Global Economic Outlook

July 2022

Czech National Bank —— Global Economic Outlook —— July 2022

CNB CZECH NATIONAL BANK

Cut-off date for data
15 July 2022

CF survey date
11 July 2022

GEO publication date
22 July 2022

Notes to charts

ECB, Fed, BoE and BoJ: 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 Refinitiv 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.

Contact
gev@cnb.cz

Authors

Luboš Komárek	Editor-in-chief, I. Introduction
Petr Polák	Editor
Filip Novotný	II.1 Euro area, II.2 Germany
Michaela Ryšavá	II.3 United States, II.5 United Kingdom, II.10 Turkey
Martin Motl	II.4 China
Martin Kábrt	II.6 Japan
Oxana Babecká	II.7 Russia
Jaromír Tonner	II.8 Poland, II.9 Hungary, V. Focus
Jan Hošek	IV.1 Oil, IV.2 Other commodities

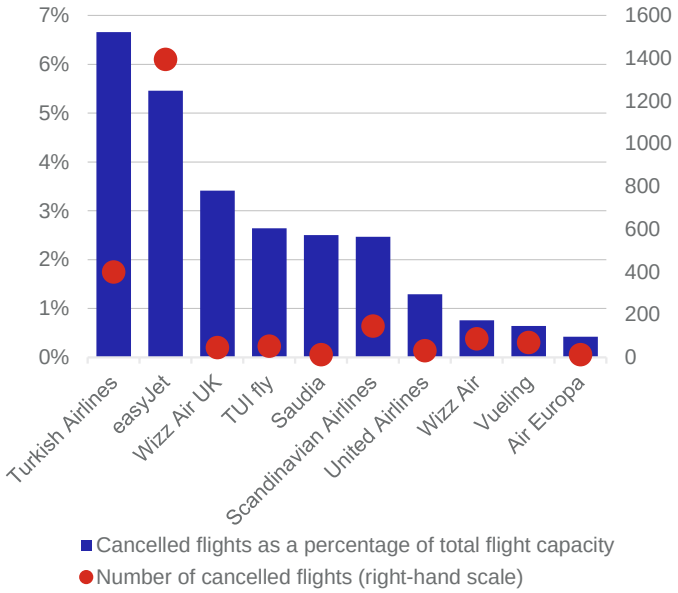
I. Introduction

Hopefully, the world and Europe in particular will not get used to Russian aggression in Ukraine... Unfortunately, it is still difficult to predict when the war will end and the loss of life continues. Heavy fighting is ongoing, especially in eastern Ukraine, and the isolation of Russia increases.

The armed conflict has significant economic and redistribution costs. The greater an economy's dependency on Russia, the higher these costs. The shift in oil trade clearly illustrates how much the war has redirected energy supplies worldwide. More European countries have started importing oil from the USA, while Russia is offering its oil at cut prices to countries like India and China, which have not imposed any sanctions. Europe now surpasses Asia as the largest consumer of US oil. There is an even bigger nightmare ahead for Europe – the risk that natural gas supplies will be halted or heavily restricted when the annual maintenance of the Nord Stream 1 gas pipeline ends on 21 July. Canada plays an important role, as Russian compressor turbines are serviced there. Their return is shrouded in great uncertainty and conflicts of interests.

A halt in natural gas supplies into Europe would have a very big impact, particularly on the German economy, to which many companies in the EU have strong links. The Bundesbank even expects gas supply restrictions to be extended to households, which will make greater use of wood and other fossil fuels for heating. It appears the pressure on the vision for a green Europe will ease off in the coming years.

Top ten airlines in Europe by number of flights cancelled



Source: Mabrian Travel Intelligence Platform
Note: The comparison shows how many of the flights scheduled to fly from 1–15 July were cancelled from 14–28 June.

Inflation is still at all-time highs. Central banks are trying to extinguish the inflation fire, but accommodative fiscal policy and strong wage pressures may reignite it. At its July meeting, the Fed will probably again react with a sharp rate hike of at least 0.75 pp. The ECB should finally join the "hiking" central banks with an expected rate increase of 0.5 pp.

The chart of the July issue highlights the unusual rise in the percentage of cancelled flights with the start of the summer tourist season. This development can be attributed both to the post-Covid travel bug and insufficient airline and airport employees. According to Mabrian, Turkish Airlines is cutting back on flights the most, cancelling nearly 7% of its total flight capacity in the period under review. British airline easyJet is in second place, with more than 5% of cancellations.

The current issue also contains an analysis: "Current trends in macroeconomic modelling in central banks in light of the turbulent nature of recent events." The article looks at how modelling systems adapt to unpredictable events such as pandemics and conflicts, i.e. to the completely new challenges also faced by central banks. .

Barometr of Global Economic Outlook for selected countries

		EA	DE	US	UK	JP	CN	RU
GDP	**2022**	2.7 ↘	1.6 ↘	2.1 ↘	3.3 ↘	1.6 ↘	4.2 ↘	-8.4 ↗
(%)	**2023**	1.4 ↘	1.6 ↘	1.0 ↘	0.5 ↘	1.7 ↘	5.4 ↗	-2.2 ↘
Inflation	**2022**	7.5 ↗	7.2 ↗	7.9 ↗	8.6 ↗	2.0 ↗	2.2 ↘	17.9 ↘
(%)	**2023**	3.7 ↗	3.6 ↗	3.7 ↗	5.6 ↗	1.3 ↗	2.3 →	7.1 ↘
Unemployment	**2022**	6.8 ↘	5.1 ↗	3.7 ↗	3.9 →	2.6 →	3.4 →	5.0 →
(%)	**2023**	6.9 ↗	5.0 ↗	4.2 ↗	3.9 →	2.5 →	3.3 →	6.3 →
Exchange rate	**2022**	1.07 ↘	1.07 ↘		1.25 ↘	128.6 ↗	6.75 ↗	70.3 ↘
(against USD)	**2023**	1.10 ↘	1.10 ↘		1.29 ↘	124.5 ↗	6.66 ↗	78.0 ↘

Source: Consensus Forecasts, Oxford Economics
Note: The arrows indicate the direction of the revisions compared with the last GEO.

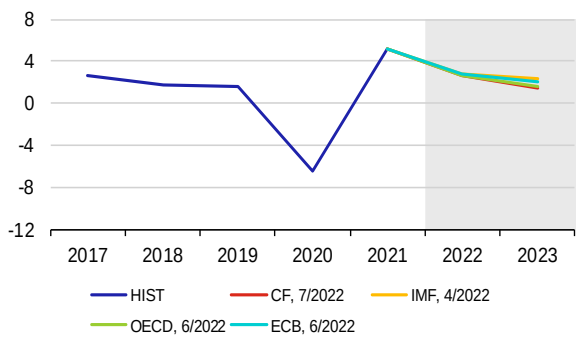
II.1 Euro area

With the threat of recession looming, the post-Covid euro area recovery is on hold. After the lifting of restrictions, the hospitality, entertainment and service sectors opened up, but the war in Ukraine, the complicated situation in supply chains and high inflation have dampened the recovery. Industry saw moderate growth in April and May, although PMI surveys clearly indicate a loss of momentum and a drop in new orders, especially from around the world. The services PMI remained in the expansion band, but a loss of momentum is evident after the total lifting of restrictions. Price pressures in services are significant, while in industry we have probably passed the peak in price rises. Inflation is also reflected in retail sales growth and poor household sentiment. Europeans are trying to enjoy the summer and travel, with cooler autumn weather just around the corner. The depletion of pandemic savings and rising energy and food bills will squeeze already tight household budgets. Firms are still benefiting from orders from previous months, but even this buffer will gradually shrink. Thus, a recession at the end of the year is already on the cards, even without disruptions of Russian gas supplies.

Inflation pressures in the euro area continue to surprise in their strength; inflation accelerated again in June to 8.6%. Strongly rising prices for energy (more than 40% y-o-y) and food (almost 9% y-o-y) in particular are feeding into inflation. Core inflation is also high, which will support the ECB's decision to raise policy rates for the first time in July. The July meeting will also be key in terms of the ECB's next steps, with details of the financial markets fragmentation tool to be published. An increase in interest rates means the risk that there will be a disproportionate rise in the yields of the southern euro area countries (fragmentation). The weakening euro is another cause for concern for ECB officials, having reached parity with the US dollar for the first time in its history in mid-July, as the ECB's steps lag behind the vigour of the Fed.

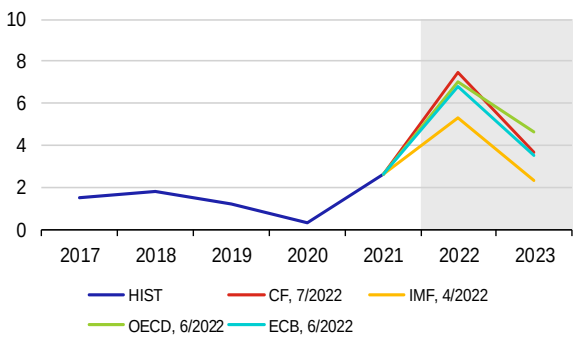
It is therefore not surprising that the new CF contained a lower GDP growth outlook for both years, while the revision for 2023 in particular was sizeable. On the contrary, the inflation outlook was revised upwards in both years.

GDP growth, %



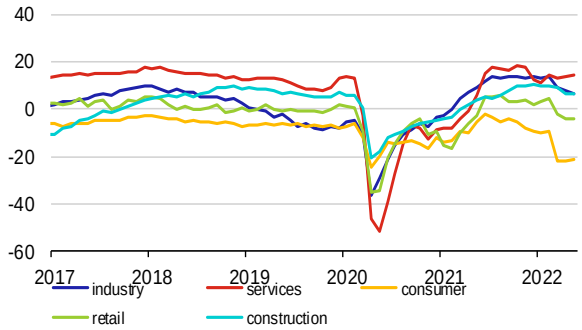
	CF	IMF	OECD	ECB
2022	2.7	2.8	2.6	2.8
2023	1.4	2.3	1.6	2.1

Inflation, %



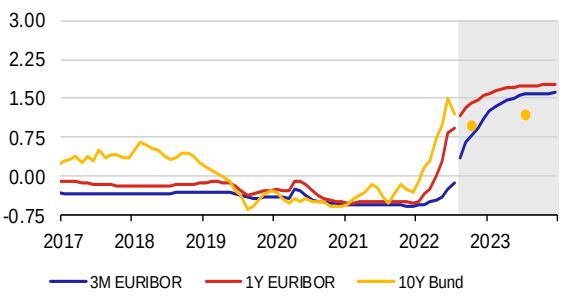
	CF	IMF	OECD	ECB
2022	7.5	5.3	7.0	6.8
2023	3.7	2.3	4.6	3.5

ESI leading indicators



	industry	services	consum.	retail	constr.
4/22	7.8	13.6	-22.1	-4.0	6.6
5/22	6.5	14.1	-21.2	-4.2	6.3
6/22	7.4	14.8	-23.6	-5.1	3.7

Interest Rates, %



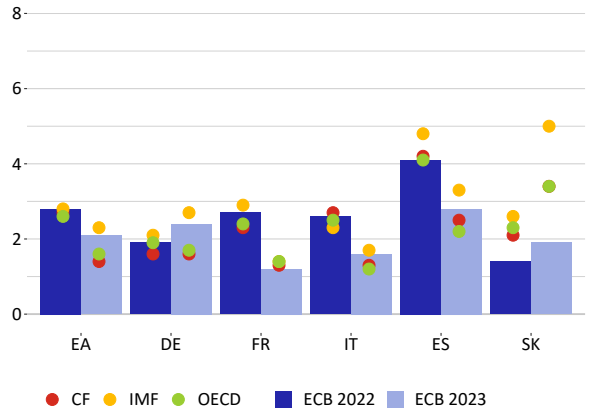
	6/22	7/22	10/22	7/23
3M EURIBOR	-0.24	-0.12	0.78	1.58
1Y EURIBOR	0.85	0.92	1.40	1.74
10Y Bund	1.50	1.20	1.00	1.20

II.2 Germany

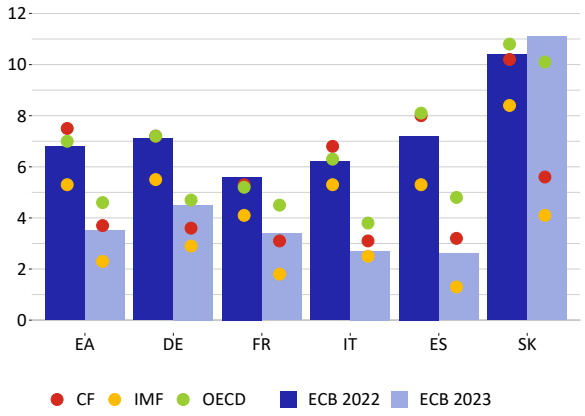
The German economy has withstood the initial impacts of the war in Ukraine, but the possibility of a halt in gas supplies poses a serious threat to its output in the coming months. Germany has benefited from the functioning of global supply chains and cheap energy for decades. After the pandemic and the Russian invasion of Ukraine, it lost many of its competitive advantages. Weaker global demand (from Asia in particular), supply chain disruptions and high prices lead to worse growth prospects. The first significant decline was for consumer sentiment. According to the PMI survey, sentiment in manufacturing is also falling due to concerns about a combination of high inflation, continued supply disruptions and shrinking orders. New orders have been falling for the third consecutive month, which, along with ongoing difficulties with supplies of inputs, has contributed to the drop in current production. Input inflation moderated to a 16-month low. Price pressures in the consumer sector also slowed. In June, inflation in Germany slowed for the first time in five months to 7.6%. In addition to the significant impact of energy, a special 9-euro public transport ticket has had a positive impact on inflation. Optimism in services is also waning, as the catch-up effect after the shutdowns has partially worn off, while economic uncertainty and prices are rising. Uncertainty regarding further gas supplies from Russia has been affecting the unfavourable situation. There are concerns that gas supplies from Russia will not be turned on again after the scheduled annual maintenance of the Nord Stream 1 gas pipeline. Germany has announced the second of three warning levels, which corresponds to a state of emergency, due to uncertainty regarding gas supplies. So far the government is calling on citizens to already start cutting down on their use of gas. This is to be supported by a new price adjustment mechanism, allowing companies to pass on costs to consumers. Its decision to rescue the Uniper energy company is more controversial.

CF analysts again lowered their economic growth outlook and revised expected inflation upwards. GDP growth will reach 1.6% this year and the next. Inflation will slow from 7.2% this year to 3.6% in 2023. According to the analysts, inflation will only start to drop this year from October, when the impact of the government measures to counter energy poverty fades.

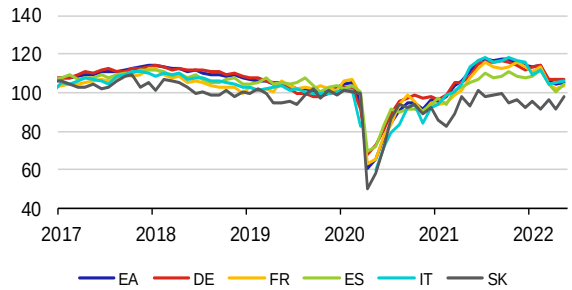
GDP growth in selected euro area countries in 2022 and 2023, %



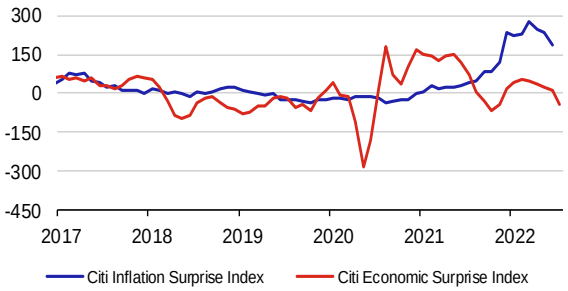
Inflation in selected euro area countries in 2022 and 2023, %



ESI leading indicators



Economic and inflation surprises in the euro area, %



	EA	DE	FR	ES	IT	SK
4/22	104.9	106.8	102.2	100.2	105.7	91.2
5/22	105.0	107.1	103.8	104.3	106.4	98.0
6/22	104.0	105.2	102.8	102.4	105.4	92.4

Inflation expectations based on 5year inflation swap and SPF

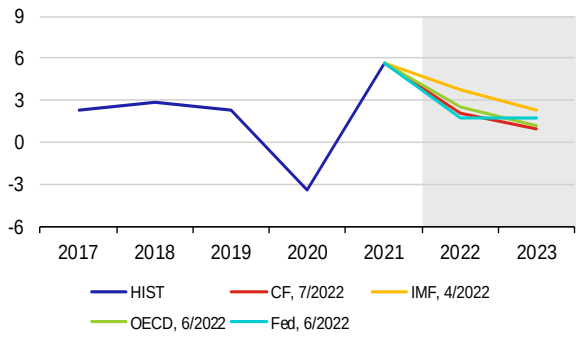
	5y5y	SPF
5/22	2.24	2.05
6/22	2.21	2.05
7/22	2.04	

II.3 United States

In June, inflation surged to a new high, and it may be difficult to avoid a potential recession next year. In its new outlook CF has again revised GDP growth significantly downwards, expecting growth of 2.1% in 2022 and only 1% in 2023. The CF outlook, especially for next year, is thus becoming somewhat pessimistic when compared to the IMF, OECD and Fed forecasts. CF's new outlooks for higher inflation, which is expected to hit 8% this year and almost 4% in 2023, are also less than encouraging – a forecast relatively far from the Fed's expectations. Consumer price inflation accelerated to 9.1% year on year in June, as against 8.6% in May, and is thus at its highest level since the end of 1981, i.e. at a 40-year high. This was mostly due to the surging prices of energy (41.6%), food (10.4%), housing (5.6%) and cars (11.4%). However, core inflation – which does not include food and energy – slowed for the third consecutive month (to 5.9%), despite prices having risen across the board. Consumer confidence is still at a record low, and a deterioration can also be observed in business. The composite PMI fell to 52.3 in June from 53.6 in May. However, it still remains within the expansion band. The decline was recorded both in manufacturing and in services sectors. The June numbers confirmed that the US labour market remains tight, with the unemployment rate at 3.6%, the same as in the previous three months.

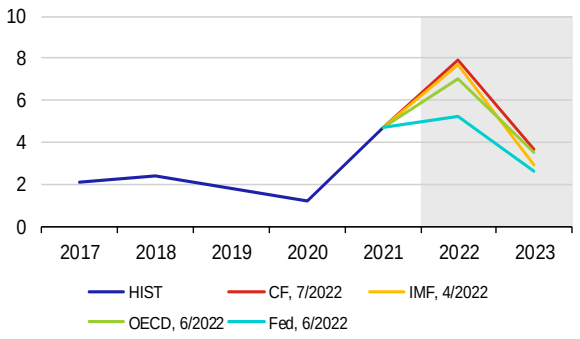
Under pressure from rising inflation, the Fed is determined to raise interest rates further at its July meeting. There is apparent support for a further increase in rates among top Fed officials, with rates expected to rise to almost 4% by December from the current range of 1.50%–1.75%. Market expectations after the publication of June's high inflation indicate an increase in rates of 1 pp. According to Fed Chair Jerome Powell, the US economy is sufficiently resilient to withstand tougher monetary policy, but he does not rule out a recession. He is thus clearly signalling support for a much greater tightening of monetary policy this year.

GDP growth, %



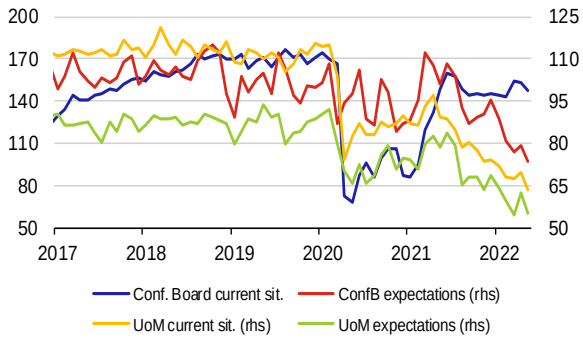
	CF	IMF	OECD	Fed
2022	2.1	3.7	2.5	1.7
2023	1.0	2.3	1.2	1.7

Inflation, %



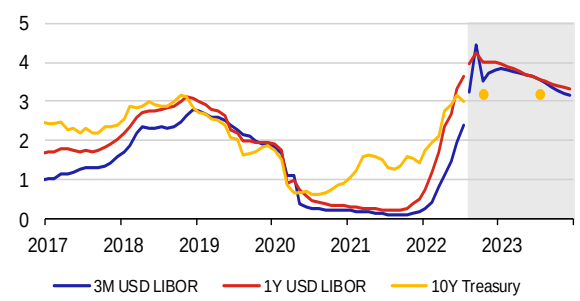
	CF	IMF	OECD	Fed
2022	7.9	7.7	7.0	5.2
2023	3.7	2.9	3.5	2.6

Leading indicators



	ConfB curr.	ConfB exp.	UoM curr.	UoM exp.
4/22	152.9	79.0	69.4	62.5
5/22	147.4	73.7	63.3	55.2
6/22	147.1	66.4	53.8	47.5

Interest Rates, %



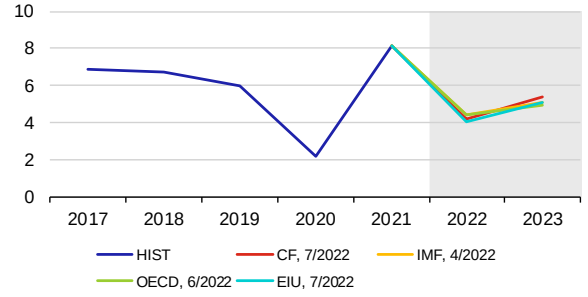
	6/22	7/22	10/22	7/23
USD LIBOR 3M	1.97	2.40	3.54	3.56
USD LIBOR 1R	3.32	3.32	4.01	3.56
Treasury 10R	3.15	2.99	3.20	3.20

II.4 China

Annual growth of the Chinese economy slowed significantly from 4.8% in 2022 Q1 to only 0.4% in Q2, thus hitting its lowest level since the outbreak of the pandemic and the drop in GDP in early 2020. This mainly reflects the negative effects of strict quarantine measures in response to the rapid spread of the virus, especially during April and May, when China faced its largest wave to date. As part of its zero-Covid policy, there were also shutdowns in the country's largest cities (e.g. Shanghai, Beijing and Shenzhen), with only some large firms in operation. The associated growing tensions in value chains were also reflected in a downturn in industrial production. However, following the easing of anti-epidemic measures in June, certain forms of checks and restrictions are currently being reintroduced in response to the resurge in Covid-19 cases in some regions of China, which account for about one-quarter of GDP. In addition to the persistent risk to the growth of economic activity in the second half of this year in the form of a further deterioration of the epidemic situation and weaker domestic demand, external risks are also starting to come to the fore, namely global stagflation and a tightening of monetary policy around the world. CF analysts expect year-on-year growth of the Chinese economy at 4.2% this year. However, this would mean that the Chinese government target of around 5.5% GDP growth for 2022 will not be met, despite the announced huge monetary and fiscal expansion. According to the CF analysts, China is not expected to broadly reach its target for GDP growth until 2023.

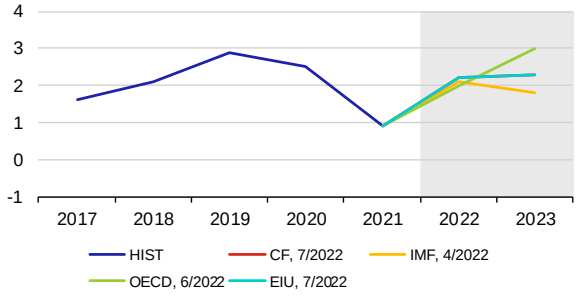
Consumer price inflation reached 2.5% in June, its highest level in two years. This was largely due to a surge in pork and energy prices. According to the CF analysts, inflation is expected to be slightly above 2% in 2022 and 2023, i.e. well below inflation in the USA and Europe. On the one hand, this is creating room for further monetary policy easing by the Chinese central bank, which also committed in July to maintain reasonably high liquidity and further reduce funding costs. On the other hand, however, this space is limited by the rapid monetary policy tightening, especially by the Fed, which is already reflected in the depreciation of the renminbi against the dollar.

GDP growth, %



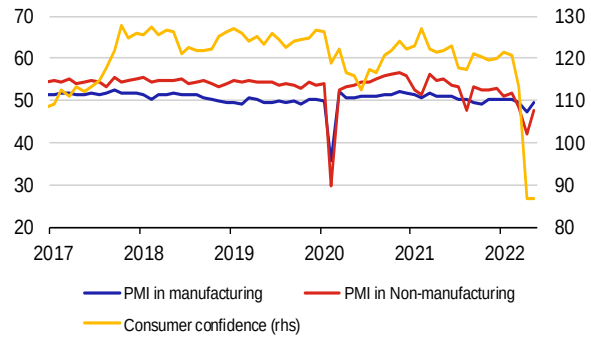
	CF		IMF	OECD	OE	
2022	4.2	↘	4.4	4.4	4.0	→
2023	5.4	↗	5.1	4.9	5.1	↘

Inflation, %



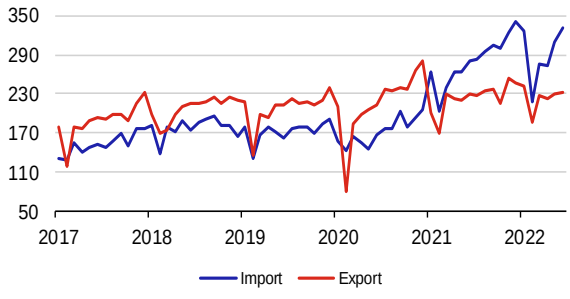
	CF		IMF	OECD	OE	
2022	2.2	↘	2.1	2.0	2.2	↘
2023	2.3	→	1.8	3.0	2.3	↘

Leading indicators



	PMI manuf.	PMI Non-manufacturing	Cons. conf (rhs)
4/22	47.4	41.9	86.7
5/22	49.6	47.8	86.8
6/22	50.2	54.7	

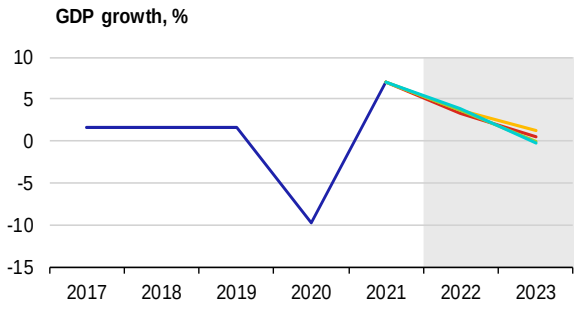
Development of China foreign trade, bil. USD



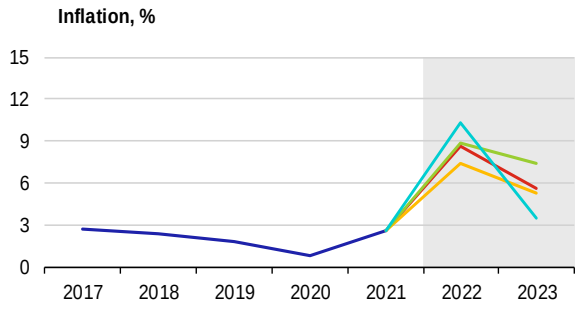
Source: Bloomberg

II.5 United Kingdom

In the end, Boris Johnson did not retain his position and resigned as leader of the ruling Conservative Party. A series of scandals and a wave of government resignations led to his stepping down. He plans to remain as prime minister until a successor is elected. In addition, the UK continues to grapple with rising inflation, which reached 9.1% in May as against 9% in April, when a surge in food prices accounted for the biggest share in its increase. More than half of the items in the UK consumer basket have gone up by more than 7% in the past year. In addition, BoE Governor Andrew Bailey has warned that the UK will suffer from high inflation for longer than other countries, with inflation set to exceed 11% in the autumn according to BoE forecast. Further rate increases may be needed to return inflation to the 2% target. However, according to a survey of company executives, inflation is expected to peak only in the spring of next year. CF lowered the GDP growth outlook again, even to 0.5% in 2023. The composite PMI increased slightly to 53.7 (as against 53.1 in May). The services sector in particular proved more resilient, with its growth offsetting the decline in manufacturing sector.



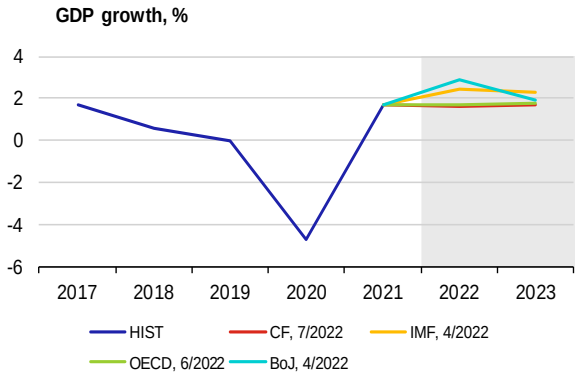
	CF	IMF	OECD	BoE
2022	3.3	3.7	3.6	3.8
2023	0.5	1.2	0.0	-0.3



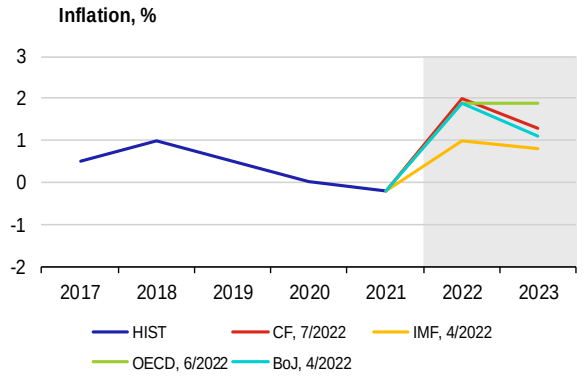
	CF	IMF	OECD	BoE
2022	8.6	7.4	8.8	10.3
2023	5.6	5.3	7.4	3.5

II.6 Japan

The political significance of the price increases is growing despite the continued low inflation rate in official statistics. Consumer price inflation of 2.1% (y-o-y) in May was low compared with other advanced economies. In Japan, however, food prices are not included in the main price index, which is also targeted by the BoJ. At the same time, growth in food prices is accelerating and has already exceeded 10% for some subgroups. This is due to both the increase in agricultural commodity prices on world markets and the sharply weakening yen, which makes food imports more expensive. The rise in food and energy prices mainly affects low-income households. This is gaining political importance in a country with long-term stagnating wages. Household inflation expectations are also rising much faster than official inflation, contributing to further declines in consumer sentiment. Business sentiment also worsened again in Q2, according to the regular Tankan survey.



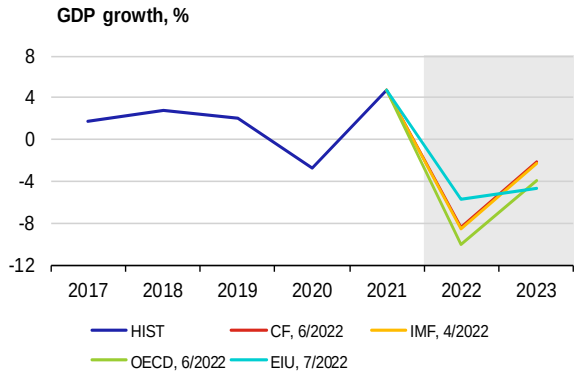
	CF	IMF	OECD	BoJ
2022	1.6	2.4	1.7	2.9
2023	1.7	2.3	1.8	1.9



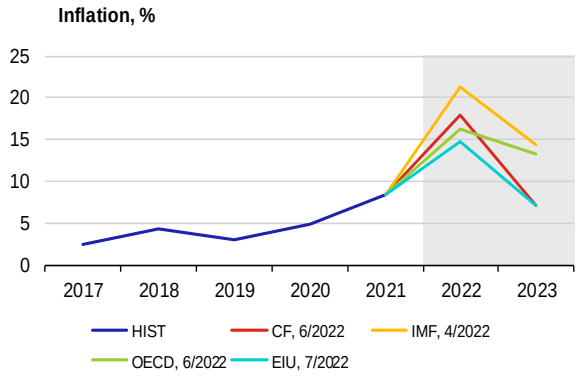
	CF	IMF	OECD	BoJ
2022	2.0	1.0	1.9	1.9
2023	1.3	0.8	1.9	1.1

II.7 Russia

The leading indicators so far indicate a slight improvement in June after the previous drop. After three months of decline, the June composite PMI returned to the economic expansion band due to new orders and a resumption of private sector output growth. Regular monitoring of the economic situation by the Russian central bank indicates a halt in the drop in economic activity in May and June, while the bank assumes that the economic downturn will be more moderate, but longer-lasting. The Q2 trade balance only slightly exceeded the value in the previous quarter (estimated at USD 80.7 billion versus USD 77.7 billion in 2022 Q1). The value of net exports in roubles fell significantly due to the controlled appreciation of the exchange rate. The rouble goods and services surplus has more than doubled y o y due to the sharp rise in natural gas and oil prices in recent months, and a drop in imports. Inflation slowed to 15.9% y o y in June due to exchange rate movements and a fall in fruit and vegetable prices. The central bank envisages a return to the 4% inflation target in 2024.



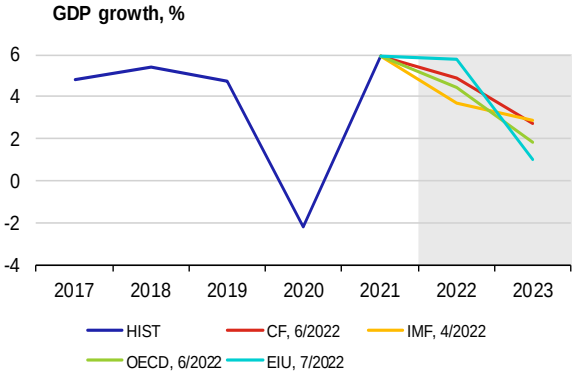
	CF	IMF	OECD	OE
2022	-8.4	-8.5	-10.0	-5.7
2023	-2.2	-2.3	-4.0	-4.6



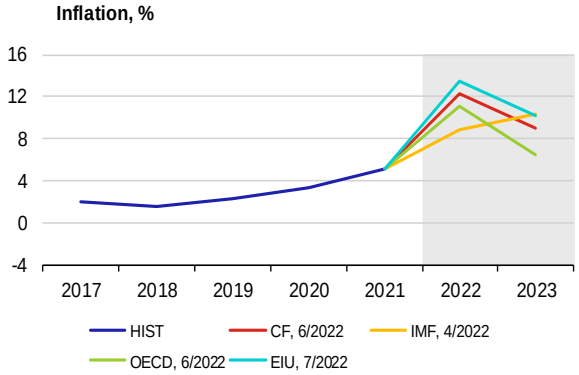
	CF	IMF	OECD	OE
2022	17.9	21.3	16.2	14.7
2023	7.1	14.3	13.2	7.1

II.8 Poland

Polish inflation continues to break historical records. In June, annual consumer price inflation reached its highest level in 25 years (up from 13.9% in May to 15.5% in June), due to a surge in global commodity prices caused largely by the war in Ukraine. At its meeting on 7 July, the Monetary Policy Council of the Polish central bank decided to raise interest rates again (from 6% to 6.5%). The labour market recorded a further drop in unemployment from 5.2% in April to 5.1% in May. Industrial production has seen double-digit growth rates since November 2021 (15% year on year in May). Although annual wage growth in the corporate sector slowed slightly to 13.5% in May as against 14.1% in April, it has also remained in double digits for a long time. On the other hand, consumer confidence in the Polish economy remains at historical lows, even exceeding the scepticism seen in April 2020. The business confidence survey is also extremely pessimistic.



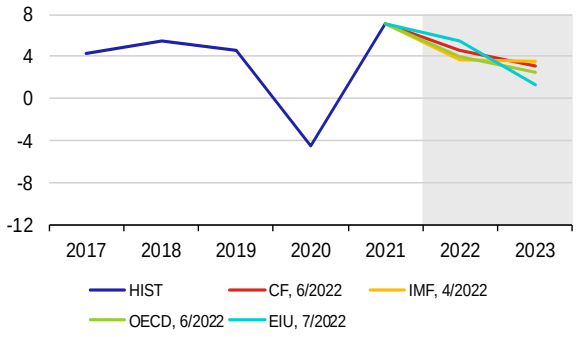
	CF	IMF	OECD	OE
2022	4.9	3.7	4.4	5.8
2023	2.7	2.9	1.8	1.0



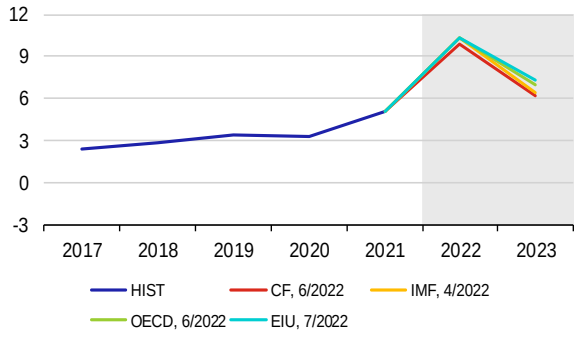
	CF	IMF	OECD	OE
2022	12.3	8.9	11.1	13.5
2023	9.0	10.3	6.5	10.2

II.9 Hungary

At its meetings on 28 June and 12 July, the Monetary Council of the Hungarian central bank (MNB) decided to raise the policy rate to a record high (initially by 1.85 pp, then by 2 pp) from 5.9% to its current level of 9.75%. The MNB is thus trying to limit rising inflation pressures and support the forint, which has weakened by more than 20% to the dollar since the start of 2022. Annual consumer price inflation accelerated from 10.7% in May to 11.7% in June, with core inflation up to 13.8%. Retail sales are growing at record rates (15.7% in April, 11.1% in May). The Hungarian labour market reported a further fall in unemployment in May (from 3.5% in April to 3.4%). Wages have been growing in double digits since the start of 2022 (15.1% y-o-y in April). Annual industrial production growth rose markedly to 9.4% in May (from 3.1% in April). According to GKI Economic Research, business confidence in the Hungarian economy fell to 3.7 in June from 6.9 in May.



	CF	IMF	OECD	OE
2022	4.5	3.7	4.0	5.4
2023	3.1	3.6	2.5	1.3



	CF	IMF	OECD	OE
2022	9.9	10.3	10.3	10.3
2023	6.2	6.4	7.0	7.3

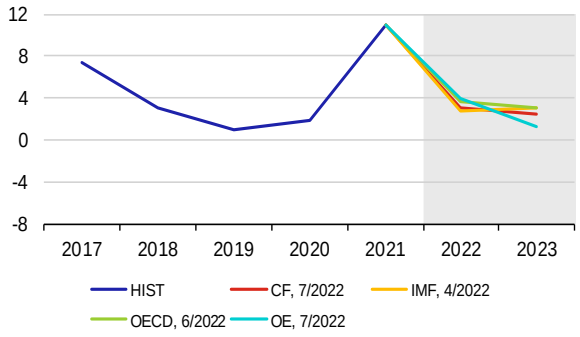
II.10 Countries in the spotlight – Turkey

GDP growth has moderated following a strong economic recovery in 2021 (growth of 11%). Annual GDP growth slowed in 2022 Q1 (from 9.1% to 7.3%), but remains relatively strong due in part to exports. The IMF forecasts GDP growth of 2.7% for 2022 (similar to CF), with the OECD expecting growth 1 pp higher. Both household consumption and investment have been negatively impacted due to geopolitical risks and galloping inflation. Annual inflation officially surged to 78.6% in June (its highest level since 1998), compared to 73.5% in the previous month, and has been well above the 5% target of the Central Bank of Turkey (CBRT) for the past several years. Transport and food prices have risen sharply, and according to the OECD and OE, inflation is expected to remain above 70% this year. Fiscal policy should provide some support to consumers.

The CBRT has kept the key repo rate unchanged since December 2021 (14%) despite increasing inflation. President Erdogan's opposition to raising rates is key factor to understanding Turkey's monetary policy settings. This has already led him to dismiss several governors. Less than a year before the presidential elections, the government is also pushing to underestimate real consumer price inflation, which the independent research group ENAG has estimated at more than double the official rate. Thus, the credibility and independence of the central bank is again declining, with the risk of another Turkish lira crisis increasing. The lira is one of the worst-performing emerging market currencies.

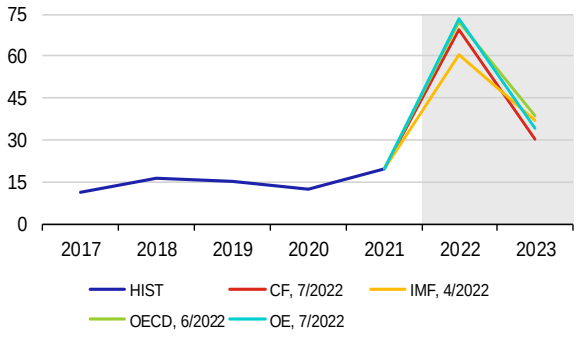
The WHO has praised Turkey for its successful Covid-19 pandemic response. There was increased concern in February due to a rapid rise in case numbers, but the virus then started to wane and Turkey gradually began lifting almost all its anti-pandemic measures. At present, the only remaining measure is the obligation to wear a face mask in hospitals. Turkey has recorded more than 15 million cases since the start of the pandemic in March 2020, with recovery has come due to vaccination and the Omicron variant. In recent weeks, the number of cases has started to rise again, but not at an alarming rate so far.

GDP growth, %



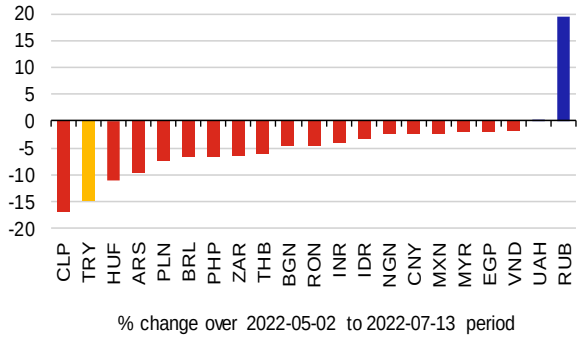
	CF	IMF	OECD	OE
2022	3.0	2.7	3.7	4.0
2023	2.4	3.0	3.0	1.3

Inflation, %



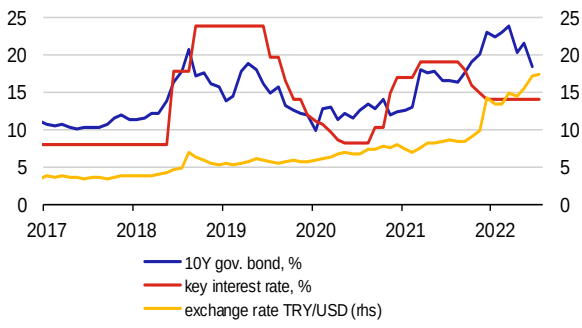
	CF	IMF	OECD	OE
2022	69.2	60.5	72.0	73.4
2023	30.4	37.2	38.9	34.2

Currency performance vis-à-vis USD



% change over 2022-05-02 to 2022-07-13 period

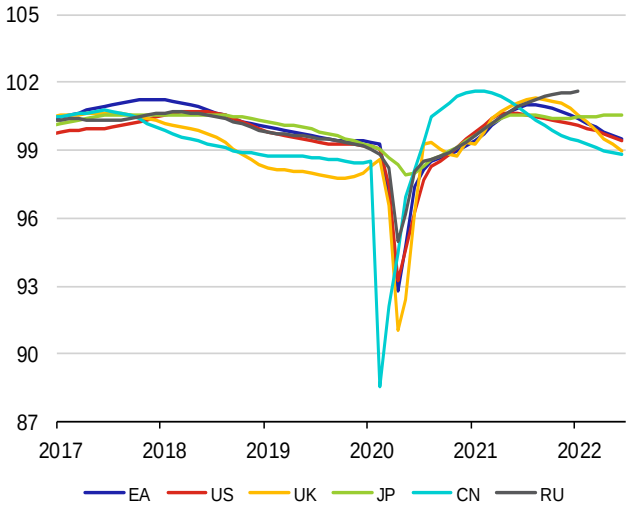
Selected indicators



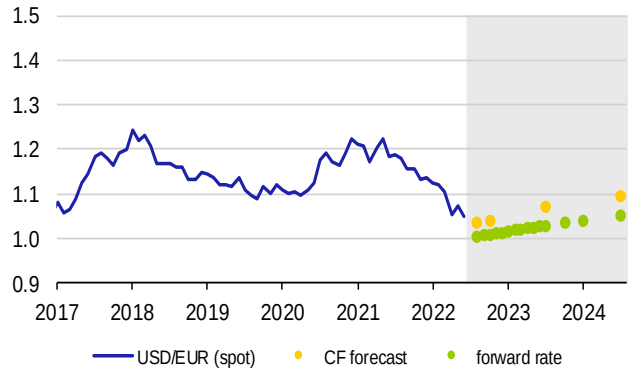
	10Y gov. bond, %	interest rate, %	TRY/USD
4/2022	20.27	14.00	14.57
5/2022	21.56	14.00	15.45
6/2022	18.54	14.00	17.25

III. Leading indicators and outlook of exchange rates

OECD Composite Leading Indicator

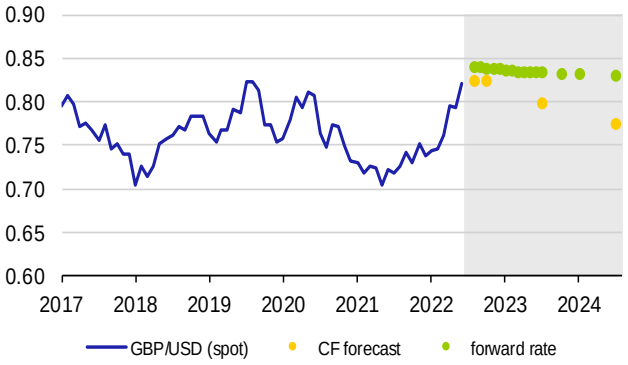


The US dollar (USD/EUR)



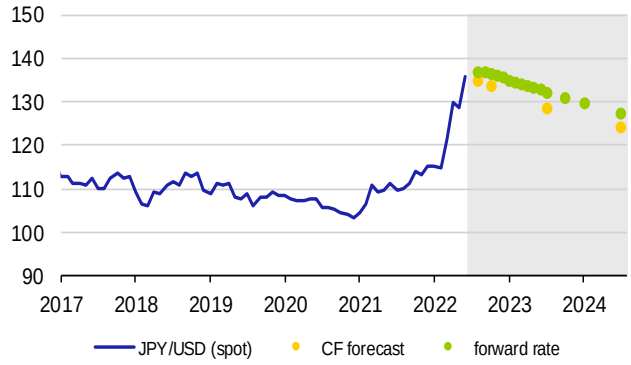
	11/7/22	8/22	10/22	7/23	7/24
spot rate	1.008				
CF forecast		1.039	1.040	1.072	1.098
forward rate		1.006	1.011	1.032	1.053

The British pound (GBP/USD)



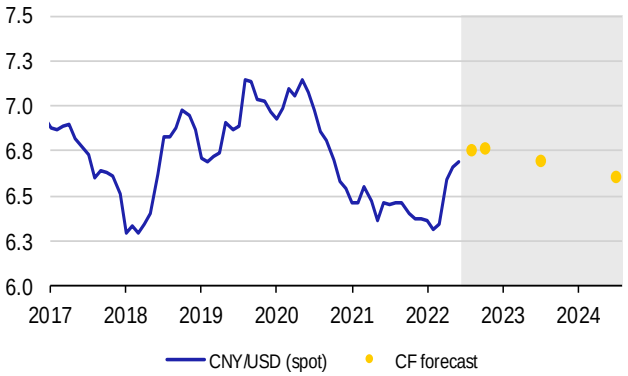
	11/7/22	8/22	10/22	7/23	7/24
spot rate	0.841				
CF forecast		0.826	0.826	0.800	0.775
forward rate		0.840	0.839	0.834	0.831

The Japanese yen (JPY/USD)



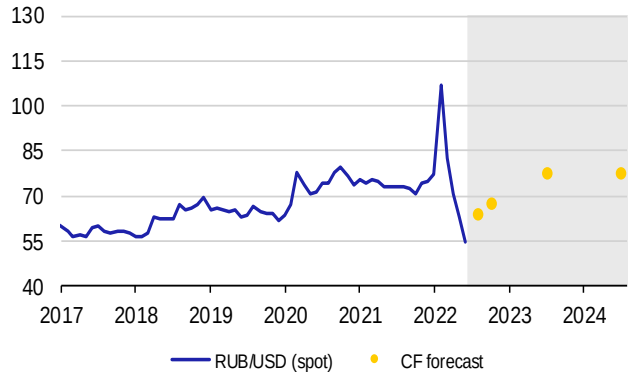
	11/7/22	8/22	10/22	7/23	7/24
spot rate	137.4				
CF forecast		134.8	133.8	128.6	124.5
forward rate		137.2	136.5	132.4	127.7

The Chinese renminbi (CNY/USD)



	11/7/22	8/22	10/22	7/23	7/24
spot rate	6.708				
CF forecast		6.755	6.769	6.704	6.607

The Russian rouble (RUB/USD)



	11/7/22	8/22	10/22	7/23	7/24
spot rate	62.70				
CF forecast		64.23	68.05	78.00	77.92

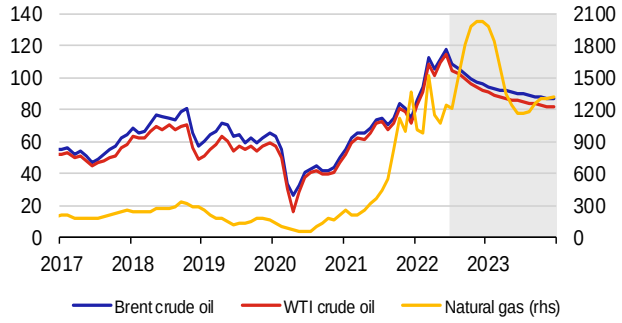
Note: Exchange rates as of last day of month. Forward rate does not represent outlook; it is based on covered interest parity, i.e. currency of country with higher interest rate is depreciating. Forward rate represents current (as of cut-off date) possibility of hedging future exchange rate.

IV.1 Oil

The oil price continued to grow strongly until mid-June, but after that fears of a slowdown in global economic growth began to prevail, especially in the derivatives market. Oil prices were supported by strong demand from refineries (which further increased margins) and production outages in Libya and Ecuador. Concerns about planned strikes by Norwegian oil workers, diminishing oil stocks in the USA (despite the large-scale release of about one million barrels a day from strategic reserves), the demand growth outlook in China due to the easing of anti-epidemic measures and the planned ban on imports of Russian oil and oil products into the EU also had the same effect. Demand for fuels then rose at the start of the motoring season in the northern hemisphere. In the second half of June, however, the price of oil started to drop due to concerns of a slowdown in the global economy as a result of a rapid increase in interest rates by some major central banks, including the Fed. Hedge funds started to reduce their net long positions in oil (by 11% or the equivalent of about 53 million barrels in June) due to growing uncertainty. The rapid appreciation of the US dollar (the dollar index reached its highest value since 2002) and, last but not least, weak data on the growth of the Chinese economy also contributed to a reduction in the oil price. However, demand in the physical oil market remains strong. This has led to a further increase in the negative slope of the futures price curve, especially at its short end.

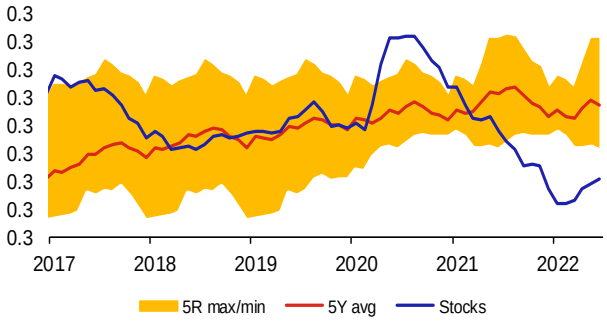
The market curve from mid-July has shifted significantly downwards compared to the previous month. It continues to signal a strong drop in prices to USD 96/bbl at the close of 2022 and USD 87/bbl at the end of 2023. The EIA expects a strong drop in the price of Brent for the rest of 2022 to USD 95/bbl in December. Prices are expected to decrease only gradually in 2023, to USD 93/bbl at the end of the year. The July CF forecast is the highest (Brent price of USD 97/bbl one year ahead).

Outlook for prices of oil (USD/barrel) and natural gas (USD / 1000 m³)

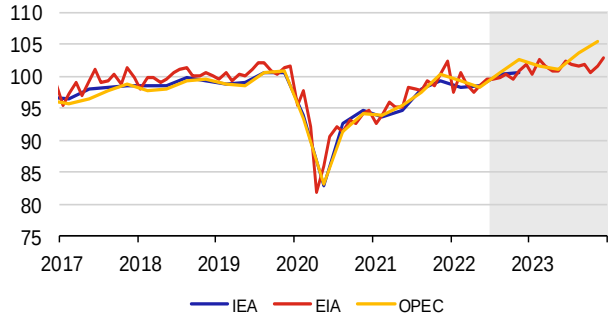


	Brent	WTI	Natural gas
2022	103.05	99.69	1467.82
2023	90.32	85.66	1393.95

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

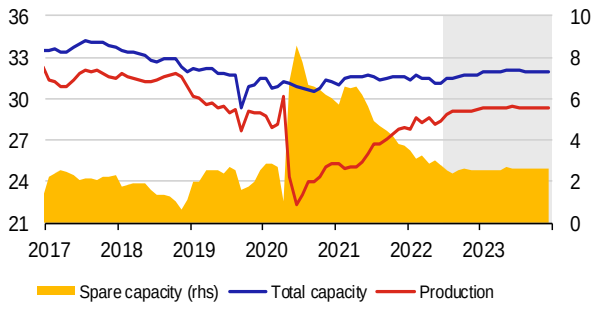


Global consumption of oil and oil products (mil. barrel / day)



	IEA	EIA	OPEC
2022	99.45	99.59	100.27
2023		101.59	102.97

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



	Production	Total capacity	Spare capacity
2022	28.68	31.48	2.80
2023	29.35	31.95	2.61

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.

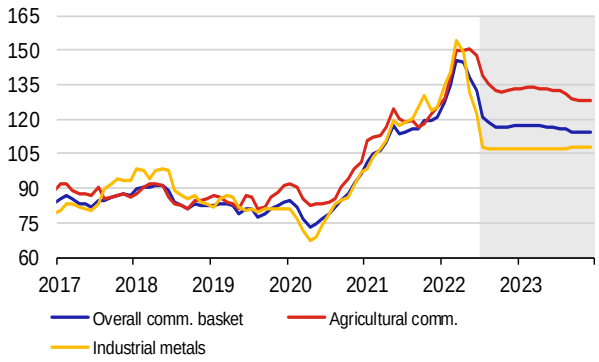
IV.2 Other commodities

After a two-month decline, the average monthly price of natural gas in Europe rose again in June and continued to show strong growth at the start of July. The spot price at the Dutch trading hub (TTF) rose by more than 100% in the second half of June and in early July and has been fluctuating in the range of EUR 175–185/MWh ever since. This was in response to the fall in LNG exports from the USA and limited pipeline gas supplies from Russia, including concerns about their future development. According to market contracts, gas prices are expected to rise much further this winter, returning to around their current levels in the course of next year. A more significant drop in natural gas prices is not expected until 2024. A similar development can also be expected for electricity prices. As the price of natural gas goes up, growth in coal prices has also surged again. Demand for coal is increasing, especially in Europe. Some of the coal-fired power stations, which have already been closed down, are expected to renew operation. At the same time, a ban on Russian coal imports has been approved. However, this is offset around the world by higher exports of cheaper Russian coal to China and India, so the shortage of coal on the global market is not as pronounced as for gas. Therefore, the growth in coal prices is weaker.

The average monthly industrial metal price index fell in June for the third consecutive month, and prices continued to fall sharply across the index in the first half of July, due to rising supply from China and weaker global demand from manufacturing owing to high energy costs, despite a strong drop in metal inventories. The iron ore price fell markedly again.

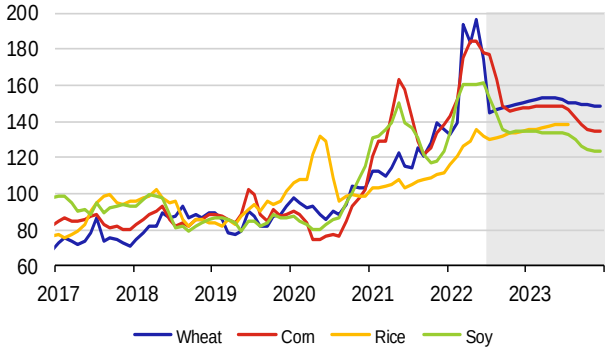
In June, the food commodity price index also dropped slightly from its all-time high, and its decline strengthened significantly in the first half of July. This is due to an improved outlook for the harvest in North and South America and an easing of protectionist measures in India and Indonesia. However, the geopolitical situation in Ukraine continues to pose an upward risk for food prices, despite the current agreement which should allow the export of Ukrainian wheat.

Non-energy commodities price indicies



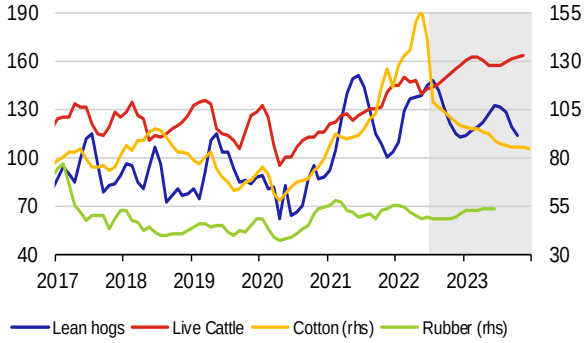
	Overall	Agricultural	Industrial
2022	127.5	139.1	123.0
2023	115.9	131.3	107.3

Food commodities



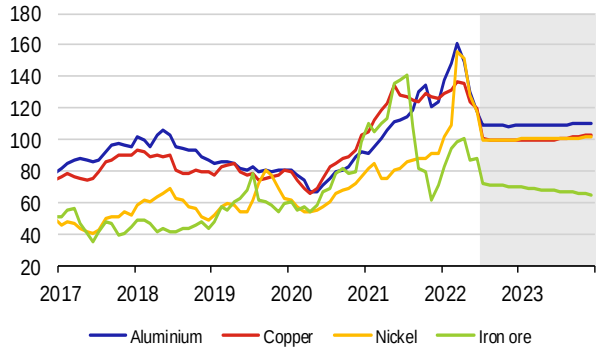
	Wheat	Corn	Rice	Soy
2022	158.9	162.0	129.7	146.9
2023	150.9	143.5	137.0	130.3

Meat, non-food agricultural commodities



	Lean hogs	Live Cattle	Cotton	Rubber
2022	130.2	147.8	121.3	50.1
2023	122.1	160.0	89.4	52.8

Basic metals and iron ore



	Aluminium	Copper	Nickel	Iron ore
2022	124.9	114.9	113.8	82.0
2023	109.7	101.1	101.1	67.9

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.

Current trends in macroeconomic modelling in central banks in light of the turbulent nature of recent events[1]

Forecasters worldwide are often criticised for failing to forecast certain events. They also face criticism that their forecasts do not materialise. It is human nature to perceive negative events much more strongly than positive ones. To put this into context: we only notice peace when there is a war; we perceive health only after we become ill; we are quick to forget our successes, while analysing and dwelling on our failures. In this way, the human brain tries to learn from negative events to avoid them in the future, or at least to be prepared for them. This also applies to the way in which we perceive the non-fulfilment of forecasts, be it weather forecasts or economic forecasts. The diversity of the real world also brings with it events which are unpredictable in nature and scope, and it is not possible for us to fully prepare for their effects in advance. All we can do is adapt to them gradually. In forecasting language, the level of "off-the mark" forecasts we are all very much observing, is on the rise. On the other hand, there are certain economic principles we can rely on. For instance, if the labour market is overheated, we can expect its impacts on the economy to last for some time. In this article, we will show the areas and contexts in which the current development of macroeconomic models – whose purpose it is to capture events for which there are strong economic regularities – is taking place. We will also show that central banks have the tools to deal with unpredictable events. However, some degree of inaccuracy is unavoidable, and this must be reduced with each subsequent forecast, as incoming data about the event becomes available.

Motivation

This article aims to map the current trends in macroeconomic modelling in central banks. This knowledge is also important for developing the Czech National Bank's modelling system. Revisions of monetary policy strategies, tools and communication are the usual tasks of central banks, with the ECB and the Fed being the main examples. Overall, the main current trend in macroeconomic modelling in central banks is to enhance model structures by introducing higher levels of heterogeneity, non-linearities and the distinctive characteristics of the energy sector to capture the impacts of climate change, i.e. generally deepening the micro-foundations of models. This reflects supranational discussions about the challenges facing modern-day economies, even though they do not fall traditionally within central banks' expertise. Another important trend is the extension of the modelling system with an emphasis on the complementarity of models. An example of this would be the introduction of the ECB-BASE semi-structural model into standard forecasting practice at the ECB.

The key areas of the new strategy for developing models at the ECB are summed up in detail in Paries et al. (2021), which may be used as an inspiration for other central banks. The authors identified the following key areas for improving the main projection models at the ECB: expectations formation and their empirical validation; analysing the transmission channels of non-standard monetary policy measures, accounting for exogenous long-term trends in growth, adapting the economic impacts of climate change to the frequency of the business cycle, and treating large shocks and non-linearities in model estimates. The specific areas for the further development of the main structural models include: complementarity across monetary policy instruments, the micro-foundations of side effects of non-standard measures and the empirical validation of their transmission channels, the use of advanced computational methods to account for non-linearities and multiple equilibria, and the incorporation of a relevant role for long-term trends. The development of new models will focus on: the inclusion of household heterogeneity and its implications for monetary policy transmission, the consideration of relevant dimensions of non-linearities in the transmission of monetary policy, and specifying climate change-related externalities and the role of climate change mitigation policies in the global setting.

The Fed is also working on revising its tools; the subject of discussion is mainly the conditions and tools to fulfil the dual mandate. Altig et al. (2020) outlined the important elements of the Fed's future direction in their paper. The first is a discussion regarding the decline in the neutral real rate of interest and uncertainty about its future level and path. Its persistent reduction implies less "policy cushion" – less leeway to lower the federal funds rate in the event of a decline in the neutral real interest rate – and thus a greater likelihood of hitting the effective lower bound. The second element is the persistent shortfall of inflation relative to target, which has arguably led to some slippage of long-term expectations below the inflation target.[2] The third element analyses estimates of the long-term natural unemployment rate in connection with the pandemic crisis. The relatively large changes in its estimates, coupled with the intrinsic uncertainty of such estimates, makes its use as a guide to policy even more fraught than it has been historically. The fourth element is a discussion about a weaker relationship between the output gap and inflation, i.e. "a flatter Philips curve". Many models interpret the reduced sensitivity as, at least in part, a structural feature of the economy – that is, the true coefficient linking inflation to the real economic activity gap in the structural models of the economy is lower – though it is possible that this reduced sensitivity is instead due to the success of the Fed in reducing inflation and anchoring inflation expectations. It is important that a flatter Phillips curve may make it more difficult to move inflation towards its target, be it from above or below.

---

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

[2] Let us add that this finding is likely to be specific to the period before the surge in inflation in 2022.

Macroeconomic models of large economies and international institutions and their development

The European Central Bank uses two main forecasting models: the structural NAWM II and the semi-structural ECB-BASE or ECB-MC[3]. The NAWN II model was created in 2018 as an extended version of the previous micro-founded NAWM model, which incorporates the financial sector (see Coenen et al. (2019)). Above all, the role of financial frictions in the propagation of economic shocks was taken into account, the role of bank lending rates was captured, the transmission of monetary policy into the euro area economy was revised, and the macroeconomic impact of the ECB's asset purchases was captured. This model is currently being updated. The ECB-BASE semi-structural model and its extension (ECB-MCE) are completely new, see Angelini et al. (2019). The semi-structural model has been included in order to best capture the economic links between the individual euro area countries.

Box 1 – Possible methods of assessing model changes

The following methods for assessing model changes are preferred in the current literature. The impulse response analysis is the most widely used analytical approach to model changes. Unfortunately, central banks and international institutions confine themselves only to this type of analysis, without using more advanced sets of tools. One of the reliable ways of examining the properties of a new model is the decomposition of time series into contributions of shocks (see e.g. Brázdik et al. (2020)). This tool gives a clear and comprehensive insight into the model interpretation of historical developments. Since many institutions also use models as forecasting tools, it is also suitable to use a historical simulation tool (see e.g. Corrigan et al. (2021)). This enables a quantitative assessment of a change in models' predictive properties by calculating the Root Mean Square Forecast Error (RMSFE). Another option is to compare the published forecast and the actual outcome. However, this comparison is partly misleading because it compares the predictive properties of various models using various samples. Therefore, if a model has "forecasted" in a more turbulent period of time, its predictive accuracy can be expected to be worse even if its predictive properties have improved.

The European Commission is developing the QUEST and GM structural models. A third version of the QUEST model (QUEST III) was launched in 2008, see Ratto et al. (2008). It was expanded to better capture the interactions between fiscal and monetary policy and to be able to address a wider range of economic and financial issues. Various model versions of QUEST III were later developed, each with a specific focus and regional and sectoral breakdowns. QUEST III is fully estimated using euro area and US data while applying Bayesian techniques. The GM model was created in 2014 as a complement to QUEST to support analyses in macroeconomic supervision, monitoring and forecasting, see Croitorov et al. (2017).

The core models of the Federal Reserve System include the structural EDO and the semi-structural FR/BUS. Unlike other dynamic stochastic general equilibrium (DSGE) models, the EDO model, see Chung et al. (2010), contains a more detailed breakdown of US domestic expenditure, especially expenditure on housing and consumer durables. Another prominent feature is the introduction of two final good sectors, for fast- and slow-growing industrial sectors. EDO has recently been expanded to include unemployment following the example of Gali, Smets and Wouters (NBER, 2011). The semi-structural FR/BUS model, see Flint et al. (2014), is designed for a detailed analysis of monetary and fiscal policy. Compared to DSGE models, it is characterised by its ability to switch between alternative assumptions about the creation of economic agents' expectations. Another characteristic is the level of detail of the model: FR/BUS contains all the main components of the product and income sides of US national accounts. The model has been continuously adjusted to cope with the evolving structure of the economy, including conceptual revisions to the sectoral definitions of the national accounts.

The core model of the International Monetary Fund is the semi-structural GMP, which is used to make projections for the World Economic Outlook (WEO). This model has been expanded gradually to reliably capture interactions between the important areas of the global economy, see Carabenciov et al. (2013). In addition to GPM, two key DSGE models were developed: the Global Economic Model (GEM), see Laxton and Pesenti (2003) and Pesenti (2008), and the Global Integrate Monetary and Fiscal Model (GIMF), described in Kumhof et al. (2010). Another important part of the IMF's modelling system is a set of macroeconomic models called the Flexible System of Global Models (FSGM; see Andrle et al., 2015), which is based on a modular approach and is semi-structural.

The Bank of England uses the COMPASS structural model for forecasting and macroeconomic analysis. The model has been in operation since 2013 and its further development consists in the development of infrastructure and supplementary models aimed at addressing misspecifications of the COMPASS model, and at providing cross-checks on the forecast, see Burgess et al. (2013).

[3] A theoretically consistent model (derived from microeconomic foundations), e.g. a dynamic stochastic general equilibrium (DSGE) model, is generally considered a structural model. Models largely containing relationships which are not consistently derived from economic theory but from the empirical properties of the data (e.g. error correction models), are considered semi-structural models. Note, however, that there is no precise dividing line, i.e. DSGE models can also contain ad hoc equations, while semi-structural models can include models derived from microeconomic foundations.

The Bank of Canada's (BoC) models consist of a structural ToTEM model and a semi-structural LENS model. The ToTEM core model is specific in that it captures the property market and household debt in more detail. The latest version called ToTEM III, see Corrigan et al. (2021), develops this area further in an analysis of how higher household debt affects the sensitivity of consumption to interest rates and in an assessment of the impacts of regulating the loan-to-value ratio. Compared to ToTEM, LENS (see Gervais et al. (2014)) is more driven by the empirical properties of the data than economic theory and generally provides better forecast performance. In addition, LENS is more disaggregated, thereby allowing the analysis of a broader set of issues related to the economic outlook, which makes it a useful complement to ToTEM.

The Reserve Bank of Australia's models also consist of a structural DSGE model and a semi-structural MARTIN model. The semi-structural MARTIN model has been used since 2017 to create scenarios and macroeconomic analysis, see Cusbert and Kendall (2018).

Macroeconomic models of small open economies and their evolution

Central banks of small open economies usually have only one core model (structural or semi-structural), which they tend to adjust to developments in macroeconomic modelling.[4] The Czech National Bank's structural DSGE model (g3) captures the main characteristics of the Czech economy through variables such as prices, wages and GDP components in nominal and real terms. Given the high level of openness of the Czech economy, emphasis is placed on foreign trade and the exchange rate and its effects. The structural linkages within the model provide a relatively detailed view of the relationships between nominal variables and the real economy and of the supply side of the economy in an analytically consistent framework. The model was last expanded in 2020 (g3+). The main changes consist in a greater development of the foreign block (now a quarterly projection model, QPM), the insertion of the energy sector, the introduction of the heterogeneity of households and other minor adjustments, see Brázdik et al. (2020).

The Riksbank's MAJA structural model is one of the most elaborate small open economy DSGE models. It focuses on capturing the generally strong empirical relationships between Swedish and foreign macroeconomic variables due to a high interconnectedness of Swedish product markets and the rest of the world. It is thus worth mentioning the latest extension of the foreign block of this model to include a DSGE model of two countries, i.e. the euro area and the USA, see Corbo and Strid (2020).

The core model of the Narodowy Bank Polski is the semi-structural NECMOD. The model encompasses all major channels of monetary policy transmission and explicitly incorporated inflation expectations, a complex labour market, fiscal policy and heterogeneous capital stock. It is therefore able to capture a wide range of macroeconomic shocks and the specific characteristics of a converging economy, which is the reason it is the main forecasting and simulation tool of the Polish central bank. The development of this model consists in expanding its structure and estimating its parameters capturing the current economic environment, see Budnik et al. (2009).

The Magyar Nemzeti Bank also used a semi-structural QPM model called NEM, see Benk et al. (2006). In response to the financial and economic crisis in 2008, it developed a new DSGE-based model of the Hungarian economy, see Békési et al. (2016). The main purpose of developing this model was to deviate from the rational expectation hypothesis so that expectations could be treated flexibly and pragmatically. Compared to the MNB's previous forecasting models, the new DSGE model contains heterogeneous households and a financial accelerator mechanism representing the financing constraints of firms.

Another large group are models of central banks in Africa, Asia or Australia and Oceania. They are usually semi-structural models (QPM) with simple foreign blocks (VAR models), which use the outputs from the IMF's GPM model. An exception would be, for example, the core model of the Reserve Bank of New Zealand (NZSIM), which is a DSGE model, though with a VAR foreign block, see Neroli and Reid (2017).

Central banks' modelling systems in turbulent times

Central banks' macroeconomic models focus in principle on capturing the key economic links for the business cycle. Under this assumption, they are not primarily designed to capture "unforeseen" phenomena and phenomena "outside the economic system". However, central banks and other institutions must be able to deal with them. Therefore, they create complex analytical systems outside the core model (see Box 2), whose outputs are then inserted into the core models through expert adjustments. This part of the article will focus primarily on the tools used by central banks to determine and quantify the impacts of non-economic phenomena with an emphasis on the recent experience with the coronavirus pandemic.

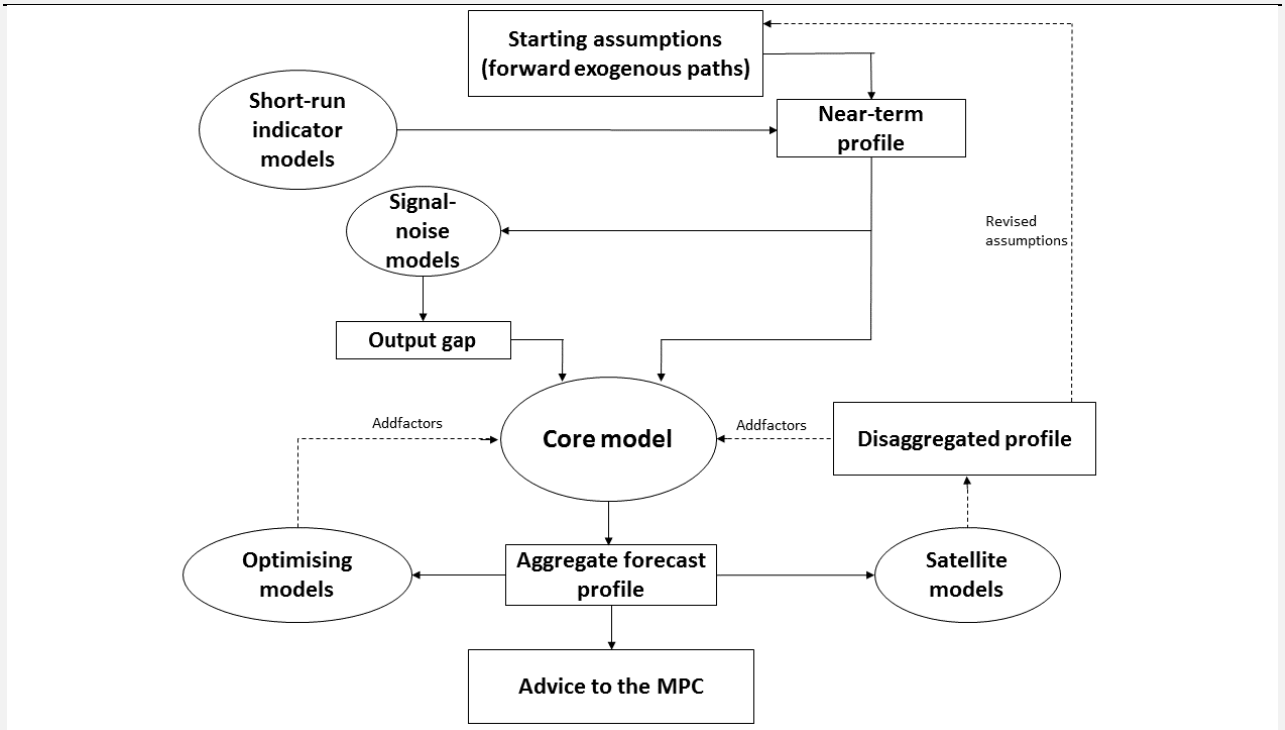
[4] Models of central banks in the individual euro area economies make up a large group. They are specific in that they use the euro and are therefore not mentioned explicitly in the text. A comprehensive overview of these models can be found in Table 3 in Paries et al. (2021).

Reactions to sudden phenomena virtually differ only with respect to the capacity constraints of each institution. While large institutions such as the ECB and the Fed are able to activate their large analytical capacity for the construction of comprehensive model systems within a relatively short period of time, smaller institutions usually respond by drawing up partial analyses using the tools they already have available. However, the capacity constraints of smaller institutions and the portfolio of the tools used do not preclude achieving a similar accuracy of capturing the impacts of unforeseen phenomena on the economy. Table 2 contains some selected papers on relevant topics.

Box 2 – Forecasting and Policy Analysis System (FPAS)

Most central banks prepare forecasts in complex Forecasting and Policy Analysis Systems (FPAS). Chart 1 captures the whole process schematically, using the example of the IMF. The main prediction model, which absorbs all the information provided by experts, is at the core of the entire system. Its output is an integrated forecast, which contains all available and relevant (also non-economic) information for the forecast.

Chart 1 – Scheme of the forecasting and monetary policy analysis system (IMF recommendations for ensuring consistency between the models used)



Source: MMF, Laxton et al. (2009)

The International Monetary Fund, the Fed, the European Central Bank and the Bank of England have created entire platforms of tools for capturing events such as a pandemic or climate change in a short period of time. For example, the IMF, the Fed and the Bank of England have websites where they present papers on relevant topics. The ECB has created an extension of the semi-structural ECB-BASE model called ECB-BASIR, which is capable of systemically analysing and consistently capturing the impacts of the coronavirus pandemic in forecasts. In connection with the impacts of climate change on monetary policy, the ECB has issued a comprehensive report exploring the macroeconomic and financial risks of climate change and policies aimed at mitigating such impacts.

Smaller central banks usually respond by preparing partial analyses whose results are input by experts into the forecasts created by the core model. Table 2 shows selected examples. The Bank of Canada issued a paper which analyses payment habits during the COVID-19 pandemic (Dahlhaus and Welte (2021)) and a paper dealing with the quantitative analysis of the short-run and long-run effects of various trade-restricting policies in the presence of global value chains and multinational production (Imura (2019)). It published a comprehensive report on the creation of scenarios relating to climate change. The Czech National Bank published a in-depth analysis of the impacts of the pandemic on the world's major economies (Brůha et al. (2021)) and an analysis of the impacts of climate change on the world economy (Motl and Tonner (2021)). The regular monetary policy reports also include partial analyses of logistics and production chains, e.g. in Benecká (2021).

Conclusion

The main aim of this article was to summarise the current key trends in macroeconomic modelling in central banks. The following can be regarded as the most important ones: large central banks and institutions mostly use multiple own models, usually a combination of structural and semi-structural models. Their development is in line with the changes taking place in the respective economies and the identified objectives of the institution concerned and may thus be in different directions, e.g. the ECB recently expanded the structural model to include a financial block, while the Bank of Canada's model was expanded more towards the property market. Central banks of small open economies usually have only one core model (structural or semi-structural), which they tend to adjust to developments in macroeconomic modelling. It is worth mentioning the most recent expansion of the foreign block of the Riksbank's MAJA model (2020) to a two-country DSGE model or the upgrade of the Czech National Bank's model to the g3+ model. Incorporating the impacts of climate change into their models and capturing the build-up of events such as the Covid crisis, the war in Ukraine and the preceding problems in global value chains are likely to be important issues for all central banks.

In turbulent times, large institutions are able to activate a large analytical potential relatively quickly, while smaller institutions tend to respond by performing partial analyses using existing tools. These analytical outputs are used as expert inputs in core macroeconomic models. However, even large institutions are unable to create and test new models within a few weeks, so even they are dependent on using partial analyses in the event of a need to quantify the impacts of sudden changes within a very short period of time.

References

Altig, D., Fuhrer, J., Giannoni, M. P., Laubach, T. (2020). The Federal Reserve's Review of Its Monetary Policy Framework: A Roadmap. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, August 27, 2020, https://doi.org/10.17016/2380-7172.2767.

Andrle, M., Hledik, T., Kamenik, O., Vlcek J. (2009): Implementing the New Structural Model of the Czech National Bank. Working Papers 2009/2, Czech National Bank. https://www.cnb.cz/export/sites/cnb/en/economic-research/.galleries/research_publications/cnb_wp/cnbwp_2009_02.pdf

Andrle, M., Blagrave, P., Espaillat, P., Honjo, K., Hunt, B. L., Kortelainen, M., Lalonde, R., Laxton, D., Mavroeidi, E., Muir, D. V., Mursula, S., Snu, S. (2015). The Flexible System of Global Models – FSGM. IMF Working Papers, No 15/64, International Monetary Fund, Washington, DC, March. https://www.imf.org/external/pubs/ft/wp/2015/wp1564.pdf

Angelini, E., Bokan, N., Christoffel, K., Ciccarelli, M., Zimic, S. (2019). Introducing ECB-BASE: The blueprint of the new ECB semi-structural model for the euro area. ECB Working Paper 2315/September 2019. https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2315~73e5b1c3cd.en.pdf

Angelini, E., Damjanović, M., Pariès M. D., Zimic, S. (2020). ECB-BASIR: a primer on the macroeconomic implications of the Covid-19 pandemic. ECB Working Paper Series No 2431, June 2020. ECB-BASIR: a primer on the macroeconomic implications of the Covid-19 pandemic (europa.eu)

Békési, L., Köber, C.,Kucsera, H.,Várnai, T.,Világi, B. (2016). The macroeconomic forecasting model of the MNB. MNB Working Papers 2016/4, Budapest, December 2016. https://www.mnb.hu/letoltes/mnb-wp-2016-4-final.pdf

Benecká, S. (2021). The shortage of materials and components as a production-limiting and price-increasing factor. Global Economic Outlook, August, 2021, Czech National Bank. https://www.cnb.cz/export/sites/cnb/en/monetary-policy/.galleries/geo/geo_2021/gev_2021_08_en.pdf#page=14

Benk, S., Jakab, Z. M.,Kovács, M. A.,Párkányi, B.,Reppa, Z.,Vadas G. (2006). The Hungarian Quarterly Projection Model (NEM). MNB Occasional Papers 2006/60, Magyar Nemzeti Bank (Central Bank of Hungary). https://www.mnb.hu/letoltes/op-60.pdf

Brázdik, F., Hlédik, T., Humplová, Z., Martonosi, I., Musil, K., Ryšánek, J. a kol. (2020). The g3+ Model: An Upgrade of the Czech National Bank's Core Forecasting Framework. Working Papers 2020/7, Czech National Bank. https://www.cnb.cz/export/sites/cnb/en/economic-research/.galleries/research_publications/cnb_wp/cnbwp_2020_07.pdf

Brůha, J., Hlédik, T., Holub, T., Polanský, J., Tonner, J. (2013). Incorporating Judgments and Dealing with Data Uncertainty in Forecasting at the Czech National Bank. Research and Policy Notes, Czech National Bank. https://www.cnb.cz/export/sites/cnb/en/economic-research/.galleries/research_publications/irpn/download/rpn_2_2013.pdf

Brůha, J., Motl, M., Tonner, J. (2021). Assessment of the impacts of the pandemic on the world's major economies: A crisis of supply or demand? Global Economic Outlook, May 2021, Czech National Bank. https://www.cnb.cz/export/sites/cnb/en/monetary-policy/.galleries/geo/geo_2021/gev_2021_05_en.pdf#page=13

Budnik, K., Greszta, M., Hulej, M., Kolasa, M., Murawski, K., Rot, M., Rybaczyk, B., Tarnicka, M. (2009). The new macroeconometric model of the Polish economy. WP 62, National Bank of Poland, Warsaw 2009. https://www.nbp.pl/polityka_pieniezna/dokumenty/raport_o_inflacji/new_macroeconometric_model_2009_06_24.pdf

Burgess, S., Fernandez-Corugedo, E., Groth, C., Harrison, R., Monti, F., Theodoridis, K., Waldron, M. (2013). The Bank of England's forecasting platform: COMPASS, MAPS, EASE and the suite of models. May 2013. Working Paper No. 471,

Bank of England. https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2013/the-boes-forecasting-platform-compass-maps-ease-and-the-suite-of-models.pdf

Carabenciov, I., Freedman, C., Garcia-Saltos, R., Laxton, D., Kamenik, O., Manchev, P. (2013). GPM6 - The Global Projection Model with 6 Regions. IMF Working Paper, WP/13/87, IMF, April 2013. https://www.imf.org/external/pubs/ft/wp/2013/wp1387.pdf

Cigna, S., Gunnella, V., Quaglietti, L. (2022). Global value chains: measurement, trends and drivers. ECB Occasional Paper Series No 289, January 2022. Global value chains: measurement, trends and drivers (europa.eu)

Chung, H., Kiley, M. T., Laforte, J.-P. (2010). Documentation of the Estimated, Dynamic, Optimization-based (EDO) Model of the U.S. Economy Finance and Economics Discussion Series 2010-29. Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/pubs/feds/2010/201029/201029pap.pdf

Work stream on climate change (2021). Climate change and monetary policy in the euro area. ECB Occasional Paper Series. No 271 / September 2021. Climate change and monetary policy in the euro area (europa.eu)

Coenen, G., Karadi, P., Schmidt, S., Warne, A. (2019). The New Area-Wide Model II: an extended version of the ECB's micro-founded model for forecasting and policy analysis with a financial sector. ECB Working Paper 2200/November 2018, Revised December 2019. https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2200.en.pdf

Cook, D., Patel, N. (2022). Dollar Invoicing, Global Value Chains, and the Business Cycle Dynamics of International Trade. IMF Working Papers, February 2022. https://www.imf.org/en/Publications/WP/Issues/2022/02/11/Dollar-Invoicing-Global-Value-Chains-and-the-Business-Cycle-Dynamics-of-International-Trade-512786

Corbo, V., Strid, I. (2020). MAJA: A two-region DSGE model for Sweden and its main trading partners. WP 391, Sweriges Riksbank, July 2020. https://www.riksbank.se/globalassets/media/rapporter/working-papers/2019/no.-391-maja-a-two-region-dsge-model-for-sweden-and-its-main-trading-partners.pdf

Corrigan, P., Desgagnés, H., Dorich, J., Lepetyuk, V., Miyamoto, W., Zhang, Y. (2021). ToTEM III: The Bank of Canada's Main DSGE Model for Projection and Policy Analysis. Technical Report No. 119, Bank of Canada, June 28, 2021. https://www.bankofcanada.ca/wp-content/uploads/2021/06/tr119.pdf

Croitorov, O., Calès, L., Ratto, M. et al. (2017). The Global Multi-country Model (GM) : an estimated DSGE model for the Euro Area Countries, European Commission, Joint Research Centre, 2017. https://op.europa.eu/en/publication-detail/-/publication/144d109e-f103-11e7-9749-01aa75ed71a1/language-en

Cusbert, T., Kendall, E. (2018). Meet MARTIN, the RBA's New Macroeconomic Model. Bulletin March 2018, Reserve Bank of Australia, March 2018. https://www.rba.gov.au/publications/bulletin/2018/mar/pdf/meet-martin-the-rbas-new-macroeconomic-model.pdf

D'Aguanno a kol. (2021). Global value chains, volatility and safe openness: is trade a double-edged sword? Financial Stability Paper No. 46, Bank of England, January 2021. https://www.bankofengland.co.uk/financial-stability-paper/2021/global-value-chains-volatility-and-safe-openness-is-trade-a-double-edged-sword

Dahlhaus, T., Welte, A. (2021). Payment Habits During COVID-19: Evidence from High-Frequency Transaction Data. Staff Working Paper/Document de travail du personnel 2021-43, Bank of Canada, September 2021. https://www.bankofcanada.ca/wp-content/uploads/2021/09/swp2021-43.pdf

Flint, B., Laubach, T., Reifschneider, D. (2014). The FRB/US Model: A Tool for Macroeconomic Policy Analysis. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, April 03, 2014. https://www.federalreserve.gov/econresdata/notes/feds-notes/2014/a-tool-for-macroeconomic-policy-analysis.html

Gervais, O., Gosselin, M.-A. (2014). Analyzing and Forecasting the Canadian Economy through the LENS Model. Technical Report No. 102, Bank of Canada, July 2014. https://www.bankofcanada.ca/wp-content/uploads/2014/07/tr102.pdf

Imura, Y. (2019). Reassessing Trade Barriers with Global Value Chains. Staff Working Paper/Document de travail du personnel 2019-19, May 2019, Bank of Canada. https://www.bankofcanada.ca/wp-content/uploads/2019/05/swp2019-19.pdf

Kumhof, M., Laxton, D., Muir, D., Mursula, S. (2010). The Global Integrated Monetary and Fiscal Model (GIMF) – Theoretical Structure. IMF Working Papers, No 10/34, International Monetary Fund, Washington, DC, February. https://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Global-Integrated-Monetary-and-Fiscal-Model-GIMF-Theoretical-Structure-23615

Laxton, D., Pesenti, P. (2003). Monetary Rules for Small, Open, Emerging Economies. Journal of Monetary Economics, Vol. 50, No 5, pp. 1109-1146. https://www.nber.org/system/files/working_papers/w9568/w9568.pdf

Laxton, D., Rose, D., Scott, A. (2009). Developing a Structured Forecasting and Policy Analysis System to Support Inflation-Forecast Targeting (IFT). IMF Working Papers, No 09/55, International Monetary Fund, Washington, DC, March. https://www.imf.org/external/pubs/ft/wp/2009/wp0955.pdf

Motl, M., Tonner, J. (2021). Modelling the impacts of climate change on the global economy: Stagflationary shock looming. Global Economic Outlook, September 2021, Czech National Bank. https://www.cnb.cz/export/sites/cnb/en/monetary-policy/.galleries/geo/geo_2021/gev_2021_09_en.pdf#page=14

Neroli, A.,Reid, G. (2017). NZSIM: A model of the New Zealand economy for forecasting and policy analysis. Reserve Bank of New Zealand, Bulletin, Vol. 80, No. 1, January 2017. https://www.rbnz.govt.nz/-/media/ReserveBank/Files/Publications/Bulletins/2017/2017jan80-01.pdf?revision=023b03ec-1cd4-4560-9319-c1641f87ab41

Paries, M. D., Notarpietro, A., Kilponen, J. (2021). Review of macroeconomic modelling in the Eurosystem: current practices and scope for improvement. ECB Occasional Paper No 267 / September 2021. https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op267~63c1f094d6.en.pdf

Pesenti, P. (2008). The Global Economy Model: Theoretical Framework. IMF Staff Papers, Vol. 55, No 2, pp. 243-284. https://www.elibrary.imf.org/view/journals/024/2008/004/article-A002-en.xml

Ratto, M., Roeger, W., G., in 't Velt, J. (2008). QUEST III: an estimated DSGE model of the euro area with fiscal and monetary policy. European Economy, Economic Papers, 335 / July 2008. https://ec.europa.eu/economy_finance/publications/pages/publication12918_en.pdf

Keywords

Macroeconomic modelling, strategy review, small open economy, monetary policy

JEL Classification

C5, E47, E52, E58, F4

.

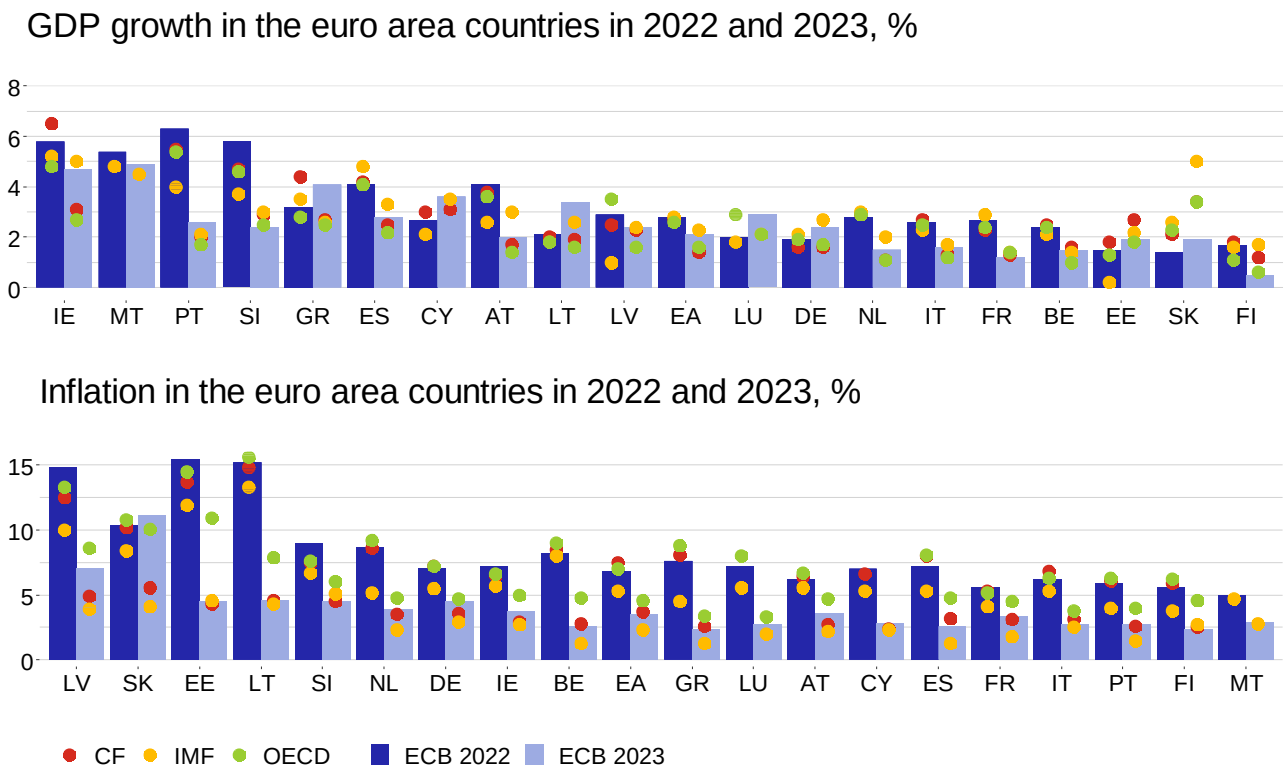
A1. Change in predictions for 2022

	GDP growth, %								Inflation, %							
	CF		IMF		OECD		CB / EIU		CF		IMF		OECD		CB / EIU	
EA	-0.1	2022/7 2022/6	-1.1	2022/4 2022/1	-1.7	2022/6 2021/12	-0.9	2022/6 2022/3	+0.3	2022/7 2022/6	+3.6	2022/4 2021/10	+4.3	2022/6 2021/12	+1.7	2022/6 2022/3
US	-0.5	2022/7 2022/6	-0.3	2022/4 2022/1	-1.2	2022/6 2021/12	-1.1	2022/6 2022/3	+0.2	2022/7 2022/6	+4.2	2022/4 2021/10	+2.2	2022/6 2021/12	+0.9	2022/6 2022/3
UK	-0.2	2022/7 2022/6	-1.0	2022/4 2022/1	-1.1	2022/6 2021/12	0	2022/5 2022/2	+0.1	2022/7 2022/6	+4.8	2022/4 2021/10	+4.4	2022/6 2021/12	+4.5	2022/5 2022/2
JP	-0.1	2022/7 2022/6	-0.9	2022/4 2022/1	-1.7	2022/6 2021/12	-0.9	2022/4 2022/1	+0.1	2022/7 2022/6	+0.5	2022/4 2021/10	+1.1	2022/6 2021/12	+0.8	2022/4 2022/1
CN	-0.1	2022/7 2022/6	-0.4	2022/4 2022/1	-0.7	2022/6 2021/12	0	2022/7 2022/6	-0.1	2022/7 2022/6	+0.3	2022/4 2021/10	+0.3	2022/6 2021/12	-0.1	2022/7 2022/6
RU	+1.2	2022/6 2022/5	-11.3	2022/4 2022/1	-12.7	2022/6 2021/12	+1.8	2022/7 2022/6	-3.0	2022/6 2022/5	+16.5	2022/4 2021/10	+10.3	2022/6 2021/12	-0.9	2022/7 2022/6

A2. Change in predictions for 2023

	GDP growth, %								Inflation, %							
	CF		IMF		OECD		CB / EIU		CF		IMF		OECD		CB / EIU	
EA	-0.6	2022/7 2022/6	-0.2	2022/4 2022/1	-0.9	2022/6 2021/12	-0.7	2022/6 2022/3	+0.5	2022/7 2022/6	+0.9	2022/4 2021/10	+2.8	2022/6 2021/12	+1.4	2022/6 2022/3
US	-0.8	2022/7 2022/6	-0.3	2022/4 2022/1	-1.2	2022/6 2021/12	-0.5	2022/6 2022/3	+0.1	2022/7 2022/6	+0.2	2022/4 2021/10	+1.0	2022/6 2021/12	-0.1	2022/6 2022/3
UK	-0.3	2022/7 2022/6	-1.1	2022/4 2022/1	-2.1	2022/6 2021/12	-1.6	2022/5 2022/2	+0.4	2022/7 2022/6	+3.3	2022/4 2021/10	+5.0	2022/6 2021/12	+1.0	2022/5 2022/2
JP	-0.2	2022/7 2022/6	+0.5	2022/4 2022/1	+0.7	2022/6 2021/12	+0.8	2022/4 2022/1	+0.1	2022/7 2022/6	+0.1	2022/4 2021/10	+1.1	2022/6 2021/12	0	2022/4 2022/1
CN	+0.2	2022/7 2022/6	-0.1	2022/4 2022/1	-0.2	2022/6 2021/12	-0.2	2022/7 2022/6	0	2022/7 2022/6	-0.1	2022/4 2021/10	+0.6	2022/6 2021/12	-0.2	2022/7 2022/6
RU	-1.0	2022/6 2022/5	-4.4	2022/4 2022/1	-5.3	2022/6 2021/12	-1.7	2022/7 2022/6	-0.6	2022/6 2022/5	+9.8	2022/4 2021/10	+8.8	2022/6 2021/12	-0.7	2022/7 2022/6

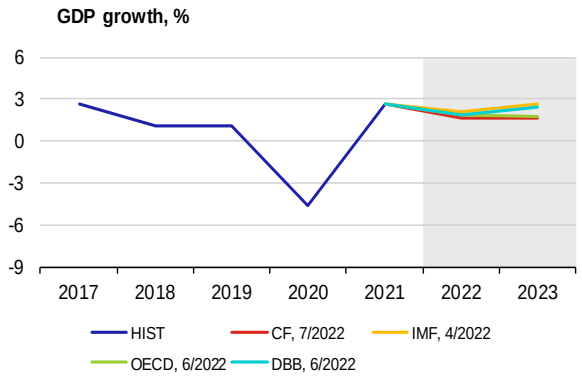
A3. GDP growth and inflation outlooks in the euro area countries



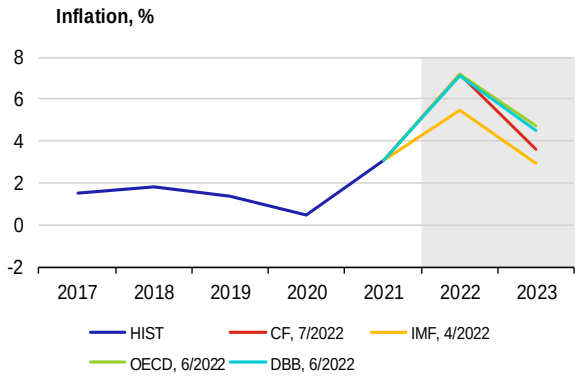
Note: Charts show institutions' latest available outlooks of for the given country.

A4. GDP growth and inflation in the individual euro area countries

Germany

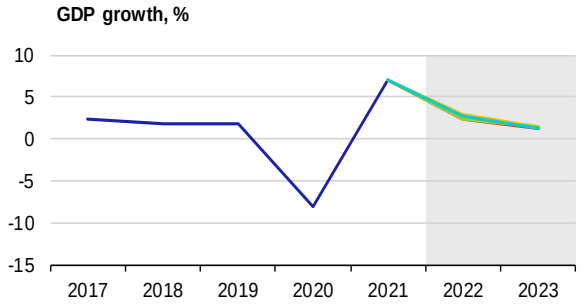


	CF	IMF	OECD	DBB
2022	1.6	2.1	1.9	1.9
2023	1.6	2.7	1.7	2.4

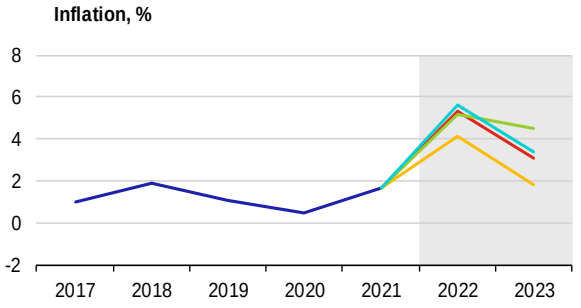


	CF	IMF	OECD	DBB
2022	7.2	5.5	7.2	7.1
2023	3.6	2.9	4.7	4.5

France

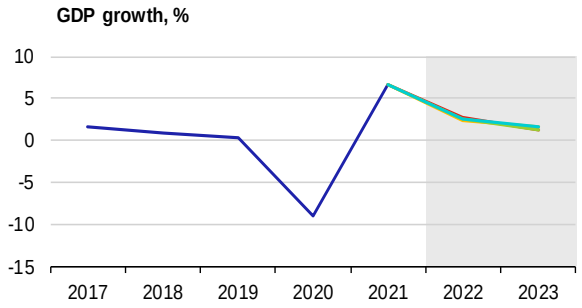


	CF	IMF	OECD	ECB
2022	2.3	2.9	2.4	2.7
2023	1.3	1.4	1.4	1.2

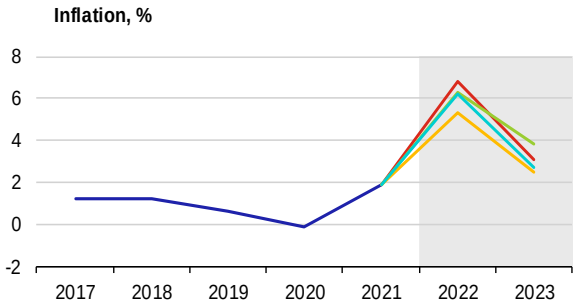


	CF	IMF	OECD	ECB
2022	5.3	4.1	5.2	5.6
2023	3.1	1.8	4.5	3.4

Italy

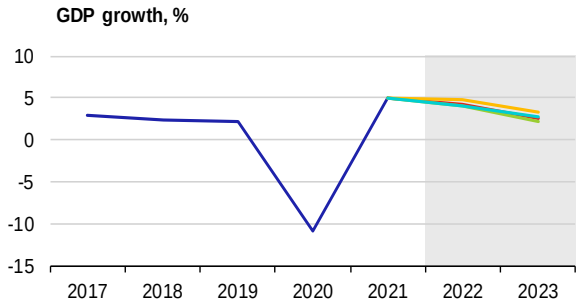


	CF	IMF	OECD	ECB
2022	2.7	2.3	2.5	2.6
2023	1.3	1.7	1.2	1.6

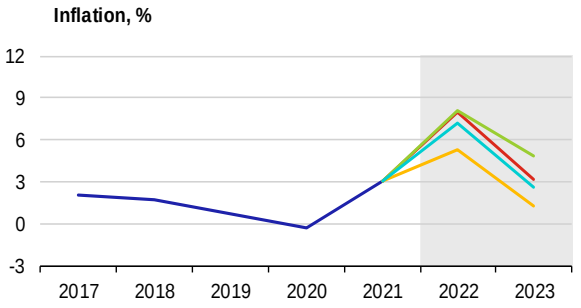


	CF	IMF	OECD	ECB
2022	6.8	5.3	6.3	6.2
2023	3.1	2.5	3.8	2.7

Spain

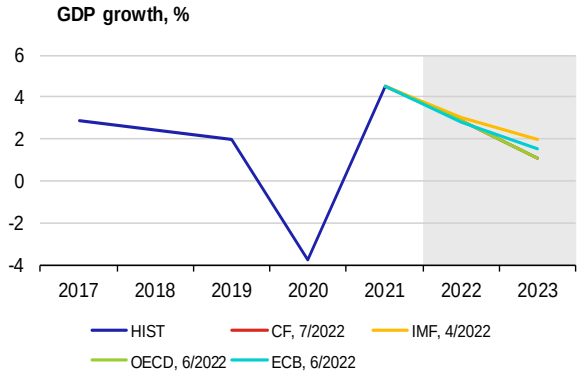


	CF	IMF	OECD	ECB
2022	4.2	4.8	4.1	4.1
2023	2.5	3.3	2.2	2.8

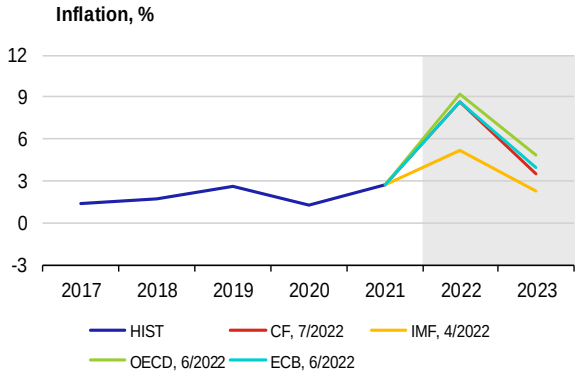


	CF	IMF	OECD	ECB
2022	8.0	5.3	8.1	7.2
2023	3.2	1.3	4.8	2.6

Netherlands

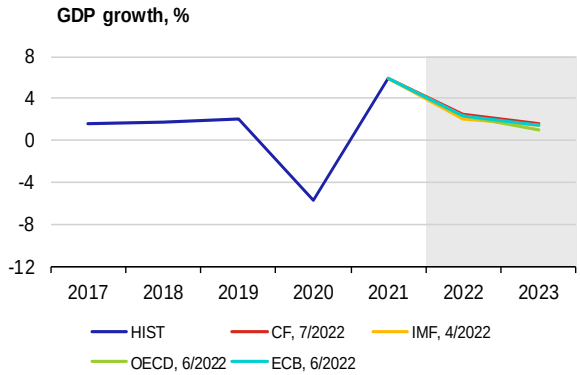


	CF	IMF	OECD	ECB
2022	2.9	3.0	2.9	2.8
2023	1.1	2.0	1.1	1.5

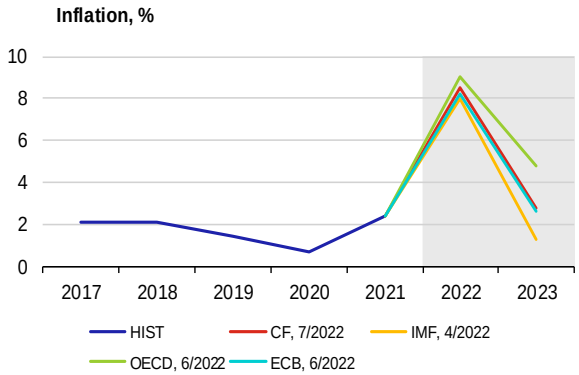


	CF	IMF	OECD	ECB
2022	8.6	5.2	9.2	8.7
2023	3.5	2.3	4.8	3.9

Belgium

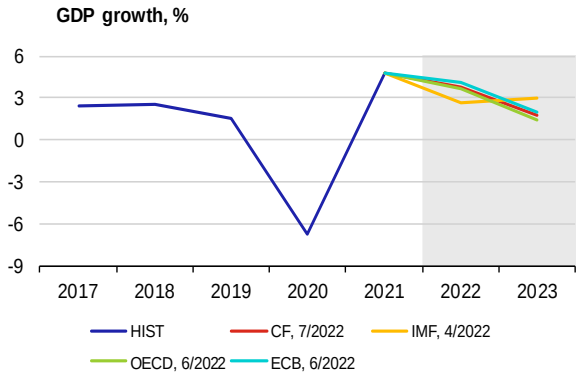


	CF	IMF	OECD	ECB
2022	2.5	2.1	2.4	2.4
2023	1.6	1.4	1.0	1.5

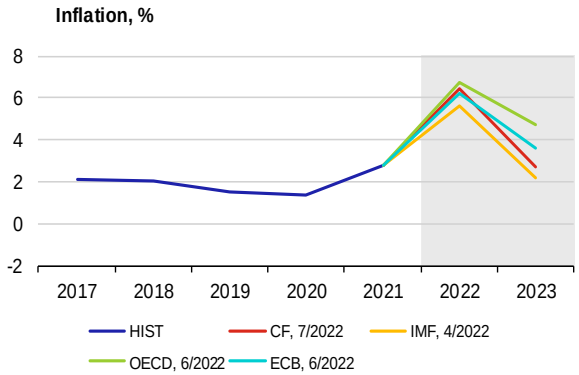


	CF	IMF	OECD	ECB
2022	8.5	8.0	9.0	8.2
2023	2.8	1.3	4.8	2.6

Austria



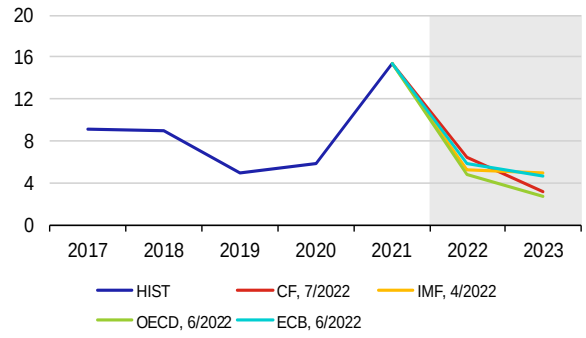
	CF	IMF	OECD	ECB
2022	3.8	2.6	3.6	4.1
2023	1.7	3.0	1.4	2.0



	CF	IMF	OECD	ECB
2022	6.4	5.6	6.7	6.2
2023	2.7	2.2	4.7	3.6

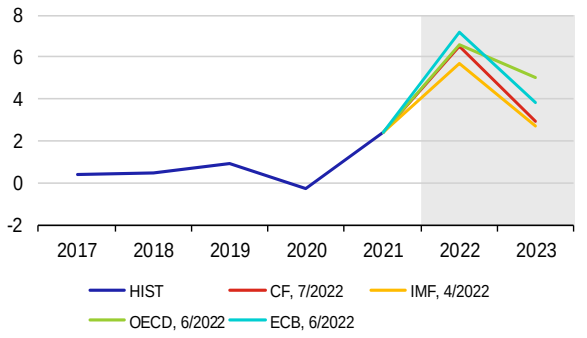
Ireland

GDP growth, %



	CF	IMF	OECD	ECB
2022	6.5	5.2	4.8	5.8
2023	3.1	5.0	2.7	4.7

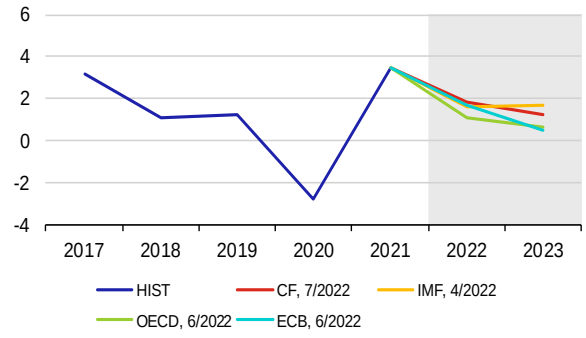
Inflation, %



	CF	IMF	OECD	ECB
2022	6.5	5.7	6.6	7.2
2023	2.9	2.7	5.0	3.8

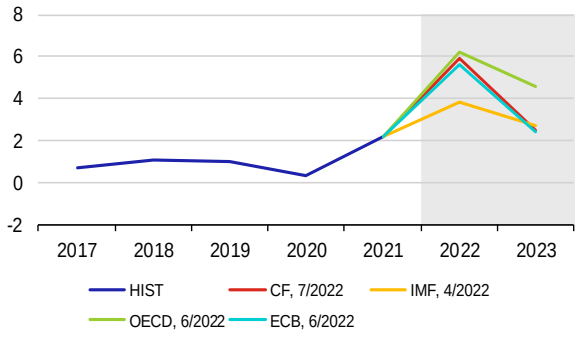
Finland

GDP growth, %



	CF	IMF	OECD	ECB
2022	1.8	1.6	1.1	1.7
2023	1.2	1.7	0.6	0.5

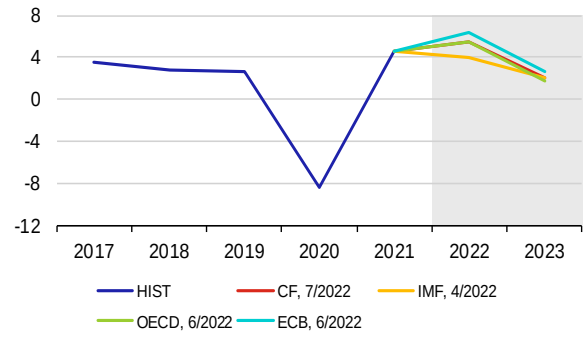
Inflation, %



	CF	IMF	OECD	ECB
2022	5.9	3.8	6.2	5.6
2023	2.5	2.7	4.6	2.4

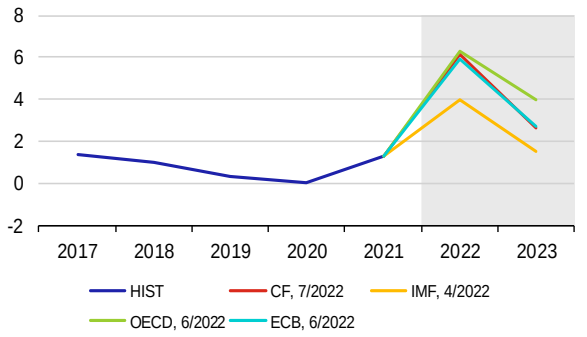
Portugal

GDP growth, %



	CF	IMF	OECD	ECB
2022	5.5	4.0	5.4	6.3
2023	2.0	2.1	1.7	2.6

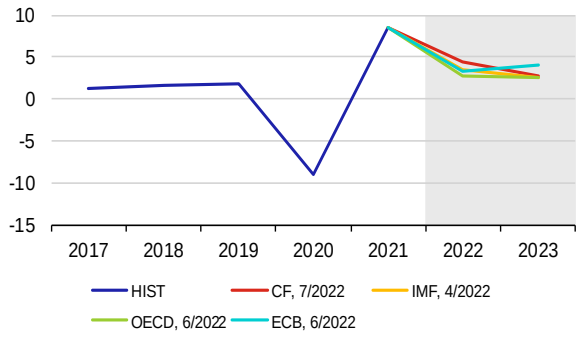
Inflation, %



	CF	IMF	OECD	ECB
2022	6.1	4.0	6.3	5.9
2023	2.6	1.5	4.0	2.7

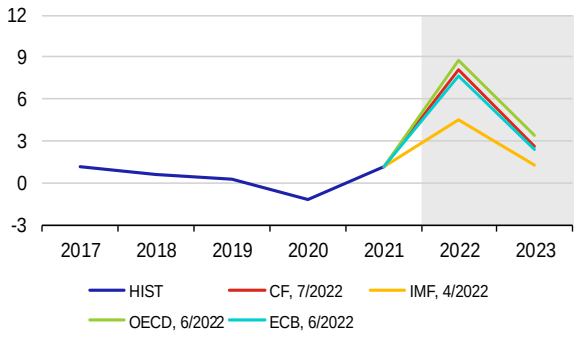
Greece

GDP growth, %



	CF	IMF	OECD	ECB
2022	4.4	3.5	2.8	3.2
2023	2.7	2.6	2.5	4.1

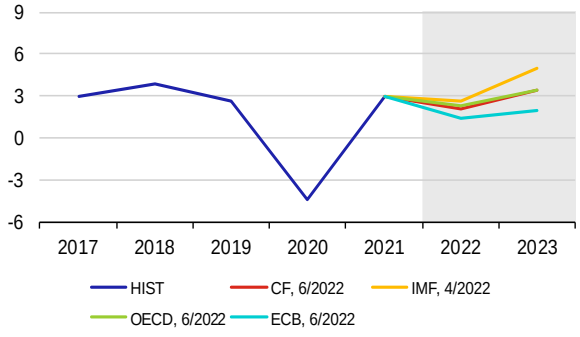
Inflation, %



	CF	IMF	OECD	ECB
2022	8.1	4.5	8.8	7.6
2023	2.6	1.3	3.4	2.4

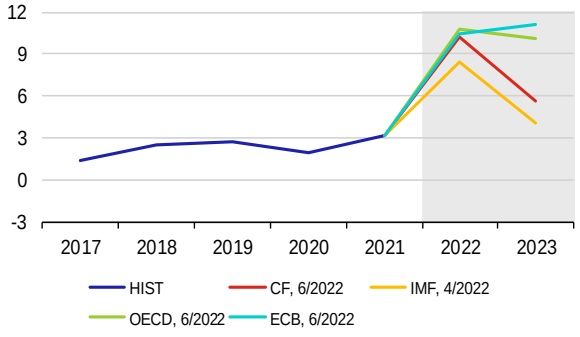
Slovakia

GDP growth, %



	CF	IMF	OECD	ECB
2022	2.1	2.6	2.3	1.4
2023	3.4	5.0	3.4	1.9

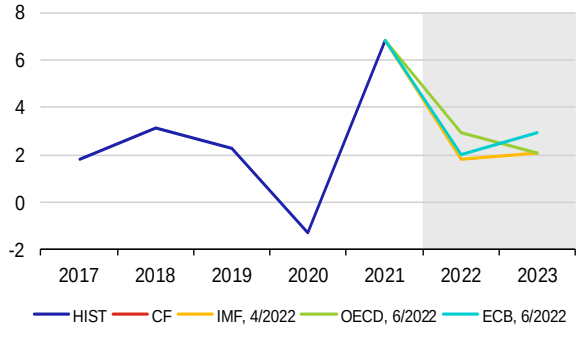
Inflation, %



	CF	IMF	OECD	ECB
2022	10.2	8.4	10.8	10.4
2023	5.6	4.1	10.1	11.1

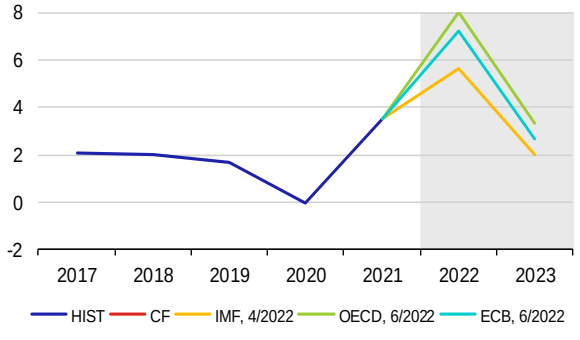
Luxembourg

GDP growth, %



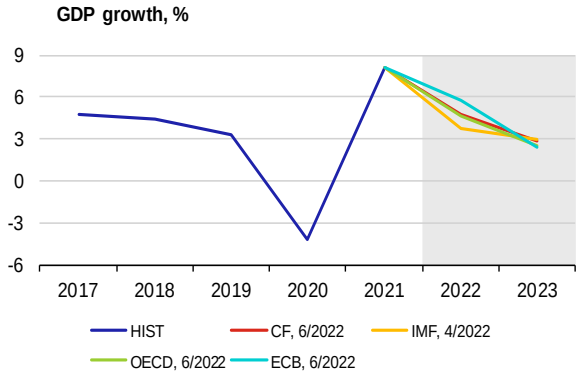
	CF	IMF	OECD	ECB
2022	n. a.	1.8	2.9	2.0
2023	n. a.	2.1	2.1	2.9

Inflation, %

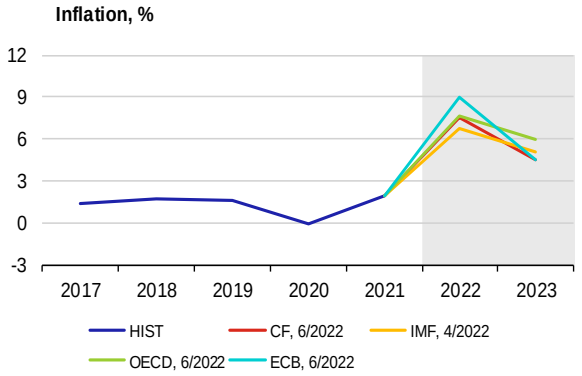


	CF	IMF	OECD	ECB
2022	n. a.	5.6	8.0	7.2
2023	n. a.	2.0	3.3	2.7

Slovenia

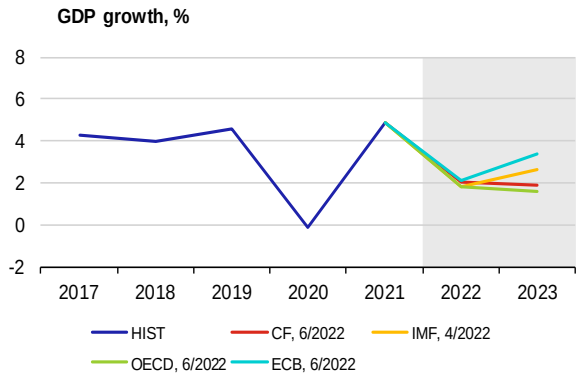


	CF	IMF	OECD	ECB
2022	4.7	3.7	4.6	5.8
2023	2.9	3.0	2.5	2.4

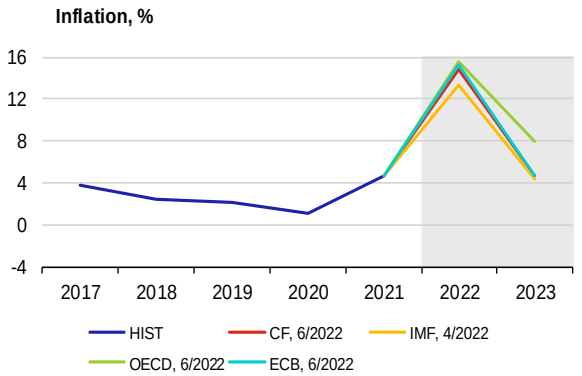


	CF	IMF	OECD	ECB
2022	7.5	6.7	7.6	9.0
2023	4.5	5.1	6.0	4.5

Lithuania

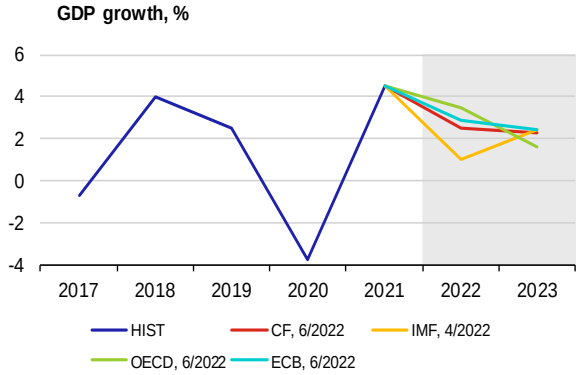


	CF	IMF	OECD	ECB
2022	2.0	1.8	1.8	2.1
2023	1.9	2.6	1.6	3.4

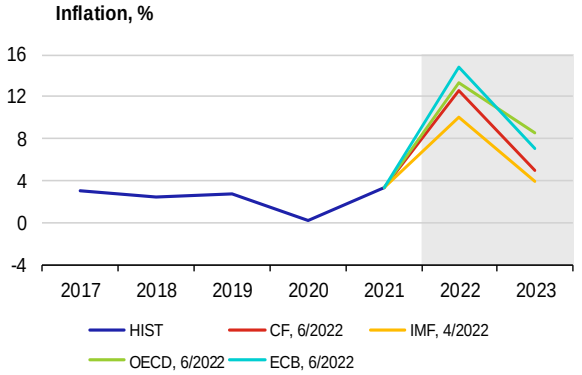


	CF	IMF	OECD	ECB
2022	14.8	13.3	15.6	15.2
2023	4.6	4.3	7.9	4.6

Latvia



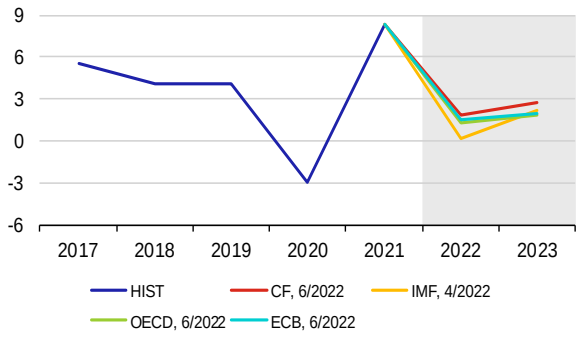
	CF	IMF	OECD	ECB
2022	2.5	1.0	3.5	2.9
2023	2.3	2.4	1.6	2.4



	CF	IMF	OECD	ECB
2022	12.5	10.0	13.3	14.8
2023	4.9	3.9	8.6	7.0

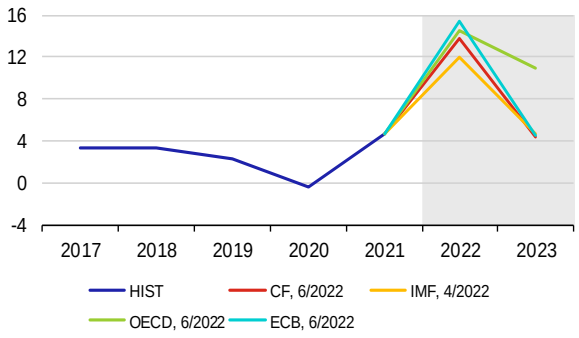
Estonia

GDP growth, %



	CF	IMF	OECD	ECB
2022	1.8	0.2	1.3	1.5
2023	2.2	2.2	1.8	1.9

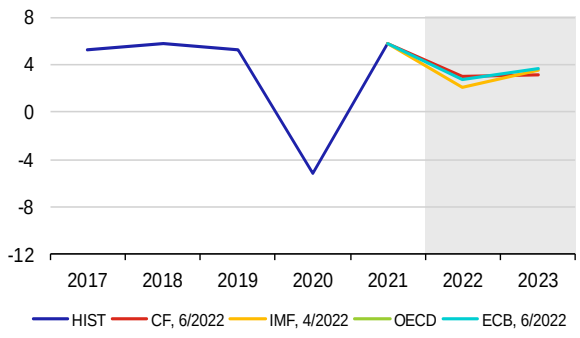
Inflation, %



	CF	IMF	OECD	ECB
2022	13.7	11.9	14.5	15.4
2023	4.3	4.6	10.9	4.5

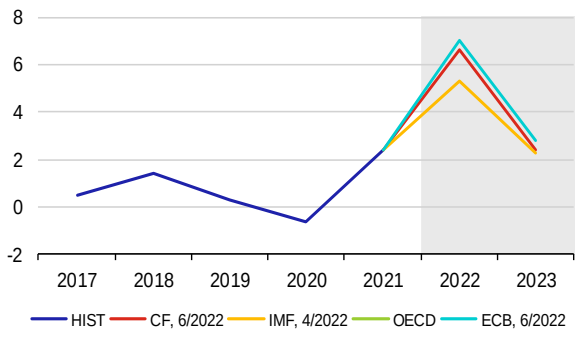
Cyprus

GDP growth, %



	CF	IMF	OECD	ECB
2022	3.0	2.1	n. a.	2.7
2023	3.1	3.5	n. a.	3.6

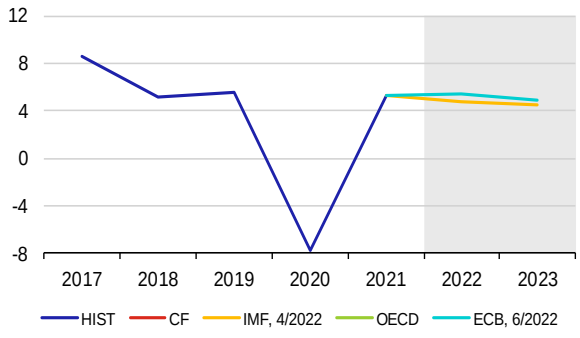
Inflation, %



	CF	IMF	OECD	ECB
2022	6.6	5.3	n. a.	7.0
2023	2.4	2.3	n. a.	2.8

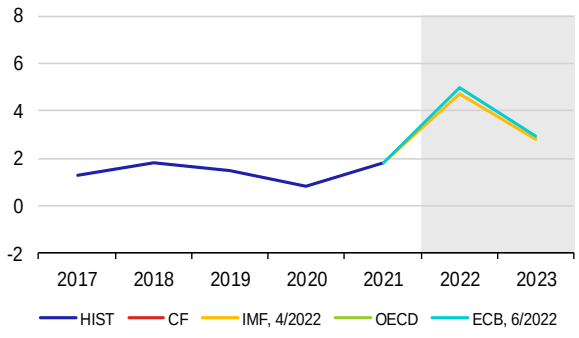
Malta

GDP growth, %



	CF	IMF	OECD	ECB
2022	n. a.	4.8	n. a.	5.4
2023	n. a.	4.5	n. a.	4.9

Inflation, %

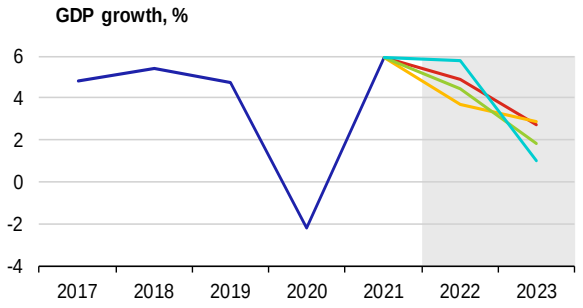


	CF	IMF	OECD	ECB
2022	n. a.	4.7	n. a.	5.0
2023	n. a.	2.8	n. a.	2.9

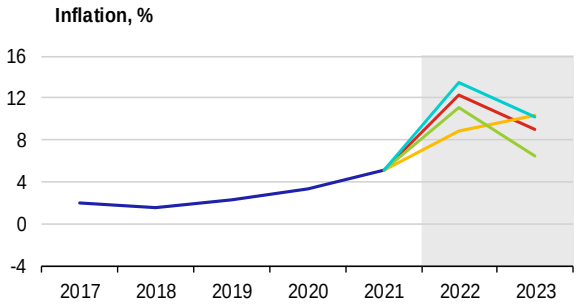
Ddd

A5. GDP growth and inflation in other selected countries

Poland

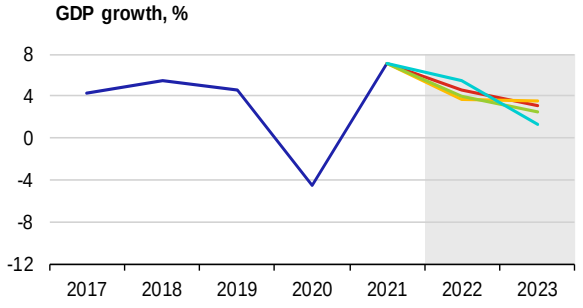


	CF	IMF	OECD	OE
2022	4.9	3.7	4.4	5.8
2023	2.7	2.9	1.8	1.0

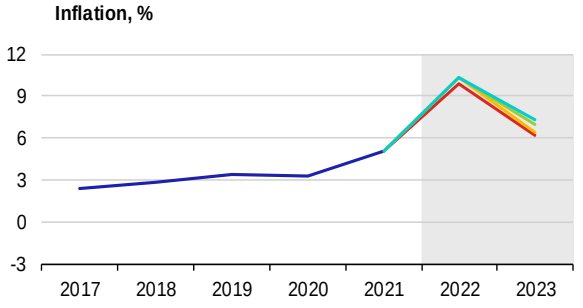


	CF	IMF	OECD	OE
2022	12.3	8.9	11.1	13.5
2023	9.0	10.3	6.5	10.2

Hungary

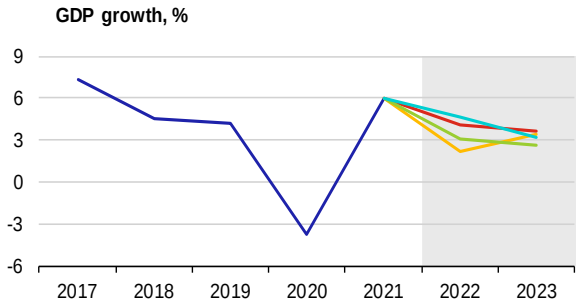


	CF	IMF	OECD	OE
2022	4.5	3.7	4.0	5.4
2023	3.1	3.6	2.5	1.3

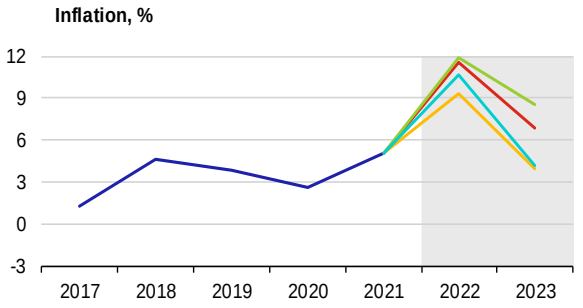


	CF	IMF	OECD	OE
2022	9.9	10.3	10.3	10.3
2023	6.2	6.4	7.0	7.3

Romania



	CF	IMF	OECD	OE
2022	4.1	2.2	3.1	4.6
2023	3.6	3.4	2.6	3.2



	CF	IMF	OECD	OE
2022	11.5	9.3	11.9	10.7
2023	6.8	4.0	8.5	4.2

A6. List of abbreviations

AT	Austria
bbl	barrel
BE	Belgium
BoE	Bank of England (the UK central bank)
BoJ	Bank of Japan (the central bank of Japan)
bp	basis point (one hundredth of a percentage point)
CB	central bank
CBR	Central Bank of Russia
CF	Consensus Forecasts
CN	China
CNB	Czech National Bank
CNY	Chinese renminbi
ConfB	Conference Board Consumer Confidence Index
CXN	Caixin
CY	Cyprus
DBB	Deutsche Bundesbank (the central bank of Germany)
DE	Germany
EA	euro area
ECB	European Central Bank
EE	Estonia
EIA	Energy Information Administration
EIU	Economist Intelligence Unit
ES	Spain
ESI	Economic Sentiment Indicator of the European Commission
EU	European Union
EUR	euro
EURIBOR	Euro Interbank Offered Rate
Fed	Federal Reserve System (the US central bank)
FI	Finland
FOMC	Federal Open Market Committee
FR	France
FRA	forward rate agreement
FY	fiscal year
GBP	pound sterling
GDP	gross domestic product
GR	Greece
ICE	Intercontinental Exchange
IE	Ireland
IEA	International Energy Agency
IFO	Leibniz Institute for Economic Research at the University of Munich
IMF	International Monetary Fund
IRS	Interest Rate swap
ISM	Institute for Supply Management
IT	Italy
JP	Japan
JPY	Japanese yen
LIBOR	London Interbank Offered Rate
LME	London Metal Exchange
LT	Lithuania
LU	Luxembourg
LV	Latvia
MKT	Markit
MT	Malta
NIESR	National Institute of Economic and Social Research (UK)
NKI	Nikkei
NL	Netherlands
OECD	Organisation for Economic Co-operation and Development
OECD-CLI	OECD Composite Leading Indicator
OPEC+	member countries of OPEC oil cartel and 10 other oil-exporting countries (the most important of which are Russia, Mexico and Kazakhstan)
PMI	Purchasing Managers' Index
pp	percentage point
PT	Portugal
QE	quantitative easing
RU	Russia
RUB	Russian rouble
SI	Slovenia
SK	Slovakia
UK	United Kingdom
UoM	University of Michigan Consumer Sentiment Index - present situation
US	United States
USD	US dollar
USDA	United States Department of Agriculture
WEO	World Economic Outlook
WTI	West Texas Intermediate (crude oil used as a benchmark in oil pricing)
ZEW	Centre for European Economic Research

Publisher:
ČESKÁ NÁRODNÍ BANKA
Na Příkopě 28
115 03 Praha 1
Česká republika

Contact:
ODBOR KOMUNIKACE SEKCE KANCELÁŘ
Tel.: 224 413 112
Fax: 224 412 179
www.cnb.cz