks, a number of prudential measures were also taken to help ease market strains.

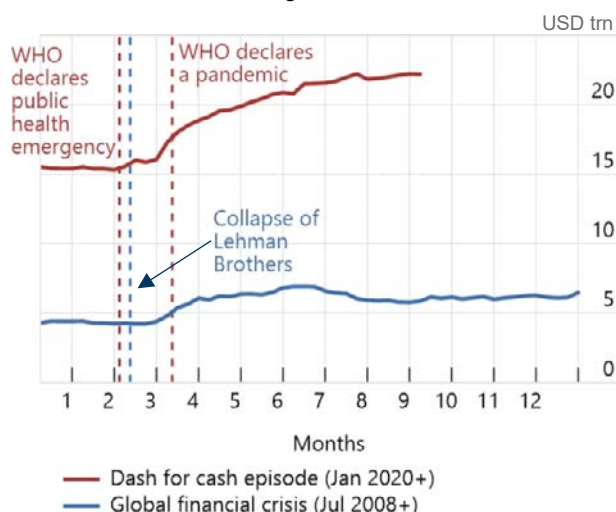
There was significant heterogeneity in the policy response across jurisdictions. This reflected a number of factors, including the nature of the shock locally, the importance of market-based finance in each economy, policy frameworks and available tools. For example, in the largest advanced economies, with large non bank financial sectors, the policy response ranged from cuts to interest rates, an expansion in government bond purchases, and the provision of liquidity to the banking system to the buying of risk assets and targeted liquidity facilities for specific entities, including dealers and money market funds (Graph 5.1 RH panel). Whereas in a number of emerging market economies, where the shock manifested itself as a shortage for US dollars, the response was focussed on more traditional monetary policies, or measures to provide dollar liquidity.

⁴³ These include: (1) government guarantees and direct lending, loan restructuring, capital injections and other corporate relief; (2) central bank policy interventions to ease credit conditions and keep markets open and functioning; (3) prudential measures to facilitate the continued flow of credit to the real economy and provide operational flexibility to supervised firms; and (4) actions to support market functioning. See the FSB's *COVID-19 pandemic: Financial stability implications and policy measures taken – Report to the G20* (July 2020) for details.

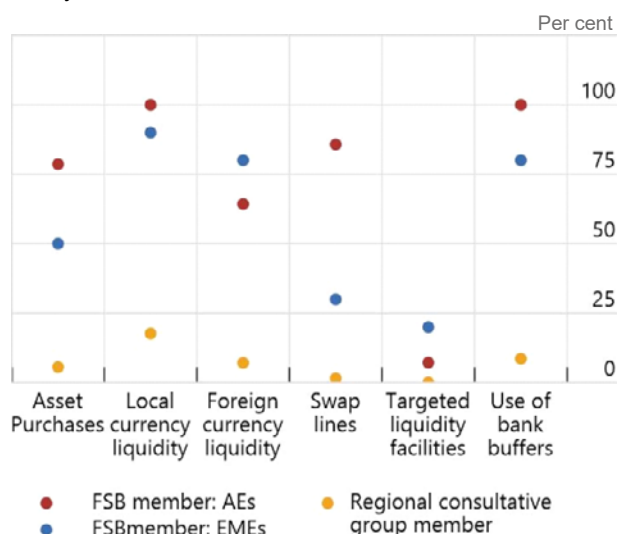
Central bank balance sheets expanded rapidly

Graph 5.1

Central bank assets during crisis¹



Policy measures



¹ Includes central bank assets in Canada, the euro area, Japan, United Kingdom and United States.

Sources: Datastream; national data; FSB calculations

These measures have been working to alleviate market stress through different channels (Table 1). These channels effect the various aspects of the dash for cash episode, discussed in Section 4, either directly—where the policy measure is aimed at targeting a specific market or entity—or indirectly—where the measure has a positive spillover effect on other markets and entities, for example by improving investor sentiment or making more liquidity available in the financial system as a whole.

- A first channel is through central bank asset purchases. Initially this occurred through an expansion of government bond purchase programmes. These purchases provided indirect support to markets by reducing risk free rates, supporting risk appetite, lowering market volatility and improving market liquidity. Central banks did not limit themselves to sovereign debt and purchases included a range of risk assets, including corporate bonds, CP and asset-backed securities (sometimes with government backing). In the US corporate bond purchases targeted primary and secondary markets, and also included high yield bond ETFs, which had operational advantages relative to buying a heterogeneous portfolio of underlying bonds. Overall, purchases of risk assets supported markets indirectly by lowering risk premiums, which helped increase risk appetite further, and provided indirect support to MMFs by increasing the demand for the commercial paper and asset-backed securities held by those funds.
- The second main channel is central bank liquidity operations. These more traditional operations provided broad-based liquidity support to the banking sector in local currency. This helped anchor funding rates and also indirectly helped other markets as banks used part of the new liquidity to purchase assets or to lend to other market actors that themselves bought securities. Furthermore, some central banks widened the pool of collateral that they accepted in these operations, and increased risk tolerances, and this helped indirectly support the markets with eligible collateral by increasing the demand for those assets.

Table 5.1: Typical measures taken to help restore market functioning

	Asset purchases		Broad-based liquidity support		Targeted liquidity support	Regulatory/supervisory measures
	Government bonds	Risk assets	Local currency	US dollar		
Funding liquidity shortage	Asset purchases provide liquidity to those selling the assets to central banks.		Central bank lending to the banking sector.		Targeting lending helps liquidity shortages in those sectors.	Use of bank capital and liquidity buffers helps support lending and reduce liquidity shortages for others.
Sudden increase in margin calls	Purchases help to lower market volatility and reduce the need for margin calls.			-	-	-
Dealer intermediation constraints	Purchases help to reduce dealer inventories and improved appetite to intermediate.	-	-	-	Central bank direct lending to dealers.	Changes to leverage rules.
High demand for US dollar funds	-	-	-	Central bank swap lines and Fed repo facility.	-	Use of bank buffers to support lending.
Outflows from prime MMFs	-	-	Increasing the demand for assets by reducing liquidity constraint on banks and/or widening the pool of eligible collateral.	More dollar liquidity helps reduce fire sales of dollar assets.	Central bank backstop lending against assets purchased from MMFs.	MMF facility temporarily excluded from the leverage ratio.
Investment fund redemptions	Asset purchases supported prices and hence improved risk appetite, reduced risk-free rates and risk premiums, and helped reverse fund outflows.				-	-
Portfolio outflows from EMEs					-	-

¹ See the annex for more information on the classification adopted here.

- Liquidity operations were also provided outside the US in dollars to directly help alleviate the dollar cash shortage. On 15 March, in the first major coordinated response to the crisis, five central banks – the Bank of Canada, the Bank of England, the Bank of Japan, the ECB and the Swiss National Bank – that already had arrangements with the Federal Reserve reduced the pricing and increased the frequency and tenor of their swap lines. On 19 March, new swap line arrangements were agreed with nine other countries: Australia, Brazil, Denmark, Korea, Mexico, Norway, New Zealand, Singapore, and Sweden. On 31 March, the Federal Reserve announced the establishment of a new temporary repo facility for foreign and international monetary authorities that would allow them to enter into repurchase agreements with the Federal Reserve. Dollar liquidity operations also helped to indirectly ease redemption pressures in money market and other funds – by reducing the need for fire sales of assets to gain cash – and helped support portfolio flows to emerging market economies.
- A third channel of support for markets is through backstop facilities designed to provide targeted liquidity to specific financial entities. These facilities directly support market entities by providing them with liquidity. Most of the examples have been in the US. For example, the Federal Reserve's Primary Dealer Credit Facility expands the range of eligible counterparties by providing collateralised liquidity to primary dealers to directly alleviate dealer intermediation constraints. In the Money Market Mutual Fund Liquidity Facility, the Federal Reserve lends to banks where the collateral consists of assets that the banks have purchased from money market funds, directly supporting those funds. The Covid Corporate Financing Facility in the UK purchased eligible, highly-rated CP from dealers and so in the process helped to provide them with liquidity support.
- In some jurisdictions a fourth channel, regulatory measures, complemented these central bank interventions. Authorities in many countries, as well as the Basel Committee on Banking Supervision (BCBS), have been encouraging banks to use capital and liquidity buffers to support lending. This provides indirect support to counter liquidity shortages and the high demand for US dollar funds. Supervisors have also taken a number of measures to free-up resources and alleviate operational burdens, for example by extending implementation deadlines, temporarily relaxing compliance requirements and reprioritising timetables for policy initiatives.⁴⁴ A number of authorities temporarily modified leverage ratio rules to exclude bank reserves at the central bank from the leverage exposure calculation, directly helping to ease dealer intermediation constraints. Furthermore, in Canada and the US the leverage ratio was temporarily amended to exempt holdings of government securities, while the US authorities exempted bank purchases of assets in connection with central banks' support programs from capital and liquidity requirements. In addition, the Federal Reserve and the Securities and Exchange Commission allowed a few sponsors of MMFs to buy assets from their affiliates to directly ease outflow pressures. US authorities also allowed banks to accelerate the adoption of the Basel III standardised approach for calculating the exposure of derivative contracts.

⁴⁴ International standard setters' implementation timetables have also been extended. For example, the BCBS extended the implementation date of the final Basel III framework by one year, and the International Association of Insurance Supervisors extended the timetable for putting the Holistic Framework for systemic risk into operation. The BCBS and IOSCO also deferred by one year the final implementation phases of the framework for margin requirements for non-centrally cleared derivatives.

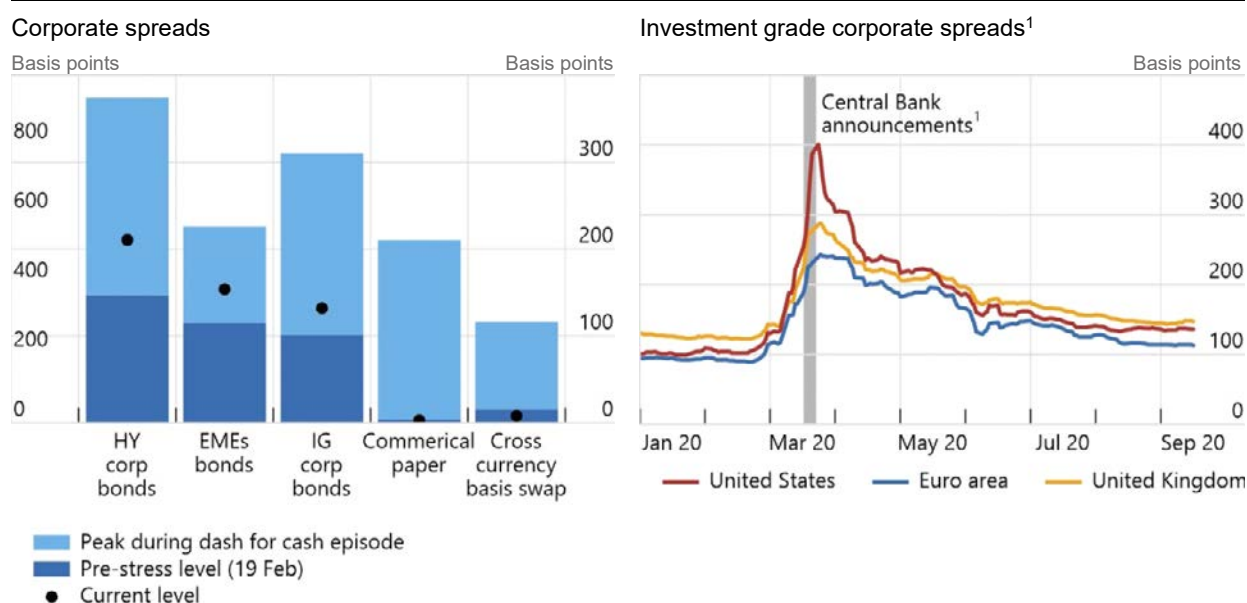
- Securities regulators also took a number of measures to support market functioning, including: close monitoring of the resilience of market infrastructures and of investment fund liquidity; the issuance of additional guidance to market participants; and the continued flow of information to markets, while ensuring targeted relief on certain reporting requirements.

5.2. Outcomes

The policy measures succeeded in alleviating market strains to date. In the absence of the central bank interventions, the stresses in markets would have likely continued and may well have been amplified. Conditions eased across a range of different markets, also supported by massive subsequent fiscal stimulus. Graph 5.2 (LH panel) shows that market spreads are now back to around their pre-stress levels, from substantially wider positions in March, across corporate bond, commercial paper and cross-currency markets. At the same time, volatility subsided, measures of market liquidity such as bid-ask spreads reverted to pre-crisis levels, and investor risk appetite returned. Many emerging market central banks launched a broad set of measures and facilities to provide liquidity and relief to markets. In some cases, asset purchase schemes were implemented for the first time. The announcement of these schemes helped to restore investor confidence, leading to a fall in local currency bond yields.⁴⁵

Policy measures have eased pressures in markets

Graph 5.2



¹ The shaded area shows the period 17-23 March when many policy measures were introduced by central banks.

Sources: ICE BofAML indices; FSB calculations.

Investment grade corporate bond yields tightened following a series of announced asset purchase schemes from major central banks during 17-23 March (Graph 5.2 RH panel). On the third day, the Bank of England announced it would increase its stock of asset purchases by £200 billion, including an increase in purchases of corporate bonds. On the following day the ECB's Pandemic Emergency Purchase Program was announced. This seemed to slow the widening in

⁴⁵ See Arslan et al, *Central bank bond purchases in emerging market economies*, BIS Bulletin No 20 (June 2020).

bond spreads in these two economies. Finally, on 23 March the Federal Reserve announced its Primary and Secondary Market Corporate Credit Facilities, and gave a commitment to purchase treasuries and asset-backed securities in “amounts needed”. This seemed to stem the market strains, corporate bond spreads began to tighten in earnest, and bond issuance recovered.⁴⁶

Funding conditions eased, both in local and cross-currency markets. The activation of dollar swap lines were effective in providing a lender of last resort function in foreign currency and led to an easing in dollar funding costs and substantial declines in cross currency basis swap spreads.⁴⁷ In these markets there was a direct link between the degree to which the facilities were used and the impact on market prices.⁴⁸ The Federal Reserve’s repo facility has also helped to ease dollar funding markets in countries without access to the swap lines. The launch of new or modified liquidity facilities in non-dollar jurisdictions also helped support local current liquidity. For example, the Bank of England launched a Contingent Term Repo Facility to support funding conditions for banks and a Covid Corporate Financing Facility to support the short-term financing needs of higher-rated corporates. The ECB expanded the assets it accepted as collateral for its liquidity operations, enabling banks to draw from its facilities using a broader range of assets.

Financial market outflows were also stabilised. The suite of central bank measures, which helped to restore market confidence and supported bond and commercial paper markets through asset purchases, helped to calm the outflows from prime and municipal money market funds, redemptions from some open-ended investment funds with more illiquid assets (as discussed in Section 4), and capital outflows from emerging market economies. Money market funds were targeted by the Federal Reserve and these interventions helped to not only stabilise flows, but to also helped short-term funding markets recover.⁴⁹ Indeed, it is likely that without these measures the MMF industry would have been more severely affected.

⁴⁶ See Haddad et al, *When selling becomes viral: disruptions in debt markets in the covid-19 crisis and the fed’s response*, NBER Working Paper, No. 27168 (May 2020).

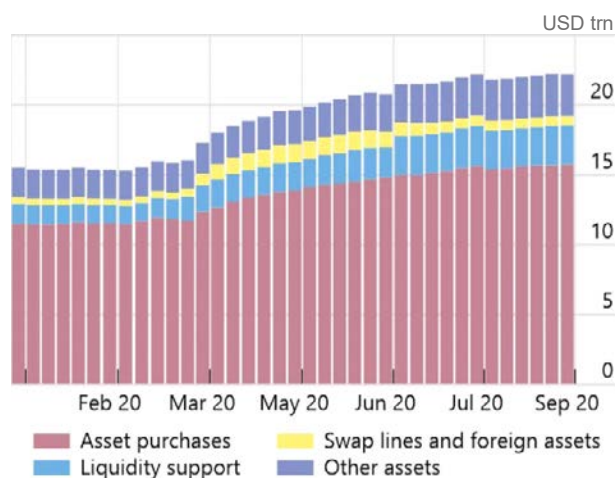
⁴⁷ See Avdjiev et al, *Dollar funding costs during the Covid-19 crisis through the lens of the FX swap market*, BIS Bulletin, No. 1 (April 2020); and Eren et al, *US dollar funding markets during the Covid-19 crisis – the international dimension*, BIS Bulletin, No. 15 (May 2020).

⁴⁸ See Bahaj and Reis, *Central bank swap lines during the Covid-19 pandemic*, CEPR Covid Economics, Issue 2 (April 2020).

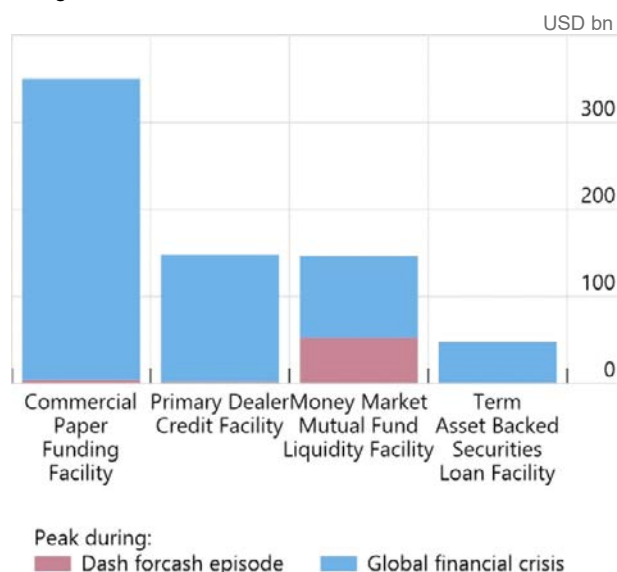
⁴⁹ See Li et al, *Runs and interventions in the time of Covid-19: Evidence from money funds*, CEPR Covid Economics, Issue 29 (June 2020).

Most of the increase in central bank assets has been through asset purchases Graph 5.3

Central bank assets breakdown¹



Usage of Fed credit facilities²



¹ Includes central bank assets in Canada, the euro area, Japan, United Kingdom and United States.

² In 2008-09 there was not a Money Market Mutual Fund Liquidity Facility but a similar one called the AMLF (Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility).

Sources: Datastream; national data; Remarks by Daleep Singh, New York Fed Executive Vice President and Head of the Markets Group, at the Hudson Valley Pattern for Progress (8 July 2020); FSB calculations

Announcement effects seem to have been important for alleviating market pressures, working through the expectations of market participants. Investors seemed to be calmed by the announcement of asset purchases, in anticipation of buying by central banks, as discussed above. The announcements coincided with substantial improvements in trading conditions, including declines in bid-ask spreads as two-way flow conditions improved across markets. For example, corporate bond spreads started to decline on 23 March but the Federal Reserve did not actually start purchasing corporate bonds on the secondary market until 12 May. Similarly, in the UK, the announcement of the Contingent Term Repo Facility helped to mollify market conditions before any funds were ultimately drawn.

The easing effect on markets cannot, however, be explained by announcement effects alone. As mentioned earlier, central bank assets expanded significantly in a few weeks. Most of the expansion was due to asset purchases, which accounted for about 65 percent of the increase in G7 central bank assets, rather than direct liquidity support or backstop measures (Chart 5.3 LH panel). Furthermore, in the US, the peak use of the backstop facilities during the dash for cash episode was significantly below the level during the 2008 financial crisis (Chart 5.3 RH panel). This all suggests that the impact of asset purchases in providing liquidity to the financial system was notable in influencing the outcome in markets.

Some markets not directly affected by central bank measures have not recovered to date. For example, open-ended funds in some jurisdictions – such as commercial property funds – continue to be suspended. This, in turn, can be seen as evidence of the impact that policy measures have had on those markets that were within the reach of measures.

6. Conclusion

6.1. Lessons learned and issues raised

The external COVID-19 shock in March tested the resilience of a global financial system that has become increasingly reliant on market-based intermediation to finance growing levels of debt. With the overall growth of NBFIs, market liquidity and the provision of market making capacity have become more central to financial resilience. At the same time, market-making capacity by banks may have become more constrained, while the provision of liquidity by some new entities and in electronic markets is potentially less robust.

The breadth and dynamics of the economic shock and related liquidity stress experienced in March were unprecedented. Given the size and scope of the economic shock, some degree of financial stress would be expected. Indeed, as in previous cases, the shock led to a fundamental repricing of risk and a heightened demand for safe assets. However, the stress also led to large and persistent imbalances in the demand for, and supply of, liquidity needed to support intermediation. These imbalances also emerged in core government bond markets.

Large-scale and swift policy intervention – including fiscal, monetary, and prudential policy measures – succeeded in stabilising markets. While fiscal policy helped to shield the real economy from the effects of the pandemic and maintain credit supply, central bank actions eased liquidity strains. The importance of central bank announcement effects may suggest risk aversion of market participants (and related unwillingness to supply or redistribute liquidity) was an important driver of the turmoil. Concerns about side-effects include distortions to price discovery in financial markets and a further build-up of financial risks.

Absent central bank intervention, it is highly likely that the stress in the financial system would have worsened. This would have had a major impact on the financial conditions for financial sector and real economy firms and their ability to raise funds. However, by the necessity to intervene in such a substantial way central banks had to take on material financial risk. Moreover, aggressive policy actions may have changed private sector expectations of central bank actions in the future. This could lead to moral hazard issues in the future, to the extent that markets do not fully internalise their own liquidity risk in anticipation of future central bank interventions in times of stress.

The measures taken by central banks were aimed at restoring market functioning, and not at addressing the underlying vulnerabilities that caused markets to amplify the stress. The financial system remains vulnerable to another liquidity strain, as the underlying structures and mechanisms that gave rise to the turmoil are still in place.

The March turmoil has underscored the need to strengthen resilience in the NBFIs sector for the global financial system to be able to absorb shocks and ensure the smooth provision of financing to the real economy. There is a need for the FSB, working together with the SSBs, to promptly initiate work to enhance that resilience. The episode has further highlighted issues associated with individual types of market activities and particular mechanisms that may have caused liquidity imbalances and propagated stress.

- Significant outflows from non-government MMFs reflecting liquidity mismatches and perceptions by end-investors as cash-equivalent or redeemable on demand. Redemption dynamics may have been exacerbated by certain fund structures and regulations that may have created perceptions of first-mover advantage.
- Similar dynamics, albeit less intense and widespread, may have been present in other types of open-ended funds. In particular, funds invested in less liquid assets (such as property, high yield corporate bonds and bonds issued in EMEs), may have faced redemption pressures because of their liquidity mismatch as well as because of the uncertainty associated with the value of their investments.
- The challenge faced by some market participants to cope with liquidity demands arising from variation and initial margin calls raises questions about whether they were fully expecting those calls and whether they were adequately prepared for funding them. It also raises questions as to whether their actions to raise liquidity may have adversely affected other parts of the financial system, and whether the assets they hold to meet their liquidity needs can be easily monetised in stress.
- While initially dealers absorbed bond sales in an orderly manner, intense selling pressure temporarily overwhelmed their willingness or capacity to intermediate in core funding markets, including less liquid segments of the corporate debt markets. This may have contributed to illiquidity and severe price moves, raising questions about the financial system's ability to handle liquidity imbalances during stress, as markets continue to grow.
- The dislocations in key government bond markets raise questions about the role of leveraged investors in those markets.
- The rise in settlement fails during the period of acute stress raises questions about market participants' operational capacity to source and deliver securities on time.
- The turmoil also highlighted the increased importance of interconnectedness and system-wide liquidity conditions for the resilience of the financial system.
 - Interconnectedness within the NBFIs sector and with banks, as well as greater reliance on market and funding liquidity to support market-based intermediation reinforce the need to analyse the system as a whole.
 - Related are questions about market structure in core government bond markets, which form de facto global safe assets and pricing benchmark, and the role of these markets in supporting resilient NBFIs.
 - The lack of liquidity in CP and CD markets also raises questions whether the structure of these markets limits their capacity to absorb demand or supply shocks.
 - In a global context, the turmoil has brought to the fore questions about fragilities in USD cross-border funding, including the interaction of dollar funding markets, foreign exchange markets, and domestic currency bond markets in EMEs.

Adopting a system-wide perspective on these issues presents significant challenges for authorities given the difficulties in collecting the relevant data; mapping the transmission of risks through the financial system; and having the policy tools to respond as needed.

6.2. Policy implications and areas of further work

The analysis conducted and the issues identified in this report suggest that the efforts of the international regulatory community to reinforce the resilience of NBFIs, while preserving its essential functions and benefits, should focus on three main areas:

- i. In the short-term, work to examine and, where appropriate, address individual risk factors and specific markets that contributed to amplification of the shock. This includes analysing whether mitigants put in place after the 2008 financial crisis have worked as intended, and assessing implementation progress on related G20 reforms;
- ii. Enhancing the understanding of systemic risks in NBFIs and the financial system as a whole, including the interactions between banks and non-banks, the resilience of the NBFIs sector and cross-border spill-overs; and
- iii. Assessing policies to address systemic risks in NBFIs, including the adequacy of policy tools and the concept and desired level of resilience in NBFIs. These efforts to strengthen resilience in the NBFIs sector should not compromise the resilience in other parts of the system or the important role that NBFIs play in financing the real economy.

First, the review of specific risk factors and markets would encompass the areas identified in this report as contributing to the amplification of the shock in March. These include examining:

- 1) liquidity risks, core functions and aspects of the structure or regulations in non-government MMFs which experienced large outflows and contributed to the stress in short-term funding markets;
- 2) whether and how other types of open-ended funds invested in illiquid assets could amplify liquidity stress, recognising the variety of fund structures (including interactions between mutual funds and ETFs), underlying assets (including their role in facilitating investment for the real economy) and the availability and use of liquidity management tools across different jurisdictions;
- 3) whether market participants were fully prepared for the margin calls they experienced, their ability to liquidate assets to meet margin calls under stressed conditions, and the role of margining practices both in centrally cleared and bilateral markets in amplifying funding strains;
- 4) the role of leveraged investors in core government bond markets, to assess whether excessive leverage could be a cause for concern in future episodes; and
- 5) the structure of core funding markets for both governments and corporates, including the sources and drivers of market-making capacity and the role of banks and non-banks in the provision of liquidity, including in times of stress.

Whether reforms in these areas have been implemented and if so, the extent to which they may have mitigated the turmoil or have had unintended consequences, also needs to be examined in this context.

Second, enhancing the understanding of the resilience properties of the system as a whole would encompass analysing:

- 1) the interconnections between banks and the NBFIs sector and their implications for financial resilience. This includes questions as to whether changes to the structure of core financial markets can increase the ability of the system to absorb shocks without ceasing to perform its functions.
- 2) the concept and desired level of resilience of the system, with a particular focus on the resilience of financial markets that are core to the global financial system and the provision of financial services to the real economy, such as markets for government and corporate bonds, foreign exchange and derivatives.
- 3) the role of public policy in ensuring system resilience and the provision of financial service to the real economy.

This work, which would be exploratory by design, should take into account whether shocks are generated by the financial system itself or are external to it, the likelihood of large shocks materialising, and the mechanisms within the system that would dampen or amplify the shock.

Third, as a more complete understanding of the properties of the system is being developed, the role of policies to address systemic risks in NBFIs should be assessed. A range of policy tools already exists, or are being implemented, in NBFIs. While adjustments/refinements to some of these tools may be considered to support NBFIs resilience, there is the question of whether and how those tools should be embedded in a framework that take account of their impact on the system as a whole. Clarifying the role of mechanisms to strengthen resilience *ex ante* (including effective structural risk mitigants such as central clearing and avoidance of procyclicality), in order to minimise the need for exceptional *ex-post* interventions (e.g. through system-wide liquidity backstops provided by central banks), would be important elements of such work. This will also help address concerns about the risk of any unintended consequences, including moral hazard, due to expectations of central bank interventions.

Work on the first area should proceed at pace to minimise the chances that similar vulnerabilities expose the real economy to unnecessary risks going forward. The second area of work will require more time to develop a set of specific questions to answer as well as determining the preferred approach to doing so. Finally, the analysis on policies to address systemic risks in the non-bank sector should be flexible enough so that any insights gained in the other two areas can be reflected in any future policy outcome.

The FSB will coordinate the international regulatory community's assessment of identified vulnerabilities and the appropriate financial policy response, working closely with standard setting bodies and its members. As part of this review, the FSB published a comprehensive NBFIs work programme covering the key issues at a high level (see the Executive Summary).

Annex 1: Timeline of financial market developments

This Annex describes the events that took place during the market turmoil. The main period of analysis is divided into three separate sub-periods. An initial period, labelled “flight to safety” (approximately 21 February - 11 March), when investors reduced their exposures to risky assets and increased their exposure to safe ones. Then the “dash for cash” period (approximately 11 March - 23 March), when investors sold almost every asset to increase their cash balances. Finally the “easing of market stress” period (approximately 23 March onwards) which was the result of the interventions of many authorities and resulted in the end of the most acute phase of the crisis. For completeness, and to aid the reader in understanding the developments of the turmoil some of the events that took place beforehand - mainly in China, where the pandemic started - are also part of the analysis. This period is labelled “prelude to the market turmoil”.

The timeline heavily relies on the daily IMF Global Markets Monitor reports published at the time. These reports summarise developments in global financial markets across the globe. Other sources include international organisations, mainly the World Health Organisation (WHO), specialised newspaper articles, and reports from think tanks and commentators.

Graph A.1 presents the timeline visually.

Prelude to the market turmoil

Early in the year, financial markets were buoyed by a relative sense of optimism on the back of supportive monetary policies, reduced trade tensions, and tentative signs of stabilisation in the global economy.

Following some local reports in the press in the previous week, on 9 January 2020 the WHO reported⁵⁰ that Chinese authorities identified a novel coronavirus in a hospitalised person with pneumonia in the city of Wuhan. Five days later, on 14 January it stated⁵¹ that, based on previous experience with respiratory pathogens there was potential for human-to-human transmission. On the same date, the total number of confirmed cases in China stood at 41.

In the following week the number of confirmed cases continued to increase, the WHO confirmed evidence of human-to-human transmission on 19 January⁵². Financial markets in China and elsewhere initially took little notice of these developments and fluctuated until 23 January. On this date, following confirmation of the 17th death in the country, Chinese authorities imposed a lockdown in the city of Wuhan. This was a day before a week of national holidays for the Chinese New Year, which would have resulted in hundreds of millions of people travelling across the country. Financial markets in China then started to show signs of strain with the Shanghai Composite Index losing 2.8% on 23 January reflecting the potential effects on growth of the spread of the virus.

⁵⁰ See <https://www.who.int/china/news/detail/09-01-2020-who-statement-regarding-cluster-of-pneumonia-cases-in-wuhan-china>.

⁵¹ See <https://twitter.com/UNGeneva/status/1217146107957932032>.

⁵² See <https://twitter.com/WHOWPRO/status/1218741294291308545?s=20>.

The following week Chinese markets were closed because of the national holiday mentioned above. Travel restrictions were imposed in a number of Chinese provinces and a growing number of cases was reported in various countries (including Brazil, Germany, Italy, Japan and Thailand) showing that the virus was starting to spread globally. A number of international travel restrictions were imposed during the week, including Russia closing its border with China. A number of Chinese provinces extended their national holiday to reduce the spread of the virus. Global financial markets, especially in Asia, declined somewhat reflecting concerns about the virus but were still calm.

On 1 February, the Chinese government announced⁵³ a multi-agency package to support the financial system. The People's Bank of China (PBC) conducted large open market operations and cut interest rates. The PBC injected RMB1.2 trillion into the financial system, which was its largest one-day operation since 2004 and pledged to maintain abundant market liquidity.

The announcement notwithstanding, on 3 February, Chinese markets re-opened and lost approximately 8% in a single day, reflecting concerns about the effects of the virus. In the following two weeks, the Chinese government announced additional stimulus measures.⁵⁴ Global financial markets started to respond to news related to developments in the spread of the virus and recovered substantially in response to easing concerns in China. In the US and continental Europe stock markets reached all-time highs on 19 February. In China markets rose by more than 10% from 3 to 21 February and other indexes (such as the UK FTSE 100 and the Japanese Nikkei 225) were close to the all-time highs at around the same time.

Flight to safety

The number of coronavirus cases continued to increase outside of China with Italy, Iran and South Korea experiencing large increases.

On 21 February, Italian authorities announced local lockdowns in the Northern towns experiencing the highest number of cases (the measures were extended on 9 March). Investors' fears intensified and a general "risk-off" sentiment spread through markets. Volatility rose substantially, with the VIX index reaching 25 on 24 February and 39 on 27 February. Global financial markets experienced their fastest correction ever and even countries that had not reported cases were subject to considerable selling pressure.

Global bond yields declined substantially amid surging demand for safe assets. At the beginning of February, 10 year US treasury bond yields were around 1.5%, by the end of the month they declined to 1.16% and at the trough on 9 March they will be as low as 0.57%. Similarly German bunds were yielding -0.4% in early February, -0.64% in late February and at the trough of 9 March they will reach a record low of -0.83%.

⁵³ See <http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3965907/index.html>.

⁵⁴ See the following links for additional information. First announcement on 7 February, second announcement on 7 February, announcement on 17 February and announcement on 20 February.

In the third week of February bond funds in emerging markets reported inflows, while equity funds reported moderate outflows, consistently with investors rebalancing their portfolio from risky to safer assets.

In late February and early March a number of Central Banks started signalling that they would be supporting markets. On 28 February US Fed Chair Jerome Powell issued a statement⁵⁵ pledging to use the Fed tools and “act as appropriate” in response to the virus. On 2 March, Bank of Japan (BoJ) Governor Haruhiko Kuroda issued an emergency statement⁵⁶ indicating that the BoJ “will closely monitor future developments, and will strive to provide ample liquidity and ensure stability in financial markets through appropriate market operations and asset purchases”. On the same day, ECB President Christine Lagarde issued a statement⁵⁷ confirming that the ECB would “stand ready to take appropriate and targeted measures, as necessary and commensurate with the underlying risks”. One day later, on 3 March, Bank of England Governor Mark Carney stated⁵⁸ that “the Bank will take all necessary steps to support the UK economy and financial system, consistent with its statutory responsibilities.” On the same day, following an unscheduled meeting, the Fed cut rates⁵⁹ by 50 basis points.

These statements however were unsuccessful in calming markets with investors still believing that the virus could result in substantial damage to growth. At around the same time the IMF also reported⁶⁰ that divergence in credit markets was becoming apparent. The spread between investment grade and high yield corporate bonds widened to the largest level since 2016. In addition, even among investment grade issuers those more exposed to the virus saw their yields widen relative to the broader index.

With respect to investment flows, high yield ETFs had seen outflows of 8.4% up to this point in the year while investment grade funds were up 2.2%. In emerging markets, fund outflows started picking up in early March with outflows in equity and essentially zero inflows in bond funds in the last week of February.

Between 6 and 9 March the mood in financial markets deteriorated further. Amid the continuous rise in the number of cases in Asia and Europe safe haven assets such as US treasury bonds and German bunds saw very large price increases (implying large reduction in yields). Funding stress indicators increased substantially and credit markets were showing additional stress. Fund outflows from both US and European credit funds increased substantially. Equity markets continued to experience large losses.

On 9 March, Italy - one of the countries most affected by the pandemic up to this point - introduced a restrictive lockdown throughout the country. Financial markets declined further as negotiations among OPEC countries broke down triggering a large fall in the price of oil. As

⁵⁵ See <https://www.federalreserve.gov/newsevents/pressreleases/other20200228a.htm>.

⁵⁶ See <https://www.japantimes.co.jp/news/2020/03/02/business/bank-of-japan-stability-coronavirus/>.

⁵⁷ See <https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200302~f2f6113f52.en.html>.

⁵⁸ See <https://www.bankofengland.co.uk/news/2020/march/governor-statement-to-tsc-on-behalf-of-the-fp-mp-and-pr-committees>.

⁵⁹ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200303a.htm>.

⁶⁰ See <https://www.imfconnect.org/content/dam/imf/News%20and%20Generic%20Content/GMM/archive/GMM%20Mar%203%202020.pdf>.

Saudi Arabia was ready to substantially increase production, Brent crude prices dropped by around 30%.

To this date the virus had infected more than 100,000 people worldwide and killed in excess of 3,500.

Notwithstanding the above, conditions in the corporate bond markets were orderly despite the selling pressure; initial signs of investor outflows from MMFs started to materialise but weren't particularly worrying and the fixed-income ETF market was also functioning orderly. However, in Europe, primary markets were at a standstill with essentially no issuance.

Dash for cash

It is difficult to point to a precise moment where the standard flight to safety behaviour of selling risky assets to buy safe ones morphed into broad based selling. As stated above, US treasury and German bund yields reached their lowest point on 9 March and markets were still functioning orderly on that day. On 11 March however the WHO officially declared⁶¹ the COVID 19 outbreak a pandemic and a number of cracks in markets appeared at around the same time. These dates are therefore used to represent the beginning of the most severe stress period.

A number of countries announced strict containment measures. Iran, France and Germany imposed lockdowns. Others such as Australia, New Zealand and Switzerland closed their borders to non-residents and introduced quarantine requirements for people returning from high-risk areas.

Also on 11 March, and ahead of the government discussing its yearly budget, the Bank of England announced⁶² a number of policy interventions. It reduced interest rates by 50bp, launched a new Term Funding Scheme; reduced the counter-cyclical capital buffer and communicated supervisory expectations that banks should not increase dividends or other distributions. A day before EU leaders agreed⁶³ additional stimulus measures to combat the virus.

US and European money markets started to exhibit significant signs of stress. Outflows from prime MMFs in the US and from European Low Volatility variable NAV (LVNAV) funds denominated in US dollars started gathering pace while at the same time government MMFs started to experience considerable inflows evidencing the fact that investors were looking to hold only cash or cash-like products.

Volatility remained elevated and not just for risky assets. The MOVE index, a measure of interest rate volatility, was close to its highest level in ten years. The 10-year US treasury yield moved

⁶¹ See https://twitter.com/WHO/status/1237777021742338049?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E1237777021742338049&ref_url=https%3A%2F%2Fwww.who.int%2Femergencies%2Fdiseases%2Fnovel-coronavirus-2019%2Fevents-as-they-happen.

⁶² See <https://www.bankofengland.co.uk/news/2020/march/boe-measures-to-respond-to-the-economic-shock-from-covid-19>.

⁶³ See https://ec.europa.eu/commission/presscorner/detail/en/IP_20_440.

by more than 10 bps for five sessions in a row highlighting the fact that investors were experiencing an incredibly high level of uncertainty. The Fed increased⁶⁴ its repo offering further.

On 12 March the ECB announced⁶⁵ a comprehensive package of monetary policy and other measures. These included additional long term refinancing operations, a reduction in the interest charged for such operations, an increase in asset purchases and temporary capital and operational relief to banks. Later in the day, the Fed announced⁶⁶ additional measures to facilitate the flow of credit.

Liquidity in the US Treasury futures and cash markets continued to deteriorate. While a number of reports highlighted that many companies were starting to tap their credit lines as liquidity in bond markets dried up. According to the FT⁶⁷, by 25 March, European and American companies had drawn at least US\$124 billion from their credit lines in the previous two weeks.

Global equity funds saw net outflows of US\$1.8 billion, compounding outflows in the prior two weeks. Fixed income funds experienced very large outflows (US\$26 billion). In addition, EME bond and equity funds also experienced significant outflows. Of the EM bond funds, both hard currency ETFs (-US\$1.4bn) and local currency ETFs (-US\$1.5 billion) saw the largest outflows in over three years. From a regional perspective, Asia ex-Japan equity funds saw redemptions for the seventh consecutive week.

On 13 March both the BoJ⁶⁸ and the PBC⁶⁹ announced additional measures. The BoJ doubled its annual ETF purchases and substantially increased its purchases of corporate bonds and commercial paper. The PBC reduced banks' reserve requirements.

Over the weekend of 14 and 15 March, the Fed announced⁷⁰ a comprehensive package of support measures. It reduced the federal funds rate by 100bp; announced purchases of US\$500 billion in longer-term Treasury securities and US\$200 billion in agency mortgage-backed securities. It also reduced the discount window rate by 150bp to 0.25 percent. In addition, it also announced steps to support the flow of credit through changes to bank capital and liquidity buffers as well as reserve requirements.

Finally, a separate release⁷¹ announced coordinated action with other central banks (Bank of Canada, Bank of England, ECB and Swiss National Bank) to enhance the provision of liquidity via the standing US dollar liquidity swap.

Notwithstanding the significant measures announced by the Fed and other central banks in the previous days, financial markets collapsed on Monday 16 March. The S&P 500 lost 12% in a single day, the worst one day drop since *Black Monday* in 1987 and the VIX reached its peak at 83. Liquidity conditions were particularly bad across asset classes. The IMF GMM reported

⁶⁴ See https://www.newyorkfed.org/markets/opolicy/operating_policy_200311.

⁶⁵ See <https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.mp200312~8d3aec3ff2.en.html>.

⁶⁶ See https://www.newyorkfed.org/markets/opolicy/operating_policy_200312a.

⁶⁷ See <https://www.ft.com/content/c405fe29-9e78-4ade-9ee5-1f890911bdb3>.

⁶⁸ See https://www.boj.or.jp/en/announcements/release_2020/rel200313c.pdf.

⁶⁹ See <http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3989112/index.html>.

⁷⁰ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315a.htm>.

⁷¹ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315c.htm>.

analysis by JP Morgan which showed that that market depth in several asset classes (including US Equities and Treasuries) was comparable to the worst period of the 2008 financial crisis. This was accompanied by a large increase in the transaction costs in the inter-dealer markets.

In addition, data on cross-currency basis swaps indicated that USD funding was still expensive despite the coordinated central bank action and that trading in fixed income markets (especially corporate bonds) was particularly impaired with banks unwilling to support risk taking. Measures of liquidity in corporate bond markets confirmed that liquidity had deteriorated sharply with bid ask spreads and the Amihud⁷² measure reaching levels last seen during the global financial crisis of 2008.

Between 17 March and 23 March a wealth of additional measures were announced by authorities. These measures will have the outcome of ending the extreme stress, but markets would still experience a week of very high uncertainty and very poor liquidity.

On 17 March the Bank of England launched⁷³ the Covid Corporate Financing Facility (CCFF) to provide funding to businesses by purchasing commercial paper of up to one-year maturity. The facility helped businesses who could demonstrate they were in sound financial health prior to the crisis, to pay wages and suppliers, even while experiencing severe disruption to cashflows.

On the same day, the Fed announced the creation of a Commercial Paper Funding Facility (CPFF) and of a Primary Dealer Credit Facility⁷⁴. The former provided a liquidity backstop to issuers of commercial paper: a special purpose vehicle (SPV) would purchase unsecured and asset-backed commercial paper rated directly from eligible companies. The latter allowed primary dealers to support smooth market functioning and facilitate the availability of credit to businesses and households by providing dealers with funding.

On 18 March, the US enacted an economic relief plan including a number of fiscal measures. The Fed also announced⁷⁵ the launch of a Money Market Mutual Fund Liquidity Facility (MMLF). Through this facility, the Fed made loans available to financial institutions to purchase assets directly from money market funds. The facility will be expanded⁷⁶ on 20 March to include funds investing in municipal bonds.

In Europe, the ECB announced⁷⁷ the Pandemic Emergency Purchase Program (PEPP), a €750 billion asset purchase programme including both public and private sector securities. The ECB clarified that the PEPP was subject to considerably fewer constraints compared to previous programmes and hence granted itself considerable flexibility with respect to which assets to include in its purchases.

⁷² The Amihud measure is often used to assess liquidity in bond markets.

⁷³ See <https://www.bankofengland.co.uk/news/2020/march/hmt-and-boe-launch-a-covid-corporate-financing-facility>.

⁷⁴ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200317a.htm> and <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200317b.htm>.

⁷⁵ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200318a.htm>.

⁷⁶ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200320b.htm>.

⁷⁷ See https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200318_1~3949d6f266.en.html.

On 19 March, the Bank of England added⁷⁸ to the measures it had adopted in the previous days. It reduced interest rates to 0.1%, increased asset purchases (including of investment-grade corporate bonds) and enlarged the term funding scheme. While the Fed announced⁷⁹ the creation of temporary US dollar liquidity arrangements (swap lines) with nine additional central banks, some of which were in emerging markets, providing additional avenues for agents in these jurisdictions to access dollar funding.

In the week ending 20 March global financial markets were still under severe stress. In Europe, sovereign bond yields of euro area countries with lower credit ratings were under considerable pressure before the ECB PEPP announcement, bond funds were still experiencing substantial outflows and volatility still very elevated (the VIX stood at 66 on 20 March).

On Monday 23 March the Fed announced⁸⁰ extensive additional measures to support the economy. These included two new facilities which did not previously exist and were designed to support credit to large employers: the Primary Market Corporate Credit Facility and the Secondary Market Corporate Credit Facility, which supported the corporate bond market both in terms of new issuance and for existing bonds. The package included also additional Treasury purchases and agency MBS “in the amounts needed to support smooth market functioning and effective transmission of monetary policy to broader financial conditions and the economy”. It also expanded the MMLF and CPFF to include a wider range of securities.

Taken together, the measures introduced essentially removed risk from investors and transferred it to the balance sheet of central banks and hence of the public sector as a whole.

Easing of market stress

Global stock markets bottomed out between 18 March (Europe) and 23 March (US, China). From 23 March onwards, conditions in financial markets started to improve. Stock markets started to recover, with US, European and Asian indexes posting substantial gains on 24 March. Furthermore, the USD dollar depreciated against a number of currencies highlighting the fact that the demand for dollars was abating reflecting ameliorating funding conditions. Treasury yields declined, reflecting better liquidity conditions in the market and the large purchases by the Fed.

By the beginning of April, markets were past the extreme stress they experienced earlier. While the primary corporate bond markets was essentially closed until this point, issuance in the last week of March increased substantially, liquidity conditions in treasury markets, although still poor by normal standards, considerably improved. Outflows from prime MMF started to reverse and turned positive on 1 April.

By 7 April most global stock indexes were in bull markets, liquidity continued to improve and the extreme stress abated.

⁷⁸ See <https://www.bankofengland.co.uk/monetary-policy-summary-and-minutes/2020/monetary-policy-summary-for-the-special-monetary-policy-committee-meeting-on-19-march-2020>.

⁷⁹ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200319b.htm>.

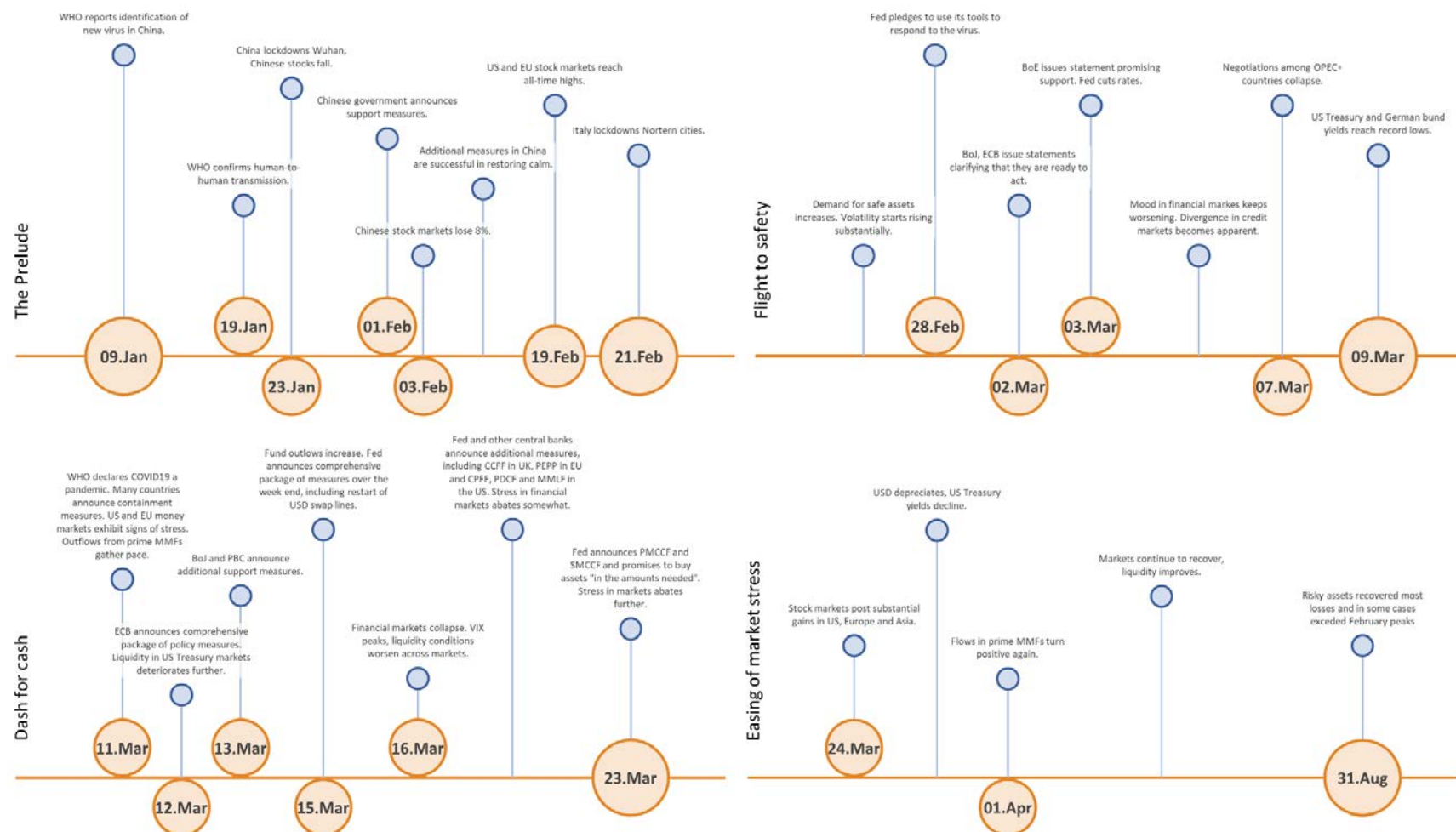
⁸⁰ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200323b.htm>.

In the following months the recovery in financial markets continued. By late August most risky assets had recovered at least three quarters of the losses experienced during the initial stages of the pandemic. US equity indexes were at all times high, while high yield bonds recovered 80% of the losses. European equities recovered more than two thirds of their losses and even oil prices were 50% above their lowest point.

Improving market sentiment has lifted risky asset prices but global output losses have been very large. According to the latest IMF forecast, global GDP could be 6-10 percentage points lower than earlier 2020 estimates. While some indicators suggest a rebound in activity, the path of recovery remains highly uncertain, suggesting a potential disconnect with the prices of risky assets.

Timeline of financial market developments

Graph A.1

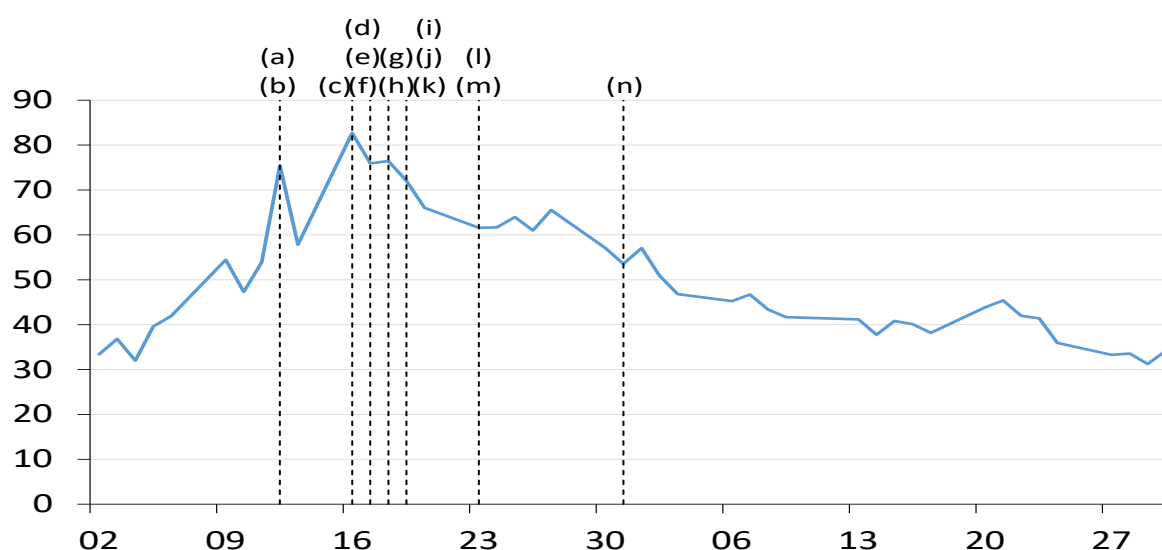


Annex 2: Classification of policy measures

Central banks took unprecedented, fast and wide-ranging actions to mollify the market turmoil. Major central banks introduced a total of 14 different measures over a period of just three weeks (Graph A.2). Most of these actions were taken in the week beginning 16 March when market tensions were at their height and when there were sometimes a number of different central bank announcements on the same day. The combined impact of all these measures by many central banks across different economies calmed investors and helped to resolve the market turmoil.

Reflecting the crucial role of US dollar funding, the Federal Reserve carried out a number of interventions. It not only provided enhanced liquidity support to the banking system, but engaged in asset purchases, spearheaded efforts to provide dollar liquidity, and even revived backstop measures to provide liquidity to non-bank financial sector entities that had not been used since the global financial crisis. Many other central banks also expanded asset purchase schemes and started to buy more risky securities, in some cases for the first time. This was also true in EMEs, where some central banks initiated their inaugural asset purchases.

Equity market volatility and central bank policy measures across jurisdictions¹ Graph A.2



¹ The dotted lines show the dates of major policy measures, as follows: (a) Bank of Canada Bond Buyback Program, (b) expansion of ECB Asset Purchase Program, (c) expansion of Bank of Japan asset purchases, (d) Bank of England Covid Corporate Financing Facility, (e) Federal Reserve Commercial Paper Funding Facility, (f) Federal Reserve Primary Dealer Credit Facility, (g) ECB Pandemic Emergency Purchase Program, (h) Federal Reserve Money Market Mutual Fund Facility, (i) Reserve Bank of Australia government bond purchases; (j) expansion of Bank of England Asset Purchase Facility; (k) central bank US dollar swap lines, (l) Federal Reserve Primary Market Corporate Credit Facility, (m) Federal Reserve Secondary Market Corporate Credit Facility, (n) Federal Reserve Facility for Foreign and International Monetary Authorities.

While asset purchases were a common approach to ameliorating market strains, there were differences in the way that the programs were designed (Table A.1). The scope of the assets purchased in the schemes varied, extending in some cases to asset-backed securities and ETFs in addition to corporate bonds and commercial paper. While many schemes purchased assets in the secondary market, some others also bought in the primary market. Some of the schemes were operated in conjunction with the finance ministry, which in the United States explicitly covered part of the credit risk inherent in the schemes. Some of the programs had an explicit

size envelope, while this was not specified in some of the other schemes. Finally, the termination dates varied with some closing at the end of the year and others lasting for one calendar year.

Table A.1: Features of selected central bank asset purchase schemes

Measure	Assets purchased	Other features
Federal Reserve Commercial Paper Funding Facility (17 Mar. 2020 to 17 Mar. 2021)	3-month US dollar denominated commercial paper that is rated at least A1/P1/F1.	Purchases conducted by a special purpose vehicle (SPV) which has a loan from the Federal Reserve Bank of New York. The US Treasury has a US\$10 billion equity stake in the SPV.
Federal Reserve Primary and Secondary Market Corporate Credit Facility (23 Mar. 2020 to 31 Dec. 2020)	Corporate bonds issued by a non-bank US investment grade company with a maturity of 4 years or less in the primary market or 5 years or less in the secondary market. Syndicated loans with a maturity of four years or less. US listed ETFs with an investment objective to provide broad exposure to the US corporate bond market.	Purchases conducted by a special purpose vehicle (SPV) which has a loan from the Federal Reserve Bank of New York. The US Treasury has a US\$75 billion equity stake in the special purpose vehicle.
Bank of England Covid Corporate Financing Facility (17 Mar. 2020 to 16 Mar 2021)	Commercial paper issued by investment grade UK firms with a maturity of up to one year	The Bank of England operates the scheme on behalf of HM Treasury.
ECB Pandemic Emergency Purchase Program (18 Mar. 2020 to (at least) 30 Jun. 2021)	Euro denominated public sector securities, investment grade commercial paper, asset-backed securities and covered bonds.	The facility has an overall envelope of €1,350 billion.

The different policy measures used to restore market functioning can be classified into four main groups.

1. Central bank purchases of assets – both government bonds and risk assets;
2. Central bank broad-based liquidity support – in local currency and US dollars – to the banking sector;
3. Targeted liquidity support for financial entities; and
4. Regulatory measures that helped market functioning, such as an encouragement for banks to use capital and liquidity buffers to support lending or temporary changes to capital requirements for banks.

A number of examples of each of these types of measures are included in Table A.2.

There were also other types of measures that may have also affected financial market conditions – for example, by helping to support the economy and market sentiment. Such measures include: (1) government guarantees and direct lending, loan restructuring, capital injections and other corporate relief; (2) central bank policy interventions to ease credit conditions and keep markets open and functioning; (3) prudential measures to facilitate the continued flow of credit to the real economy and provide operational flexibility to supervised firms; and (4) other actions to support market functioning, such as circuit breakers and short-sales bans.⁸¹ While these policies were an important part of the overall effort to combat the economic impact of COVID-19 lockdown measures, they go beyond the scope of this report.

Table A.2: Examples of measures taken to help restore market functioning¹

Policy measure		Selected examples
Asset purchases	Government bonds	12 Mar. Bond Buyback Program (CA) 12 Mar. Expansion of Asset Purchase Program (EA) 16 Mar. Expansion of government bond and treasury bill purchases (JP) 19 Mar. Purchases to target a 3-year government bond yield of 0.25 per cent (AU) 19 Mar. Expansion of Asset Purchase Facility (UK) 23 Mar. Purchases of treasury securities in “amounts needed” (US)
	Risk assets	16 Mar. Expansion of corporate bond, commercial paper and ETF purchases (JP) 17 Mar. Covid Corporate Financing Facility (UK) 17 Mar. Commercial Paper Funding Facility (US) 18 Mar. Pandemic Emergency Purchase Program (EA) 23 Mar. Primary and Secondary Market Corporate Credit Facilities (US)
Broad-based liquidity support to banks	Local currency	Larger or more frequent Open Market Operations (many) Expansion of eligible collateral (many) 24 Mar. Contingent Term Repo Facility (UK) 26 Mar. Expansion of liquidity operation counterparties (KR) 30 Apr. Pandemic Emergency Longer-Term Refinancing Operations (EA)
	US dollars	Foreign currency swap auctions (many) 15/19 Mar. Central Bank US dollar swap lines (US with 14 jurisdictions) 31 Mar. Facility for Foreign and International Monetary Authorities (US with many)
Targeted liquidity support		17 Mar. Primary Dealer Credit Facility (US) 18 Mar. Money Market Mutual Fund Liquidity Facility (US) 31 Mar. Central bank purchases of government bonds from primary dealers (TR) 27 Apr. Special Liquidity Facility for non-bank financial companies (IN)
Regulatory measures		Encourage banks to use buffers to support lending (many) Exclusion of central banks reserves from the leverage ratio (many) 17 Mar. Temporary exemption of program assets from capital requirements (US) 19 Mar. Money market fund sponsors able to buy assets from affiliates (US) 9 Apr. Temporary exemption of government bonds from leverage ratio (CA)

¹ The jurisdiction where the measure was taken is shown in parentheses - here, EA is for euro area. The entries in the table are ordered chronologically then alphabetically by jurisdiction.

⁸¹ See the FSB's *COVID-19 pandemic: Financial stability implications and policy measures taken – Report to the G20* (July 2020).

Abbreviations

APC	Anti-procyclicality
AE	Advanced Economy
AUM	Assets under Management
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BOJ	Bank of Japan
CCP	Central Counterparty
CD	Certificate of Deposit
CLO	Collateralised Loan Obligation
CP	Commercial Paper
CPFF	Commercial paper Funding Facility (US)
ECB	European Central Bank
EME	Emerging Market Economy
ETF	Exchange Traded Fund
FSB	Financial Stability Board
IM	Initial Margin
IMF	International Monetary Fund
IOSCO	International Organization of Securities Commissions
LVNAV	Low Volatility NAV (EU)
MMF	Money Market Fund
MMLF	Money Market Mutual Fund Liquidity Facility (US)
NAV	Net Asset Value
NBFI	Non-Bank Financial Intermediation
OPEC	Organization of the Petroleum Exporting Countries
OTC	Over the Counter
PBC	People's Bank of China
PDCNAV	Public Debt Constant NAV (EU)
PEPP	Pandemic Emergency Purchase Programme (EU)
SPV	Special Purpose Vehicle
VM	Variation Margin
WHO	World Health Organisation