BIS Bulletin

No 28

Inflation at risk from Covid-19

Ryan Banerjee, Aaron Mehrotra and Fabrizio Zampolli

23 July 2020

BIS Bulletins are written by staff members of the Bank for International Settlements, and from time to time by other economists, and are published by the Bank. The papers are on subjects of topical interest and are technical in character. The views expressed in them are those of their authors and not necessarily the views of the BIS. The authors are grateful to Teuta Turani for excellent analysis and research assistance, and to Louisa Wagner for administrative support.

The editor of the BIS Bulletin series is Hyun Song Shin.

This publication is available on the BIS website (www.bis.org).

ISSN: 2708-0420 (online)
ISBN: 978-92-9197-414-5 (online)

Ryan Banerjee
ryan.banerjee@bis.org

Aaron Mehrotra
aaron.mehrotra@bis.org

Fabrizio Zampolli
fabrizio.zampolli@bis.org

Inflation at risk from Covid-19

Key takeaways

- *The pandemic has increased downside tail risks in advanced economies (AEs), while it has increased both downside and upside tail risks in emerging market economies (EMEs).*
- *The collapse in output and oil prices, on balance, increases downside inflation risks.*
- *Recent exchange rate depreciations increase upside risks to inflation in EMEs.*
- *Tighter financial conditions raise both downside and upside risks. In AEs, the increase in downside risks is more prominent.*

A number of important drivers of inflation have shifted dramatically as a result of the Covid-19 outbreak. Economic activity has collapsed and oil prices have fallen sharply. At the same time, financial conditions have tightened and exchange rates in many EMEs have depreciated. Official and private sector economists have adjusted their forecasts accordingly; the IMF April *World Economic Outlook*, for example, sees headline inflation falling by 0.9 and 0.4 percentage points below the 2019 level in AEs and emerging market and developing economies, respectively.

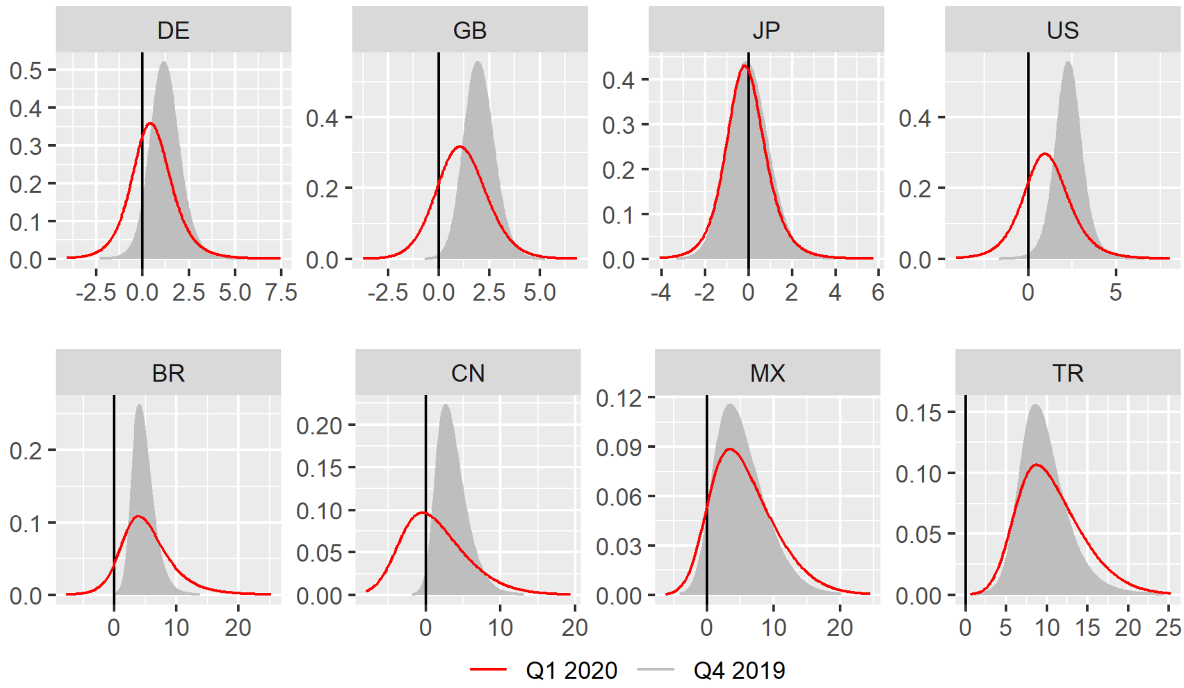
While most forecasters focus on the expected level of inflation, monitoring inflation risks and understanding what factors drive them is particularly relevant in calibrating the appropriate policy response. In the current environment, many central banks are relying on scenarios instead of point forecasts to understand economic and financial risks. A complementary approach to scenario analysis is the inflation-at-risk framework developed in Banerjee et al (2020). In this Bulletin, we examine inflation risks and their drivers within this new framework.

Our analysis shows that inflation risks – downside, upside, or both – have increased almost everywhere. Graph 1 illustrates this with four-quarter-ahead conditional distributions – the full ranges of possible outcomes – for headline inflation. For AEs deflationary risks are dominant (top panels), whereas in EMEs the probabilities of both low and high inflation outcomes have increased (bottom panels).

In the remainder of this Bulletin, we briefly describe the modelling of inflation at risk and examine how different economic and financial factors associated with the crisis have contributed to the observed shifts in the distribution of future inflation.

The economic and financial fallout shifts inflation forecast distributions

Probability density functions for four-quarter-ahead CPI inflation, Q4 2019 and Q1 2020 Graph 1



Sources: Bloomberg; national data; authors' calculations.

Underlying model

The starting point of our analysis is a Phillips curve – a workhorse model that links inflation to its main drivers. In our open-economy Phillips curve, four-quarter-ahead inflation is driven by current output growth and current inflation as well as changes in the exchange rate and oil prices. We augment the model with equity return volatility to investigate the effect of financial conditions and the broader effect of uncertainty (Lopez-Salido and Loria (2019), Gilchrist et al (2017)).[1]

To investigate inflation-at-risk, the Phillips curve is estimated as a quantile regression. While a conventional regression would tell us how inflation moves on average as the inflation drivers fluctuate, a quantile regression highlights when tail risks for inflation – ie the chance of very high or low realisations of inflation – evolve differently from average outcomes. For example, a tightening of financial conditions could at times act as a cost shock that raises inflation. During other times, tighter financial conditions could instead significantly lower demand, reducing inflation. However, on average it could appear as if financial conditions have no impact on inflation, as these two effects cancel each other out. Our empirical strategy is similar to that applied by Adrian et al (2019) to examine GDP at risk, where the authors highlight how tighter financial conditions drive the extremely low growth outcomes, but on average have only a weaker effect.

While there are questions as to how well a Phillips curve framework can deal with large and highly unusual shocks such as Covid-19, researchers have also pointed out the resilience of the Phillips curve for policy use (eg Eser et al (2020)). Moreover, our data set includes a number of episodes such as the Great Financial Crisis of 2007–09 and EME crises that also saw major volatility (Table 1; see also Banerjee et al (2020)). And, while much of the focus has been on the measurement and the strength of the output gap

[1] The model also includes two dummy variables related to monetary policy frameworks and policy constraints. These capture, first, whether the central bank in the economy is explicitly targeting inflation and, second, whether policy rates are at the zero lower bound (ZLB).

in Phillips curves, we also include other inflation drivers such as exchange rates and oil prices, which are particularly relevant for small open economies.

Our data set covers 43 economies – 12 AEs and 31 EMEs – from 1990 onwards. We pool the data in a panel quantile regression that produces a common estimate of the effect of each explanatory variable. We estimate the panels separately for AEs and EMEs. Yet, while the estimated effects of the different factors on inflation are the same within each of these two groups, inflation risks still vary between individual countries, as the values of the explanatory variables differ. The discussion focuses on how four-quarter-ahead inflation risks – the location and shape of the inflation distributions – have changed in eight major economies due to changes in the main explanatory variables in Q1 2020 (shown in Table 1).[2] This is a pure forecasting exercise that works on the basis of past relationships in the data.[3]

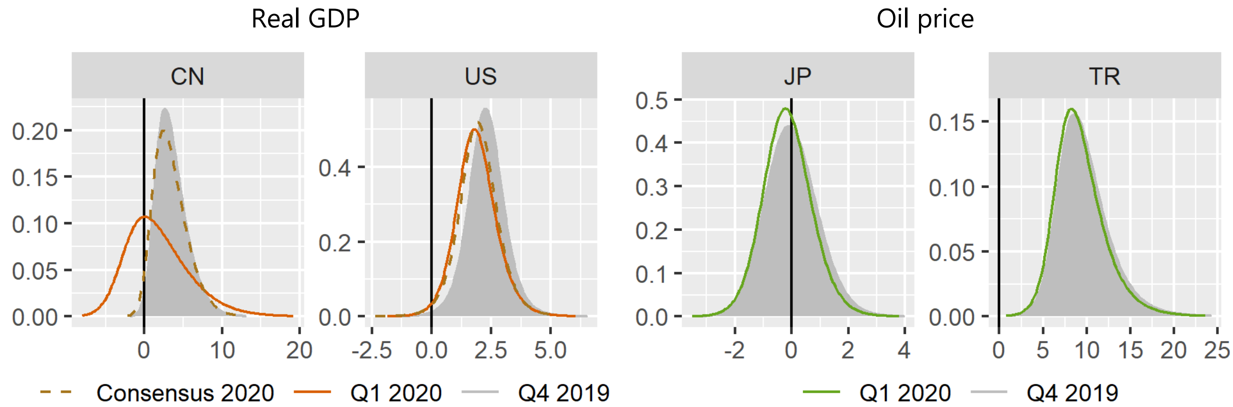
In the next two sections, we consider how the recent shifts in the economic and financial conditions – with the different factors considered separately – have affected near-term inflation risks in the eight economies. Afterwards, we do a decomposition of their relative importance and quantify how much each of the factors contributes to shifts in the lower and upper tails of the distribution.

Inflation risks associated with falling output and oil prices

There are three major challenges in analysing the impact of output contractions on inflation risks at the current juncture. One is to simply assess the Covid-19-driven output decline in the first quarter. We use official GDP releases, but acknowledge that measurement is challenging due to lockdowns. Second, beyond potential non-linearities associated with the atypical shock, as discussed above, output in some economies is likely to have fallen off a cliff in the second quarter and is then expected to recover during the latter part of 2020, with contrasting implications for inflation risks. The third issue is uncertainty about the extent to which output contractions free up resources in the economy and, in other words, are generally associated with greater economic slack that reduces inflation pressures (see below).

As economic activity and oil prices decline, future inflation distributions edge to the left[1]

Probability density functions for four-quarter-ahead CPI inflation, Q4 2019 and Q1 2020 Graph 2



[1] All other variables except those shown in the headings are maintained at their Q4 2019 values.

Sources: Bloomberg; Consensus Economics; national data; authors' calculations.

The output collapse has, on balance, increased downside inflation risks. Such effect is consistent with firms keeping their prices rigid in "normal times" but applying steep discounts when firm demand is

[2] These countries are selected on the basis of their economic size and to illustrate heterogeneity in the effects of the risk factors. Inflation risks for additional countries are available in an online annex.

[3] Regime changes in monetary policy could be quite important, especially in EMEs. Banerjee et al (2020) show that while there are some differences, the results are qualitatively similar when shorter samples from 2000 onwards are used.

sufficiently low (see eg Nakamura and Steinsson (2011)). To illustrate this, the first and second panels of Graph 2 display the estimated shift in the inflation risk distribution resulting from the drop in GDP growth alone, for China and the United States. In both economies, using data for output for the first quarter, deflation risks rise (orange solid lines). Using instead the Consensus 2020 full-year forecasts for GDP growth, which smooth out potential mid-year volatility, we find that the results are broadly similar in the United States (dashed line). However, for China the estimate based on Consensus GDP indicates little downside inflation risk.[4]

Our analysis, which uses GDP as the measure of activity, does not distinguish between demand and supply factors. Yet, in our data for EMEs, GDP and inflation have historically moved in opposite directions in the upper tail, ie 95th percentile, of the distribution. That is, as growth slows, upside inflation risks rise. This could reflect changes in external financing conditions, changes in the terms of trade, or supply factors. Upside inflation risks appear to increase somewhat in China as activity drops in the first quarter (Graph 2, first panel).[5]

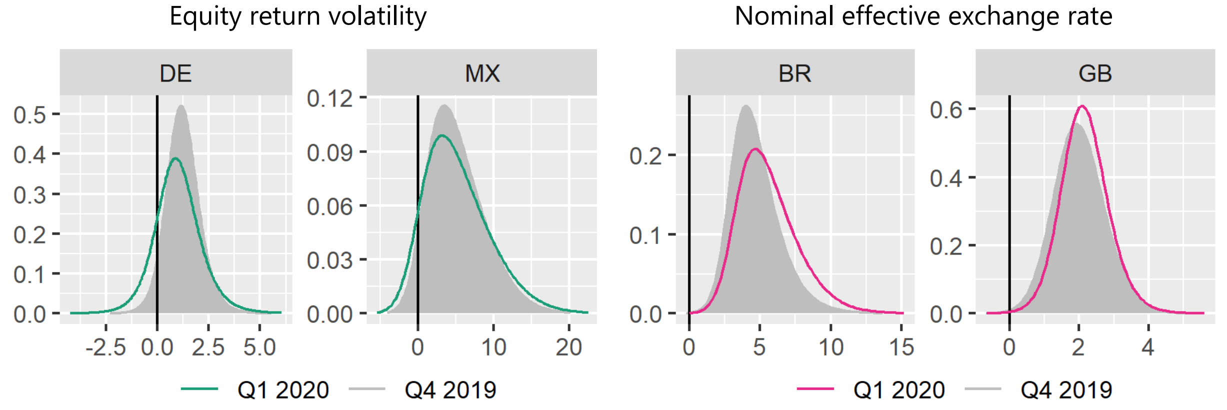
The oil price drop results in leftward shifts in the inflation distribution – the average inflation forecast declines marginally. For illustrative purposes, we show the impacts in Japan and Turkey (Graph 2, third and fourth panels). But while the distributions edge to the left, largely with limited economic significance, the oil price decline appears to reduce upside inflation risks by more than it increases downside risks in both economies (see also Graph 4 further below).

Implications of financial conditions and exchange rate swings

While tighter financial conditions have only a very small economic effect on average future inflation, they have greater effects on the tails. The first two panels of Graph 3 consider the effects of higher equity return volatility on inflation risks in Germany and Mexico, where both the upper and lower tails have widened. This may reflect various mechanisms. As to the upside effect, firms may try to pass on the costs associated

Tighter financial conditions and exchange rate depreciations increase tail risks[1]

Probability density functions for four-quarter-ahead CPI inflation, Q4 2019 and Q1 2020 Graph 3



[1] All other variables except for those shown in the headings are maintained at their Q4 2019 values.

Sources: Bloomberg; national data; authors' calculations

[4] In the rest of the Bulletin, we use the measure based on first quarter GDP figures due to small differences between the two estimates for GDP growth in the first quarter (Table 1). An exception is China, where the modal inflation forecast with Consensus GDP growth is around 400 basis points higher.

[5] Using the Consensus forecast for the average unemployment rate in 2020 instead of GDP growth in the Phillips curve for AEs results in a decline in the median forecast by 0.3 percentage points between Q4 2019 and Q1 2020 in the UK and by 0.6 percentage points in the US. There is little change in Germany and Japan, where unemployment rates are forecast to rise less.

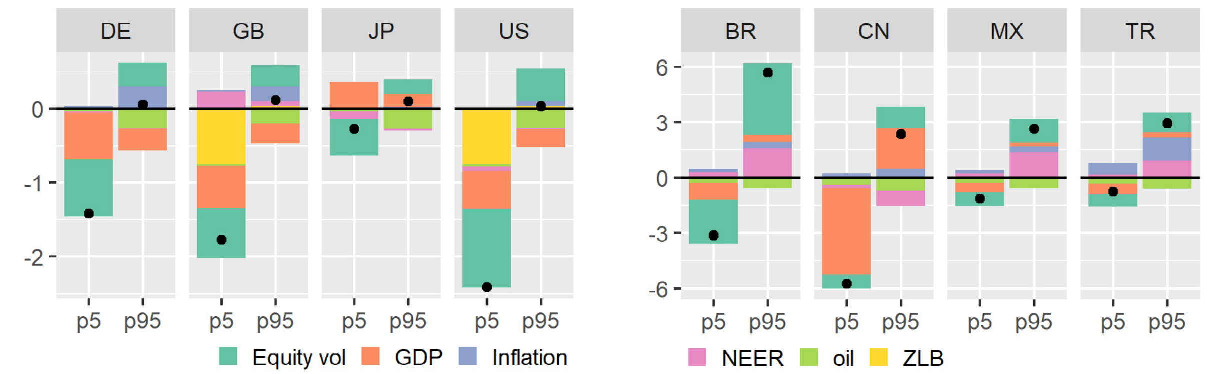
with tighter financial conditions to consumers. Moreover, faced with tighter conditions, credit-constrained firms may attempt to protect their cash flows by raising their price markups (Gilchrist et al (2017)). As to the downside, greater volatility and tighter financial conditions could be associated with lower investment and consumption and hence lower future growth, which may dampen inflation (eg Bloom (2009)). Both mechanisms could be especially relevant during inflation tail events, such as those driven by recessions and where financial volatility is elevated, yet less so during normal times.

Not surprisingly, the effects of exchange rate swings are more pronounced in EMEs than in AEs (Graph 3, third and fourth panels). For a similarly sized movement in the exchange rate, the impact on median inflation is estimated to be around six times larger in EMEs than in AEs, consistent with higher exchange rate pass-through to inflation in EMEs (BIS (2019)). The depreciation of the Brazilian real in the first quarter has a relatively strong effect in raising upside inflation risks, as shown by a proportionately larger movement in the upper tail than in the lower tail. This appears to be consistent with firms adjusting prices more often in a higher inflation environment (see eg Alvarez et al (2019)) as well as the monetary uncertainty that has historically gone hand in hand with currency collapses (BIS (2019)).

Contributions of the different factors to shifts in the tails

How much do the different risk factors contribute to the movements of the tails? In AEs, at the left tail, ie at the 5th percentile of the four-quarter-ahead inflation distribution, the Covid shock is associated with lower inflation, by between ¼ (Japan) and 2½ percentage points (United States) (Graph 4, dots). The collapse in output and tighter financial conditions are major contributors (bars). By contrast, the right tail, ie the 95th percentile, barely moves, even as oil prices exert downward pressure. Higher equity volatility raises the right tails.[6] The contribution from a dummy variable that captures the decline of interest rates to zero is negative for both the United Kingdom and the United States, given the historical association between zero interest rates and downside inflation risks.[7]

Contributions of risk factors to change in tail inflation risks[1] Graph 4



[1] Change in one-year-ahead tail inflation risks between Q4 2019 and Q1 2020 computed at 5th (p5) and 95th (p95) percentiles. "ZLB" denotes the contribution from a dummy variable that captures the possibility that interest rates are at the zero lower bound.

Sources: Bloomberg; national data; authors' calculations

Relative to AEs, the tails of EME inflation are more affected by the exchange rate and financial conditions. As to financial conditions, their upward effect on inflation is more pronounced in EMEs, likely stemming from more pronounced financial constraints that make firms set higher prices in response to contractionary financial shocks.

[6] At the time of writing, as financial conditions have loosened in the second quarter, tail risks have declined somewhat.

[7] In Germany and Japan, interest rates were already at levels close to zero in Q4 2019, so that the dummy variable does not indicate changes in inflation risks.

Conclusion

Our analysis suggests that, for AEs, the output collapse due to the Covid crisis is associated mainly with greater downside risks to inflation in the near term. For some EMEs, the exchange rate depreciation appears to lead to a prominent increase in upside risks to inflation. Moreover, tighter financial conditions seemingly contribute to both downside and upside inflation risks.

Two final issues are worthy of note. First, the lockdowns may have changed consumption patterns in ways not well captured by headline price indices, making them less indicative of changes in the cost of living. Second, our framework does not consider fiscal variables which could be quite relevant for the inflation outlook in the current context (see eg Blanchard (2020)).

References

Adrian, T, N Boyarchenko and D Giannone (2019): "Vulnerable growth", *American Economic Review*, vol 109, no 4, pp 1263–89.

Alvarez, F, M Beraja, M Gonzalez-Rozada and P Andrés Neumeyer (2019): "From hyperinflation to stable prices: Argentina's evidence on menu cost models", *Quarterly Journal of Economics*, vol 134, no1, pp 451–505.

Banerjee, R, J Contreras, A Mehrotra and F Zampolli (2020): "Inflation at risk in advanced and emerging economies", mimeo.

Bank for International Settlements (2019): *BIS Annual Economic Report 2019*, June.

Blanchard, O (2020): "Is there inflation or deflation in the future?", *VoxEU*, 24 April 2020.

Bloom, N (2009): "The impact of uncertainty shocks", *Econometrica*, vol 77, pp 623–85.

Eser, F, P Karadi, P Lane, L Moretti and C Osbat (2020): "The Phillips curve at the ECB", ECB, *Working Paper Series*, no 2400.

Gilchrist, S, R Schoenle, J Sim and E Zakrajšek (2017): "Inflation dynamics during the financial crisis", *American Economic Review*, vol 107, no 3, pp 785–823.

Lopez-Salido, J and F Loria (2019): "Inflation at risk", *CEPR Discussion Papers*, no 14074.

Nakamura, E and J Steinsson (2011): "Price setting in forward-looking customer markets", *Journal of Monetary Economics,* 58, pp 220–33.

Changes in economic and financial conditions in Q1 2020 — Table 1

	Δ GDP	Δ NEER	Δ oil price	Eq return volatility		Δ GDP	Δ NEER	Δ oil price	Eq return volatility
BR	–1.6% (–1.4%)	–6.6%	–14.3%	4.6	JP	–0.6% (–1.4%)	0.2%	–21.9%	1.9
CN	–9.8% (0.3%)	1.8%	–23.0%	1.9	MX	–1.2% (–2.0%)	–2.9%	–18.3%	2.0
DE	–2.2% (–1.6%)	–0.1%	–21.7%	2.9	TR	0.6% (–1.1%)	–4.8%	–16.8%	2.3
GB	–2.0% (–2.0%)	–0.2%	–21.5%	2.7	US	1.3% (-1.4%)	0.7%	-22.1%	3.5
Percentiles of the above figures relative to the historical distribution									
BR	4 (4)	4	11	100	JP	8 (4)	54	6	86
CN	0 (27)	82	5	86	MX	5 (3)	13	8	89
DE	3 (4)	47	7	97	TR	38 (5)	6	9	93
GB	3 (3)	45	7	96	US	4 (4)	65	6	98

GDP is quarter-on-quarter change; the numbers in parentheses are Consensus estimates for 2020 GDP growth converted into quarterly growth rates. The exchange rate and oil price (West Texas Intermediate (WTI), in local currency) are quarterly averages. Using Brent instead of WTI results in approximately the same price decline. Equity return volatility is standard deviation of daily returns, using benchmark indices. Increase in nominal effective exchange rate (NEER) denotes an appreciation of local currency. The historical distribution for the 43-country panel runs from 1990 to 2019.

Previous issues in this series

No 27 16 July 2020	Global banks' dollar funding needs and central bank swap lines	Iñaki Aldasoro, Torsten Ehlers, Patrick McGuire and Goetz von Peter
No 26 01 July 2020	Corporate credit markets after the initial pandemic shock	Sirio Aramonte and Fernando Avalos
No 25 26 June 2020	Investors' risk attitudes in the pandemic and the stock market: new evidence based on internet searches	Marlene Amstad, Giulio Cornelli, Leonardo Gambacorta and Dora Xia
No 24 19 June 2020	Trade credit, trade finance, and the Covid-19 Crisis	Frédéric Boissay, Nikhil Patel and Hyun Song Shin
No 23 17 June 2020	The fiscal response to the Covid-19 crisis in advanced and emerging market economies	Enrique Alberola, Yavuz Arslan, Gong Cheng and Richhild Moessner
No 22 15 June 2020	How are household finances holding up against the Covid-19 shock?	Anna Zabai
No 21 06 June 2020	Central banks' response to Covid-19 in advanced economies	Paolo Cavallino and Fiorella De Fiore
No 20 02 June 2020	Central bank bond purchases in emerging market economies	Yavuz Arslan, Mathias Drehmann and Boris Hofmann
No 19 22 May 2020	Dealing with Covid-19: understanding the policy choices	Frédéric Boissay, Daniel Rees and Phurichai Rungcharoenkitkul
No 18 20 May 2020	EME bond portfolio flows and long-term interest rates during the Covid-19 pandemic	Peter Hördahl and Ilhyock Shim
No 17 19 May 2020	On health and privacy: technology to combat the pandemic	Carlos Cantú, Gong Cheng, Sebastian Doerr, Jon Frost and Leonardo Gambacorta
No 16 15 May 2020	Covid-19 and regional employment in Europe	Sebastian Doerr and Leonardo Gambacorta
No 15 13 May 2020	US dollar funding markets during the Covid-19 crisis – the international dimension	Egemen Eren, Andreas Schrimpf and Vladyslav Sushko
No 14 12 May 2020	US dollar funding markets during the Covid-19 crisis – the money market fund turmoil	Egemen Eren, Andreas Schrimpf and Vladyslav Sushko
No 13 11 May 2020	The CCP-bank nexus in the time of Covid-19	Wenqian Huang and Előd Takáts

All issues are available on our website www.bis.org.