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# Monthly Report

## The War Dividend

## The Polish Catering Sector: Falling Demand but Rising Prices

## The Impact of Foreign Direct Investment on Innovation in the EU

## Innovation in Climate Change Mitigation Technologies Across Europe

The Vienna Institute for International Economic Studies
Wiener Institut für Internationale Wirtschaftsvergleiche

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ALEKSANDR ARSENEV
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LEON PODKAMINER

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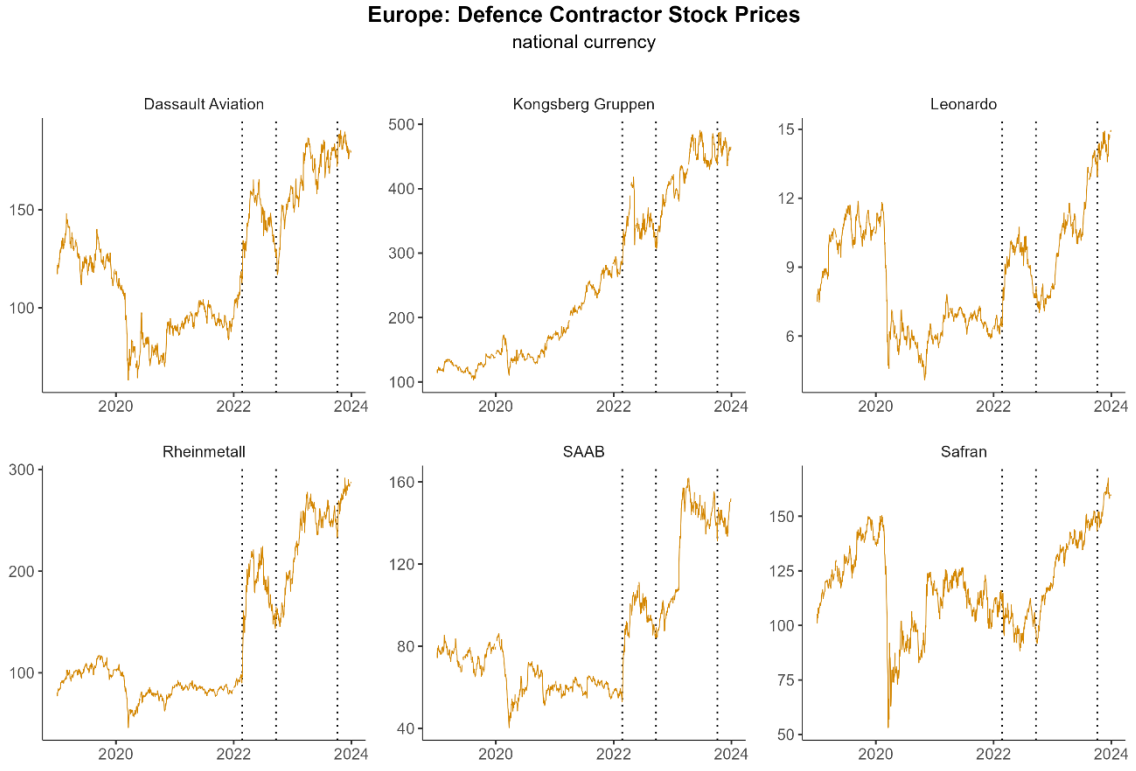
# Chart of the Month: The war dividend

BY ALEKSANDR ARSENEV

The shattering of the so-called peace dividend – brought about by Russia's full-scale invasion of Ukraine in 2022 – means more money for guns and less money for butter right across the globe. The Pentagon and the largest US defence companies, such as Lockheed Martin, Raytheon, Northrop Grumman and others, are working hard on reigniting the capacity of the national military industry to produce Stingers, Javelins, advanced medium-range air-to-air missiles (AMRAAMs), national advanced surface-to-air missile systems (NASAMS) and other military staples (Stone, 2022). The same is true of Europe, with the manufacture (and the production goals) of aerial technology, next-generation light anti-tank weapons (NLAWs), joint strike missiles (JSMs) and artillery shells soaring. Driven by military aid to Ukraine and self-provisioning programmes, the stock prices of weapons producers long ago outstripped pre-COVID levels, reflecting increased demand and investor confidence. This trend aligns with major escalation points in 2022 through 2023, such as the start of the Ukraine war, Russia's mobilisation and the Hamas attack on Israel – each of which is marked in the charts by a vertical dotted line.

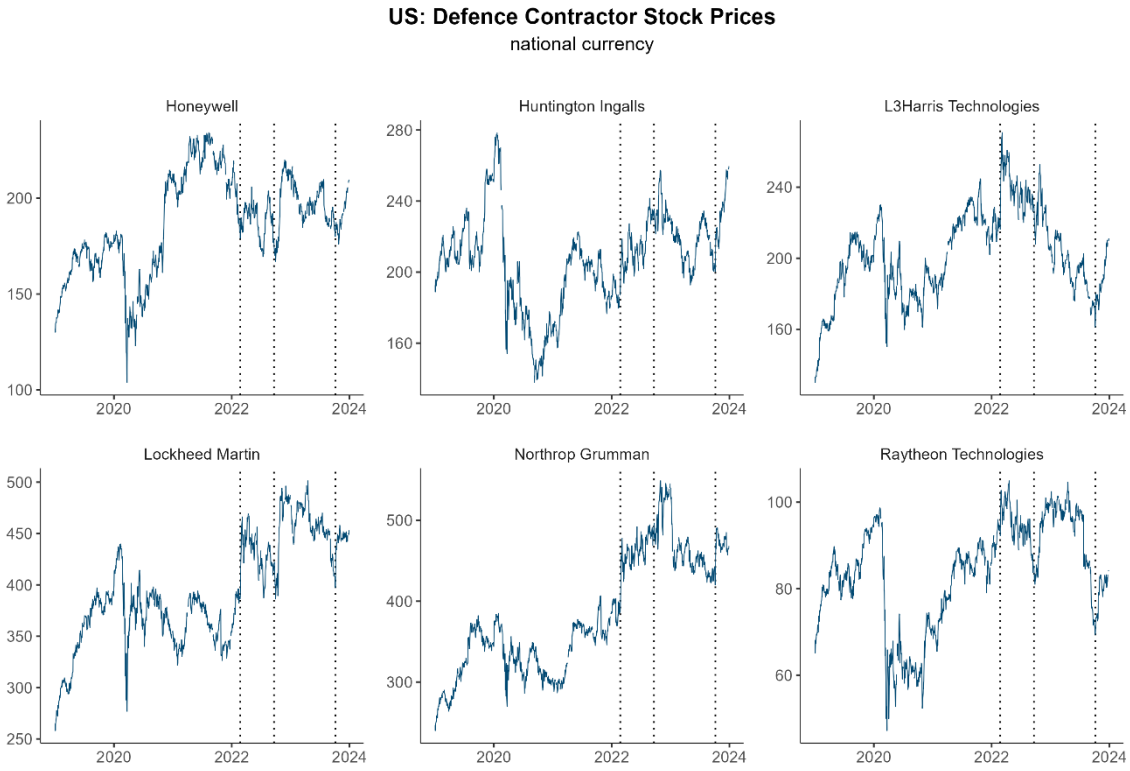
**Figure 1 / Stock prices of European companies in the defence sector (January 2019 – January 2024)**




Note: stock prices in EUR, except for Kongsberg Gruppen (NOK) and SAAB (SEK). The vertical dotted lines correspond to major escalation points: the start of the Ukraine war (February 2022), Russia's announcement of its partial mobilisation (September 2022) and the Hamas attack on Israel (October 2023), one day before the actual event for the sake of clarity.
Source: Yahoo Finance (2024) (API Python).

Figures 1 and 2 display the stock performance of 12 of the 33 largest publicly traded defence companies by market capitalisation. Although this is a significant sample, with a considerable market share, differences do exist, of course. While these are too numerous to detail in full here, one can see that European contractors (Figure 1) show a largely uniform pattern of stock price development, while the dynamics of US stock prices (Figure 2) is more varied. Some US companies experienced stock price declines even after two of the three major escalations, and the trends are less uniform than in Europe. Another major difference is that the US companies are reported to have used the corporate revenue windfalls for stock buybacks, thus reducing their own capitalisation, boosting stock prices – and complicating analysis for observers (McGinn et al., 2024; Tucker 2024).

**Figure 2 / Stock prices of US companies in the defence sector (January 2019 – January 2024)**




Note: stock prices in USD. The vertical dotted lines correspond to major escalation points: the start of the Ukraine war (February 2022), Russia's announcement of its partial mobilisation (September 2022) and the Hamas attack on Israel (October 2023), one day before the actual event for the sake of clarity.
Source: Yahoo Finance (2024) (API Python).

The growth in the stock prices of defence contractors against the backdrop of a major aggression event hardly qualifies as news: what is noteworthy, however, is the persistence of the trend and the larger fiscal implications. In some cases, the market capitalisation of defence contractors has reached an all-time high, which is symptomatic of the creeping securitisation around the globe. The similar trends witnessed in the stock prices of the world's largest contractors indicate the stock markets' belief in the inevitability of rearmament. This also means there will be less money available for more peaceful endeavours.

Not all defence contractors have benefited from the new geopolitical reality, though. The stock price of US-based Boeing, the largest global aerospace contractor, has taken a hit due to its involvement in the commercial jetliner sector in Russia and Ukraine (Boeing, 2022). Meanwhile, Baykar – the Turkish drone company made famous by the deadly efficiency of its output during the second Karabakh war between Azerbaijan and Armenia and the early months of the war in Ukraine – has seen its stocks perform less well than all the media hype might have led one to expect. Finally, the stock prices of Honeywell (US) and QinetiQ (UK) have only now reached their pre-COVID levels, even taking account of inflation. These exceptions do not, however, cancel out the generally worrying global security trend we are witnessing.

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# The Polish catering sector: falling demand but rising prices*

BY LEON PODKAMINER[1]

*Recent data suggest that while demand for the services of Polish catering companies may be falling, the prices charged by larger firms – and their profits – are rising. Cooling the economy through restrictive macro policy reduces demand, but eliminates a swathe of smaller producers, making life easier for those firms that survive. They can generate above-average profits by charging more than the 'normal' prices that obtain under more effective competition.*

A recent GfK Consumer Panel Services report documents the still quite dramatic shrinkage of the Polish catering industry, attributing it mainly to the rising costs of doing business and to a decline in real demand for the industry's services.[2] In 2023, the turnover value of the catering market increased by around 10% in nominal terms – well below the rate of inflation.

## HIGH PROFITABILITY OF LARGE COMPANIES AND RAPID GROWTH OF CATERING PRICES

It is worth fleshing out those fundamental reasons with some additional information. First, it would appear that the profitability of large companies in the catering (and hospitality, taken together) business sector has been above average over the past two years (Figure 1). After a dramatic slump in 2020, the sector's profitability rapidly returned to very high values.

Of course, it should be borne in mind that the CSO data on profitability refer to approximately 300 large catering companies (including the accommodation industry) with more than 50 employees. However, there are probably over 80,000 smaller catering companies. Thus, concerns about the plight of catering companies apply to the 'mass' of smaller entrepreneurs in the industry – not to the large companies, which are apparently doing well.

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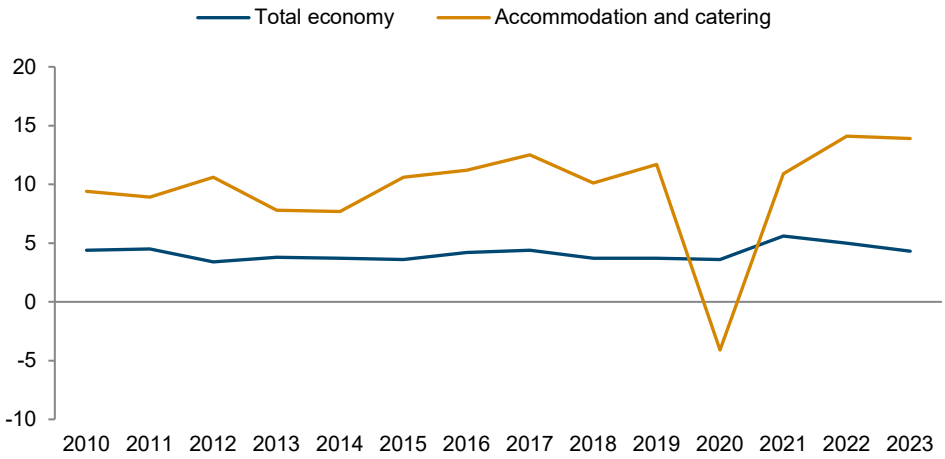
* Disclaimer: This article does not necessarily reflect the views of either the NBP or wiiw.

1 The author is a Senior Research Associate with wiiw and Advisor to the Governor of the National Bank of Poland (NBP). An earlier version of it (in Polish) was published in Rzeczpospolita on 6 January 2024, https://www.rp.pl/opinie-ekonomiczne/art39661611-podkaminer-popyt-spada-a-ceny-rosna-jak-w-gastronomii.

2 https://www.horecanet.pl/rynek-gastronomiczny-w-polsce-raport/

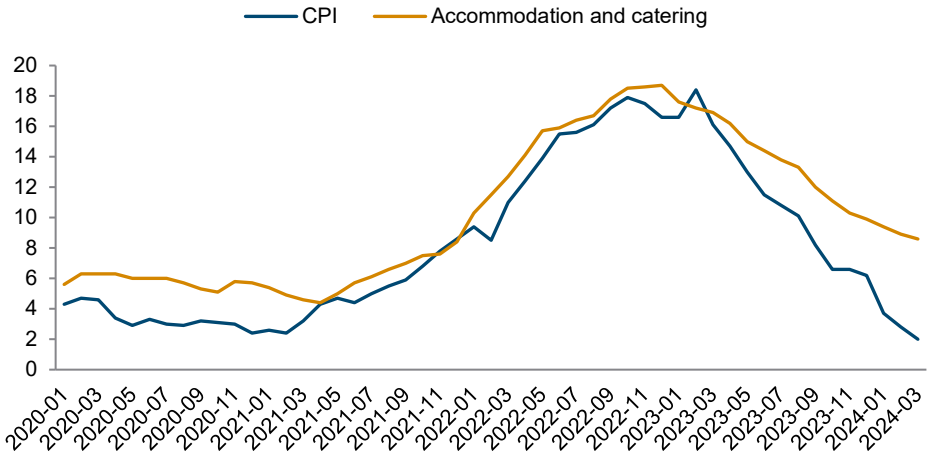
**Figure 1 / Net turnover profitability indicator (%)**




Source: Central Statistical Office (CSO).

The second piece of information worthy of note is the behaviour of the retail price index for catering services (including accommodation). It turns out that the retail price index for the services of this industry has consistently outperformed the general inflation index (CPI). Significantly, the gap between the two indices widened significantly over 2023 and has continued to grow in the first months of this year (Figure 2). In March 2024, the CPI was 2.2%, while the retail price index for catering (including accommodation) was as high as 8.6%. (Price increases in catering and accommodation accounted for around 0.3 percentage points of the overall inflation rate.)

**Figure 2 / CPI and retail price index for catering and accommodation services (% year on year)**




Source: CSO.

## TWO MARKET SEGMENTS

The following conclusions can be drawn from the above.

First, with the progressive increase in costs, the reduction in the scale of demand removes many of the 'smaller' (and financially weaker) companies from the market. It is noteworthy that these companies are apparently unable to pass on rising costs (and tax burdens) by raising their prices. The clientele of these companies – numerous, but generally less affluent – cannot afford the increased expense of eating out. Therefore, an active demand barrier appears in the way of those businesses.

Secondly, however, bigger companies are doing very well – especially the large businesses. Their profitability is high and growing – in spite of the cost increases that have put paid to smaller companies. The larger companies' clientele (less numerous, but wealthier) can still afford services that are becoming disproportionately expensive. For this segment of the market, demand does not seem to set a limit on price increases.

Thirdly, as small businesses go to the wall, the shrinking of the segment makes life easier for those companies that are able to survive (especially the large ones): they enjoy greater freedom to raise their prices, as there is less competition from small firms that are struggling to survive.

## 'NO' TO 'COOLING' THE ECONOMY

What follows from all of this? First of all, there is a need for a less simplistic understanding of the causes of the inflationary process currently under way. Quite high inflation is not necessarily simply the result of excess demand: the matter is more complex than that.

Therefore, 'cooling' the economy through restrictive monetary and/or fiscal policy measures would not necessarily bring about disinflation. 'Cooling' reduces demand; but by eliminating many producers and suppliers from the market, it can also reduce supply. As a result, an implicit excess of demand over supply may persist – with a reduced scale of economic activity. Moreover, by removing some producers from the market, 'cooling' may make life easier for the surviving firms: their market position is strengthened and they are able to generate above-average profits – not least by dictating prices and charging more than would be 'normal' if competition were more effective.

# The impact of foreign direct investment on innovation in the EU

BY FRANCESCA MICOCCI[1] AND MAHDI GHODSI

*This study examines the influence of foreign direct investment (FDI) on innovation within European regional industries. Using the number of patents as a measure of innovation, we find compelling evidence to support FDI's positive impact. Notably, among the measures of FDI explored, mergers and acquisitions (M&A) activity has the biggest effect on innovation, suggesting that this is a fundamental channel for knowledge transfer to the firms acquired and their markets.*

## INTRODUCTION

FDI has emerged as a pivotal catalyst for economic growth in both developed and developing economies (Aitken and Harrison, 1999; Hermes and Lensink, 2003; Beugelsdijk et al., 2008; Castillo et al., 2014; Paul and Feliciano-Cestero, 2021; Fang et al., 2023; Keller and Yeaple, 2009), facilitating the transfer of valuable know-how and technology from multinational enterprises (MNEs) to host countries (Blalock and Gertler, 2008; Gong, 2023). Regarding its effect on innovation, FDI fosters two distinct categories of knowledge spillover. Direct spillover occurs when knowledge and expertise are transferred from foreign MNEs to the local firms that have been acquired or affiliated. Indirect spillover arises for domestic enterprises from the vertical and horizontal demand (or supply) stimulated by MNEs (Javorcik, 2004; Rojec and Knell, 2017; Di Ubaldo and Siedschlag, 2022; Nguyen et al., 2024), alongside enhancements in market structures (Barrios et al., 2005) and intensified competition in host markets (Doan et al., 2015). Furthermore, Marshall-Arrow-Romer (MAR) spillovers (Marshall, 1980; Arrow, 1962; Romer, 1986) or Porter's (1990) spillovers may facilitate the diffusion of knowledge and know-how to adjacent firms, leveraging the proximity to foreign-owned enterprises (Yue and Huang, 2024; Martins, 2011).

Similar factors shape innovation intensity across the advanced economies. Innovation is inherently embedded within specific territories and cannot be fully comprehended without considering the social and institutional context (Rodrìguex-Pose and Crescenzi, 2008). In this regard, Furman et al. (2002) identified four key drivers of innovation. The first is the availability of high-quality and specialised innovation inputs, such as trained scientists and engineers, predominantly to be found in more educated areas. The second is the extent to which the local competitive context is intense and rewards successful innovators. These factors are greatly affected by regulations and openness to international trade (Sakakibara and Porter, 2000). A third driver is the nature of domestic demand for cluster producers and services, where a wealthier population tends to generate higher demand for advanced goods, driven by a sophisticated, quality-sensitive local customer base. The final driver is the availability, density and interconnectedness of vertically and horizontally related industries, significantly impacting innovation dynamics.

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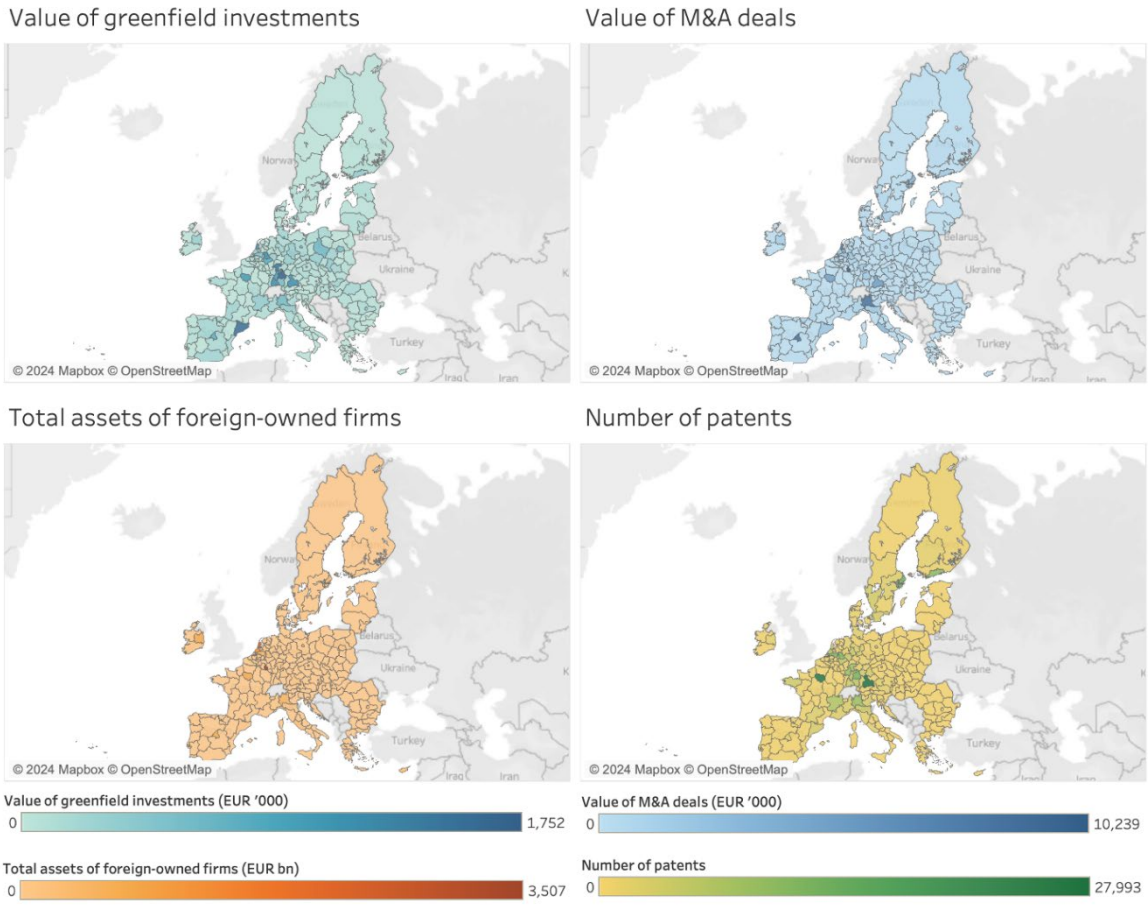
Given the broad overlap among the determinants, it is evident that disentangling the impact of multinational activities on the innovation of domestic firms poses a significant empirical challenge, due to the endogenous correlation between FDI and economic development in host countries (Keller, 2021). If the decision of a foreign company to invest in a country is endogenous to the productivity of its domestic firms, the resulting analysis will be biased. Some empirical models have addressed this endogeneity bias by introducing industry and time fixed effects. However, residual endogeneity may persist if other industry- and year-specific shocks are not controlled for (Blalock and Gertler, 2008). To mitigate endogeneity concerns further, some scholars have explored alternative measures of innovation, such as the number of patents, rather than productivity (Bloom et al., 2013; Hovhannisyan and Keller, 2015). Given that the FDI spillovers will augment the knowledge set of the firm, it is plausible that this could benefit the firm's creation of fresh knowledge, in terms of either new processes or new products.

In an attempt to combine these approaches, we propose an analysis whereby we utilise the number of patents published in the EU's regional industries as the innovation outcome. Moreover, we incorporate industry and time fixed effects and additional controls to mitigate the influence of other industry- and year-specific shocks.

## DATA AND DESCRIPTIVE ANALYSIS

In our analysis, we utilise three different proxies for FDI: (a) the total assets of foreign-owned firms, (b) greenfield investment, in terms of both number and value and (c) M&A deals, in terms of both number and value. Figure 1 illustrates the geographical distribution of the published number of patents in the EU, alongside the various FDI proxies. It reveals some patterns that raise concern about the endogeneity of FDI. It is worth noting the close correspondence between the distribution of the value of greenfield investments and the distribution of patents. Similarly, Table 1 presents information on FDI and patenting activity in the top 10 EU regions with the most patents from 2008 to 2018. Columns 7-12 of the table indicate each region's position in the respective regional rankings for each variable. Notably, those regions with the greatest patenting activity also rank highly in the other FDI-related metrics, further underscoring the potential endogeneity of FDI.

**Figure 1 / Geographical distribution of FDI and the number of patents published across the EU, 2008-2018, annual averages**




Source: Own elaboration on Orbis data.

**Table 1 / Top 10 patenting regions in the EU, 2008-2018**

a) Annual averages

| | | Values | | | | | |
|---|---|---|---|---|---|---|---|
| NUTS2 code | Region | Greenfield no. (1) | Greenfield value (EUR '000) (2) | M&A no. (3) | M&A value (EUR' 000) (4) | Total assets foreign-owned firms (EUR' m) (5) | Patents no. (6) |
| DE21 | Oberbayern | 111 | 1,158 | 25 | 4,912 | 151,754 | 27,993 |
| FR10 | Île de France | 91 | 996 | 31 | 4,915 | 776,694 | 26,631 |
| SE11 | Stockholm | 20 | 148 | 35 | 3,195 | 374,065 | 12,630 |
| DE11 | Stuttgart | 136 | 1,752 | 12 | 1,664 | 70,595 | 11,961 |
| NL41 | North Brabant | 17 | 459 | 18 | 2,240 | 448,647 | 11,397 |
| DEA1 | Düsseldorf | 152 | 1,139 | 15 | 1,708 | 232,584 | 10,404 |
| FI1B | Helsinki-Uusimaa | 36 | 335 | 29 | 1,630 | 88,468 | 9,719 |
| DEB3 | Rheinhessen-Pfalz | 6 | 142 | 4 | 330 | 11,811 | 8,436 |
| ITC4 | Lombardia | 62 | 586 | 49 | 8,531 | 524,423 | 8,321 |
| DE71 | Darmstadt | 83 | 1,489 | 19 | 1,730 | 228,438 | 8,167 |

b) Ranking

| | | Ranking | | | | | |
|---|---|---|---|---|---|---|---|
| NUTS2 code | Region | Greenfield no. (1) | Greenfield value (EUR '000) (2) | M&A no. (3) | M&A value (EUR '000) (4) | Total assets foreign-owned firms (EUR' m) (5) | Patents no. (6) |
| DE21 | Oberbayern | 4 | 4 | 12 | 6 | 19 | 1 |
| FR10 | Île de France | 8 | 8 | 9 | 5 | 4 | 2 |
| SE11 | Stockholm | 56 | 56 | 7 | 7 | 9 | 3 |
| DE11 | Stuttgart | 1 | 1 | 23 | 17 | 37 | 4 |
| NL41 | North Brabant | 18 | 18 | 16 | 9 | 8 | 5 |
| DEA1 | Düsseldorf | 6 | 6 | 18 | 13 | 13 | 6 |
| FI1B | Helsinki-Uusimaa | 21 | 21 | 10 | 18 | 30 | 7 |
| DEB3 | Rheinhessen-Pfalz | 59 | 59 | 76 | 51 | 103 | 8 |
| ITC4 | Lombardia | 14 | 14 | 4 | 3 | 7 | 9 |
| DE71 | Darmstadt | 3 | 3 | 15 | 12 | 14 | 10 |

## THE ECONOMETRIC MODEL

In this analysis, we try to estimate how different measures of FDI in the EU in a given year influence innovation and patenting in the EU's regional industries the following year. Patents as the output of successful innovative efforts through R&D activities are our measure of technological advancement. The equation to be estimated is as follows:

$$P_{tr(c)s} = \exp\big[\beta_0 + \beta_{FDI} FDI_{t-1,r(c)s} + \beta_2 TBT_{t-1,cs} + \beta_3 SPS_{t-1,cs} + \beta_4 Tariffs_{t-1,cs} + \beta_5 STRI_{t-1,cs} + \beta_6 Prod_{t-1,r(c)s} + \beta_7 kl_{t-1,r(c)s} + \beta_8 GDP_{t-1,r(c)} + \beta_9 R\&D_{t-1,r(c)} + \beta_{10} Edu_{t-1,r(c)} + \beta_{11} Competition_{t-1,r(c)s} + \beta_{12} Specialisation_{t-1,r(c)s} + \alpha_r + \gamma_s + \delta_t\big] + \epsilon_{tr(c)s}$$

Here, $P_{tr(c)s}$ represents the number of patents published at time $t$ by all firms operating in sector $s$ and region $r$ in country $c$. The primary variable of interest is $FDI_{t-1,r(c)s}$, a measure of the FDI in the previous year within the sector and region. As already mentioned, we employ five different proxies for FDI: (a) the total assets of foreign-owned firms, (b, c) greenfield investments in number and value, and (d, e) M&A deals in number and value. While the first measures the FDI stocks, the other four measure FDI flows.

We introduce a set of control variables to capture year- and industry-specific shocks that might influence both the innovation activity of firms and FDI intensity. These include tariffs and non-tariff measures (NTMs), which could affect the EU's technological development and serve as a determinant of FDI. Tariffs ($Tariffs_{t-1,cs}$), technical barriers to trade ($TBT_{t-1,cs}$) and sanitary and phytosanitary ($SPS_{t-1,cs}$) measures are computed as weighted averages of tariffs and NTMs imposed by country *c* and sector *s* vis-à-vis all trading partners, with weights based on the sector imports value from each partner. This would give importance to the level of protection by tariffs or NTMs levied on larger trade flows. Similarly, we use the OECD's Services Trade Restrictiveness Index ($STRI_{t-1,cs}$) to account for the presence of trade barriers in services.

Additionally, we incorporate the variable $Prod_{t-1,r(c)s}$, measured as the ratio of operating revenues of all firms relative to their employment, to account for shocks in the sector's productivity in the region. $kl_{t-1,r(c)s}$ represents the capital-to-labour ratio in region $r$ and sector $s$ of country $c$. This ratio is influenced both by the presence of FDI (Hijzen et al., 2011) and by improvements in human capital (Toner, 2011), which in turn positively affect innovation. To account for the level of regional development, we control for GDP and R&D expenditure and the share of the tertiary-educated population $Edu_{t-1,r(c)}$, all of which positively correlate with innovation and incentivise FDI. $Competition_{t-1,r(c)s}$ is a proxy for intra-sectoral and intra-regional competition, measured by the Herfindahl-Hirschman Index computed on firms' employment figures. $Specialisation_{t-1,r(c)s}$ measures rather the agglomeration of employed labour in sector $s$ in region $r$ in year $t$-1 relative to the total employed labour in that region. The latter is a proxy for MAR or Porter's externalities associated with sector knowledge spillovers (see, for example, Cieślik and Ghodsi, 2015). Finally, consistent with the literature, we include time, regional (NUTS2) and industry (NACE Rev. 2, 2-digit) fixed effects.

Since the dependent variable is a count measure (including zero values) when the number of published patents in a regional sector in a year is considered, the equation is estimated using the Poisson Pseudo Maximum Likelihood (PPML) method proposed by Santos Silva and Tenreyro (2006). Due to the widespread presence of zeroes, all trade and FDI measures are inverse hyperbolic sine transforms, which – as with logarithmic transformation in regressions – give an asymptotic elasticity (Bellemare and Wichman, 2020).

## ECONOMETRIC RESULTS

Table 2 presents the estimation results of the above equation using various proxies for FDI. Notably, all measures of FDI exhibit positive and statistically significant coefficients, even after accounting for specific sector and regional characteristics that might influence both FDI incentives and the innovation environment.

**Table 2 / Estimation results: the impact of FDI on the number of patents**

| | Number of patents (1) | Number of patents (2) | Number of patents (3) | Number of patents (4) | Number of patents (5) |
|---|---|---|---|---|---|
| Total assets of foreign-owned firms (t-1) | 0.0701*** | | | | |
| | (8.92) | | | | |
| Number of greenfield investments (t-1) | | 0.0585* | | | |
| | | (2.17) | | | |
| Value of greenfield investments (t-1) | | | 0.0394** | | |
| | | | (2.87) | | |
| Number of M&A deals (t-1) | | | | 0.258*** | |
| | | | | (6.30) | |
| Value of M&A deals (t-1) | | | | | 0.0557*** |
| | | | | | (4.58) |
| Controls | Yes | Yes | Yes | Yes | Yes |
| Fixed effects: | | | | | |
| - NACE Rev. 2 (2-digit) | Yes | Yes | Yes | Yes | Yes |
| - NUTS2 | Yes | Yes | Yes | Yes | Yes |
| - Year | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 95,394 | 95,394 | 95,394 | 95,394 | 95,394 |

The FDI channel that is found to be correlated most strongly with innovation is the number of M&A activities in the region in the previous year. A 1% increase in the number of M&A deals corresponds to a 0.258% rise in the number of published patents in a regional industry in the EU. The number of M&A deals is of greater significance than their value. Increased M&A activity provides domestic firms with access to funds and knowledge from their parent companies, thereby stimulating innovation activities. If some of this knowledge spills over into the network of the M&A targets, we might expect an even more significant effect on the sector and region. Conversely, larger M&A values could be directed towards only a few large targets, potentially limiting their impact on the firms' market. Similar observations may be made regarding greenfield investments, although the coefficients associated with the number and value of greenfield investments are far closer in magnitude.

Another important measure of FDI is the total assets of foreign-owned firms, which serves as a proxy for FDI stock in the sector and region. It is worth noting that innovation, as measured by patents, needs time to feed though. Thus, an increase in the total assets of a foreign-owned firm which benefits from the resources and knowledge of its parent company and which has a longer-established relationship with the local market may induce innovation to spread more readily through the firm's markets.

While our study remains a correlation analysis, it does yield intriguing evidence that the coefficients associated with the FDI proxy remain positive and significant even with all the controls and fixed effects included. We tested the robustness and sensitivity of these results by employing different measures of competition and by including additional variables to account for technological advantages in the region's industries. While the coefficients varied slightly in size, they remained consistently positive and statistically significant.

In conclusion, our analysis provides compelling evidence that FDI has a positive and statistically significant correlation with innovation across the European regions. By examining various proxies for FDI, indeed, we find consistent patterns, indicating that FDI is positively associated with innovation in regional industries, even after controlling for sector-specific and regional characteristics. Such evidence supports the hypothesis that FDI stimulates innovation in regional industries.

## CONCLUSIONS

Our study has investigated the influence of foreign direct investment on innovation in European regional industries. Using patents as a measure of innovation, we found compelling evidence to support FDI's positive impact on innovation. Our analysis revealed a consistent positive correlation between FDI and innovation, even after accounting for factors that may incentivise both phenomena. Particularly notable were the significant contributions to innovation of M&A activities and total assets of foreign-owned firms.

Our findings underscore the pivotal role of FDI in driving innovation and economic growth. They emphasise the importance of policies to attract and support foreign investment in fostering innovation and stimulating economic development in regional industries.

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# Innovation in climate change mitigation technologies across Europe

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*Innovation can act as an effective instrument for climate change mitigation (CCM), fostering the green transition. This study aims to assess regional technological capabilities in the climate change domain through two main innovation channels: technological specialisation and foreign direct investment (FDI) in green technologies over the period 2008-2018. The main findings reveal significant disparities across European regions, especially among the less developed areas. As such, while some transition regions have great potential to become attractive hubs for green innovators, others still need more structural interventions to cope with the challenges of implementing the twin green and digital transitions.*

## INTRODUCTION

Europe is currently making a huge effort to implement its strategy to manage the European Green Deal (EGD), a climate policy measure that aims to mitigate climate change, while at the same time achieving greater competitiveness in the global economy. The EGD entails various initiatives to transform the EU into a sustainable, efficient and competitive economy. As climate change becomes a prominent challenge in the current political context, the role of green and environmental technologies has been gaining momentum, serving as an effective tool for climate change mitigation.

This study aims to identify those regions with technological capabilities in the climate change domain through two main channels of innovation. The first channel considers regional technological specialisation, using detailed patent data from PATSTAT, provided by the European Patent Office (EPO). This allows us to focus on the production of climate change mitigation technologies across European regions, as embodied in patent applications. The second channel relies on inward foreign direct investment (FDI) from those firms that own climate change mitigation technology patents. The data on the latter are obtained by merging information on patent owners that is available from the Bureau van Dijk's Amadeus database with their total assets, as reported in the financial statements compiled by Orbis (also Bureau van Dijk). This approach enables us to examine regional attractiveness to foreign capital, which is recognised as an important driver of technology transfer leading to economic growth (De Mello, 1999). By examining these trends from 2008 to 2018, we can gain a better understanding of Europe's heterogeneity in terms of its specialisation in green technologies over the medium and long term.

Previous studies, such as Bachtrögler-Unger et al. (2023), Maucorps et al. (2023) and Ghodsi and Mousavi (2023) have emphasised the prominent role of green and digital technologies in achieving more rapid green transition, as well as highlighting the disparities between countries and regions. Our study

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contributes to the literature by providing insights into Europe and incorporating the direct links between green and environmental patents with FDI. Moreover, it sheds light on the role played by the Revealed Technological Advantage (RTA) (analogous to Balassa's relative comparative advantage (RCA; Balassa, 1965)) of green technologies in promoting inward FDI. By focusing on these factors, we can better understand the drivers of green innovation and the part they play in climate change mitigation, thus contributing to the policy recommendations for those regions.

## PRODUCTION OF CLIMATE CHANGE MITIGATION TECHNOLOGIES IN THE EU REGIONS

To consider climate change mitigation technologies (hereafter: green technologies), we rely on the classification proposed by the Organisation for Economic Co-operation and Development (OECD) (Haščič and Migotto, 2015; Angelucci et al., 2018). These technologies are considered 'green' because of the direct and indirect impacts that their application can have on the reduction in greenhouse gas (GHG) emissions. In particular, we focus on the following five categories of green technologies:[3]

1. *Energy*: the development of renewable energy sources and increased energy efficiency in the use of fossil fuels.
2. *GHGs*: the capture, storage and sequestration of carbon dioxide ($CO_2$), as well as all other GHGs – e.g. nitrous oxide, methane and hexafluoride.[4]
3. *Construction*: integration of renewable energy sources and energy saving in the heating, ventilation and lighting of buildings.
4. *Manufacturing*: reduction in the emissions coming from any industrial process, from the production of raw materials (including agriculture) to the manufacture of intermediate and final goods.
5. *Transport*: technologies that reduce the use of fossil fuels (e.g. hybrid vehicles), or improve the efficiency of combustion engines, as well as the aerodynamics of trains and aircraft, among other things.

Figure 1 provides an overview of comparative advantage in the production of green technologies across EU regions by considering two indicators of innovation: (i) the cumulative stock (number) of patent applications in this domain (panel A) and (ii) the average RTA (panel B) over the period 2008-2018. While patent count provides the absolute value of patents owned by firms located in a region, the regional RTA is based on the share of patent publications in the green technologies within the total number of all published patents, relative to the figure for the EU as a whole. A value of the regional RTA greater than 1 indicates that the region has a higher share of climate-related patents than the EU average, thus indicating a specialisation in green technologies.[5]

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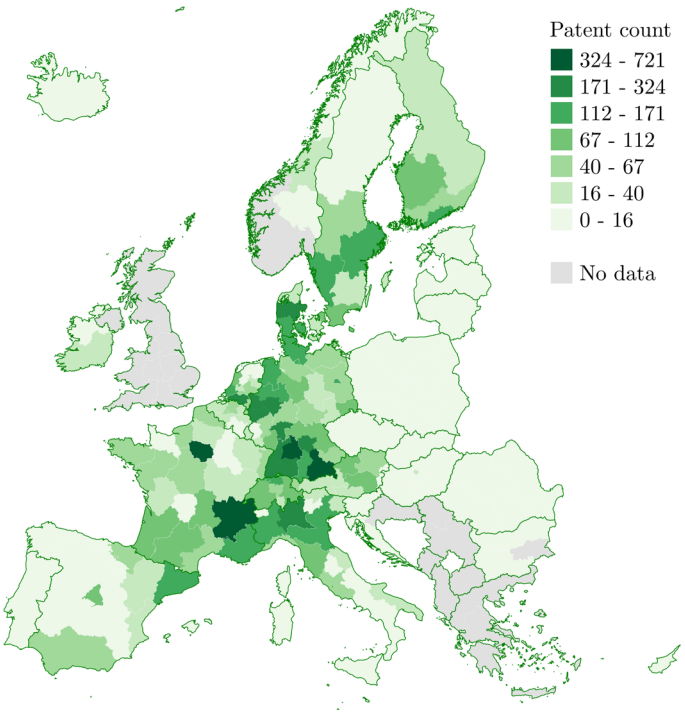
[3] We should note that these categories are not exhaustive: those proposed in Haščič and Migotto (2015) and Angelucci et al. (2018) also include waste and water management and air pollution and soil erosion control as additional categories. Nevertheless, given that green technologies account for the vast majority of climate-related innovations (Ghodsi and Mousavi, 2023), and given the additional limited data availability for those other technologies, we focus on those proposed in the main text.

[4] Many of which have higher global warming potential (GWP) than $CO_2$ (US EPA, 2024).

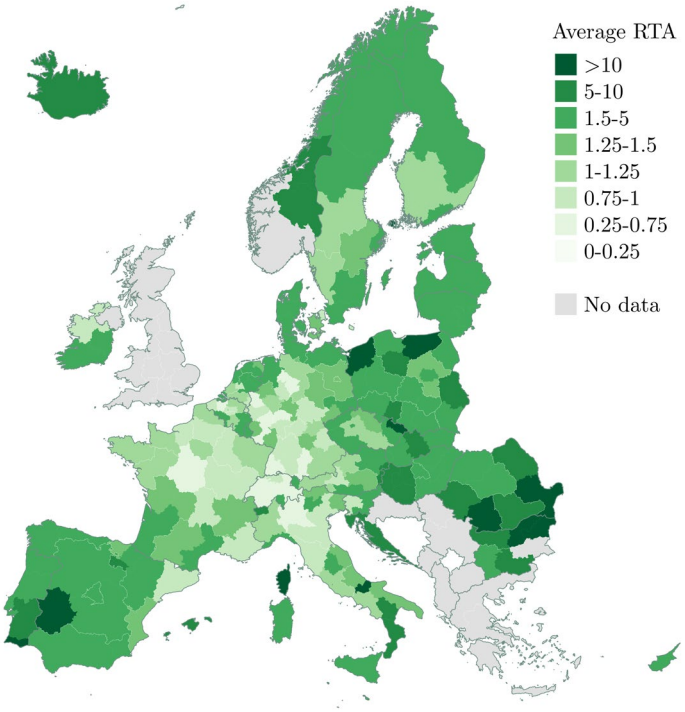
[5] Specifically, fixing a region r and a technology class g can compute the corresponding RTA as:
$RTA_{g,r} = \frac{patents_{g,r}/patents_r}{\sum patents_{g,r}/\sum patents_r}$

**Figure 1 / Cumulative number of patents in green technologies (panel A) and their average RTA (panel B) over the period 2008-2018**

Panel A




Panel B




Source: EPO PATSTAT, own calculations based on the fractional head count of patent applications considering inventors' location at the NUTS2 level (2016 classification).

Interestingly, even a cursory glance at the two panels of Figure 1 shows only a partial overlap between the two indicators. On the one hand, northwestern regions of Denmark (i.e. DK03-Midtjylland and DK04-Sydjylland) and Germany (i.e. DEF0-Schleswig-Holstein, DE94-Weser-Ems, DE92-Hannover, DEA4-Detmond and DEA3-Münster), as well as southern Sweden (i.e. SE11-Stockholm and SE22-Sydsverige) and Finland (i.e. FI1B-Helsinki) show both a strong specialisation in patent production and a high level of relative specialisation. On the other hand, in the most patenting regions of France (i.e. FR10-Île-de-France, FRK2-Rhône-Alpes and FRL0-Provence-Alpes-Côte d'Azur), southern Germany (i.e. DE21-Oberbayern, DE1-Baden Württemberg, DE25-Mittelfranken), northern Italy (ITC1-Piemonte, ITC4-Lombardia and ITH3-Veneto) and Spain (ES651-Catalunya), the RTA counterpart shows rather low values – especially when compared to those of other regions of eastern EU, notably of Poland, Hungary and Romania.[6]

As already pointed out in previous studies (Bachtrögler-Unger et al., 2023), this counterintuitive result is partly due to the natural inflation of RTA values in territories that are highly specialised but that produce few patents, where the concentration of patenting activity in a few technologies leads to a relatively higher share, and thus higher specialisation, than in territories with a large and more diversified patent production.[7]

Therefore, when looking at the distribution of technological specialisation, patent counts and RTA should be regarded as complementary in the analysis to capture this multifaceted phenomenon. Indeed, when focusing on high values for both indicators, the strongest innovators in climate-related technologies appear to be regions in the northwest of the EU, as shown in Table 1 (panel A). That is, for each technology, we can identify the most innovative region, with RTAs well above unity and a patent production more than 10 times greater than the EU average.

However, not all innovators belong to the European core countries.[8] In fact, following the EC classification for eligibility for the Cohesion Policy funds in 2021-2027, we can identify several *transition* regions with well-established (panel B) and potential (panel C) comparative advantage in green technologies. A prominent case is that of Andalusia (Spain), which shows a high technological specialisation in three of the five green technologies considered, as reflected in above-average patent production and high RTA values. In addition, regions of southern Italy, Poland and Slovenia show potential for development in this field, as they are already relatively specialised in green technologies (i.e. RTA greater than 1) and have patent publication close to the EU average. It is in these areas that support measures to promote innovation could be most effective in advancing regional cohesion, while reducing the existing regional technological disparities highlighted in the context of the twin transition (Maucorps et al., 2023).

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6 This includes, for instance, regions PL42-Zachodniopomorskie, PL62-Warmińsko-Mazurskie, HU21- Közép-Dunántúl, BG32-Veliko Tarnovo Province and RO42-Vest.

7 To validate this result, we examine the regional patterns for the cumulative patent stock across all technologies. Regions with high production of green patents are also those with high patent production in general, which makes them relatively less specialised in a specific technology class. On the other hand, regions with little innovation in green technologies, such as those in Eastern Europe, also shows low overall patent production, which results in relatively higher shares when calculating RTAs.

8 i.e. Belgium, Denmark, Germany, France and the Netherlands.

**Table 1 / Technological specific specialisation in climate change mitigation (CCM) patents, selected groups of regions**

| CM technology | NUTS2 | No. patents | EU avg. | RTA |
|---|---|---|---|---|
| **Panel A: Stars: developed regions with no. patents > EU avg., and RTA > 1.5** | | | | |
| Y02B Buildings | NL41 West-North Brabant | 152.20 | 4.84 | 3.88 |
| Y02C GHGs | FR10 Île-de-France | 5.11 | 0.34 | 1.54 |
| Y02E Energy | DK04 Central Denmark | 191.54 | 12.51 | 9.39 |
| Y02P Manufacturing | FRK2 Rhône-Alpes | 65.26 | 4.72 | 1.70 |
| Y02T Transport | FR10 Île-de-France | 287.46 | 8.01 | 2.76 |
| **Panel B: Hidden innovators: transition regions with no. patents > EU avg., and RTA > 1** | | | | |
| Y02C GHGs | ES61 Andalusia | 0.57 | 0.34 | 11.99 |
| Y02E Energy | ES61 Andalusia | 23.71 | 12.51 | 3.72 |
| Y02P Manufacturing | ES61 Andalusia | 4.99 | 4.72 | 2.18 |
| **Panel C: Potential innovators: transition regions with no. patents > 50% EU avg., and RTA > 1** | | | | |
| Y02E Energy | ITF4 Apulia | 6.32 | 12.51 | 1.71 |
| Y02B Buildings | ITG1 Sicily | 2.19 | 4.84 | 2.76 |
| Y02B Buildings | PL21 Małopolskie | 2.53 | 4.84 | 1.95 |
| Y02B Buildings | SI03 Eastern Slovenia | 2.76 | 4.84 | 3.09 |

Note: Classification of technology class follows the Cooperative Patent Classification (CPC), at 4-digit level.

## FOREIGN DIRECT INVESTMENT IN CLIMATE CHANGE MITIGATION TECHNOLOGIES

Specialisation in green technologies is recognised as a fundamental prerequisite for the EU to achieve climate neutrality by 2050 and to cope adequately with the UN's Sustainable Development Goals agenda. One channel through which this occurs is foreign direct investment. In particular, the positive role that FDI plays in promoting long-term growth in host economies is a well-established fact in the international economic literature (De Mello, 1999). This growth-enhancing mechanism is activated by the technological upgrading resulting from the knowledge transfer that multinational firms mediate through their network of affiliates and subsidiaries around the world, which is a key source of value creation (Mudambi et al., 2014). Therefore, it is important to monitor the EU's FDI attractiveness, in order to understand whether openness to global capital markets can help drive technological change towards a cleaner and greener economy, as already highlighted in the literature (Pazienza, 2015).

A simple way of looking at the strength of the relationship between FDI and innovation in green technologies is through correlation coefficients, as calculated in Table 2 below.[9] Focusing on the first row of this table, it is interesting to see that while the correlation between RTA, patent production and the two FDI measures calculated – i.e. the total asset value of FDI stock in green technologies and their share in total FDI[10] – appears negative when the whole sample of EU regions is included (panel A), the same correlation becomes insignificant almost everywhere when the focus is on the core of the EU (panel B). This result aligns with the previously discussed phenomenon of natural inflation in RTA values within highly specialised regions with low patent production. Indeed, once the sample is restricted to the

[9] To compute FDI in green technologies, we consider both intra-EU and extra-EU foreign-owned firms that published at least one patent in climate change mitigation technologies in the EPO over the period 2008-2018. We merge this information with annual financial data provided by Orbis (Bureau van Dijk) at the firm level.

[10] That is, we consider FDI stock in green technologies both as the total value of the assets of firms producing these technologies (expressed in constant prices) and as a share of total FDI (expressed as a percentage).

core countries of the EU, where the inverse correlation between patent production and RTA no longer holds, the association between RTA and the share of FDI in green technologies also loses its significance. Alternatively, if green RTA is associated with regional environmental enforcement, this pattern raises the worrying possibility of pollution havens – i.e. that FDI in the non-core countries is seeking to avoid environmental regulations. That said, a look at the cumulative number of patents produced over time reveals a more consistent positive correlation across FDI measures and regional groups, thus supporting the existence of a mutual synergy between regional innovation capabilities and their business attractiveness.

**Table 2 / Pairwise correlation between innovation and FDI variables in the whole EU sample (panel A) and in the EU core countries (panel B)**

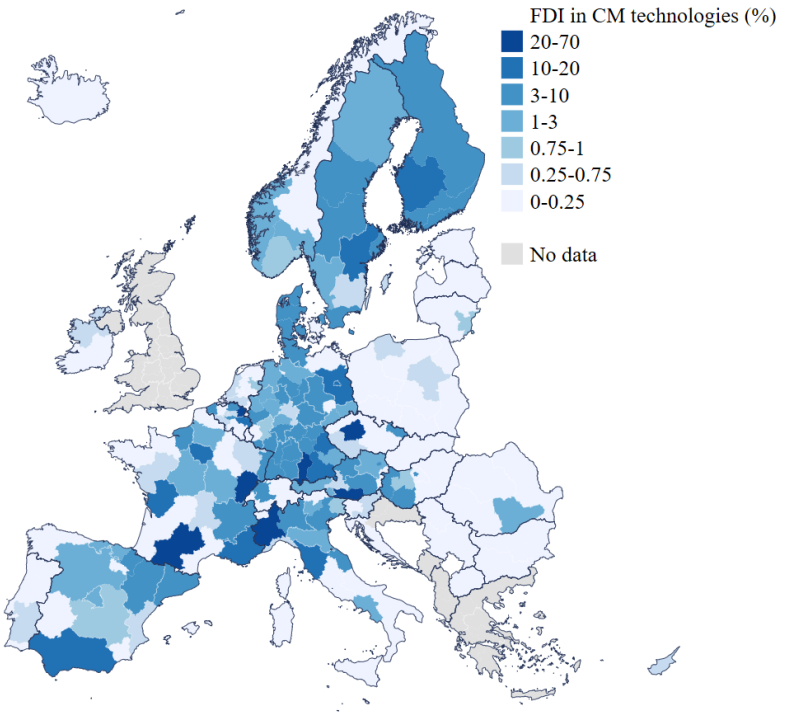
| | Panel A Whole EU | | | | Panel B Core EU | | | |
|---|---|---|---|---|---|---|---|---|
| | RTA | No. Pat (stock) | Tot. FDI (%) | Tot. FDI (USD m) | RTA | No. Pat (stock) | Tot. FDI (%) | Tot. FDI (USD m) |
| RTA | 1 | -0.1 | -0.05 | -0.15 | 1 | **-0.06** | **-0.05** | -0.12 |
| No. Pat (stock) | | 1 | 0.18 | 0.47 | | 1 | 0.14 | 0.42 |
| Tot. FDI (%) | | | 1 | 0.55 | | | 1 | 0.51 |
| Tot. FDI (USD m) | | | | 1 | | | | 1 |

Note: Bold values highlight Pearson's correlation coefficients with significance level exceeding 5%.
Source: Own calculations based on PATSTAT and Orbis (Bureau van Dijk).

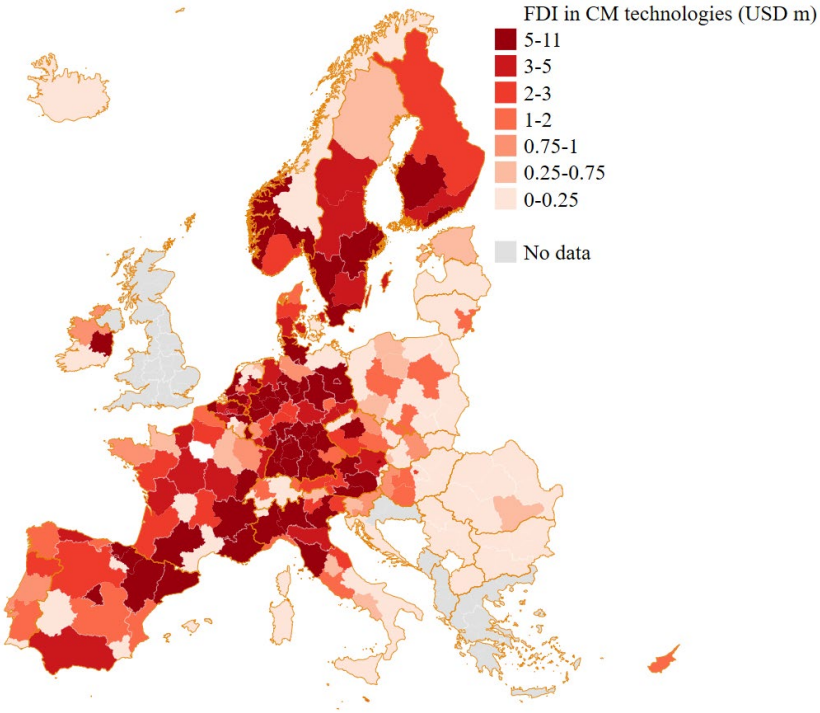
Figure 2 provides a more detailed picture of the regional distribution of FDI in green technologies, expressed in terms of their share of total FDI averaged over time (panel A) and their stock value at the end of the period (panel B). As with the patterns of technological specialisation shown in Figure 1, regions within countries that are highly specialised in green technologies in the northwestern area (most notably Finland, Sweden, the Netherlands and southern Germany), as well as those located in the more fragmented innovative clusters of southern and eastern EU countries (e.g. northern Italy, Catalonia in Spain and southeastern France), show a high concentration of FDI in green technologies in both absolute and relative terms.

**Figure 2 / FDI in climate change mitigation technologies: their share of total FDI averaged over the period 2008-2018 (panel A) and their stock value at the end of 2018 (panel B)**

Panel A




Panel B




Source: Orbis (Bureau van Dijk), own calculations.

## CONCLUSION

Consistent with previous research (Bachtrögler-Unger et al., 2023; Maucorps et al., 2023; Ghodsi and Mousavi, 2023), we find significant disparities among European regions. Some regions excel in the production of green technologies, thanks to a supportive business environment (OECD, 2019), while others struggle. This disparity highlights the need for coordinated efforts at the European level to ensure that less developed regions with innovation potential can contribute fully to sustainable technology development. In addition, to the extent that non-core FDI may also be motivated by efforts to avoid environmental regulation, this technology inequality may lead to pollution inequality.

To promote cohesion across Europe, it is essential to support research and development projects in these regions through programmes such as Horizon Europe, the Cohesion Fund and the European Regional Development Fund. In addition, the promotion of interregional cooperation between these regions and more developed areas, and the attraction of private investment from national and international markets are also crucial policies in terms of fostering innovation activities with the greatest competitiveness. Additionally, structural aspects such as developing human capital, improving institutional quality, improving access to finance and upgrading infrastructure should be prioritised in transition regions with limited innovation capacity. These measures would be crucial for the creation of a favourable business environment capable of fostering innovation by attracting both public and private investors, thus promoting sustainable economic growth to reflect the principles of the twin transition.

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# Monthly and quarterly statistics for Central, East and Southeast Europe

The monthly and quarterly statistics cover **23 countries** of the CESEE region. The graphical form of presenting statistical data is intended to facilitate the **analysis of short-term macroeconomic developments**. The set of indicators captures trends in the real and monetary sectors of the economy, in the labour market, as well as in the financial and external sectors.

Baseline data and a variety of other monthly and quarterly statistics, **country-specific** definitions of indicators and **methodological information** on particular time series are **available in the wiiw Monthly Database** under: **https://data.wiiw.ac.at/monthly-database.html**. Users regularly interested in a certain set of indicators may create a personalised query which can then be quickly downloaded for updates each month.

**Conventional signs and abbreviations used**

| | |
|---|---|
| % | per cent |
| ER | exchange rate |
| GDP | Gross Domestic Product |
| HICP | Harmonised Index of Consumer Prices (for new EU member states) |
| LFS | Labour Force Survey |
| NPISHs | Non-profit institutions serving households |
| p.a. | per annum |
| PPI | Producer Price Index |
| reg. | registered |
| y-o-y | year on year |

The following national currencies are used:

| | | | | | |
|---|---|---|---|---|---|
| ALL | Albanian lek | HUF | Hungarian forint | RON | Romanian leu |
| BAM | Bosnian convertible mark | KZT | Kazakh tenge | RSD | Serbian dinar |
| BGN | Bulgarian lev | MDL | Moldovan leu | RUB | Russian rouble |
| BYN | Belarusian rouble | MKD | Macedonian denar | TRY | Turkish lira |
| CZK | Czech koruna | PLN | Polish zloty | UAH | Ukrainian hryvnia |

EUR euro – national currency for Montenegro, Kosovo and for the euro-area countries Estonia (from January 2011, euro-fixed before), Latvia (from January 2014, euro-fixed before), Lithuania (from January 2015, euro-fixed before), Slovakia (from January 2009, euro-fixed before), Slovenia (from January 2007, euro-fixed before) and Croatia (from January 2023, euro-fixed before).
Sources of statistical data: Eurostat, National Statistical Offices, Central Banks and Public Employment Services; wiiw estimates.

**Online database access**


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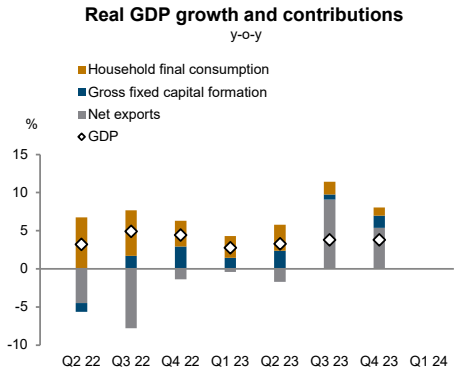
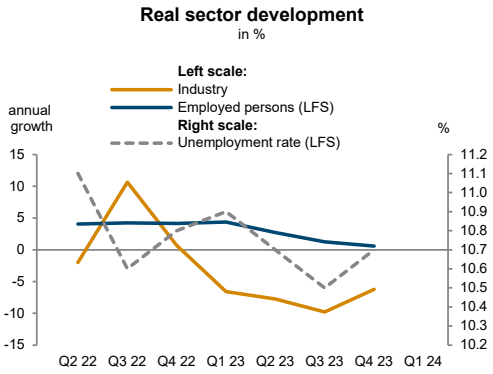
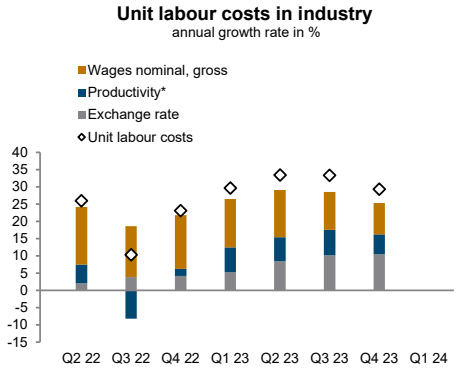
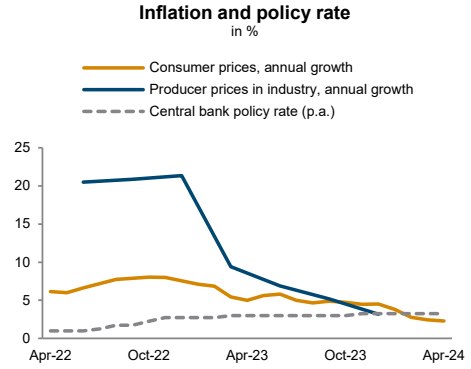
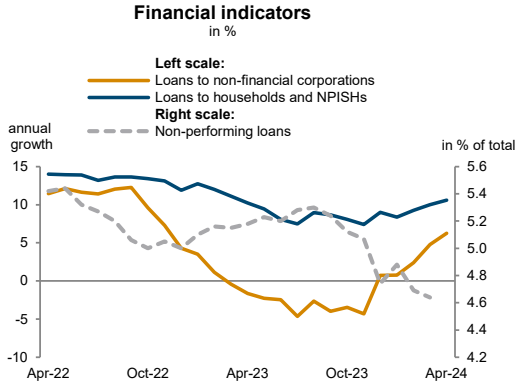
# Albania

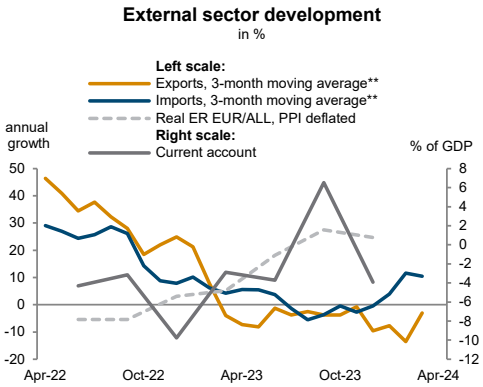
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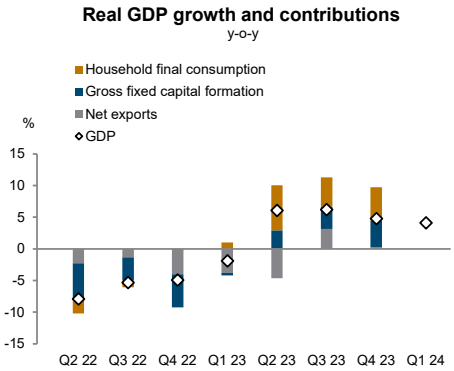
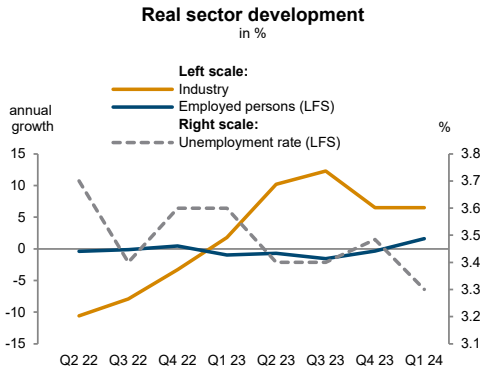
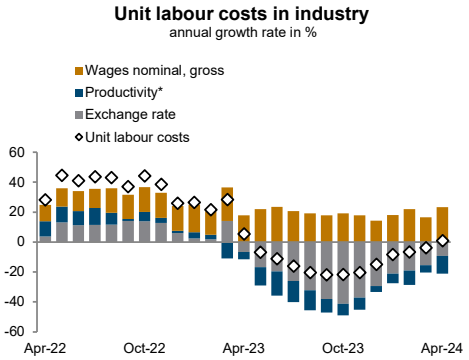
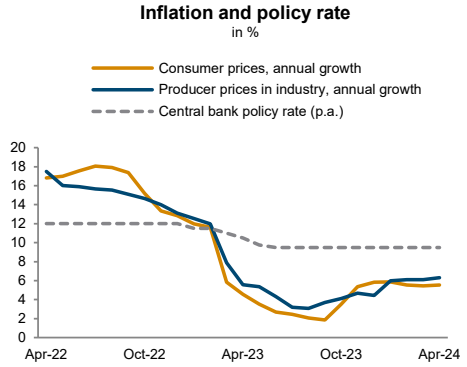
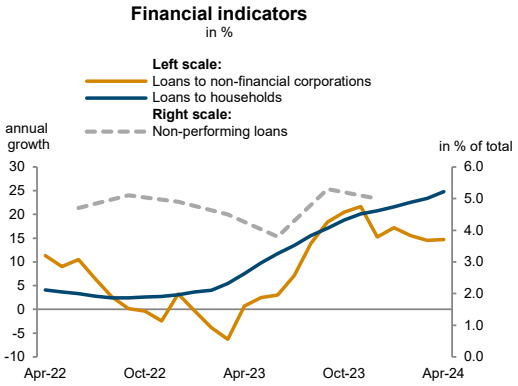
# Belarus

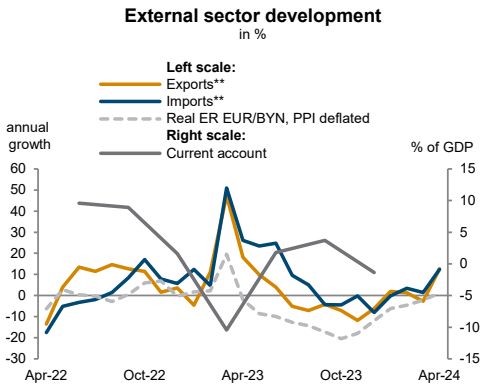
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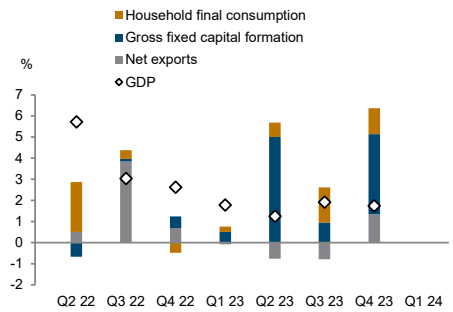
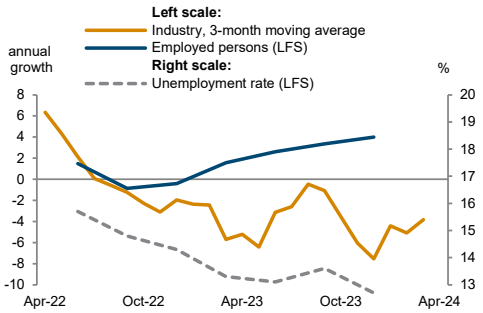
# Bosnia and Herzegovina

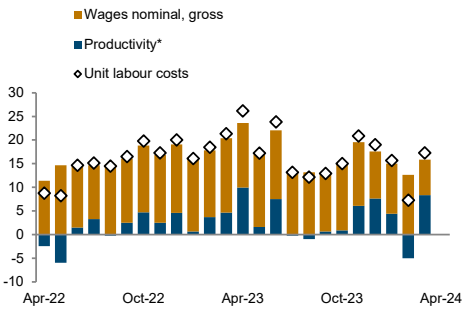
**Real GDP growth and contributions**
y-o-y



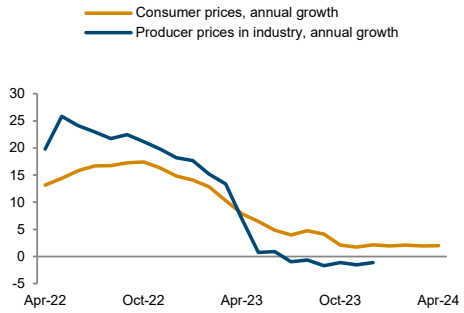

**Real sector development**
in %



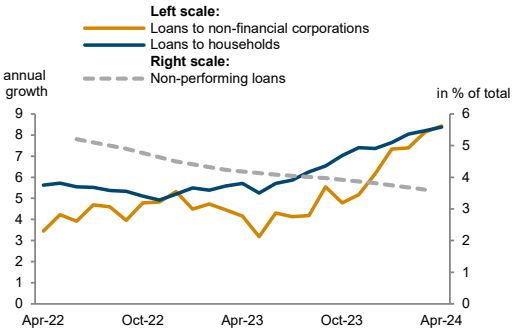

**Unit labour costs in industry**
annual growth rate in %



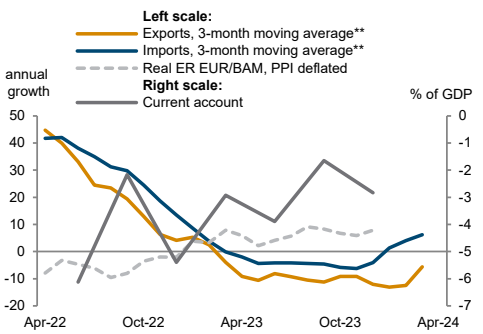

**Inflation**
in %




**Financial indicators**
in %




**External sector development**
in %

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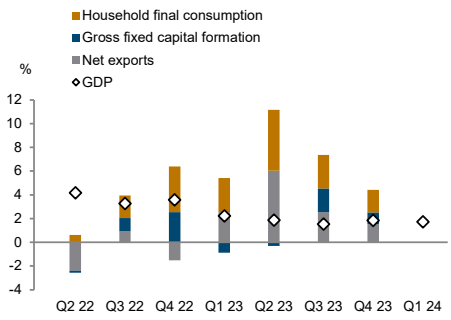
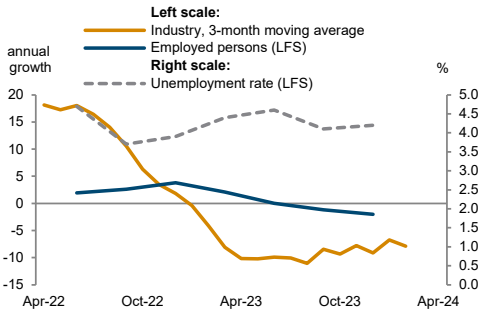
# Bulgaria

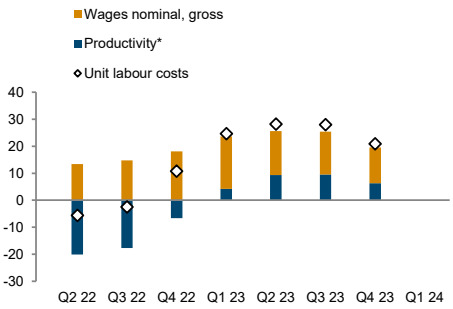
**Real GDP growth and contributions**
y-o-y



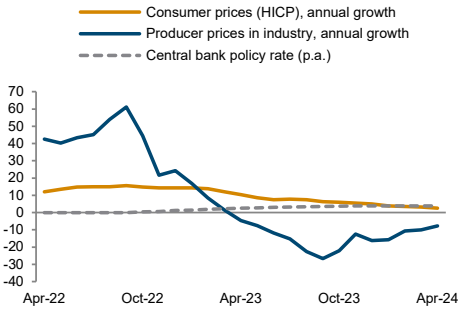

**Real sector development**
in %



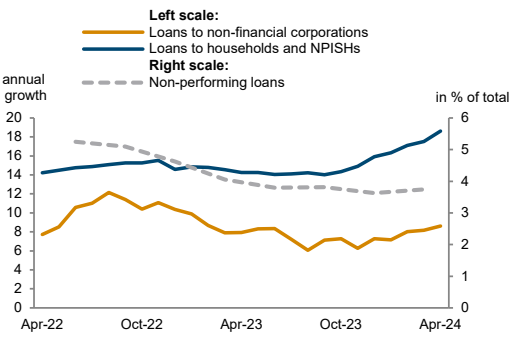

**Unit labour costs in industry**
annual growth rate in %



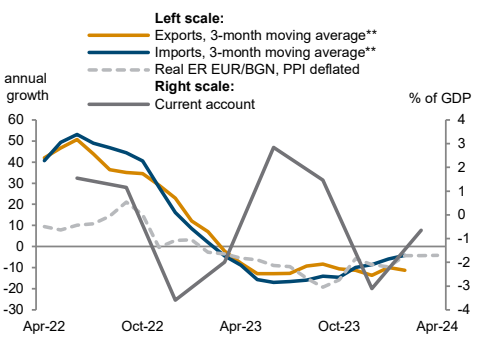

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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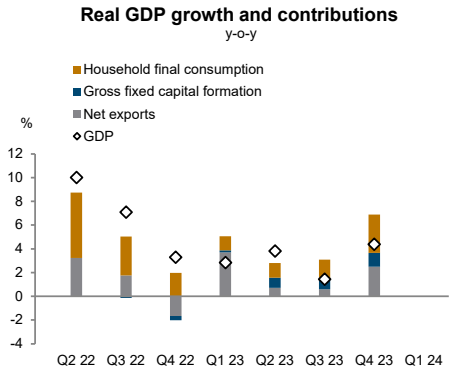
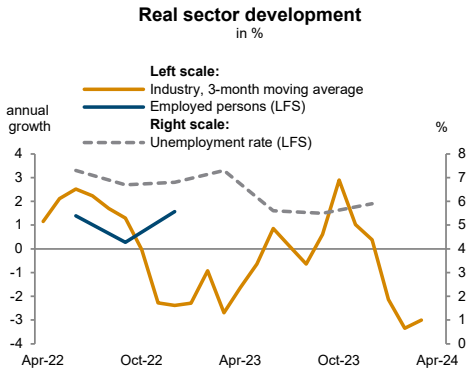
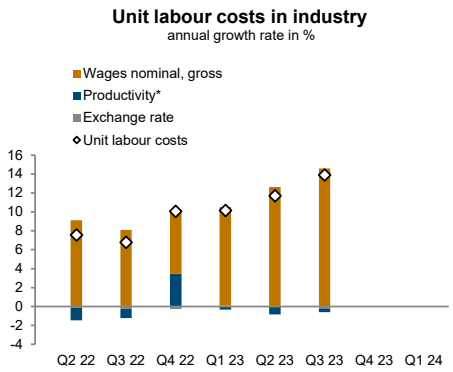
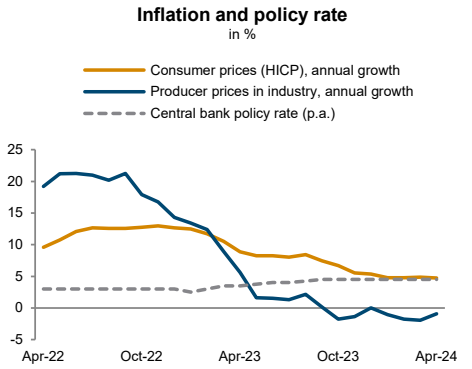
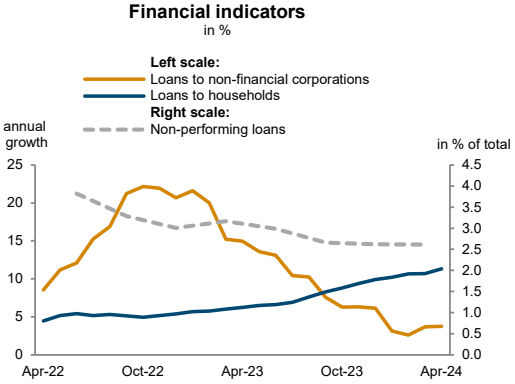
# Croatia

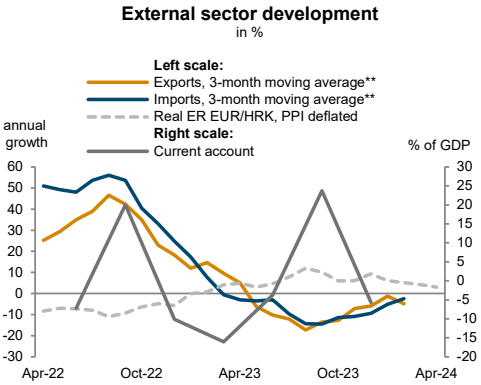
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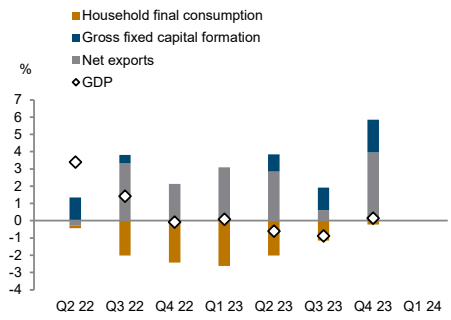
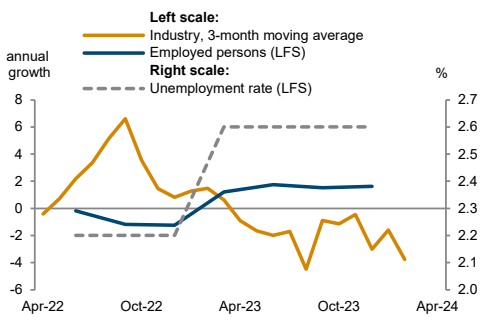
# Czechia

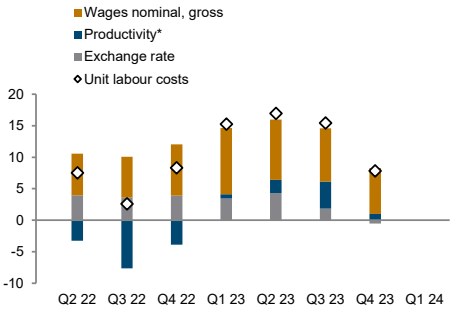
**Real GDP growth and contributions**
y-o-y



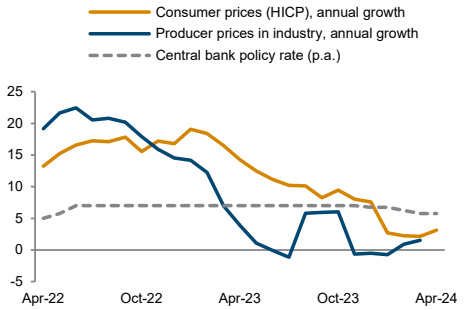

**Real sector development**
in %



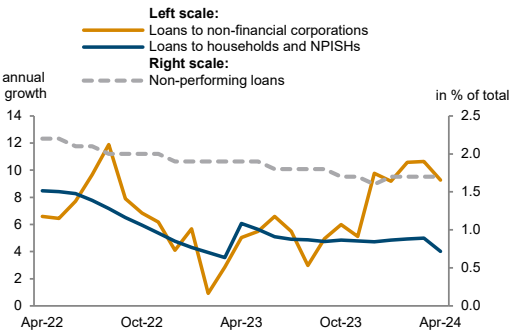

**Unit labour costs in industry**
annual growth rate in %



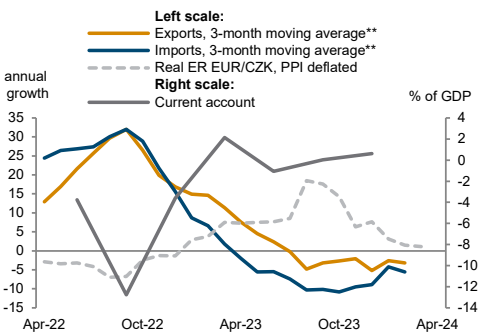

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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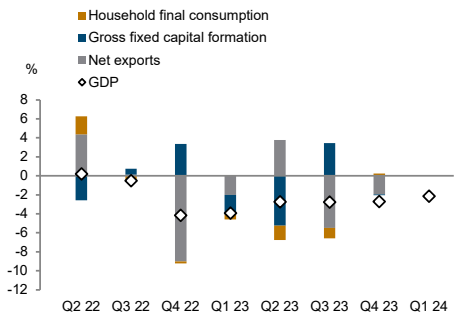
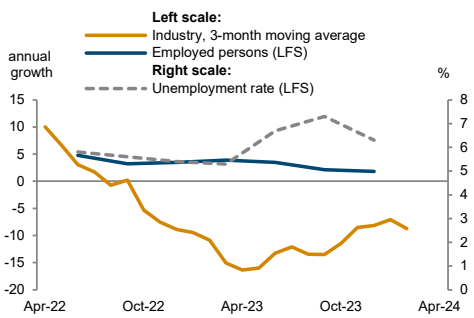
# Estonia

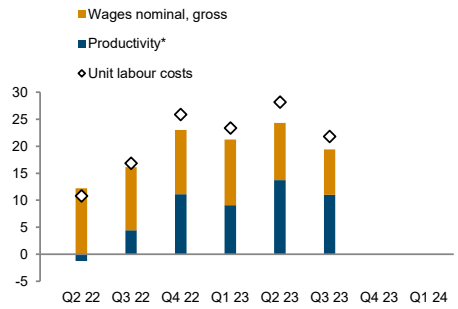
**Real GDP growth and contributions**
y-o-y



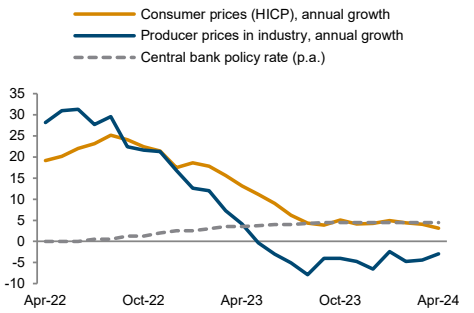

**Real sector development**
in %



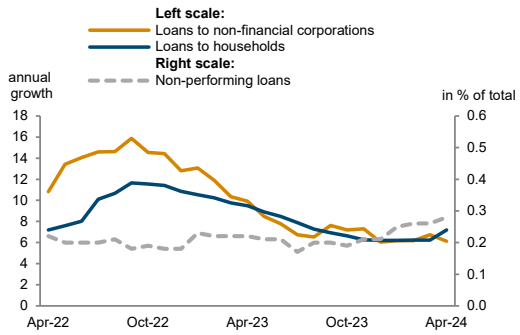

**Unit labour costs in industry**
annual growth rate in %



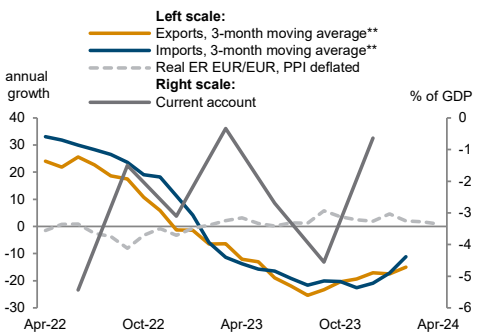

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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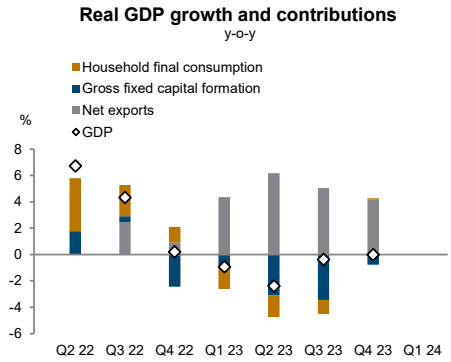
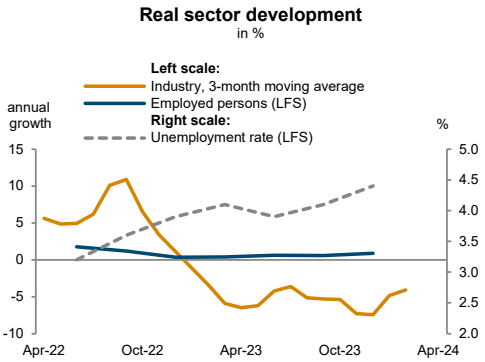
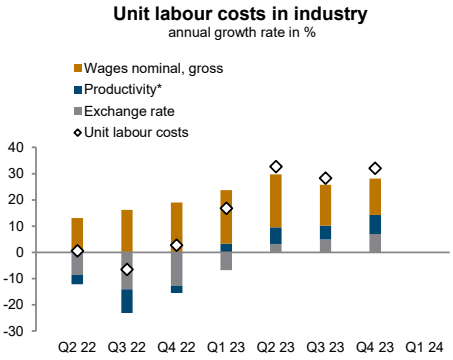
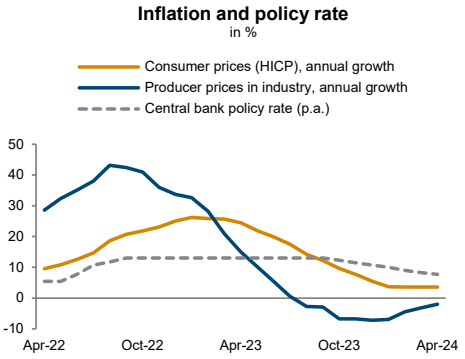
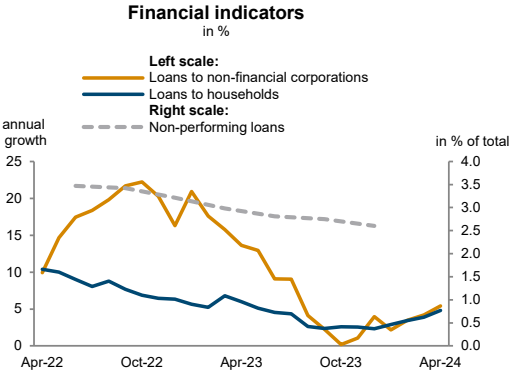
# Hungary

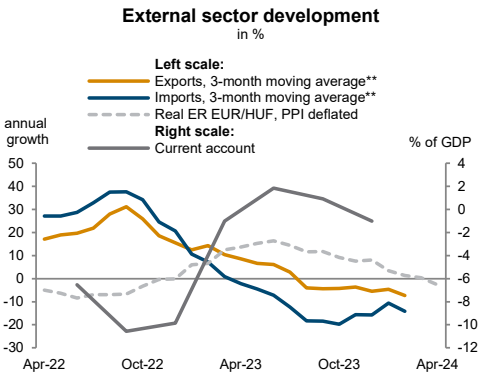
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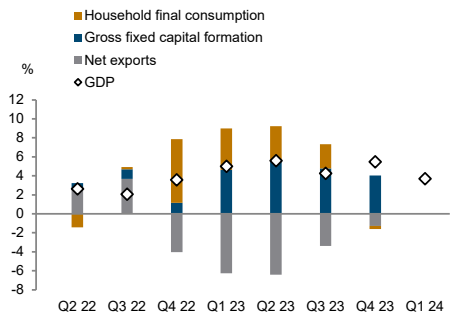
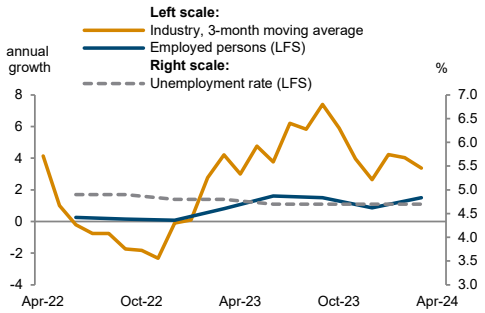
# Kazakhstan

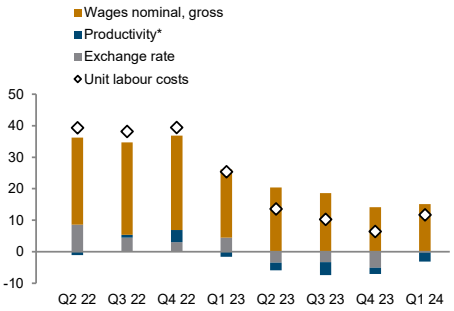
**Real GDP growth and contributions**
y-o-y



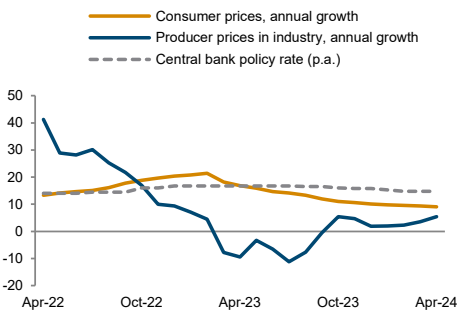

**Real sector development**
in %



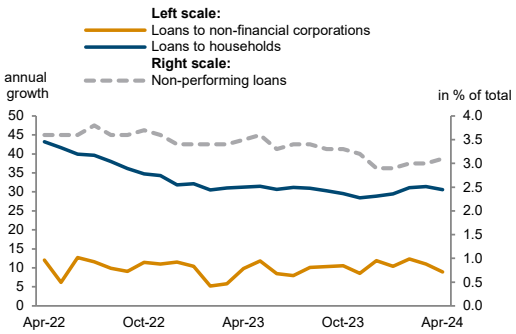

**Unit labour costs in industry**
annual growth rate in %



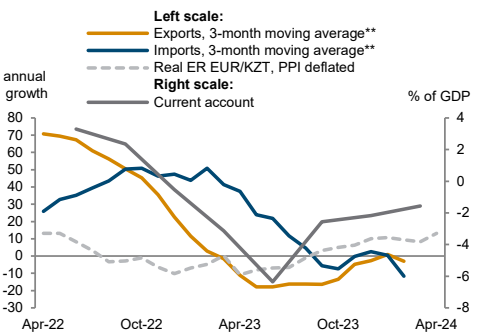

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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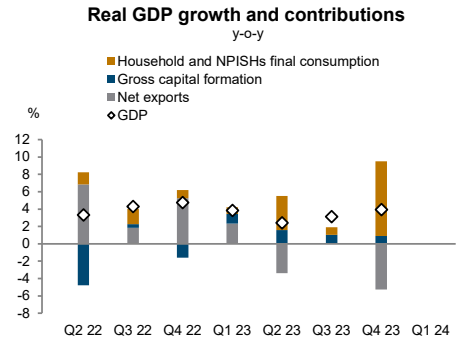
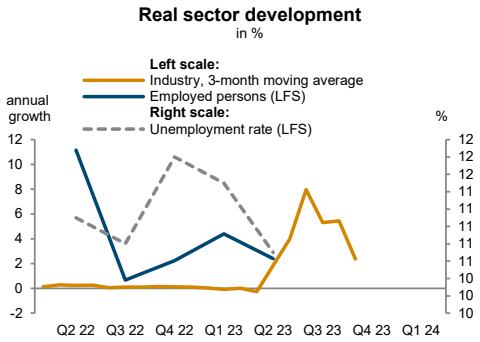
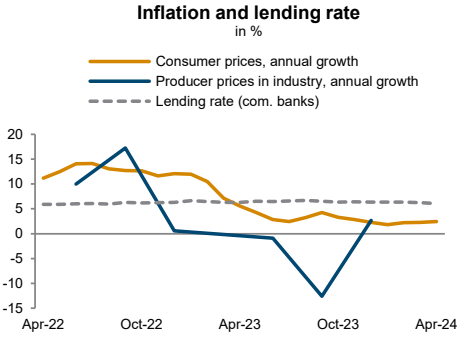
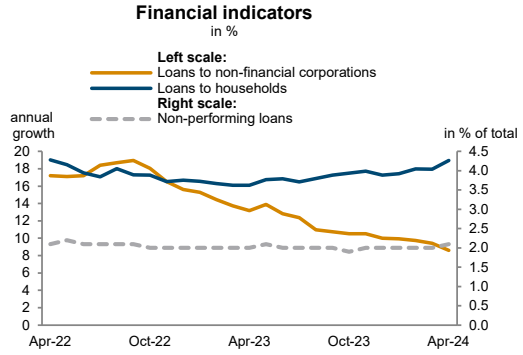
# Kosovo

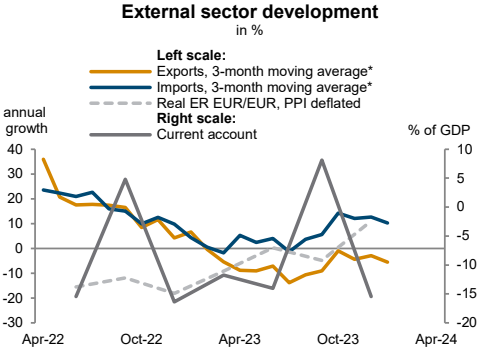







*EUR based.

Source: wiiw Monthly Database incorporating Eurostat and national statistics.
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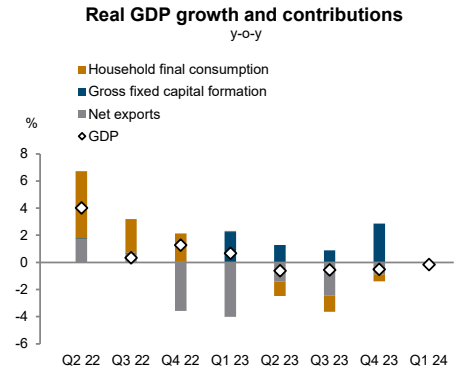
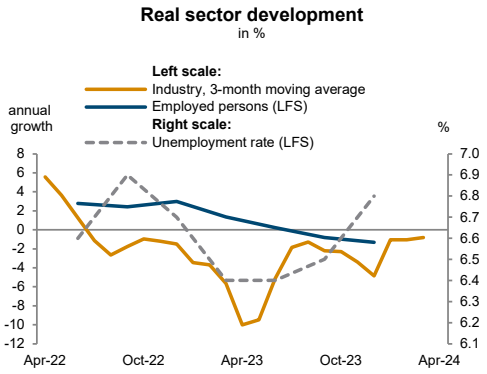
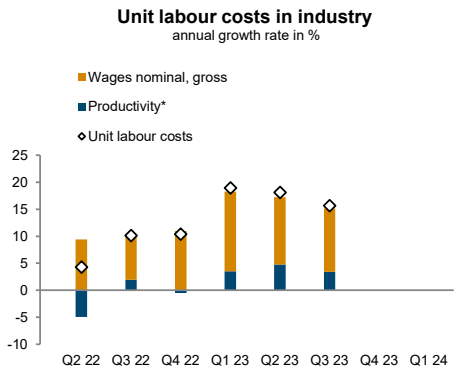
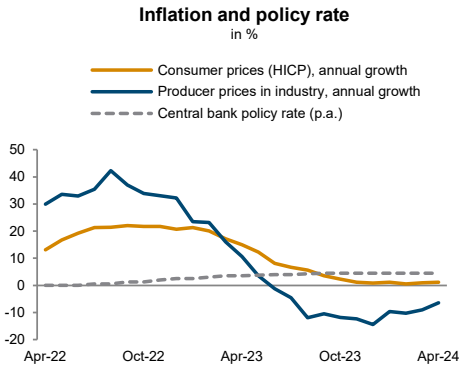
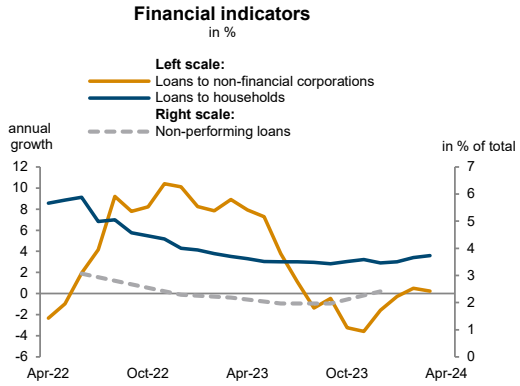
# Latvia

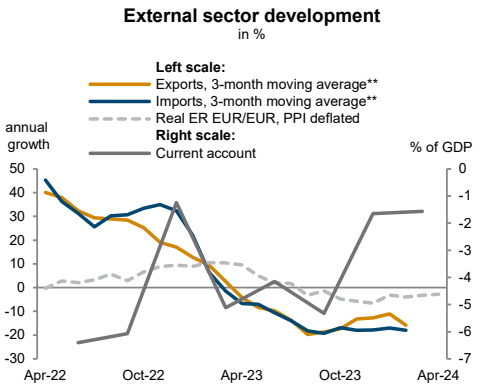



*Positive values of the productivity component on the graph reflect decline in productivity and vice versa.
**EUR based.

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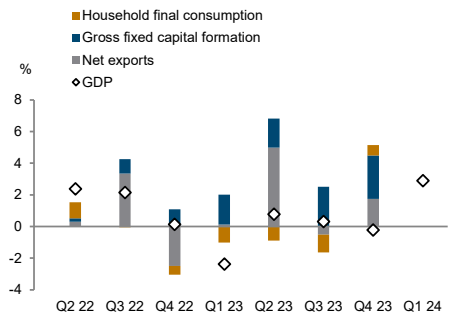
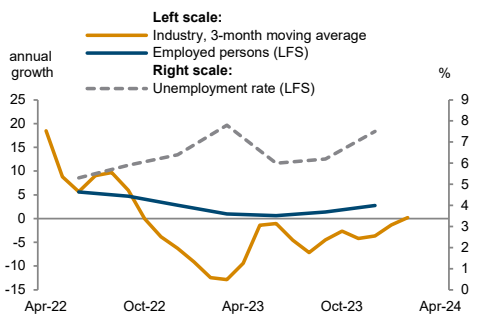
# Lithuania

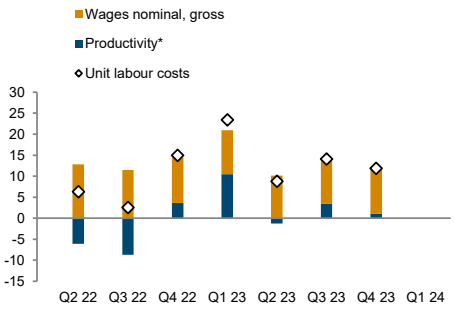
**Real GDP growth and contributions**
y-o-y



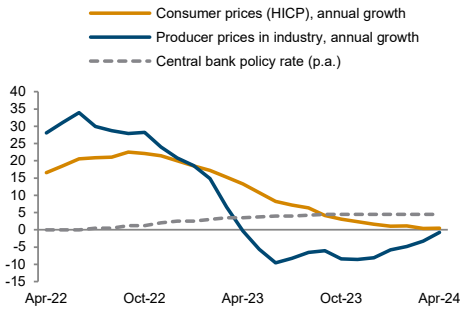

**Real sector development**
in %



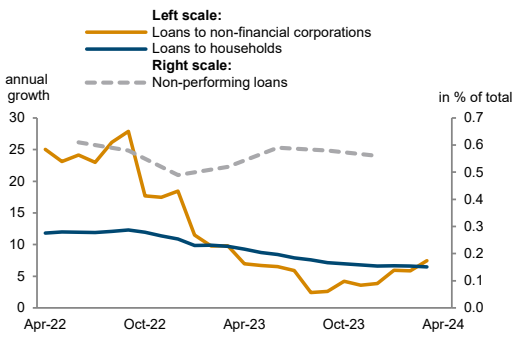

**Unit labour costs in industry**
annual growth rate in %



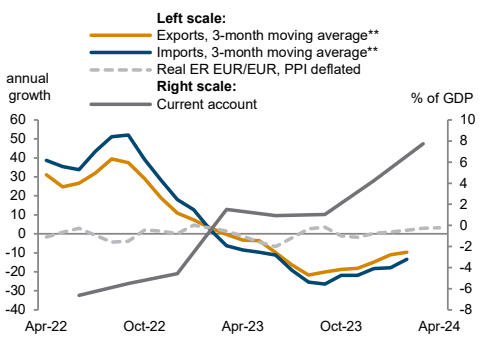

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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**EUR based.

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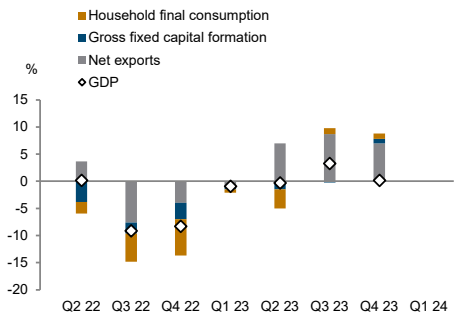
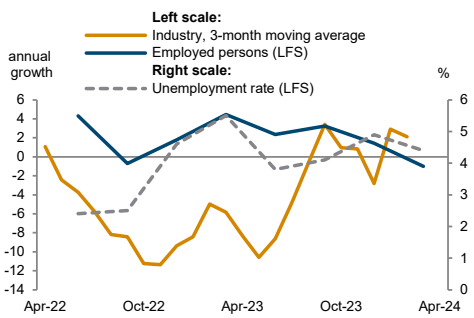
# Moldova

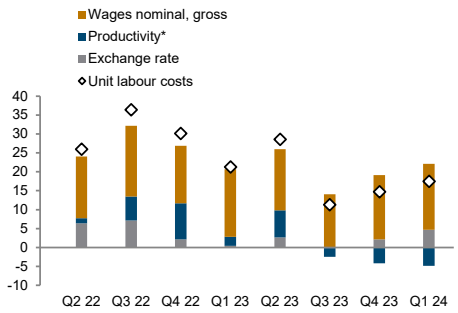
**Real GDP growth and contributions**
y-o-y



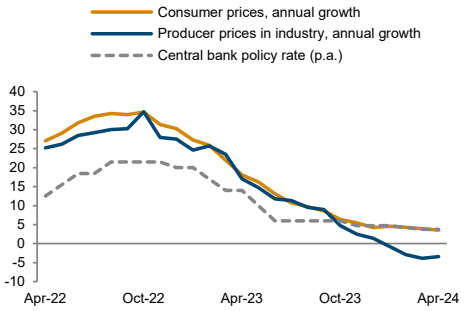

**Real sector development**
in %



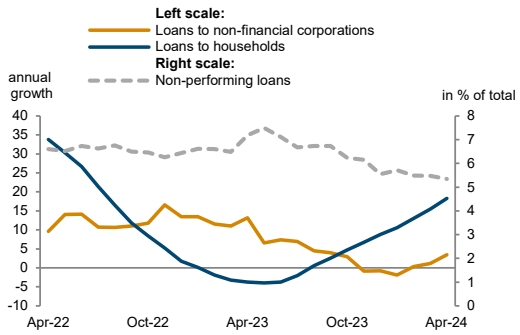

**Unit labour costs in industry**
annual growth rate in %



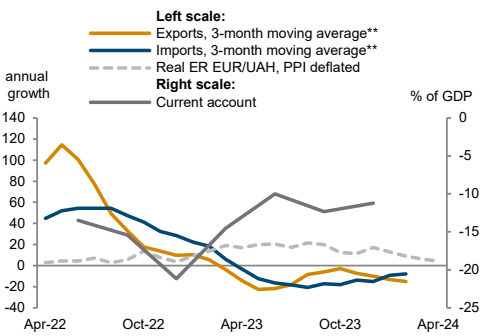

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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**EUR based.

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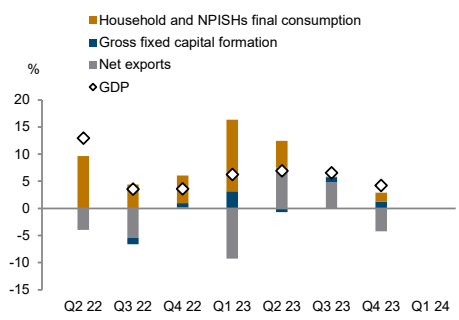
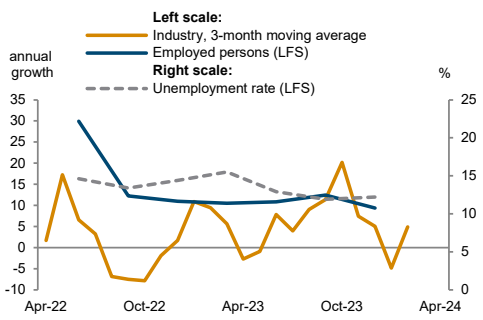
# Montenegro

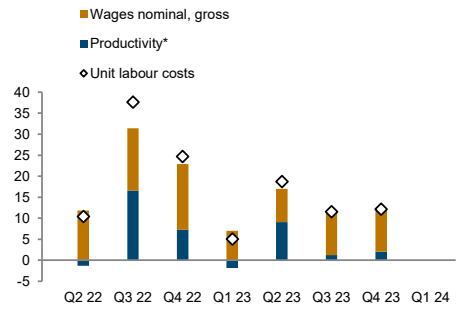
**Real GDP growth and contributions**
y-o-y



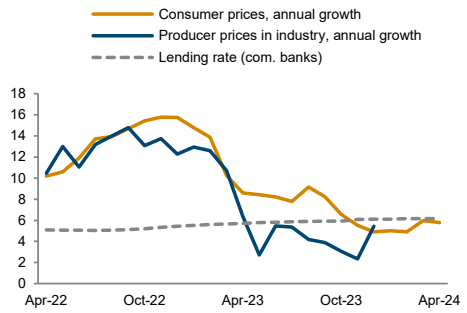

**Real sector development**
in %



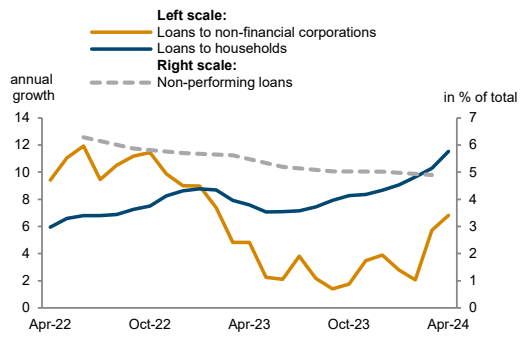

**Unit labour costs in industry**
annual growth rate in %



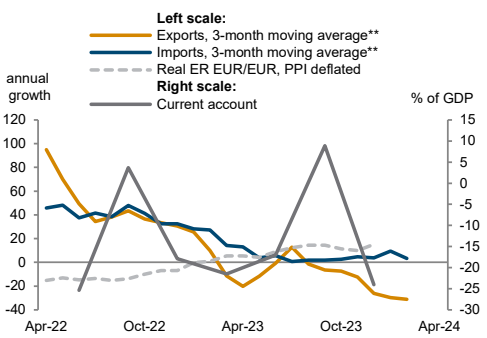

**Inflation and lending rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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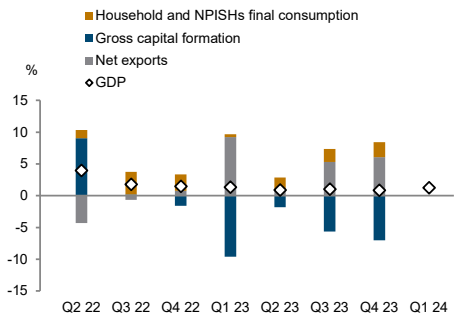
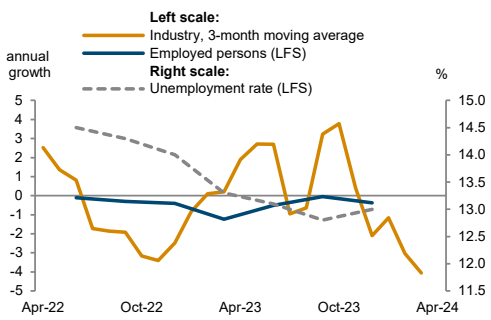
# North Macedonia

**Real GDP growth and contributions**
y-o-y

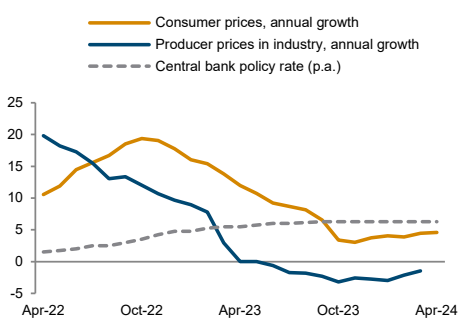



**Real sector development**
in %

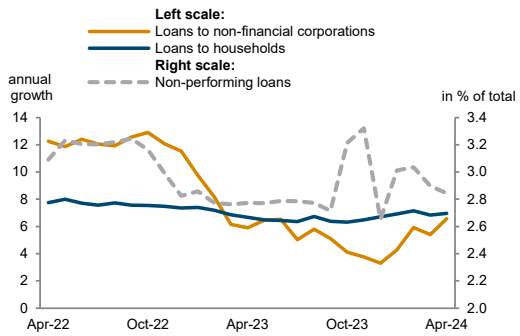



**Unit labour costs in industry**
annual growth rate in %

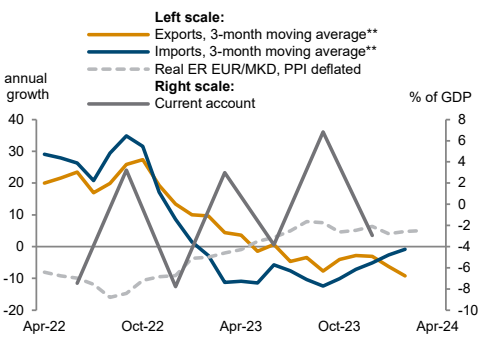

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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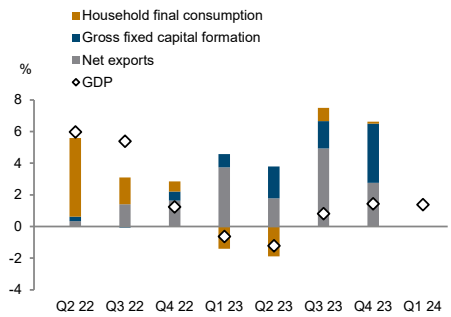
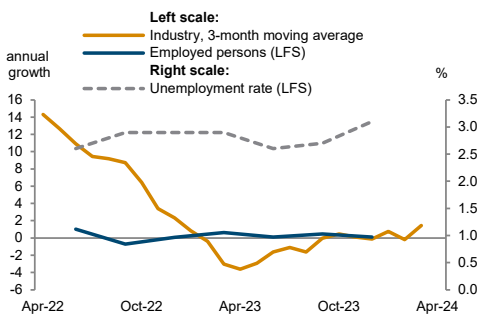
# Poland

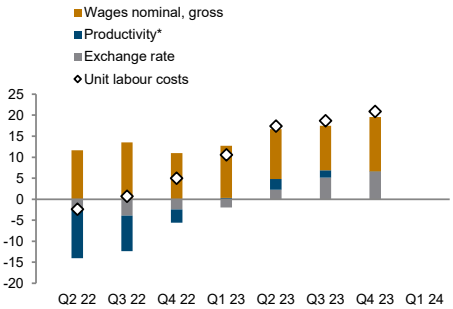
**Real GDP growth and contributions**
y-o-y



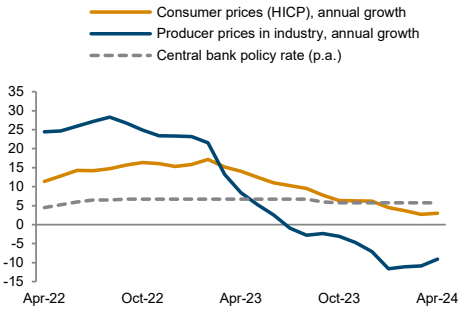

**Real sector development**
in %



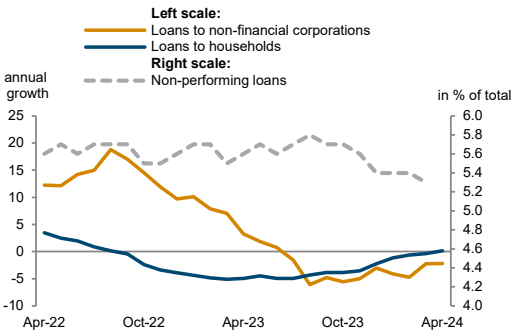

**Unit labour costs in industry**
annual growth rate in %



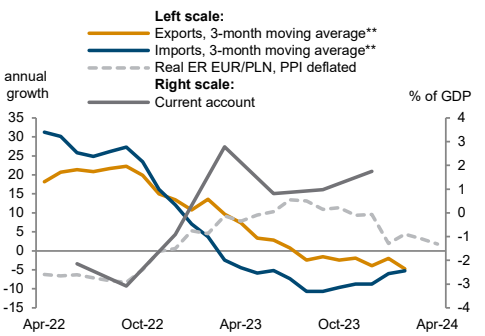

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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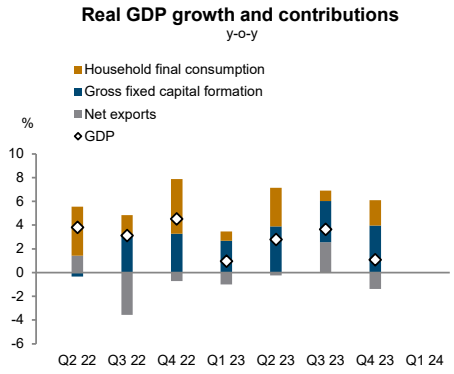
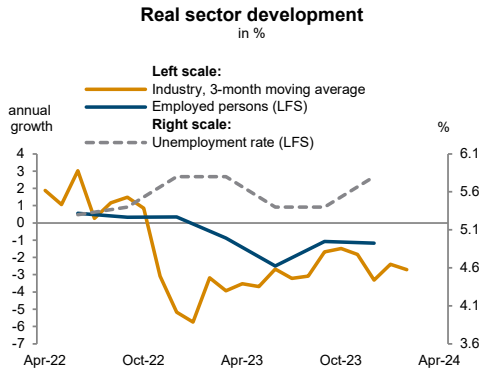
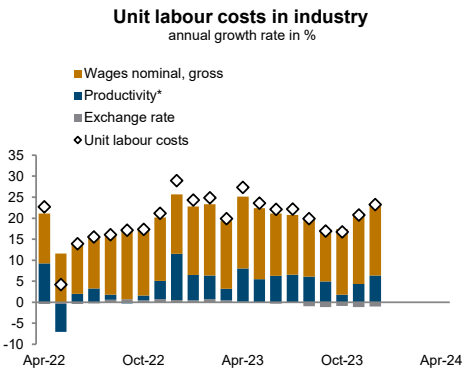
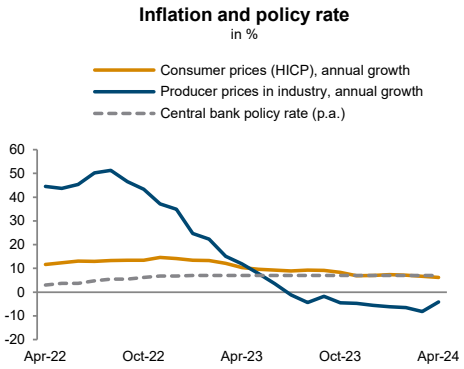
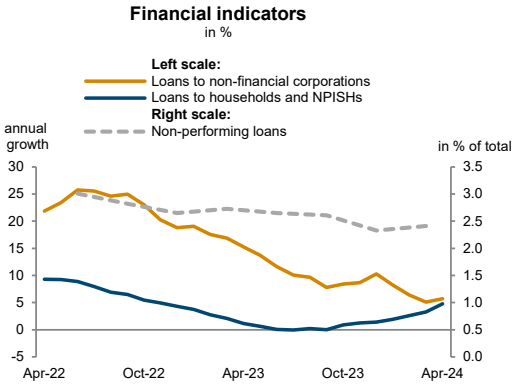
# Romania

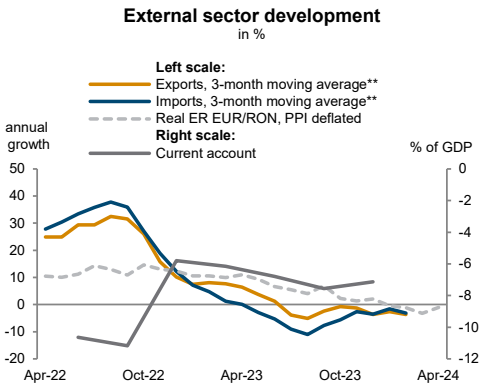
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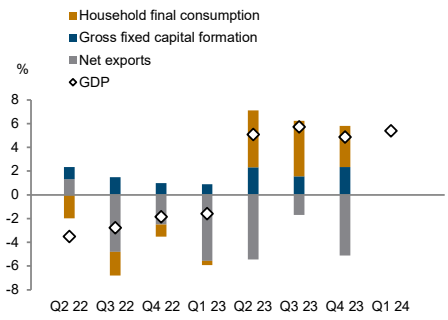
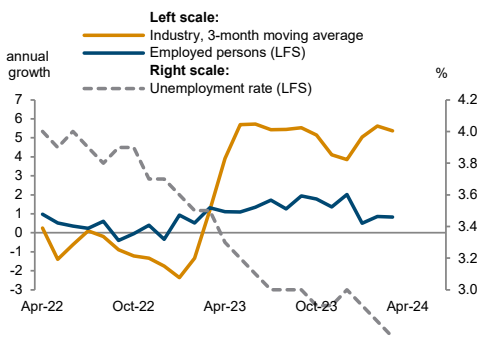
# Russia

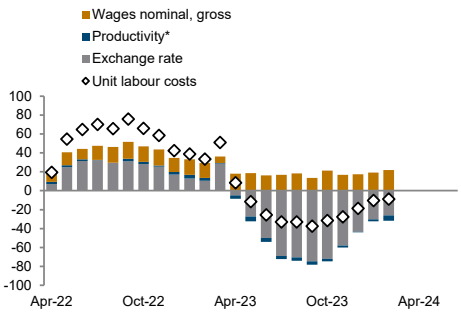
**Real GDP growth and contributions**
y-o-y



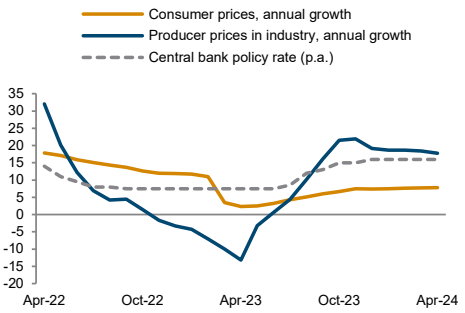

**Real sector development**
in %



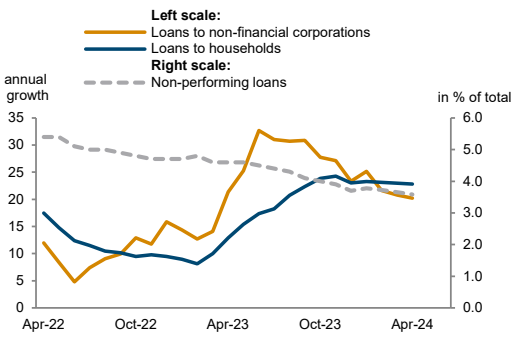

**Unit labour costs in industry**
annual growth rate in %



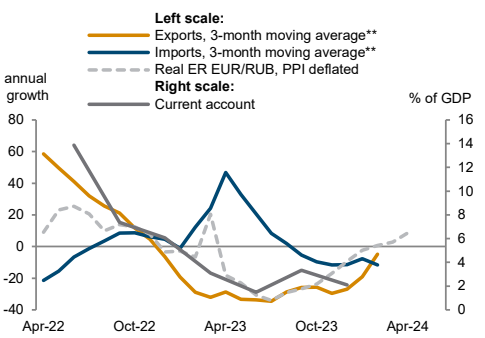

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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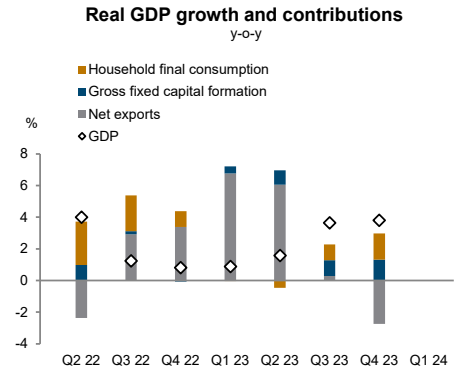
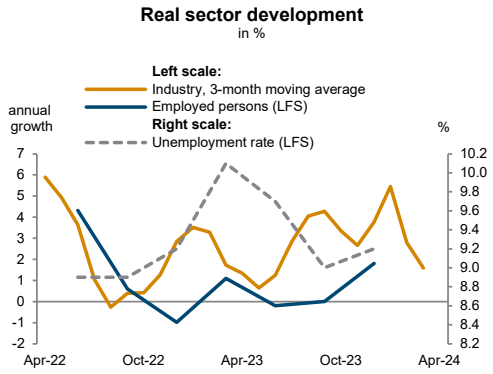
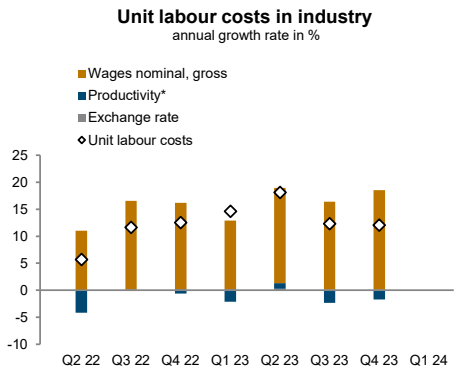
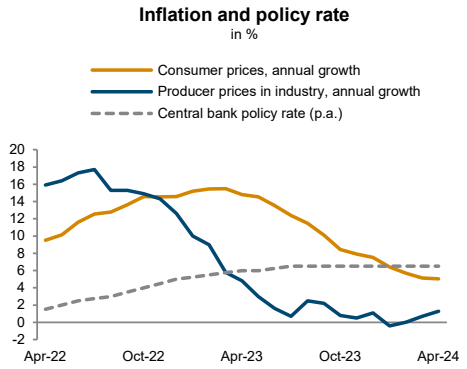
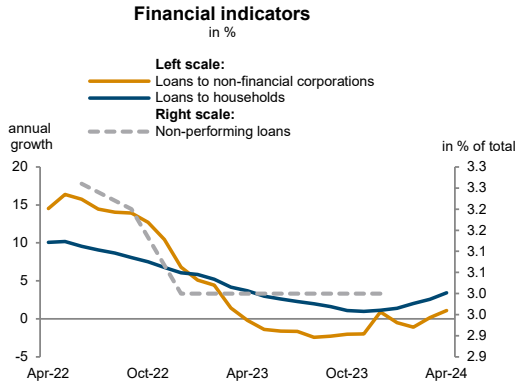
# Serbia

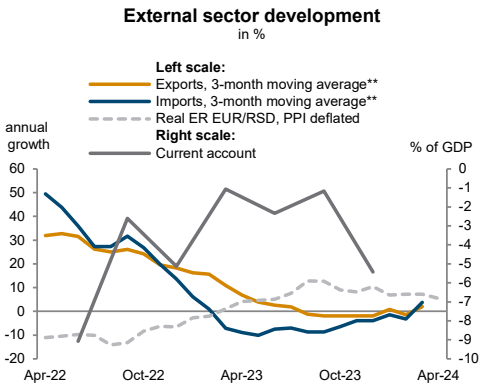



*Positive values of the productivity component on the graph reflect decline in productivity and vice versa.
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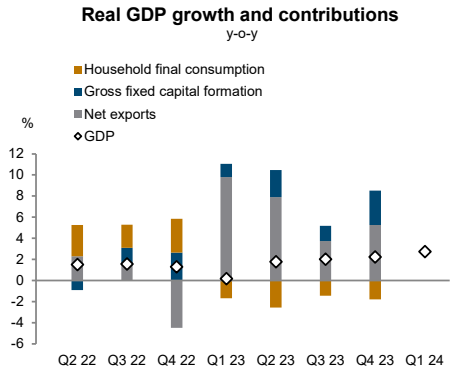
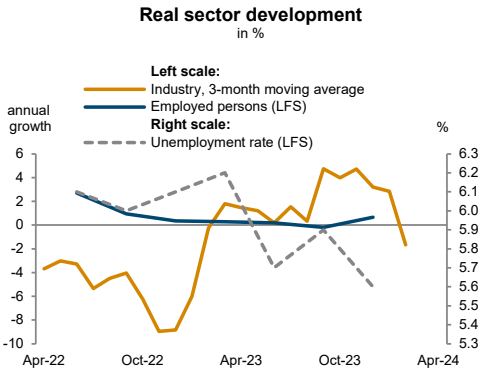
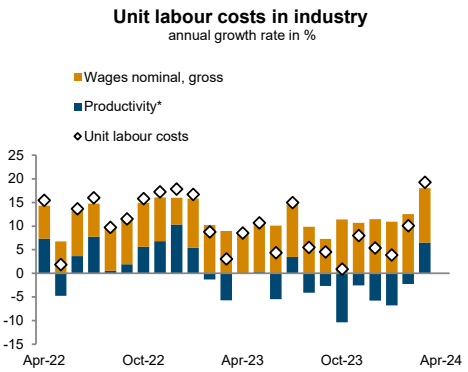
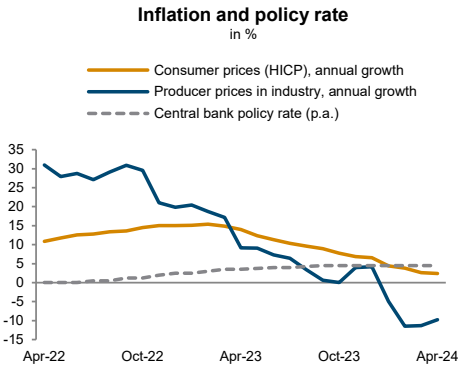
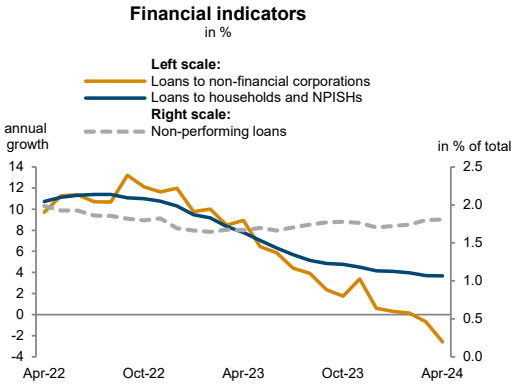
# Slovakia

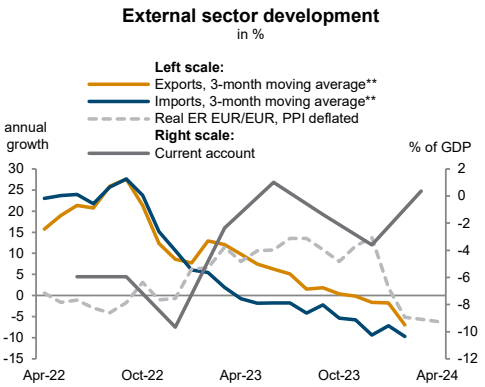
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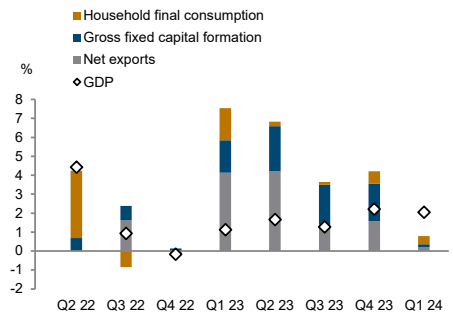
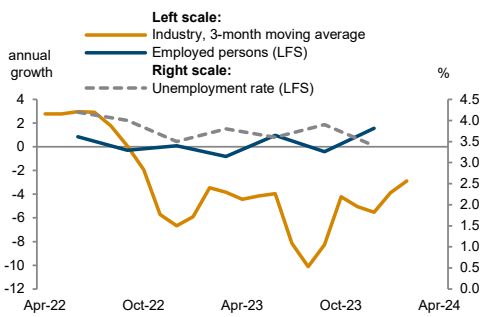
# Slovenia

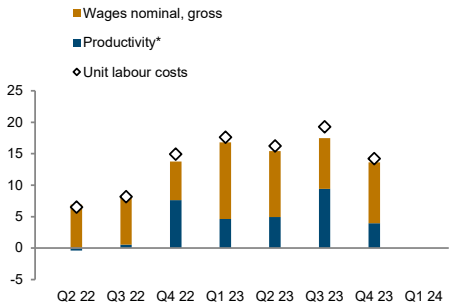
**Real GDP growth and contributions**
y-o-y



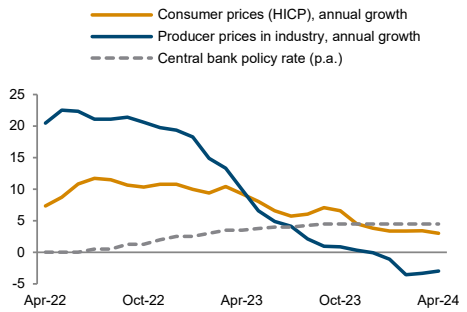

**Real sector development**
in %



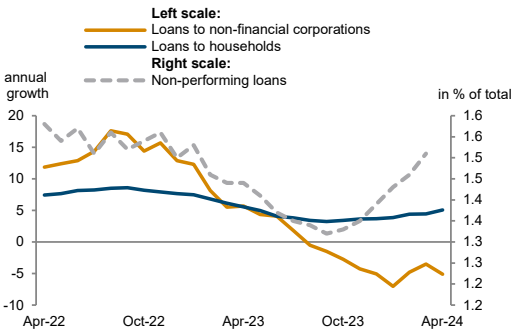

**Unit labour costs in industry**
annual growth rate in %



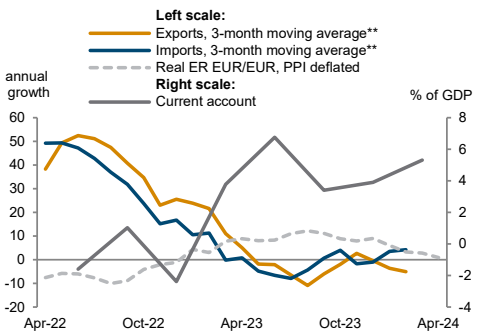

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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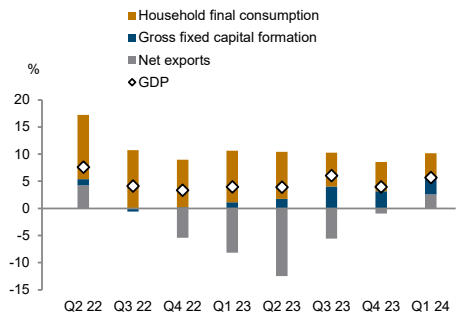
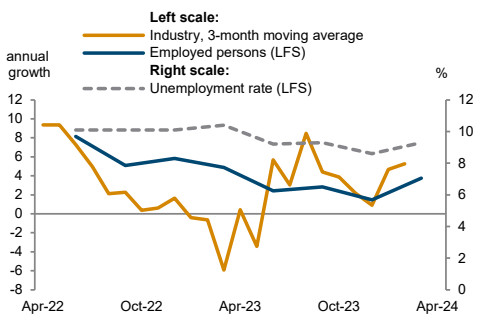
# Turkey

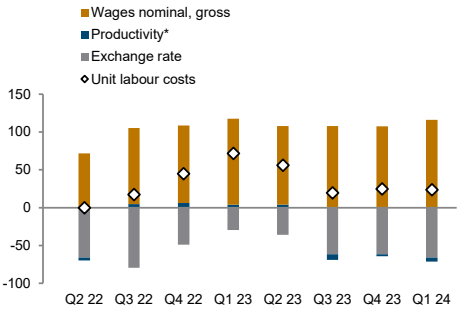
**Real GDP growth and contributions**
y-o-y



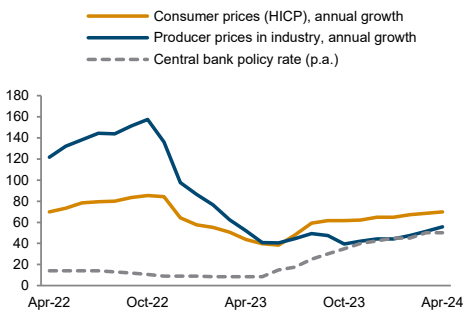

**Real sector development**
in %



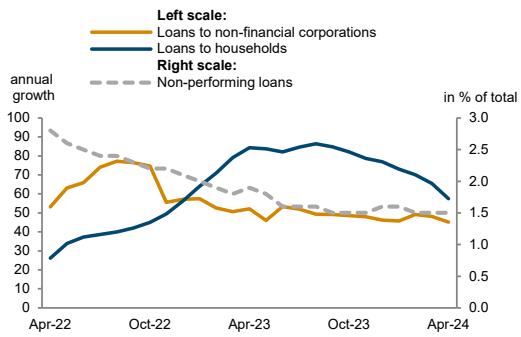

**Unit labour costs in industry**
annual growth rate in %



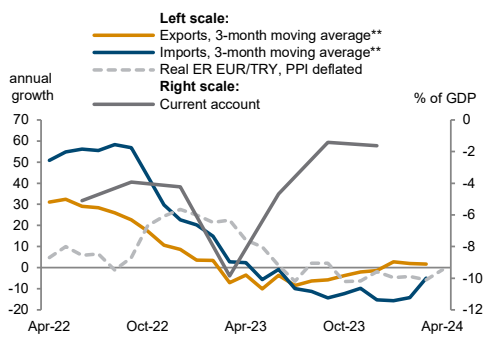

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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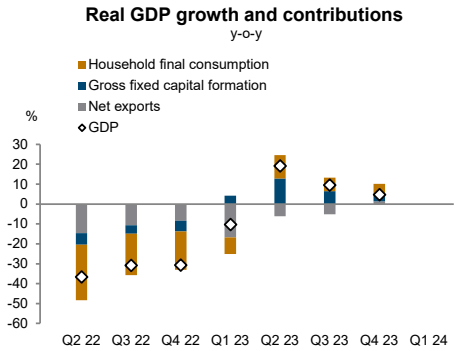
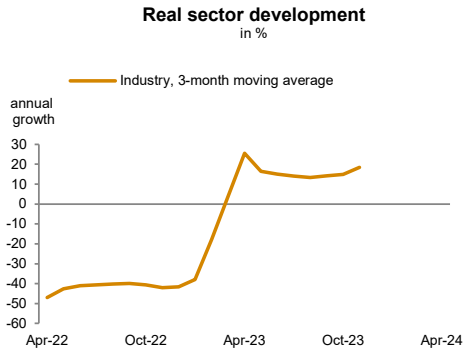
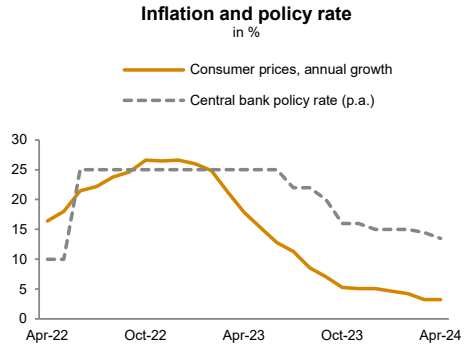
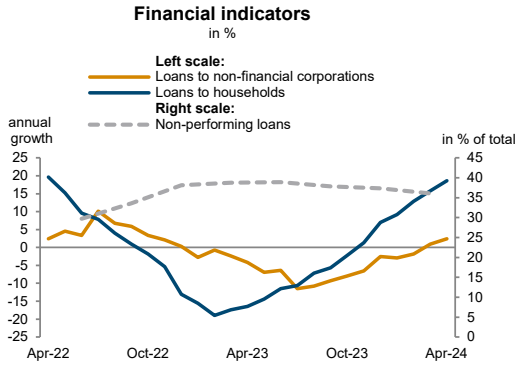
# Ukraine

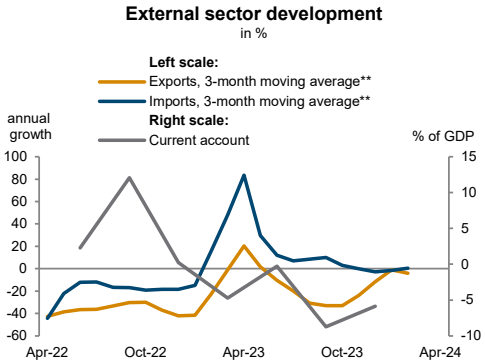




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**multi-country articles and statistical overviews**

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