

GLOBAL ECONOMIC OUTLOOK - FEBRUARY

Monetary Department
External Economic Relations Division

2017

I. Summary	2
II. Economic outlook in advanced countries	3
II.1 Euro area	3
II.2 Germany	4
II.3 United States	5
II.4 United Kingdom	6
II.5 Japan	6
III. Economic outlook in BRIC countries	7
III.1 China	7
III.2 India	7
III.3 Russia	8
III.4 Brazil	8
IV. Leading indicators and outlook of exchange rates	9
IV.1 Advanced economies	9
IV.2 BRIC countries	10
V. Commodity market developments	11
V.1 Oil and natural gas	11
V.2 Other commodities	12
VI. Focus	13
The effect of (un)conventional measures on shadow rates in the euro area and the USA	13
A. Annexes	17
A1. Change in GDP predictions for 2017	17
A2. Change in inflation predictions for 2017	17
A3. GDP growth in the euro area countries	18
A4. Inflation in the euro area countries	19
A5. List of abbreviations	20

Cut-off date for data

17 February 2017

CF survey date

13 February 2017

GEO publication date

24 February 2017

Notes to charts

ECB and Fed: midpoint of the range of forecasts.

The arrows in the GDP and inflation outlooks indicate the direction of revisions compared to the last GEO. If no arrow is shown, no new forecast is available. Asterisks indicate first published forecasts for given year. Historical data are taken from CF, with exception of MT and LU, for which they come from EIU.

Leading indicators are taken from Bloomberg and Datastream.

Forecasts for EURIBOR and LIBOR rates are based on implied rates from interbank market yield curve (FRA rates are used from 4M to 15M and adjusted IRS rates for longer horizons). Forecasts for German and US government bond yields (10Y Bund and 10Y Treasury) are taken from CF.

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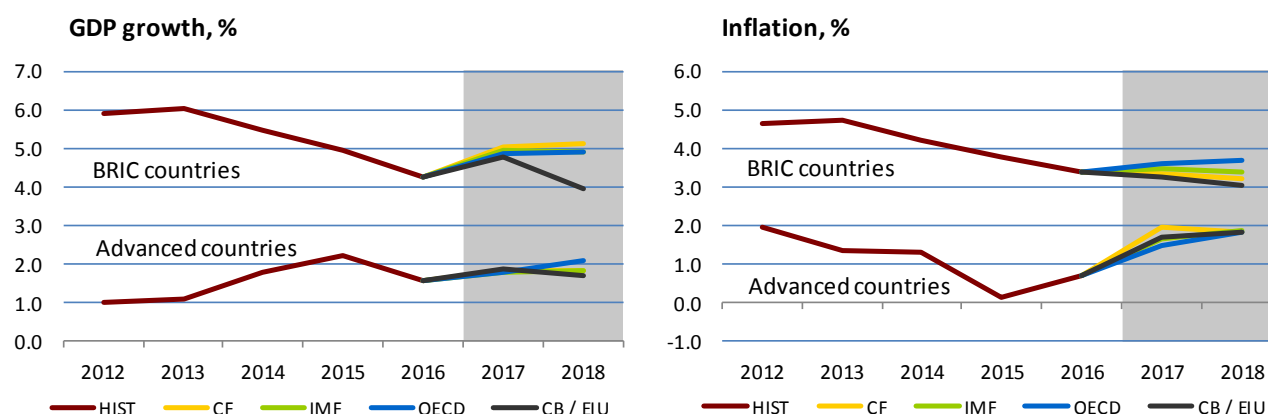
The February issue of Global Economic Outlook presents the regular monthly overview of recent and expected developments in selected territories, focusing on key economic variables: inflation, GDP growth, leading indicators, interest rates, exchange rates and commodity prices. In this issue, we tend to explore analytically the effect of (un)conventional monetary policy measures on shadow interest rates in the euro area and the USA. Based on our estimates, we show in this article that the effect of monetary policy measures on shadow rates differs depending on whether they were aimed at stabilising financial markets or further easing monetary conditions. We also indicate how the effects of measures taken by central banks can change depending on the current level of financial stress.

The current outlooks for annual economic growth in the advanced countries we monitor are practically the same as in January. The USA – the world's strongest economy – is expected to grow by just under 2.5% this year and the next. This is still almost 1 pp higher than the rate of growth expected for the euro area, Germany (its strongest economy) and the UK in this period. A comparison with Japan reveals an even larger difference, as the Japanese economy is expected to show growth of only about 1% next year. The expected inflation figures for the individual countries for this year and the next remain close to the economic growth figures given above. The inflation forecast for Germany rose compared to the previous month. However, as in the euro area as a whole, Germany's inflation outlook is well below the 2% level generally regarded as the price stability criterion in advanced countries. By contrast, inflation in the USA and the UK is expected to hover about 0.5 pp above the 2% level. In Japan, inflation will probably struggle to reach 1%.

The February outlooks for annual GDP growth in the BRIC group confirmed that the rates of growth will be mixed across countries, although the gaps are starting to narrow slowly over time. The outlooks for the fast-growing economies of India and China were revised downwards, while those for the countries hit by slumpflation (Russia and Brazil) were revised upwards. However, the differences in expected growth remain very pronounced. The Indian economy is expected to maintain growth of around 7.5% until the end of 2018 amid non-accelerating inflation, whereas the Chinese economy may ultimately slow by more than previously expected. The most pessimistic outlooks estimate China's growth rate to slow to just above 4%, but the consensus forecast is still slightly below 6% up to the end of 2018. After overcoming this year's slumpflation (an economic slump accompanied by relatively high inflation), the Russian and Brazilian economies are expected to record almost identical macroeconomic parameters next year, albeit for different reasons. Economic growth in both countries will gradually increase and be within reach of 2% at the end of 2018, while inflation will be just below 5%.

The outlooks for euro area interest rates remain very low, with no sign of them rising markedly before the end of 2017. The ECB has declared that its securities purchases will continue at a reduced monthly pace of EUR 60 billion at least until that date. By contrast, US rates can be expected to increase further this year. According to CF, the US dollar will keep appreciating moderately against all the monitored currencies at the one-year horizon as well as further into the future. The only exceptions are the Brazilian real, the Russian rouble and the Chinese renminbi, against which it will firm more markedly. The price of Brent crude oil is expected to average around USD 57 a barrel this year and the next. Prices of non-energy commodities are expected to rise very slightly at the one-year horizon, due to both industrial metals and food commodities.

GDP growth and inflation development and outlook in monitored countries

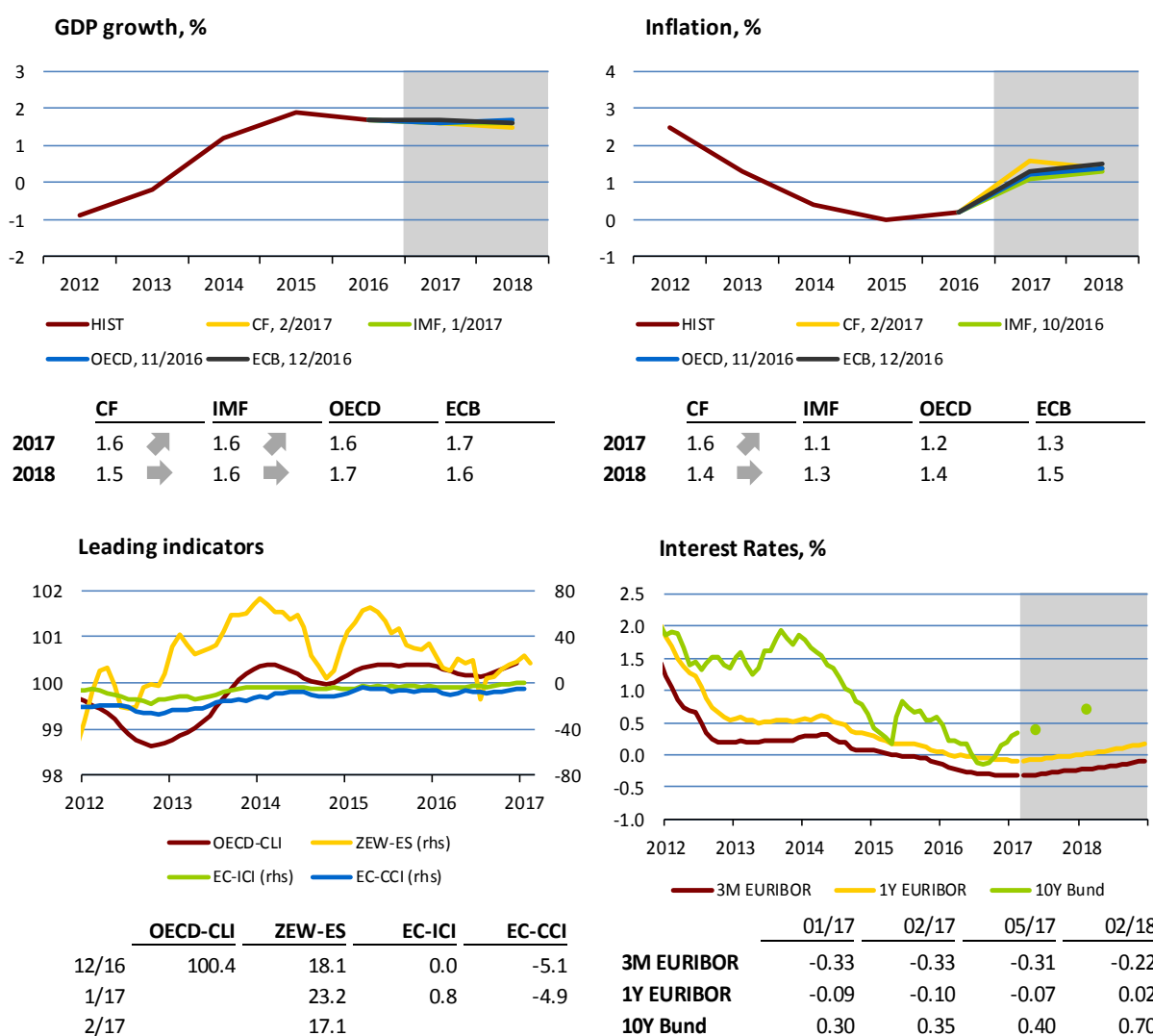


Note: The figures represent the weighted averages of historical series / outlooks in individual countries. The weights are based on nominal GDP measured in USD during 2011–2015 (source: EIU). Advanced countries: euro area, United States, United Kingdom, Japan. BRIC countries: China, India, Russia, Brazil.

II.1 Euro area

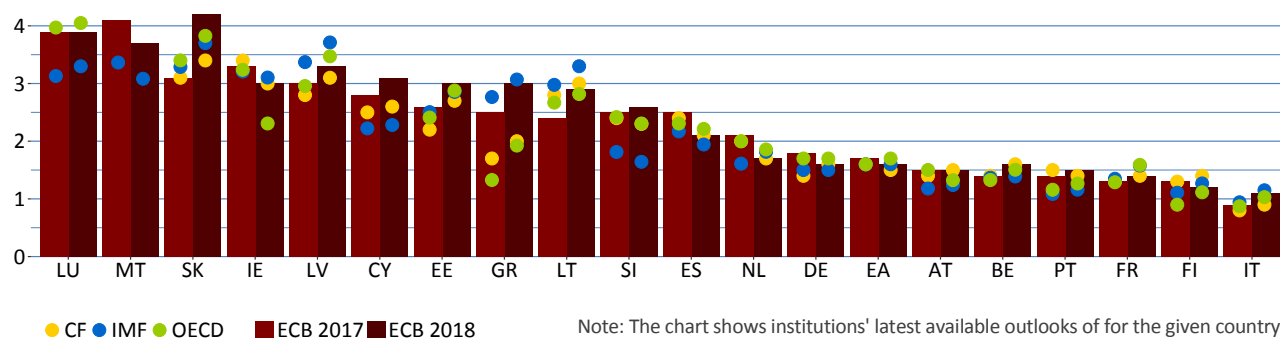
The flash estimate of GDP growth in the euro area indicated solid performance in 2016 Q4. According to Eurostat, the economy grew by 0.4% quarter on quarter, i.e. at the same pace as in the previous quarter. In year-on-year terms it rose by 1.7%. The growth probably continued to be driven mainly by household consumption, supported by an improving labour market situation (unemployment dropped slightly again to 9.6% in December) and low interest rates. Economic confidence indicators are mostly positive, although the ZEW indicator fell moderately in February. The [PMI](#) in manufacturing reached a more than five-year high (55.2) in January, due in part to a weaker [euro](#) according to the survey. It thus seems that the reasons for the considerable uncertainty regarding the outlook – related to Brexit, elections in the Netherlands, France and Germany, and developments in Greece – have had no major impact on either the economy or confidence in it yet. This was confirmed by CF, which raised its growth outlook for this year. The SPF panel also revised its outlook for 2017 upwards, to 1.5%. It should stay at this level in the next two years as well. The other monitored outlooks, including the new EC forecast, expect similar growth rates.

HICP inflation rose sharply again in January (to 1.8% from 1.1% in December) according to the Eurostat flash estimate. Its fast growth mainly reflects an energy price base effect, while the contributions from the other components of the index to the growth were similar as in previous months. CF revised its inflation outlook for this year upwards to 1.6% and expects inflation to drop to 1.4% next year as the energy price base effect unwinds. The ECB's policy stance, which was left unchanged at the January meeting, is expected to remain accommodative. The ECB is not currently observing any growth in inflation pressures from the real economy that would secure a sustained return of inflation towards the target, and hence sees a need to maintain easy monetary policy. 3M EURIBOR market outlooks thus remain negative. German ten-year bond yields have been going up since the end of 2016, in line with the global trend, and their outlook is slightly rising.

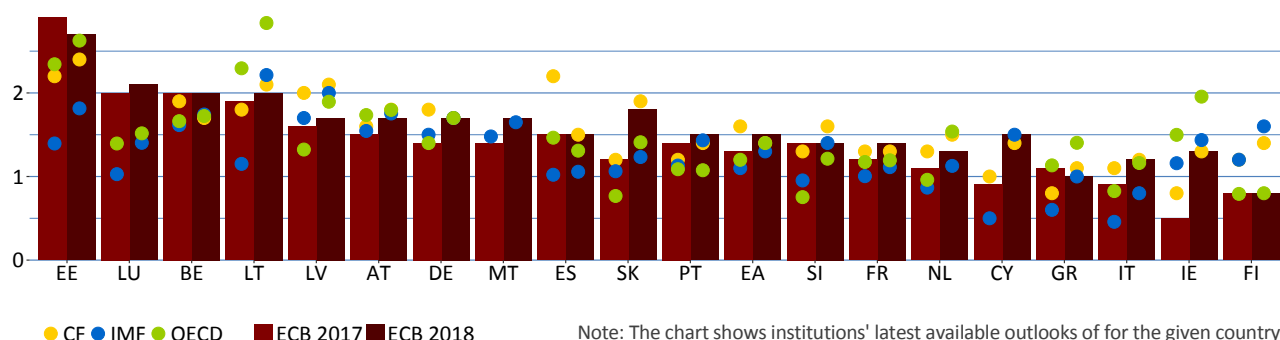


II. ECONOMIC OUTLOOK IN ADVANCED ECONOMIES

GDP growth outlooks in the euro area countries in 2017 and 2018, %

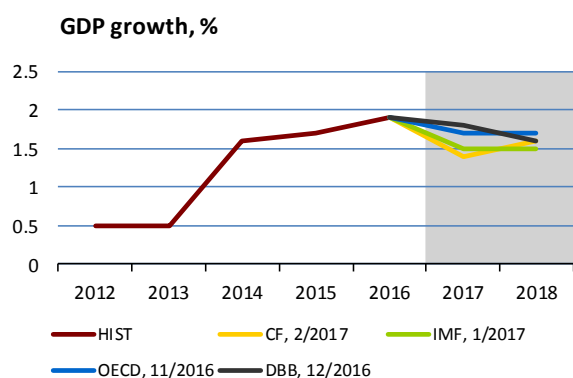


Inflation outlooks in the euro area countries in 2017 and 2018, %

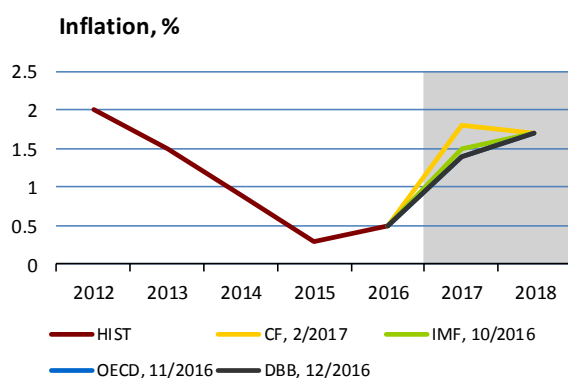


II.2 Germany

German GDP growth accelerated to 1.9% in 2016. In 2016 Q4, GDP rose by 1.8% year on year (and by 0.4% compared to the previous quarter). The growth was driven mainly by higher government expenditure related to the refugee crisis and by strong private consumption boosted by job creation and high employment. Although the contribution of foreign trade to GDP growth was still slightly negative, goods exports reached a record high, contributing to the highest-ever trade surplus in 2016. In line with these developments, CF and the IMF raised their GDP growth outlooks for both this year and the next. Nevertheless, growth will slow slightly compared to 2016. Inflation went up further to 1.9% in January after having risen sharply in December. However, according to the outlooks from the monitored institutions, it will remain below 2% this year and the next. Inflation excluding energy and food prices was flat at 1.2%.



	CF	IMF	OECD	DBB
2017	1.4	1.5	1.7	1.8
2018	1.6	1.5	1.7	1.6



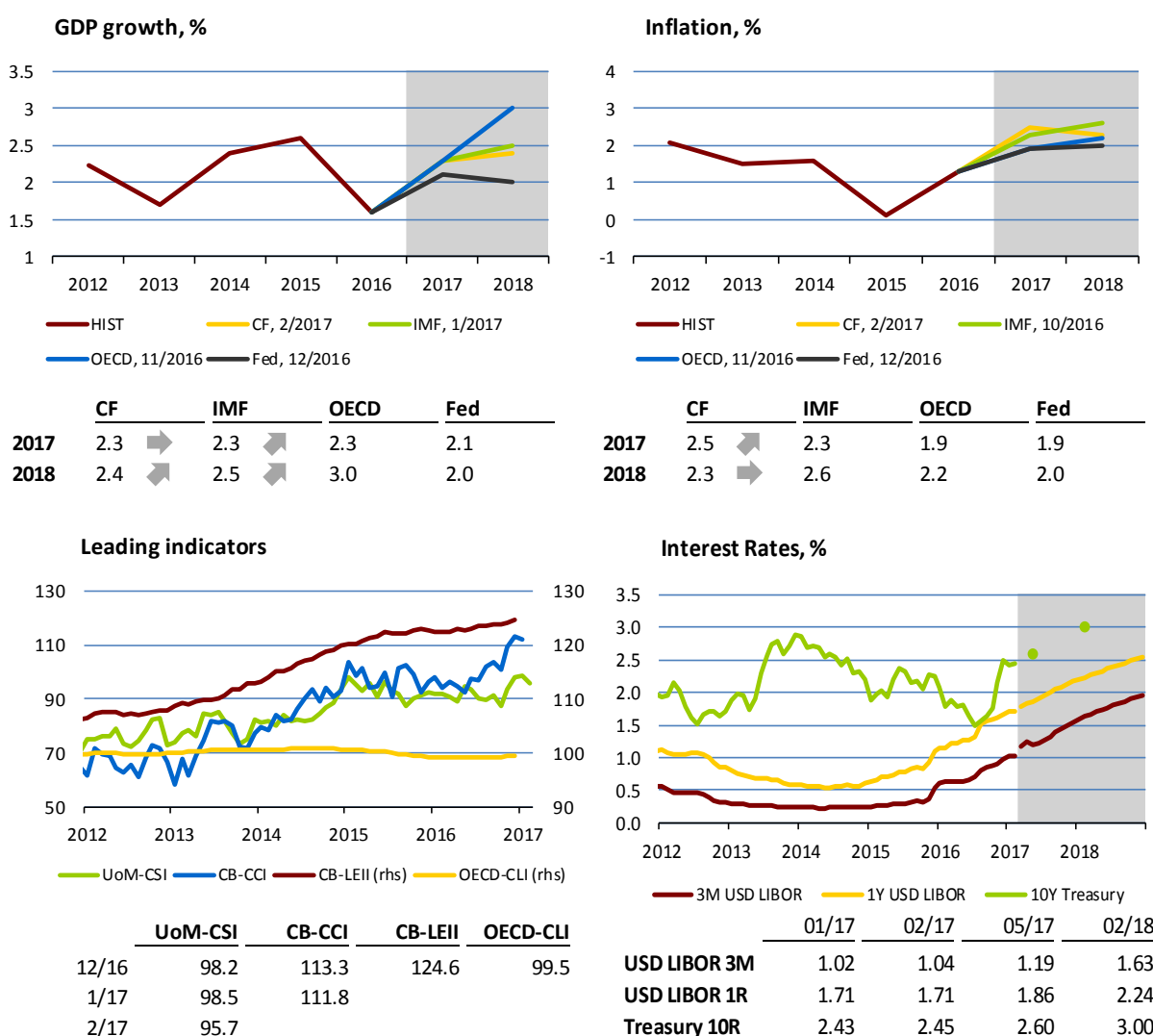
	CF	IMF	OECD	DBB
2017	1.8	1.5	1.4	1.4
2018	1.7	1.7	1.7	1.7

II.3 United States

US economic growth slowed to 1.9% in 2016 Q4 (quarter on quarter, annualised) according to the flash estimate. This was mainly due to a slump in exports as the effect of record-high soybean exports unwound. On the other hand, imports recorded the highest growth in two years. However, domestic demand was confirmed to be robust, with private consumption rising at a solid pace of 2.5% (quarter on quarter, annualised). The growth was also fostered by higher corporate inventories and investment. Spending on machinery and equipment posted positive growth for the first time in 2016, reflecting an upswing in oil and gas production linked with higher commodity prices.

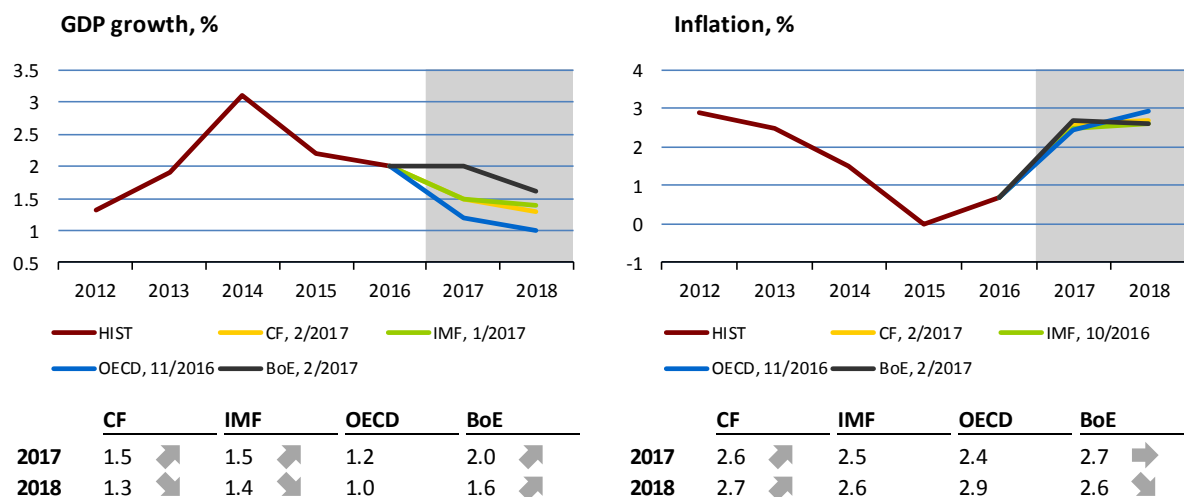
The labour market (particularly in construction and retail) recorded higher-than-expected growth in early 2017, whereas wage growth was disappointingly low. Non-farm payrolls rose by 227,000 in January, whereas 180,000 had been expected. The unemployment rate was below 5% for the ninth consecutive month (4.8% in January). However, the average hourly wage rose by only 2.5% year on year (versus an expected 2.8%). Consumer optimism remained at an all-time high in January, while retail sales showed the highest annual growth since mid-2012 (5.6%). Industrial activity in the USA also accelerated at the end of 2016. The year-on-year change in industrial production was positive (0.7%) for the first time in two years, and the [PMI](#) leading indicator rose again in January (56).

The continued expansion of the US economy is also positively reflected in growth in inflation pressures – headline annual consumer price inflation reached 2.5% and core inflation 2.3%. Inflation expectations also rose in line with the latest price developments, reaching their highest level since 2015. Unclear statements by the new president and a turnaround towards greater protectionism caused the US [dollar](#) to weaken against the other major world currencies in January. The February CF raised its outlooks for GDP growth in 2018 and inflation in 2017. The new IMF forecast expects slightly higher economic growth in both years.



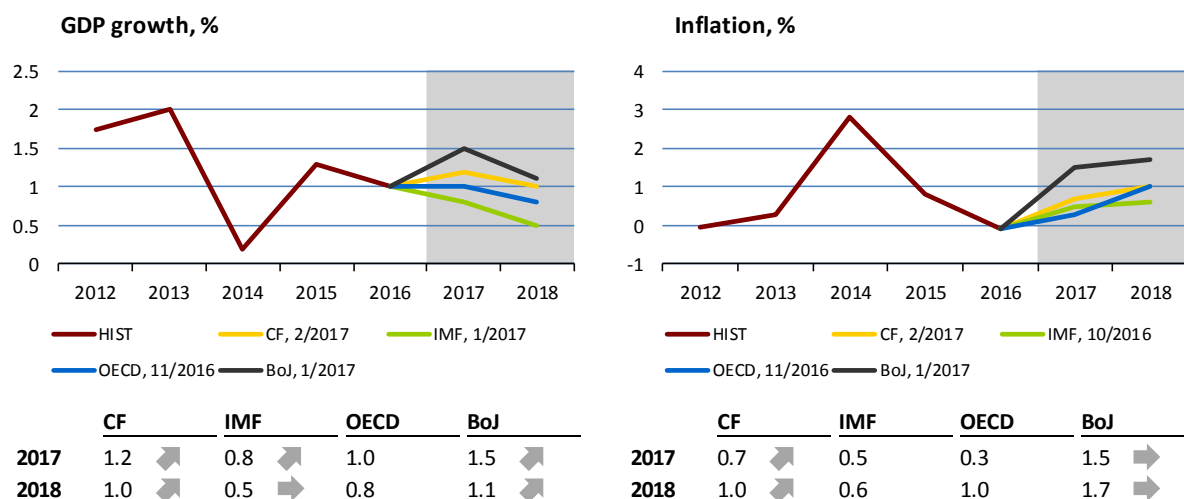
II.4 United Kingdom

According to flash estimates, the robust growth of the UK economy did not slow at the end of 2016. GDP grew by 2.2% year on year in Q4 and 2% in 2016 as a whole, making the UK one of the fastest-growing G7 economies. Quarter-on-quarter growth, driven almost exclusively by growth in the services sector in Q4, remained at 0.6%. Industrial production growth accelerated to 4.3% year on year in December. Retail sales grew at a similar pace (but by only 1.5% in January). Purchasing managers remain optimistic about the future (the [PMI](#) remains at around 55 in both services and manufacturing). The monitored institutions raised their outlooks for UK GDP growth this year to 1.5% (CF and the IMF) and 2% (the BoE). The weaker [pound](#) is gradually raising consumer price inflation (to 1.8% in January) via increasing prices of production inputs. The BoE thus expects inflation to go up to 2.7% in 2016 as a whole. However, it is not planning to tighten monetary policy at the moment.



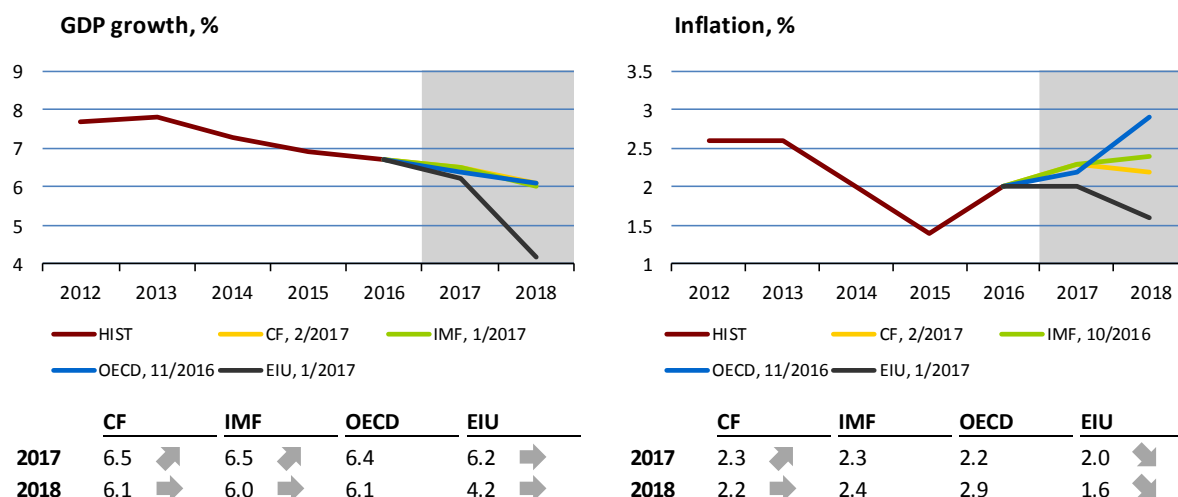
II.5 Japan

The Japanese economy expanded by 1% (annualised, quarter on quarter) in 2016 Q4 according to flash estimates. The growth was fostered by investment and net exports, while private consumption was flat. Industrial production growth slowed in December despite positive leading indicators. Retail sales growth fell in December due to a steady decline in household spending and an outbreak of bird flu in the country. However, the [PMI](#) in manufacturing rose further in January. Purchasing managers' assessments are improving in all categories. CF and the BoJ raised their GDP growth predictions for both monitored years by 0.1 pp and 0.2 pp respectively. The IMF revised its 2017 outlook upwards by 0.2 pp. Inflation fell (to 0.3%) in December due to slower growth in prices of fresh food. CF raised its inflation outlooks by 0.1 pp for both 2017 and 2018. The BoJ left its monetary policy stance and inflation outlooks unchanged in February.



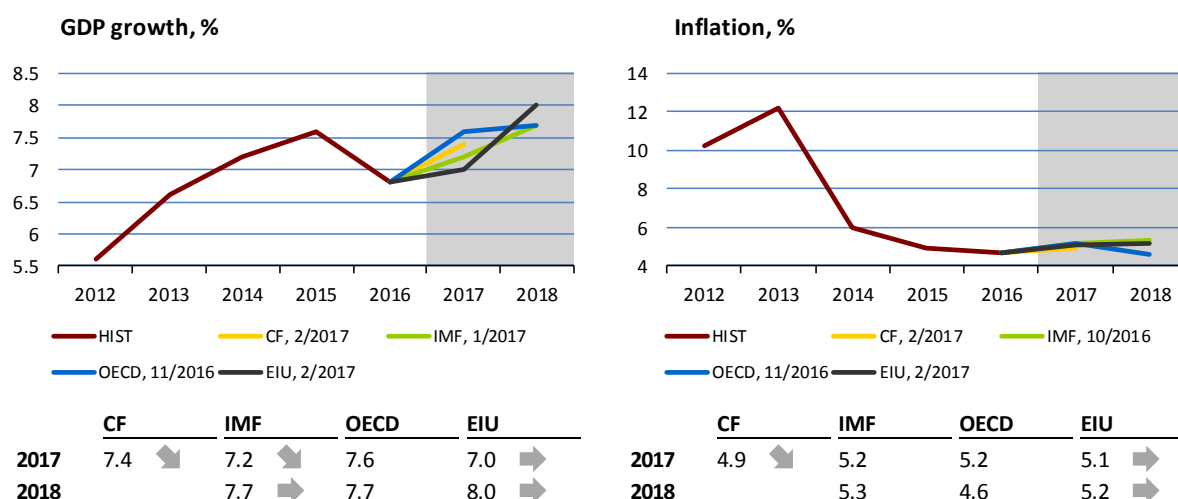
III.1 China

Newly published figures confirm stable growth in inflation pressures in the Chinese economy. Annual industrial producer price inflation rose to a six-year high in January (6.9%), with prices of steel and other materials surging. Consumer inflation reached a three-year high (2.5%), due mainly to rising fuel and food prices. The price pressures, together with a continued outflow of capital, prompted the central bank to raise the main repo rate by 10 pp. However, higher rates could jeopardise economic growth, since higher interest costs might induce highly indebted firms to cut their debt. The capital controls introduced at the end of 2016 led to greater stability of the [exchange rate](#), but foreign exchange reserves continued to fall, dropping below USD 3 trillion in January for the first time. The February CF raised its outlooks for GDP growth and inflation this year. The EIU revised its outlook for inflation in both years downwards. The new IMF forecast expects higher GDP growth in 2017.



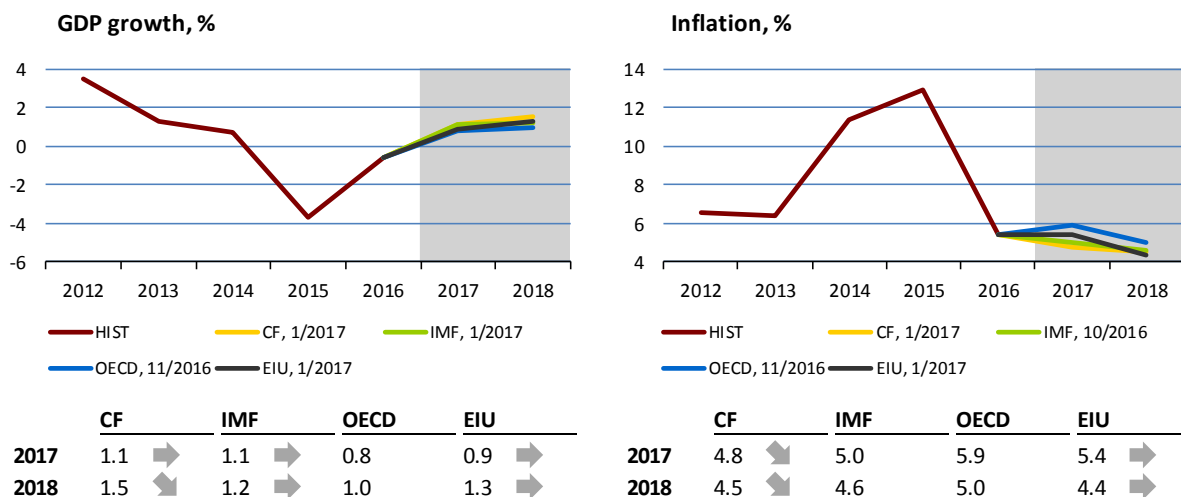
III.2 India

Indian industrial production dropped in December due to a slump in manufacturing output, reflecting the effect of demonetisation in the country. However, the [PMI](#) in manufacturing returned to the expansion band in January, due mainly to a favourable assessment of output and new orders. The IMF cut its GDP growth outlook by a full 1 pp (to 6.6%) due to an expected slowdown of the Indian economy in the second half of this fiscal year and by 0.4 pp for the next fiscal year 2017/18. The February CF revised its prediction for the 2017/18 fiscal year downwards by 0.1 pp. Inflation fell to 3.2% in January as growth in food prices slowed further due to a drop in prices of vegetables and legumes. According to CF, inflation in both this fiscal year and the next will be 0.1 pp lower than forecasted by the previous survey. The Reserve Bank of India left its interest rates unchanged at its February meeting. The key repo rate is therefore still 6.25%.



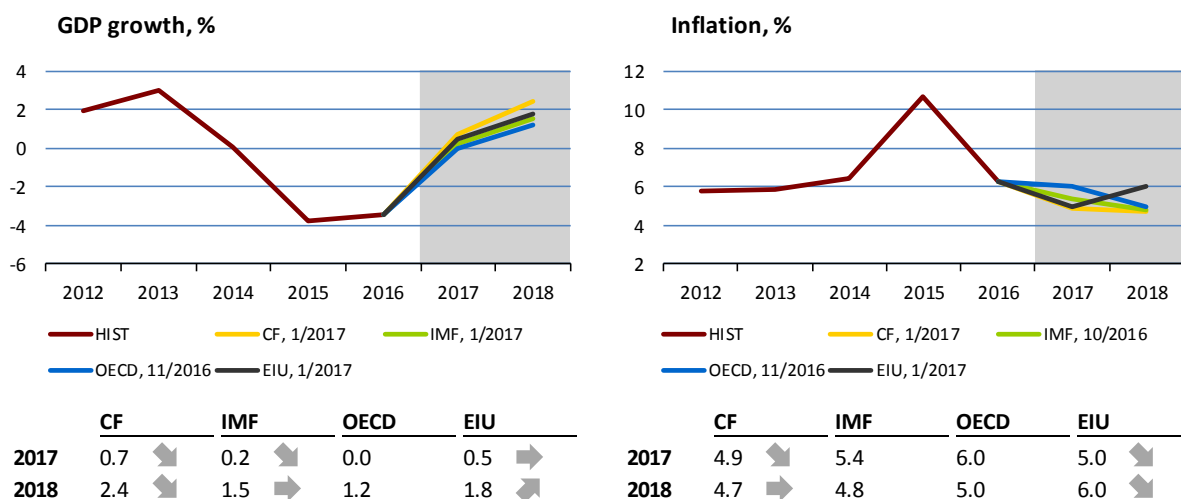
III.3 Russia

According to Rosstat's first estimate, the Russian economy contracted by just 0.2% in 2016. (The latest available CF estimate for 2016 is -0.6%.) Household consumption and imports recorded the biggest fall, declining by 5% at constant prices in 2016. By contrast, the economy was boosted by exports, which rose by 2.3%. Gross fixed capital formation fell by 1.4%. The 2014–2015 GDP calculation was revised along with the first estimate for 2016. As a result, the rate of contraction in 2015 was cut to 2.8% from the original 3.5%. According to the new CF, IMF and EIU outlooks, the economy will grow by about 1% this year. The recovery of the Russian economy will thus be much weaker than, for example, in Brazil, whose economy is also expected to start growing this year. Next year, Russian GDP is expected to go up by 1.5% at most. Annual inflation will fall from the current 5% (in January 2017) to 4.4%–4.5% at the two-year horizon.



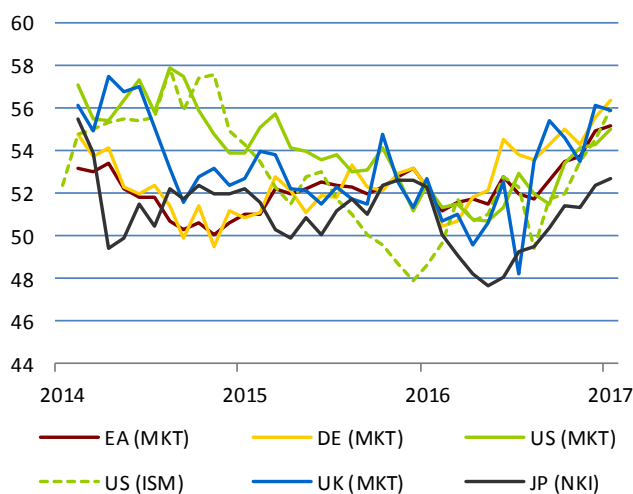
III.4 Brazil

Consumer price inflation in Brazil slowed in January to a new record of 5.4% year on year, the lowest level since September 2012. The sharp fall in inflation is not only raising analysts' hopes that inflation will reach the mean target value (or even drop below it) still this year, but is also strengthening expectations of a reduction of the inflation target itself, whose mean has been set at 4.5% since mid-2005. The inflation target for 2019 will be announced in June. The anchoring of inflation expectations, together with a reduction of the interest rate (currently at 13%), will boost investment activity and hence also the overall recovery of the Brazilian economy, which should pull out of a two-year recession this year. The new CF, IMF and EIU forecasts estimate GDP growth of 0.2%–0.7% this year (and 1.5%–2.4% next year) and a fall in inflation to 4.9%–5.0% at the end of 2017 (CF and the EIU).

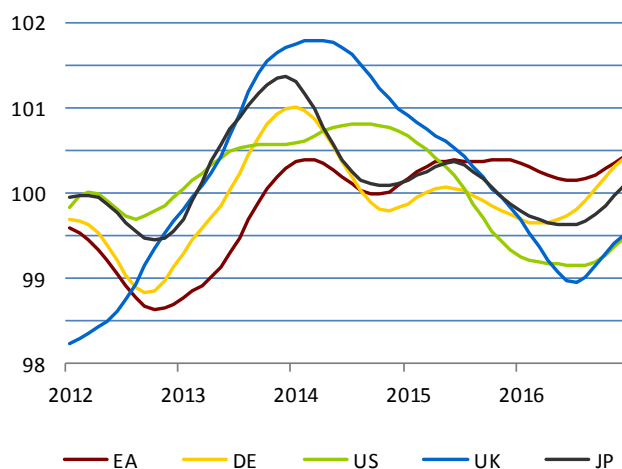


IV.1 Advanced economies

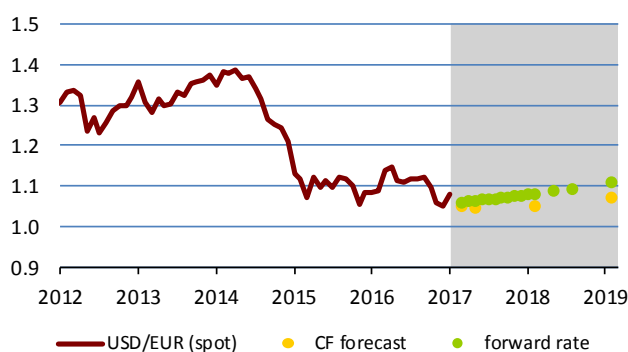
PMI in manufacturing



OECD-CLI

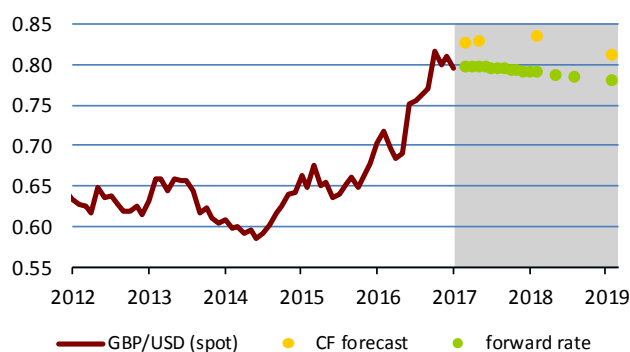


The US dollar (USD/EUR)



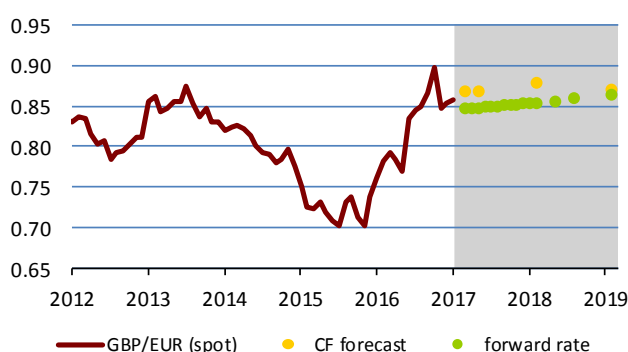
	13/2/17	03/17	05/17	02/18	02/19
spot rate	1.061				
CF forecast		1.050	1.047	1.051	1.071
forward rate		1.061	1.064	1.081	1.107

The British pound (GBP/USD)



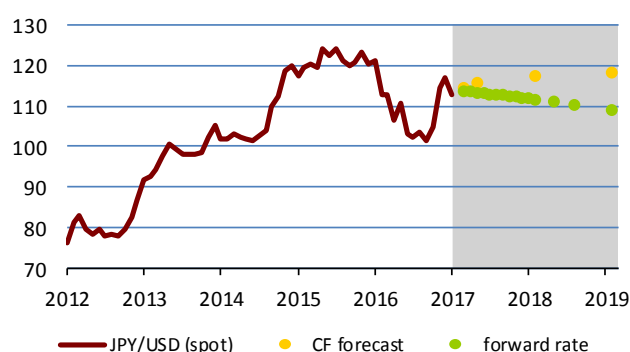
	13/2/17	03/17	05/17	02/18	02/19
spot rate	0.800				
CF forecast		0.826	0.829	0.835	0.812
forward rate		0.798	0.797	0.790	0.780

The British pound (GBP/EUR)



	13/2/17	03/17	05/17	02/18	02/19
spot rate	0.849				
CF forecast		0.867	0.868	0.878	0.869
forward rate		0.847	0.848	0.854	0.863

The Japanese yen (JPY/USD)

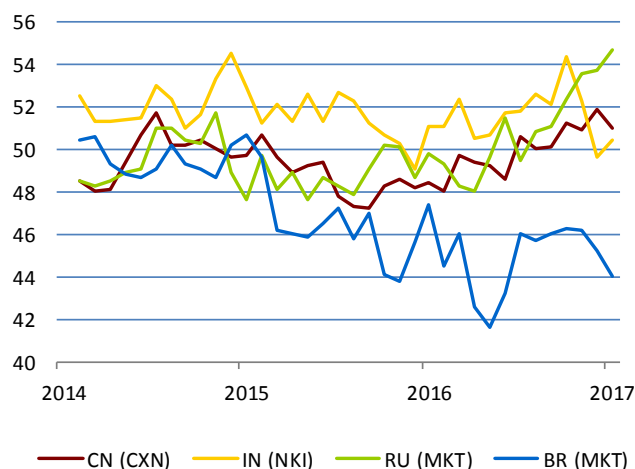


	13/2/17	03/17	05/17	02/18	02/19
spot rate	113.9				
CF forecast		114.6	115.5	117.2	118.1
forward rate		113.7	113.3	111.6	108.8

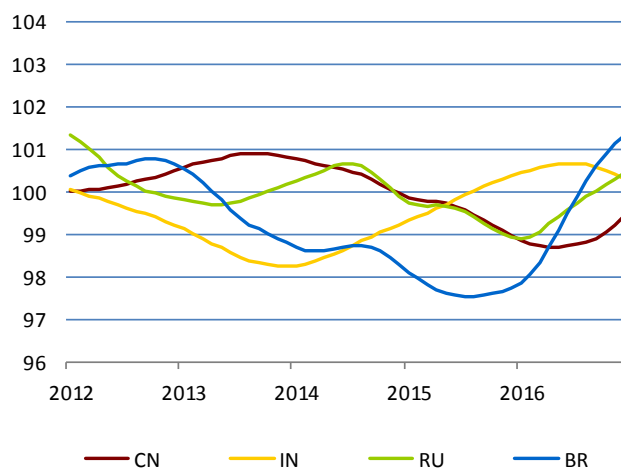
Note: Exchange rates as of last day of month. Forward rate does not represent outlook; it is based on covered interest parity, i.e. currency of country with higher interest rate is depreciating. Forward rate represents current (as of cut-off date) possibility of hedging future exchange rate.

IV.2 BRIC countries

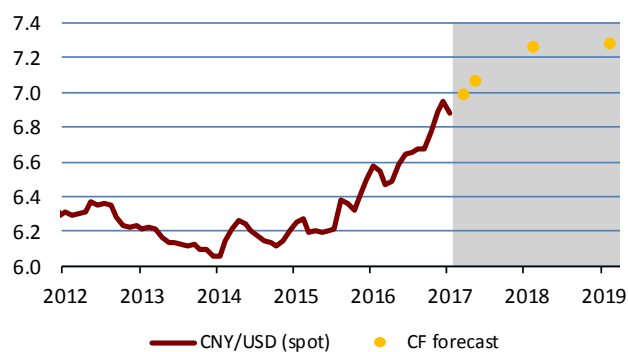
PMI in manufacturing



OECD-CLI

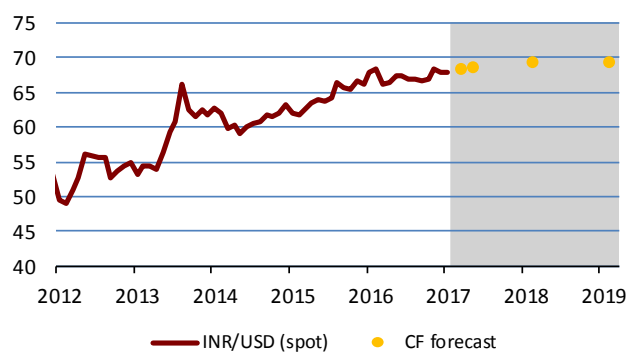


The Chinese renminbi (CNY/USD)



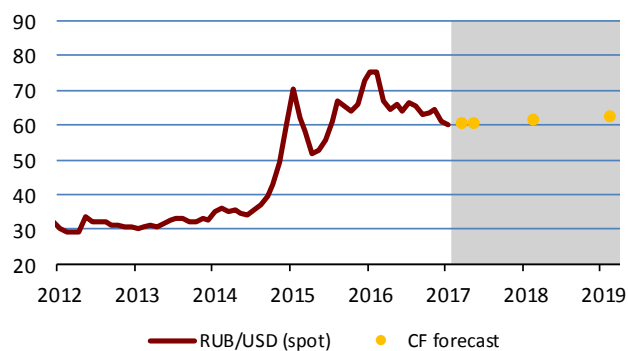
	13/2/17	03/17	05/17	02/18	02/19
spot rate	6.878				
CF forecast		6.990	7.066	7.259	7.278

The Indian rupie (INR/USD)



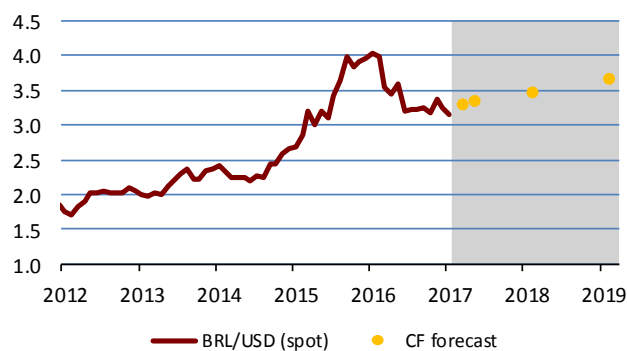
	13/2/17	03/17	05/17	02/18	02/19
spot rate	67.00				
CF forecast		68.27	68.63	69.31	69.30

The Russian rouble (RUB/USD)



	13/2/17	03/17	05/17	02/18	02/19
spot rate	58.09				
CF forecast		60.38	60.66	61.55	62.62

The Brazilian real (BRL/USD)



	13/2/17	03/17	05/17	02/18	02/19
spot rate	3.116				
CF forecast		3.286	3.338	3.459	3.668

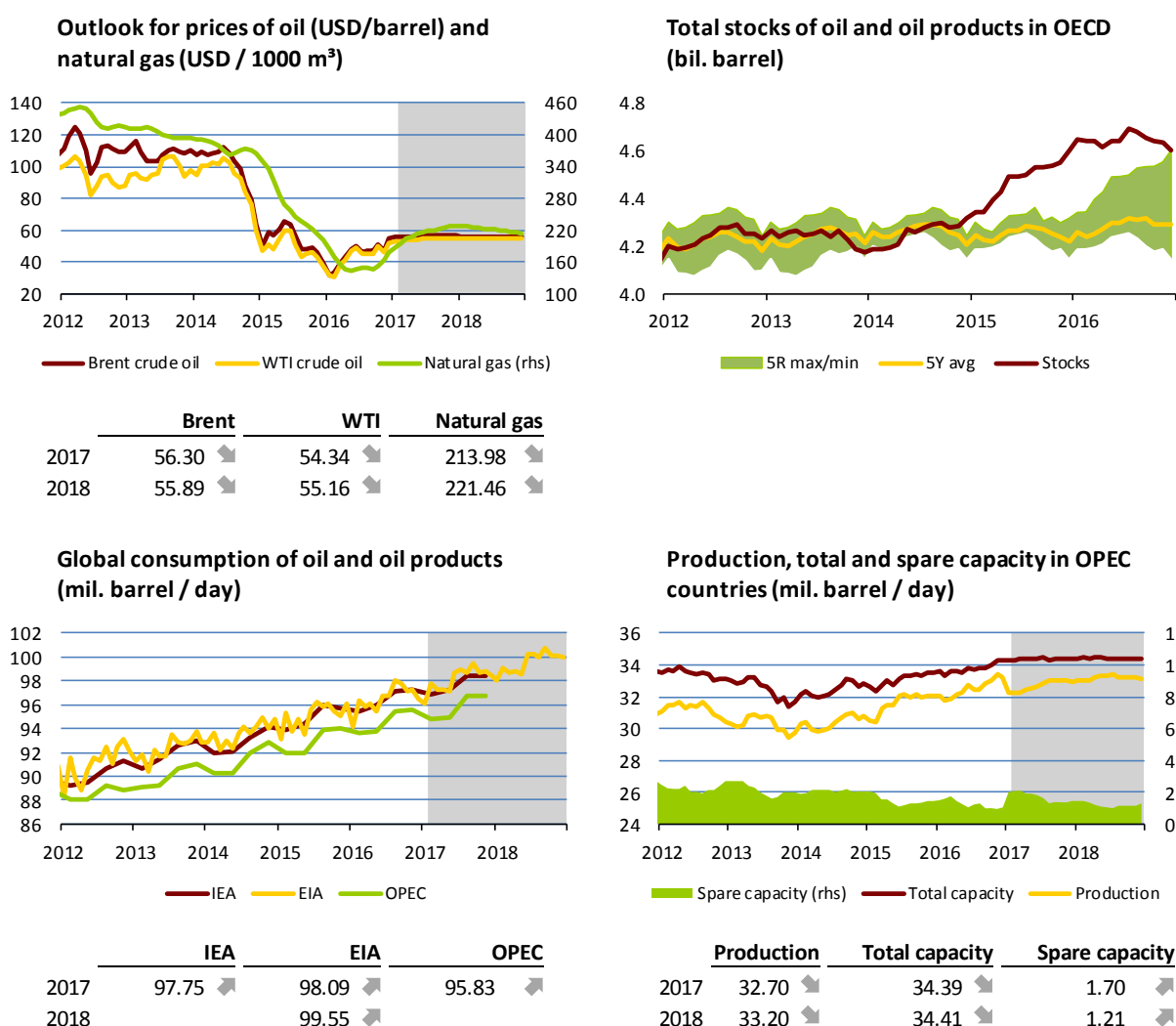
Note: Exchange rates as of last day of month.

V.1 Oil and natural gas

The average price of Brent crude oil has been just above USD 55/bbl since mid-December 2016 and is currently being affected by two main factors: the reduction in oil output agreed between OPEC and other large producers, and concerns about an upswing in shale extraction in the USA, which is having the opposite effect. Compliance by OPEC countries with the agreed output cuts is estimated at 90% (compared with only about 60% for similar commitments in the past) and there is even speculation that the deal could be extended to 2017 H2 and tightened if global oil stocks do not drop sufficiently. However, WTI oil prices above USD 50/bbl raise drilling activity in the USA and the resulting growth in shale extraction will reduce the effectiveness of the action taken by OPEC and other large oil producers.

As of the survey date of the February CF, the market futures curve implied an average price of USD 56.3/bbl for this year and a drop to USD 55.9/bbl for 2018. This is in line with the CF forecast of USD 56.4/bbl one year ahead. By contrast, in its February forecast the EIA expects the price to rise slightly from average of USD 55/bbl this year to USD 57/bbl next year. According to the EIA, global stocks will fall only slightly on average this year and rise only marginally in 2018. Record-high net long positions of speculative funds represent a risk for the oil price going forward. These signal expectations of further oil price growth, but they may also be reduced quickly, which would lead to a drop in oil prices.

Natural gas prices in the USA dropped sharply in response to above-average temperatures in late January. Gas prices in Europe also fell slightly even though temperatures there were well below average. Coal prices sank after output in China hit a one-year high in December when government restrictions were relaxed.



Source: Bloomberg, IEA, EIA, OPEC, CNB calculation

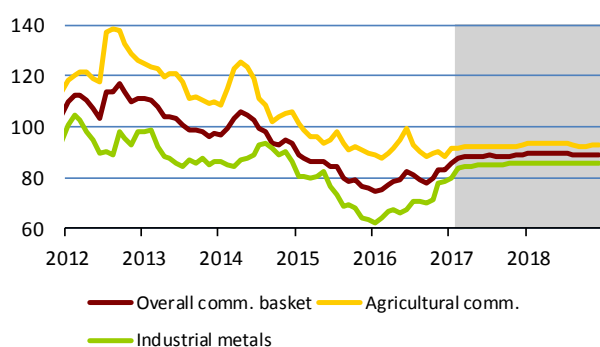
Note: Oil price at ICE, price of Russian natural gas at German border – IMF data, smoothed by the HP filter. Future oil prices (grey area) are derived from futures and future gas prices are derived from oil prices using model. Total oil stocks (commercial and strategic) in OECD countries – IEA estimate. Production and extraction capacity of OPEC – EIA estimate.

V.2 Other commodities

The average monthly non-energy commodity price index rose for the fourth straight month in January and kept rising in the first half of February. Between September 2016 and mid-February it went up by 12%. The basic metals price index showed a similar trend, rising by almost 20% in the same period (and by about 35% since the start of 2016). The food commodity price index also rose in January and early February, but remains close to its lowest levels since mid-2010. All three indices are virtually flat over the outlook horizon. Prices of basic metals were supported on the demand side by global manufacturing growth, although the [PMI](#) in China dropped slightly (to 51 points). On the supply side, news about potential output cuts in China fostered growth in aluminium prices, while copper prices increased on news of a strike threat at the world's biggest mine in Chile. Prices also grew in response to the weaker [dollar](#). By contrast, a drop in property prices in China acted against growth in metal prices.

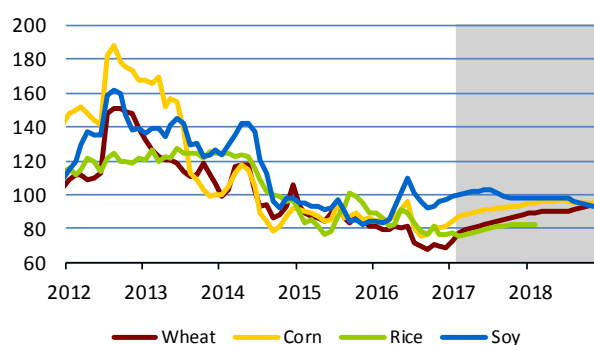
The food commodity price index was driven higher mainly by grain prices. The USDA estimates that the wheat harvest will drop by 10% year on year, as wheat acreage will be the second-lowest since records began. The growth in grain prices was also due to drought in the main agricultural regions in early 2017. The price of sugar increased due to a lower estimate of production in India as a result of drought in 2016. By contrast, cocoa prices continued to slump. Growth in beef prices halted and pork prices are near their seasonal high. As for non-food commodities, growth was recorded by the cotton price and especially by the rubber price, which has risen by more than 100% since August 2016 thanks to growing demand for Chinese tyre production.

Non-energy commodities price indices



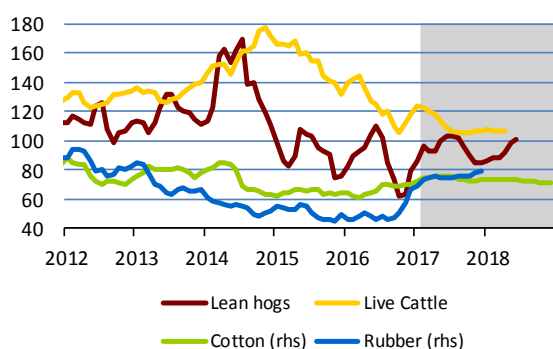
	Overall	Agricultural	Industrial
2017	88.3 ↗	92.3 ↗	84.6 ↗
2018	89.3 ↗	93.2 ↗	85.6 ↗

Food commodities



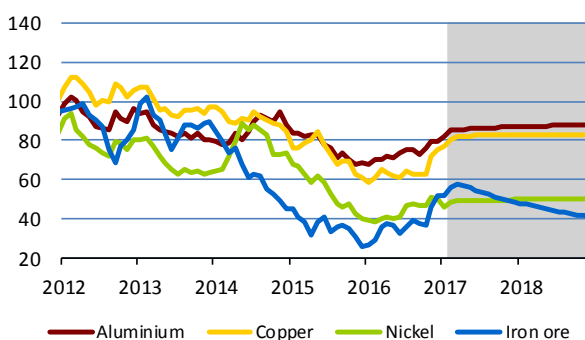
	Wheat	Corn	Rice	Soy
2017	82.3 ↗	90.7 ↗	79.6 ↗	100.3 ↗
2018	91.2 ↗	95.7 ↗	82.0 ↗	96.7 ↗

Meat, non-food agricultural commodities



	Lean hogs	Live Cattle	Cotton	Rubber
2017	94.3 ↗	112.0 ↗	81.4 ↗	82.9 ↗
2018	92.6 ↗	106.9 ↗	79.0 ↗	

Basic metals and iron ore



	Aluminium	Copper	Nickel	Iron ore
2017	85.8 ↗	81.9 ↗	49.0 ↗	53.2 ↗
2018	87.5 ↗	83.0 ↗	50.2 ↗	44.3 ↗

Source: Bloomberg, CNB calculations.

Note: Structure of non-energy commodity price indices corresponds to composition of The Economist commodity indices. Prices of individual commodities are expressed as indices 2010 = 100.

The effect of (un)conventional measures on shadow rates in the euro area and the USA¹

This paper sets out to show how the "shadow rates"² of the two most important economic territories (the euro area and the USA) have reflected their monetary policy-making. This topic has not been addressed in the literature. However, central banks use shadow rates as a measure of the monetary policy stance, and simple rules relating to (un)conventional instruments might simplify the debate. Our rough estimates suggest that the effect of monetary policy measures on shadow rates differs depending primarily on whether they were aimed at stabilising financial markets or further easing monetary conditions. Purchases of securities (government bonds) have a clearly negative effect. The available modelling techniques also suggest that the effects of measures taken in the euro area can change depending on the current level of financial stress.

1 Shadow rates and operations by the Fed and the ECB

The term "shadow rate" refers to the hypothetical path market rates would follow if the zero lower bound (ZLB) was not binding. Nominal rates cannot fall significantly below zero, because if they did, cash would be preferred as a risk-free investment. Black (1995) provided a way to calculate the value of the call option to hold cash at the ZLB. This value can then be subtracted from bond yields. A hypothetical yield curve is thus constructed as if no physical cash existed. Many studies have used option-pricing models to estimate the price of the call option to hold cash at the ZLB (the ZLB/currency option effect), but here we will concentrate solely on shadow rates as in Krippner (2014). This approach derives shadow rates from the yield curve (shadow short rates, SSRs³).

Although SSRs are available for the euro area, the USA, Japan and the UK, we will focus solely on the first two economic areas in this analysis. Chart 1 shows the history of shadow rates and the ECB's measures, i.e. main refinancing operations (MRO), long-term refinancing operations (LTRO), bond purchases and other operations (the marginal lending facility, etc.). Before the crisis, growth in main refinancing operations was visible, whereas in 2009–2012 the ECB implemented LTRO programmes. The unconventional measures have increased in volume over the last two years due to asset purchase programmes.

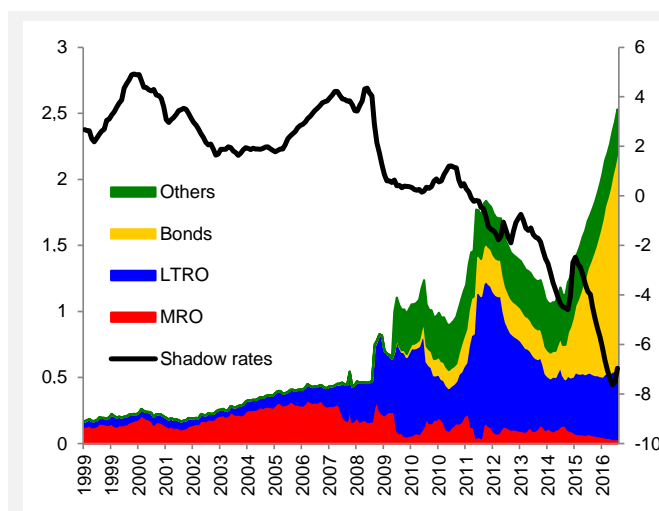


Chart 1 Euro area

Source: Datastream, Krippner (2014)

Note: shadow rates in %, otherwise in EUR trillions

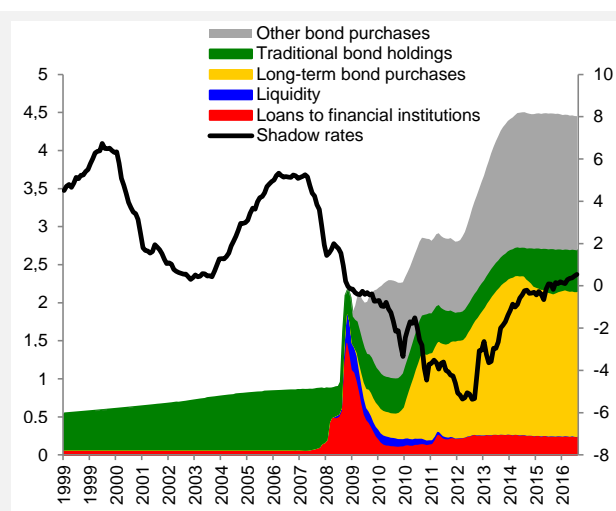


Chart 2 USA

Source: Cleveland Fed, Krippner (2014)

Note: shadow rates in %, otherwise in USD trillions

Shadow rates in the USA are given in Chart 2, along with the Fed's credit easing instruments. The Cleveland Fed database (credit easing tools⁴) contains operations that can be divided into three categories: lending to financial institutions, providing liquidity to key credit markets and purchasing longer-term securities.

¹ Author: Soňa Benecká. The views expressed in this article are those of the author and do not necessarily reflect the official position of the Czech National Bank.

² An introduction to the concept of shadow rates and the quantification thereof can be found in Benecká, Komárek and Novotný (2015).

³ <http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures>

⁴ <https://www.clevelandfed.org/our-research/indicators-and-data/credit-easing.aspx>

2 Estimates of the impacts of monetary policy measures on shadow rates in the euro area

Before the zero lower bound is reached, shadow rates copy market rates. Chart 3 shows the evolution of shadow rates by comparison with the 3M Euribor market rate. The difference between the rates, i.e. the rate gap, rose significantly for the first time in 2008 owing to ECB measures aimed at providing financial markets with liquidity. A sharp increase is also visible in the period when the ECB introduced long-term financial operations and bond purchases. As a result of continued expansion of unconventional programmes, shadow rates dropped to an all-time low at the end of 2016 (-7.6%).

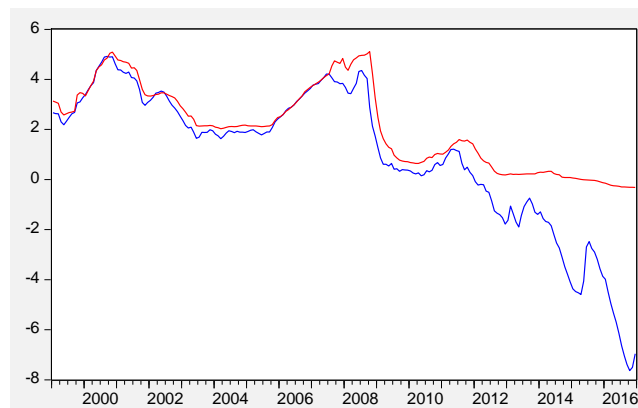


Chart 3 Shadow rates and the 3M Euribor

Source: ECB, Krippner (2014)

Note: red – 3M Euribor; blue – shadow rates

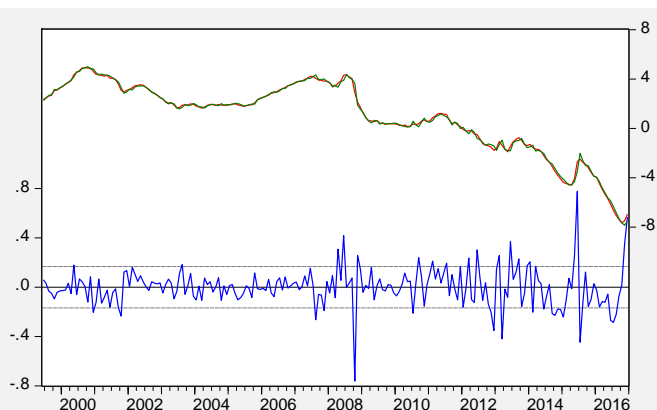


Chart 4 Modelling shadow rates using the ARDL

Source: author's calculations

Note: red – reality; green – estimate; blue – residuals

We attempted to model the rates (SHADOW) using the ARDL (Autoregressive Distributed Lag) regression method.⁵ The explanatory variables are the 3M Euribor (EURIBOR), main refinancing operations (MRO), long-term refinancing operations (LTRO), bond purchases (SEC) and other operations (OTHER). We used the trend and an indicator of systemic stress in the euro area (CISS) as fixed regressors. The resulting ARDL model (3, 3, 5, 5, 2, 4) estimates the gap very well (see Chart 4). Substantial deviations are visible only in 2008 and 2015 and at the end of the period under review. It is possible that a change in expectations caused the one-off deviation on bond markets.

The advantage of ARDL models is that they can be transformed to long-run form. The long-run relationship found (significant⁶) is:

$$\text{Cointeq} = \text{SHADOW} - (0.6691(\text{EURIBOR})^{***} + 14.0529(\text{MRO})^{***} + 4.2298(\text{LTRO})^{***} - 5.5236(\text{SEC})^{**} + 4.2891(\text{OTHER}) + 0.6916(\text{CISS}) - 0.0395(\text{TREND})^{***})$$

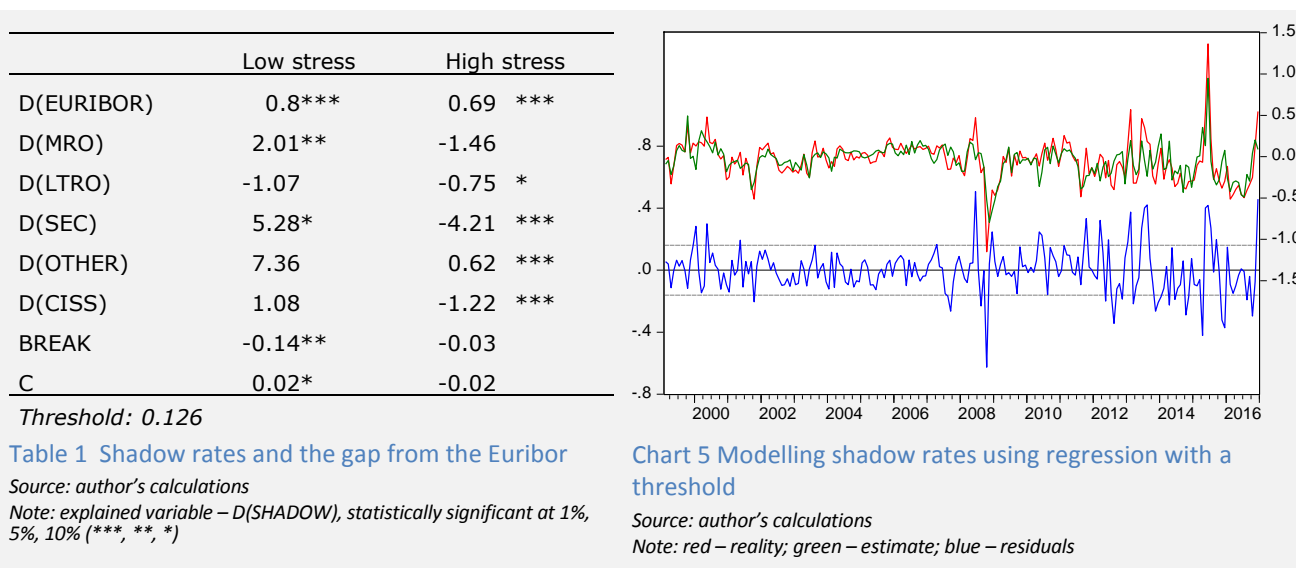
The effect of financial stress is not statistically significant, not even in the short run. While refinancing operations tend to increase the shadow rate, bond purchases clearly have an opposite, rate-reducing effect. The effect of bond purchases seems to be strongest, whereas the other operations have no effect on the shadow rate in the long run. Unfortunately, tests indicate instability of the coefficients (recursive estimates) and the result for long-term financial operations is not intuitive. On the other hand, the two LTRO programmes differed in their expected impact on financial markets (liquidity provision vs. credit support).

We therefore also prepared a non-linear model with a threshold (threshold regression) as an alternative. This method searches for the number of regimes depending on a threshold variable. The level of financial stress in the euro area was used as the threshold variable. Unconventional measures are thus expected to have different impacts on shadow rates depending on the instability on financial markets.

As the model must be constructed in differences, we can focus on changes in the shadow rate (SHADOW). In addition to the above-mentioned variables, it is explained by the 3M Euribor (EURIBOR) and a dummy variable for the period of negative rates (BREAK). The results are shown in Table 1. Different impacts are apparent for different measures in the two regimes. While main refinancing operations tended to support liquidity in the market, long-term refinancing operations and bond purchases resulted in a decline in the shadow rate at times of financial stress. The positive sign for securities purchases in the low financial stress regime might reflect a change in expectations, but the importance of this effect will be small. The low-stress period after the ZLB was reached was marked by a lower level of shadow rates on average than before it was reached. Fluctuations in the CISS also affect shadow rates in periods of financial stress. However, more complex methods beyond the scope of this paper would have to be applied to explain some phenomena.

⁵ This is a regression model in the ARDL form (p, q): $y_t = \beta_0 + \beta_1 y_{t-1} + \dots + \beta_p y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \dots + \alpha_q x_{t-q} + \varepsilon_t$

⁶ The F statistic for the bound test was 5.9, i.e. it clearly exceeded the 1% critical value for the upper bound. The EC (error correction) coefficient is negative and significant. Statistically significant – at 1%, 5%, 10% (***, **, *).



3 Estimates of the impacts of monetary policy measures on shadow rates in the USA

We applied the same approach as in the case of the euro area to shadow rates in the USA (SHADOW). Chart 6 shows their evolution by comparison with the 3M repo rate (REPO).

The explanatory variables of the rate gap are loans to financial institutions (LOAN), liquidity (LIQ), long-term bond purchases (TREAS), traditional bond holdings (THOLD) and other securities purchases (OTHER). As fixed regressors we again used the trend and an indicator of financial stress in the USA (STRESS), specifically the Kansas City Financial Stress Index.⁷ The ARDL model (2, 2, 2, 0, 5, 0, 4, 0) again estimates the gap very well (see Chart 7).

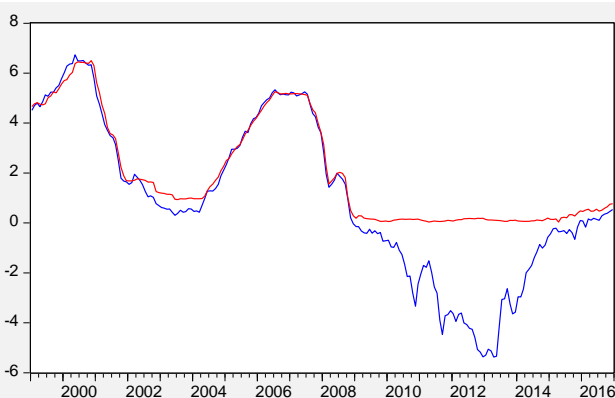


Chart 6 Shadow rates and the 3M repo

Source: Datastream, Krippner (2014)

Note: red – the 3M repo; blue – shadow rates

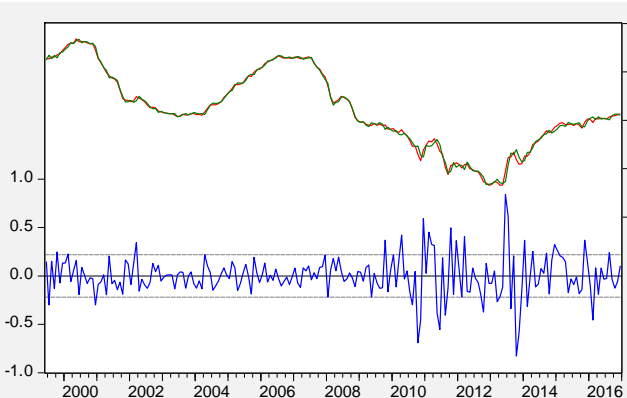


Chart 7 Modelling the gap using the ARDL

Source: author's calculations

Note: red – reality; green – estimate; blue – residuals

The resulting long-run relationship (significant⁸) takes the following form:

$$\text{Cointeq} = \text{SHADOW} - (1.1513(\text{REPO})^{***} + 31.6745(\text{LOAN})^{***} - 54.2727(\text{LIQ})^{***} - 3.9739(\text{TREAS})^{***} + 20.6475(\text{THOLD})^{***} + 9.3692(\text{OTHER})^{***} - 1.4430(\text{STRESS})^{*} + 1.4730(\text{BREAK}) - 0.0898(\text{TREND})^{***})$$

The negative impact on shadow rates is significant for two measures – long-term bond purchases and liquidity provision. By contrast, lending to financial institutions helped stabilise the fall in the rates as liquidity disappeared from financial markets. Traditional bond holding is a standard Fed instrument, but shadow rates also react to financial stress.

As in the case of the euro area, we tested a non-linear model with a threshold (see Chart 8), where the threshold is again financial stress. The model with two regimes is not as successful as it is for shadow rates

⁷ <https://www.kansascityfed.org/research/indicatorsdata/kcfsi>

⁸ The F statistic for the bound test was 4.3, i.e. it exceeded the 1% critical value for the upper bound. The EC (error correction) coefficient is negative and significant. Statistically significant – at 1%, 5%, 10% (***, **, *).

for the euro area. As shown in Table 2, liquidity provision can have the opposite effect on shadow rates depending on the level of financial stress.

	Low stress	High stress
D(REPO)	0.8***	1.02***
D(LOAN)	-0.85	0.82**
D(LIQ)	69.3***	-2.00*
D(TREAS)	2.79*	-5.03***
D(THOLD)	-4.8	1.24
D(OTHER)	7.36	-2.5*
BREAK	0.005	0.09
C	0.04**	-0.05*

Threshold: 0.55

Table 2 Shadow rates and the gap from the Euribor

Source: author's calculations

Note: explained variable – D(SHADOW), statistically significant at 1%, 5%, 10% (***, **, *)

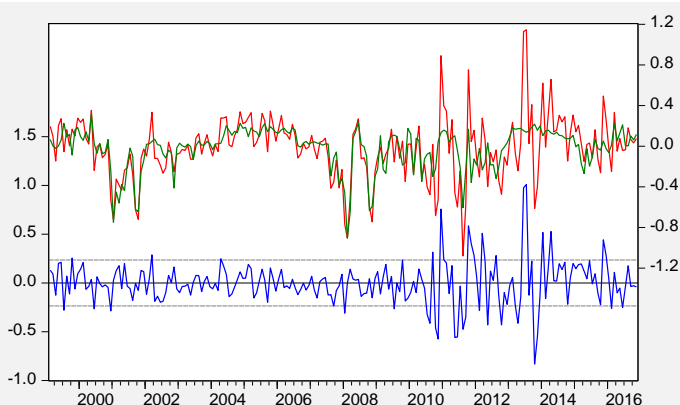


Chart 8 Modelling shadow rates using regression with a threshold

Source: author's calculations

Note: red – reality; green – estimate; blue – residuals

4 Conclusion

Our rough estimates suggest that the effect of monetary policy measures on shadow rates differs depending primarily on the objective (stabilising financial markets vs. easing monetary conditions). Purchases of government bonds have a clearly negative effect. The effect of measures taken in the euro area can also change depending on the current level of financial stress. However, more sophisticated methods would be needed to identify the relationships more accurately.

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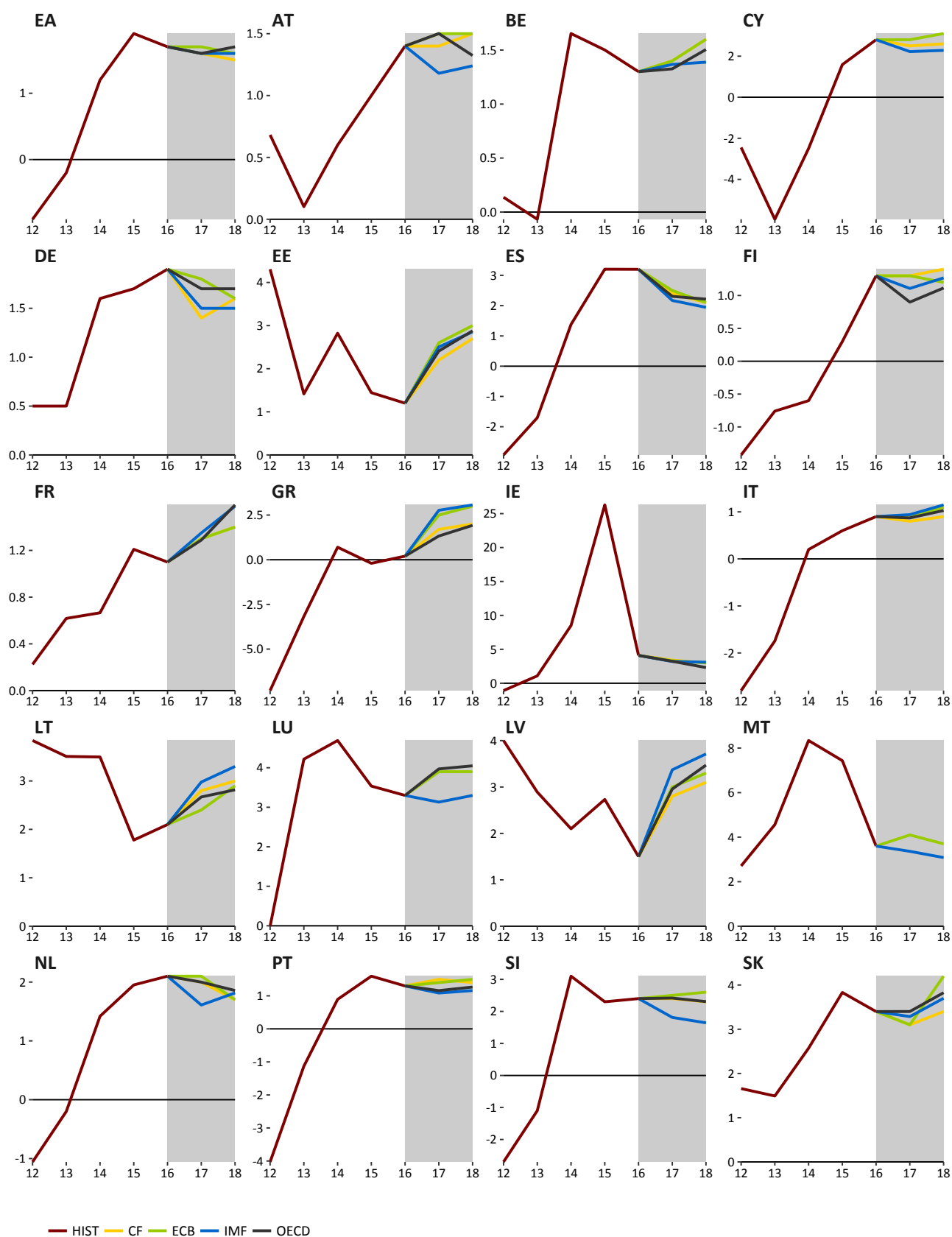
A1. Change in GDP predictions for 2017

	CF		IMF		OECD		CB / EIU	
EA	+0.2	2017/2	+0.1	2017/1	+0.2	2016/11	+0.1	2016/12
		2017/1		2016/10		2016/9		2016/9
DE	+0.1	2017/2	+0.1	2017/1	+0.2	2016/11	+0.2	2016/12
		2017/1		2016/10		2016/9		2016/6
US	0	2017/2	+0.1	2017/1	+0.2	2016/11	+0.1	2016/12
		2017/1		2016/10		2016/9		2016/9
UK	+0.1	2017/2	+0.4	2017/1	-0.8	2016/11	+0.6	2017/2
		2017/1		2016/10		2016/6		2016/11
JP	+0.1	2017/2	+0.2	2017/1	+0.3	2016/11	+0.2	2017/1
		2017/1		2016/10		2016/9		2016/11
CN	+0.1	2017/2	+0.3	2017/1	+0.2	2016/11	0	2017/1
		2017/1		2016/10		2016/9		2016/12
IN	-0.1	2017/2	-0.4	2017/1	+0.1	2016/11	0	2017/2
		2017/1		2016/10		2016/9		2016/12
RU	0	2017/1	0	2017/1	+0.3	2016/11	0	2017/1
		2016/12		2016/10		2016/6		2016/12
BR	-0.1	2017/1	-0.3	2017/1	+0.3	2016/11	0	2017/1
		2016/12		2016/10		2016/9		2016/12

A2. Change in inflation predictions for 2017

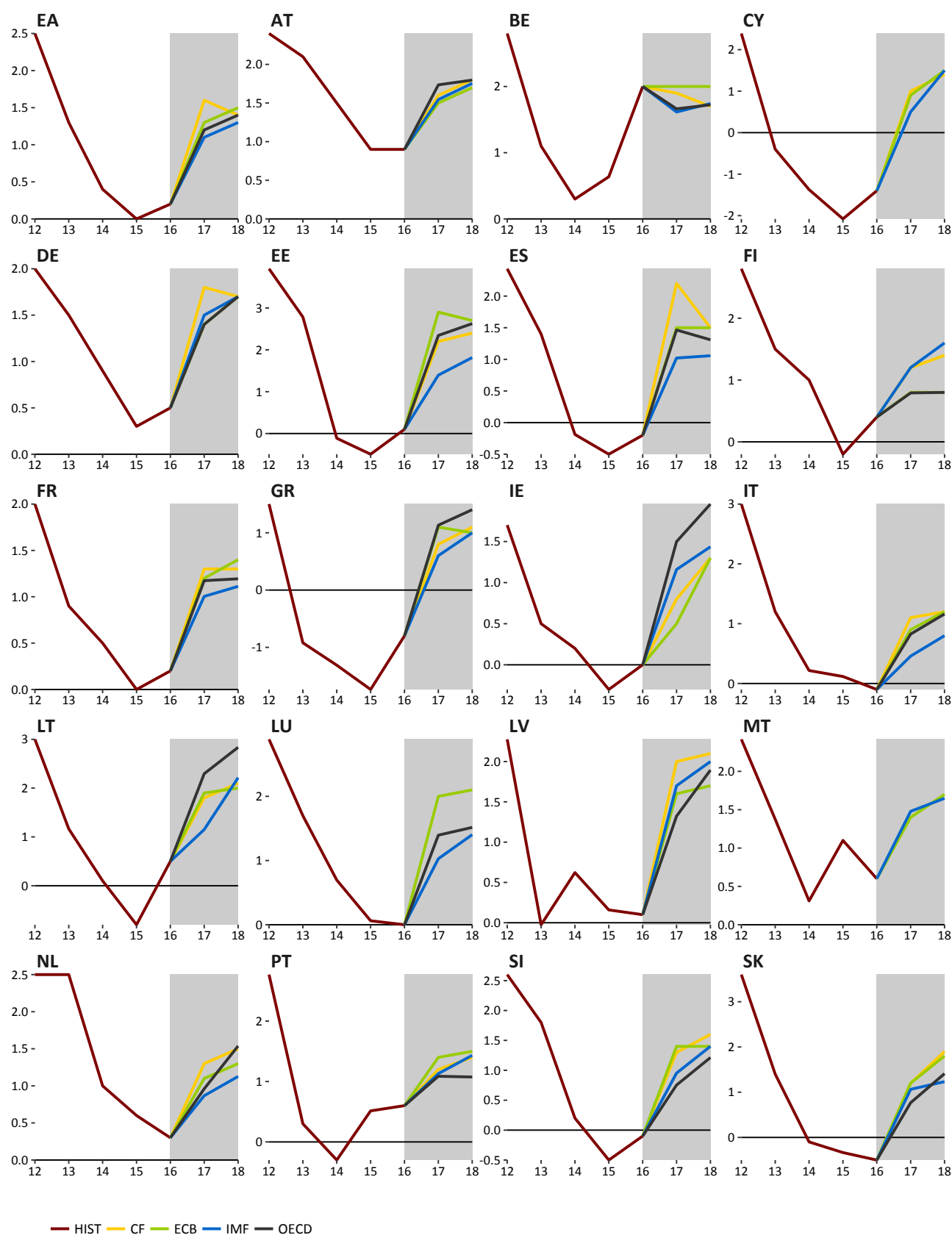
	CF		IMF		OECD		CB / EIU	
EA	+0.2	2017/2	0	2016/10	0	2016/11	+0.1	2016/12
		2017/1		2016/4		2016/6		2016/9
DE	+0.1	2017/2	+0.1	2016/10	-0.1	2016/11	-0.1	2016/12
		2017/1		2016/4		2016/6		2016/6
US	+0.1	2017/2	+0.8	2016/10	-0.1	2016/11	0	2016/12
		2017/1		2016/4		2016/6		2016/9
UK	+0.1	2017/2	+0.6	2016/10	+0.8	2016/11	0	2017/2
		2017/1		2016/4		2016/6		2016/11
JP	+0.1	2017/2	-0.7	2016/10	-1.8	2016/11	0	2017/1
		2017/1		2016/4		2016/6		2016/11
CN	+0.1	2017/2	+0.3	2016/10	-0.8	2016/11	-0.2	2017/1
		2017/1		2016/4		2016/6		2016/12
IN	-0.1	2017/2	-0.1	2016/10	+0.6	2016/11	0	2017/2
		2017/1		2016/4		2016/6		2016/12
RU	-0.1	2017/1	-1.5	2016/10	+0.6	2016/11	0	2017/1
		2016/12		2016/4		2016/6		2016/12
BR	-0.1	2017/1	-0.7	2016/10	+0.3	2016/11	-2.7	2017/1
		2016/12		2016/4		2016/6		2016/12

A3. GDP growth in the euro area countries



Note: The chart shows institutions' latest available outlooks of for the given country (in %).

A4. Inflation in the euro area countries



Note: The chart shows institutions' latest available outlooks of for the given country (in %).

A5. List of abbreviations

AT	Austria	GR	Greece
bbl	barrel	ICE	Intercontinental Exchange
BE	Belgium	IE	Ireland
BoE	Bank of England	IEA	International Energy Agency
BoJ	Bank of Japan	IMF	International Monetary Fund
bp	basis point (one hundredth of a percentage point)	IN	India
BR	Brazil	INR	Indian rupee
BRIC	countries of Brazil, Russia, India and China	IRS	Interest Rate swap
BRL	Brazilian real	ISM	Institute for Supply Management
CB	central bank	IT	Italy
CB-CCI	Conference Board Consumer Confidence Index	JP	Japan
CB-LEII	Conference Board Leading Economic Indicator Index	JPY	Japanese yen
CBR	Central Bank of Russia	LIBOR	London Interbank Offered Rate
CF	Consensus Forecasts	LME	London Metal Exchange
CN	China	LT	Lithuania
CNB	Czech National Bank	LU	Luxembourg
CNY	Chinese renminbi	LV	Latvia
CXN	Caixin	MKT	Markit
CY	Cyprus	MT	Malta
DBB	Deutsche Bundesbank	NKI	Nikkei
DE	Germany	NL	Netherlands
EA	euro area	OECD	Organisation for Economic Co-operation and Development
ECB	European Central Bank	OECD-CLI	OECD Composite Leading Indicator
EC	European Commission	PMI	Purchasing Managers' Index
EC-CCI	European Commission Consumer Confidence Indicator	pp	percentage point
EC-ICI	European Commission Industrial Confidence Indicator	PT	Portugal
EE	Estonia	QE	quantitative easing
EIA	Energy Information Administration	RU	Russia
EIU	Economist Intelligence Unit	RUB	Russian rouble
ES	Spain	SI	Slovenia
EU	European Union	SK	Slovakia
EUR	euro	SPF	ECB Survey of Professional Forecasters
EURIBOR	Euro Interbank Offered Rate	TLTRO	targeted longer-term refinancing operations
Fed	Federal Reserve System (the US central bank)	UK	United Kingdom
FI	Finland	UoM-CSI	University of Michigan Consumer Sentiment Index
FOMC	Federal Open Market Committee	US	United States
FR	France	USD	US dollar
FRA	forward rate agreement	USDA	United States Department of Agriculture
FY	fiscal year	WEO	World Economic Outlook
GBP	pound sterling	WTI	West Texas Intermediate (crude oil used as a benchmark in oil pricing)
GDP	gross domestic product	ZEW-ES	ZEW Economic Sentiment