

GLOBAL ECONOMIC OUTLOOK - MAY

Monetary Department
External Economic Relations Division

2018

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Cut-off date for data

18 May 2018

CF survey date

14 May 2018

GEO publication date

25 May 2018

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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II.4 United Kingdom	III.3 Russia III.4 Brazil	V.1 Oil and natural gas V.2 Other commodities		

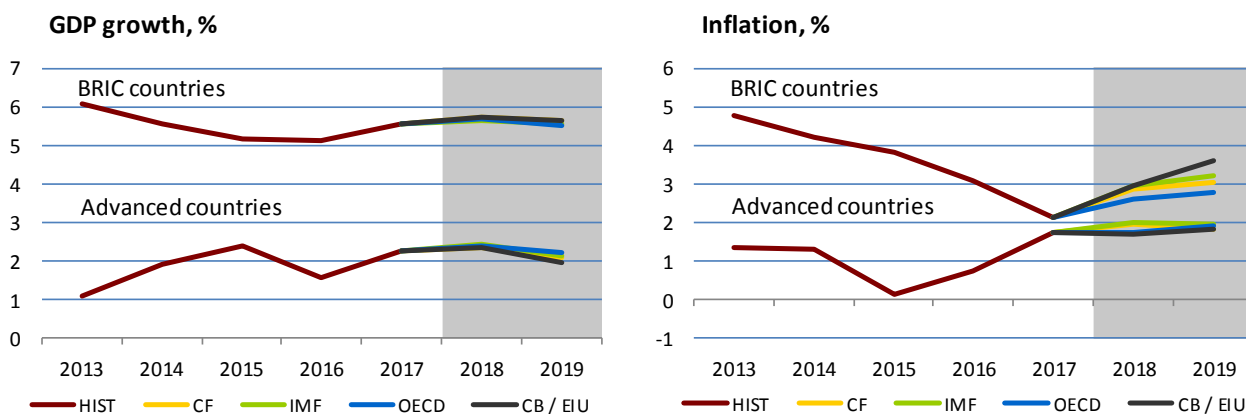
The May issue of Global Economic Outlook presents the regular monthly overview of recent and expected developments in selected territories, focusing on key economic variables: inflation, GDP growth, leading indicators, interest rates, exchange rates and commodity prices. The analytical section of this issue tests the interest parity condition on data obtained from Consensus Forecasts (CF). The article shows that the uncovered interest parity theory applies only partially. This is due to the existence of the risk premium and also because central banks' unconventional monetary policy significantly affects expectations about the movement of exchange rates. By contrast, the covered interest parity theory, which works with forward rates instead of expectations, holds exactly as expected in normal times.

The current outlooks for economic growth in the advanced countries we monitor except the USA have decreased for this year. The USA will continue to enjoy robust economic growth, which is expected to reach almost 3%. This figure should foster inflation pressures and enable the Fed to raise interest rates further, which it could do as early as its June meeting. The situation in the euro area, whose growth slowed quite sharply at the start of this year, is rather different. Weaker growth, along with a subdued inflation outlook and problematic developments in some euro area countries, may lead the ECB to postpone the increase in interest rates. The German economy, like that of the euro area, slowed at the start of the year. For 2018 as a whole, it is nonetheless expected to show continued solid growth amid low inflation. The outlooks for the UK and Japan, which have been lowered slightly for this year, still indicate distinctly lower economic growth (compared to the USA and the euro area). In the case of the UK, this is due to a combination of negative Brexit-related factors, which have been in evidence for some time now, and unusually bad weather in past months. The inflation outlooks for the UK have been reduced compared to last month, as inflation there is returning faster than expected towards the target. The inflation outlooks for Japan have also been revised down. However, this is not good news in this case, as inflation there will thus fluctuate around 1% only.

The current outlooks for the BRIC countries still expect solid GDP growth rates. Both India and China are showing strong economic growth as usual, recording no change from last month. The May outlooks thus indicate a slightly slower decline in Chinese GDP growth than was expected just a couple of months ago. By contrast, the Indian economy will return to more than 7.5% growth from its current slightly weaker rates. The inflation estimates for China are low, only just above the 2% level. Annual inflation of almost 5% is expected for India. However, this rate can still be considered acceptable given the high economic growth in that country. The economic situation of the remaining two BRIC countries, particularly Brazil, can also be viewed as quite positive from the post-crisis perspective. The Brazilian economy will approach 3% GDP growth at the end of next year. The situation in Russia improved compared to the previous month and its economy is expected to grow by 2% this year. The good news for these countries is that they will succeed in keeping inflation close to 4%.

According to market outlooks, euro area interest rates will remain negative until the end of 2019. By contrast, US interest rates can be expected to keep rising gradually. According to CF, the US dollar will weaken slightly against all the monitored currencies one year ahead, except for a modest strengthening against the renminbi. The Brent crude oil price moved visibly higher compared to the April outlook. It will fluctuate around USD 73 a barrel at the one-year horizon. Food commodity prices are expected to grow for the rest of the year after a temporary fall in Q2. Base metals prices are also expected to rise slightly.

GDP growth and inflation development and outlook in monitored countries

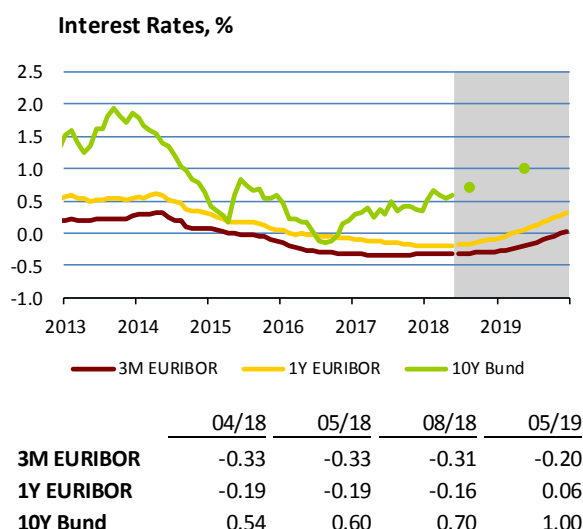
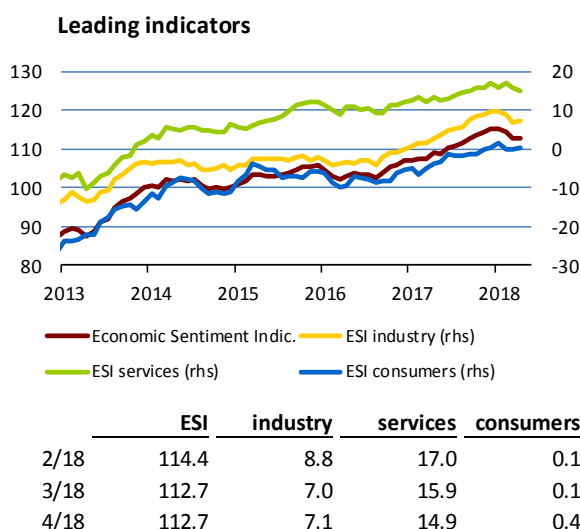
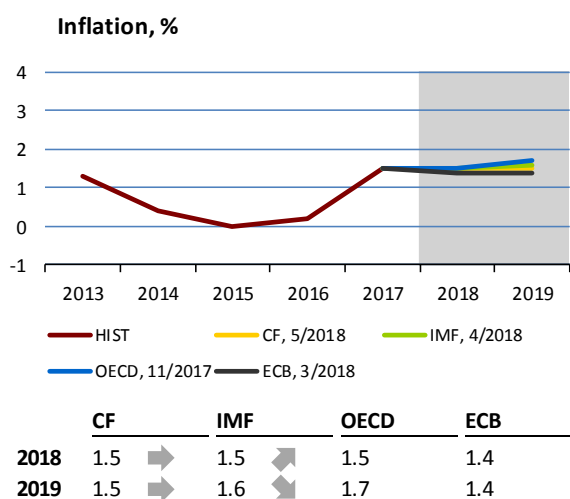
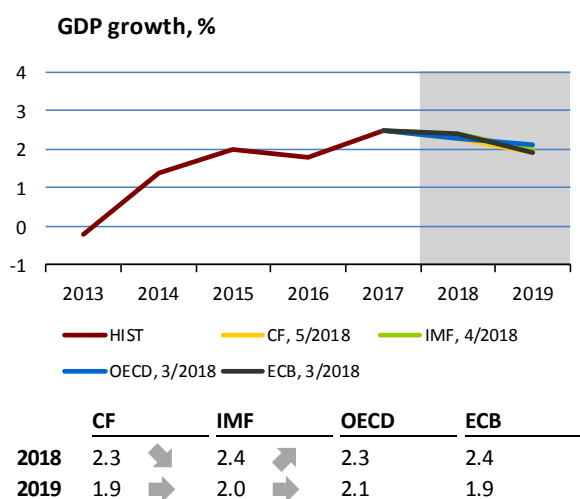


Note: The figures represent the weighted averages of historical series / outlooks in individual countries. The weights are based on nominal GDP measured in USD during 2013–2016 (source: EIU). Advanced countries: euro area, United States, United Kingdom, Japan. BRIC countries: China, India, Russia, Brazil.

II.1 Euro area

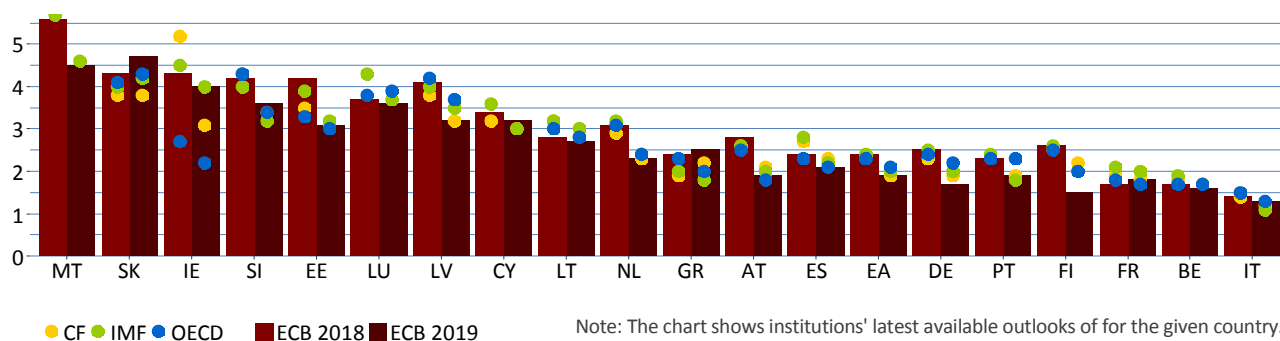
Euro area GDP growth slowed to 0.4% in quarter-on-quarter terms at the start of this year. The 0.3 pp slowdown is in line with leading indicators, which fell from historical highs in Q1, and also with the drop in growth in industrial production and retail sales. Of the large countries, France recorded the largest quarter-on-quarter slowdown (0.4 pp), followed by Germany (0.3 pp). Both these countries grew at the same rate as Italy (by 0.3%). GDP growth in Spain stayed at 0.7%. The euro area slowdown is due partly to one-off factors – weather fluctuations, strikes and a flu epidemic. However, the question remains to what extent the slowdown reflected longer-term factors such as the stronger euro and a decline in economic growth to long-term average levels. The euro area recorded solid growth of 2.5% in year-on-year terms. Leading indicators stabilised in April and are expected to continue rising at solid rates over the outlook horizon, although CF revised its outlook for this year down slightly to 2.3%; by contrast, the IMF raised its outlook for this year slightly. All the monitored outlooks expect growth to slow to around 2% next year.

Headline HICP inflation slowed to 1.2% in April and core inflation fell quite sharply to 0.7%, due mainly to lower growth in services prices. The monitored outlooks expect inflation of around 1.5% both this year and the next. The absence of fundamental inflationary pressures, in an environment of slowing, albeit still solid, growth, is thus generating uncertainty regarding the potential prolongation of securities purchases by the ECB. These purchases should continue at a monthly pace of EUR 30 billion until at least September this year. The April ECB meeting brought no fundamental news on the pace of policy normalization, so clearer message regarding the future parameters of unconventional monetary policy tools is not likely to come until the June meeting. The interest rate outlook remains stable. The 3M Euribor is not expected to turn positive again until the end of 2019. The exchange rate of the euro against the dollar weakened again, reflecting the worse macroeconomic data in the euro area.

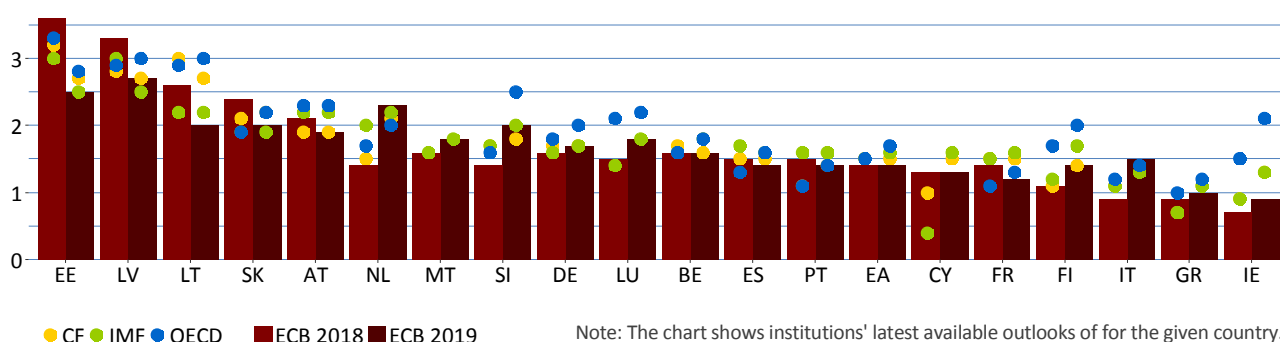


II. ECONOMIC OUTLOOK IN ADVANCED ECONOMIES

GDP growth outlooks in the euro area countries in 2018 and 2019, %

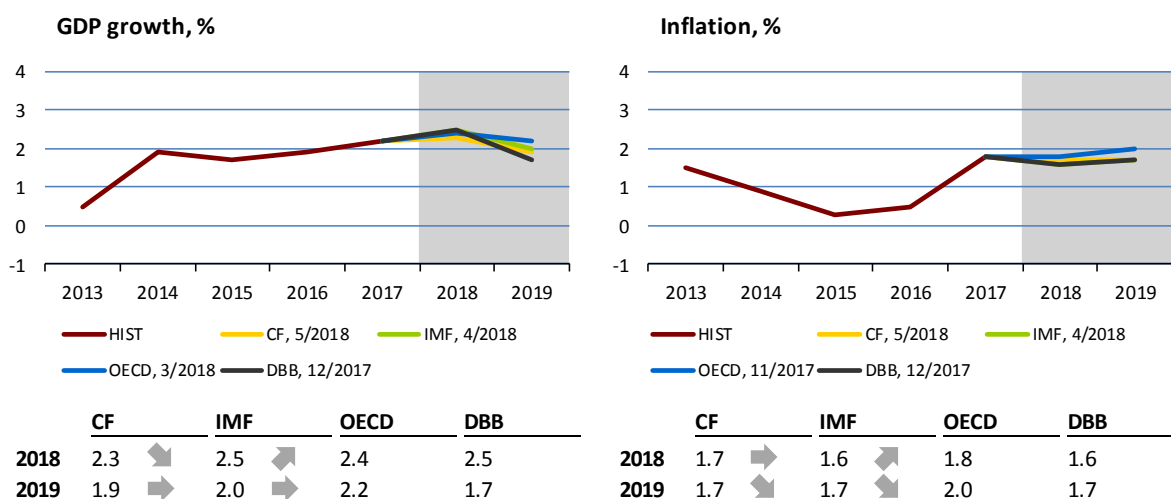


Inflation outlooks in the euro area countries in 2018 and 2019, %



II.2 Germany

Annual and quarterly GDP growth slowed to 2.3% and 0.3% respectively at the start of this year. Year-on-year growth in industrial production also slowed in February and March. However, the leading PMI indicator in manufacturing is currently relatively high up in the expansion band. By contrast, the IFO and ZEW indicators fell in April, possibly on concerns about the introduction of protectionist trade measures by the USA. Despite these uncertainties, similarly favourable economic developments as in 2017 are expected for this year (CF slightly lowered its GDP growth outlook for this year, while the IMF increased its outlook). All the monitored institutions expect economic growth to slow in 2019. Nevertheless, inflation expectations remain low for both monitored years, i.e. 2018 and 2019, and do not exceed 2%. Annual consumer price inflation (HICP) stood at just 1.4% in Germany in April.

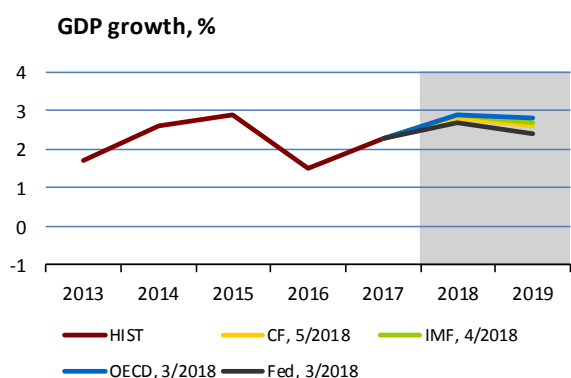


II.3 United States

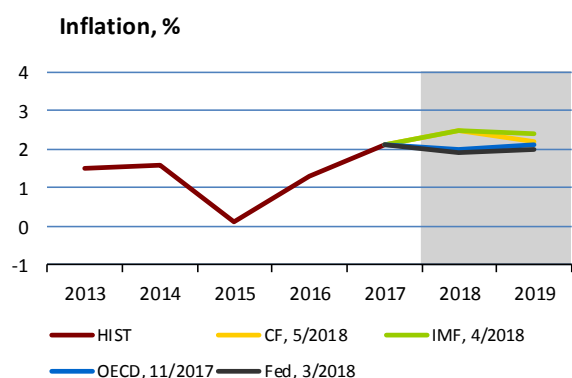
The talks between the USA and China brought no major turnaround in mutual trade relations, although both sides pledged to resolve trade disputes through dialogue. The dispute centres on the USA's criticism of China for insufficient protection of intellectual property and high trade surpluses. China offered a package of measures in mid-May aimed at reducing the US trade deficit with China by up to USD 200 billion, including the cancellation of some tariffs on trade in US agricultural products. The plan is very ambitious relative to the overall bilateral trade deficit (USD 375 billion in 2017).

The talks are affecting sentiment on financial markets, but the overall impact on the US economy might only be observed at a horizon of several quarters. The US economy continued to expand at the start of 2018, with GDP growth reaching 2.3% in quarter-on-quarter annualised terms in 2018 Q1. The growth rate is usually lower in the first quarter of the year, so the data cannot be interpreted as a sign of a slowdown. On the contrary, according to the Atlanta Fed the economy might accelerate to 4% in Q2. Retail sales grew by 4.7% year on year in April and consumer confidence also remains at historical highs. Non-farm payrolls amounted to 164,000 in April and the unemployment rate dropped to 3.9%, the lowest level since December 2000. The average hourly wage increased by 2.6% year on year.

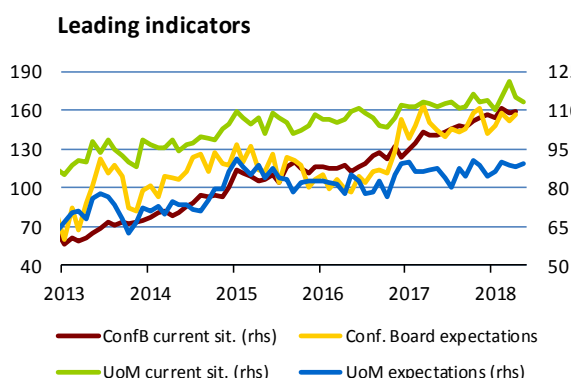
Headline consumer price inflation rose further to 2.4% in April. Core inflation was 2.1% and growth in the core personal consumption expenditure (PCE) index also neared the central bank's target (1.9% in March). As expected, the US central bank left monetary policy unchanged at its May meeting. The bank evaluates risks as balanced and inflation as close to the target. The Fed will probably raise the target range for the policy rate next month. The May CF increased its inflation outlook for 2019 only. The new IMF forecast expects higher GDP growth in both years and higher inflation in 2018. By contrast, the inflation outlook for 2019 was revised downwards.



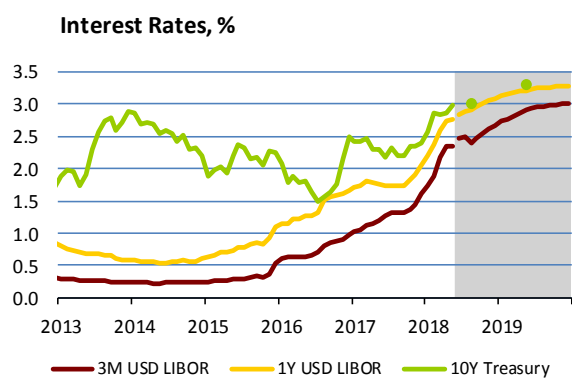
	CF	IMF	OECD	Fed
2018	2.8 →	2.9 ↗	2.9	2.7
2019	2.6 →	2.7 ↗	2.8	2.4



	CF	IMF	OECD	Fed
2018	2.5 →	2.5 ↗	2.0	1.9
2019	2.2 ↘	2.4 ↗	2.1	2.0



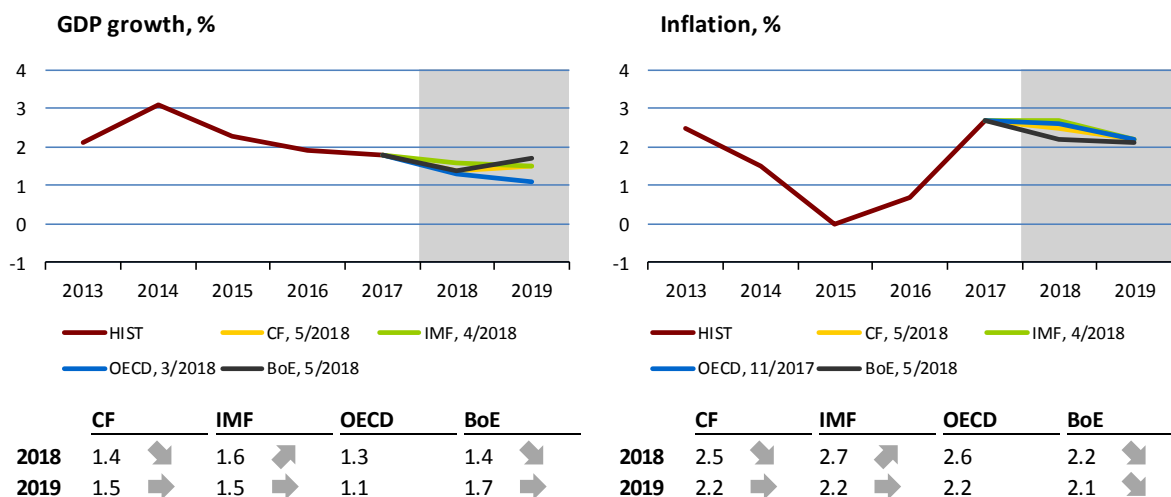
	ConfB curr.	ConfB exp.	UoM curr.	UoM exp.
3/18	158.1	106.2	121.2	88.8
4/18	159.6	108.1	114.9	88.4
5/18			113.3	89.5



	04/18	05/18	08/18	05/19
USD LIBOR 3M	2.35	2.35	2.39	2.90
USD LIBOR 1R	2.73	2.73	2.90	3.21
Treasury 10R	2.87	2.99	3.00	3.30

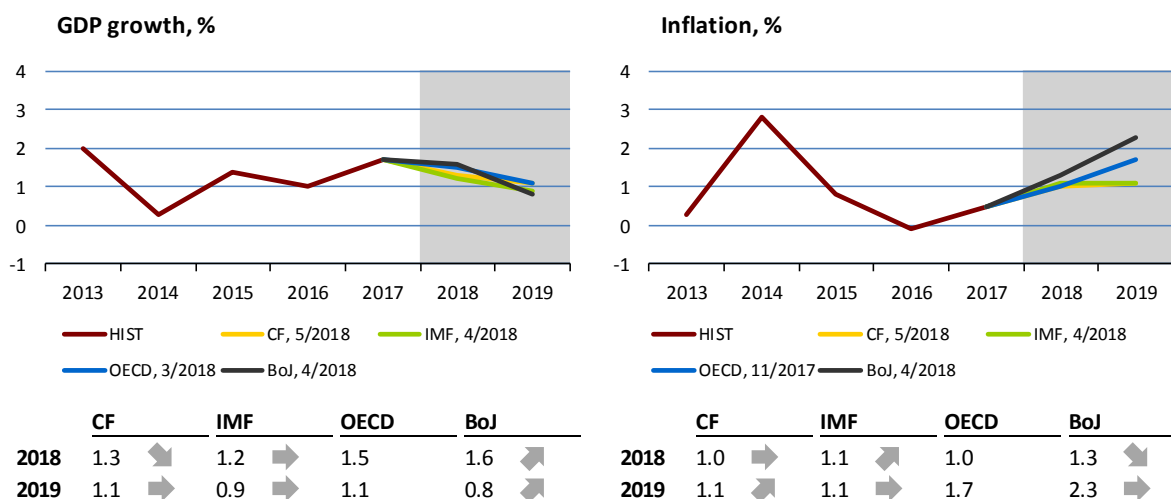
II.4 United Kingdom

The first GDP growth estimate confirmed concerns that the bad weather in late February and early March and other factors had caused the UK economy to slow. The UK economy grew by just 1.2% year on year in Q1, while in quarter-on-quarter terms the growth almost halted (reaching just 0.1%). In response, the BoE and CF lowered their growth forecasts for this year to 1.4%. The bad weather mainly affected construction. Its output has been decreasing year on year since January. The rate of decline gradually increased to a sizeable 4.9% in March. However, a return of the PMI index for this sector above 50 points in April indicates an improvement in the situation. Inflation slowed to 2.5% in March. This was reflected in lower BoE and CF outlooks. According to the BoE's new forecast, inflation will return to the target faster than expected. Together with the unfavourable GDP developments, this reduced the need to tighten monetary policy. The BoE thus left interest rates unchanged at its May meeting.



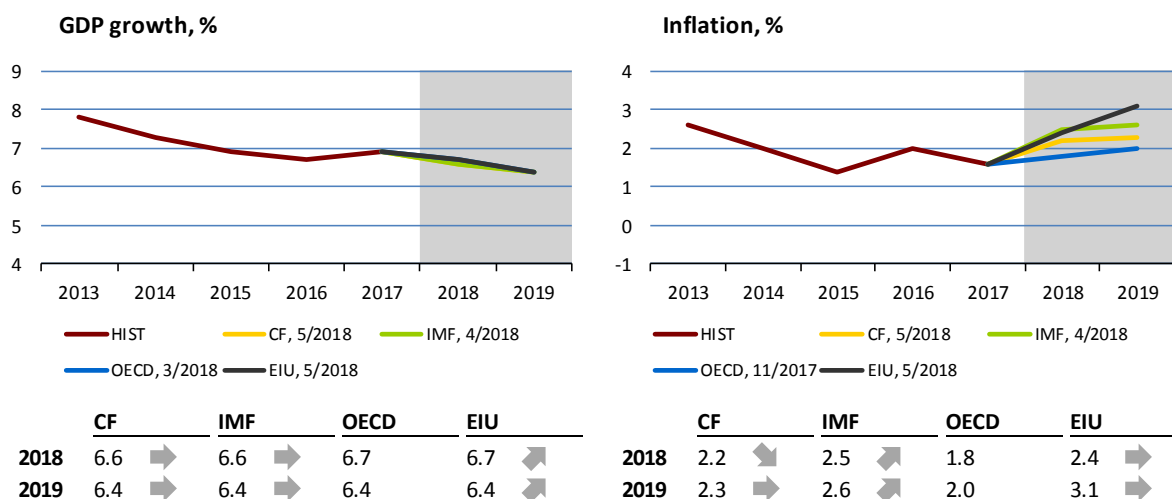
II.5 Japan

According to preliminary data, the Japanese economy contracted by 0.6% in quarter-on-quarter annualised terms in Q1. Its growth was 1.2 pp lower than in the previous quarter. This was due mainly to a drop in investment and private consumption. Retail sales growth slowed in March. Household spending also declined. By contrast, wage growth grew markedly. Year-on-year growth in industrial production accelerated. The PMI in manufacturing went up to 53.3 points in April. According to purchasing managers, output, new orders and employment rose at a faster rate. The BoJ raised its GDP growth projection, while CF slightly lowered its forecast for this year. Annual consumer price inflation slowed in March and April (to 1.1% and 0.6% respectively) due to a significant fall in food prices. According to the outlooks, inflation will be above 1% in 2018 and 2019. The BoJ left its monetary policy stance unchanged in April.



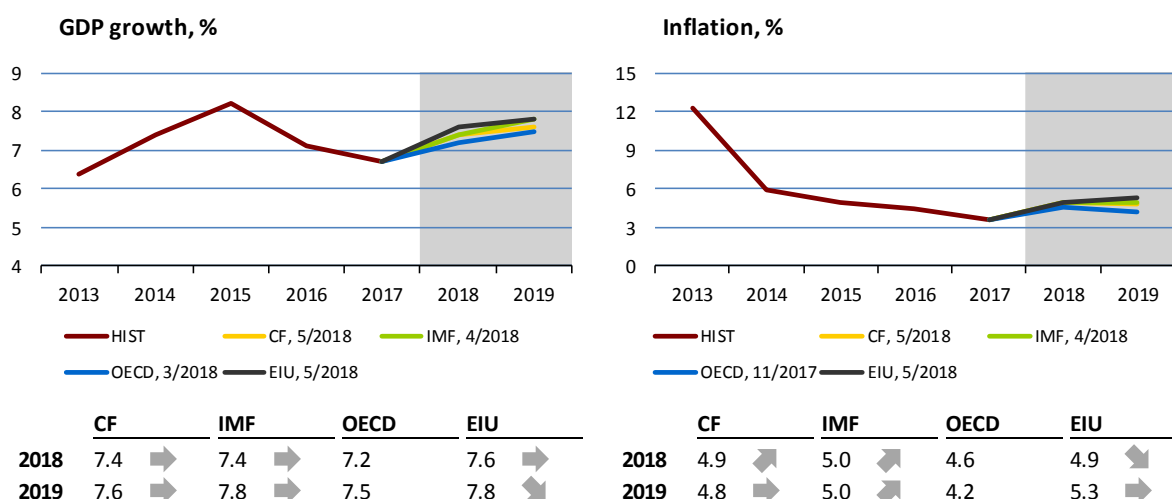
III.1 China

The Chinese economy grew by 6.8% year on year in 2018 Q1, the same as in the previous two quarters. The economic expansion was driven by strong consumer demand and property investment, which remain surprisingly robust given the measures taken to curb property price growth. Industrial production growth increased in April (to 7%), but growth in retail sales and fixed investment slowed (to 9.4%). No impact of trade disputes on the performance of the Chinese economy has been observed yet. The April foreign trade data exceeded financial market expectations, but leading indicators suggest that firms are worried about a drop in foreign orders. Consumer price inflation fell to 1.8%, mainly due to lower food prices. The EIU raised its outlook for Chinese economic growth in both years, while the IMF revised its inflation outlook upwards. The new CF forecast brought only a slightly lower inflation outlook for this year.



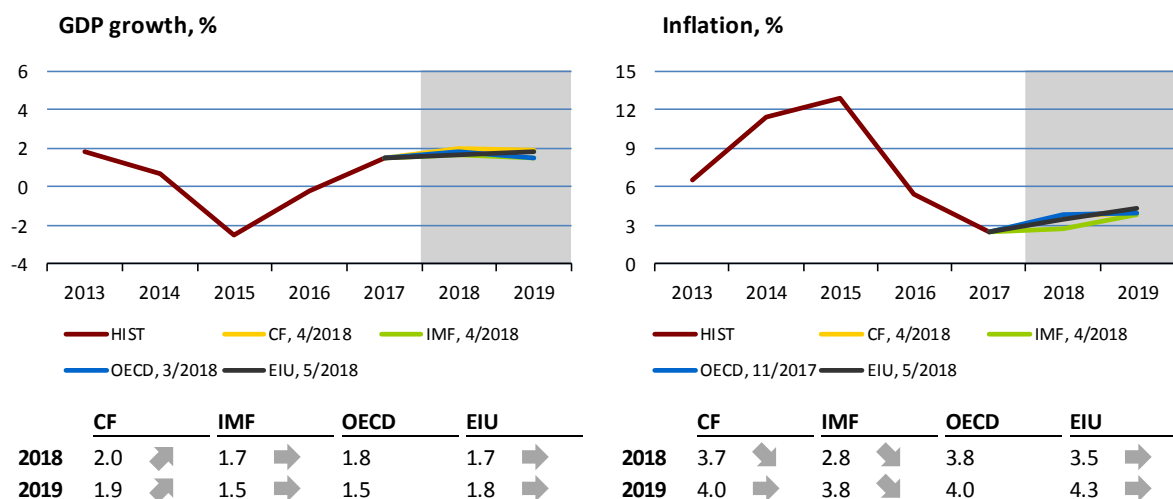
III.2 India

Industrial production growth slowed in year-on-year terms in March due to a drop in manufacturing output. The PMI in manufacturing went up to 51.6 points in April. According to purchasing managers, this was due to faster growth in output and new orders and strengthening business sentiment. The GDP growth forecasts were almost unchanged. The Indian economy is thus expected to record growth of more than 7% in both monitored years. Inflation rose by 0.3 pp to 4.6% in April. Food prices declined further, but the fall was outweighed by a rise in prices of other consumer basket items, with housing prices showing the strongest growth. CF and the IMF revised their inflation outlooks for 2018 up, whereas the EIU revised its forecast down. The IMF expects slightly higher inflation in 2019 than in the previous forecast. Inflation should thus be in the upper half of the tolerance band around the inflation target (4% ± 2%) in both years.



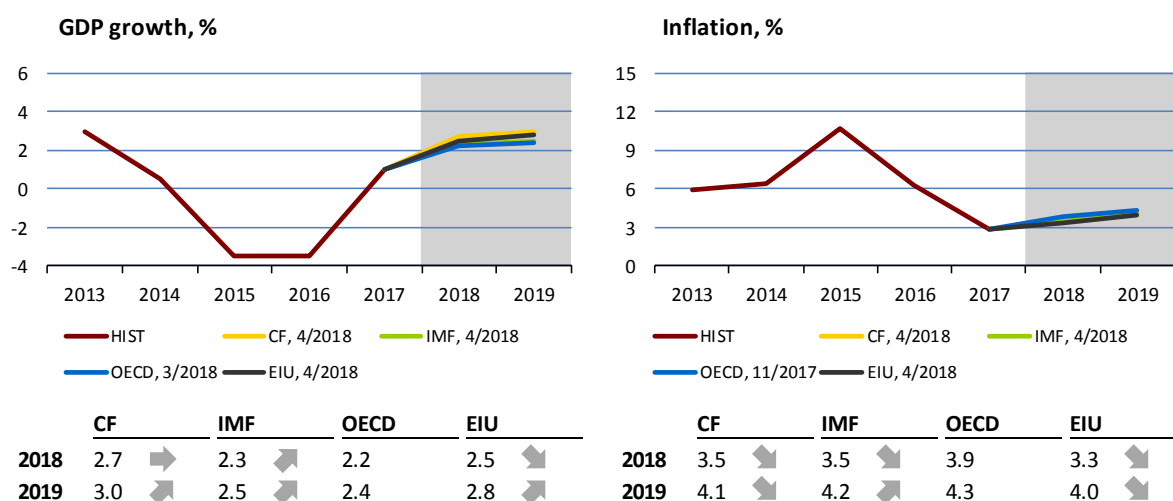
III.3 Russia

The preliminary outlook for GDP growth in Q1 suggests a moderate acceleration compared to the end of last year, when the slowest growth in the past four quarters was recorded. Turning to short-term indicators, growth in industrial production gradually slowed in Q1 (from 2.9% in January to 1.0% in March). By contrast, the month-on-month growth at the end of the quarter was the strongest in the entire period. Unusually cold weather in March boosted energy sector output but negatively affected construction. The Russian rouble remains above RUB 61.3/USD in May following a sharp weakening in early April related to geopolitical tensions. Growth in oil prices is currently putting modest appreciation pressure on the Russian currency. CF revised its GDP growth forecasts for this year and the next upwards (to 2.0% and 1.9%), while the IMF and EIU left their outlooks unchanged.



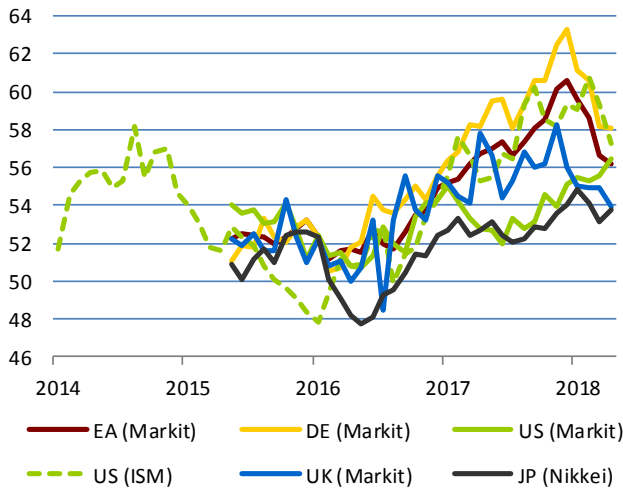
III.4 Brazil

Year-on-year growth in manufacturing almost halved again in March (to 1.6%). In addition, the unemployment rate rose for the third consecutive month, reaching 13.1% in March (compared to 11.8% in December). The PMI in manufacturing is suggesting no improvement in the situation yet. On the contrary, this indicator fell to 52.3 in April (from 53.4 the previous month) due to weaker growth in output, new orders and exports. Last but not least, leading indicators were affected by unemployment growth. The PMI in services also declined. Although the change was not so dramatic (50.0 versus 50.4), the indicator reached the level separating expansion from recession. The key interest rate was unchanged in May. The CF, IMF and EIU outlooks expect GDP growth of around 2.3%–2.7% this year and a slight acceleration next year. Consumer price inflation can also be expected to pick up moderately by the end of 2019.

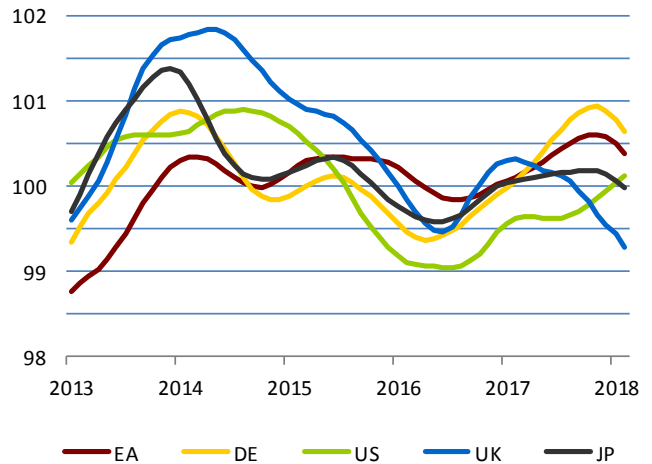


IV.1 Advanced economies

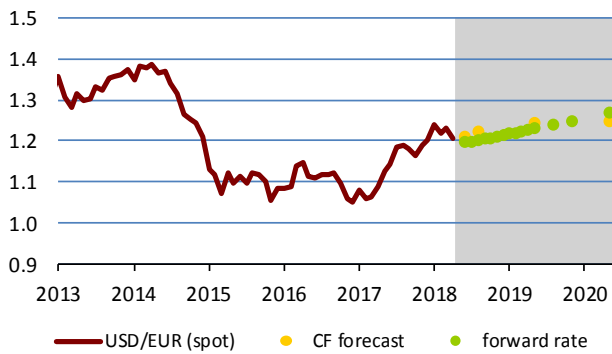
PMI in manufacturing



OECD Composite Leading Indicator

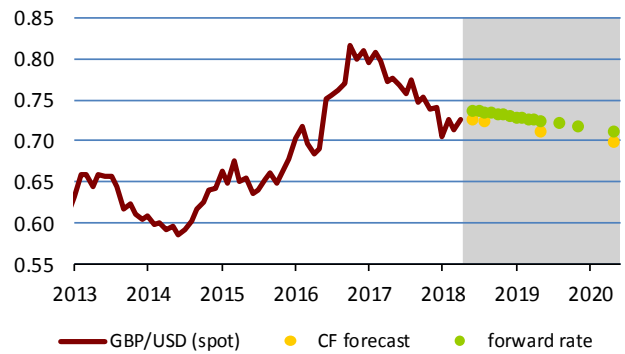


The US dollar (USD/EUR)



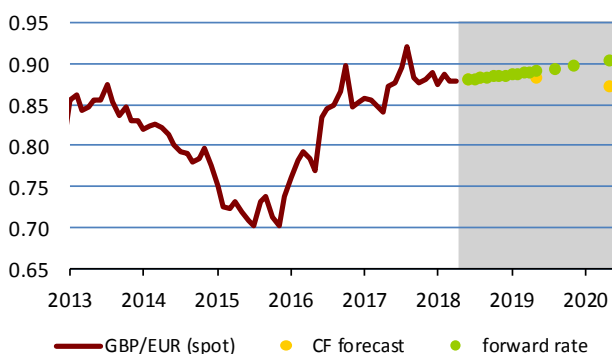
	14/5/18	06/18	08/18	05/19	05/20
spot rate	1.197				
CF forecast		1.212	1.221	1.243	1.249
forward rate		1.195	1.201	1.229	1.269

The British pound (GBP/USD)



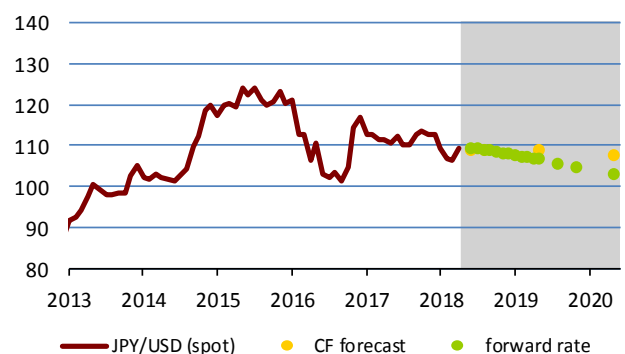
	14/5/18	06/18	08/18	05/19	05/20
spot rate	0.735				
CF forecast		0.727	0.724	0.711	0.698
forward rate		0.737	0.735	0.724	0.711

The British pound (GBP/EUR)



	14/5/18	06/18	08/18	05/19	05/20
spot rate	0.880				
CF forecast		0.881	0.884	0.883	0.872
forward rate		0.881	0.882	0.890	0.903

The Japanese yen (JPY/USD)

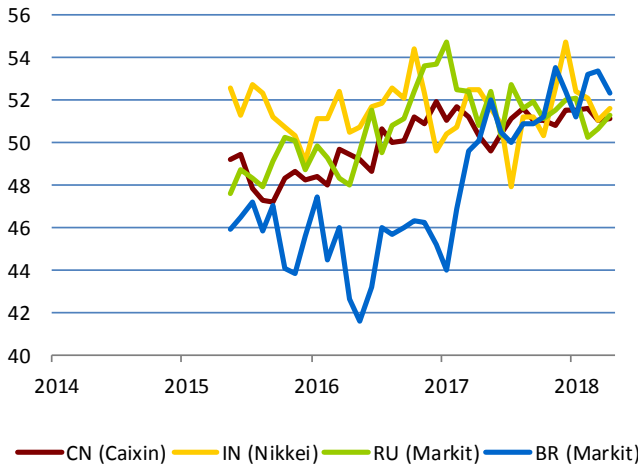


	14/5/18	06/18	08/18	05/19	05/20
spot rate	109.6				
CF forecast		108.7	108.8	108.8	107.7
forward rate		109.4	109.0	106.6	103.1

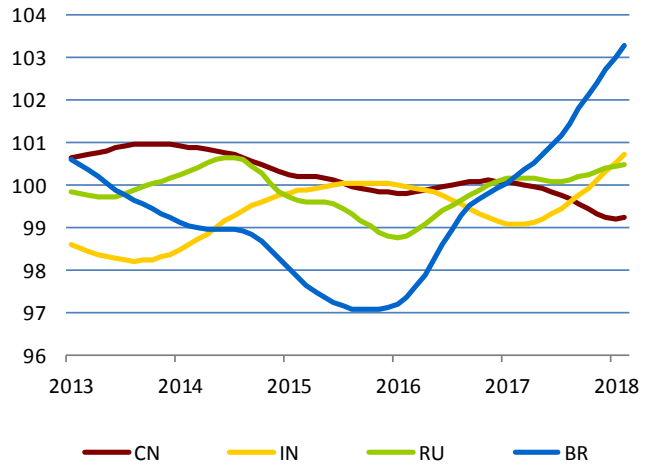
Note: Exchange rates as of last day of month. Forward rate does not represent outlook; it is based on covered interest parity, i.e. currency of country with higher interest rate is depreciating. Forward rate represents current (as of cut-off date) possibility of hedging future exchange rate.

IV.2 BRIC countries

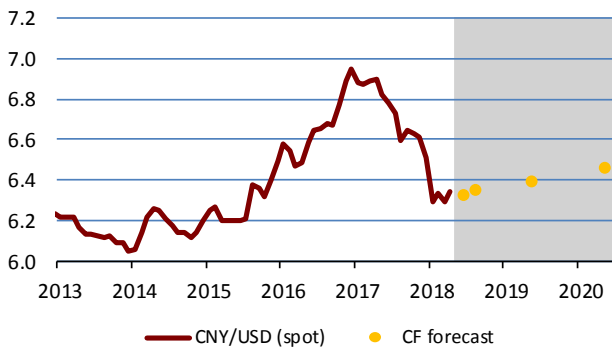
PMI in manufacturing



OECD Composite Leading Indicator

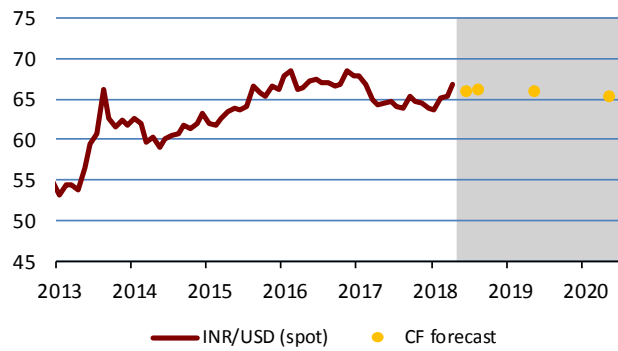


The Chinese renminbi (CNY/USD)



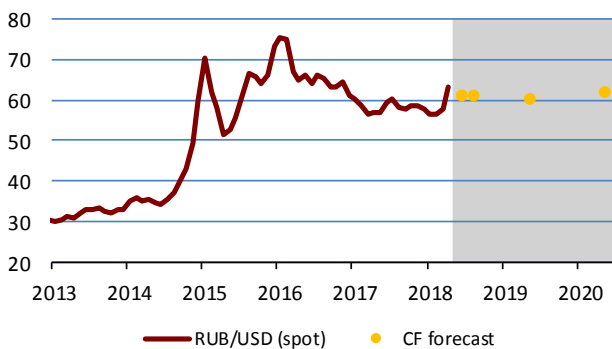
	14/5/18	06/18	08/18	05/19	05/20
spot rate	6.337				
CF forecast		6.327	6.350	6.390	6.458

The Indian rupee (INR/USD)



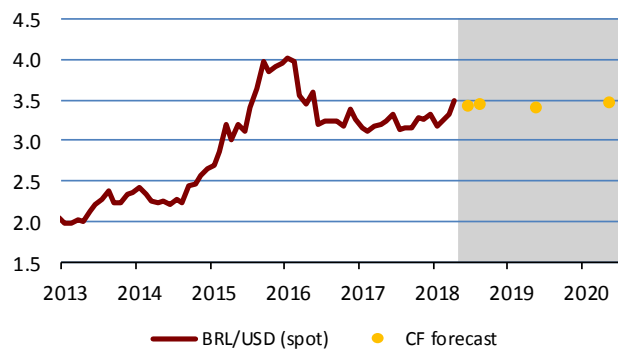
	14/5/18	06/18	08/18	05/19	05/20
spot rate	67.59				
CF forecast		66.05	66.13	65.87	65.25

The Russian rouble (RUB/USD)



	14/5/18	06/18	08/18	05/19	05/20
spot rate	61.69				
CF forecast		61.06	60.88	60.05	61.93

The Brazilian real (BRL/USD)



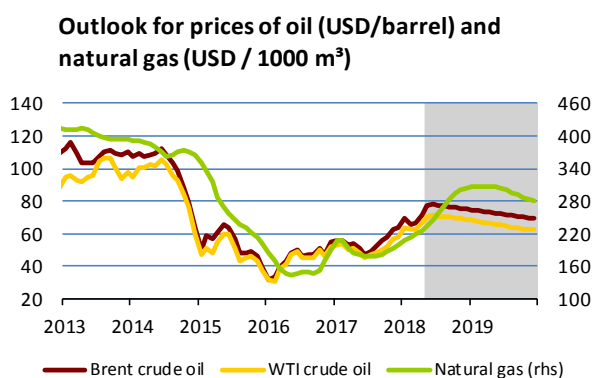
	14/5/18	06/18	08/18	05/19	05/20
spot rate	3.619				
CF forecast		3.421	3.454	3.404	3.477

Note: Exchange rates as of last day of month.

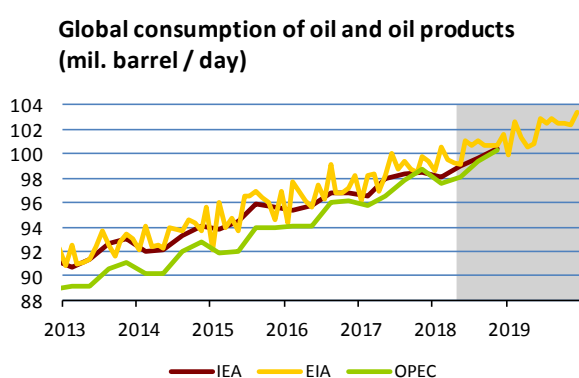
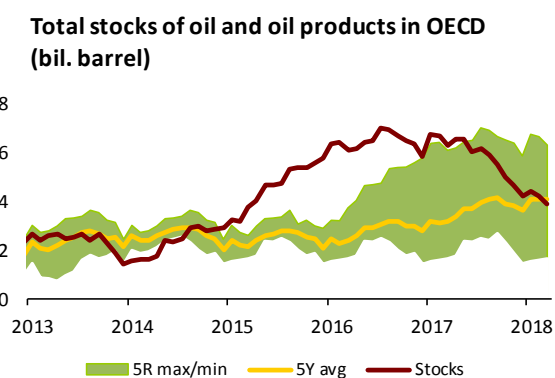
V.1 Oil and natural gas

Oil prices have been showing a strong upward trend since the start of April. The price of Brent crude oil surged to USD 80/bbl in May on the back of both fundamentals (continued robust growth in demand, limited production by OPEC and falling global oil stocks approaching the five-year average) and rising geopolitical tensions. Analysts' attention is shifting to Iran now that the situation in Syria has calmed somewhat. The USA withdrew from the nuclear agreement between Iran and world powers. This means that sanctions against Iran will be renewed. Iran's trading partners have 180 days to limit mutual trade. However, the real impact of this step is highly uncertain. The estimated drop in Iranian exports is between 0.2 and 1.0 million barrels a day. A key factor will be how the other signatories to the agreement approach the sanctions, whether China and India, the largest buyers of oil from Iran, will uphold them, and how the other OPEC members and Russia will react. The latter are promising to compensate for any drop in oil supply on the market by increasing their output. However, this would reduce their reserve production capacity and could increase oil price volatility. The observed oil price growth would probably have been even stronger had it not been for the current rapid strengthening of the dollar. The spread between the Brent price (which is responding more strongly to geopolitical tensions) and the WTI price (whose growth is being counteracted by a continued massive increase in shale extraction in the USA and by logistical problems with transport to refineries and exports) has recently started to widen again.

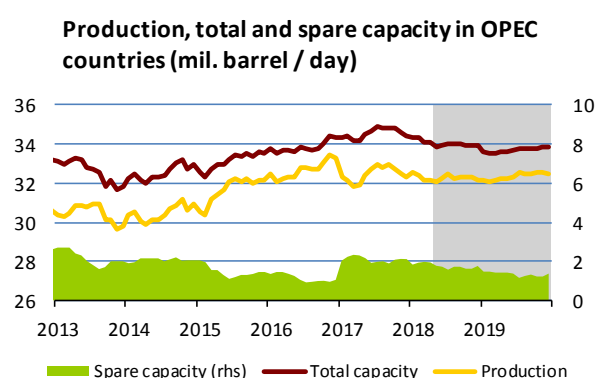
The market curve based on Brent futures recorded a further large upward shift compared to the previous month, implying an average price of USD 74 and USD 72/bbl for this year and the next respectively.



	Brent	WTI	Natural gas
2018	73.82 ↗	67.93 ↗	254.55 ↗
2019	71.87 ↗	65.03 ↗	297.74 ↗



	IEA	EIA	OPEC
2018	99.28 ↗	100.29 ↗	98.85 ↗
2019		102.02 ↗	



	Production	Total capacity	Spare capacity
2018	32.27 ↗	34.03 ↗	1.76 ↗
2019	32.35 ↗	33.69 ↗	1.34 ↗

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

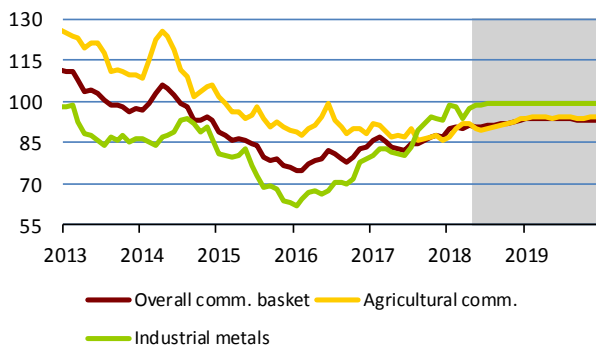
Note: Oil price at ICE, average gas price in Europe – World Bank data, smoothed by the HP filter. Future oil prices (grey area) are derived from futures and future gas prices are derived from oil prices using model. Total oil stocks (commercial and strategic) in OECD countries – IEA estimate. Production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

V.2 Other commodities

The aggregate non-energy commodity price index edged up in April but erased part of the gain in the first half of May. The food commodity price sub-index was flat at the March level in April but declined in the first half of May. By contrast, after a sharp fall in March, the base metals price sub-index increased by almost the same amount in April. It also rose in early May, albeit at a slower rate. The outlook for all three indicators is slightly rising in the months ahead and is then more or less flat.

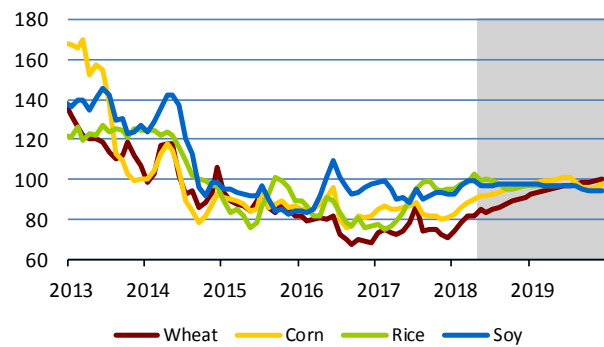
The strong growth in the metals price index in April was driven mainly by the price of aluminium due to sanctions imposed by the USA on Russian producer Rusal. The price of nickel also went up on fears that the sanctions would be widened to Russian producer Norilsk. The two firms are the second largest producers in the world. Metals prices were also supported by a better global manufacturing outlook, as the JPMorgan PMI rose from 53.3 to 53.5 in April after falling in Q1. The Chinese PMI also went up slightly to 51.1. By contrast, the strengthening dollar has been dampening growth in metals prices since the start of April. The price of iron ore fell sharply in March and rose only slightly in April due to high stocks in Chinese ports and lower steel prices. The prices of wheat and corn are being supported by still strong demand and a slight drop in production from last year's record high, which will lead to a moderate fall in stocks. By contrast, soy output is expected to rise due to the harvest in Argentina, which is recovering from last year's drought. A record-high rice harvest is expected for this year, in line with rising demand. The May decline in the food commodity price index was thus due mainly to prices of sugar and beef, while the price of pork moved in the opposite direction.

Non-energy commodities price indices



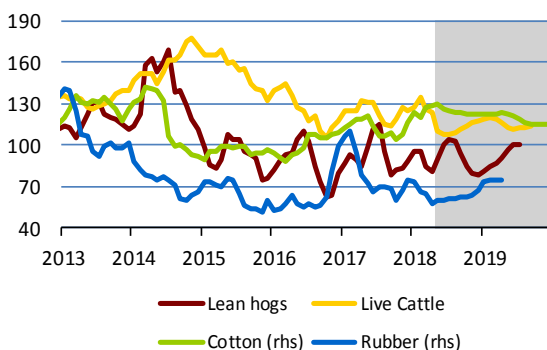
	Overall	Agricultural	Industrial
2018	91.4 ↗	90.9 ↘	98.5 ↗
2019	93.5 ↗	94.3 ↘	99.3 ↗

Food commodities



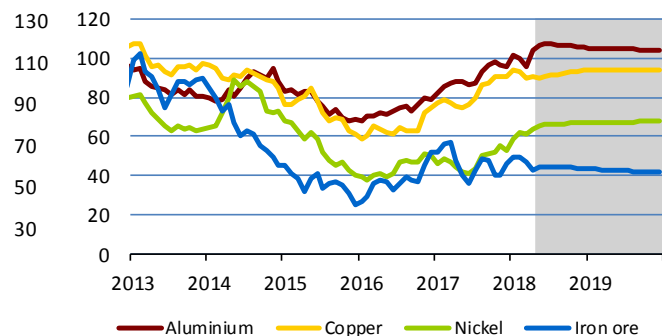
	Wheat	Corn	Rice	Soy
2018	84.5 ↘	91.8 ↘	97.8 ↘	97.2 ↘
2019	96.7 ↘	98.4 ↘	97.2 ↗	96.1 ↘

Meat, non-food agricultural commodities



	Lean hogs	Live Cattle	Cotton	Rubber
2018	91.0 ↘	117.1 ↗	86.4 ↘	45.6 ↗
2019	91.6 ↘	115.2 ↘	82.9 ↗	52.7 ↗

Basic metals and iron ore



	Aluminium	Copper	Nickel	Iron ore
2018	104.3 ↗	91.7 ↘	64.8 ↗	45.2 ↘
2019	104.5 ↗	94.1 ↗	67.3 ↗	42.4 ↘

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 uncovered interest parity condition in Consensus Forecasts¹

The uncovered interest parity (UIP) theory describes the arbitrage condition which relates the difference in interest rates on asset holdings in two countries (the interest rate differential) to the expected change of their mutual exchange rate. In its simplest form, UIP assumes that the currency of the country with the higher interest rate will depreciate over the outlook horizon and thus offset the lower interest income on the other currency. If this condition did not hold on average, there would be investment opportunities enabling a risk-free return, which could be expected to be eliminated over time as investors took advantage of them. This theory is hard to test because expectations about exchange rate changes are unobserved and their proxies are difficult to obtain. In the literature, therefore, it is usually tested on real data. Such tests usually find that UIP is impossible to prove *ex post*. By contrast, this article illustrates to what extent market expectations captured by Consensus Forecasts are consistent with the theory. It shows that the UIP theory applies only partially. This is due to the existence of the risk premium and also because central banks' unconventional monetary policy significantly affects expectations about the movement of exchange rates. By contrast, the covered interest parity (CIP) theory, which works with forward rates instead of expectations, holds exactly as expected in normal times.

The interest parity theory and its three forms

The interest parity theory is based on the hypothesis that investors should expect the same return on identical assets held in any currency. If the return on an asset held in one currency (such as the interest rate on a three-month deposit) is higher than the return on an equivalent asset held in another currency, the higher-return currency should depreciate against the lower-return currency by the difference in returns (the interest rate differential) to ensure that the arbitrage condition of the same expected return in any currency holds. This relationship can formally be described by the following equation:

$$i_t = i_t^* + \frac{E_t(\Delta S_{t+1})}{S_t}, \quad (1)$$

where i_t is the return on the domestic asset and i_t^* is the return on the foreign asset at time t , $E_t(\Delta S_{t+1})$ is the expected change in the exchange rate of the domestic currency against the foreign currency at time $t + 1$ and S_t is the current value of that exchange rate.

The definition of interest parity does not itself guarantee its *ex post* validity (on real data), as the actual movement of the exchange rate may ultimately differ from the initial expectation. New information that may affect the exchange rate and was not known at time t appears during period $t + 1$. In general, deviations from the UIP condition are attributed to market imperfections and risk aversion. The literature (e.g. Froot and Thaler, 1990; Chinn and Meredith, 2005) therefore does not confirm the validity of the interest parity condition on historical data (*ex post* UIP). However, some authors have shown the *ex post* validity of the interest parity condition on long-term interest rates, which reflect fundamentals more than short-term ones do (Chinn and Meredith, 2004). Berk and Knot (2001) show that the longer the investment horizon, the higher the validity of the interest parity condition.

The interest rate parity condition is usually satisfied in the case of covered interest rate parity (CIP), where the expectations of forex market participants are replaced by forward rates agreed in advance. This version of interest rate parity between two currencies is usually satisfied except in periods characterised by certain market anomalies (see the next section). Rather than an outlook, forward rates therefore reflect the current ability to hedge the future exchange rate.² If both the UIP and CIP conditions held at the same time, the forward rate would represent an unbiased forecast of the future spot rate.

Exchange rate forecasts from various surveys are often used to test the validity of (*ex ante*) UIP in the literature. One example is the survey in the publication Consensus Forecasts (CF), which is used at the CNB as an input to prepare forecasts of future developments abroad. This monthly survey is conducted by Consensus Economics mostly among research teams at commercial banks. In addition to 1-, 3-, 12- and 24-month exchange rate outlooks, to which a special publication called Foreign Exchange Consensus Forecasts is devoted, these surveys provide forecasts of the most important macroeconomic variables of individual countries and also of commodity prices.

An illustration of the validity of interest rate parity

In this analysis we use exchange rate forecasts obtained from the Consensus Forecasts survey to test the validity of the UIP hypothesis. Cuestas, Filipozzi and Staehr (2015) and Berk and Knot (2001), for example, proceeded similarly. We use the 3-month and 12-month CF exchange rate forecasts. We simultaneously test the validity of CIP by replacing the CF forecasts with 3-month and 12-month forward exchange rates. For illustration, we also present the results of tests of the *ex post* UIP hypothesis.

¹ Authors: Tomáš Adam and Filip Novotný. The views expressed in this article are those of the authors and do not necessarily reflect the official position of the Czech National Bank.

² This fact is mentioned in a note below the charts in section IV.1 of the main part of *Global Economic Outlook*.

The currency pairs tested are CZK/EUR, USD/EUR, USD/GBP, EUR/GBP, CHF/EUR, JPY/USD, BRL/USD, RUB/USD, INR/USD and CNY/USD, i.e. mainly currencies of countries regularly monitored in *Global Economic Outlook*. The source of data on forward exchange rates is Bloomberg. The actual 3-month and 12-month interest rates for the above currencies were obtained from Datastream. We additionally test the validity of UIP on the USD/EUR pair using the interest rate differential between 10-year government bond yields, again downloaded from Datastream. The reason for testing the validity of UIP using 10-year yields was that the short-term interest rates hit their effective lower bound after the great financial crisis and several central banks subsequently resorted to the quantitative easing aimed at reducing long-term rates. In the analysis, we assess the period from January 2002 to February 2018. We test the validity of UIP at monthly frequency as of the same day on which the CF survey is conducted. We thus have a total of 194 observations.

Specifically, we estimate the following regression using the ordinary least squares (OLS) method:

$$\Delta s_{t+1} = \alpha + \beta(i_t - i_t^*) + \epsilon_t, \quad (2)$$

where $(i_t - i_t^*)$ is the interest rate differential between rates on the domestic and foreign currency market or the differential between ten-year government bond yields. We consider the following three specifications for the estimates:

- 1) **Ex post interest parity:** Δs_{t+1} is the percentage change in the spot exchange rate between periods t and $t + 1$.
- 2) **Forward rate (CIP):** Δs_{t+1} is the percentage difference between the current spot rate at time t and the forward exchange rate for period $t + 1$.
- 3) **Consensus Forecasts (UIP):** Δs_{t+1} is the percentage difference between the spot rate at time t and the exchange rate outlook for the period at time $t + 1$ based on CF.

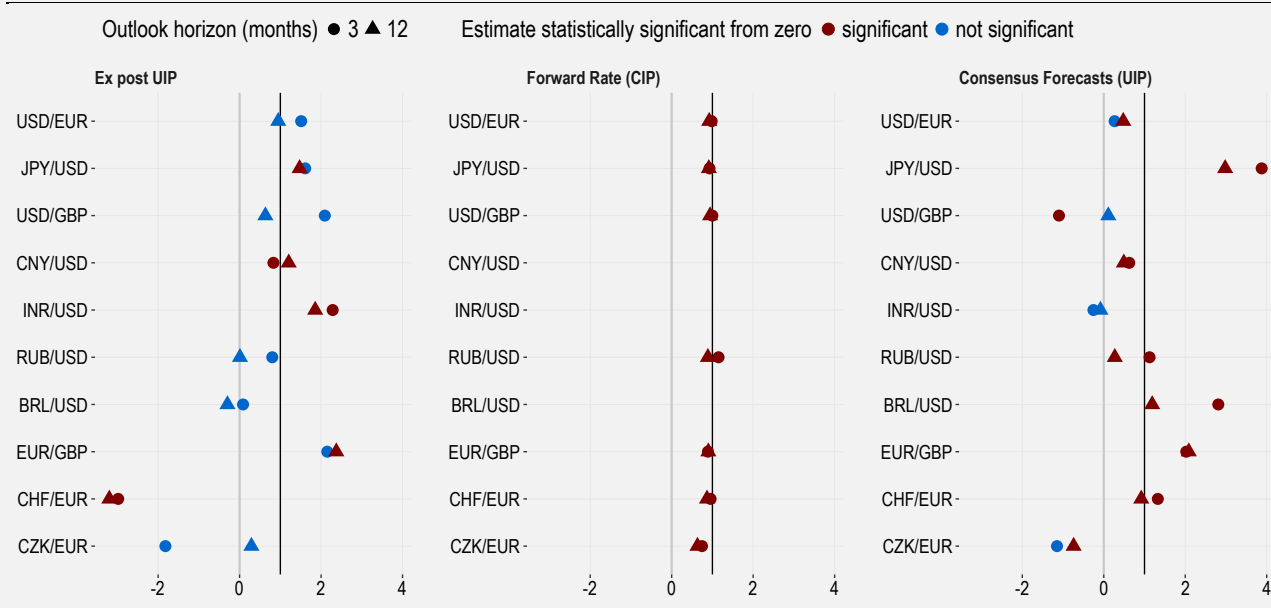
All exchange rate changes were annualised to allow for simple and consistent interpretation of parameter β , which should ideally take the value of 1; parameter α should ideally be zero. The regression should also fit exchange rate movements reasonably well. One measure of fit is the coefficient of determination (R^2), which ranges between 0 and 1, with a higher value indicating a better ability to explain an exchange rate change using the interest rate differential.

Results of interest parity estimates based on CF data and forward rates

In line with previous studies, our empirical estimates indicate that the validity of interest parity cannot be proved ex post (on real data). The first panel of Chart 1 shows that the beta coefficient of most of the currency pairs under review is positive, in line with the tested hypothesis that a positive interest rate differential should be reflected in a future depreciation of the currency with the higher interest rate. In most cases, however, this coefficient is not statistically significant and, moreover, below the ideal value of 1. The exception is the exchange rate of the Swiss franc against the euro (CHF/EUR), whose beta coefficient has a negative statistically significant value at both the 3-month and 12-month horizons. The beta coefficient of the Czech koruna exchange rate against the euro (CZK/EUR) is also distinctly negative at the 3-month horizon. However, this coefficient is not statistically significant. A common feature of the two exchange rates is that both the Swiss and Czech central banks intervened in the forex markets to weaken the domestic currency against the euro in the period under review.

The case of the exchange rate of the Chinese renminbi against the dollar (CNY/USD) is also interesting. The beta coefficient of this currency pair is statistically significant and close to the ideal level at both the 3-month and 12-month horizons. This could be interpreted as evidence of the validity of the ex post UIP. However, to some extent it could be just a coincidence (as signalled by the generally low coefficient of determination of the estimated regressions), since capital flows in China are not fully liberalised and the interest rate differential thus should not play such an important role in the expected movement of the exchange rate. Rather than interest rate differentials, market participants tend to follow information about the Chinese government's planned actions in the areas of monetary policy and exchange rate management. The relatively strictly managed float of the Chinese currency against the dollar at the start of the period under review allowed for expectations about its future value to be relatively well-anchored (see Chart A2 (CNY/USD)). However, the exchange rate regime was changed in 2015 and market mechanisms play now more important role when determining the benchmark for the daily exchange rate of the renminbi. This has given rise to greater uncertainty regarding its future development.

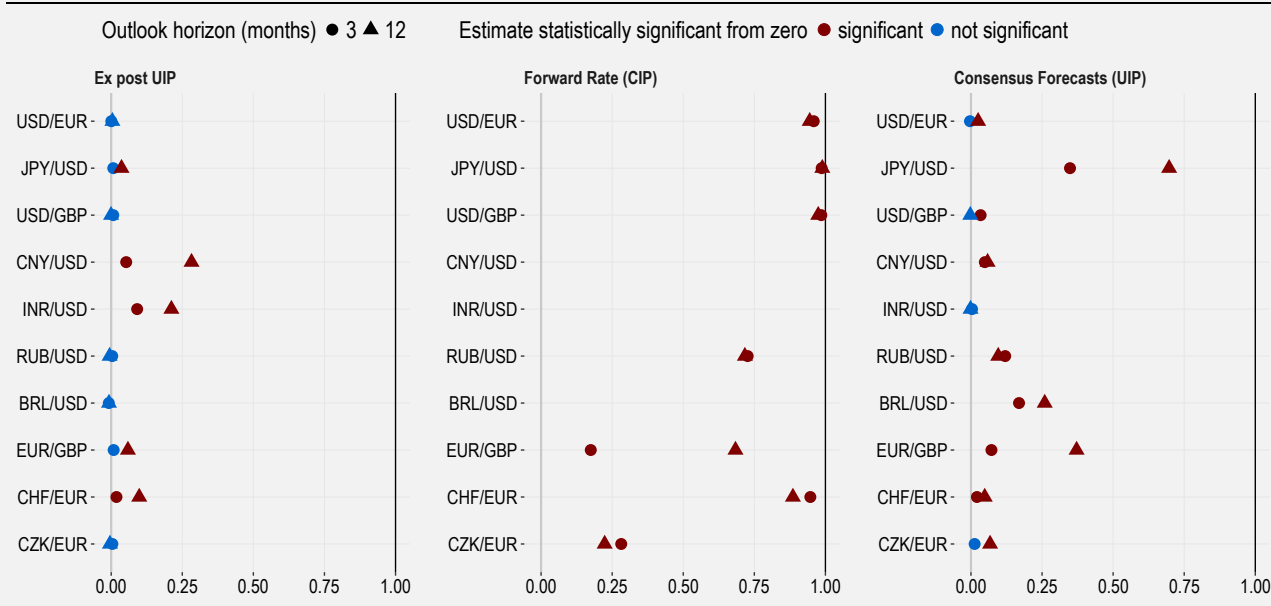
Moreover, low coefficients of determination (the first panel of Chart 2) **indicate that the interest rate differential can explain only a small part of exchange rate movements ex post.** This indicator was slightly higher only in the case of the above-mentioned renminbi at the 12-month horizon and to a lesser extent also in the case of the Indian rupee against the dollar (INR/USD). However, these levels, too, were very low compared to the other two specifications.

Chart 1 – Estimated β coefficients in the regressions

Source: Consensus Forecasts, Bloomberg, Datastream, authors' calculations

Note: The vertical lines intersecting the value of 1 show the theoretical value of coefficient β in Equation 2 corresponding to the ideal functioning of interest parity.

Market data on forward contracts for the CNY/USD, INR/USD and BRL/USD currency pairs are not available at the required frequency or over a sufficiently long period.

Chart 2 – Coefficients of determination (R^2) in the regressions

Source: Consensus Forecasts, Bloomberg, Datastream, authors' calculations

Note: The vertical lines intersecting the value of 1 show the theoretical value of the coefficient of determination in the regression (Equation 2) that would be achieved if the UIP/CIP relationship fully explained the expected and actual exchange rate movements. Market data on forward contracts for the CNY/USD, INR/USD and BRL/USD currency pairs are not available at the required frequency or over a sufficiently long period.

In contrast to the unconvincing results based on ex post data, the relationship between the pre-agreed exchange rate and the interest rate differential (CIP) is almost ideal. The future exchange rate is in this case replaced by the pre-agreed forward exchange rate. Rather than an outlook, forward rates therefore represent the current ability to hedge the future exchange rate. Chart 1 shows that the beta coefficient values of all the currency pairs are statistically significant and very close to the ideal value of 1 at both the 3-month and 12-month horizons. The coefficients of determination (see Chart 2) reveal that the forward rate is almost fully determined by the current interest rate differential in most cases. However, not even CIP applies perfectly (see below), even though it holds according to expectations for very liquid currencies in calm times. The large deviations from CIP at the start of the global financial crisis in 2007 and 2008 were due, for example, to increased counterparty risk. The Fed therefore opened swap lines with the ECB and other central banks to supply dollar liquidity on foreign markets.

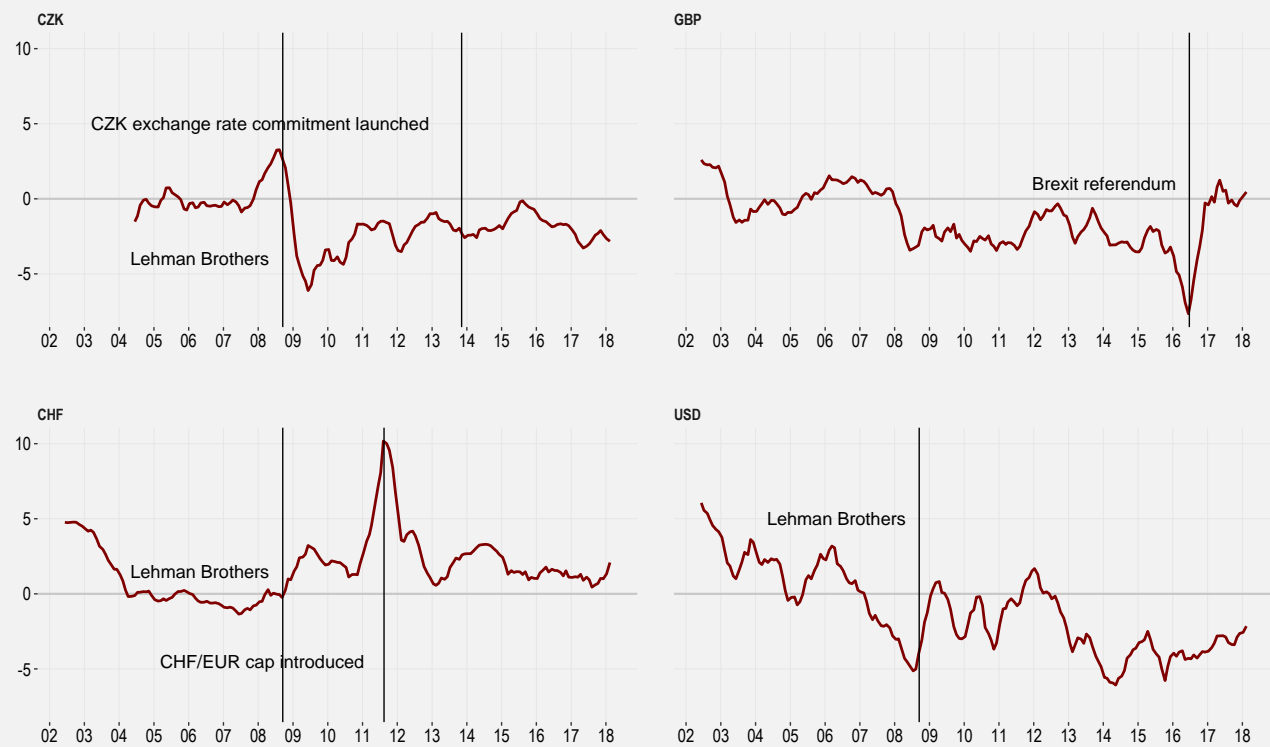
Substituting CF forecasts for exchange rate expectations in the UIP equation yields heterogeneous results for the currency pairs. In most cases, the beta coefficient (the third panel of Chart 1) is statistically significant and has the intuitive positive sign. Specifically, the CF forecasts reflected the UIP condition mainly in the case of the exchange rate of the Swiss franc against the euro (CHF/EUR) at both monitored horizons and also in the case of the 3-month outlook for the rate of the Russian rouble against the dollar (RUB/USD) and the 12-month outlook for the rate of the Brazilian real against the dollar (BRL/USD). The exchange rate of the Chinese currency was also almost in line with the UIP assumption at both monitored horizons. By contrast, the beta coefficient recorded statistically significant negative values in the cases of the Czech koruna against the euro at the 12-month horizon and the US dollar against the British pound (USD/GBP) at the 3-month horizon.

Other factors affecting expectations about exchange rate movements

It is apparent that the CF exchange rate forecasts reflect not only interest rate differentials but also other factors. This is indicated, for example, by the coefficient of determination of the estimated regression, which, unlike in the CIP case, is very low (see the third panel in Chart 2). The CF forecasts thus probably consider also other factors, such as the expected difference in economic performance, the expected change in relative price levels and the related expected monetary policy changes in the two considered economies. The risk premium and unconventional monetary policy, which are discussed below, also play an important role in shaping expectations about the future exchange rate.

Chart 3 – Risk premia of the euro vis-à-vis other currencies

(in %, 6M moving averages of the risk premium estimated using the CF 12M exchange rate forecasts)



Source: Consensus Forecasts, Bloomberg, authors' calculations

Note: A positive risk premium signals a preference for the given currency over the euro among investors. A negative value thus signals that *ceteris paribus* investors prefer to hold the euro rather than the other currency.

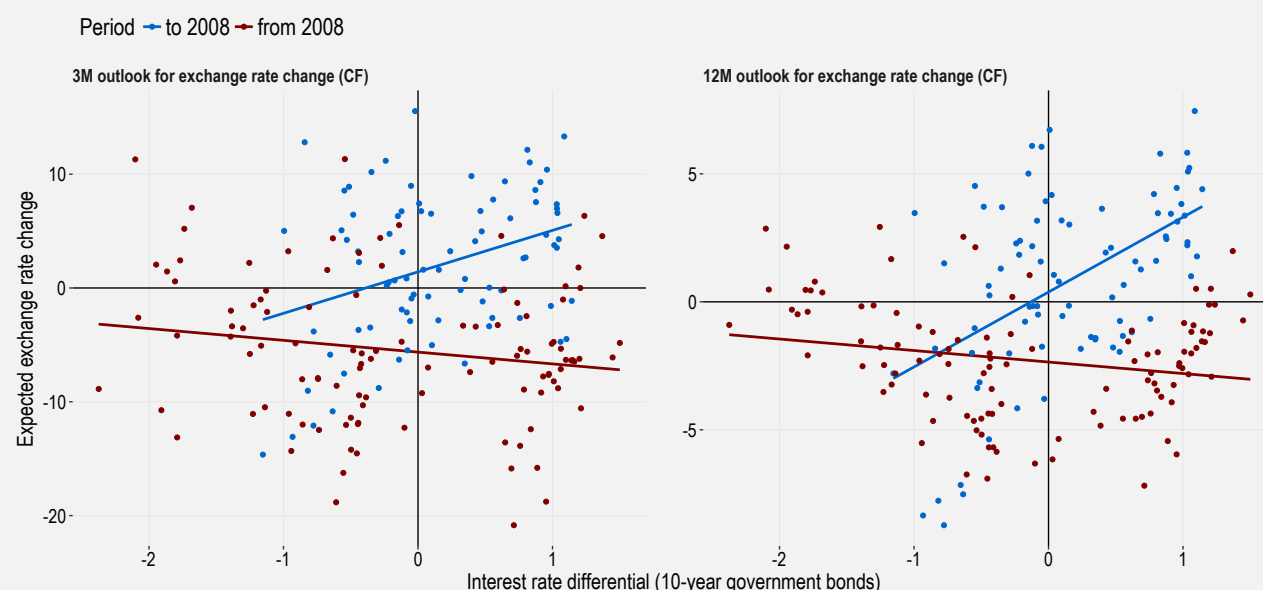
Part of the exchange rate change expected by CF, which is not explained by the interest rate differential, can be accounted for by the "risk premium", which compensates investors for the risk they take on by holding assets in the given currency. The basic UIP relationship assumes the absence of credit risk, capital controls and transaction costs, which are usually non-zero in reality. So if an asset with a higher nominal yield is riskier, the currency can be expected to depreciate less than if the asset was risk-free. This additional return is called the risk premium. The risk premia implied by the CF outlooks move in the intuitive direction, as illustrated in Chart 3, which shows the six-month moving average of the implied risk premium (similarly to Balakrishnan, 2016, for example) on asset holdings in euros vis-à-vis four other currencies at the one-year horizon. A positive premium means that investors are compensated for holding assets in euros as against assets in alternative currencies. A negative premium, in other words, means that *ceteris paribus* investors prefer euro-denominated assets.

- Looking at the risk premium of **euro** assets with respect to the **US dollar** assets, for example, we see that from 2002 onwards the premium followed a downward trend as the single currency gradually gained in credibility until the peak of the financial crisis, when this trend reversed. The premium then increased to positive levels at the peak of the debt crisis in the euro area (around 2012) but dropped back to negative levels as monetary policy was eased further.³
- After the collapse of Lehman Brothers, we also see growth in the risk premium on euro asset holdings in relation to the **Swiss franc**. Moreover, the safe haven effect led to a sharp increase in the risk premium of the euro against the franc, especially during the euro area debt crisis. The franc appreciated considerably following this increase and the Swiss central bank responded by introducing a ceiling on the franc/euro rate in the second half of 2011.
- In relation to the **British pound** we see a negative risk premium on euro holdings, i.e. a preference for the euro over sterling among investors, since 2008. The negative premium fell during the euro area debt crisis and rose again after the launch of LTRO operations and again on the launch of quantitative easing by the ECB. The risk premium of the pound against the euro rose apace as the Brexit referendum approached. However, it fell sharply to zero after the referendum as the pound depreciated, and CF expected a further movement roughly in line with the interest rate differential.
- As for the risk premium in relation to the **Czech koruna**, the episode before the fall of Lehman Brothers, i.e. the early stage of the financial crisis, is worth mentioning. In that period, the Czech Republic had quite a high negative interest rate differential vis-à-vis the euro area. Under UIP, this would have been consistent with an expected future strengthening of the koruna against the euro. However, the koruna firmed significantly in this period due to the diversification of large investors' portfolios at the start of the financial crisis (Adam et al., 2018), and the CF outlooks expected a turnaround in this trend and a gradual depreciation of the koruna. This exchange rate path and its expectations are consistent with a negative risk premium.

The deviations of the expected exchange rate changes from the interest rate differentials were also due to central banks' unconventional monetary policies. Central banks, especially those in Japan, the USA, the euro area and the UK, bought long-term bonds (and the ECB and BoJ are continuing to do so) with the aim of reducing their yields. The expected direction of the exchange rate movement could therefore be expected to depend not on the short-term interest rate differential on the money market (which, moreover, was close to zero in many cases), but on the differential in government bond yields, which unconventional monetary policy was meant to affect. However, Chart 4 does not support this hypothesis. Although there had been a positive relationship between the 10-year interest rate differential and the expected exchange rate change at both three-month and one-year horizons until the end of

Chart 4 – The UIP relationship in CF – 10-year government bonds

(interest rate differential, in %, expected change in USD/EUR, in %)



Source: Consensus Forecasts, Bloomberg, authors' calculations

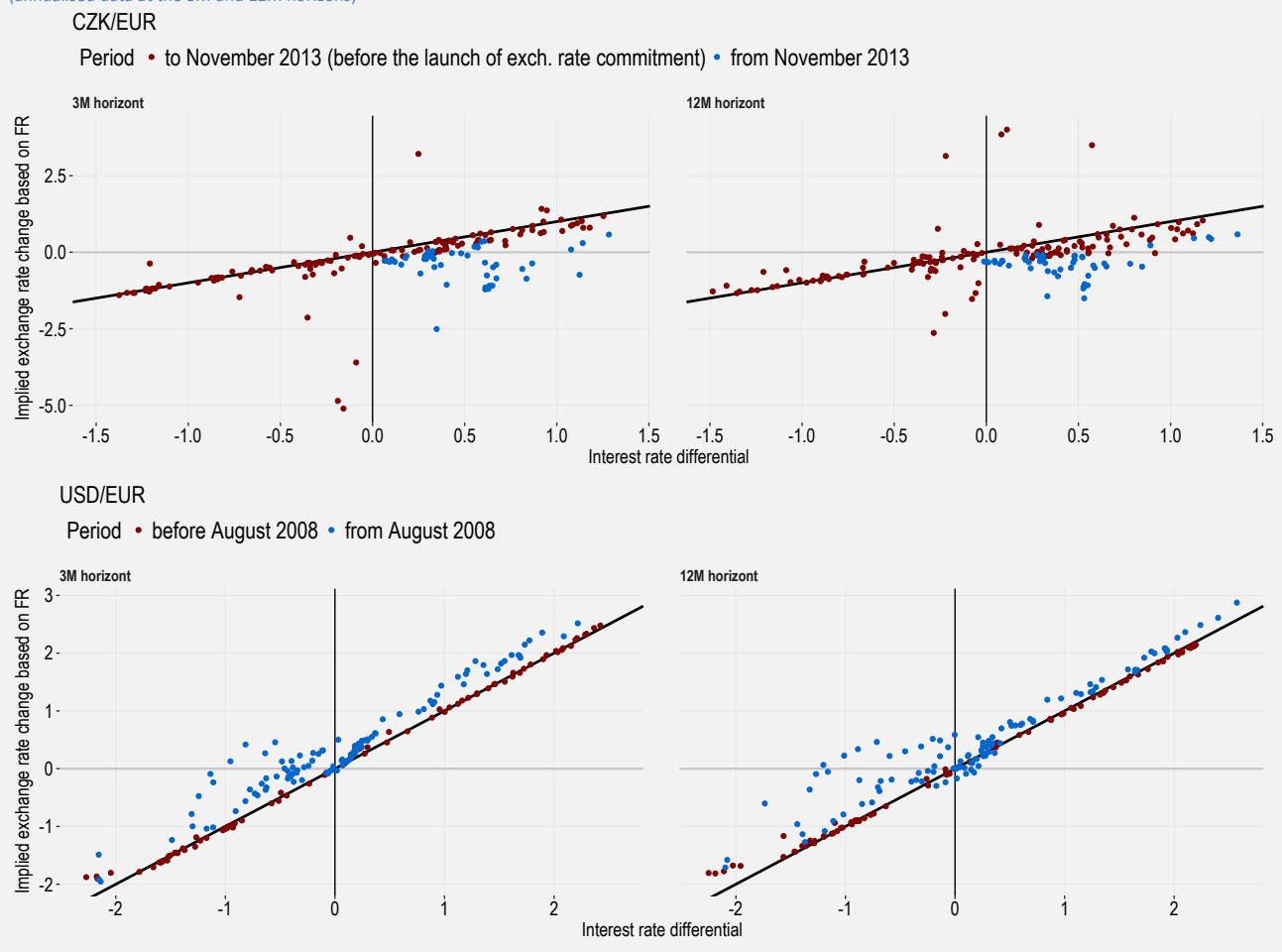
³ The interest rate differential implied a strengthening of the euro due to expectations of a further monetary policy easing by the ECB and a tightening by the Fed, but CF expected the euro to weaken.

2008, this relationship ceased to apply after quantitative easing was launched in the USA. One explanation is that CF expectations may have started to reflect central banks' communications more. From January 2013 to mid-2014, for example, the interest rate differential between the US and the euro area was below 0.25 pp, implying a slight depreciation of the dollar against the euro, whereas the CF outlooks expected the euro to depreciate sharply,

Besides the validity of UIP, unconventional monetary policy also affected the CIP relationship. Chart 5 illustrates that the relationship between the interest rate differential and the implied exchange rate change based on forward contracts often did not hold for the CZK/EUR currency pair. A large part of the observations when the relationship did not work occurred during the CNB's exchange rate commitment. The relative deviation of the beta coefficient estimate from the theoretical value (1) in the CIP testing is consistent with this (see Chart 1). Investors accepted a negative implied yield (a negative risk premium) on the koruna in expectation of it appreciating after the exit from the exchange rate commitment. We also observe deviations of the forward rate of the USD/EUR currency pair (see Chart 5) from the ideal value after August 2008. These deviations first occurred in connection with the liquidity crisis on the interbank market in the USA and the euro area at the peak of the financial crisis. The subsequent deviations are due to, for example, market inefficiencies and new banking sector regulations, which make arbitrage transactions offsetting the CIP relationship more difficult to execute. Another reason is quantitative easing by central banks, which led to a large liquidity surplus in the banking sector.

Chart 5 – CIP and unconventional monetary policies

(annualised data at the 3M and 12M horizons)



Conclusion

The interest rate parity theory is based on the idea that there should be no arbitrage opportunities in the financial markets, which would allow investors to make a systematically risk-free positive profit. This article has illustrated, however, that the validity of this hypothesis is challenging to prove. In line with the existing literature, the article has shown that the interest rate parity relationship does not hold when tested on historical data (ex post UIP). In the case of covered parity, by

contrast, the relationship does hold, although there have been periods when CIP has not applied fully even to very liquid currencies. As for uncovered parity, we have shown that market expectations proxied by the CF outlook take the relationship between the interest rate differential and the expected exchange rate movement into account, albeit only to a limited extent. Other factors forming market expectations include risk premia and unconventional monetary policy.

It is therefore necessary to make assumptions regarding risk premia and other unobserved factors when the UIP relationship is used in practice. Despite all its shortcomings, the interest rate parity theory is an essential building block in macroeconomic general equilibrium models, which links economic developments at home to those abroad and allows the exchange rate movements to be described endogenously. Given the uncertainty about unobserved variables, these models must make assumptions regarding, among other things, the size of the risk premium. The BoE and the CNB, for example, make such assumptions and even publish their exchange rate forecasts. Other central banks (such as the ECB, the Bank of Canada and the Magyar Nemzeti Bank) assume a constant exchange rate at the current level in their forecasts.⁴

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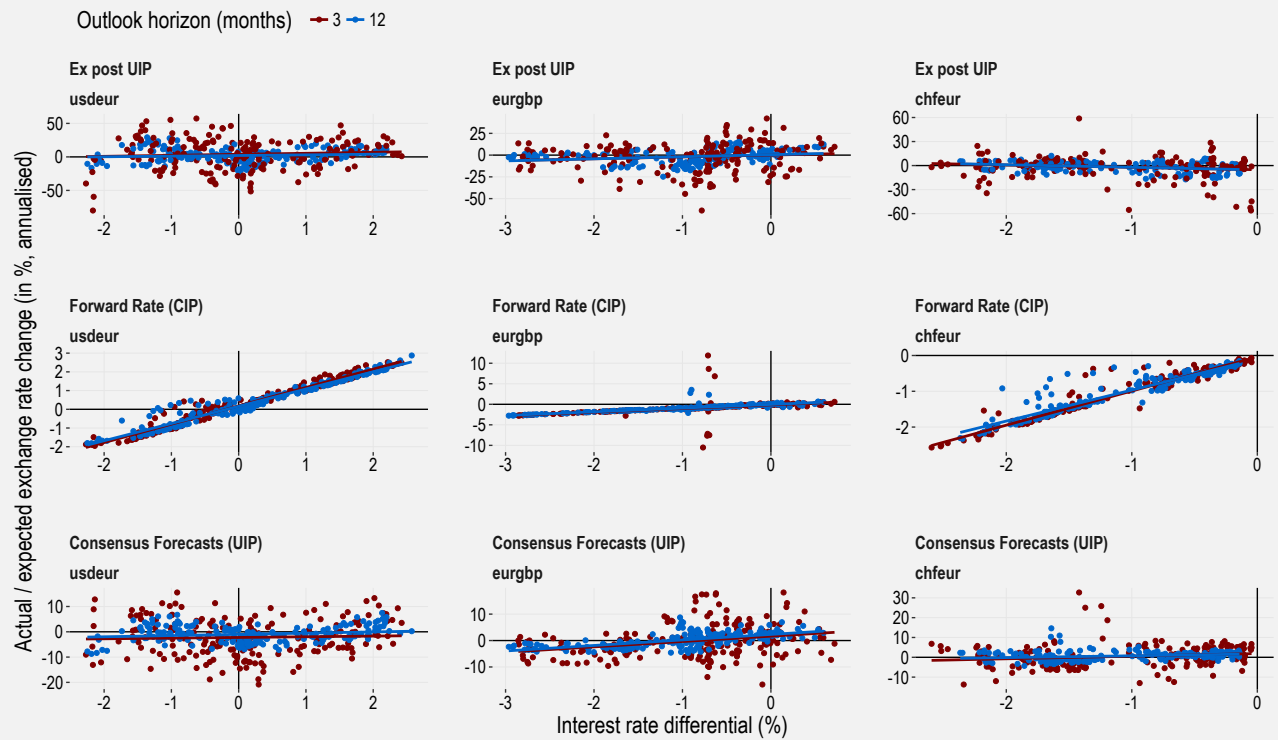
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⁴ For more information, see https://www.cnb.cz/cs/o_cnb/blog_cnb/prispevky/filacek_holub_kral_20180312.html

Appendix

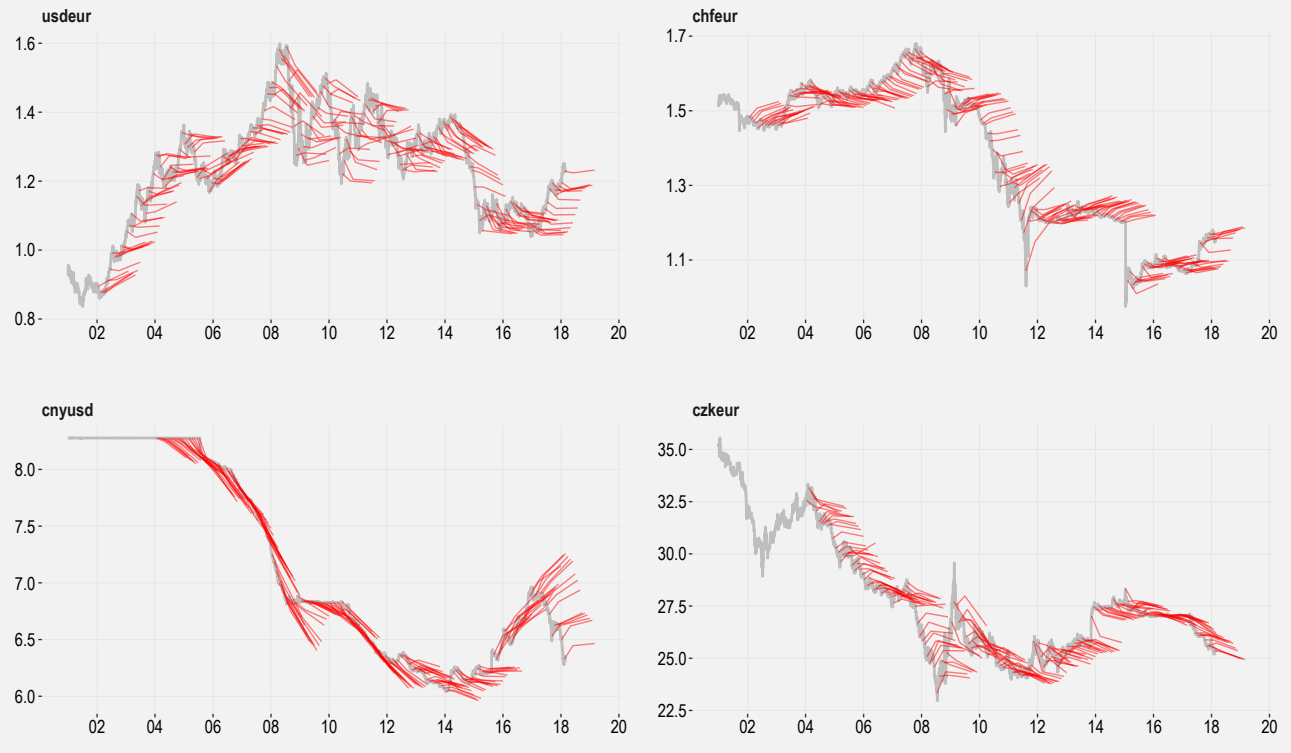
Chart A1 – Interest rate differentials and expected/actual exchange rate changes



Source: Consensus Forecasts, Bloomberg, authors' calculations

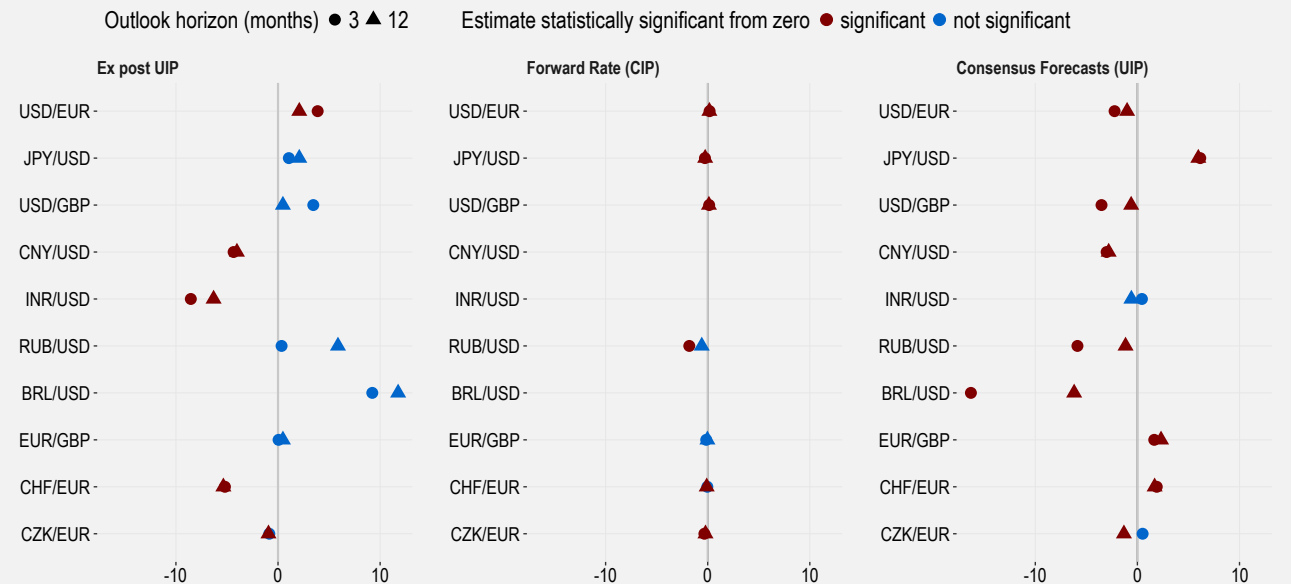
Chart A2 – The path of the exchange rate and its CF outlook

(monthly CZK/EUR and USD/EUR CF exchange rates outlooks at the 3M and 12M horizons)



Source: Consensus Forecasts, Datastream, authors' calculations

Chart A3 – Estimated α coefficients in the regressions



Source: Consensus Forecasts, Bloomberg, authors' calculations

Note: The vertical lines intersecting the value of 0 show the theoretical value of coefficient α in Equation 2. Market data on forward contracts for the CNY/USD, INR/USD and BRL/USD currency pairs are not available at the required frequency or over a sufficiently long period.

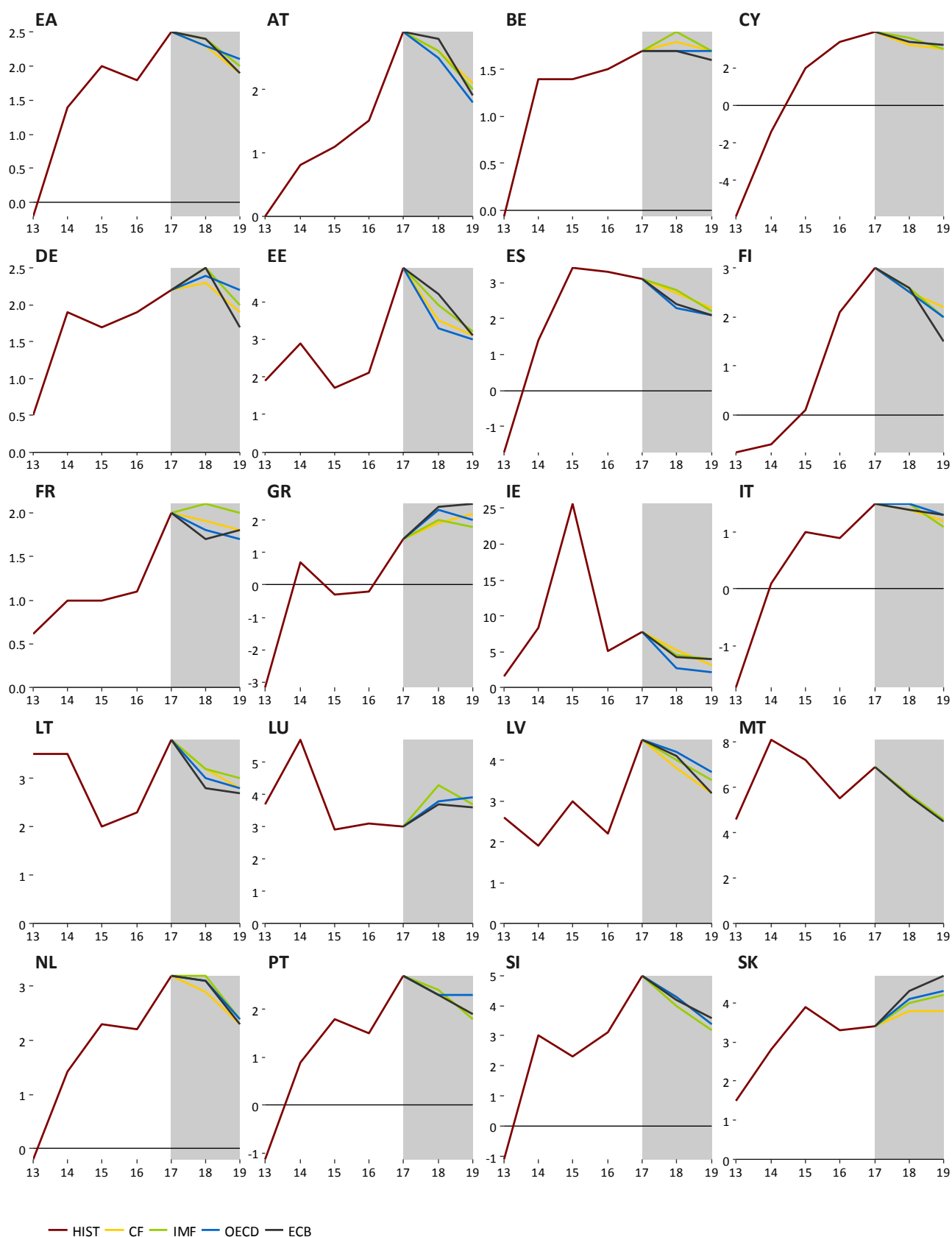
A1. Change in GDP predictions for 2018

	CF		IMF		OECD		CB / EIU	
EA	-0.1	2018/5	+0.2	2018/4	+0.1	2018/3	+0.1	2018/3
		2018/4				2018/1		
DE	-0.1	2018/5	+0.2	2018/4	+0.1	2018/3	+0.8	2017/12
		2018/4				2018/1		
US	0	2018/5	+0.2	2018/4	+0.4	2018/3	+0.2	2018/3
		2018/4				2018/1		
UK	-0.1	2018/5	+0.1	2018/4	+0.1	2018/3	-0.4	2018/5
		2018/4				2018/1		
JP	-0.1	2018/5	0	2018/4	+0.3	2018/3	+0.2	2018/4
		2018/4				2018/1		
CN	0	2018/5	0	2018/4	+0.1	2018/3	+0.3	2018/5
		2018/4				2018/1		
IN	0	2018/5	0	2018/4	+0.2	2018/3	0	2018/5
		2018/4				2018/1		
RU	+0.1	2018/4	0	2018/4	-0.1	2018/3	0	2018/5
		2018/3				2018/1		
BR	0	2018/4	+0.4	2018/4	+0.3	2018/3	-0.3	2018/4
		2018/3				2018/1		

A2. Change in inflation predictions for 2018

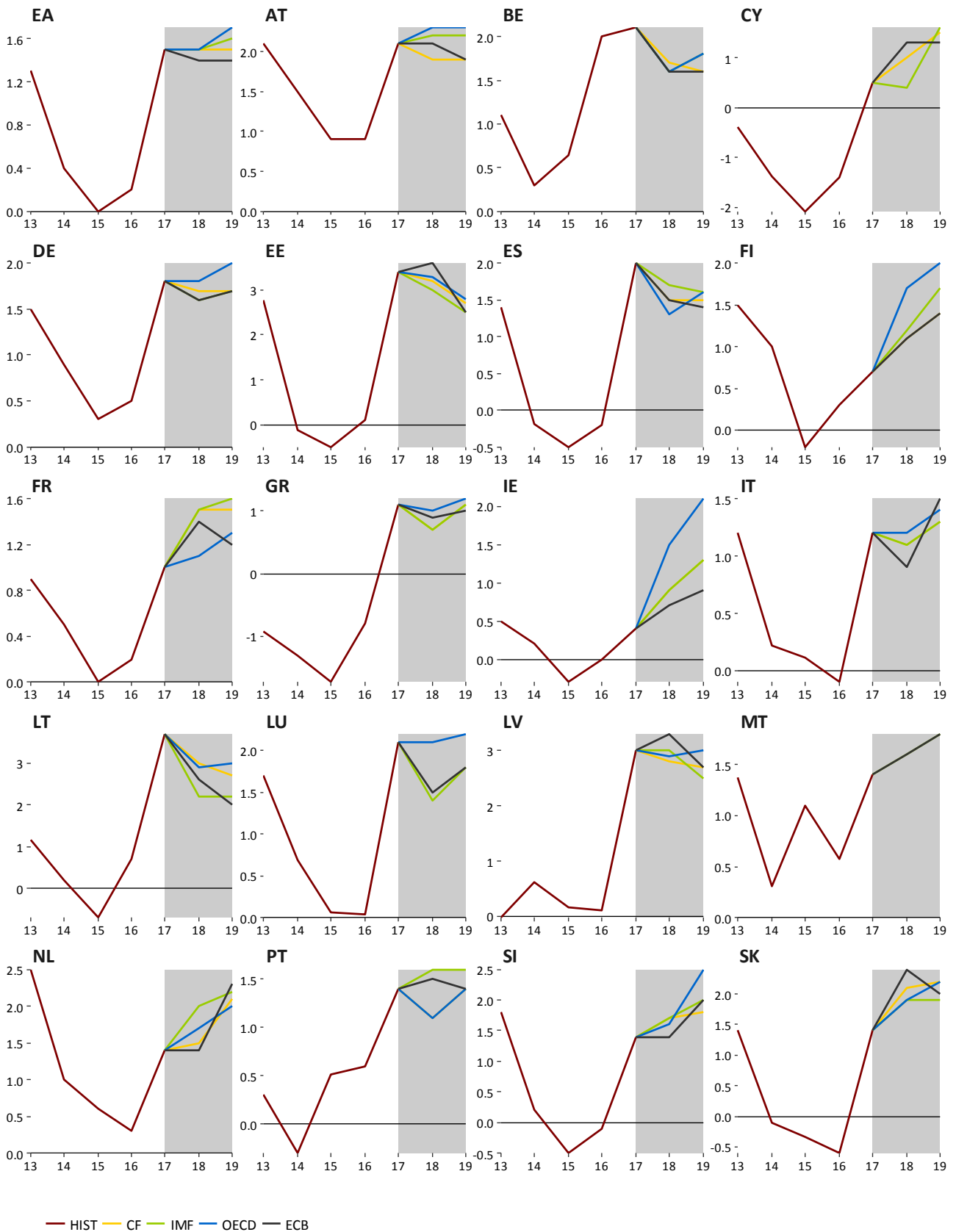
	CF		IMF		OECD		CB / EIU	
EA	0	2018/5	+0.1	2018/4	+0.1	2017/11	0	2018/3
		2018/4				2017/10		
DE	0	2018/5	+0.1	2018/4	+0.2	2017/11	+0.2	2017/12
		2018/4				2017/10		
US	0	2018/5	+0.4	2018/4	-0.2	2017/11	0	2018/3
		2018/4				2017/10		
UK	-0.1	2018/5	+0.1	2018/4	-0.1	2017/11	-0.2	2018/5
		2018/4				2017/10		
JP	0	2018/5	+0.6	2018/4	0	2017/11	-0.1	2018/4
		2018/4				2017/10		
CN	-0.1	2018/5	+0.1	2018/4	-0.2	2017/11	0	2018/5
		2018/4				2017/10		
IN	+0.1	2018/5	+0.1	2018/4	0	2017/11	-0.2	2018/5
		2018/4				2017/10		
RU	-0.1	2018/4	-1.1	2018/4	-0.2	2017/11	0	2018/5
		2018/3				2017/10		
BR	-0.2	2018/4	-0.5	2018/4	-0.6	2017/11	-0.3	2018/4
		2018/3				2017/10		

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

