

# GLOBAL ECONOMIC OUTLOOK – NOVEMBER

Monetary Department  
External Economic Relations Division

2016



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**Cut-off date for data**

11 November 2016

**CF survey date**

7 November 2016

**GEO publication date**

18 November 2016

**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.

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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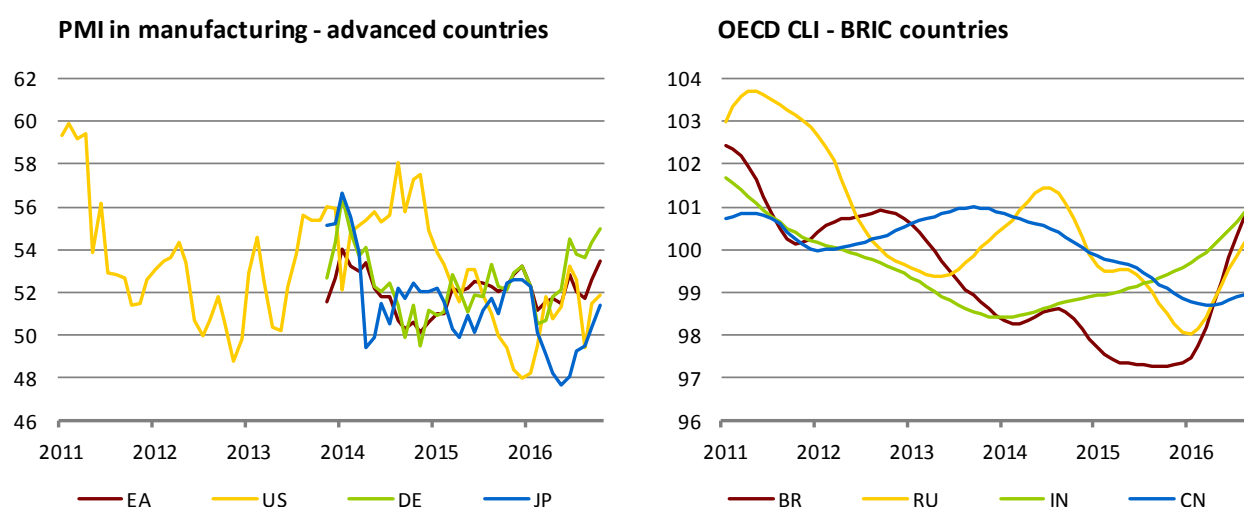
The November issue of Global Economic Outlook presents the regular monthly overview of recent and expected developments in selected territories, focusing on key economic variables: inflation, GDP growth, leading indicators, interest rates, exchange rates and commodity prices. In this issue, we also focus on the relationship between the Brent crude oil price and the US dollar exchange rate over the last ten years. The results show that the inverse relationship between the Brent price and the nominal effective exchange rate of the dollar still applies, helping dampen fluctuations in the dollar price of oil in "non-dollar" economies.

The current annual economic growth outlooks for the advanced countries we monitor are the same as in the previous month. The world's strongest economy – the USA – is thus expected to record growth of just above 2%, which is still almost 1 pp higher than that expected for the euro area and Germany. Comparisons with Japan reveal an even larger difference in forecasted growth, as Japanese GDP growth will not even reach 1% next year. The expected inflation figures for 2017 remain close to the economic growth figures described above. Except for a marginal increase for Germany, they were unchanged compared to the previous month and remain below the target of 2%, which is generally considered to be the price stability criterion. The USA thus remains one of the few advanced economies expected to achieve consumer inflation above this "magic" 2% level next year.

As usual, the annual GDP growth outlooks for the BRIC countries were again heading in completely different directions. Compared to the previous month, they were virtually unrevised. On the one hand, the fast-growing Indian economy is expected to maintain growth of just above 7.5% next year amid non-accelerating inflation. This positive development is complemented – despite all the well-known twists and turns – by still high economic growth in China, albeit with a weak downward tendency. The Chinese economy is expected to grow only 1 percentage point slower than the Indian one next year, with inflation reaching almost 2%. On the other hand, the economies of Russia and particularly Brazil, after overcoming this year's slumpflation (an economic slump accompanied by relatively high inflation), are expected to record almost identical macroeconomic parameters next year, albeit for different reasons. Their economic growth is expected to jump above 1% at inflation rates of just above 5%.

The outlooks for euro area interest rates remain very low, staying negative at the shorter end of the yield curve and still showing no sign of growth until the end of 2017. For the time being, the intensity of unconventional monetary policy remains confirmed until the end of March 2017. A tapering of the stance, with gradually declining bond purchases, can be expected in the case of the ECB as well. As for the USA, the expected interest rate hike by the Fed is not likely to occur until the last meeting of the year. According to CF, the US dollar will remain roughly stable against the euro and Russian rouble and appreciate with varying intensity against the other currencies over the one-year horizon. The market outlook for the oil price was revised downwards compared to the previous month, i.e. the oil price is expected to be around USD 52/bbl at the end of 2017. Natural gas prices were similarly revised downwards at the one-year horizon and are now expected to rise to about USD 190/thousand m<sup>3</sup>. The outlooks for prices of food commodities and industrial metals for the end of 2017 increased compared to the previous month in almost all their components. This should increase the inflation pressures in the global economy.

## Leading indicators for countries monitored in the GEO



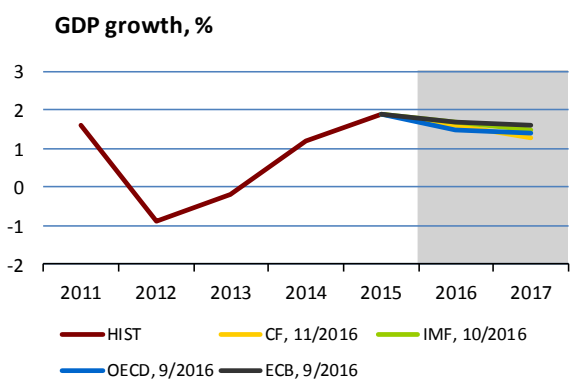
Source: Bloomberg, Datastream

II.1 Euro area

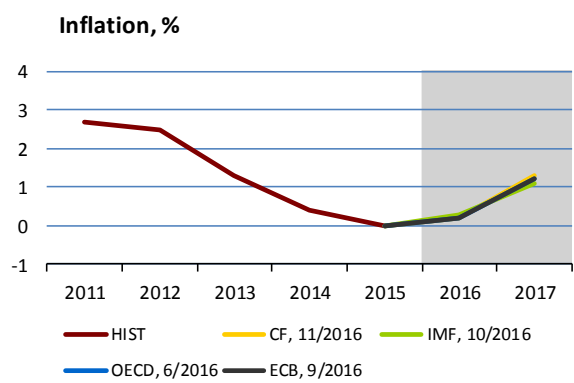
The situation in the euro area remains stable. The flash estimates of GDP growth for 2016 Q3 suggest that both year-on-year and quarter-on-quarter growth stayed at the Q2 levels (1.6% and 0.3% respectively). Rather weaker data for June and July were offset by positive developments in August, when industrial production rose by 1.8% and exports by 0.8% year-on-year. The figures for September recorded so far are not so optimistic. Based on data already released from large euro area economies, the aggregate industrial production index will fall. Year-on-year growth in retail sales slowed slightly in September, with the components of sales showing mixed trends. The unemployment rate remained at 10% in September after the figures from the previous two months were revised down by 0.1 pp. However, leading indicators improved again in October across all the monitored categories. The ZEW economic sentiment indicator rose and expectations of future production and its effect on export orders also improved. The PMI in manufacturing rose to 53.5. Its outlook remains positive for all countries except Greece. The assessment of output, new orders, exports and employment improved significantly. This positive trend indicates that the economy could maintain stable growth in 2016 Q4. This is also suggested by the outlooks of the monitored institutions. The November CF left its GDP growth outlook for this year unchanged at 1.6%.

The year-on-year decline in the industrial producer price index continued to slow gradually in September (to 1.5%), mainly due to prices of energy and durable goods. Industrial prices could thus return to year-on-year growth in late 2016/early 2017 after having fallen for three and a half years. According to preliminary data, headline consumer inflation continued to rise moderately in October, reaching 0.5%. It is being fuelled by growth in prices of services and food and a sharply slowing drop in energy prices. Core inflation stayed at 0.8%. The outlooks for this year and the next remain unchanged.

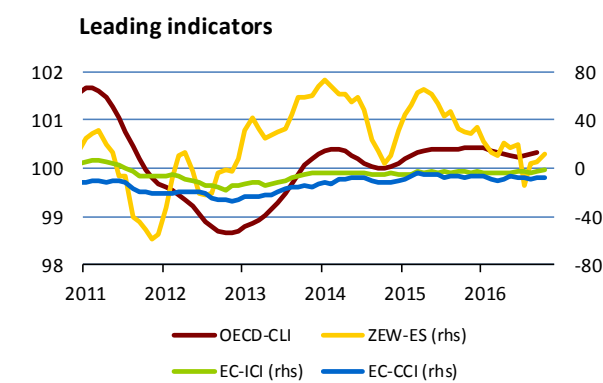
Annual M3 growth reached 5% in September, the same as in Q3. The 10Y Bund yield was briefly negative at the end of October but soon returned to positive territory, where it remains. It is expected to increase only slightly over the one-year horizon. The outlooks for short-term interest rates at the one-year horizon were slightly increased again, but the outlook for 3M EURIBOR remains negative.



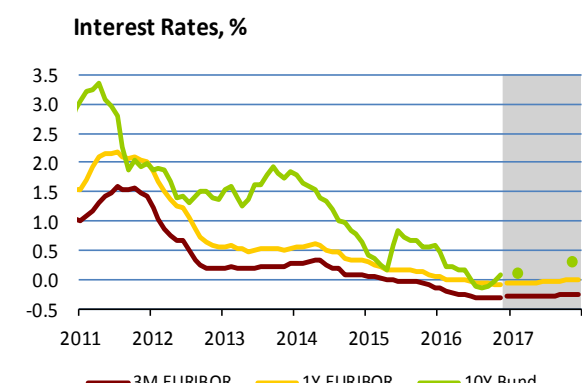
	CF	IMF	OECD	ECB
2016	1.6 →	1.7	1.5	1.7
2017	1.3 →	1.5	1.4	1.6



	CF	IMF	OECD	ECB
2016	0.2 →	0.3	0.2	0.2
2017	1.3 →	1.1	1.2	1.2



	OECD-CLI	ZEW-ES	EC-ICI	EC-CCI
8/16	100.3	4.6	-4.3	-8.5
9/16	100.3	5.4	-1.8	-8.2
10/16		12.3	-0.6	-8.0



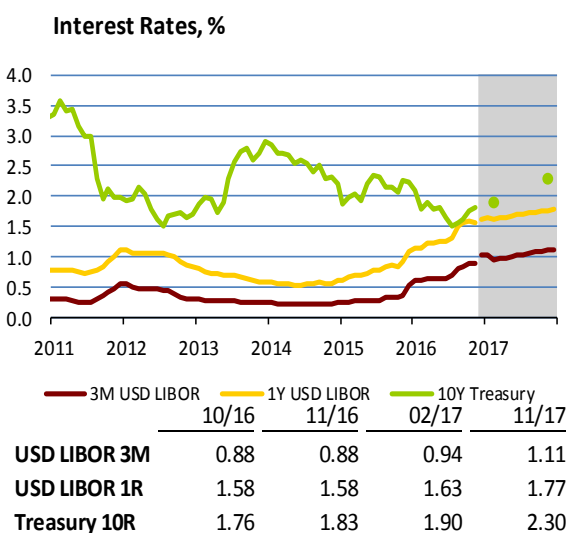
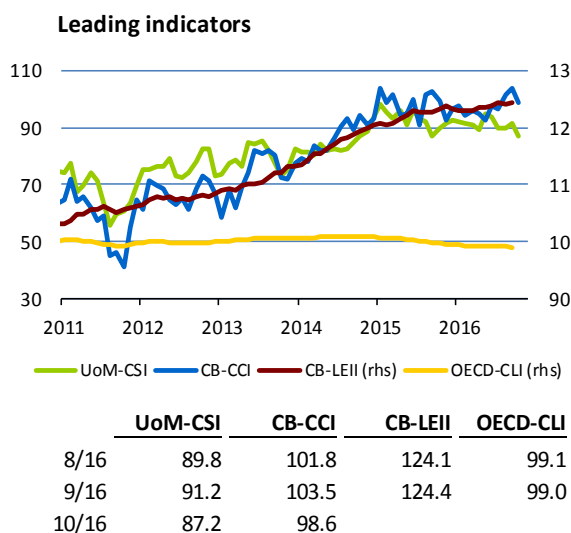
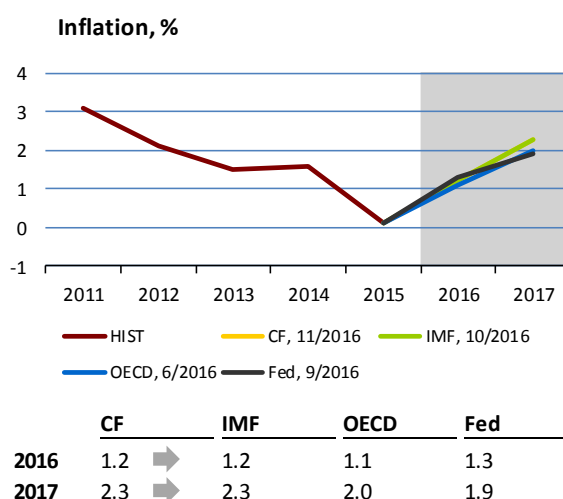
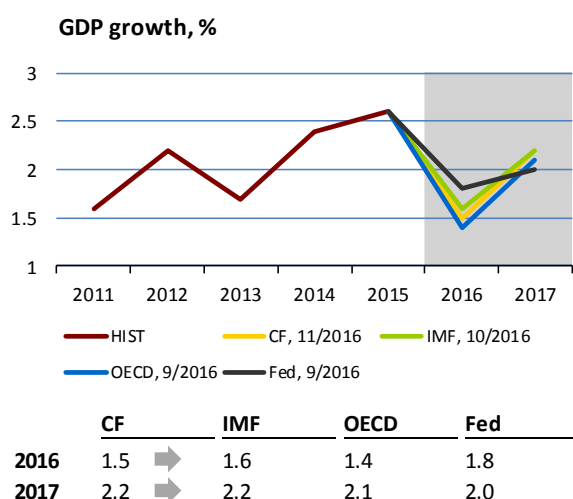
	10/16	11/16	02/17	11/17
3M EURIBOR	-0.31	-0.31	-0.29	-0.26
1Y EURIBOR	-0.07	-0.07	-0.06	0.00
10Y Bund	-0.03	0.07	0.10	0.30

## II.2 United States

According to the flash estimate, the US economy recorded its fastest growth in two years in Q3, with GDP growth reaching 2.9% (quarter-on-quarter, annualised). Unlike in previous quarters, exports and inventories improved markedly while private consumption slowed. Exports reflected the one-off effect of a sharp rise in soybean exports. Farmers are harvesting a record crop for the third straight year now. Moreover, Brazilian production was considerably diminished by drought, which raised the soy price on world markets and motivated US producers to increase exports. The new GDP growth data thus allayed concerns that the US economy will soon slip into recession. The current models of the Atlanta Fed instead indicate growth of more than 3% for Q4.

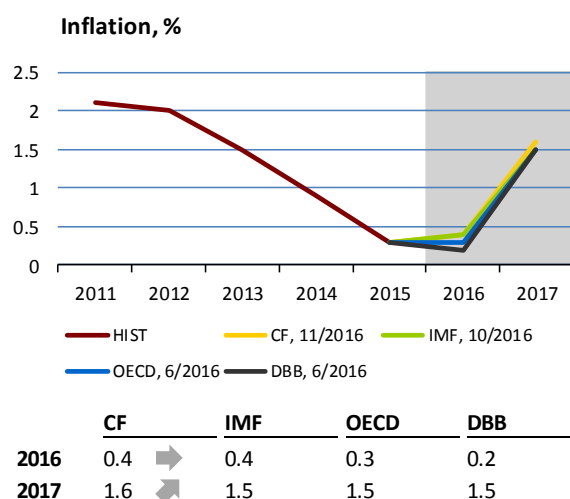
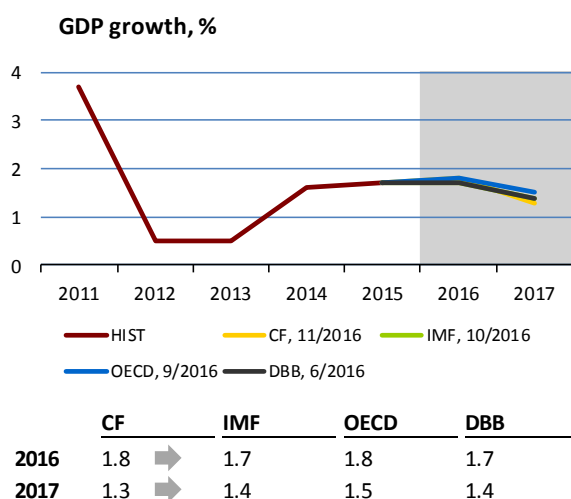
The labour market improved further in October. Non-farm payrolls rose by 161,000 in October and the unemployment rate dropped slightly (to 4.9%), as did the participation rate (to 62.8%). The average hourly wage also kept rising. Retail sales (year-on-year growth of 2.7% in September) were boosted by higher car sales. Consumer confidence remains high. The year-on-year fall in industrial production slowed to 1.0% in September and the ISM PMI leading indicator in manufacturing is in the expansion band (51.9 in October).

Growth in inflationary pressures is now apparent in the US economy. Annual headline consumer price inflation rose again in September (to 1.1%) on the back of higher fuel prices and rents. Inflation pressures are also being fuelled by rising wage costs. The Fed left monetary policy unchanged at its November meeting, but financial markets expect a rate hike in December. This opinion was shared by 76.8% of CF analysts in the November survey. Ten-year government bond yields rose again due to the approaching monetary policy tightening. The [dollar](#) weakened against other currencies on increased concerns about how the new political situation after the presidential election will be reflected in economic policy and support for economic growth. Proposals for changes to public finances were made during the election campaign, but the definitive steps must be confirmed by the new administration. The November CF, which polled its respondents just before the election, brought no changes to the outlook.



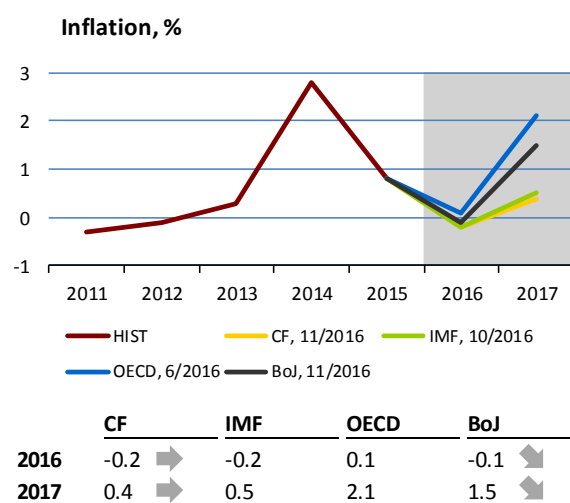
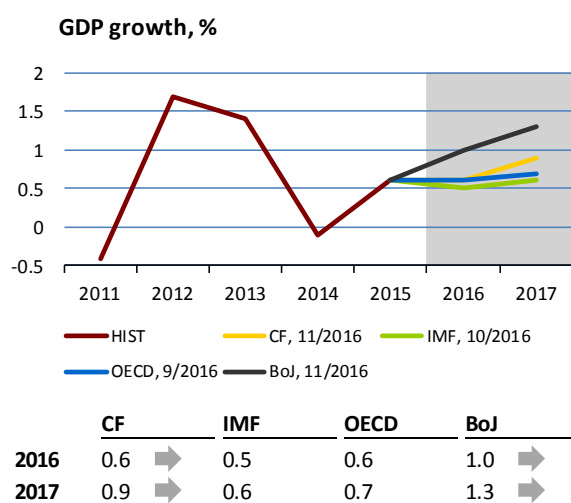
### II.3 Germany

Quarterly German GDP growth fell by 0.3 pp to 0.4% and annual growth by 0.1 pp to 1.7% in 2016 Q2. The unemployment rate dropped to 4.1% in September and employment rose by 1.2% year on year. For Q3, we expect continued economic growth at roughly the Q2 level. This is indicated by the average growth rates of industrial production and retail turnover for this period, which remained approximately at the Q2 level. All leading indicators strengthened in October, indicating higher growth for the last quarter of this year. The November CF predicts that GDP growth will reach 1.8% for 2016 as a whole. Due to a smaller drop in energy prices and continued growth in services prices, annual consumer price inflation went up by 0.1 pp to 0.8% in September. According to CF, inflation will reach 0.4% in 2016 as a whole, rising to 1.6% next year.



### II.4 Japan

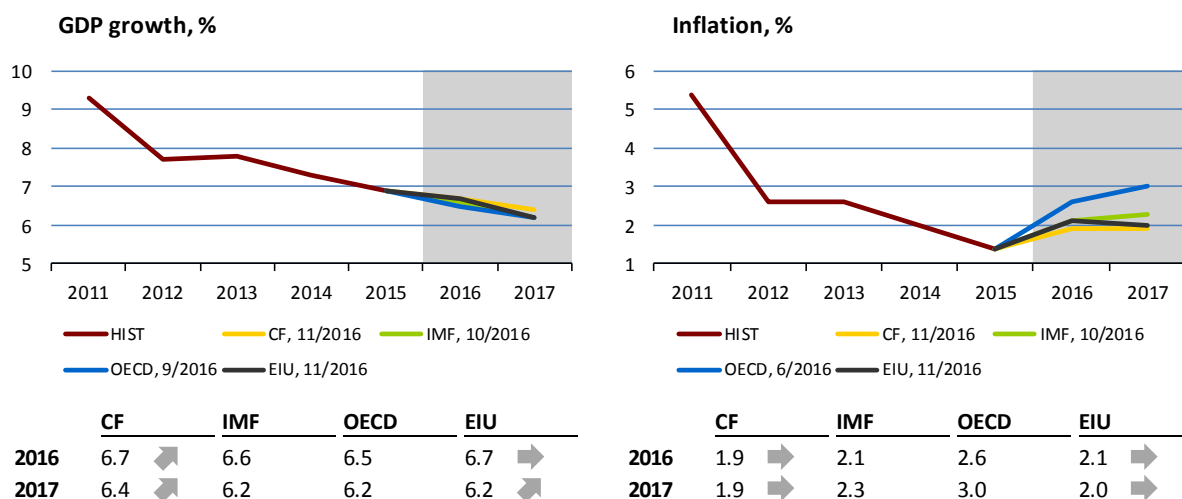
According to revised data, the Japanese economy expanded by 0.7% (quarter-on-quarter, annualised)<sup>1</sup> in Q2, with exports and capital expenditure negatively affected by the strong yen and weak demand. The growth probably continued into Q3. The PMI leading indicator in manufacturing reached a nine-month high (51.7) in October, mainly because of higher orders. However, retail sales slumped year on year in September (by 1.9%) and consumer confidence is showing no clear trend. Unemployment fell to a record 3% in September. However, inflation pressures are still not apparent – both headline inflation and core inflation excluding food prices are flat at -0.5%. The November CF brought no changes to the outlook. The central bank, however, again reduced its inflation outlooks for both years.



<sup>1</sup> A debate about the official GDP data erupted in Japan in October after the Japanese central bank published a study containing GDP estimates until the end of 2014 based on a different methodology. Those estimates are much higher than the officially published ones and indicate positive economic growth even in 2014, i.e. after the introduction of higher sales tax, when Japan officially slipped into recession.

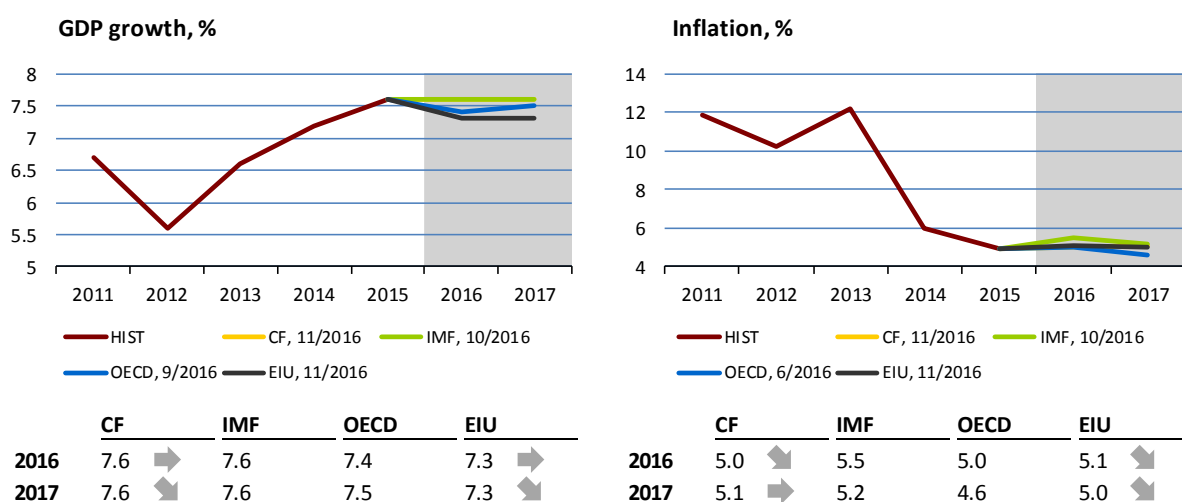
### III.1 China

All the monitored institutions continue to foresee a gradual slowdown of the Chinese economy. CF and the EIU nonetheless revised their GDP growth outlooks up slightly in the last month. The PMI in manufacturing also rose quite considerably (to 51.2) in October. China recorded stable annual growth of 6.7% for the third consecutive quarter in 2016 Q3. However, the growth is being driven mainly by public spending rather than private demand, raising concerns about the soundness of the economy. Consumer price inflation is also expected to rise to as much as 3% in annual terms in 2017 according to the OECD. In October inflation went up to 2.1%. The [renminbi](#) stabilised in November after a drop in October. Its further weakening will be aided by persisting capital outflows, which have started to put downward pressure on foreign exchange reserves, which decreased in October. According to CF, the renminbi is expected to depreciate by more than 3% against the dollar at the one-year horizon.



### III.2 India

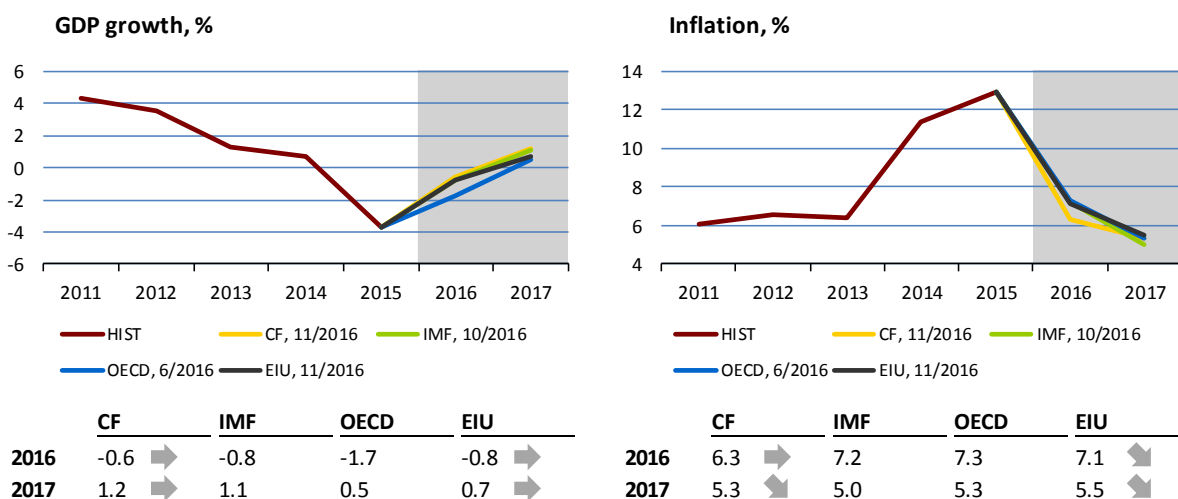
India is currently one of the few economies enjoying high economic growth. The monitored institutions expect this growth to continue in 2017. Nonetheless, CF and the EIU trimmed their GDP growth outlooks for next year. Industrial production has been broadly flat since November 2015 after previous year-on-year increases. The sharp rise of the PMI leading indicator in manufacturing, implying a reversal of the previous trend, is good news from this point of view. CF and the EIU also revised their outlooks for consumer price inflation down slightly. It is expected to slow slightly to 5% next year and will thus be safely inside the Indian central bank's target band. Despite weakening slightly in early November, the [exchange rate of the rupee against the dollar](#) has been relatively stable since late summer. The CF analysts expect the rupee to depreciate against the dollar by almost 3% at the one-year horizon.





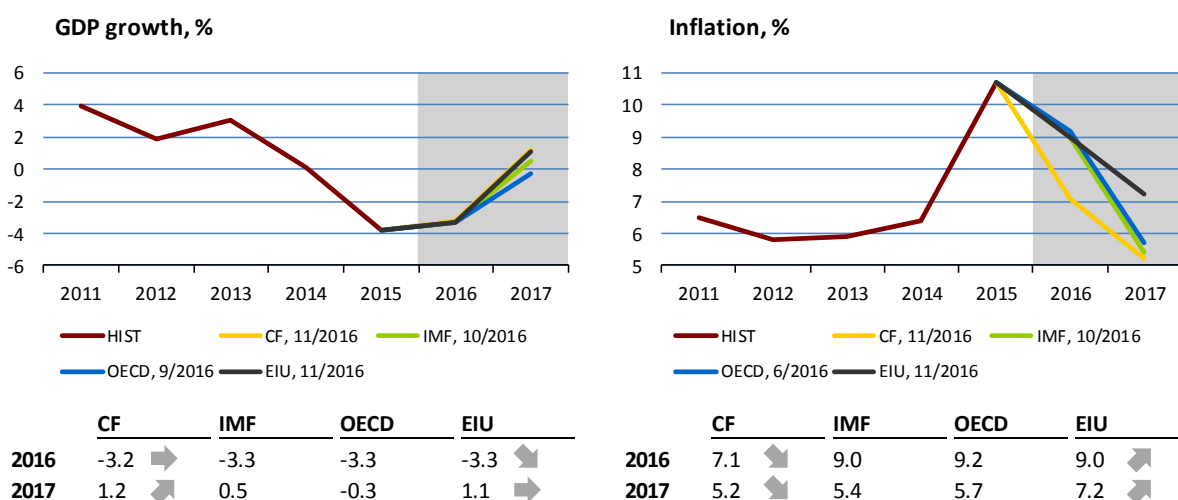
### III.3 Russia

Short-term developments indicate continued stabilisation of the Russian economy and a gradual overcoming of the economic crisis. The exception is industrial production, which fell by 0.8% year on year in September after previous weak growth. In late October, the Russian central bank (CBR) published a draft strategy for the single state monetary policy for the next three years. The CBR expects inflation to fall to the target of 4% in late 2017 and then stabilise at this level. The CBR's baseline economic scenario assumes that the price of Urals crude oil next year will remain at this year's average of USD 40/bbl. Russia's economic growth is predicted to be 0.5%–1.0%, slightly below the November CF and EIU outlooks (0.7%–1.2%). In line with the CBR, both institutions expect inflation to go down gradually. Unlike the CBR outlook, however, the CF and EIU outlooks expect inflation to stay above the target (5.3%–5.5%) at the end of next year.



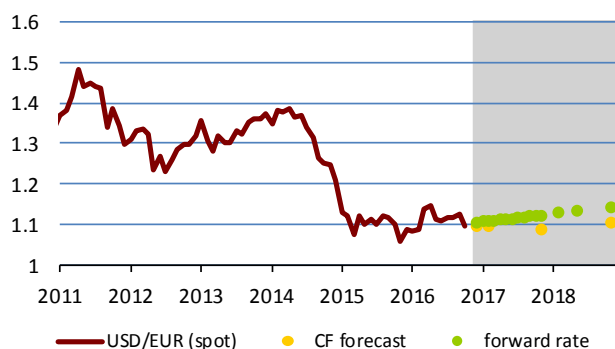
### III.4 Brazil

Brazil's industrial production fell by 4.9% year on year in September. Retail sales recorded a year-on-year slump of almost 6% in the same month. Exports and imports declined sharply in October in both month-on-month and year-on-year terms, and leading indicators were mixed. Nevertheless, the Brazilian central bank expects the economy to recover gradually. In October, it cut the benchmark SELIC rate by 0.25 pp to 14%, the first cut in four years. Inflation slowed from 8.5% to 7.9% in October, the lowest level since February 2015. According to the new CF and EIU outlooks, the overall fall in economic activity will reach 3.2%–3.3% this year. GDP growth is expected to rebound (to 1.1%–1.2%) next year. All the monitored institutions foresee a gradual decline in consumer price inflation. However, the specific figures in their outlooks differ greatly. CF lowered its forecast to 7.1% for 2016 and 5.2% for 2017, while the EIU raised its outlooks for both years, to 9.0% and 7.2% respectively.



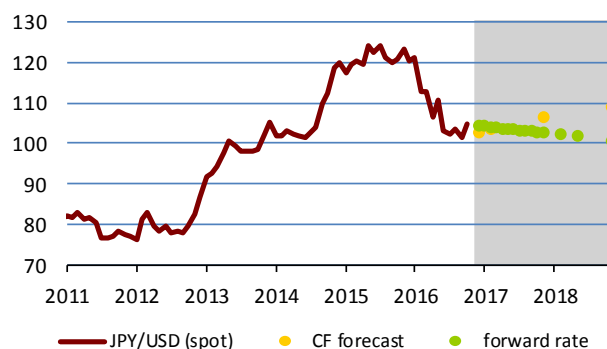
## IV. Outlook of exchange rates

The US dollar (USD/EUR)



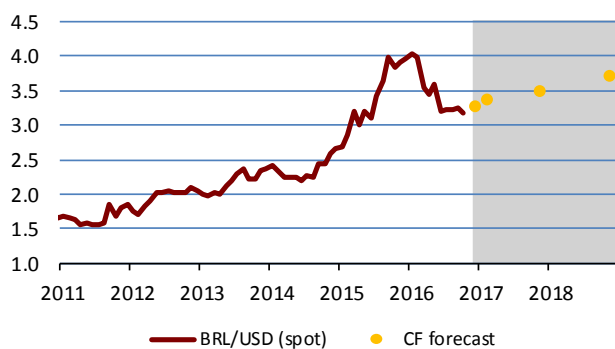
	7/11/16	12/16	02/17	11/17	11/18
spot rate	1.104				
CF forecast		1.098	1.095	1.087	1.103
forward rate		1.105	1.109	1.123	1.143

The Japanese yen (JPY/USD)



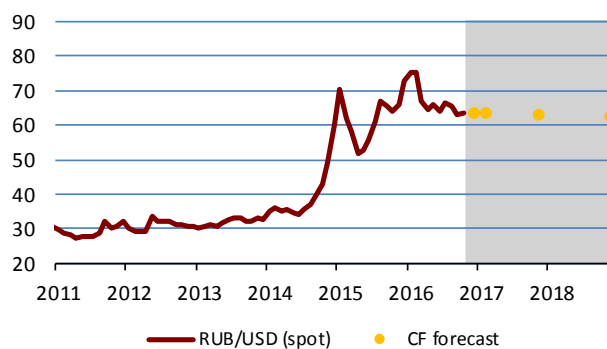
	7/11/16	12/16	02/17	11/17	11/18
spot rate	104.5				
CF forecast		102.7	103.4	106.4	108.8
forward rate		104.4	104.0	102.7	100.7

The Brazilian real (BRL/USD)



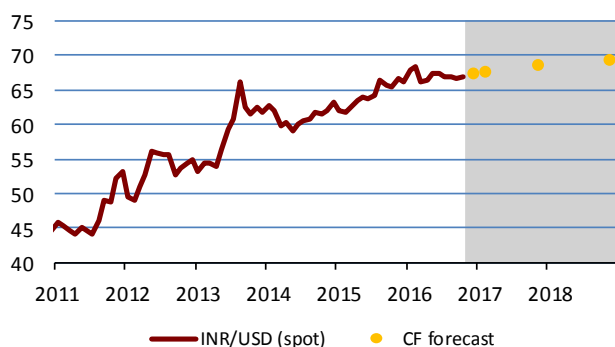
	7/11/16	12/16	02/17	11/17	11/18
spot rate	3.200				
CF forecast		3.274	3.369	3.482	3.711

The Russian rouble (RUB/USD)



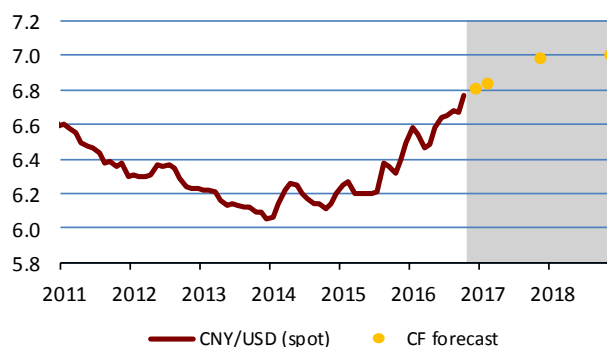
	7/11/16	12/16	02/17	11/17	11/18
spot rate	63.88				
CF forecast		63.64	63.46	63.20	62.71

The Indian rupee (INR/USD)



	7/11/16	12/16	02/17	11/17	11/18
spot rate	66.74				
CF forecast		67.43	67.71	68.66	69.22

The Chinese renminbi (CNY/USD)



	7/11/16	12/16	02/17	11/17	11/18
spot rate	6.776				
CF forecast		6.808	6.835	6.988	6.998

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.

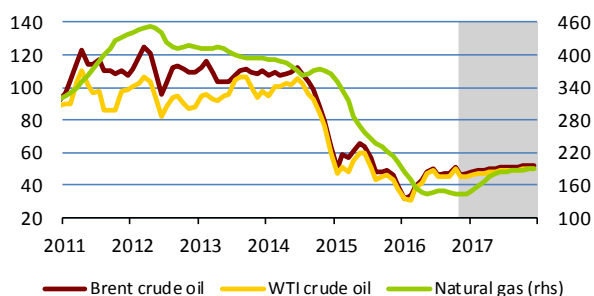
### V.1 Oil and natural gas

The Brent crude oil price rose sharply at the end of September when OPEC representatives surprisingly agreed in Algiers to cut oil output by about 700,000 barrels a day. The oil price then surged for two more weeks on the back of positive sentiment, recording total growth of more than 15%. However, the price trend reversed in the rest of October and the oil price thus erased virtually all its gains on growing concerns that the agreement reached in Algiers would not be implemented. The October swing would probably have been even bigger had it not been dampened by the dollar, whose strengthening depressed the oil price growth in the first half of the month and then acted in the opposite direction. The Brent price stabilised at about USD 46/bbl in the first half of November.

The market futures curve moved significantly downwards compared to the previous month, implying an average price of USD 50.5/bbl and USD 53.3/bbl for the next two years respectively. The EIA expects the Brent price to stay close to the current levels until mid-2017 and then rise gradually. The average Brent price should thus be USD 51/bbl and the WTI price about one dollar lower in 2017. This is in line with the November CF, which expects a Brent price of USD 53.8/bbl one year ahead. The risks to the forecasts are tilted to the downside, as production in Libya and Nigeria could grow faster if the political situation calms, and the stance of Iraq and Iran is putting the implementation of the OPEC Algiers agreement at risk.

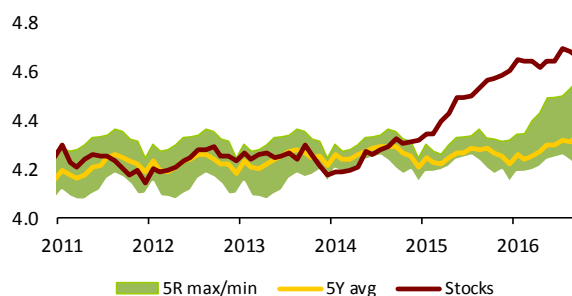
Abnormally warm weather in the USA in October led to a drop in gas prices despite slower filling of underground storages due to a drop in local gas extraction. By contrast, gas prices in Europe continued to display the strong growth recorded since mid-September. Coal and electricity prices also continued to increase.

**Outlook for prices of oil (USD/barrel) and natural gas (USD / 1000 m<sup>3</sup>)**

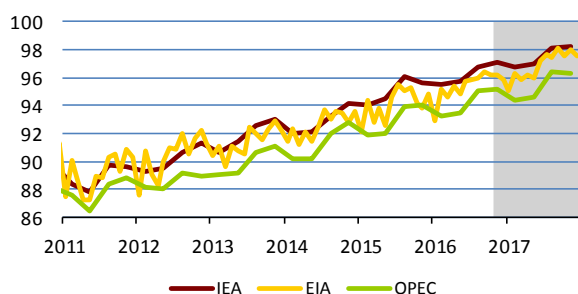


	Brent	WTI	Natural gas
2016	44.38 ↘	42.72 ↘	151.81 ↘
2017	50.50 ↘	48.59 ↘	178.44 ↘

**Total stocks of oil and oil products in OECD (bil. barrel)**

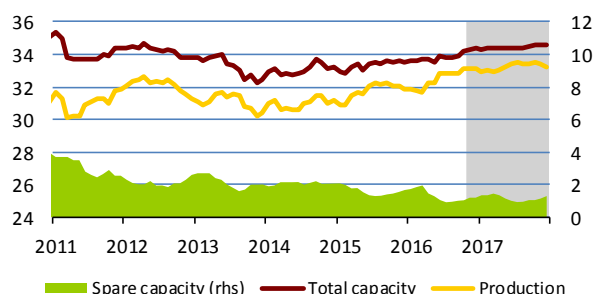


**Global consumption of oil and oil products (mil. barrel / day)**



	IEA	EIA	OPEC
2016	96.27 ↗	95.41 ↗	94.25 ↗
2017	97.50 ↗	96.92 ↗	

**Production, total and spare capacity in OPEC countries (mil. barrel / day)**



	Production	Total capacity	Spare capacity
2016	32.54 ↗	33.84 ↗	1.30 ↘
2017	33.26 ↗	34.43 ↗	1.17 ↘

Note: Oil price in USD/barrel, price of Russian natural gas at German border in USD / 1,000 m<sup>3</sup> (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 including average, maximum and minimum in past five years in billions of barrels. Global consumption of oil and oil products in millions of barrels a day. Production and extraction capacity of OPEC in million barrels a day (EIA estimate).  
 Source: Bloomberg, IEA, EIA, OPEC, CNB calculation

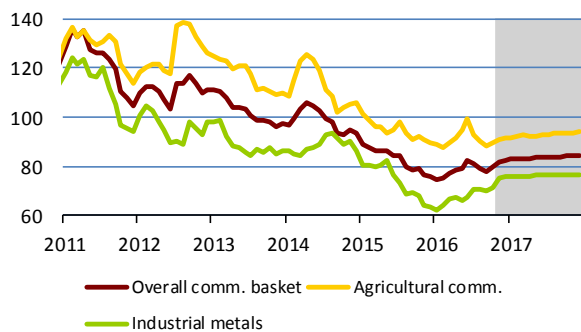
## V.2 Other commodities

The average monthly non-energy commodity price index rose slightly in October and accelerated further in the first half of November. The food commodity index recorded a similar pattern, while the industrial metals index has been trending upwards since February this year and in November reached its highest level since June 2015. The outlooks for all three indices continue to be only modestly rising.

Prices of most basic metals (especially those whose production is energy intensive, such as aluminium and copper) grew in October, with rising prices of thermal and coking coal causing costs in metallurgical industry to increase. The growth was also fostered by an improvement in the manufacturing PMI in China from 50.1 in September to 51.2 and by continued expansion of the Chinese residential market. The iron ore price benefited from year-on-year growth in steel production in September (2% globally and 3.9% in China).

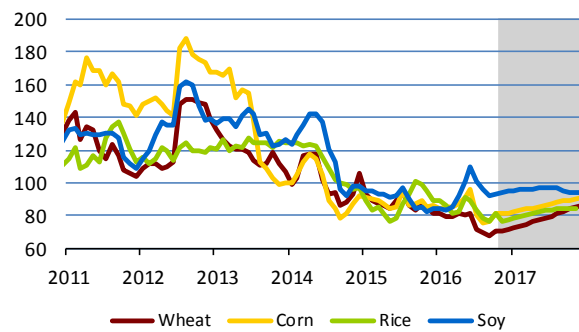
Agricultural commodity prices recorded mixed trends. Wheat and corn prices rose marginally after the USDA slightly reduced its forecast for global stocks after the 2016/2017 season. The price of soy also went up even though the estimate of soy stocks was increased slightly due to a recovery in production in Brazil. It is recovering from this year's drought, which led to growth in soy exports from the USA. The estimate of rice stocks was also increased markedly due to higher estimated production in Thailand and lower demand. The price of rice fell in response. Palm oil prices dropped owing to growth in stocks in Malaysia at the end of September stemming from a decline in exports. Sugar prices were flat near a four-year high, due mainly to reports of lower production in the main growing areas in Brazil between mid-September and mid-October. The price of lean hogs fell to its lowest level since 2002 and the price of live cattle was at a six-year low.

### Non-energy commodities price indices



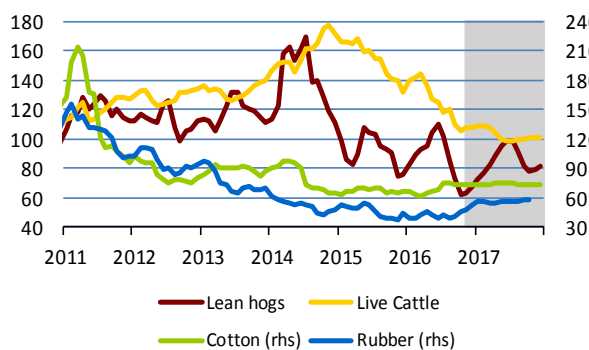
	Overall	Agricultural	Industrial
2016	79.1 ↗	91.3 ↗	69.0 ↗
2017	83.7 ↗	93.0 ↗	76.4 ↗

### Food commodities



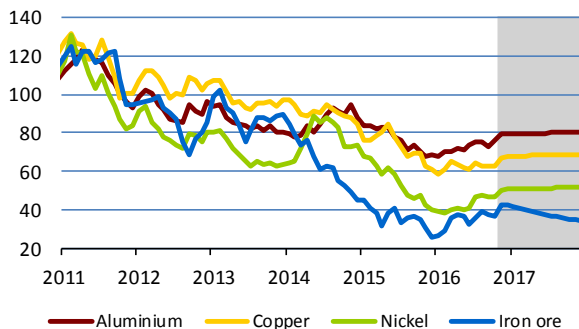
	Wheat	Corn	Rice	Soy
2016	75.5 ↗	83.9 ↗	82.8 ↘	93.9 ↗
2017	79.5 ↗	86.9 ↘	82.6 ↘	95.8 ↗

### Meat, non-food agricultural commodities



	Lean hogs	Live Cattle	Cotton	Rubber
2016	85.9 ↗	123.7 ↗	69.6 ↗	43.0 ↗
2017	85.6 ↗	102.5 ↗	74.2 ↗	56.4 ↗

### Basic metals and iron ore



	Aluminium	Copper	Nickel	Iron ore
2016	73.6 ↗	63.2 ↗	44.0 ↗	36.1 ↗
2017	80.0 ↗	68.4 ↗	51.3 ↗	37.6 ↗

Note: Structure of non-energy commodity price indices corresponds to composition of The Economist commodity indices. All prices are given as indices, 2010 = 100 (charts) and percentage changes (tables).

Source: Bloomberg, CNB calculations.

## The relationship between the Brent oil price and the dollar exchange rate<sup>2</sup>

Pronounced growth in the intensity of the relationship between the Brent crude oil price and the US dollar exchange rate – with a weakening (strengthening) dollar being accompanied by a rising (falling) Brent price – has been observed since 2005. The Granger causality test indicates that the direction of this relationship runs from the dollar exchange rate to the oil price. In this paper, we update our 2011 estimate of this relationship<sup>3</sup> and confirm that the inverse relationship between the Brent price and the nominal effective exchange rate of the dollar still applies to the extended time series. Since 2005, a weakening of the dollar of 1% has caused the oil price to rise by around 2%–3%. This relationship helps dampen fluctuations in the dollar price of Brent crude oil in “non-dollar” economies, including the Czech Republic.

### 1 Introduction

After a more than five-year hiatus, the November GEO revisits the relationship between the Brent crude oil price and the US dollar exchange rate. The impetus for this is the sharp fall recorded by the Brent price since mid-2014, which has been accompanied by appreciation of the nominal effective exchange rate of the dollar (see Figure 1). Originally, the relationship between the oil price and the dollar exchange rate was analysed using data up to September 2010, with Novotný (2012) identifying growth in the intensity in the said relationship as from January 2005. The elevated intensity of the relationship between the two variables might have been fostered by the rapid M2 growth seen in the USA in 2004 and 2005 (the fastest rate of growth since the end of the 1980s). It would seem that investors probably seek alternative investment returns on commodity markets in an environment of low real interest rates and excess liquidity. This updated analysis thus focuses solely on the period from 2005 to the present.

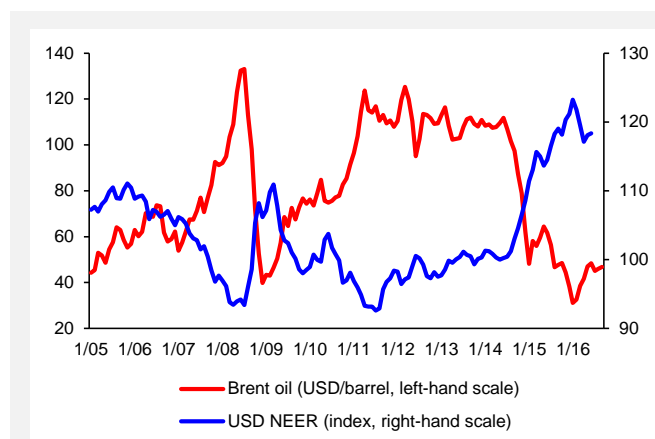


Figure 1 Evolution of the Brent crude oil price and the US dollar exchange rate

Source: Datastream (Brent crude oil) and IMF-IFS (NEER USD)

Note: An increase in the USD NEER index means appreciation of the dollar.

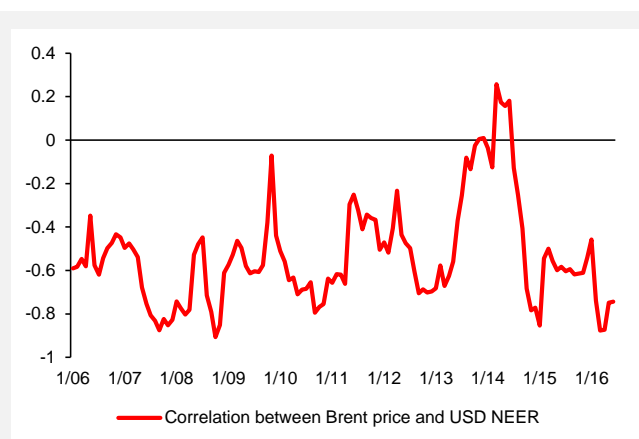


Figure 2 Annual moving coefficient of correlation between monthly returns on the price of Brent crude oil and the nominal effective exchange rate of the US dollar.

Source: Datastream (Brent crude oil) and IMF-IFS (NEER USD)

Note: An increase in the USD NEER index means appreciation of the dollar.

Figure 1 shows two time periods characterised by a sizeable movement in the Brent crude oil price and a contrary movement in the dollar exchange rate.<sup>4</sup> The first period peaks in mid-2008, with the Brent price reaching a high of USD 133/bbl and the USD NEER recording a sharp depreciation of 10% year on year. The second starts in mid-2014 with a sharp fall in the Brent price – which reached a 12-year low of USD 31/bbl in January 2016 – coupled with a year-on-year appreciation of the USD NEER of almost 17%. Except for the period between 2013 and 2014, the coefficient of correlation between the month-on-month changes in the Brent price and the USD NEER was negative, albeit with varying intensity (see Figure 2).

According to Muñoz and Dickey (2009), fluctuations of the US dollar generally affect commodity prices simply because commodity prices are quoted in dollars. The results of our approach essentially confirm contrary movements of the two variables, i.e. a weakening dollar causes prices of oil and other commodities to rise and a strengthening dollar conversely causes them to fall (Cuaresma and Breitenfellner, 2008; Brown et al., 2008; European Commission, 2008; Schulmeister, 2009; Hošek et al., 2011).

There are several explanations for the inverse relationship between the oil price and the US dollar exchange rate. One of them involves the growing role of investors in commodity markets, related to falling financial

<sup>2</sup> Author Filip Novotný (filip.novotny@cnb.cz). The views expressed in this article are those of the author and do not necessarily reflect the official position of the Czech National Bank.

<sup>3</sup> See the February 2011 GEO.

<sup>4</sup> The coefficient of correlation between the month-on-month changes in the USD NEER and the month-on-month changes in the EUR/USD bilateral exchange rate in the period between January 2005 and June 2016 was high at 0.9. Similar results would therefore have been obtained using the EUR/USD exchange rate directly.

asset returns in advanced countries. In this case, oil is a recognised investment asset used as a means of diversifying the risk of inflation, the risk of US dollar depreciation or the risk of a stock market decline. Furthermore, a depreciation of the US dollar or an easing of monetary policy in the USA implies an easing of the monetary conditions in countries whose exchange rate is tied to the dollar. Oil-exporting countries and China are typical examples. Demand in these countries, including demand for oil products, then increases, reinforcing the effect of US monetary policy on commodity market prices. In addition, a weakening of the dollar against the currencies of countries with floating exchange rates means that the oil price in local currency becomes lower. This can cause a rise in demand for oil in these countries as well (for details, see, for example, Cuaresma and Breitenfellner, 2008, p. 7). If US monetary policy is tightened, or the US dollar appreciates, this sequence of course has the opposite effect.

## 2 Factors affecting the price of oil

The oil market is characterised by low price elasticity of both demand and supply. Although the price elasticity of both sides has gradually been increasing,<sup>5</sup> greater price fluctuations are necessary to achieve equilibrium on the oil market. Oil supply is affected above all by limited reserve capacity, which is concentrated largely in just one country (Saudi Arabia) and by the long time – often between five and ten years – it takes to establish new oil fields for commercial use.

As both time series – the Brent oil price as well as the nominal effective exchange rate of the dollar – are non-stationary, we examine the interdependence between their monthly logarithmic returns, which fulfil the condition of stationarity. Specifically, we estimate the following equation for the Brent oil price, which contains other relevant (control) variables in addition to the nominal effective exchange rate on the right-hand side of the equation:<sup>6</sup>

$$\Delta \ln(Brent_t) = \beta_1 \Delta \ln(NEER_t^{USD}) + \beta_2 \Delta \ln(IP_t^{OECD}) + \beta_3 \Delta r_t^{USA} + \beta_4 \Delta \ln(OIL\_INV_{t-1}^{USA}) + \beta_5 \Delta \ln(RAFINERY_{t-2}^{USA}) + \varepsilon_t,$$

where  $Brent_t$  is the nominal price of Brent crude oil in US dollars per barrel;  $NEER_t^{USD}$  is the nominal effective exchange rate of the dollar (growth in the index implies appreciation of the dollar);  $IP_t^{OECD}$  is the seasonally adjusted industrial production index in OECD countries;  $r_t^{USA}$  denotes annual real interest rates in the USA;  $OIL\_INV_{t-1}^{USA}$  are oil inventories in the USA excluding strategic reserves in barrels, adjusted for seasonal effects;  $RAFINERY_{t-2}^{USA}$  is the percentage rate of use of oil refineries in the USA, adjusted for seasonal effects; and  $t$  is time in months. The corresponding coefficients are expressed by  $\beta_1$  through  $\beta_5$ , while  $\varepsilon_t$  is the i.i.d. term.<sup>7</sup>

The results of the estimate of the oil price equation are shown in Table 1. The estimate was performed separately for three time periods. First, we updated the original estimate of the Brent oil price equation (see the February 2011 GEO), which was performed for the period from January 2005<sup>8</sup> to September 2010. The new estimate gives roughly the same results as the previous one.<sup>9</sup> The dollar exchange rate and industrial production in OECD countries therefore have contrary effects on the oil price. Based on this time sample, a strengthening of the dollar of 1% implies a decline in the Brent price of 2.2%, while growth in industrial production of 1% causes the oil price to increase by 2.8%. A decline in the real interest rate (monetary policy easing) in the USA, which is another statistically significant variable affecting the oil price, has an upward effect on the oil price, in line with our expectations. Finally, growth in oil inventories in the USA also causes the oil price to rise (with a one-month lag).

The extension of the original data sample to June 2016 shows that the significance of the dollar exchange rate for oil price movements has intensified in recent years, mainly at the expense of industrial production in OECD countries. Unlike the original results, on the basis of the expanded sample an appreciation of the dollar of 1% results in a decline in the Brent price of 3.1%, while growth in industrial production of 1% causes an increase in the oil price of just 1.5%. The effect of real interest rates – another of the explanatory variables – is maintained.

As the original results (re-estimate) were obtained for a period characterised by sharp oil price fluctuations (sharp growth followed by a decline and a return to growth), in the next step we omitted the period of relative stability of the Brent crude oil price, i.e. from January 2011 to June 2014, from the estimate based

<sup>5</sup> On the one hand, China responds flexibly to the oil price by increasing or decreasing imports of oil into its strategic (and also commercial) reserves. On the other hand, US shale extraction has a much shorter investment horizon and producers can relatively quickly increase or reduce drilling activity or bring uncompleted wells into production.

<sup>6</sup> The Granger causality test indicates that the causality runs from the dollar exchange rate to the Brent price.

<sup>7</sup> The data are taken from the databases of IMF-IFS ( $NEER_t^{USD}$ ), Datastream ( $Brent_t, r_t^{USA}$ ), Bloomberg ( $OIL\_INV_{t-1}^{USA}$ ,  $RAFINERY_{t-2}^{USA}$ ) and the OECD ( $IP_t^{OECD}$ ).

<sup>8</sup> Until 2005 the effect of the dollar exchange rate on the Brent oil price is statistically insignificant with a very low coefficient. All the other explanatory variables are statistically significant, with industrial production in OECD countries having the largest effect. Growth in industrial production of 1% had an upward effect on the oil price of around 5.3% in that period. Growth in oil inventories (with a one-month lag) and growth in the use of refineries (with a two-month lag) both result in an increase in the price of oil.

<sup>9</sup> The slight deviations are due to revisions to time series and to the use of one-year real interest rates instead of the previously used three-month real interest rates.

	Re-estimate 2005:1–2010:9	Extended sample 2005:1–2016:6	Shorter sample 2005:1–2010:12; 2014:7–2016:6
$\Delta \ln(NEER_t^{USD})$	-2.2*** (0.65)	-3.1*** (0.47)	-2.9*** (0.57)
$\Delta \ln(IP_t^{OEC})$	2.8*** (0.94)	1.47* (0.82)	2.7*** (0.92)
$\Delta r_t^{USA}$	-0.05*** (0.02)	-0.04*** (0.01)	-0.05*** (0.02)
$\Delta \ln(OIL\_INV_{t-1}^{USA})$	0.75** (0.33)	0.36 (0.22)	0.63** (0.29)
$\Delta \ln(RAFINERY_{t-2}^{USA})$	0.003 (0.003)	0.001 (0.002)	0.002 (0.003)
$\bar{R}^2$	0.52	0.42	0.46
<i>D-W</i>	2.0	1.8	1.9
<i>Number of observations</i>	66	135	93
<i>Dependent variable (avg./std. dev.)</i>	0.1 / 0.006	-0.001/0.1	-0.001/0.1

Table 1 Estimate of variables affecting the price of Brent crude oil

Note: Monthly logarithmic returns for the Brent crude oil price are the dependent variable. Estimated by the least squares method. Standard errors of the coefficient estimates are shown in brackets. Asterisks denote significance as follows: \*\*\* 1%, \*\* 5%.

on the extended sample. The results of this control estimate are also shown in Table 1 (shorter sample). Although they are rather closer to the original estimate (especially as regards the effect of growth in industrial production and real interest rates), the significance of the dollar exchange rate remains stronger than in the case of the initial estimate based on the 2005–2010 data.

### 3 Conclusion

In this analysis, we updated the estimate of the effect of the US dollar exchange rate on the dollar price of Brent crude oil using an extended time sample. The inverse relationship between the Brent price and the dollar exchange rate is confirmed over the longer time scale. Moreover, when the longer updated period up to June 2016 is included, the link between the value of the dollar and the nominal Brent oil price increases at the expense of the effect of industrial production on the Brent price. The original estimate seems to have been characteristic mainly of the period of greater volatility in the Brent price. This is confirmed by an estimate based on a shorter time series excluding the period of relative stability of the Brent price from January 2011 to June 2014, the results of which are closer to the original estimate, which was conducted on the time series ending in September 2010. Based on all the calculations made, we estimate that since the start of 2005, a weakening (strengthening) of the nominal effective exchange rate of the dollar of 1% has implied an increase (decrease) in the oil price of 2%–3%.

The contrary movements in the US dollar exchange rate and oil prices thus dampen the sizeable fluctuations in the dollar price of Brent crude oil in “non-dollar” economies, including the Czech Republic. The effect of growth in the dollar price of oil on the Czech economy was therefore dampened significantly between August 2007 and September 2008. Since the second half of 2014, by contrast, the koruna-dollar exchange rate has fostered a smaller koruna decline in the oil price as compared to the dollar decline in the oil price.

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## A1. Change in GDP predictions for 2016

	CF		IMF		OECD		CB / EIU	
EA	0	2016/11	+0.1	2016/10	-0.1	2016/9	+0.1	2016/9
		2016/10		2016/7		2016/6		2016/6
US	0	2016/11	-0.6	2016/10	-0.4	2016/9	-0.2	2016/9
		2016/10		2016/7		2016/6		2016/6
DE	0	2016/11	+0.1	2016/10	+0.2	2016/9	-0.1	2016/6
		2016/10		2016/7		2016/6		2015/12
JP	0	2016/11	+0.2	2016/10	-0.1	2016/9	0	2016/11
		2016/10		2016/7		2016/6		2016/7
BR	0	2016/11	0	2016/10	+1.0	2016/9	-0.3	2016/11
		2016/10		2016/7		2016/6		2016/10
RU	0	2016/11	+0.4	2016/10	-1.3	2016/6	0	2016/11
		2016/10		2016/7		2015/11		2016/10
IN	0	2016/11	+0.2	2016/10	0	2016/9	0	2016/11
		2016/10		2016/7		2016/6		2016/10
CN	+0.1	2016/11	0	2016/10	0	2016/9	0	2016/11
		2016/10		2016/7		2016/6		2016/10

## A2. Change in inflation predictions for 2016

	CF		IMF		OECD		CB / EIU	
EA	0	2016/11	-0.1	2016/10	-0.7	2016/6	0	2016/9
		2016/10		2016/4		2015/11		2016/6
US	0	2016/11	+0.4	2016/10	+0.1	2016/6	-0.1	2016/9
		2016/10		2016/4		2015/11		2016/6
DE	0	2016/11	-0.1	2016/10	-0.7	2016/6	-0.9	2016/6
		2016/10		2016/4		2015/11		2015/12
JP	0	2016/11	0	2016/10	-0.6	2016/6	-0.2	2016/11
		2016/10		2016/4		2015/11		2016/7
BR	-0.2	2016/11	+0.3	2016/10	+3.4	2016/6	+0.6	2016/11
		2016/10		2016/4		2015/11		2016/10
RU	0	2016/11	-1.2	2016/10	-2.2	2016/6	-0.1	2016/11
		2016/10		2016/4		2015/11		2016/10
IN	-0.1	2016/11	+0.2	2016/10	+0.1	2016/6	-0.4	2016/11
		2016/10		2016/4		2015/11		2016/10
CN	0	2016/11	+0.3	2016/10	+0.1	2016/6	0	2016/11
		2016/10		2016/4		2015/11		2016/10



### A3. List of abbreviations

<b>ABS</b>	asset-backed securities	<b>HICP</b>	harmonised index of consumer prices
<b>bbl</b>	barrel	<b>CHF</b>	Swiss franc
<b>BoJ</b>	Bank of Japan	<b>ICE</b>	Intercontinental Exchange
<b>BR</b>	Brazil	<b>IEA</b>	International Energy Agency
<b>BRIC</b>	countries of Brazil, Russia, India and China	<b>IFO</b>	Institute for Economic Research
<b>BRL</b>	Brazilian real	<b>IFO-BE</b>	IFO Business Expectations
<b>CB</b>	central bank	<b>IMF</b>	International Monetary Fund
<b>CB-CCI</b>	Conference Board Consumer Confidence Index	<b>IN</b>	India
<b>CB-LEII</b>	Conference Board Leading Economic Indicator Index	<b>INR</b>	Indian rupee
<b>CBOT</b>	Chicago Board of Trade	<b>IRS</b>	Interest Rate swap
<b>CBR</b>	Central Bank of Russia	<b>ISM</b>	Institute for Supply Management
<b>CF</b>	Consensus Forecasts	<b>JP</b>	Japan
<b>CN</b>	China	<b>JPY</b>	Japanese yen
<b>CNB</b>	Czech National Bank	<b>LI</b>	leading indicators
<b>CNY</b>	Chinese renminbi	<b>LIBOR</b>	London Interbank Offered Rate
<b>DBB</b>	Deutsche Bundesbank	<b>LME</b>	London Metal Exchange
<b>DE</b>	Germany	<b>MER</b>	Ministry of Economic Development (of Russia)
<b>EA</b>	euro area	<b>MMBtu</b>	million of British Thermal Units
<b>EBRD</b>	European Bank for Reconstruction and Development	<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>EC</b>	European Commission	<b>OECD-CLI</b>	OECD Composite Leading Indicator
<b>ECB</b>	European Central Bank	<b>PMI</b>	Purchasing Managers' Index
<b>EC-CCI</b>	European Commission Consumer Confidence Indicator	<b>PPI</b>	producer price index
<b>EC-ICI</b>	European Commission Industrial Confidence Indicator	<b>QE</b>	quantitative easing
<b>EIA</b>	Energy Information Administration	<b>RU</b>	Russia
<b>EIU</b>	Economist Intelligence Unit	<b>RUB</b>	Russian rouble
<b>EU</b>	European Union	<b>TLTRO</b>	targeted longer-term refinancing operations
<b>EUR</b>	euro	<b>UoM</b>	University of Michigan
<b>EURIBOR</b>	Euro Interbank Offered Rate	<b>UoM-CSI</b>	University of Michigan Consumer Sentiment Index
<b>Fed</b>	Federal Reserve System (the US central bank)	<b>US</b>	United States
<b>FOMC</b>	Federal Open Market Committee	<b>USD</b>	US dollar
<b>FRA</b>	forward rate agreement	<b>USDA</b>	United States Department of Agriculture
<b>FY</b>	fiscal year	<b>WEO</b>	World Economic Outlook
<b>GBP</b>	pound sterling	<b>WTI</b>	West Texas Intermediate (crude oil used as a benchmark in oil pricing)
<b>GDP</b>	gross domestic product	<b>ZEW-ES</b>	ZEW Economic Sentiment

## A4. List of thematic articles published in the GEO

### 2016

	<b>Issue</b>
The relationship between the Brent oil price and the dollar exchange rate (Filip Novotný)	2016-11
The industrial producer price index in the EU (Iveta Polášková)	2016-10
The closing of the output gap in OECD countries in the current low-inflation environment (Luboš Komárek)	2016-9
Seasonal agricultural commodity price movements (Martin Motl)	2016-8
Inflation expectations in the USA: An illusion of a fall? (Soňa Benecká)	2016-7
Annual assessment of the forecasts included in GEO (Filip Novotný)	2016-6
International comparison of competitiveness using composite indicators (Iveta Polášková)	2016-5
How global inventory levels affect commodity prices (Jan Hošek)	2016-4
The Europe 2020 strategy: Will it be fulfilled? (Pavla Břízová)	2016-3
Changes in global imbalances in the world economy (Luboš Komárek and Vladimír Žďárský)	2016-2
The FDI life cycle on the example of the Czech Republic (Filip Novotný)	2016-1

### 2015

	<b>Issue</b>
The role of China in the slowdown in international trade (Oxana Babecká Kucharčuková)	2015-12
Central banks' gold reserves (Iveta Polášková)	2015-11
Shadow policy rates – alternative quantification of unconventional monetary policy (Soňa Benecká, Luboš Komárek and Filip Novotný)	2015-10
The economic reforms of Indian Prime Minister Narendra Modi (Pavla Břízová)	2015-9
The Chinese renminbi in the SDR basket: A realistic prospect? (Soňa Benecká)	2015-8
Annual assessment of the forecasts included in GEO (Filip Novotný)	2015-7
Seasonal price movements in the commodity markets (Martin Motl)	2015-6
Assessment of the effects of quantitative easing in the USA (Filip Novotný)	2015-5
How consensus has evolved in Consensus Forecasts (Tomáš Adam and Jan Hošek)	2015-4
The US dollar's position in the global financial system	2015-3
The crisis and post-crisis experience with Swiss franc loans outside Switzerland (Alexis Derviz)	2015-2
The effect of oil prices on inflation from a GVAR model perspective (Soňa Benecká and Jan Hošek)	2015-1

**2014**

	<b>Issue</b>
Applicability of Okun's law to OECD countries and other economies (Oxana Babecká Kucharčuková and Luboš Komárek)	2014-12
Monetary policy normalisation in the USA (Soňa Benecká)	2014-11
Changes in FDI inflows and FDI returns in the Czech Republic and Central European countries (Vladimír Žďárský)	2014-10
Competitiveness and export growth in selected Central European countries (Oxana Babecká Kucharčuková)	2014-9
Developments and the structure of part-time employment by European comparison (Eva Hromádková)	2014-8
The future of natural gas (Jan Hošek)	2014-7
Annual assessment of the forecasts included in GEO (Filip Novotný)	2014-6
How far the V4 countries are from Austria: A detailed look using CPLs (Václav Žďárek)	2014-5
Heterogeneity of financial conditions in euro area countries (Tomáš Adam)	2014-4
The impacts of the financial crisis on price levels in Visegrad Group countries (Václav Žďárek)	2014-3
Is the threat of deflation real? (Soňa Benecká and Luboš Komárek)	2014-2
Forward guidance – another central bank instrument? (Milan Klíma and Luboš Komárek)	2014-1

**2013**

	<b>Issue</b>
Financialisation of commodities and the structure of participants on commodity futures markets (Martin Motl)	2013-12
The internationalisation of the renminbi (Soňa Benecká)	2013-11
Unemployment during the crisis (Oxana Babecká and Luboš Komárek)	2013-10
Drought and its impact on food prices and headline inflation (Viktor Zeisel)	2013-9
The effect of globalisation on deviations between GDP and GNP in selected countries over the last two decades (Vladimír Žďárský)	2013-8
Competitiveness and determinants of travel and tourism (Oxana Babecká)	2013-7
Annual assessment of the forecasts included in GEO (Filip Novotný)	2013-6
Apartment price trends in selected CESEE countries and cities (Michal Hlaváček and Luboš Komárek)	2013-5
Selected leading indicators for the euro area, Germany and the United States (Filip Novotný)	2013-4
Financial stress in advanced economies (Tomáš Adam and Soňa Benecká)	2013-3
Natural gas market developments (Jan Hošek)	2013-2
Economic potential of the BRIC countries (Luboš Komárek and Viktor Zeisel)	2013-1

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