Global Economic Outlook

April 2024

CNB CZECH NATIONAL BANK

Cut-off date for data
12 April 2024

CF survey date
8 April 2024

GEO publication date
19 April 2024

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 OE.
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.

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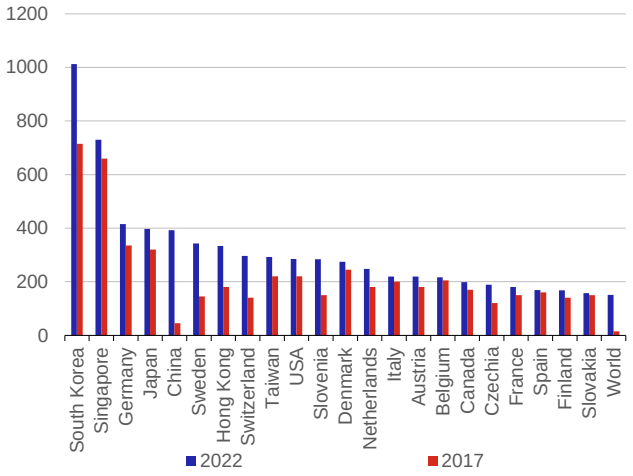
I. Introduction

Tensions in the world further increased following the attack on Israel by Iran, supported by Yemen and Lebanon. Iran directly attacked the Jewish state for the first time. The conflict in Ukraine is also continuing and the fighting has intensified in many places. US and UK governments prohibited commodity exchanges trading in metals from accepting new aluminium, copper and nickel produced in Russia and imports of these metals to the US and the UK. The measure's objective is clear, i.e. to reduce Russia's revenues from exports of these commodities.

The wait for key central banks to cut interest rates continues. The ECB seems closer to a reduction than the US Fed, mainly regarding new US inflation data. It strengthened compared to the February figures and it seems the US Fed will not succeed in starting the process of cutting interest rates, which will thus almost certainly not take place in the first half of this year. It also seems that only two cuts will occur, in place of the originally assumed three. The April meeting of the ECB's Governing Council left interest rates unchanged, but also prepared the communication ground for an expected June cut. Inflation in the euro area continues to slow, including core inflation, and wage growth is also gradually moderating. How low central bank interest rates fall is also influenced by the debate about the long-run neutral interest rate. This was probably due to the influence of the COVID period and other "mega-trends" (demographic factors dominated by the ageing population, a persisting global savings surplus, changes in productivity, climate change, etc.). However, the debate on this issue among central bankers is only beginning.

Robotisation in manufacturing in selected world economies, Number of installed robots per 10 thousand employees



Source: Datastream, World Robotics, Česká spořitelna

The BoE was another key central bank to publish its review of the framework for implementing monetary policy instruments. Former Fed Chairman Ben Bernanke, who conducted the monetary policy review process at the BoE, said, among other things, that the Bank of England had to revise its main economic model (including the use of outdated software) in order to avoid a repetition of its recent failure in predicting a sharp rise in inflation.

The chart in the current issue shows how robotisation in manufacturing has been on the rise in individual countries in recent years. Among the countries under review, the highest robotisation rate is in South Korea, where there is 1 robot for every 10 employees, while the global average is about 7 times lower. Great progress was achieved, for example, by China, which caught up with the majority of countries and came close to Japan's level. Robotisation increases productivity, but the chart shows that some countries are progressing only very slowly with robotisation and a number of EU economies will soon fall below the global average, which will reduce their competitiveness.

The current issue also contains an analysis: "Impacts of Climate Change on Monetary Policy". This article aims to identify individual shocks brought about by climate change and, based on a simulation of a global model for selected long-term climate scenarios, present recommendations for monetary policy-makers.

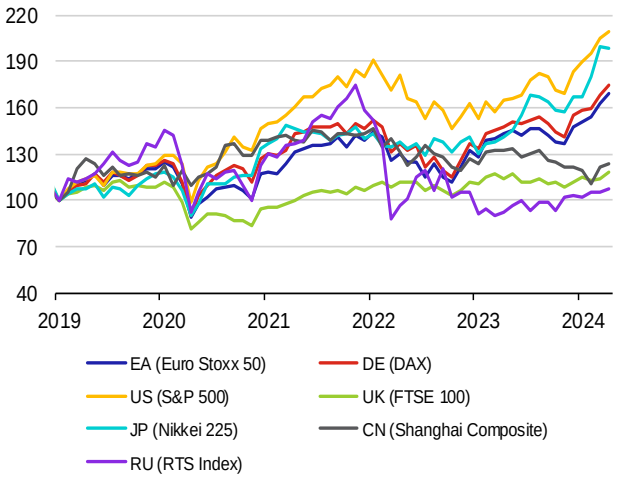
GEO barometer for selected countries

		EA	DE	US	UK	JP	CN	RU
GDP	**2024**	0.5 →	0.1 →	2.3 ↗	0.3 ↗	0.6 →	4.7 →	2.0 →
(%)	**2025**	1.4 ↗	1.1 →	1.7 ↗	1.2 ↗	1.2 ↗	4.4 →	1.4 ↗
Inflation	**2024**	2.3 →	2.4 ↘	2.9 ↗	2.5 →	2.4 ↗	0.8 →	5.3 →
(%)	**2025**	1.9 ↘	2.0 ↘	2.2 →	2.2 →	1.8 ↗	1.6 ↗	4.5 →
Unemployment	**2024**	6.6 →	5.9 →	4.0 →	4.3 ↘	2.4 ↘	3.4 →	2.5 →
(%)	**2025**	6.6 →	5.7 →	4.1 ↘	4.3 ↘	2.4 →	3.4 →	2.3 →
Exchange rate	**2024**	1.10 ↘	1.10 ↘		1.28 ↗	138.0 ↗	7.09 ↗	96.1 ↘
(against USD)	**2025**	1.13 ↘	1.13 ↘		1.31 ↗	128.9 ↗	6.87 ↗	95.6 ↗

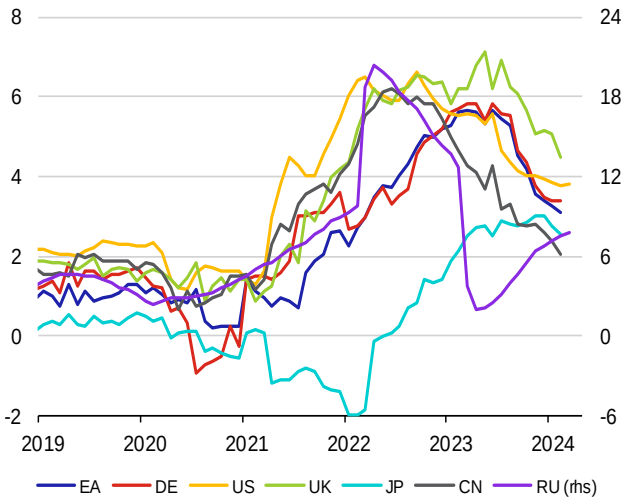
Source: Consensus Forecasts (CF)
Note: The arrows indicate the direction of the revisions compared with the last GEO.

II. Macroeconomic barometer

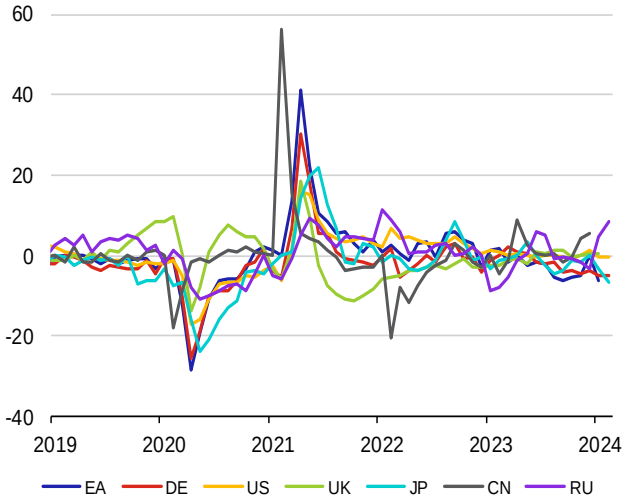
Equity markets development, index 100 = January 2019



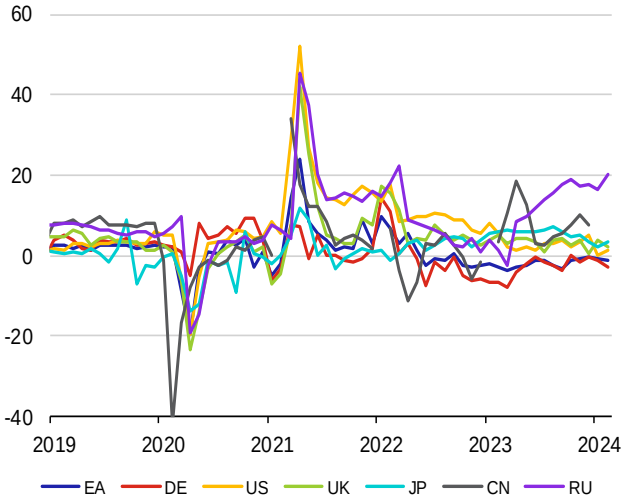
Core inflation, %



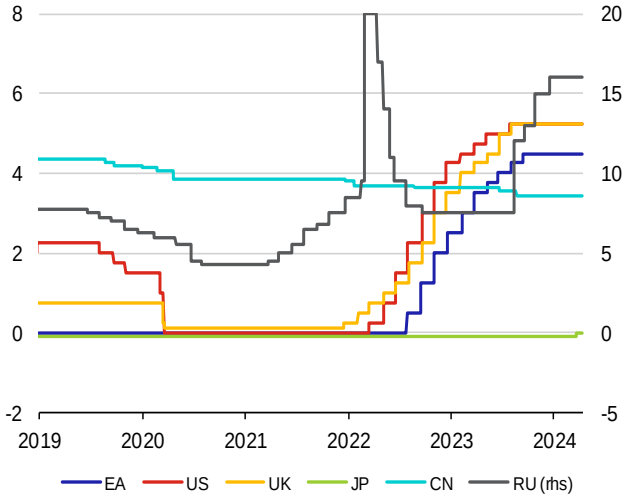
Manufacturing production, yoy %



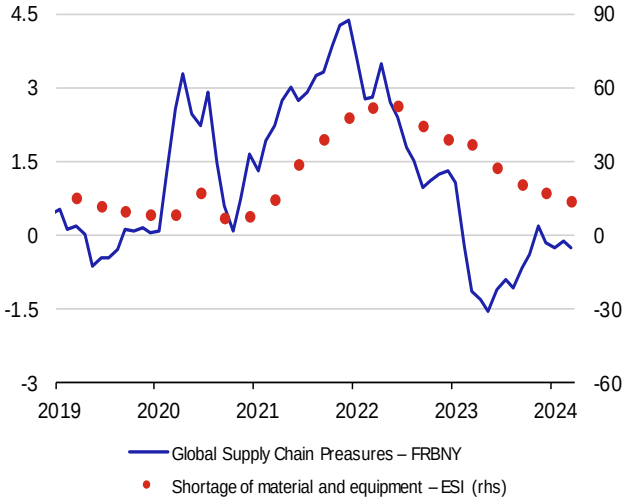
Retail sales, yoy %



Monetary policy rates, %



Supply chains development



Source: Refinitiv Datastream, European Commision.

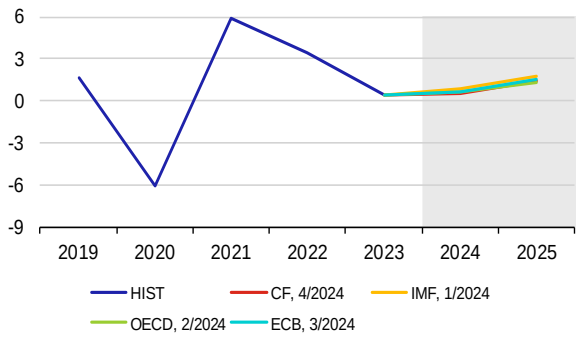
III.1 Euro area

Economic activity in the euro area remains subdued, but will accelerate significantly next year. Consumers are still holding back. Exports are being dampened by a slowdown in external demand and by a loss of competitiveness in the euro area as a result of the energy crisis. Exhausted order books and a tight monetary policy discourage firms from investing. However, the economy will gradually recover thanks to an expected pick-up in real income and external demand. The recovery will initially only be gradual. A more pronounced recovery can be expected in the second half of the year and next year, when investment activity will also build on the gradual normalisation of monetary policy by the ECB. CF respondents expect GDP to grow by 0.5% this year and 1.4% next year and to slow to 1.1% in the long term.

The latest data show that the economy bottomed out tentatively at the turn of the year. Data for individual economies indicate that euro area industrial production increased month on month in February. Construction also performed well. A recovery is also confirmed by the composite PMI, which exceeded the 50-point level for the first time in nine months. Similar signals are sent by other surveys. Although sentiment about the current situation is still by no means impressive, the rising ZEW index shows that analysts are increasingly convinced of future improvements. However, consumer optimism is still lacking, as retail sales fell again in February after stagnating in January. Real wages have been rising for some time now, but only at a modest pace, and households' uncertainty and concerns about future developments have not yet disappeared.

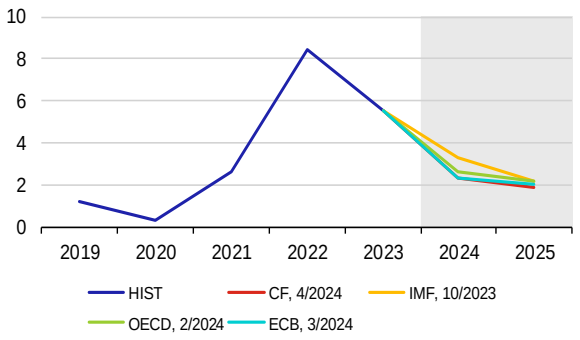
The first ECB rate cut is expected in June. The disinflation process is continuing at a gradual pace. Annual inflation slowed to 2.4% in March and core inflation fell below 3%. Month-on-month growth is currently being affected by the floating date of Easter, and year-on-year trends in the months ahead will also be influenced by the base effects of last year's energy price inflation. The European Central Bank left its key interest rates unchanged in April, but added in its statement an explicit reassurance that it was ready to ease the degree of monetary restriction once it is more certain that inflation is approaching the 2% target in a sustainable manner.

GDP growth, %



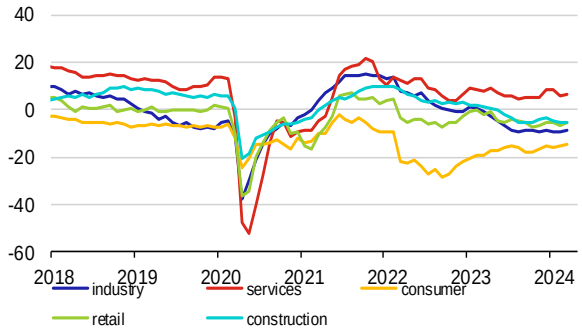
	CF		IMF	OECD	ECB
2024	0.5	→	0.9	0.6	0.6
2025	1.4	↗	1.7	1.3	1.5

Inflation, %



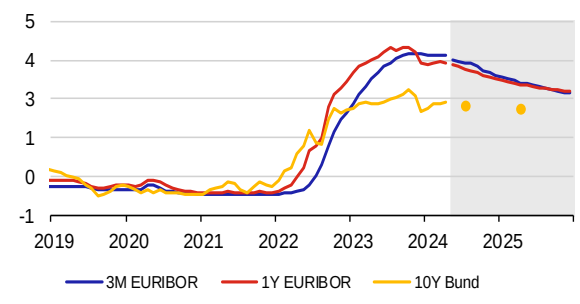
	CF		IMF	OECD	ECB
2024	2.3	→	3.3	2.6	2.3
2025	1.9	↘	2.2	2.2	2.0

ESI leading indicators



	industry	services	consum.	retail	constr.
1/24	-9.2	8.4	-16.1	-5.6	-4.6
2/24	-9.4	6.0	-15.5	-6.6	-5.5
3/24	-8.8	6.3	-14.9	-5.7	-5.6

Interest Rates, %



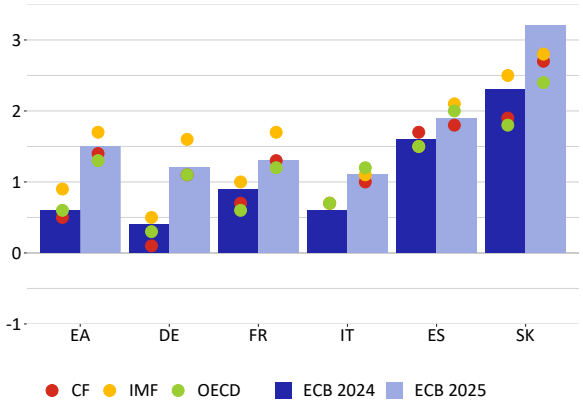
	3/24	4/24	7/24	4/25
3M EURIBOR	3.92	3.89	3.67	3.03
1Y EURIBOR	3.72	3.67	3.47	2.97
10Y Bund	2.34	2.39	2.30	2.20

III.2 Germany

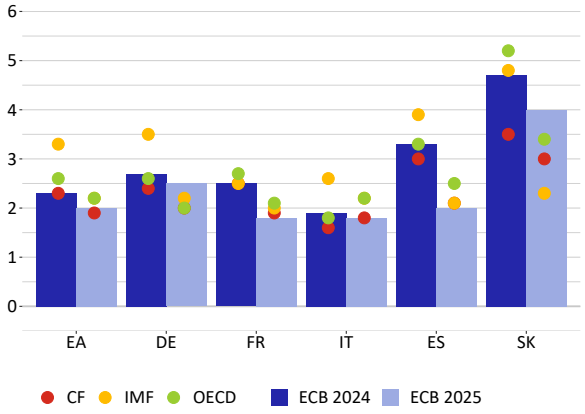
Germany's leading economic research institutes are reducing economic growth forecasts for Germany. Five institutes in total expect GDP to grow by just 0.1% this year owing to falling exports and weak domestic demand. Although a recovery is likely to occur from the spring, overall dynamism will not be very strong. Growth is set to accelerate to 1.4% in 2025. CF also predict GDP growth of 0.1% in 2024, but is slightly more pessimistic about next year (1.1%). The German economy contracted by 0.3% last year, mainly because of the affected manufacturing sector and a fall in consumer spending. However, the economy was also affected by a sharp fiscal tightening. According to indicators and surveys, however, sentiment (both consumer and business) is starting to rise very slowly, so the economy has at least some hope despite an unexpected fall in retail sales in February and subdued demand. According to GfK, consumer expectations regarding income improved, but the willingness to purchase remains low. According to the Ifo and ZEW indices, corporations' expectations regarding the coming months improved significantly, although their assessment of the current situation did not. Moreover, the composite PMI rose slightly in March (47.7), i.e. private sector activity fell at its slowest pace in the last four months, mainly reflecting the stabilisation of activity in the services sector (50.1). However, the manufacturing sector continues to contract (41.9).

Consumer prices increased in March the least in almost three years. Harmonised inflation slowed to 2.3% year on year (compared to 2.7% in February), the lowest level since June 2021, when inflation stood at 2.1%. Energy prices fell again, despite the end of the "brake" and the introduction of a higher carbon price as of January 2024. Food prices also fell for almost the first time in a decade. In general, declines in energy and food prices and slower growth in goods prices have offset a pick-up in services price inflation. Core inflation fell very slightly (by 3.3%). The new CF forecast was slightly more optimistic than in the previous month, as it expects inflation to reach 2.4% this year and slow to 2% next year. Industrial producer prices continued to fall year on year in February (by 4.1%) due to lower prices of energy and intermediate goods.

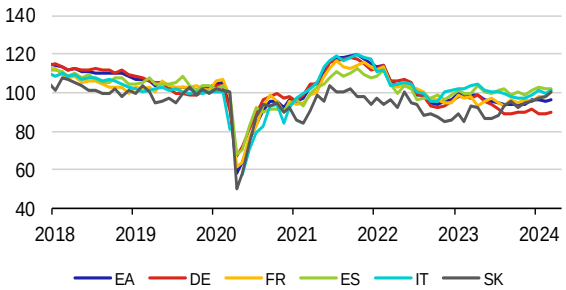
GDP growth in selected euro area countries in 2024 and 2025, %



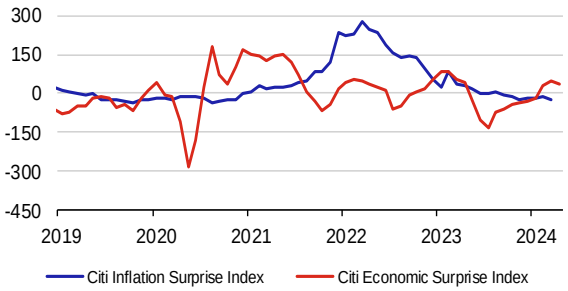
Inflation in selected euro area countries in 2024 and 2025, %



ESI leading indicators



Economic and inflation surprises in the euro area, %



	EA	DE	FR	ES	IT	SK
1/24	96.1	89.5	98.2	102.6	100.9	97.2
2/24	95.5	88.9	98.1	102.4	99.4	98.2
3/24	96.3	89.8	100.7	102.0	100.9	100.1

Inflation expectations based on 5year inflation swap and SPF

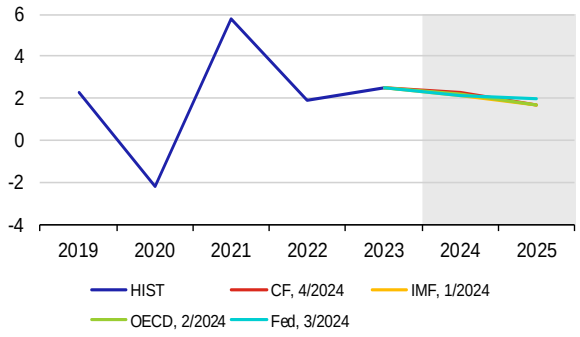
	5y5y	SPF
2/24	2.27	2.05
3/24	2.29	2.05
4/24	2.33	

III.3 United States

The GDP growth outlook for the US economy has again shifted upwards for both this year and the next. GDP growth exceeded expectations in the fourth quarter of last year, supporting the optimistic outlook for the successful soft landing that the central bank is trying to achieve. The main drivers of US economic growth are domestic consumption, which is being fostered by low unemployment, and growth in jobs in non-agricultural sectors. More than 300 thousand of these jobs were created in March, which again exceeded expectations and the situation points to the fact that even higher rates have not yet managed to cool the labour market significantly. However, as we pointed out in the previous issue of GEO, the growth is not equal, but is concentrated only on certain sectors in the economy. The number of people employed is thus rising mainly in healthcare, civil service and construction, while employment in other sectors is increasing only minimally or not at all.

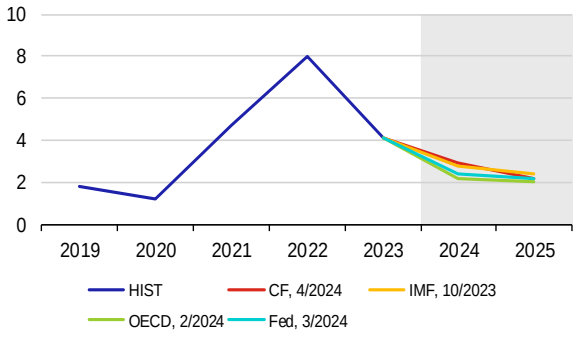
In line with market expectations, the US Fed left rates unchanged in March and the new inflation figures raised the probability that the first rate cut would be postponed. The surprisingly high figures for annual consumer price inflation in March, which amounted to 3.5% (compared to 3.2% in February), indicate that the slowdown in inflation will not be as fast as the US Fed and economists expected. Core inflation remained at 3.8%. As in other economies, prices in services are rising at a pace above the price stability objective. Some analysts still expect the first rate cut in the summer, but the predictions shifted from June to the July monetary policy meeting. However, after the new inflation figures, markets are continuing to shift their predictions to September. The new CF analysts' outlook expects consumer prices to rise by almost 3% this year, although the Fed's new outlook expects 2.4%. The outlook for next year remains at 2.2%. The long-term outlooks of CF analysts expect inflation in the USA to fluctuate around 2.2%, which is above the Fed's long-term target.

GDP growth, %



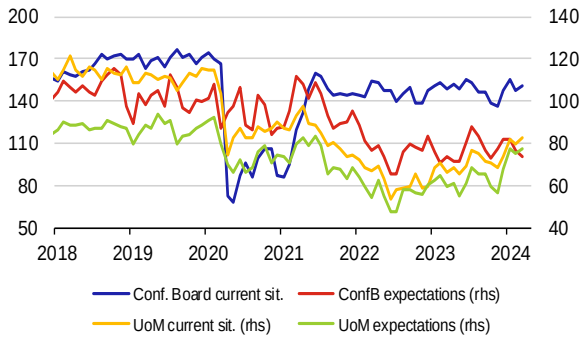
	CF	IMF	OECD	Fed
2024	2.3	2.1	2.2	2.1
2025	1.7	1.7	1.7	2.0

Inflation, %



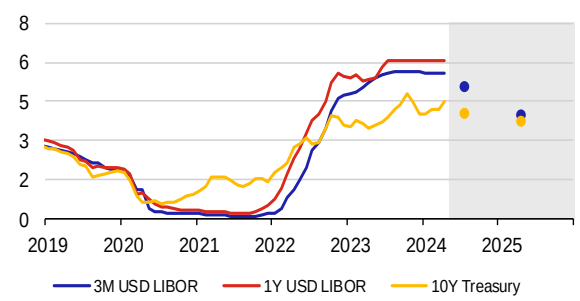
	CF	IMF	OECD	Fed
2024	2.9	2.8	2.2	2.4
2025	2.2	2.4	2.0	2.2

Leading indicators



	ConfB curr.	ConfB exp.	UoM curr.	UoM exp.
1/24	154.9	81.5	81.9	77.1
2/24	147.6	76.3	79.4	75.2
3/24	151.0	73.8	82.5	77.4

Interest Rates, %



	3/24	4/24	7/24	4/25
USD LIBOR 3M	5.58	5.56	5.10	4.00
USD LIBOR 1R	6.04	6.04		
Treasury 10R	4.21	4.47	4.10	3.80

III.4 China

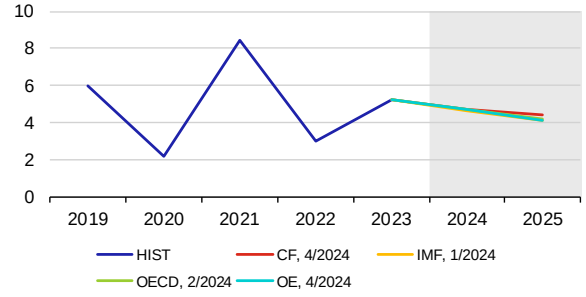
The Chinese economy's recovery in the first few months of this year was reflected in strong industrial production data for January and February. The expansion was 7% year on year, more than the 6.8% reported in December 2023 and 2 pp more than most analysts' forecasts. Private consumption rose year on year in January and February, but more slowly than at the end of last year. Unemployment in urban areas edged up to 5.3%, close to the July 2023 level.

Caixin's business confidence index in March (52.7) was a little higher than in the previous two months (52.5). The non-manufacturing sector including services (53) was the biggest contributor to this result, while the same indicator for the manufacturing sector (51.1) lagged behind, although it also increased compared to February. Business sentiment in industry moved into the expansion area (50.8) in March after six months in the contraction zone.

Consumer price inflation was positive year on year in March (0.1%), although markedly lower than in February (0.7%). In month-on-month terms, by contrast, consumer prices recorded a 1% decline following four months of growth, reversing growth of 1% a month earlier. The largest decreases were seen in the prices of food and transport. In the clothing, housing, healthcare and education segments, which contributed the most to price growth in recent months, costs have either slowed down or remained flat compared to the previous month. Core inflation remained positive (0.6% year on year), but price rises were half what they were in February.

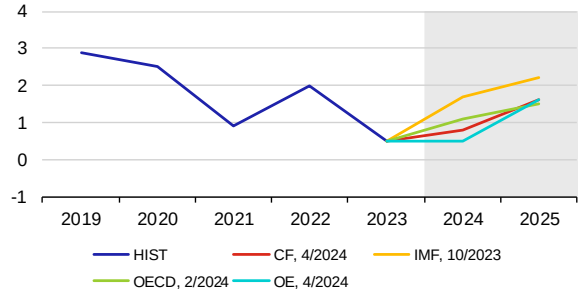
Chinese exports currently reflect an overall recovery in international trade. Annual growth of 7.1% was recorded in January–February. Exports to the economies of most major trading partners grew, except the EU, Japan, South Korea and Australia, as well as across sectors with the exception of rare earth and steel. Imports in January–February also grew (3.5%) even more than analysts expected, although some territories such as the US, EU, Japan and Australia saw declines. The trade surplus thus increased further in January–February (foreign trade data and many other indicators were reported for both months at the same time this year due to the need to smooth the effect of the moving lunar new year in year-on-year data).

GDP growth, %



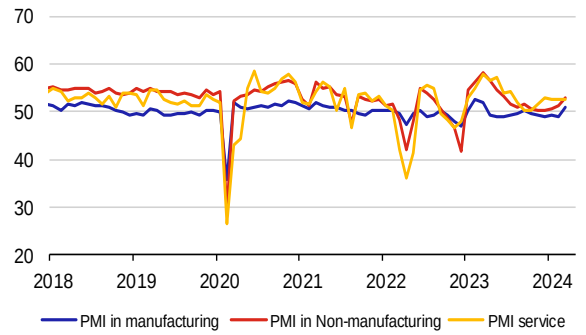
	CF	IMF	OECD	OE
2024	4.7	4.6	4.7	4.7
2025	4.4	4.1	4.2	4.1

Inflation, %



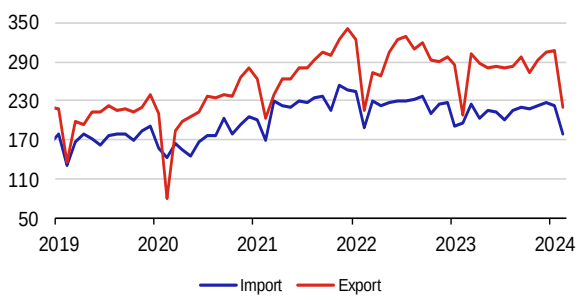
	CF	IMF	OECD	OE
2024	0.8	1.7	1.1	0.5
2025	1.6	2.2	1.5	1.6

Leading indicators



	PMI manuf.	PMI in Non-manufacturing	PMI service
1/24	49.2	50.7	52.7
2/24	49.1	51.4	52.5
3/24	50.8	53.0	52.7

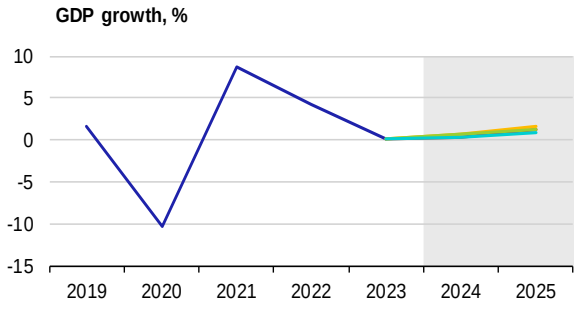
Development of China foreign trade, bil. USD



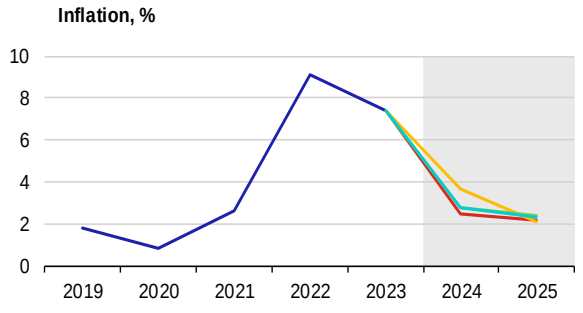
Source: Bloomberg

III.5 United Kingdom

After its March meeting, the BoE left its key interest rate at the 16-year high of August last year. For the fifth time in a row, the rate was 5.25%. The restrictive monetary policy stance is leading to an easing of the labour market and diminishing domestic inflation pressures, but key services price growth remains elevated (it was 6.1% in February). Consumer price inflation slowed to 3.4% year on year in February, its lowest level since 2021, thanks mainly to food. Core inflation also slowed, to 4.5%. The BoE expects inflation to slow below the 2% target in Q2 and then rise slightly again. The official data confirmed that the UK economy fell into recession in the second half of last year, reflecting, among other things, the impact of the cost of living crisis. However, the economy is expected to return to growth, which CF now estimates at 0.3% this year and 1.2% next year. Indicators such as retail sales and consumer and business sentiment have been cautiously improving. The composite PMI indicator in March showed growth in the private sector (52.8) for the fifth month in a row and manufacturing sector also started to grow in addition to services.



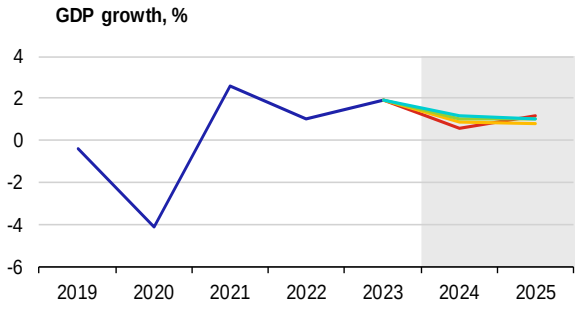
	CF	IMF	OECD	BoE
2024	0.3	0.6	0.7	0.3
2025	1.2	1.6	1.2	0.8



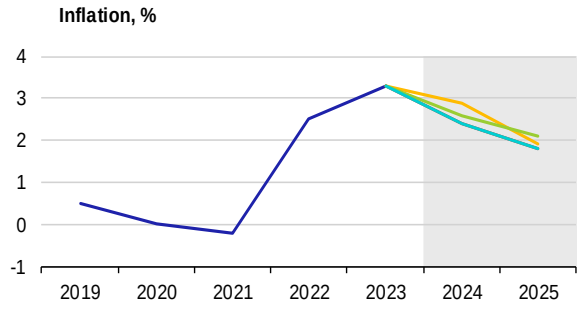
	CF	IMF	OECD	BoE
2024	2.5	3.7	2.8	2.8
2025	2.2	2.1	2.4	2.3

III.6 Japan

While other advanced economies are improving their growth outlook and timing the easing of monetary policy, the Japanese economy is cooling and preparing to tighten further. Japan has been departing from global trends since the start of the global inflation wave in 2022. It is also in an unusual situation now that GDP is stagnating, the labour market is cooling and core inflation is slowing, but the BoJ raised rates in March for the first time in 14 years and, as expected, may tighten monetary policy again this year. The tightening of monetary conditions may also be boosted by the government, which warned the market that it was ready to intervene to strengthen the yen. In both cases, however, this is a shift from a very accomodative starting position – rates in Japan are still close to zero and the yen recently reached a 34-year low against the dollar. Improving business sentiment in leading indicators and strengthening wage growth, which may support weak consumption, also favour a tighter policy.



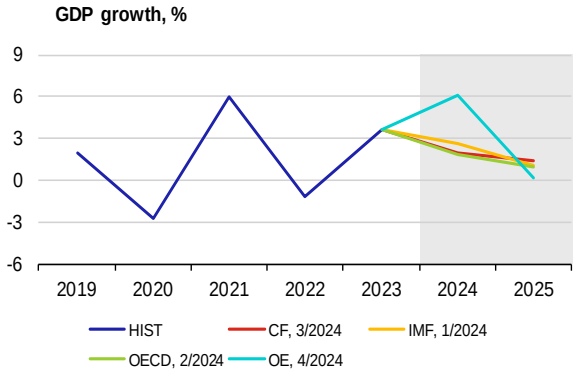
	CF	IMF	OECD	BoJ
2024	0.6	0.9	1.0	1.2
2025	1.2	0.8	1.0	1.0



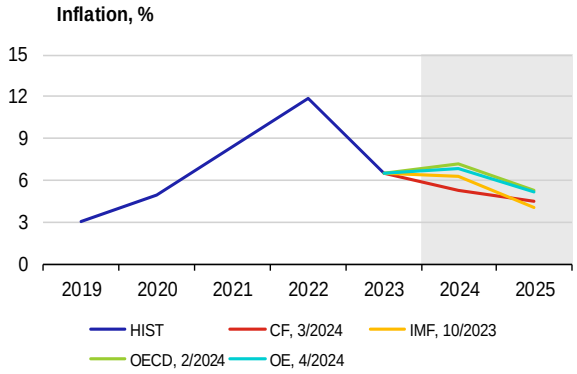
	CF	IMF	OECD	BoJ
2024	2.4	2.9	2.6	2.4
2025	1.8	1.9	2.1	1.8

III.7 Russia

The CBR left its key interest rate at 16% for the second time in a row at its March meeting. Month-on-month inflation fell from 0.7% in February to 0.4% in March and annual inflation picked up slightly to 7.7%. Although households and businesses have reduced their inflation expectations in recent months, they remain high. Expectations in retail even rose slightly in March. The tight labour market caused a historically low unemployment rate again. The share of trading in Chinese renminbi in the Russian foreign exchange market peaked in March, with the Russian central bank saying that it did not have a better alternative for its reserves, as the exchange rates of friendly countries' currencies are often highly volatile, less liquid and restrictions on capital movements exist in a number of such countries. Although the consequences of large-scale drone attacks on Russian refineries persist, daily refined oil volumes picked up at the beginning of this month. Despite this, the quantity of oil refined in recent weeks is close to its lowest level since May 2023.



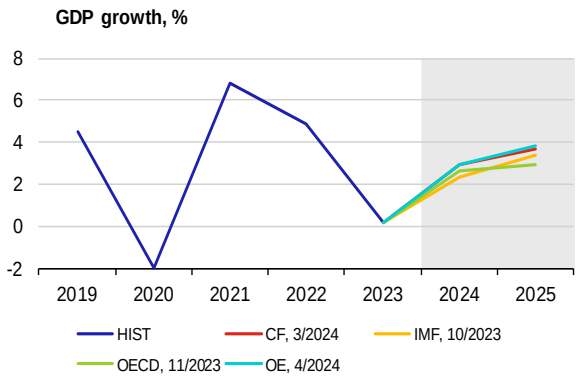
	CF	IMF	OECD	OE
2024	2.0	2.6	1.8	6.1
2025	1.4	1.1	1.0	0.2



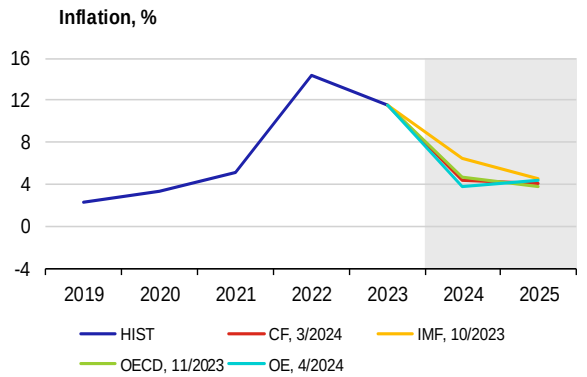
	CF	IMF	OECD	OE
2024	5.3	6.3	7.2	6.8
2025	4.5	4.0	5.3	5.2

III.8 Poland

Inflation in Poland slowed sharply in March, but the central bank remains cautious and is waiting to make rate cuts. Annual inflation fell sharply again in March (from 2.8% to 1.9%) and was thus inside the central bank's 1.5%–3.5% target band for the second consecutive month. In month-on-month terms, CPI rose by 0.2%. However, at its April meeting, the National Bank of Poland left interest rates unchanged at 5.75% for the sixth time owing to still high core inflation (4.5%) and uncertain future price trends. In April, the government restored the 5% VAT rate on food (that was temporarily reduced to zero in February 2022), which could increase inflation by up to 1 pp. Energy prices remain frozen until the end of June and could also contribute to higher inflation in the second half of the year. Strong wage growth in the private sector, which stood at almost 13% in both January and February, also poses a risk, whereas unemployment was flat at 5.4% in February. The real economy is showing signs of recovery. Year-on-year retail sales growth accelerated from 3% to 6.1% in February and industrial production growth surprisingly rose from 2.9% to 3.3% amid solid manufacturing output. Inflation is thus being dampened only by a persisting annual decline in producer prices, which exceeded 10% in both January and February.



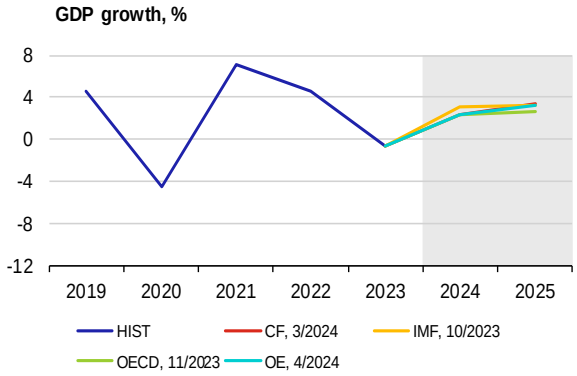
	CF	IMF	OECD	OE
2024	2.9	2.3	2.6	2.9
2025	3.7	3.4	2.9	3.8



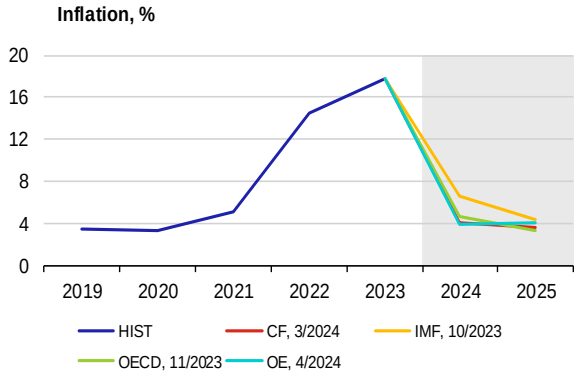
	CF	IMF	OECD	OE
2024	4.3	6.4	4.7	3.7
2025	4.0	4.5	3.7	4.4

III.9 Hungary

Falling inflation in Hungary is enabling monetary policy to ease further, albeit at a slower pace. As expected, the central bank (MNB) lowered its reference rate by 0.75 pp to 8.25% in March. This was the sixth reduction in the rate since October 2023. The MNB assesses both domestic and external inflation pressures as low and domestic inflation thus enables a further decrease in interest rates. However, favourable disinflationary factors will cease to have an effect from the middle of the year onwards, and the pace of rate cuts is thus likely to slow so as not to endanger exchange rate stability. However, the central bank rate is expected to continue falling until the middle of the year (to around 6.5%–7%). According to the MNB, inflation should be between 3.5% and 5% this year and between 2.5% and 3.5% in the next two years. GDP growth will reach 2%–3% this year and rise to 3.5%–4.5% next year. Inflation in March met the central bank's expectations, slowing further from 3.7% to 3.6%, the lowest level since February 2021. Core inflation fell from 5.1% to 4.4%, the lowest figure in 30 months. In month-on-month terms, CPI rose by 0.8%. Inflation remains highest in the services sector. As regards the real economy, the situation remains fragile. Construction did not repeat its strong January growth. By contrast, following a decline of 3.6% in January, industrial production rose by 1.8% year on year in February (the first increase since December 2022) and by 3.5% month on month (seasonally adjusted). Retail sales growth accelerated from 0.6% to 1.1% in February, but sales fell by 0.6% month on month. Households are therefore remaining cautious in their spending, although wage growth remains high (it slowed from 16.4% to 14.6% year on year in January). The average unemployment rate for the three months from December to February was 4.7%, up from 4.1% a year ago. The trade balance showed a record surplus in February, thanks to a sharp fall in imports.



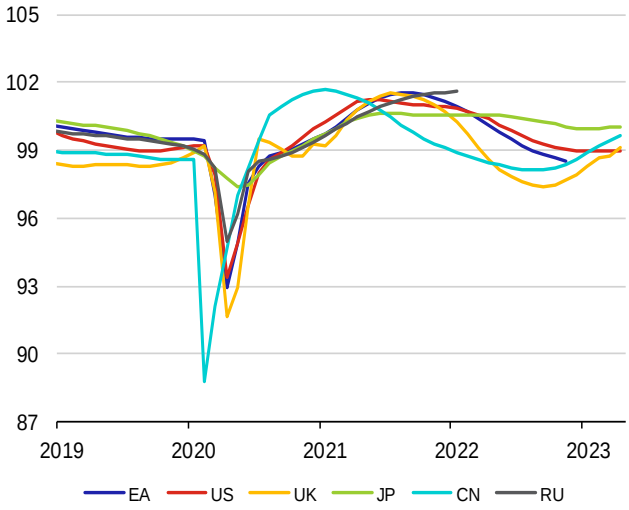
	CF	IMF	OECD	OE
2024	2.4	3.1	2.4	2.3
2025	3.4	3.3	2.7	3.3



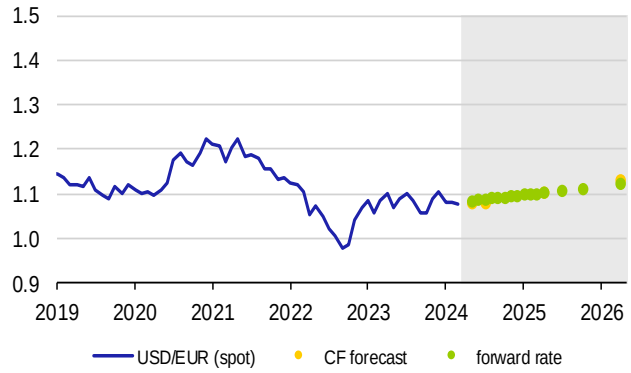
	CF	IMF	OECD	OE
2024	4.0	6.6	4.6	3.9
2025	3.6	4.3	3.3	4.1

IV. Leading indicators and exchange rate outlooks

OECD Composite Leading Indicator

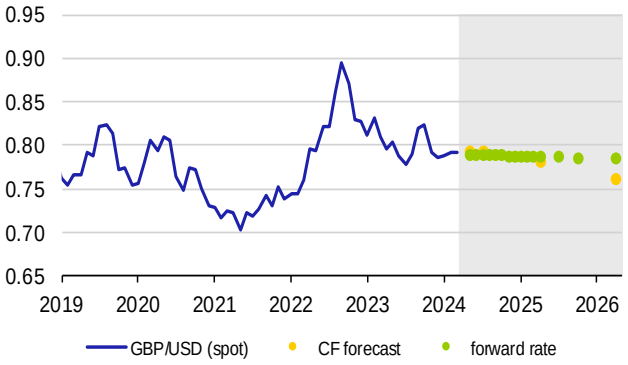


The US dollar (USD/EUR)



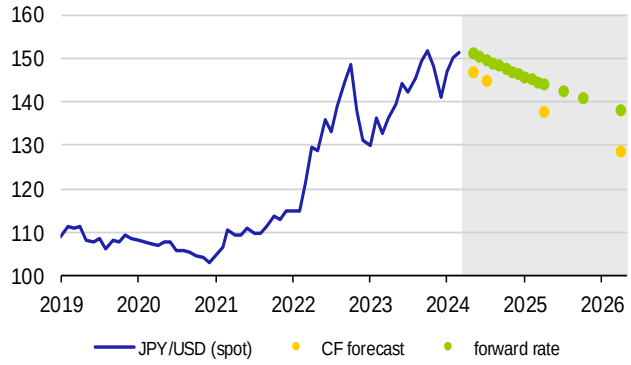
	8/4/24	5/24	7/24	4/25	4/26
spot rate	1.085				
CF forecast		1.081	1.082	1.104	1.132
forward rate		1.087	1.090	1.104	1.124

The British pound (GBP/USD)



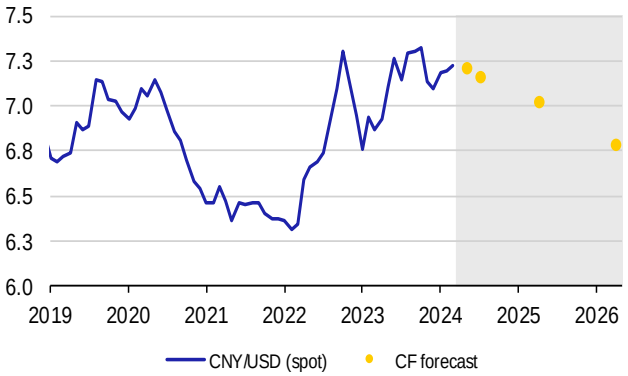
	8/4/24	5/24	7/24	4/25	4/26
spot rate	0.791				
CF forecast		0.794	0.794	0.783	0.763
forward rate		0.790	0.790	0.788	0.785

The Japanese yen (JPY/USD)



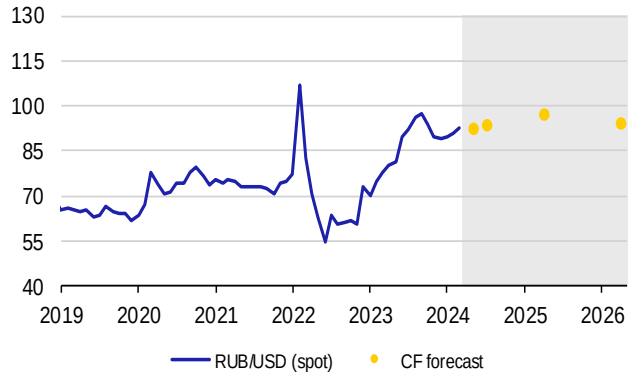
	8/4/24	5/24	7/24	4/25	4/26
spot rate	151.8				
CF forecast		146.9	145.0	138.0	128.9
forward rate		151.1	149.7	144.1	138.1

The Chinese renminbi (CNY/USD)



	8/4/24	5/24	7/24	4/25	4/26
spot rate	7.244				
CF forecast		7.209	7.167	7.023	6.793

The Russian rouble (RUB/USD)



	8/4/24	5/24	7/24	4/25	4/26
spot rate	92.60				
CF forecast		92.42	94.04	97.68	94.60

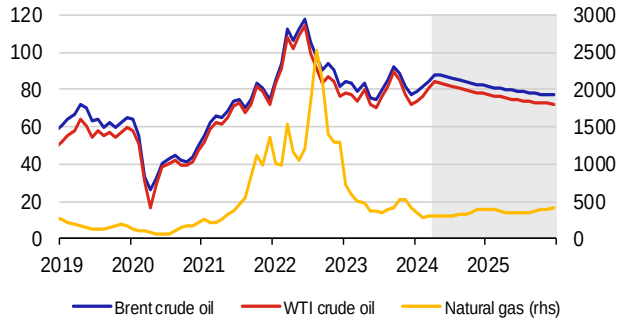
Note: Exchange rates as of last day of month. Forward rate does not represent outlook; it is based on covered interest parity, i.e. currency of country with higher interest rate is depreciating. Forward rate represents current (as of cut-off date) possibility of hedging future exchange rate.

V.1 Oil

The Brent crude oil price started to rise sharply in mid-March and exceeded USD 90/barrel in early April. Amid solid growth in global demand, limited production in OPEC+ is maintaining an oil supply deficit in the physical market. In addition to the fundamentals, however, the price of oil is being increased by a risk premium due to gradually rising geopolitical tensions in the Middle East and Eastern Europe. Attacks by Ukrainian drones took part of the capacity of Russian refineries out of action, which is particularly visible in fuel markets. Chinese refinery demand has been growing strongly since the start of the year and global demand for oil is expected to slowly reach new historical highs until August. This has also led to an improvement in sentiment among financial investors, who are increasing their net long positions in oil. The increase in physical market tensions was also fostered by tighter sanctions imposed by the USA on Russian oil exports and by reduced oil exports from Mexico. However, stronger growth in oil prices is prevented by the fact that large central banks are keeping interest rates at an elevated level. The higher rates in the USA are supporting the dollar and leading to potentially weaker demand for oil.

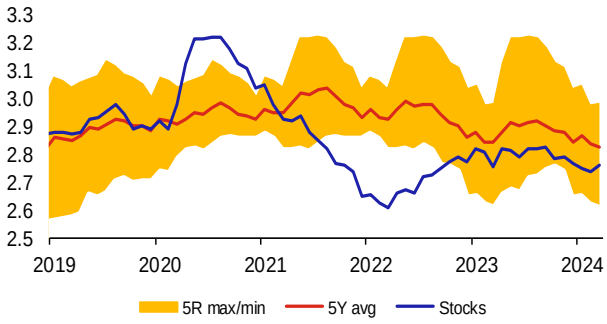
The EIA further increased its oil price forecast for this year and the next. Owing to an expected sharp decline in global inventories and persisting geopolitical tensions, the Brent price is expected to rise gradually this year to USD 92/barrel in August and then start to fall after the driving season ends. Furthermore, the EIA expects OPEC+ to end production cuts in 2025 and global inventories should turn to modest growth, leading to a fall in the Brent crude oil price to USD 85/barrel at the end of the year. The market curve in the first half of April also shifted upwards, but remains falling and implies a significantly lower path for future Brent crude oil prices (USD 82.1 and USD 76.9/barrel at the end of this year and the next respectively). The April CF is still roughly in the middle of these forecasts, with a prediction of USD 83.2/barrel at the one-year horizon.

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

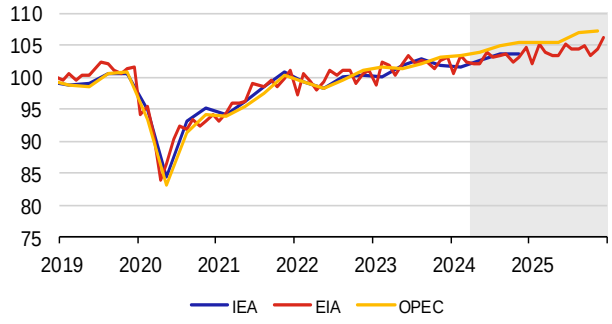


	Brent	WTI	Natural gas
2024	84.22	79.85	329.56
2025	79.07	74.39	371.40

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

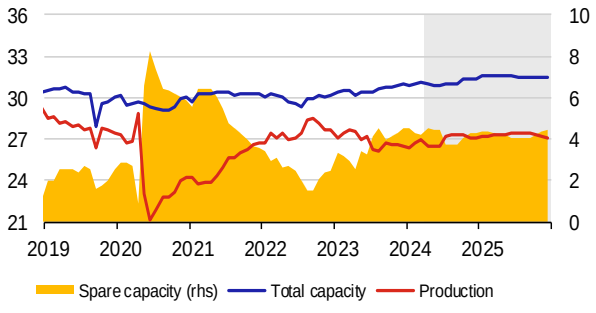


Global consumption of oil and oil products (mil. barrel / day)



	IEA	EIA	OPEC
2024	102.96	102.91	104.46
2025		104.27	106.30

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



	Production	Total capacity	Spare capacity
2024	26.89	31.06	4.18
2025	27.30	31.52	4.22

Source: Bloomberg, IEA, EIA, OPEC, CNB calculation
Note: Oil price at ICE, average natural gas price in Europe – World Bank data. Future oil and gas prices (grey area) are derived from futures. Industrial oil stocks in OECD countries – IEA estimate. Production and extraction capacity of OPEC – EIA estimate.

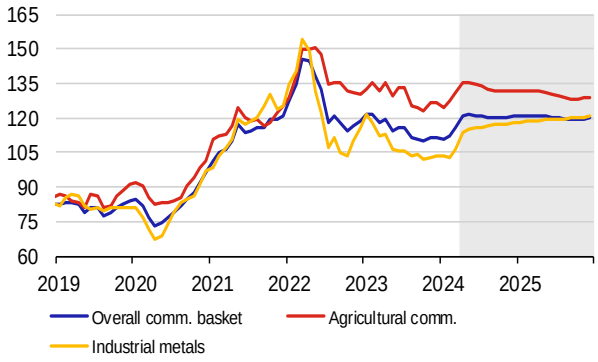
V.2 Other commodities

Following four months of decline, the price of natural gas in Europe increased in March on the back of geopolitical developments in eastern Europe and rose again above EUR 30/MWh in mid-April. Russia recently made attacks also on underground gas tanks in Ukraine. However, the increase in prices was limited due to high gas inventories in Europe. Stronger price growth is also being counteracted by the forecast for warmer weather and higher wind power generation, strong nuclear power generation in France and higher gas supplies from Norway. Together with the gas price, the price of coal for the European market rose due to strong demand from China and tighter US sanctions on Russian exports.

The industrial metals price index rose strongly in March and the first half of April, reaching its highest level since February last year. The prices of all components, except lead, rose. This was due to an improvement in global and Chinese manufacturing activity and a decline in metal inventories at the LME (with the exception of lead). By contrast, the price of iron ore fell for the third month in a row due to weak demand from the steel industry in China. Steel prices in China reached a four-year low in early April due to the bad situation in the construction industry there. Nevertheless, exports of steel from China increased in March, as foreign customers are taking advantage of the low prices and thus offsetting weak domestic demand.

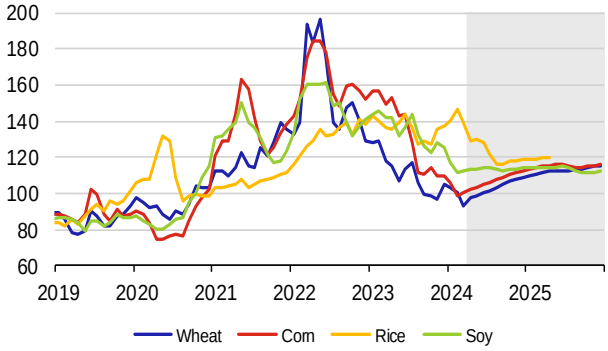
The food commodity price index also continued to rise strongly in April for the third consecutive month, reaching its highest level since February 2023. Wheat prices compensated for the previous decline, while corn and soy prices continued to rise again. Coffee prices surged in early April (due to heavy rain in Brazil and falling exports from Vietnam) and cocoa prices reached another record level (due to adverse weather in West Africa). By contrast, the downward trend in the price of rice continued, and prices of sugar and beef also started to fall slightly in April.

Non-energy commodities price indicies



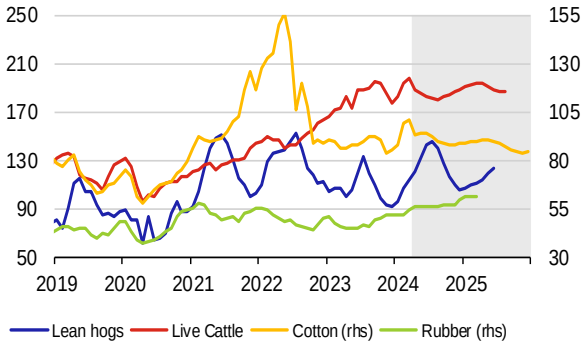
	Overall	Agricultural	Industrial
2024	118.8	131.9	113.3
2025	120.3	130.1	119.5

Food commodities



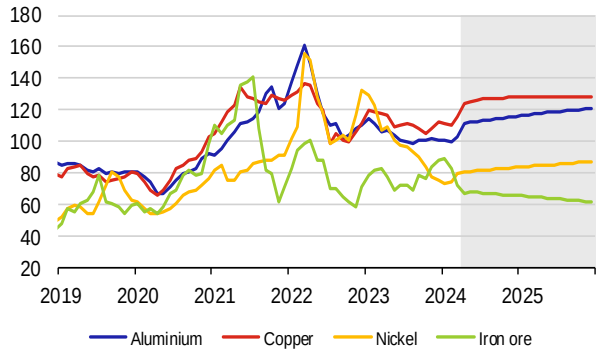
	Wheat	Corn	Rice	Soy
2024	102.4	106.1	126.8	113.6
2025	112.8	115.1	119.4	113.4

Meat, non-food agricultural commodities



	Lean hogs	Live Cattle	Cotton	Rubber
2024	121.1	185.8	92.0	55.6
2025	113.7	190.4	87.6	60.9

Basic metals and iron ore



	Aluminium	Copper	Nickel	Iron ore
2024	110.8	123.4	80.9	70.9
2025	119.1	128.2	85.8	63.9

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.

Impacts of climate change on monetary policy[1]

Climate change has become one of the most pressing challenges facing humanity today. Its impacts are becoming increasingly apparent, mainly in the form of extreme weather fluctuations, putting significant pressure on economies around the world. As the direct environmental impacts of climate change increase in intensity, accompanied by the impacts of climate-related green policies, this factor is also becoming increasingly important for the future optimum monetary policy response from central banks. Climate shocks going beyond the normal business cycle also entail fundamental changes in the structure of individual economies and hence risks to central banks' ability to achieve price stability in the future. However, the current literature – from the perspective of the overall impacts on key macroeconomic variables, including the optimum settings of central bank interest rates – does not lead to clear conclusions. This article aims to identify individual shocks brought about by climate change and, based on a simulation of a global model for selected long-term climate scenarios, present recommendations for monetary policy-makers.

Motivation and objective

There has been a majority consensus over the on-going and worsening impacts of climate change and the need to start preparing for them on a global scale for a long time. Climate change reflects an increase in average temperature due to the elevated concentration of greenhouse gases in the atmosphere caused by human activity, in particular carbon dioxide generated by the combustion of fossil fuels (coal, natural gas and oil). This leads, among other things, to weather changes in the form of the dramatically increasing frequency and magnitude of natural disasters around the world, such as long periods of drought, heat waves, forest fires, or conversely floods, cyclones and hurricanes. This is a very significant global society-wide risk. Representatives of international institutions are still in disagreement as to the level of action they should take in the fight against climate change. The available studies on the macroeconomic impacts of climate change do not yet draw any clear conclusions about the overall impacts of this shock and the implications for monetary policy. There is only quite a strong consensus that the impacts of climate change need to be captured by analytical tools, so that they can be incorporated into decision-making processes, e.g. when deciding on monetary policy.

The aim of this text is to analyse the shocks that climate change brings, including quantifying the impacts on central banks' monetary policy in the world's three largest economies. To answer this question, output from the REMIND-MAgPIE climate model[2] for the three selected long-term climate scenarios proposed in line with the NGFS were used[3]. The economic impacts on individual economies were quantified based on simulations using a global NiGEM model[4] extended to include a climate block with a time horizon up to the end of 2050.

Climate change from a monetary policy perspective

There is a consensus in the current literature[5] that the impacts of climate change on monetary policy settings will be significant. The impacts of climate change can be broadly divided into long-term and short-term ones. From a long-term perspective, studies broadly agree that the repeated and more frequent occurrence of natural disasters will lead to slower potential growth, lower global economic growth and reduced demand due to higher precautionary savings and hence to a lower long-term natural real interest rate, see BoE (2022) and Mongelli et al. (2022). On the other hand, studies also admit that the implementation of transition policies to protect the climate, assuming innovation and investment growth, will, on the contrary, put upward pressure on natural real interest rates. Which influences ultimately prevail in the aggregate will depend on the path that climate policy takes in the world. In the short term, both physical and transition risks may affect inflation in either direction, depending on whether the impact on supply or demand is predominant (Batten et al. (2020)). There is some parallel experience with the COVID-19 pandemic, which, like any other type of natural disaster, manifested itself to a greater extent in the form of a negative supply shock and the related need for a monetary policy response in a restrictive direction, see, for example, Brůha, Motl and Tonner (2021).

However, the literature describes the specific direction of the monetary policy response to the impacts of climate change very cautiously and ambiguously. Climate change will affect price stability through its impact on macroeconomic

[1] Author: Martin Motl. The opinions expressed in this article are his own and do not necessarily reflect the official position of the Czech National Bank.

[2] The Regional Model of Investment and Development (REMIND) is a model encompassing individual regions of the world economy with a focus on the energy sector and implications for the global climate system. The outputs used for the model simulation are based on the link between the REMIND model and the MAgPIE model (Model of Agricultural Production and its Impacts on the Environment).

[3] NGFS (Network for Greening the Financial System) is an association of central banks and supervisory bodies with the aim of sharing best practices, contributing to the development of climate and environmental risk management in the financial sector and mobilising core financial resources to support the transition to a sustainable economy.

[4] This is a global econometric model capturing in detail the interconnectedness of all territories in the global economy. For further details on the NiGEM model and its structure, see Hantzsche, Lopresto and Young (2020).

[5] See, for example, Batten et al. (2020), Bylund (2020), Cantelmo (2020), ECB (2021), Economides and Xepapadeas (2018), NGFS (2019b, 2020a).

indicators such as inflation, output, employment, interest rates, investment and productivity (ECB (2021)). In addition, fiscal policy measures aimed at mitigating the effects of climate change, which also affect monetary policy settings, should be considered. Climate change will also affect the value and risk profile of assets, which may lead to an undesirable build-up of financial risks, see NGFS (2019a). The disruption of financial markets and the associated repricing of climate risks could significantly reduce the prices of some assets during the transition to a low-carbon economy. This will lead to a correction in the financial market with spillovers to the real economy and impacts on monetary policy settings. Further studies by NGFS (2020a) and Bylund (2020) confirm the above conclusions, although they point out that the scale and transmission of these impacts remain highly uncertain. These works underline that the primary objective of central banks is mostly to ensure low and stable inflation; other (e.g. climate policy) objectives can only be achieved if they are in line with price stability, because central banks cannot arbitrarily extend their mandate, see, for example, BoE (2022).

Economic impacts of climate change and green climate policy

The risks stemming from the impacts of climate change can be divided into "physical", related to extreme weather events, and "transition", reflecting the implementation of climate policy. Physical risks include both various types of natural disasters and the negative impacts of high temperatures ("heat waves") on human health, which in turn can lead to the migration of large populations and geopolitical conflicts, see Brzoska and Fröhlich (2015) and Rigaud et al. (2018). The impacts of climate change will affect aggregate supply and demand. On the supply side, rising average temperatures may reduce both productivity and labour availability, as could devastating natural disasters and the associated forced migration of large populations. Extreme events can also physically destroy capital and redirect investments from expanding production into reconstruction work. Shortfalls in the production factors of labour and capital, accompanied by the frequent disruption of global trade chains and division of labour will thus reduce the potential and production capacity of the world's economies. In terms of demand, physical risks will affect the preferences and patterns of economic agents' behaviour, while elevated uncertainty will negatively affect private consumption (precautionary savings) and company consumption (deferred investment). Physical risks will also have a negative impact on asset prices and the financial sector as a whole in the form of growing problems in arranging credit, including major challenges in, for example, the insurance sector. Transition risks represent the economic costs of gradually refocusing towards a low-emission economy. They are due to changes in climate policy, unavoidable technological changes that will require major investments, or changes in consumers' preferences and habits due to new conditions. They may include, for example, new forms of taxation and regulatory restrictions, an increase in the prices of emission allowances, a carbon tax and others. This may cause a decline in the value of certain corporate assets as well as a decline in corporate profitability in some industries. These changes thus also pose risks to the financial system, with further impacts on the real economy. A gradual increase in global temperatures will lead to a shift of resources away from production and innovation towards activities linked to adaptation to climate change. For example, agricultural commodity prices may increase due to lower supply, as some agricultural land will be used for the cultivation of energy crops, thus leaving less land for the cultivation of agricultural crops.

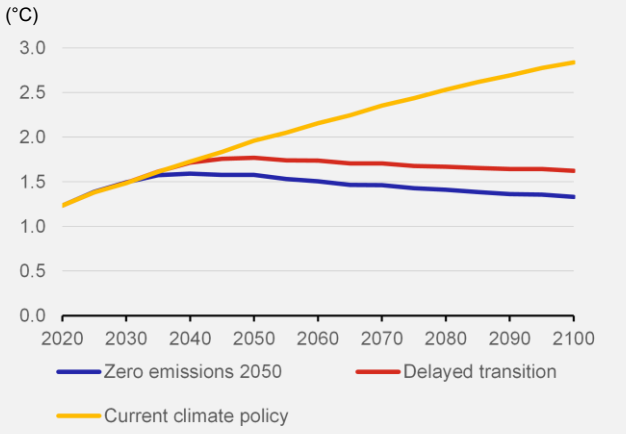
Long-term climate scenarios and model assumptions

Standardised long-term climate scenarios under Phase IV proposed by the NGFS were used to assess the economic impacts of climate change. Climate scenarios, which aim to map potential risks to the financial system in the long term, are broken down into four categories in accordance with the ambition and timing of implementing climate policies, see NGFS (2023). The first category includes orderly transition scenarios, which assume, in particular, relatively weak physical risks over the entire horizon due to the launch of a timely, credible and internationally coordinated climate policy. The second category consists of disorderly transition scenarios, which are characterised by relatively significant materialisation of transition risks arising from late implementation of climate policy or differences in the green transition across countries and sectors. The third category includes scenarios with insufficiently ambitious or no climate policy (*a hot house world*), which assume low or no transition risks and high or even extreme physical risks due to a predicted significant increase in the average global temperature. The latest new category is *too-little-too-late* scenarios, which reflect delays and international differences in the ambition of climate policy, which entail increased transition risks in some countries and high physical risks in all countries due to the overall low effectiveness of the green transition. In total, seven baseline climate scenarios are defined by the NGFS within these categories.

The simulations of the economic impacts of climate change using the NiGEM global model are based on updates to three selected hypothetical scenarios for possible future developments. The first – controlled – "zero emissions 2050" scenario corresponds to limiting global warming in the form of an increase in the average temperature of no more than 1.5 °C compared to 1850–1900 (see Chart 1). After having been slightly exceeded in 2035–2060, this target is achieved again in the second half of the current century. The average temperature increase is expected to fall below 1.4 °C at the end of the century. This scenario is considered quite ambitious, as it assumes the immediate implementation of a strict climate policy, which should lead to net zero CO_2 emissions being achieved by 2050 (see Chart 2). The second – uncontrolled – "delayed transition" scenario is characterised by the slower implementation of a global climate policy, leading to a reduction in global CO_2 emissions after 2030 compared to the previous scenario. Until 2030, this scenario assumes the same use of fossil energy sources as in the "current climate policy" scenario. This will lead to an increase in the median

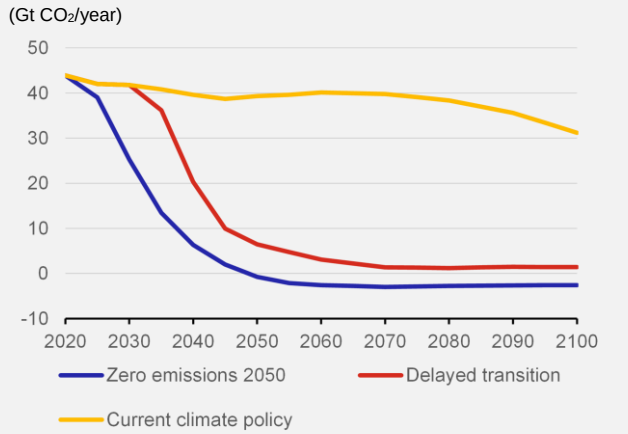
temperature of almost 1.8 °C between 2045–2050. The increase will then fall to 1.6 °C by the end of the century, following post-2030 climate measures in line with long-term temperature targets. The third – hot house world – "current climate policy" scenario is characterised by a continuation of global climate policy in line with current trends in the use of fossil energy sources and only a very slow pace of CO2 reduction. A gradual rise in the global average temperature that will approach 3 °C at the end of the century is consistent with this scenario.

Chart 1 – Average temperature profiles for individual climate scenarios compared to 1850–1900



Source: REMIND-MAgPIE-MAGICC global climate model.

Chart 2 – Total CO_2 emissions in the world

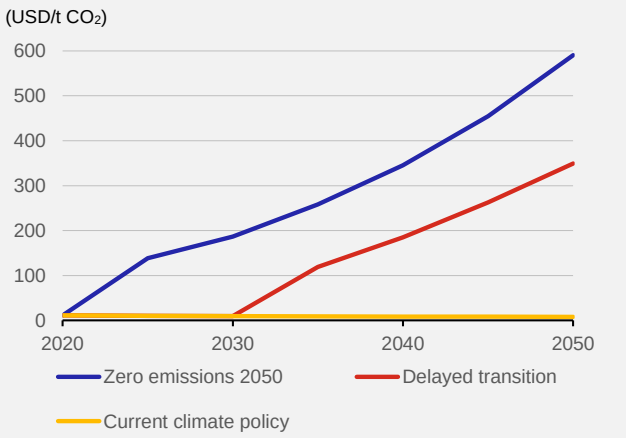


Source: REMIND-MAgPIE global climate model.

The first group of risks modelled consists of physical shocks, i.e. the direct impacts of climate change, which will have a negative impact on both supply and demand. For the above three climate scenarios, negative supply effects as a part of physical shocks have been calibrated for individual world economies on the basis of Kalkuhl and Wenz (2020), building on the projected global temperature profiles corresponding to the selected climate scenarios. Global warming and rising heat waves will have a negative impact on human health, leading to a decrease in labour availability and productivity. The increasing scale and strength of natural disasters will lead to the total or partial physical destruction of capital in the areas hit hardest. Reducing the production factors of labour and capital will lead to a decline in the potential of individual economies and hence to a decrease in total global production capacity (supply). On the demand side, physical shocks will adversely affect private consumption and investment, whose decline was derived from the negative impacts of supply effects on real economic activity. Overall, physical shocks will lead to a decline in GDP. In the case of prices, by contrast, inflationary effects stemming from supply disruptions and anti-inflationary factors reflecting the decline in demand have opposite effects.

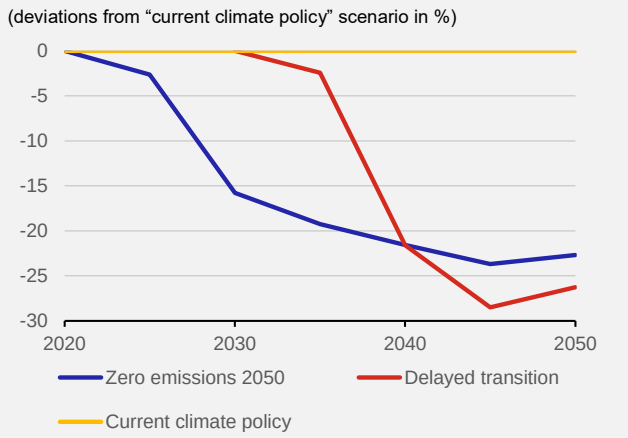
The second group of modelled risks includes transition shocks, i.e. intermediated impacts reflecting the implementation of global climate policy. The calibration of transition shocks for individual economies in the world was performed based on the outputs of the REMIND-MAgPIE global climate model only for the "zero emissions 2050" and "delayed transition" climate scenarios, as the "current climate policy" scenario does not consider transition shocks. As regards transition shocks, the model simulations assume an increase in carbon taxes for both climate scenarios (see Chart 3) and a decline in the energy intensity of production (see Chart 4). In addition, owing to their different structures, shocks

Chart 3 – World CO_2 price



Source: REMIND-MAgPIE global climate model.

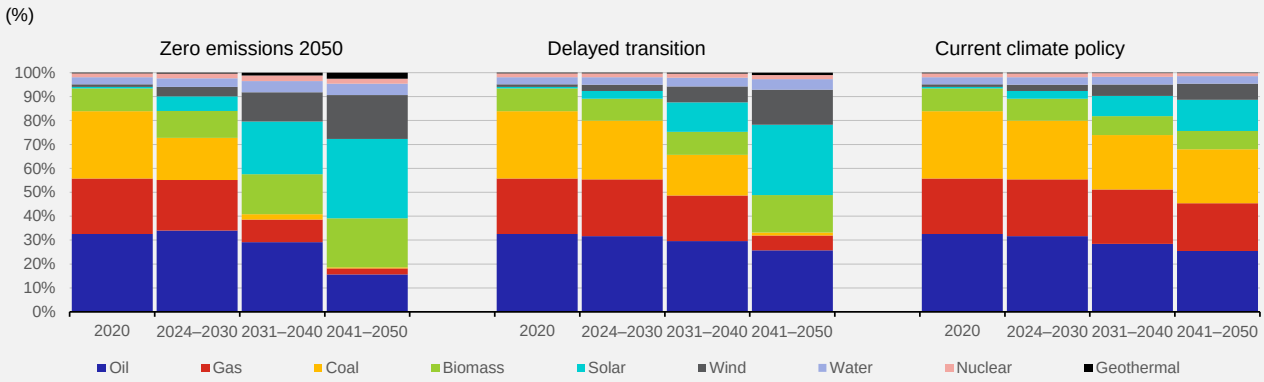
Chart 4 – Energy intensity of production worldwide



Source: REMIND-MAgPIE global climate model.

corresponding to an assumed decline in fossil energy consumption (coal, oil and gas) were calibrated for the individual climate scenarios separately for the individual economies, see Chart 5. A gradual decline in the share of fossil inputs in production will result in a temporary drop in productivity (a negative supply shock) and will therefore be another inflationary factor. Falling consumption and prices of fossil commodities will have the opposite effect on prices, while consumption of renewable energy sources preferred by global climate policy will increase over time.

Chart 5 – World energy consumption assumptions by source of production for each climate scenario



Source: REMIND-MAgPIE global climate model.

Carbon tax revenues will have a positive effect on the public budgets of national governments in the form of a new additional source of income. The model simulation of the "zero emissions 2050" climate scenario assumes that half of revenues stemming from an increase in the carbon tax beginning from the start of the forecast horizon will be returned to the economy by national governments in the form of investment. The remaining half of the carbon tax revenues will be used to reduce government debt. In the case of the "delayed transition" climate scenario, where the implementation of climate policy is delayed and carbon tax increases only after 2030, leading to lower overall revenues than in the previous scenario, these additional revenues are redistributed by national governments back to the economy through direct tax cuts. In addition, in this scenario, this positive fiscal shock after 2030 will be dampened over the next two years by negative sentiment of households and companies, which will be shaken by sudden changes in the course of climate policy. The delay in implementing climate policy will be reflected in the lower willingness of households to consume and an increase in precautionary savings. The increased uncertainty caused by the rapid introduction of new regulatory measures will also lead to an increase in the risk premium and lower corporate investment activity.

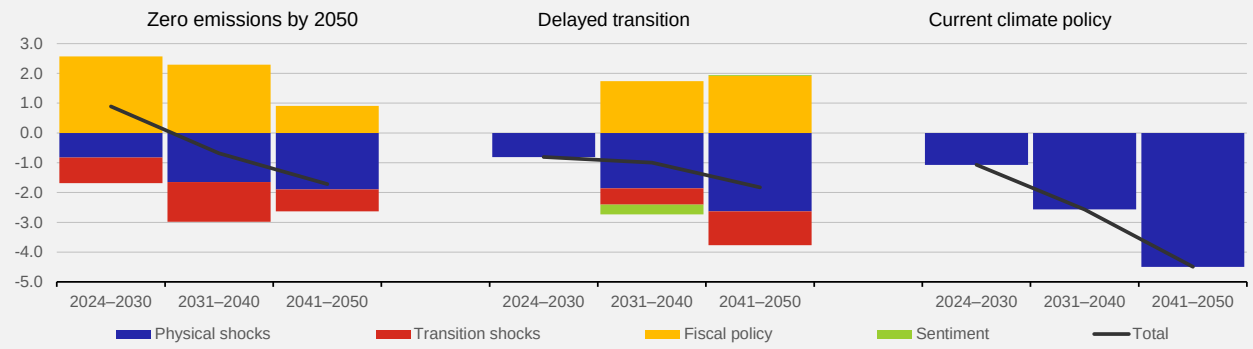
Impacts of climate change on GDP and inflation without a monetary policy response

In order to quantify the overall impacts of the interactions between different combinations and types of shocks for the individual climate scenarios, a simulation was first performed using the NiGEM model without a monetary policy response.[6] In the case of physical shocks, all three scenarios inevitably lead to greater or smaller direct negative impacts of climate change on GDP (see Chart 6). These effects reducing real economic activity are joined in the "zero emissions 2050" and "delayed transition" scenarios by the impacts of transition shocks reflecting the implementation of climate policy, which on the one hand further deepens the decline in GDP. However, if climate policy is implemented in good time, see the "zero emissions 2050" scenario, and if carbon tax revenues are used and partly distributed as government investment back into the economy, the negative impacts on GDP can be significantly eliminated or, in this scenario, even a positive overall impact on real economic activity can be achieved in the short term. In the event of a later implementation of climate policy after 2030, see the "delayed transition" scenario, in addition to the negative impacts reflecting physical shocks, temporarily worse sentiment among households and companies is added to the negative impacts of transition shocks. While both scenarios sooner or later have a negative impact on GDP, unlike the "current climate policy" scenario they lead to a very sharp slowdown in global warming and the negative effects on the economies of the world after 2050 will be low in these scenarios. On the contrary, the "current climate policy" scenario will significantly amplify the negative impacts of climate change over time, which will entail irreversible damage to the environment, human health and huge economic costs after 2050. Delaying the implementation of climate policy will require a stronger response in the future, with the effectiveness of such a response being reduced over time as a result of increased global temperature, and the damage caused by global warming will increase.

[6] All the model projections are deduced from a "climate-neutral baseline scenario", which excludes the physical and transition impacts associated with climate change.

Chart 6 – Impacts on global real GDP

(deviations from climate-neutral baseline in %)

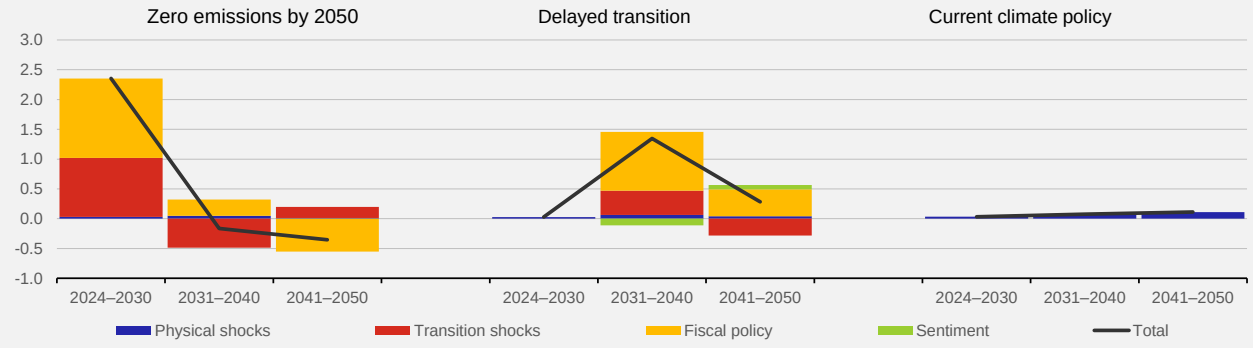


Source: Own calculations using the NiGEM model based on the outputs of the REMIND-MAgPIE climate model.

The cost of implementing global climate policy would be faster overall global price growth. Coupled with mostly negative impacts on GDP, this would cause stagflation tendencies overall. The inflationary effect in the "zero emissions 2050" scenario and the "delayed transition" scenario are dominated mainly by transition shocks together with the inflationary impacts of a positive demand shock reflecting expansionary fiscal policy (see Chart 7). Overall, inflation is thus highest in the near future in the case of the "zero emissions 2050" scenario, reflecting the assumed partial inflationary impact of government investment in an effort to support economic growth and mitigate the negative impacts of shocks arising from climate change and the implementation of global climate policy. By contrast, this effect is more moderate in the "delayed transition" scenario, as the carbon tax increase occurs with a lag and to a lesser extent. The slowest inflation over the period up to the end of 2050 is implied by the "current climate policy" scenario, which does not include transition shocks, only those of a physical nature, which, however, are the most inflationary in this scenario. On the one hand, a very slight but still positive deviation in prices in the event of physical shocks following a sharp downturn in real economic activity reveals the presence of strong negative supply-side effects, which slightly outweigh the strong anti-inflationary effects reflecting falling demand. These overall inflation pressures will strengthen further over time, as continuing global warming further disrupts supply due to lower efficiency of the use of production factors in the global economy and negative anti-inflationary demand effects will only partly dampen such growth. By contrast, in the "zero emissions 2050" scenario, the inflationary effects related to physical shocks are moderate, as upward negative supply-side effects stemming from lower global production factor productivity are largely dampened by anti-inflationary demand effects. In the "delayed transition" scenario, slightly inflationary physical shocks are temporarily dampened overall in the short term by anti-inflationary shocks reflecting the temporary negative sentiment of households and companies due to more forceful implementation of global climate policy after 2030.

Chart 7 – Impacts on annual consumer price inflation around the world

(deviations from the climate-neutral baseline in pp)



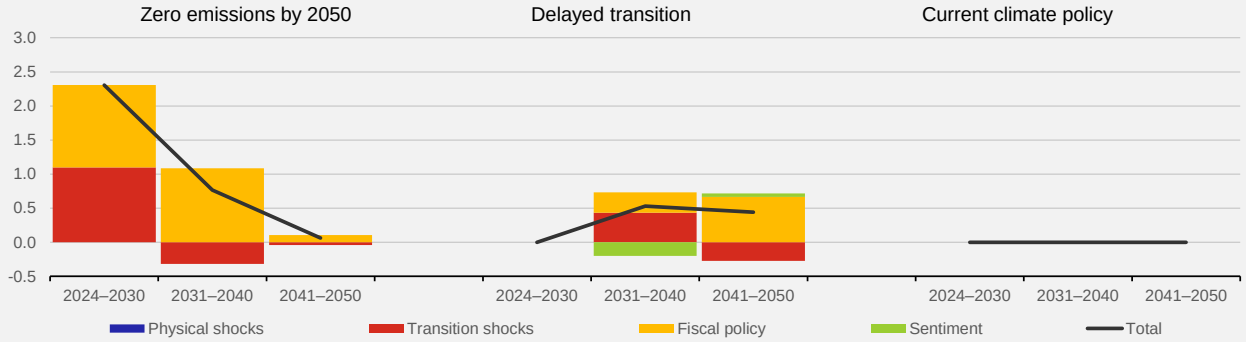
Source: Own calculations using the NiGEM model based on the outputs of the REMIND-MAgPIE climate model.

Impacts of climate change on monetary policy interest rates

The overall inflationary effect of climate change leads to a need for tighter central bank monetary policies. Charts 8, 9 and 10 show the decomposed endogenous model monetary policy response using the examples of the central banks of the USA (Fed), China (PBoC) and euro area (ECB). The results reveal a restrictive monetary policy response for all three central banks. In the case of its intensity, the differences are due to a different calibration of the climate shocks, reflecting the specific structure and energy dependence of these selected three largest economies.

Chart 8 – Impact on monetary policy interest rates in the USA (Fed)

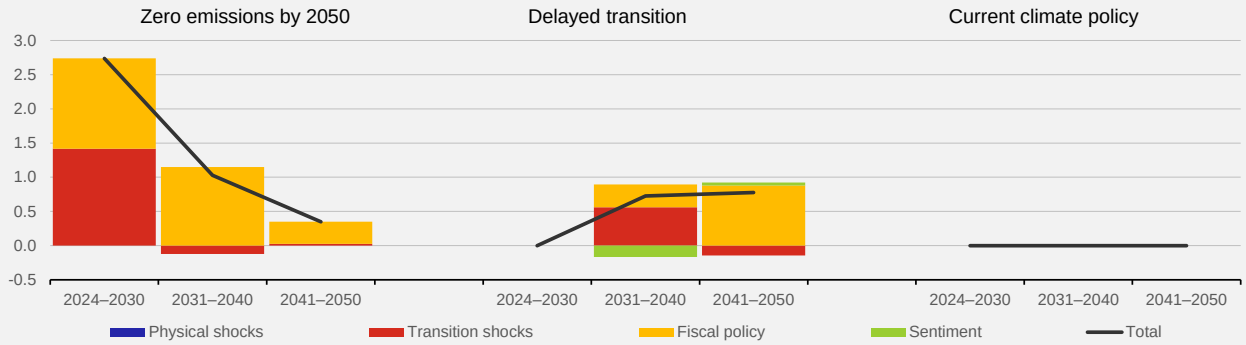
(deviations from the climate-neutral baseline in pp)



Source: Own calculations using the NiGEM model based on the outputs of the REMIND-MAgPIE climate model.
Note: Forward-looking monetary policy does not react to physical shocks, which are modelled as unexpected.

Chart 9 – Impact on monetary policy interest rates in China (PBoC)

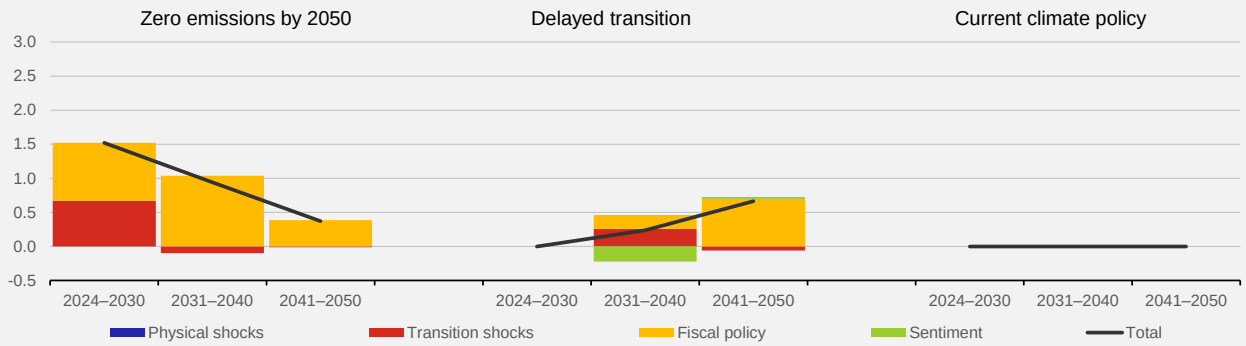
(deviations from the climate-neutral baseline in pp)



Source: Own calculations using the NiGEM model based on the outputs of the REMIND-MAgPIE climate model.
Note: Forward-looking monetary policy does not react to physical shocks, which are modelled as unexpected.

Chart 10 – Impact on monetary policy interest rates in the euro area (ECB)

(deviations from the climate-neutral baseline in pp)



Source: Own calculations using the NiGEM model based on the outputs of the REMIND-MAgPIE climate model.
Note: Forward-looking monetary policy does not react to physical shocks, which are modelled as unexpected.

The biggest increases in interest rates are observed in the US and Chinese economies, while the rate of monetary policy restriction in the euro area is lower. This reflects the fact that, whereas the US economy is a major global exporter of fossil energy commodities, the euro area economy is an importer of fossil energy commodities. Climate policy putting downward pressure on fossil fuel consumption, the price of which will decrease over time, will have a more negative impact on the US economy. This will also be reflected in a stronger euro against the dollar, which will dampen the inflationary effect on the euro area economy. By contrast, the Chinese economy displays the highest energy intensity of production. If it decreases, this will have a more inflationary effect and a negative effect on GDP by restricting supply. In contrast, the euro area economies, especially Germany, started relatively quickly in previous years, which is reflected in the related visible economic costs.

The overall increase in interest rates is dominated by positive demand-pull inflationary effects combined with negative supply and cost factors. Upward pressures on interest rates are most visible in the near future until 2030 in the "zero emissions 2050" scenario, where, on the one hand, a very sharp rise in the carbon tax and a related rise in prices of production inputs takes place amid a rapid pace of decline in the energy intensity of production. On the other hand, these additional budget revenues contribute to a stronger inflationary effect via expansionary fiscal policy. The need for tight monetary policy then decreases in the coming decades, as these effects gradually fade, but the deviation in interest rates remains positive over the entire forecast horizon. This applies even if the "delayed transition" scenario materialises, where an increase in interest rates – which, moreover, is temporarily dampened by the anti-inflationary effect of worsened economic sentiment – occurs with a lag, but interest rates remain constantly elevated until the end of 2050. In the simulation of the "zero emissions 2050" and "delayed transition" scenarios, transition shocks are modelled by their very nature as expected to which forward-looking monetary policy reacts, whereas the very opposite is true in the "current climate policy" scenario. However, this scenario also shows gradually intensifying inflationary pressures, which will increase significantly further after 2050 owing to continued growth in the global average temperature and a rising number and magnitude of devastating natural disasters reducing production capacity. Sooner or later, this will require tighter monetary policy anyway.

Conclusion

The model simulations show that, overall, climate change will have distinct global stagflation effects, which pose a significant risk to central banks with regard to safeguarding price stability in the future. This long-term, worsening partial shock going beyond the normal business cycle will foster higher inflation and slower economic growth. This is shown by analyses carried out through the NiGEM global model based on REMIND-MAgPIE climate model outcomes based on three hypothetical climate scenarios, i.e. the "zero emissions 2050", "delayed transition" and "current climate policy" scenarios designed in line with the NGFS. The simulations include the direct impacts of climate change ("physical shocks"), which overall will lead to a sharp fall in GDP amid moderate price growth, as inflationary effects stemming from supply disruptions outweigh anti-inflationary effects reflecting lower demand. The "zero emissions 2050" and "delayed transition" simulations include additional risks ("transition shocks") that take into account the impacts of implementing a climate policy to reduce CO_2 emissions, i.e. an increase in carbon tax, a decline in the energy intensity of production, a decline in fossil energy (coal, oil, gas) consumption and an increase in renewable energy consumption. These additional factors are also reflected in the inflationary effect overall, as it is a mix of a positive cost and negative supply shock, to which the impact of expansionary fiscal policy is added. In the absence of transition shocks, the slowest – but still positive – inflation in the period up to the end of 2050 is implied by the "current climate policy" scenario. In this scenario, which has a minimal effect on reducing CO_2 emissions, the prevailing inflationary negative supply effects should further increase over time due to continued global warming.

The impacts of climate change and green climate policy will lead to a need for tighter monetary policy in the world. This conclusion resulting from the model simulations is demonstrated using the example of the monetary policy of the central banks of the USA (Fed), China (PBoC) and euro area (ECB). In terms of intensity, the impacts on individual countries and regions of the world economy differ considerably. The biggest increases in interest rates are due to the structure of the economies and the energy intensity of production in the USA and China, whereas the rise in interest rates in the euro area is more moderate. The optimum level of monetary policy restrictions is the highest for all three economies in the "zero emissions 2050" scenario. Although the need for tighter monetary policy is decreasing in the coming years, a positive deviation in interest rates compared to the climate-neutral baseline scenario persists over the entire horizon until 2050. In the "delayed transition" scenario, interest rates increase beyond 2030 due to the postponement of the implementation of climate protection policies and remain steadily elevated until 2050. Given the intensifying inflationary effect, an increasing need for tighter monetary policy can also be expected in the future in the "current climate policy" scenario.

Monetary policy cannot resolve climate change, but climate change will have major macroeconomic implications for monetary policy makers. The analysis suggests that ensuring price stability and maintaining the credibility of their regimes will be the greatest benefit and role of central bank monetary policy in the ongoing fight against climate change and the transition to green zero-emission economies.

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Keywords

climate change, monetary policy, macroeconomic modelling

JEL classification

E37, E58, G11, G28, O44, Q43

A1. Change in predictions for 2024

GDP growth, %

	CF		IMF		OECD		CB / OE	
EA	0	2024/4 2024/3	-0.3	2024/1 2023/10	-0.3	2024/2 2023/11	-0.2	2024/3 2023/12
US	+0.1	2024/4 2024/3	+0.6	2024/1 2023/10	+0.7	2024/2 2023/11	+0.7	2024/3 2023/12
UK	+0.1	2024/4 2024/3	0	2024/1 2023/10	0	2024/2 2023/11	+0.3	2024/2 2023/11
JP	0	2024/4 2024/3	-0.1	2024/1 2023/10	0	2024/2 2023/11	+0.2	2024/1 2023/10
CN	0	2024/4 2024/3	+0.4	2024/1 2023/10	0	2024/2 2023/11	0	2024/4 2024/3
RU	0	2024/3 2024/2	+1.5	2024/1 2023/10	+0.7	2024/2 2023/11	+3.0	2024/4 2024/3

Inflation, %

	CF		IMF		OECD		CB / OE	
EA	0	2024/4 2024/3	+0.4	2023/10 2023/4	-0.3	2024/2 2023/11	-0.4	2024/3 2023/12
US	+0.1	2024/4 2024/3	+0.5	2023/10 2023/4	-0.6	2024/2 2023/11	0	2024/3 2023/12
UK	0	2024/4 2024/3	+0.7	2023/10 2023/4	-0.1	2024/2 2023/11	-0.5	2024/2 2023/11
JP	+0.1	2024/4 2024/3	+0.7	2023/10 2023/4	0	2024/2 2023/11	-0.4	2024/1 2023/10
CN	0	2024/4 2024/3	-0.5	2023/10 2023/4	+0.1	2024/2 2023/11	+0.2	2024/4 2024/3
RU	0	2024/3 2024/2	+1.7	2023/10 2023/4	0	2024/2 2023/11	-0.1	2024/4 2024/3

A2. Change in predictions for 2025

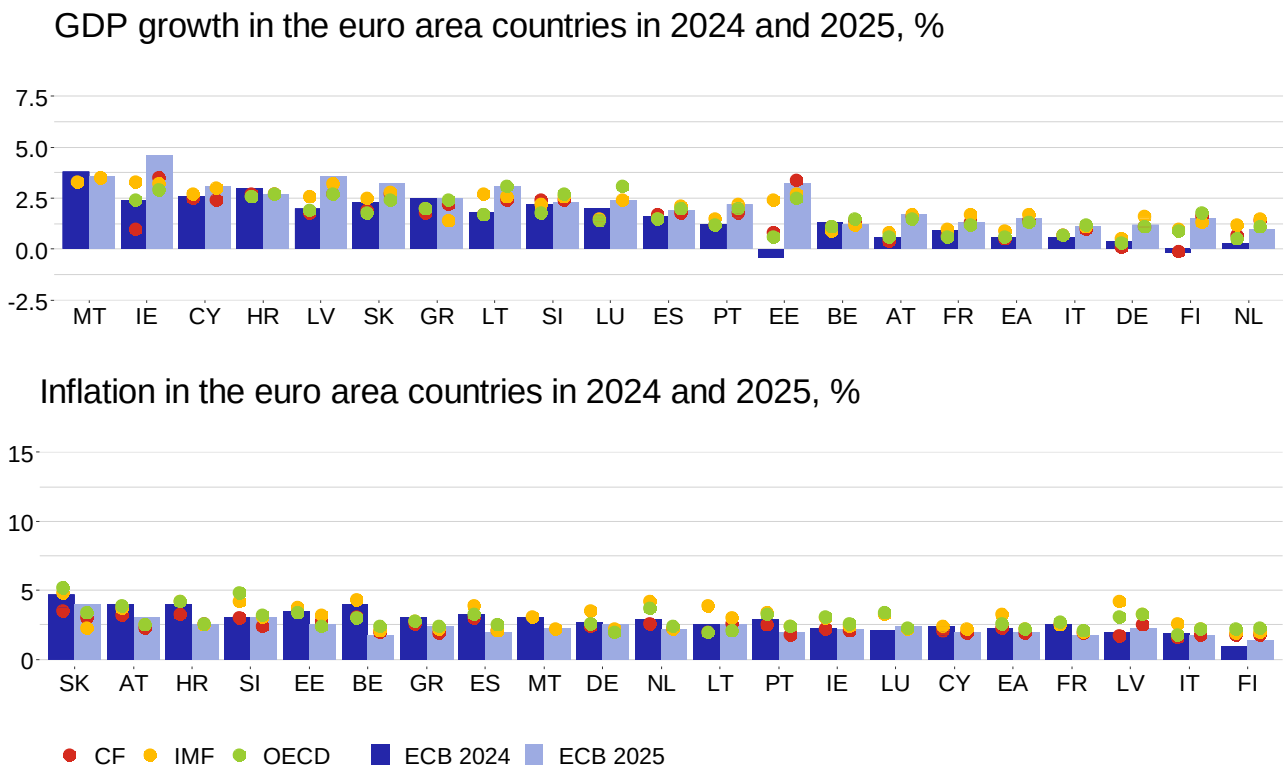
GDP growth, %

	CF		IMF		OECD		CB / OE	
EA	+0.1	2024/4 2024/3	-0.1	2024/1 2023/10	-0.2	2024/2 2023/11	0	2024/3 2023/12
US	+0.1	2024/4 2024/3	-0.1	2024/1 2023/10	0	2024/2 2023/11	+0.2	2024/3 2023/12
UK	+0.1	2024/4 2024/3	-0.4	2024/1 2023/10	0	2024/2 2023/11	+0.5	2024/2 2023/11
JP	+0.1	2024/4 2024/3	+0.1	2024/1 2023/10	-0.2	2024/2 2023/11	0	2024/1 2023/10
CN	0	2024/4 2024/3	0	2024/1 2023/10	0	2024/2 2023/11	0	2024/4 2024/3
RU	+0.1	2024/3 2024/2	+0.1	2024/1 2023/10	0	2024/2 2023/11	0	2024/4 2024/3

Inflation, %

	CF		IMF		OECD		CB / OE	
EA	-0.1	2024/4 2024/3	0	2023/10 2023/4	-0.1	2024/2 2023/11	-0.1	2024/3 2023/12
US	0	2024/4 2024/3	+0.3	2023/10 2023/4	-0.2	2024/2 2023/11	+0.1	2024/3 2023/12
UK	0	2024/4 2024/3	+0.3	2023/10 2023/4	-0.1	2024/2 2023/11	+0.3	2024/2 2023/11
JP	+0.2	2024/4 2024/3	+0.3	2023/10 2023/4	+0.1	2024/2 2023/11	+0.1	2024/1 2023/10
CN	+0.1	2024/4 2024/3	0	2023/10 2023/4	0	2024/2 2023/11	-0.1	2024/4 2024/3
RU	0	2024/3 2024/2	0	2023/10 2023/4	0	2024/2 2023/11	0	2024/4 2024/3

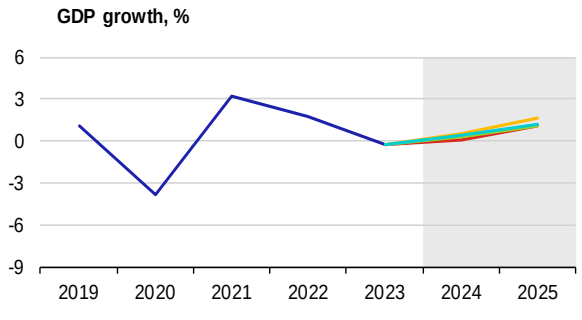
A3. GDP growth and inflation outlooks in the euro area countries



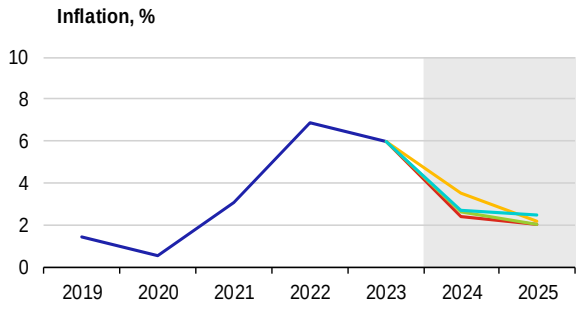
Note: Charts show institutions' latest available outlooks of for the given country.

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

Germany

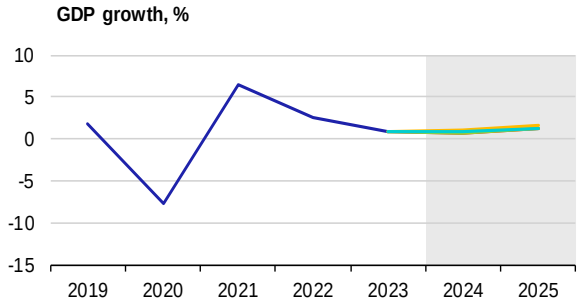


	CF	IMF	OECD	DBB
2024	0.1	0.5	0.3	0.4
2025	1.1	1.6	1.1	1.2

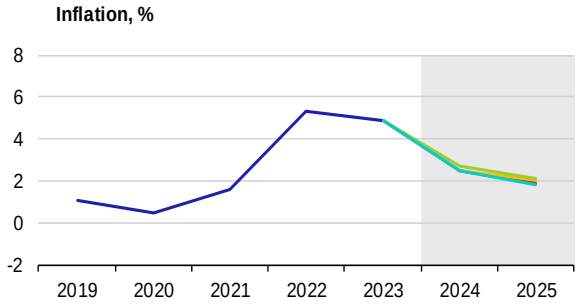


	CF	IMF	OECD	DBB
2024	2.4	3.5	2.6	2.7
2025	2.0	2.2	2.0	2.5

France

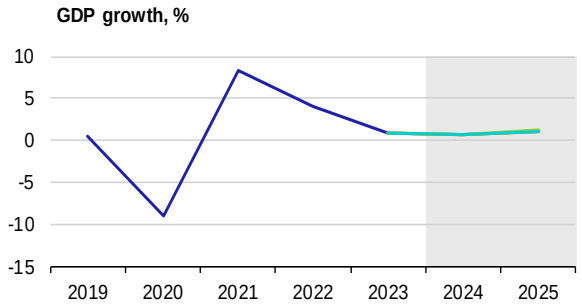


	CF	IMF	OECD	ECB
2024	0.7	1.0	0.6	0.9
2025	1.3	1.7	1.2	1.3

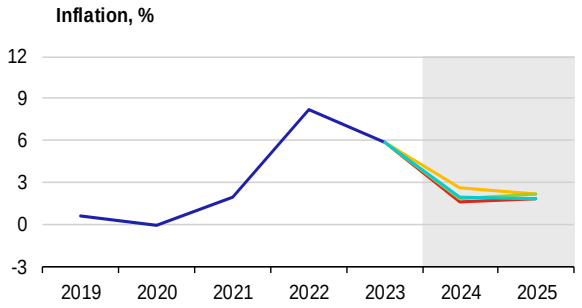


	CF	IMF	OECD	ECB
2024	2.5	2.5	2.7	2.5
2025	1.9	2.0	2.1	1.8

Italy

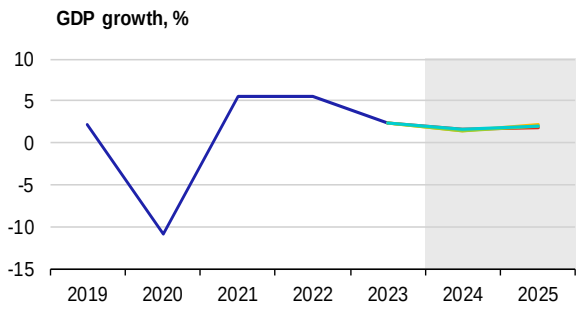


	CF	IMF	OECD	ECB
2024	0.7	0.7	0.7	0.6
2025	1.0	1.1	1.2	1.1

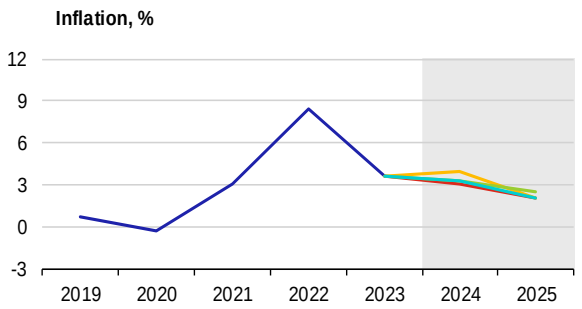


	CF	IMF	OECD	ECB
2024	1.6	2.6	1.8	1.9
2025	1.8	2.2	2.2	1.8

Spain



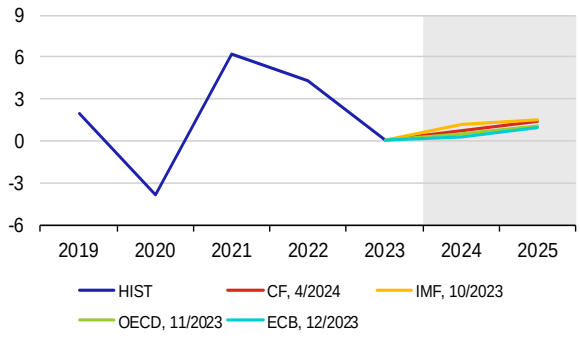
	CF	IMF	OECD	ECB
2024	1.7	1.5	1.5	1.6
2025	1.8	2.1	2.0	1.9



	CF	IMF	OECD	ECB
2024	3.0	3.9	3.3	3.3
2025	2.1	2.1	2.5	2.0

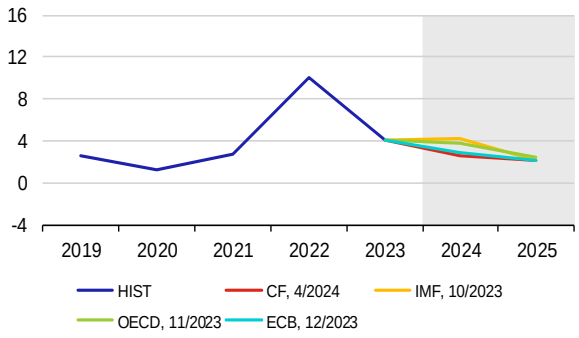
Netherlands

GDP growth, %



	CF	IMF	OECD	ECB
2024	0.7	1.2	0.5	0.3
2025	1.4	1.5	1.1	1.0

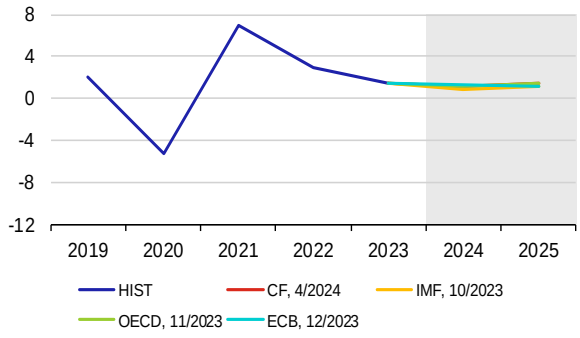
Inflation, %



	CF	IMF	OECD	ECB
2024	2.6	4.2	3.7	2.9
2025	2.2	2.2	2.4	2.2

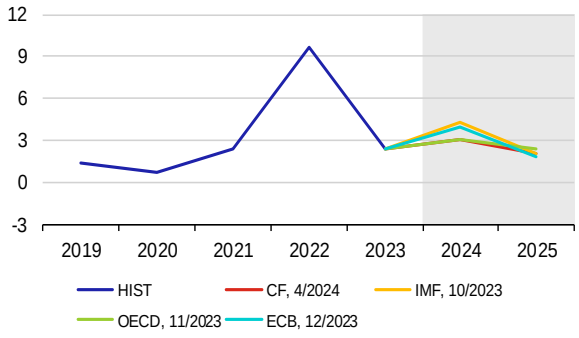
Belgium

GDP growth, %



	CF	IMF	OECD	ECB
2024	1.1	0.9	1.1	1.3
2025	1.4	1.2	1.5	1.2

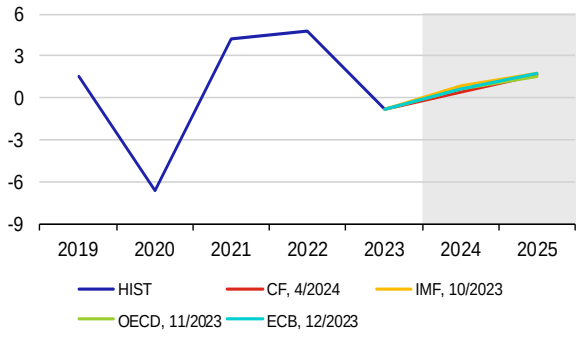
Inflation, %



	CF	IMF	OECD	ECB
2024	3.1	4.3	3.0	4.0
2025	2.0	2.1	2.4	1.8

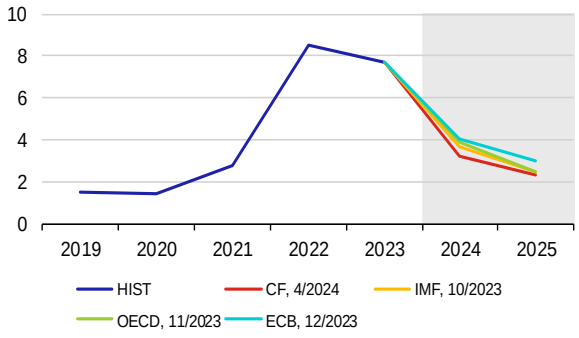
Austria

GDP growth, %



	CF	IMF	OECD	ECB
2024	0.4	0.8	0.6	0.6
2025	1.6	1.7	1.5	1.7

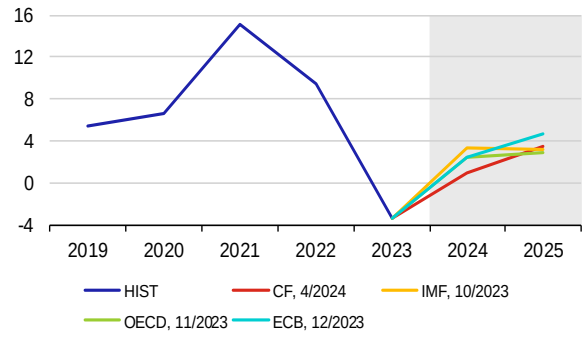
Inflation, %



	CF	IMF	OECD	ECB
2024	3.2	3.7	3.9	4.0
2025	2.3	2.5	2.5	3.0

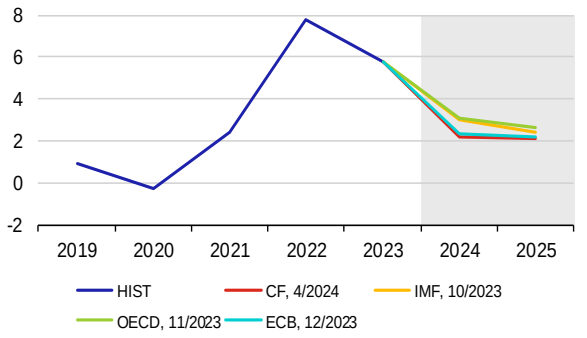
Ireland

GDP growth, %



	CF	IMF	OECD	ECB
2024	1.0	3.3	2.4	2.4
2025	3.5	3.2	2.9	4.6

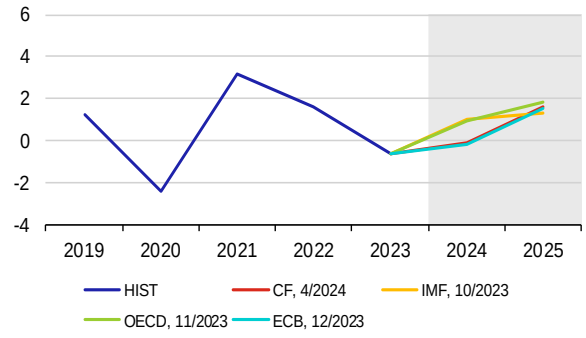
Inflation, %



	CF	IMF	OECD	ECB
2024	2.2	3.0	3.1	2.3
2025	2.1	2.4	2.6	2.2

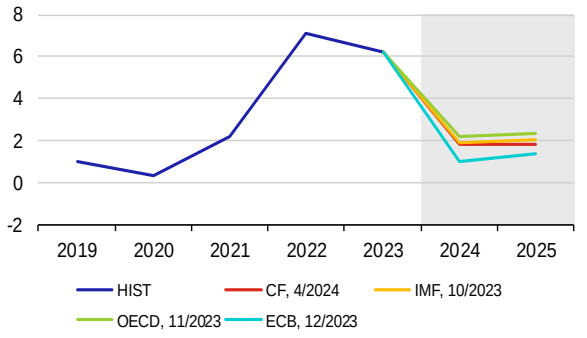
Finland

GDP growth, %



	CF	IMF	OECD	ECB
2024	-0.1	1.0	0.9	-0.2
2025	1.6	1.3	1.8	1.5

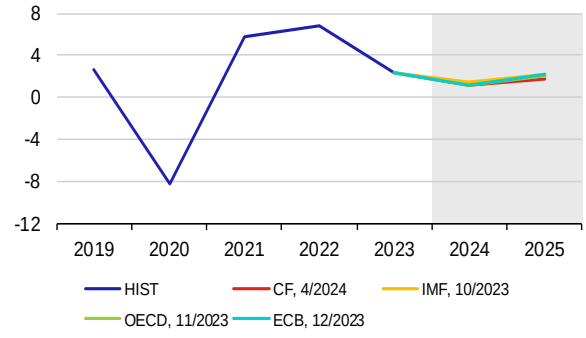
Inflation, %



	CF	IMF	OECD	ECB
2024	1.8	1.9	2.2	1.0
2025	1.8	2.0	2.3	1.4

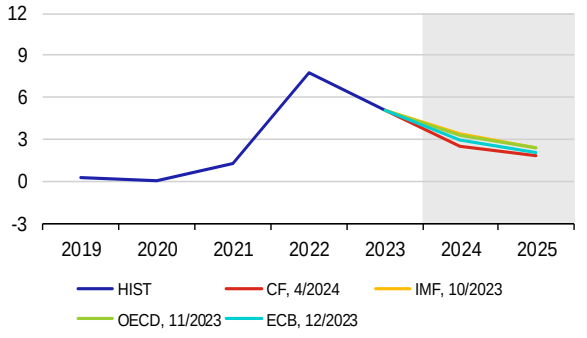
Portugal

GDP growth, %



	CF	IMF	OECD	ECB
2024	1.2	1.5	1.2	1.2
2025	1.8	2.2	2.0	2.2

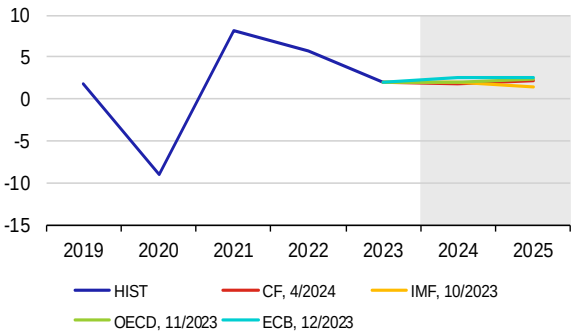
Inflation, %



	CF	IMF	OECD	ECB
2024	2.5	3.4	3.3	2.9
2025	1.8	2.4	2.4	2.0

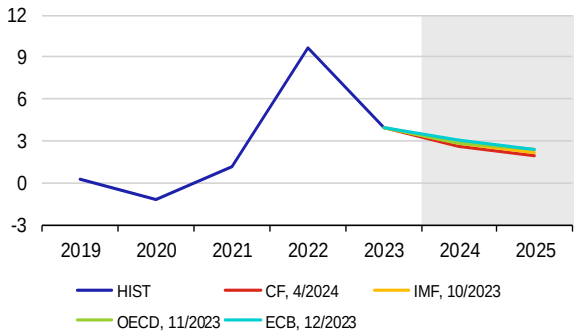
Greece

GDP growth, %



	CF	IMF	OECD	ECB
2024	1.8	2.0	2.0	2.5
2025	2.2	1.4	2.4	2.5

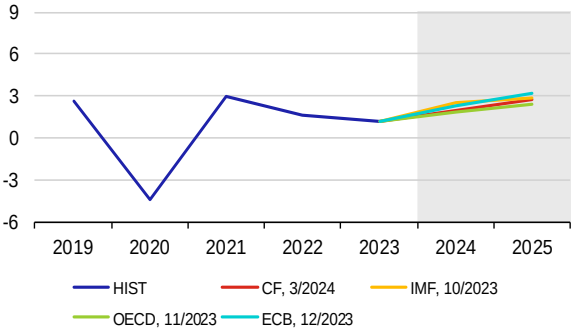
Inflation, %



	CF	IMF	OECD	ECB
2024	2.6	2.8	2.8	3.0
2025	1.9	2.2	2.4	2.4

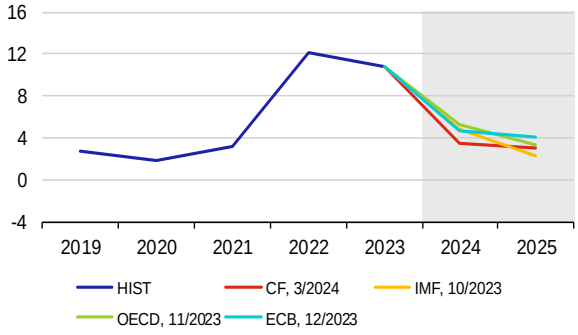
Slovakia

GDP growth, %



	CF	IMF	OECD	ECB
2024	1.9	2.5	1.8	2.3
2025	2.7	2.8	2.4	3.2

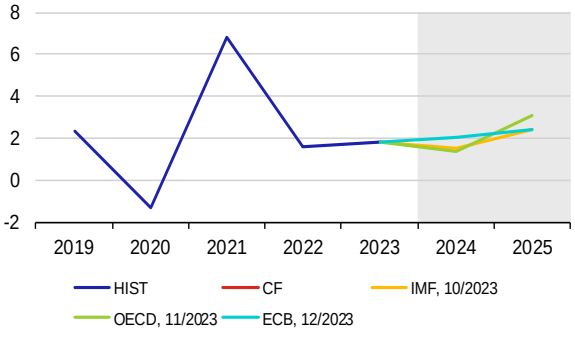
Inflation, %



	CF	IMF	OECD	ECB
2024	3.5	4.8	5.2	4.7
2025	3.0	2.3	3.4	4.0

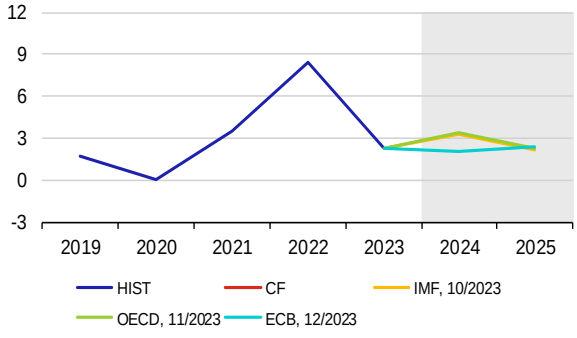
Luxembourg

GDP growth, %



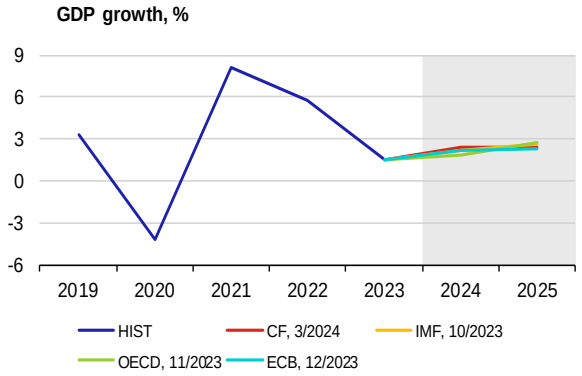
	CF	IMF	OECD	ECB
2024	n. a.	1.5	1.4	2.0
2025	n. a.	2.4	3.1	2.4

Inflation, %

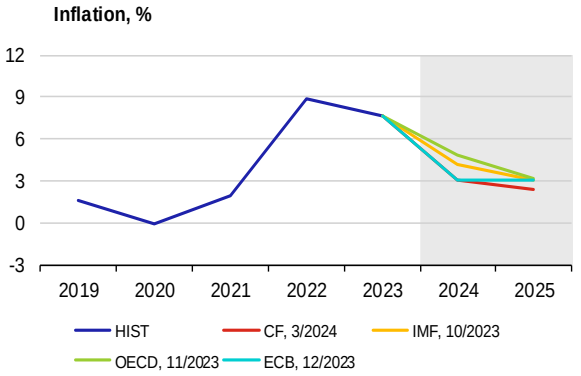


	CF	IMF	OECD	ECB
2024	n. a.	3.3	3.4	2.1
2025	n. a.	2.2	2.3	2.4

Slovenia

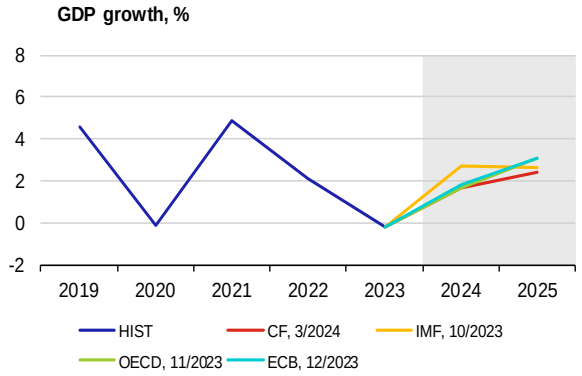


	CF	IMF	OECD	ECB
2024	2.4	2.2	1.8	2.2
2025	2.4	2.6	2.7	2.3

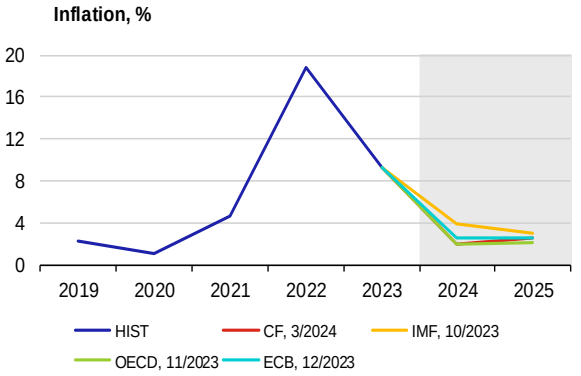


	CF	IMF	OECD	ECB
2024	3.0	4.2	4.8	3.0
2025	2.4	3.1	3.2	3.1

Lithuania

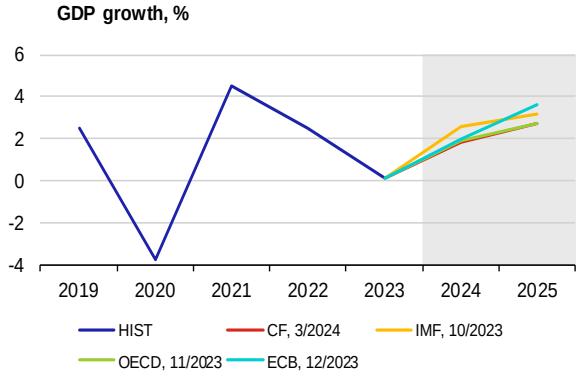


	CF	IMF	OECD	ECB
2024	1.7	2.7	1.7	1.8
2025	2.4	2.6	3.1	3.1

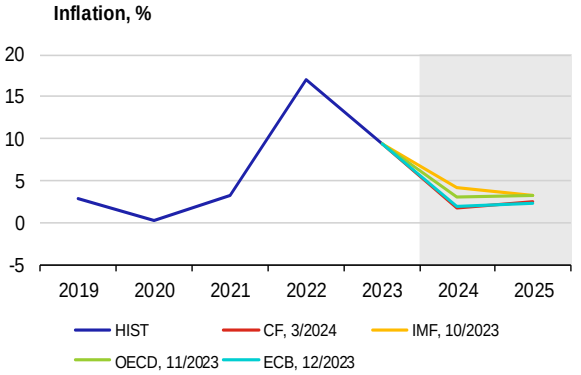


	CF	IMF	OECD	ECB
2024	2.0	3.9	2.0	2.5
2025	2.6	3.0	2.1	2.5

Latvia



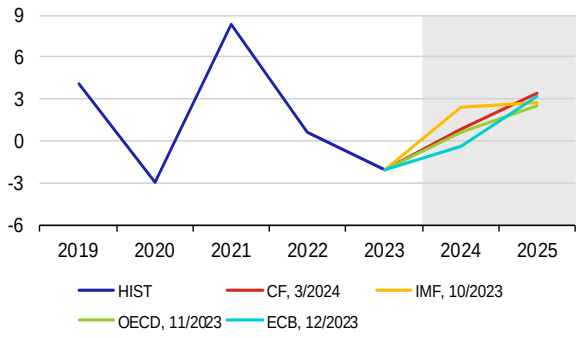
	CF	IMF	OECD	ECB
2024	1.8	2.6	1.9	2.0
2025	2.7	3.2	2.7	3.6



	CF	IMF	OECD	ECB
2024	1.7	4.2	3.1	2.0
2025	2.5	3.3	3.3	2.3

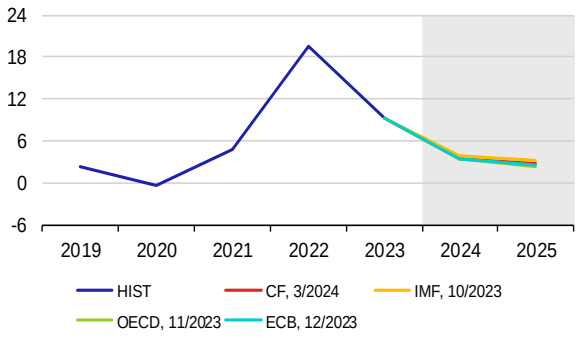
Estonia

GDP growth, %



	CF	IMF	OECD	ECB
2024	0.8	2.4	0.6	-0.4
2025	3.4	2.7	2.5	3.2

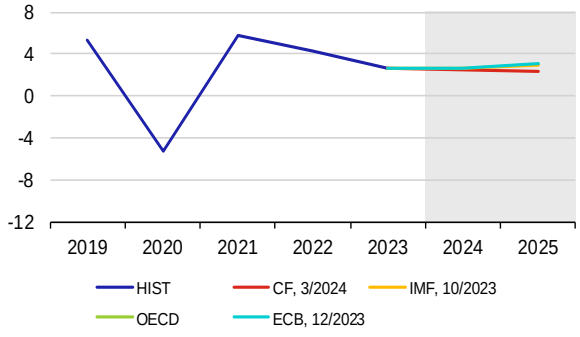
Inflation, %



	CF	IMF	OECD	ECB
2024	3.5	3.8	3.4	3.5
2025	2.8	3.2	2.4	2.5

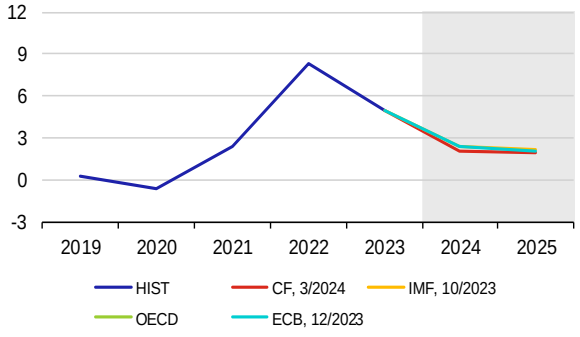
Cyprus

GDP growth, %



	CF	IMF	OECD	ECB
2024	2.5	2.7	n. a.	2.6
2025	2.4	3.0	n. a.	3.1

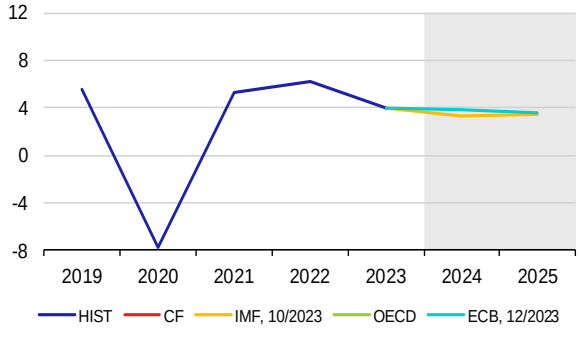
Inflation, %



	CF	IMF	OECD	ECB
2024	2.1	2.4	n. a.	2.4
2025	1.9	2.2	n. a.	2.0

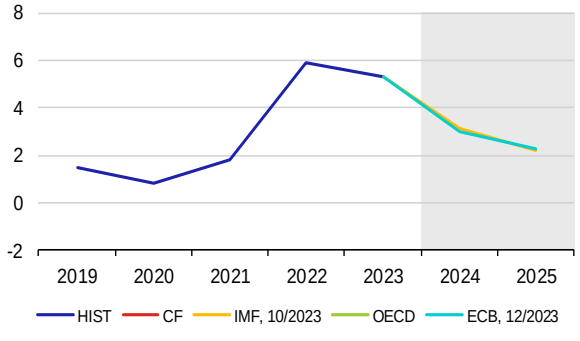
Malta

GDP growth, %



	CF	IMF	OECD	ECB
2024	n. a.	3.3	n. a.	3.8
2025	n. a.	3.5	n. a.	3.6

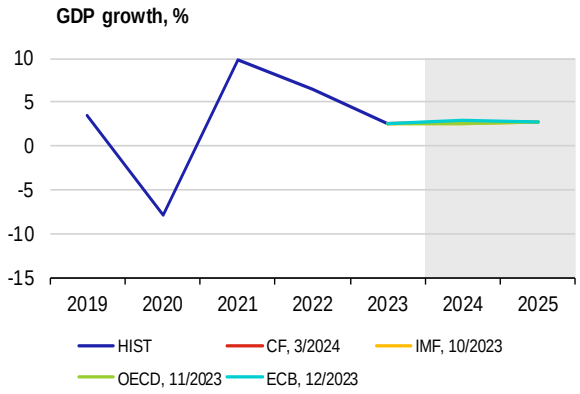
Inflation, %



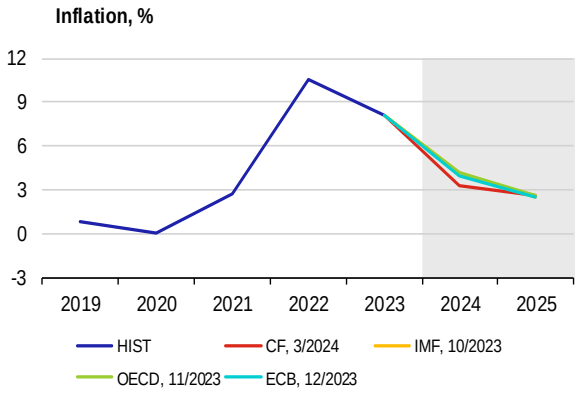
	CF	IMF	OECD	ECB
2024	n. a.	3.1	n. a.	3.0
2025	n. a.	2.2	n. a.	2.3

Ddd

Croatia



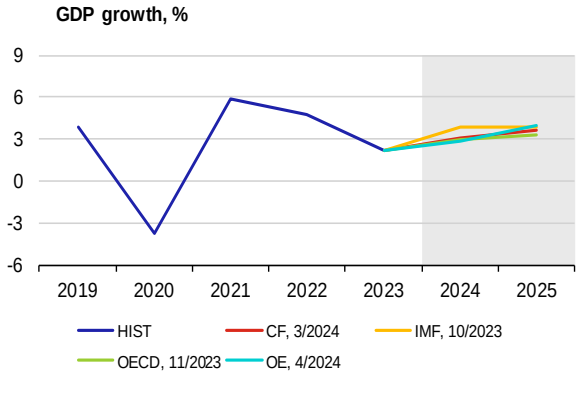
	CF	IMF	OECD	ECB
2024	2.7	2.6	2.6	3.0
2025	2.7	2.7	2.7	2.7



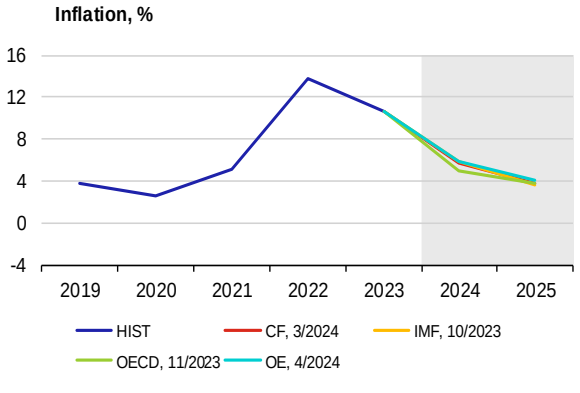
	CF	IMF	OECD	ECB
2024	3.3	4.2	4.2	4.0
2025	2.6	2.5	2.6	2.5

A5. GDP growth and inflation in other selected countries

Romania



	CF	IMF	OECD	OE
2024	3.1	3.8	3.0	2.8
2025	3.6	3.8	3.3	4.0



	CF	IMF	OECD	OE
2024	5.7	5.8	5.0	5.8
2025	3.8	3.6	3.7	4.0

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
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
HICP	Harmonised Index of Consumer Prices
HR	Croatia
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
MNB	Magyar Nemzeti Bank (the central bank of Hungary)
MT	Malta
NBP	Narodowy Bank Polski (the central bank of Poland)
NIESR	National Institute of Economic and Social Research (UK)
NKI	Nikkei
NL	Netherlands
OE	Oxford Economics
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
RU	Russia
RUB	Russian rouble
SI	Slovenia
SK	Slovakia
SPF	Survey of Professional Forecasters
TTF	Title Transfer Facility (virtual trading point for natural gas in the Netherlands)
UK	United Kingdom
UoM	University of Michigan Consumer Sentiment Index - present situation
US	United States
USD	US dollar
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

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