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## Waiting for the Vaccine Roll-out to Speed up

## Don’t Expect an Improvement in EU-Russia Relations Anytime Soon

## ICT Industries: The Eternal Concern of EU Industrial Policy

## Innovation and Company Performance in the Digital Sector

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

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# Innovation and Company Performance in the Digital Sector

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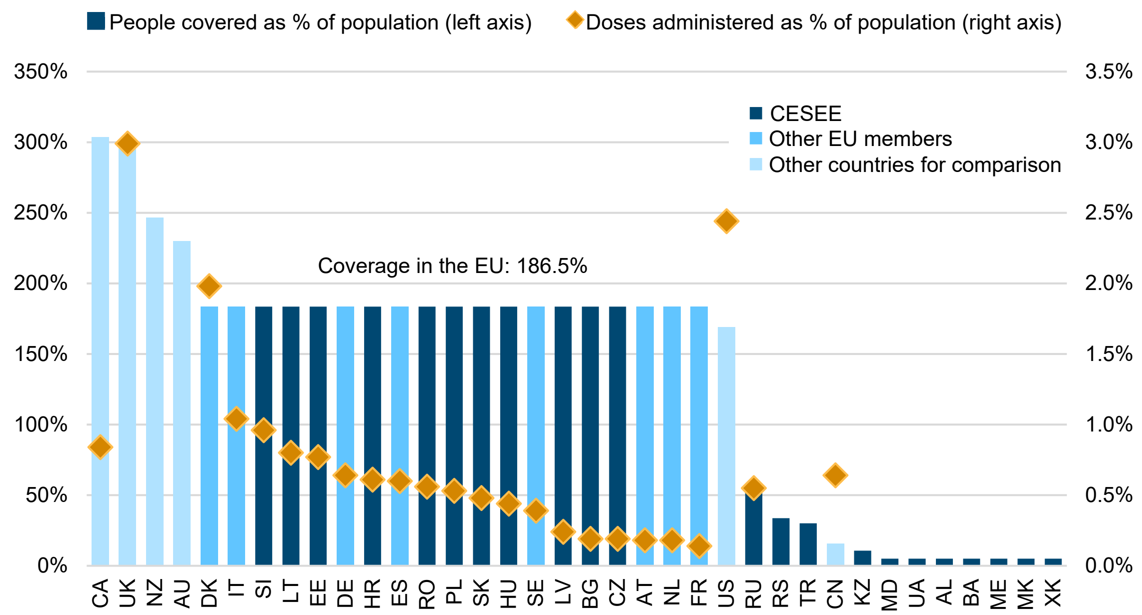
# Chart of the month: Waiting for the vaccine roll-out to speed up

BY JULIA GRÜBLER

**Coverage of vaccine contracts and administered doses as a percentage of population**




Notes: Last updates to figures on doses administered between 8 January and 10 January 2021. Data on the population coverage take account of the number of doses (typically 2) required by each vaccine. Data on vaccine purchasing contracts is restricted to publicly disclosed allocations, and do not cover vaccines produced and distributed domestically on undisclosed terms. No data available for Belarus.
Source: COVID-19 Vaccine Tracker by Bloomberg (accessed 11 January 2021).

After the development of COVID-19 vaccines at record speed in 2020, the world has started the new year with a massive vaccination campaign. By 10 January 2021, more than 25 million doses had already been administered. Russia and China started as early as summer 2020 to administer their own vaccines. In the EU, the official start of the vaccination campaign was 27 December.[1]

Using data provided by the COVID-19 vaccine tracker allows us to make some interesting cross-country comparisons, in terms of the number of doses that countries reserved via purchasing contracts (blue columns, left axis) and the speed with which the vaccinations are being given (orange diamonds, right axis). The chart distinguishes between Central, East and Southeast European (CESEE) economies and other selected EU member states, with some further countries for comparison. It contains a wealth of information.

1 See European Commission (2021): Safe COVID-19 vaccines for Europeans, https://ec.europa.eu/info/live-work-travel-eu/coronavirus-response/safe-covid-19-vaccines-europeans_en

First, there are data gaps with respect to the speed at which countries are vaccinating against COVID-19. In the chart, those countries that cannot provide this information do not have an orange diamond.[2] Among the CESEE economies, these are primarily the CIS and Western Balkan economies. However, it is crucially important to collect these data, so that they can be analysed and policy decisions be based on them.

Second, while the developed economies (including the EU) reserved far more doses than was strictly required in terms of their population size, many other countries fall well below the 100% line. This is particularly true of the Western Balkan economies: in those countries, the share of the population covered by purchases of vaccines (according to the available contracts) is as low as 5%. The data on the number of doses reserved by each country are restricted to contracts involving publicly disclosed allocations. Hence, for economies like Russia and China, which are producing their own vaccines domestically (also on undisclosed terms), the relatively low shares are less worrying.

Third, the share of the population covered across the EU member states is calculated at the same rate of 186.5%, as the EU took responsibility for purchasing vaccines centrally. However, the vaccination strategies, capabilities and willingness of the population to be vaccinated differ from country to country. Denmark is a clear front-runner, with roughly 2% of the population already having been vaccinated after the first week of January. It is followed – at some considerable distance – by Italy, which was hit particularly hard by the COVID-19 pandemic. Some CESEE economies in the EU, such as Slovenia, Lithuania, Estonia and Croatia, are well ahead of many of their Western European peers. The Netherlands, Austria and France are currently bottom of the league in the EU for rolling out vaccination.

2 Comparisons with other datasets (e.g. Our World in Data) show that these data gaps are not confined to the data chosen to create this chart.

# Opinion Corner*: Don't expect an improvement in EU-Russia relations anytime soon

BY TATIANA ROMANOVA[1]

*Five factors diminish the likelihood of any improvement in EU-Russia relations in the near future: the belief of both actors that time is on their side, deep mutual mistrust and zero-sum thinking, different interpretations of rule-based international order, weakening economic relations, and the geopoliticisation of internal politics. Yet, there are several areas of potential cooperation that could at least prevent further deterioration.*

It has become a commonplace that EU-Russian relations are at their lowest point. But nearly every day they hit another new low. As if to illustrate that, Russian Foreign Minister Sergey Lavrov recently suggested that Russia could temporarily stop communicating with the EU.[2] He was responding indirectly to European Commission President Ursula von der Leyen's assertion that Russian behaviour was getting worse all the time.[3]

Analysts had previously argued that a shared threat would force Moscow and Brussels to reassess their positions. The 2020 pandemic experience has demonstrated that (so far at least) this is not the case; instead existing problems became more pronounced and positions on both sides are now even more entrenched. Either the pandemic crisis has not (yet?) been severe enough, or the contradictions between the EU and Russia are too fundamental to overcome.

## FIVE FACTORS THAT DIMINISH THE CHANCES OF DÉTENTE

1. Both the EU and Russia believe that time is on their side, that they just have to wait. Brussels expects internal changes in Russia, resulting from profound economic problems and an aging political elite. Moscow, in turn, sees international relations as increasingly chaotic and believes that profound changes are under way that will undermine the West's positions. Internal economic and social problems in the EU reinforce Russia's negative view of its prospects. So, when the EU proposes returning to business as usual on the basis of Russia fulfilling a set of conditions (Minsk 2 first and foremost) Russia responds that it does not want to have any business with the EU at all.[4] Both the EU and Russia remain strong enough to believe that they can survive without much contact with the other.

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* Disclaimer: The views expressed in the Opinion Corner section of the Monthly Report are exclusively those of the authors and do not necessarily represent the official view of wiiw.

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2 Foreign Minister Sergey Lavrov's speech, Valdai International Discussion Club, 13 October 2020.

3 State of the Union Address by President von der Leyen at the European Parliament Plenary, 16 September 2020.

4 Foreign Minister Sergey Lavrov's speech, Valdai International Discussion Club, 13 October 2020.

2. There is a profound lack of trust on both sides. Any initiative by Moscow or Brussels is treated by the other side with suspicion and zero-sum thinking at the elite level. Mounting accusations of disinformation and dissemination of fake news percolate this mistrust into the civil societies on both sides. The level of mutual mistrust is such that both sides suspect the other of exploiting the pandemic. For example, in Brussels and other EU capitals many believe that Russia uses COVID-related developments to further discredit the EU, and that Moscow politicises the development of a vaccine. Russian experts, on the other hand, speculate about the EU making the reopening of the borders politically conditioned.

3. The entrenched problem of status entered a new cycle, best exemplified by EU-Russian debates on rules-based order. Russia defends its actions in terms of international law. The official discourse embraces the key concepts of today's international order (democracy, human rights, rule of law, sovereignty, self-determination, multilateralism) but Moscow expects other actors to recognize its right to interpret these norms when applying them to specific contexts. The collective West (including the EU) denies this right to Moscow. The notion of a rules-based order that emerged in the West on the basis of (Western) conceptual developments is a response to Russian attempts to (ab)use international law interpretations. It clearly indicates the Western preference for unilateralism in this field, which Russia is unlikely to accept.

4. The ability of economic relations to provide a safety net for EU-Russian relations is declining. Although the EU remains Russia's biggest trade partner, its importance has been reduced by both its own sanctions and US secondary sanctions. The latter are more rigid, and deprive the EU of flexibility. The EU's own economic and social problems further discredit it in the eyes of the Russian political elite. Moreover, Western sanctions fostered an import substitution strategy in Russia and enhanced its pivot to the East, while the EU's energy transition will in the long run shrink its Russian hydrocarbon imports. Finally, while the Russian economy is stagnating, it is stable enough for the present political elite to protect their positions – while increasing the citizens' welfare does not seem to be the primary goal of Russia's foreign policy.

5. Internal politics is becoming profoundly geopoliticised. Russia led the way, accusing the West of interference in its domestic affairs and placing constraints on NGOs. Recently President Vladimir Putin stressed that the civil society should be ‘nationally oriented and sovereign’ rather than ‘a product of abstract transnational intelligence behind which alien interests are concealed’.[5] That severely hinders the possibilities for people-to-people contacts. At both the national and supranational levels the EU is concerned about (alleged) Russian attempts to interfere in its political life (influencing elections and referenda, hacking data, etc.). Evidence of Russian ‘interference’ is frequently identified when the EU or its member states encounter a problem and Russian-speaking populations in some EU member states are perceived to be a potential problem, due to their exposure to Russian propaganda. This geopoliticisation of internal politics on both sides undermines trust among the peoples of the EU and Russia. In addition, the pandemic severely curtailed personal contacts (tourism, business, academic, cultural), making people more susceptible to manipulation.

[5] Meeting of the Valdai Discussion Club, 22 October 2020.

## CAN THE DAMAGE BE CONTAINED?

Given these five factors, the prospects for EU-Russia relations are poor. The window of opportunity for any long-term planning has closed. Yet neither the EU nor Russia, nor the international system as a whole are likely to change in the near future. So the duty of an analyst is to suggest paths the EU and Russia could explore to mutual benefit in the short to medium term. Three avenues deserve attention.

On the political track the EU could become more active in arms control talks (in particular on extending existing START obligations). The EU and Russia have also demonstrated their ability to cooperate on regional crises in the shared neighbourhood (Moldova in 2019) and beyond (Libya). Russia, the EU, and other major players could also think about damage limitation in information (disinformation) and cyber security. An all-embracing initiative would currently appear impossible, but specific areas could be considered (such as limiting 'infodemic' mechanisms or agreeing to refrain from cyber-attacks of specific kinds or on critical objects). Finally, bolstering international institutions could be a shared priority for Russia and the EU. The possibilities of this track will depend heavily on the outcome of the 2020 US elections.

On the economic track, the EU and Russia could engage in consultations on energy transition and climate change. Climate is a global concern, while the EU and Russia remain interdependent energy-wise, with vested economic interests. This area requires major efforts on both sides. The EU could refrain from framing the Green Deal in terms of its own energy security and self-sufficiency, and consider the economic sustainability of its transition, including continuing gas imports from Russia. The tone of the EU's external communication on climate change could become less condescending. Finally, efforts should be made to ensure that sanctions do not impede business in this field. The Russian political elite, for its part, has to realize that the energy transition is the EU's long-term policy choice. That could unlock new opportunities in Russia and EU-Russian relations (adapting existing energy businesses, creating new climate-related ones). It will also require an improvement in the business climate in Russia. In addition, Russia should more boldly push the message that limiting climate change (decarbonisation of the economy) overlaps with the energy transition but is not identical. Finally, domestic legislation to reduce Russian greenhouse gas emissions is essential to indicate that Russia means business in this field.

The EU and Russia remain neighbours; their border regions can only flourish through cross-border cooperation that makes them centres of new growth. The Arctic region could become another field of fruitful cooperation, where the EU's economic and environmental knowledge and skills could contribute to Russian plans (the 2021 review of the EU's Arctic strategy can be a starting point). This will also require a less condescending attitude on the part of the EU and shielding from the pressure of sanctions. Russia, for its part, will have to accept that there are good economic and environmental reasons in cooperating with the EU on the Arctic development. Recent environmental disasters in Russia serve as a powerful reminder.

On the transnational track, effort should be invested in education mobility in both directions. This socialisation is of great importance in fostering trust and mutual understanding. Real-life cultural exchanges, expert meetings and tourism should also restart as soon as the pandemic allows. These are essential channels of socialisation and exchange.

Cooperation in the field of research and development represents an essential contribution to long-term economic growth. Moreover, scientific cooperation, publications in renowned peer-reviewed international journals, and observance of international testing and certification requirements could limit politicisation effects in certain socially salient areas (like vaccine development). Visa constraints on both sides and COVID-related travel restrictions have negatively affected contacts. Both the EU and Russia are, however, interested in improving the commercial application of research.

These three avenues and the associated steps do not form a holistic long-term plan for EU-Russia relations. Rather they represent an outline of what could be done to prevent further deterioration. They indicate how relations can serve the interests of both Moscow and Brussels, in particular in realising their domestic policy priorities, in resolving internal problems and securing greater international stability.

The experience of détente suggests that the parties should first express their concerns and grievances before moving to the stage where they look for solutions that take into account the vulnerabilities of both sides. In EU-Russia relations the first stage has lasted at least since Vladimir Putin's notorious 2007 Munich speech, and has exhausted itself. Russia should stop reproaching the West for mismanaging (and misinterpreting) the end of the Cold War and for subsequent developments in global security architecture. That criticism is merely an excuse to justify Russia's behaviour today. The EU for its part should stop expecting Russia to return to the 1990s and become a ‘normal European country’. This rhetoric provokes the Russian elite while providing the EU with a comforting explanation for the failure of its normative power in Russia. Further, both sides could stop belittling each other and exaggerating the other side's internal problems. That does not mean that mutual criticism should stop. It is an essential part of any democratic process. And it is useful to learn from the successes and failures of the other side. However, it makes more sense for Russia and the EU to concentrate on their own internal agendas and on how mutual relations could advance their internal policy priorities.

# ICT industries: The eternal concern of EU industrial policy

BY ROMAN STÖLLINGER

*The EU's concern that European industry is falling behind the US and emerging producers in Asia in the race for new, ground-breaking technologies dates back to the 1970s. In the field of information and communication technologies (ICT), these concerns are indeed well founded. Revived industrial policy efforts, such as the Important Projects of Common European Interest (IPCEI), are a step in the right direction, but isolated projects will not be sufficient to meet the 'digital challenge'.*

## INTRODUCTION

As the European economy undergoes – or is expected to undergo – a digital transformation involving a switch to ICT-driven production processes, those industries that produce the underlying technologies, infrastructures and services will take centre stage. From a supply-side perspective, ICT industries[1] are essential for at least two reasons. First, ICT-producing industries are the drivers of the digital transformation, and can therefore be expected to be the lead industries of the future; this will have implications for countries' overall economic development. In other words, supercomputers and artificial intelligence will be crucial in the twenty-first century (in much the same way as the textile industry was in the eighteenth). Secondly, lead sectors are typically R&D intensive and innovative industries, characterised by an oligopolistic market structure. For this reason, lead sectors are also 'strategic sectors', with a high potential for generating economic rents (see, for example, Brander and Spencer, 1985; Krugman, 1986). Moreover, lead sectors are also the place to look for the national champions of the future – or in the EU context, the European champions of the future. This latter point is viewed as essential, in view of the strong foreign competition, which is increasingly being perceived as unfair (Deffains et al., 2020; Jenny and Neven, 2019). Hence, the first question is whether the ICT sector has the characteristics of a lead sector.

## DO ICT INDUSTRIES QUALIFY AS A GLOBAL LEAD SECTOR?

For once, even economists can provide an unambiguous answer: yes, the ICT sector clearly is a global lead sector. The R&D intensity of the global ICT sector (7.3% on average, over the period 2000-2016) far exceeds the corresponding value for the economy as a whole (1.5%). Moreover, labour productivity in the ICT sector (EUR 53,280 in real terms, per person employed) is more than twice the level of the economy-wide productivity (EUR 21,391). Above all, real value-added growth over the past decade and a half in the global ICT sector (5.79% per year on average) has dwarfed that of the overall economy (1.69%) (Table 1). This is also true of the two sub-categories of ICT manufacturing and ICT services.

[1] This article uses the so-called 'operational definition' of the ICT sector (JRC, 2017), which follows the OECD definition as defined by the OECD (2007) and comprises the following manufacturing and services industries (NACE Rev.2): electronic components and boards (261), computers and peripheral equipment (262), communication equipment (263), communication, consumer electronics (264), telecommunication services (61), computer services and related activities (582, 62, 631, 951).

**Table 1 / The ICT sector acts as a lead sector at the global level**

Compound annual growth rates of the ICT sector and the total economy, 2000-2016

| | Employment | Value added | | Gross output | |
|---|---|---|---|---|---|
| | | nominal | real | nominal | real |
| ICT sector | 3.12% | 3.39% | 5.79% | 3.02% | 5.48% |
| ICT manufacturing | 2.76% | 1.76% | 7.47% | 2.28% | 7.77% |
| ICT services | 3.33% | 4.01% | 4.55% | 3.48% | 4.17% |
| | | | | | |
| Total economy | 0.67% | 3.69% | 1.69% | 4.03% | 1.97% |
| Manufacturing | 0.95% | 3.10% | 2.31% | 4.12% | 3.17% |
| Services (except trade) | 2.21% | 3.69% | 1.44% | 3.62% | 1.33% |

Note: Growth rates are compound annual growth rates. The global economy comprises the following economies: EU, Australia, Brazil, Canada, Switzerland, China, India, Japan, Korea, Norway, Russia, Taiwan and the USA. Real value added at the world level is calculated as the value-added weighted average of the national (industry-level) price deflators. The services sector excludes trade services industries.
Source: PREDICT dataset, wiiw calculations.

Hence, the ICT sector provides many growth opportunities, and affects overall growth not only directly, but also via numerous forward and backward linkages with other parts of the economy. While this is not detectable in standard industry-level data, numerous case studies on ICT products – such the famous study on Apple's iPod (Dedrick et al., 2010) – clearly demonstrate that the complexity of even standard consumer electronics demands the supply of a huge number of parts and components, including (software programming) services, from various industries. The presence of strong domestic lead industries in the economy therefore also spurs economic growth indirectly, via demand spill-overs to the rest of the economy (see Reinert, 2007 for a historical perspective on lead sectors such as shipbuilding; Rennstich, 2008 for a discussion in the context of the digital transformation).

Note also that, despite widespread concern about robots rendering humans redundant in the digital age, so far the job-creation effects induced by complementarities between technology and human skills and the expansionary trend of the ICT sector have more than compensated for any job losses. Thus, the sector's employment growth has exceeded 3% per annum at the global level since 2000 (see Table 1).

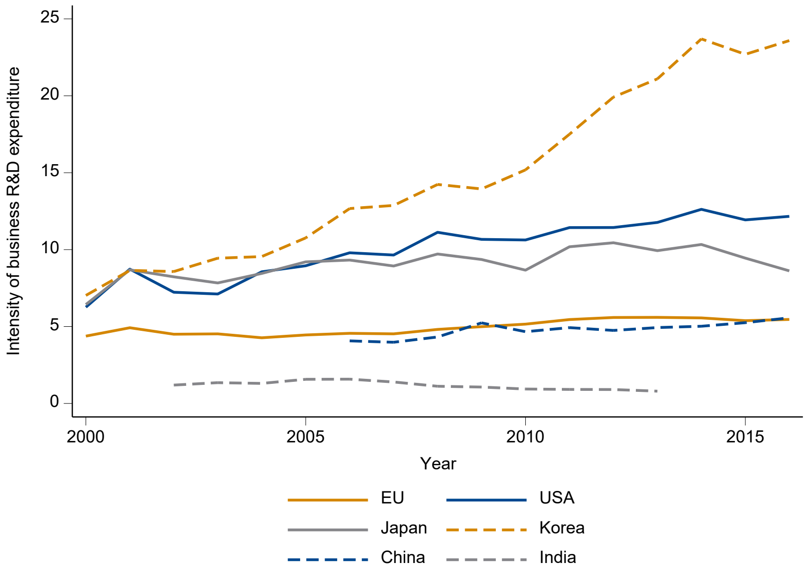
## THE EUROPEAN ICT SECTOR IS LOSING GROUND

The history of the ICT sector and of high-tech industries is full of contradictions. On the one hand, the perceived technological gap between the EU and the US has been a long-standing concern of EU industrial policy (e.g. Eaton et al., 1998; Foster-McGregor et al., 2013; Landesmann and Stöllinger, 2020a). This is particularly true of the ICT sector, where the perceived loss of technological leadership provided the initial impetus for common European research programmes. On the other hand, many EU countries are still at the technological frontier when it comes to basic research, and many EU ICT firms are doubtless there as well. In general, though, and despite the fact that the laments about EU tech firms losing their competitive edge in high-tech industries are altogether exaggerated, there are clear signs on the production side of ICT that the leading position of German software giant SAP is increasingly the exception, rather than the rule (see, for example, EPSC, 2019).

This conclusion is supported by several observations. First, the ICT sector is smaller in the EU than in the advanced competitor countries (notably the US, Japan and Korea) in terms of both employment share and share of value added. In terms of share of value added, even China and India have overtaken the EU.

Second, and most disconcerting is the fact that the R&D intensity of the European ICT sector has fallen far behind that of the US, Japan and Korea (Figure 1). The EU really does seem to have lost ground, due to a less dynamic development of R&D intensity, which hovered at around 5% over the period 2000-2016. Thus, by 2016 the EU was more or less on a par with China in this respect.

**Figure 1 / Stagnant R&D intensity in the EU ICT sector (in %), 2000-2016**



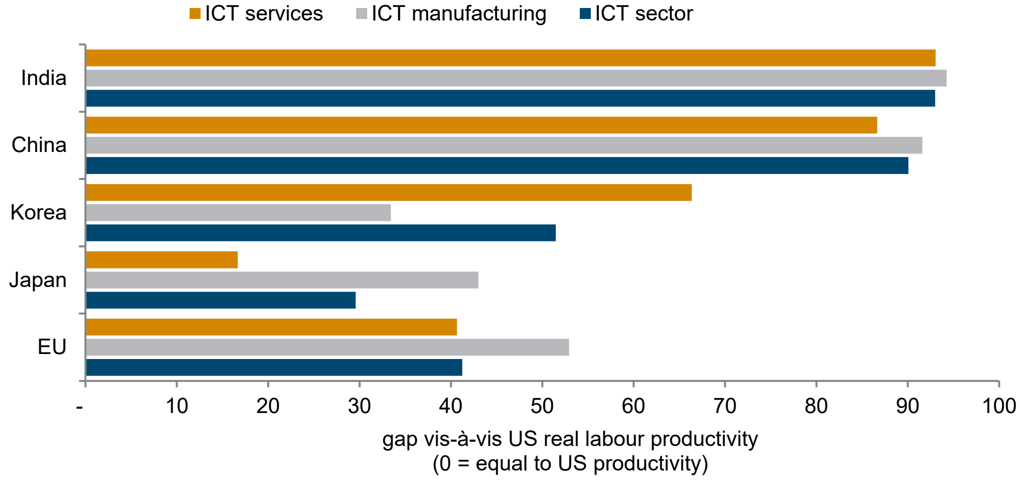

Note: R&D intensity is the share of business expenditure on R&D in the value added of each country. China: data for the years 2000-2005 not available; India: data for the years 2000-2002 and 2014-2016 not available.
Source: PREDICT dataset, wiiw calculations.

Third, the eternal concern about the EU productivity gap vis-à-vis the US is actually justified in the field of ICT (Figure 2). The productivity gap amounts to 40% for the ICT sector as a whole; and, is even higher in ICT manufacturing industries. While different industry compositions (which lead to potential aggregation biases) and differences in the price deflators may explain part of the shortfall, the gap is simply too large to declare it a statistical artefact.

Also, the fact that there is wide variation in real labour productivity across the EU member states only provides partial relief. Countries like Sweden, Denmark, France and Germany certainly have labour productivity above the EU average, but none of them can match the US productivity level.[2]

[2] A notable exception is Ireland, which registers very high labour productivity in the ICT sector. This raises the question of the influence of offshoring activities (in both directions) on the calculation of labour productivity.

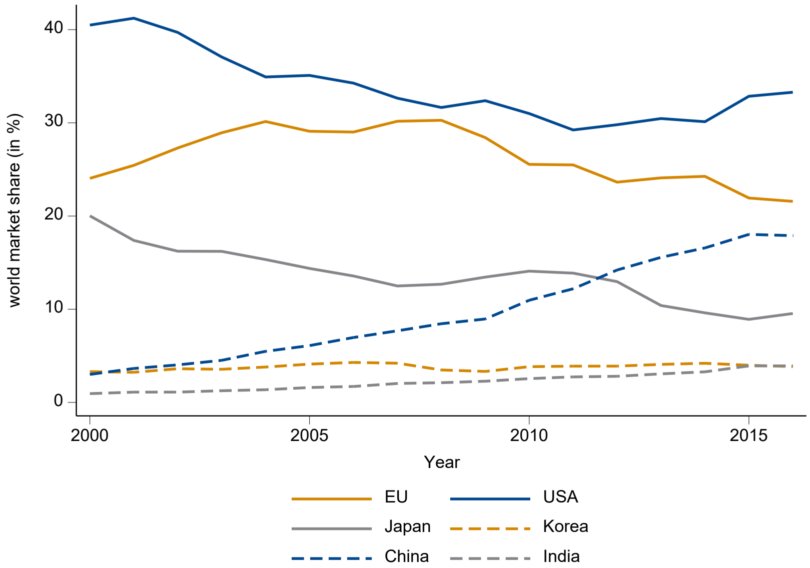
**Figure 2 / Real labour productivity gaps vis-à-vis the US in the ICT sector, average 2000-2016**




Note: The labour productivity gap ($LP^{GAP}$) of a country *j* vis-à-vis the US is calculated as $LP_j^{GAP} = (LP_{US} – LP_j) / LP_{US} * 100$ where a value of 0 indicates labour productivity equal to that of the USA. The average for China comprises the period 2006-2016; the average for India comprises the period 2000-2013.
Source: PREDICT dataset, wiiw calculations.

The above-mentioned factors, R&D intensity and labour productivity all feed into international competitiveness; this is reflected in the evolution of world market share, which is an obvious measure of success on international markets (Figure 3). Some of the trends in world market share in the ICT sector *qualitatively* resemble the trends in global GDP share since the year 2000: the economic triad of the EU, the USA and Japan have experienced a marked decline in world market share, which is mirrored by the strongly growing world market share of China and (though on a much more modest scale) India.

**Figure 3 / Development of world market share in the ICT sector, 2000-2016**




Note: World market share is based on nominal value added. The global economy comprises the following economies: EU, Australia, Brazil, Canada, Switzerland, China, India, Japan, Korea, Norway, Russia, Taiwan and the USA.
Source: PREDICT dataset, wiiw calculations.

There has been one important departure from these broad general trends in the field of ICT: in the early 2010s, the USA was able to halt and reverse the decline in the world market share of its ICT sector. For the EU, as of 2016 no such trend reversal was observable. In that year, the EU's ICT sector accounted for about 22% of global value added, putting it in second place, slightly ahead of China, but significantly behind the US, which remains in a dominant position, with a global market share of about a third.

## WILL THE IPCEI INSTRUMENT BE ENOUGH TO BRIDGE THE GAP?

For many observers, the trend depicted in Figure 3 is a reminder of the urgent need for a reinvigorated European industrial policy strategy for the digital economy and beyond. In this respect, the EU's updated industrial policy strategy (European Commission, 2020a) calls not only for a transition to a green economy, but also for a digital economy; the latter would ideally also support the former (with the help of green technologies).

Potentially more effective than repeated updates to these industrial policy communications is the more frequent use of an instrument envisaged by the EU treaty: Important Projects of Common European Interest (IPCEI). The first of these IPCEIs have been agreed (and cleared by the Commission) in the field of microelectronics and batteries for electric cars. Both of them constitute joint efforts by several member states to pool resources for investment in R&D. Importantly, and in contrast to many other European R&D programmes, the R&D support in the context of IPCEIs is not limited to pre-market research, but explicitly includes applied research up to initial industrial applications. Also, with public support amounting to EUR 1.75 billion (IPCEI microelectronics) and EUR 3.2 billion (IPCEI batteries), the projects are substantial.

The IPCEIs for microelectronics and for electric car batteries clearly support the European ICT sector, but by themselves they may be too small and isolated. This is especially true, given the substantial industrial policy support granted to US and Chinese competitors (even though provided in very different forms). In the US, ICT companies benefit from the dense networks of public agencies, massive technological spill-overs from the military, and a highly developed venture capital market, while in China they are assisted by the 'state capitalism' system. Therefore, it is questionable whether the current EU efforts will be adequate, in spite of the repeated rhetoric to create a Digital Single Market and a truly European innovation system that overcomes the problem of the fragmented national innovation systems in the EU.

## POLICY IMPLICATIONS

Against the background of these policy objectives, the relatively modest role played by the ICT sector in the EU economy would indicate that greater efforts are needed to prop up the expansion of the ICT sector. This is true of both the manufacturing and the services part of the ICT sector.

Therefore, current efforts at the EU level need to be further adjusted and strengthened along three dimensions. First, the amount of targeted innovation-related industrial policy support needs to be scaled up (scale dimension). Second, the more frequent use of existing matching clauses in European state aid rules to mirror the support provided by competitors, and the application of the reciprocity principle in areas of public procurement or domestic content requirements may help to remedy the unfair advantages granted to foreign competitors in individual cases. These elements should become part and parcel of the EU's open strategic autonomy, which is currently in the process of being developed (European Commission, 2020b) (reciprocity dimension). Third, the isolated IPCEIs should be replaced by a mission-oriented innovation and industrial policy approach, in which the individual projects are all inter-connected, insofar as they all serve a joint 'industrial mission' (joint mission dimension). Such a mission must be designed in such a way that its success is measurable and it is clear at the end of the day whether or not the mission has been accomplished (Mazzucato, 2013; Mazzucato, 2018). Also, the industrial mission, which has yet to be defined, will tackle one of the great challenges facing society such as climate change. Our proposal in this respect is clear: to make the EU carbon independent, which means zero external imports (or exports) of fossil fuels (see Landesmann and Stöllinger, 2020b). This mission obviously serves the purpose of achieving a climate-neutral economy, as called for by the European Green Deal (European Commission, 2019).

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# Innovation and company performance in the digital sector

BY DIMITRIOS EXADAKTYLOS[1] AND MAHDI GHODSI

*Here we look at how innovation affects the performance of firms operating in the information and communications technology (ICT) sector. Our findings suggest that a firm's own patents stimulate its labour productivity and improve its share of the global market. Moreover, multinational companies benefit from patents granted to their subsidiaries, whether or not the latter operate in the same sector. On the other hand, patents owned by competing firms hamper a firm's performance; this highlights the competition effects.*

The production process nowadays is characterised by the extensive use of computers. Internet is a necessary tool for communication within and between firms, while the rapid execution of convoluted tasks means that the quality of production – and with it growth – has improved significantly. Companies investing in ICT goods and services benefit from new technologies, especially when this is combined with organisational capital (Brynjolfsson and Hitt, 2003; Arvanitis and Loukis, 2009; Commander et al., 2011). Consequently, managers allocate production inputs taking ICT technologies into consideration. For that reason, much research focuses on the demand side of digitalisation (for instance, Arvanitis and Loukis, 2009; Khanna and Sharma, 2018) and its impact on the growth of other sectors. However, in this article we shed light on the production side of ICT. Hence, we examine how patents affect the productivity and market share of companies active in the ICT sector, using a dataset of global ICT producers for the period 2009-2017.

## THE 'BIG FIVE': PRODUCTIVITY AND MARKET SHARE GO HAND IN HAND

Figure 1 depicts the evolution of labour productivity and market share over the period 2009-2017 for five major producers active in the ICT manufacturing and services sector. In all cases, we observe that labour productivity increased over time – which is only to be expected, as the period of analysis covers a decade of huge expansion in digitalisation. As we can see, market share is positively related to labour productivity in most cases, indicating that there is fierce competition in the sector, which only increases over time.

The interesting point is that these global digital market leaders tend to invest heavily in research and development (R&D) to innovate and register patents. As an outcome of R&D activities, the innovation process will yield tacit knowledge that is usually protected within patents registered by the innovators. This allows firms to utilise their own innovations to increase productivity, while their competitors may not use such protected innovations. However, some ICT companies own patents through their subsidiaries that are located in countries with lower costs of patent application and lower taxation of the innovation process – for example, through 'patent boxes' (Alstadsæter et al., 2018), a tax incentive regime for R&D expenditure that generally leads to patents (European Commission, 2014).[2]

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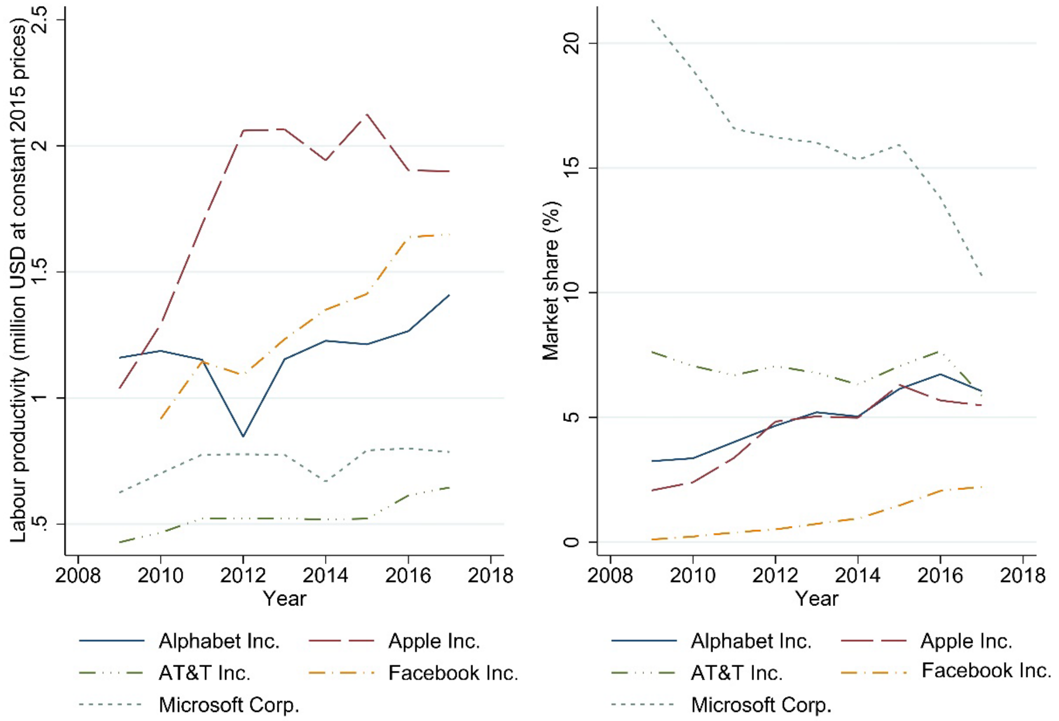
[2] Ireland was the first country to introduce a 'patent box' scheme in the early 1970s. An updated scheme was adopted in 2015. Other countries that have introduced such schemes are France, the United Kingdom, Belgium, Hungary, Spain, Luxembourg and the Netherlands.

**Figure 1 / Labour productivity and global market share for five major ICT producers, 2009-2017**




Source: Orbis database and authors' elaboration.

## DATA AND METHODOLOGY

In this article, we analyse how innovation in terms of patents granted and their ownership by an ICT firm, its subsidiaries and its competitors in the global market can affect that ICT company's productivity and market share. We source data from the Orbis database, provided by the Bureau van Dijk, consisting of balance sheet information for 182,906 ICT firms operating in 38 countries.[3] This information is reported in local currency units, and we convert them to constant 2015 US dollars, using exchange rates taken from the World Development Indicator (WDI) of the World Bank and deflators for each country collected from the Organisation for Economic Co-operation and Development (OECD), EU KLEMS and Eurostat.[4] Furthermore, we collect information about the patents that each firm is granted using the year of application as a reference from Orbis Intellectual Property Data, which gathers data from PATSTAT.

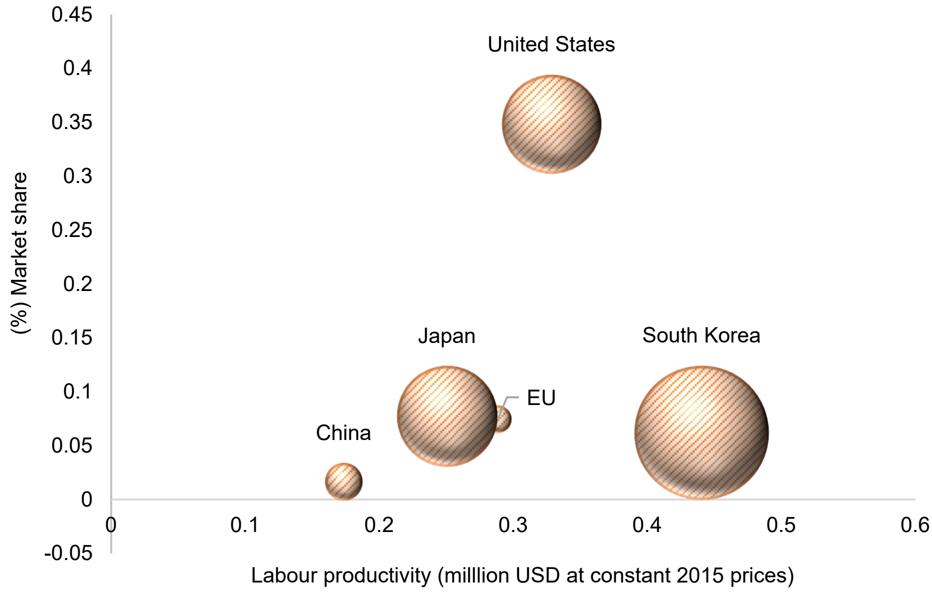
*Labour productivity* is defined as the ratio of real operating revenues to the number of employees. *Market share* is defined as the ratio of operating revenues to the sum of revenues within the same global sector. Figure 2 depicts the mean values of labour productivity (horizontal axis), market share (vertical axis) and the stock of patents (size of the bubble) of large companies (firms with at least 250 employees) operating in five countries/regions: the European Union, the United States, China, Japan and South Korea. When we compare the number of patents with the performance proxies, we find that the relationship is not straightforward. For instance, US companies appear to have the largest market share per firm; however, the mean stock of patents is smaller than in South Korea. That is possibly because

[3] The definition of the ICT sector comes from the operational ICT sectors in the PREDICT database (Benages et al., 2018).

[4] In the case of Taiwan we use the GDP deflator by industry from the National Statistics, Republic of China (Taiwan).

parent ICT companies in the US benefit more from innovation activities in other countries/regions, where they have subsidiaries able to source the patented technology. Moreover, large ICT enterprises in China fall short, compared to other countries/regions.

**Figure 2 / Mean values of labour productivity, market share and the stock of patents of large ICT companies (at least 250 employees) by country/region, 2009-2017**




Source: Orbis and authors' elaboration.

For our empirical analysis, we adopt linear regression, controlling for observable characteristics at the firm level (employment, capital intensity, firm age) and unobservable characteristics at the firm level and country level for each year (for instance, business cycles within a country), controlled for firm and country/year fixed effects.

## RESULTS

Table 1 illustrates our baseline results. The coefficients of all explanatory variables are statistically significant at 1% or 5%. Our findings suggest that patents granted to the ICT firm or its subsidiaries are positively associated with labour productivity and market share. However, companies can also benefit from patents granted to a technologically advanced subsidiary, whether or not that subsidiary operates in the same sector. Therefore, both horizontal and vertical integration is important for knowledge transfer to the ICT parent. On the other hand, patents granted to the competitors of an ICT firm are negatively associated with the ICT firm's performance, and the magnitude of this effect is greater than the sum of the positive effects deriving from patents owned directly by the ICT firm and its subsidiaries.[5] Hence, the

[5] The large negative coefficient of competitors' patents may be because some 97% of firms in the sample own no patents at all. Therefore, it could be the case that non-patentees face a stiff competition effect from patents owned by less than 3% of all ICT firms. Thus, the competitive impact from the innovation of this small fraction of companies on the market share of non-patenting companies is very large.

protection of intellectual property rights generates strong market-stealing effects, which can partially be offset by the patents owned by the ICT firm or its subsidiaries.

Finally, the effect of capital intensity on a firm's performance is positive and its magnitude is the same for both labour productivity and market share (the two proxies for company performance). This suggests that when the ratio of capital to labour of an ICT firm increases, the firm's performance should improve. This is evident in large and superstar ICT companies. In addition, the more employees that a company adds to its workforce, the larger the market share it can obtain. Finally, well-established and older firms perform better than younger ones.

**Table 1 / Explaining company performance in the ICT sector, 2009-2017**

| Dependent variable | (log) labour productivity | (log) labour productivity | (log) market share | (log) market share |
|---|---|---|---|---|
| Capital intensity | 0.15*** | 0.15*** | 0.15*** | 0.15*** |
| | (0.0018) | (0.0018) | (0.0018) | (0.0018) |
| Employment | -0.49*** | -0.49*** | 0.51*** | 0.51*** |
| | (0.0033) | (0.0033) | (0.0033) | (0.0033) |
| Firm age | 0.26*** | 0.25*** | 0.24*** | 0.24*** |
| | (0.0051) | (0.0051) | (0.0051) | (0.0052) |
| Own firm's patents | 0.049*** | 0.049*** | 0.053*** | 0.054*** |
| | (0.0088) | (0.0089) | (0.0088) | (0.0089) |
| Subsidiaries' patents | 0.022*** | | 0.023*** | |
| | (0.0075) | | (0.0075) | |
| Subsidiaries' patents (same sector) | | 0.020** | | 0.022** |
| | | (0.0088) | | (0.0089) |
| Subsidiaries' patents (different sector) | | 0.016** | | 0.019** |
| | | (0.0080) | | (0.0083) |
| Competitors' patents | -0.13*** | | -0.26*** | |
| | (0.0049) | | (0.0050) | |

Note: All variables are expressed in logarithmic terms; *, ** and *** stand for $p < 0.1$, $p < 0.05$ and $p<0.01$ respectively.
Source: Orbis and authors' elaboration.

## CONCLUSION

Today, ICT business has become an important driver of growth, since its products and services are used in all economic sectors. Therefore, any technological progress is crucial for long-term development worldwide. Policy makers should focus on providing fiscal support to stimulate innovation and boost technological advances in the production process of the ICT sector. Investment in R&D will lead to new findings that can be patented in the regional patent registration offices to protect intellectual property rights. Our results indicate that patents improve both the productivity and the market share of a given ICT firm. Moreover, multinational enterprises in the ICT sector that benefit from the lower costs of patent application through the tax incentives offered by the 'patent box' regime also perform better. Competitors' patents are negatively associated with the performance of an ICT firm, which suggests a fierce competition effect resulting from the innovative activities of competitors. However, the competition effect can be partially offset by the innovative activities and patenting of the ICT firm and its subsidiaries.

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

The monthly and quarterly statistics cover **22 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 | Harmonized 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 |

The following national currencies are used:

| | | | | | |
|---|---|---|---|---|---|
| ALL | Albanian lek | HRK | Croatian kuna | RON | Romanian leu |
| BAM | Bosnian convertible mark | HUF | Hungarian forint | RSD | Serbian dinar |
| BGN | Bulgarian lev | KZT | Kazakh tenge | 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) and Slovenia (from January 2007, euro-fixed before).

Sources of statistical data: Eurostat, National Statistical Offices, Central Banks and Public Employment Services; wiiw estimates.

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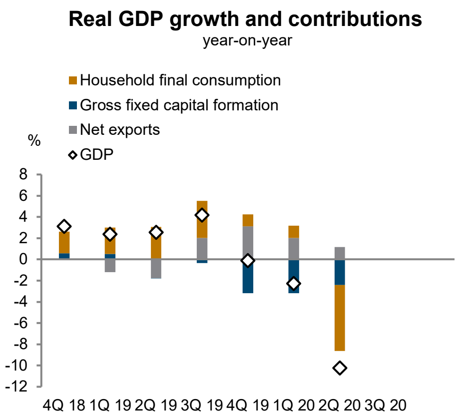
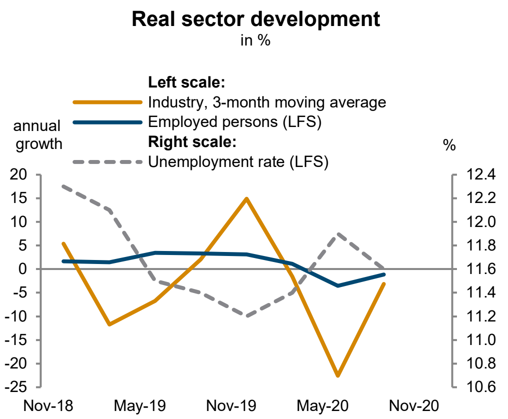
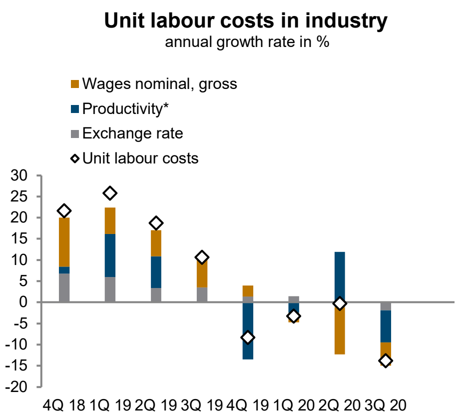
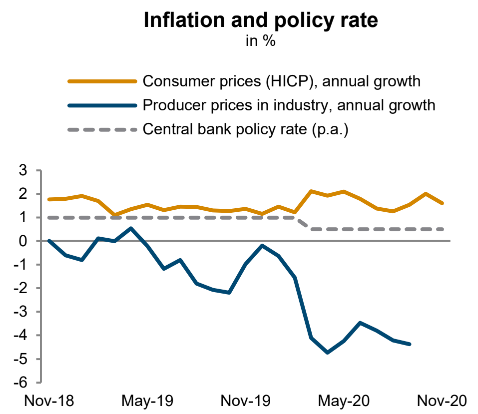
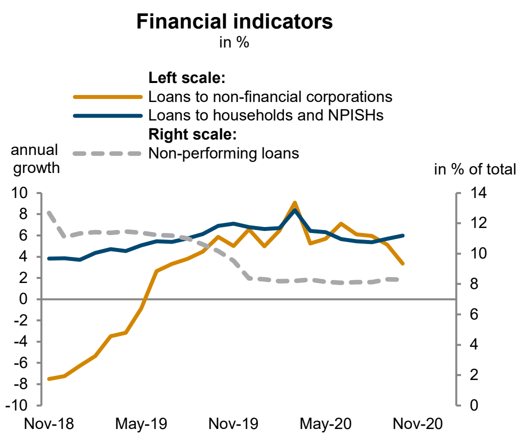
# Albania

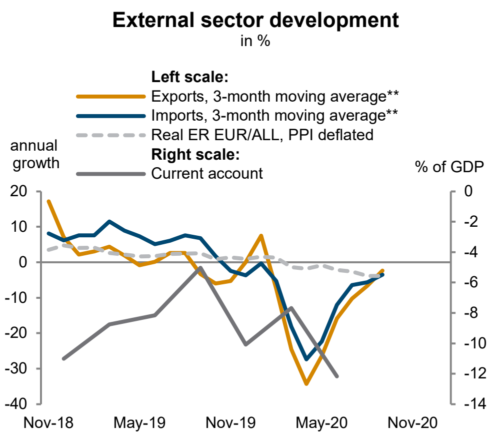


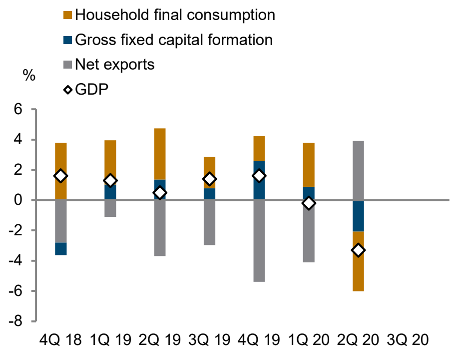




*Positive values of the productivity component on the graph reflect decline in productivity and vice versa.
**EUR based.

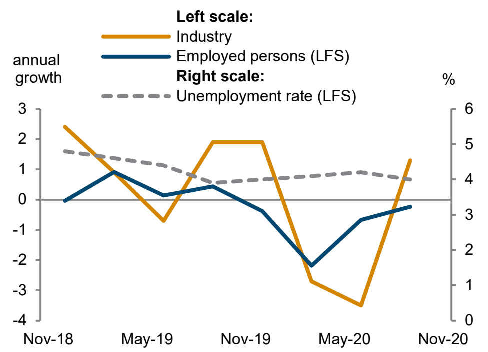
Source: wiiw Monthly Database incorporating Eurostat and national statistics.
Baseline data, country-specific definitions and methodological breaks in time series are available under: https://data.wiiw.ac.at/monthly-database.html

# Belarus

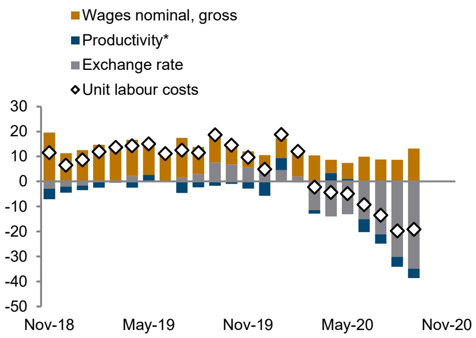
**Real GDP growth and contributions**
year-on-year



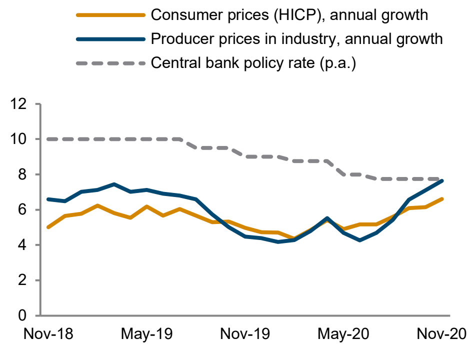

**Real sector development**
in %



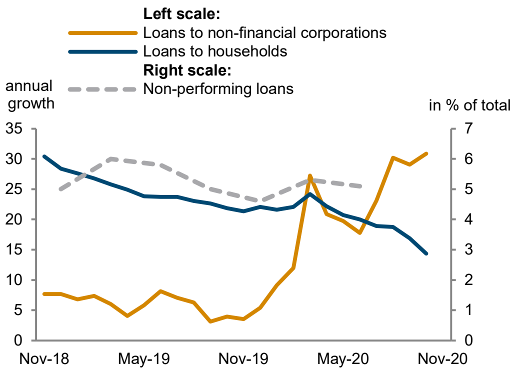

**Unit labour costs in industry**
annual growth rate in %



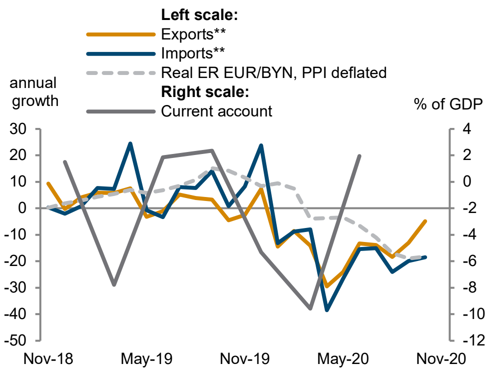

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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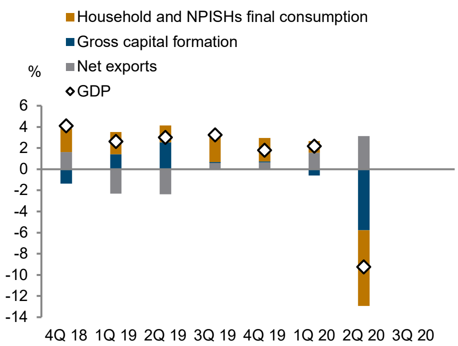
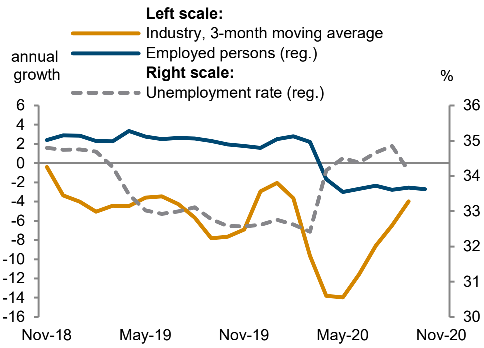
# Bosnia and Herzegovina

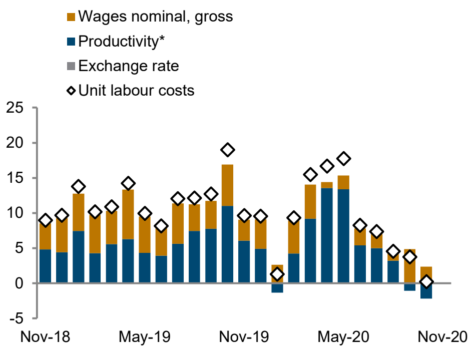
**Real GDP growth and contributions**
year-on-year



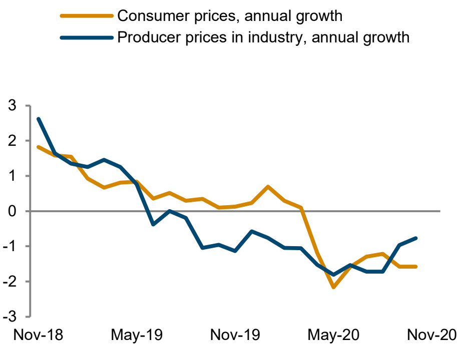

**Real sector development**
in %



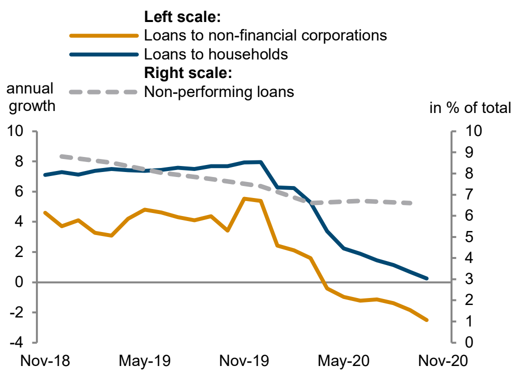

**Unit labour costs in industry**
annual growth rate in %



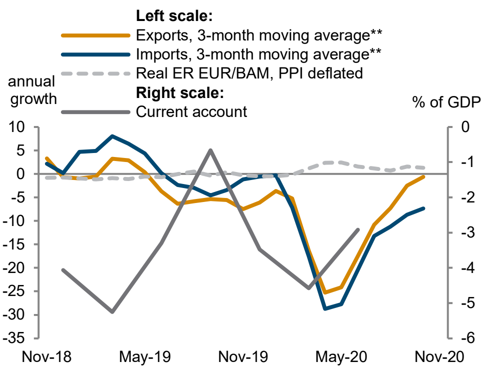

**Inflation**
in %




**Financial indicators**
in %




**External sector development**
in %

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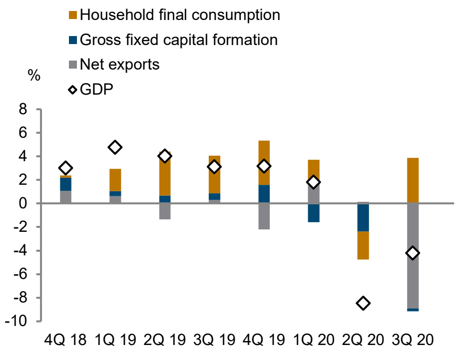
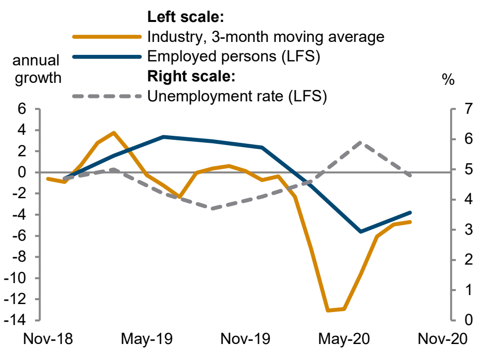
# Bulgaria

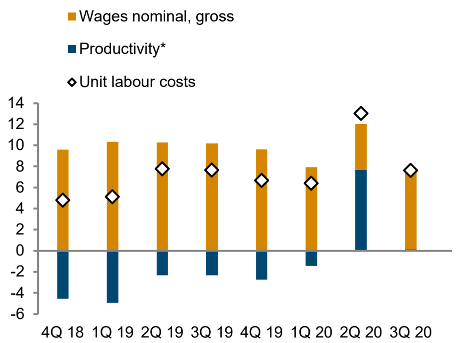
**Real GDP growth and contributions**
year-on-year



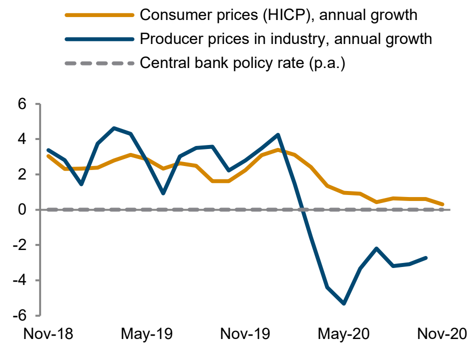

**Real sector development**
in %



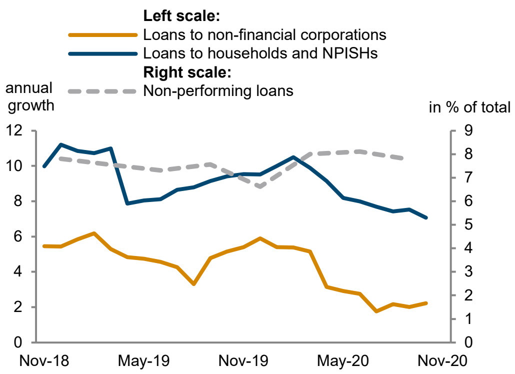

**Unit labour costs in industry**
annual growth rate in %



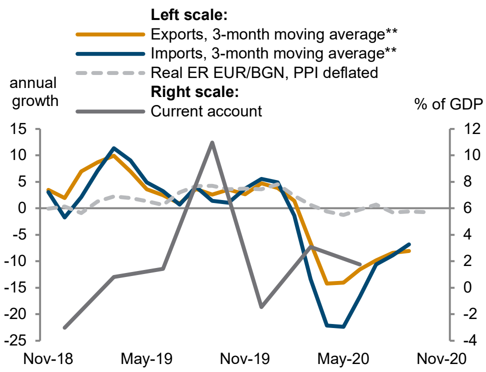

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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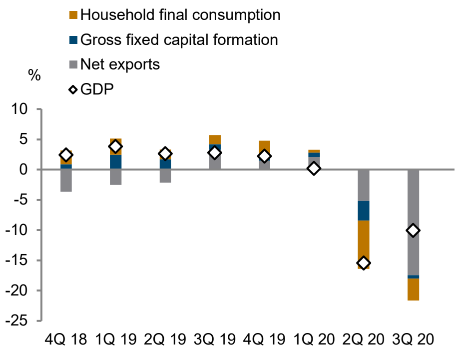
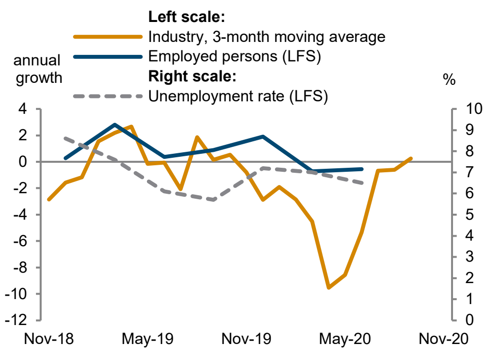
# Croatia

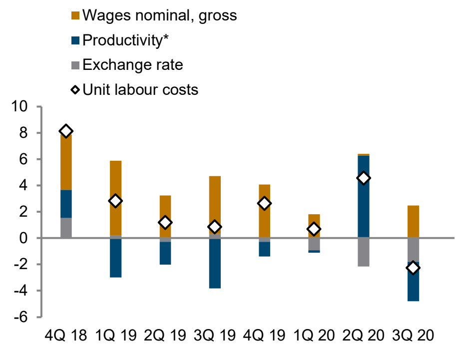
**Real GDP growth and contributions**
year-on-year



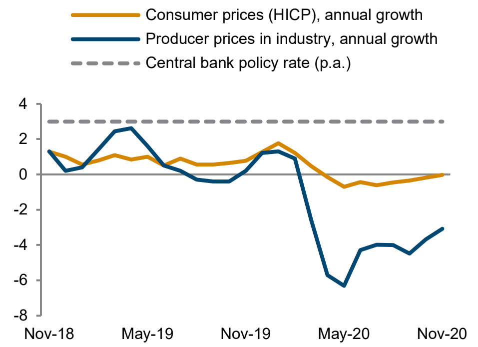

**Real sector development**
in %



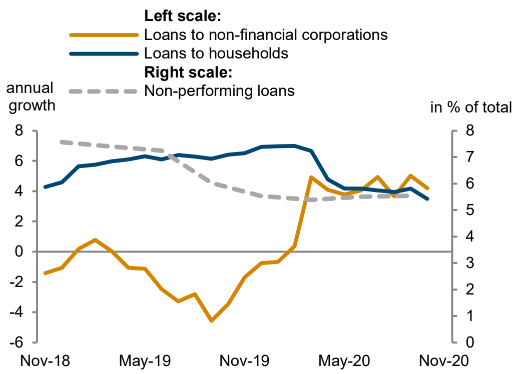

**Unit labour costs in industry**
annual growth rate in %



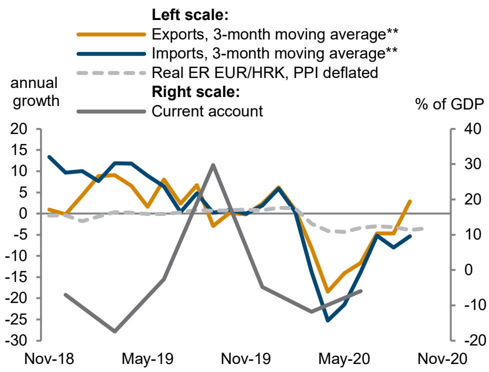

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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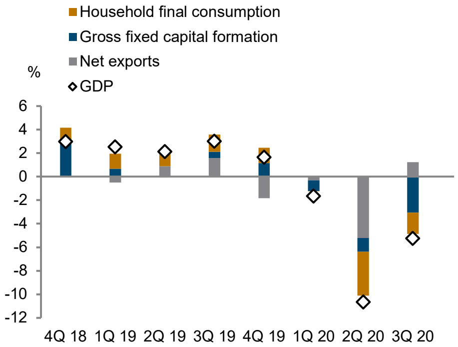
**EUR based.

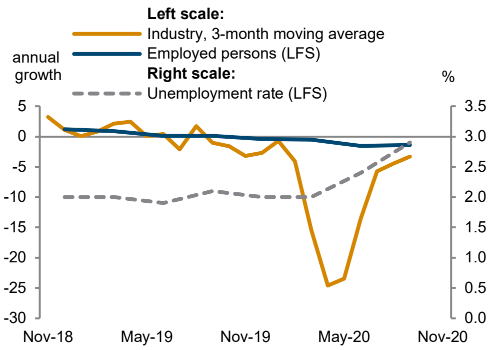
Source: wiiw Monthly Database incorporating Eurostat and national statistics.
Baseline data, country-specific definitions and methodological breaks in time series are available under:
https://data.wiiw.ac.at/monthly-database.html

# Czechia

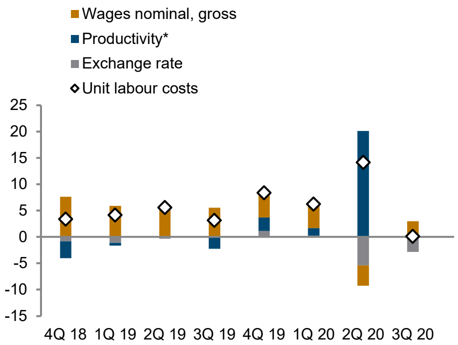
**Real GDP growth and contributions**
year-on-year



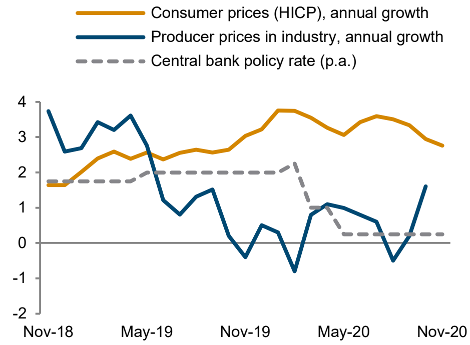

**Real sector development**
in %



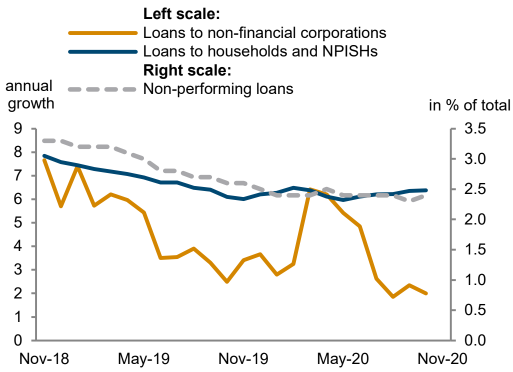

**Unit labour costs in industry**
annual growth rate in %



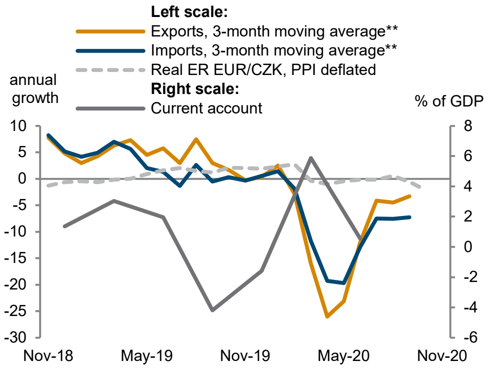

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %




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

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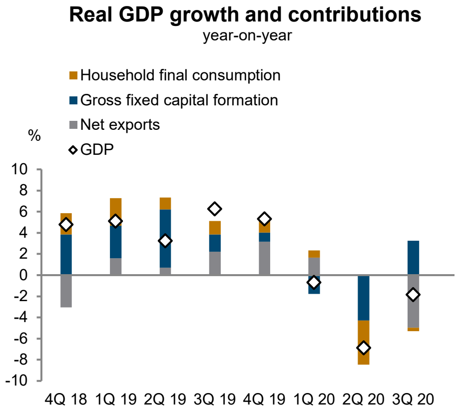
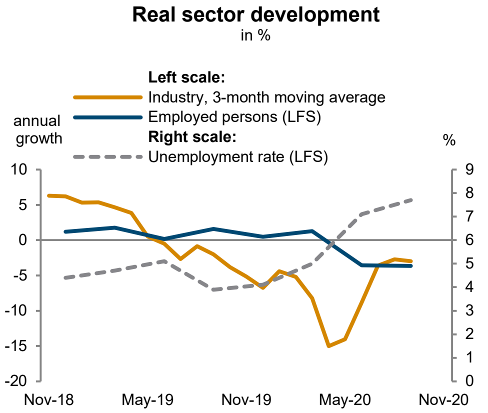
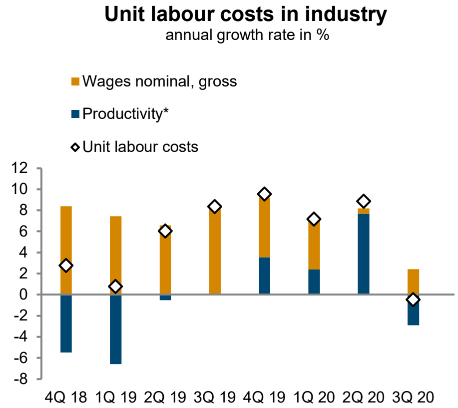
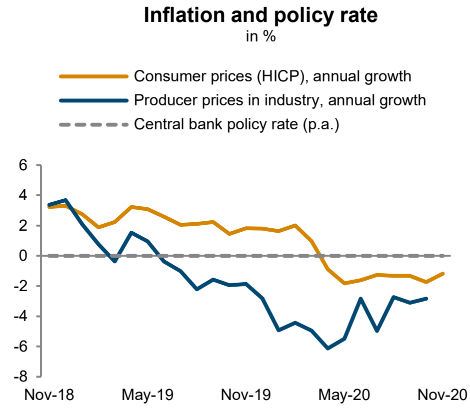
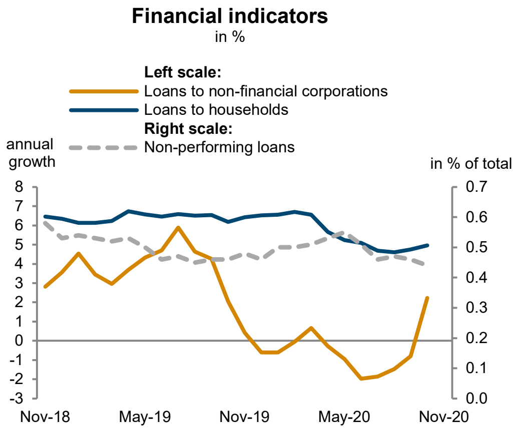
# Estonia

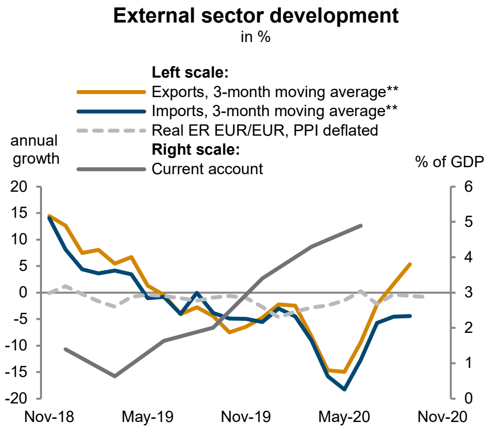
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**EUR based.

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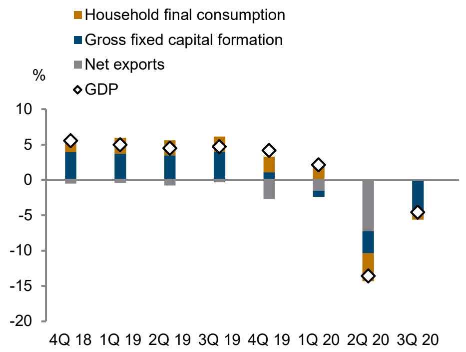
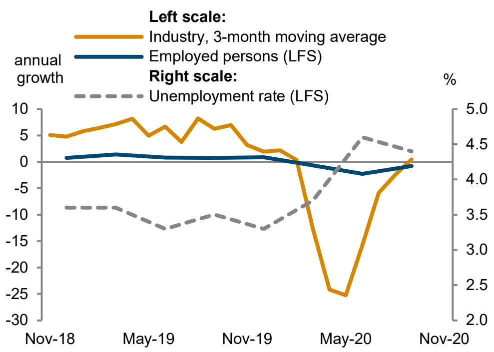
# Hungary

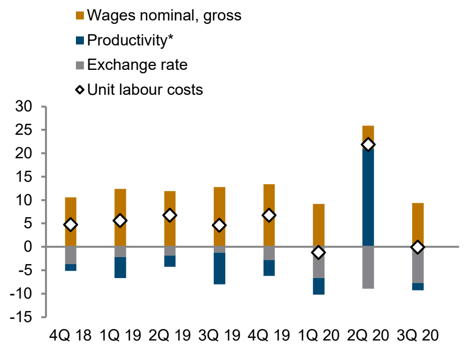
**Real GDP growth and contributions**
year-on-year



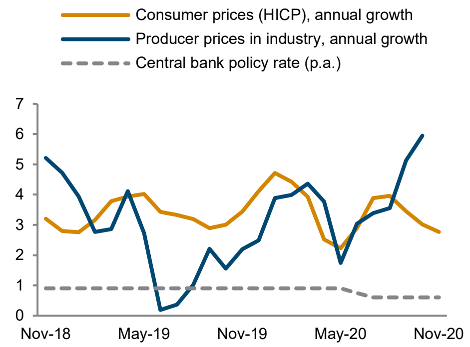

**Real sector development**
in %



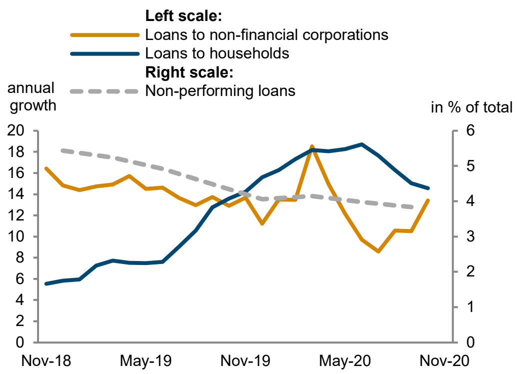

**Unit labour costs in industry**
annual growth rate in %



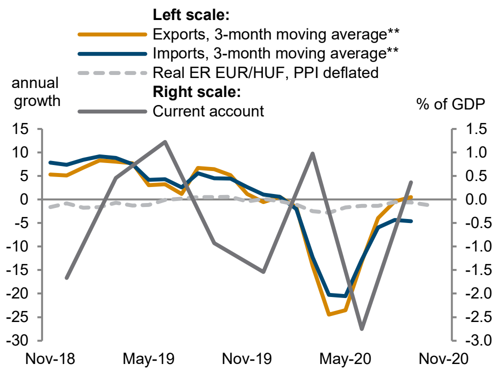

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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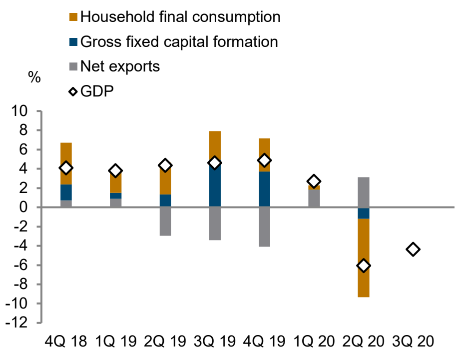
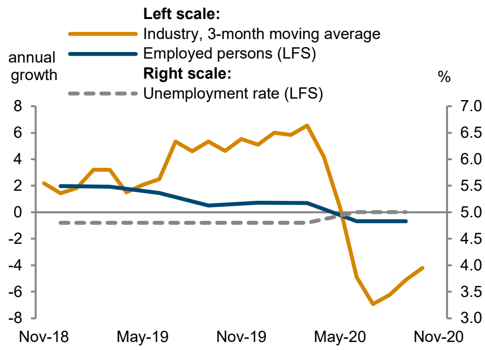
# Kazakhstan

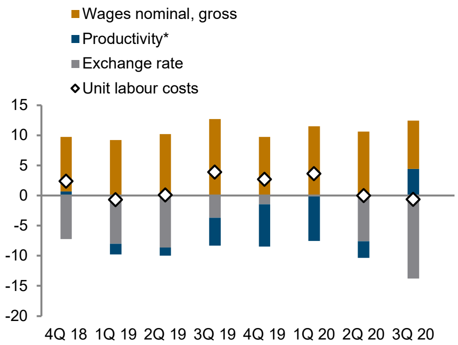
**Real GDP growth and contributions**
year-on-year



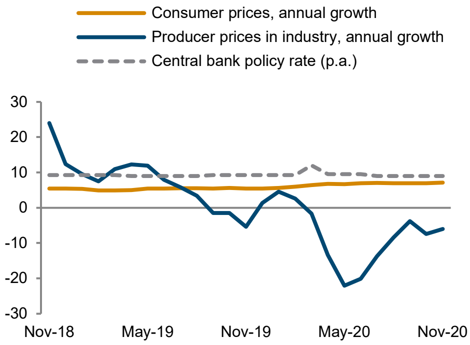

**Real sector development**
in %



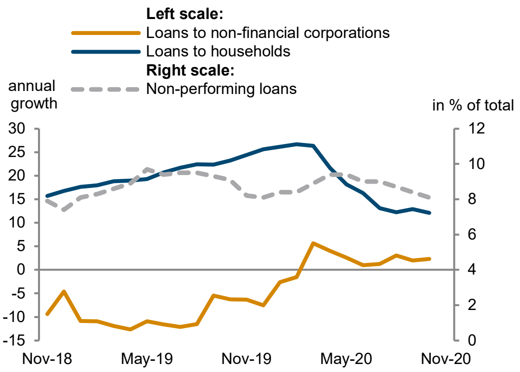

**Unit labour costs in industry**
annual growth rate in %



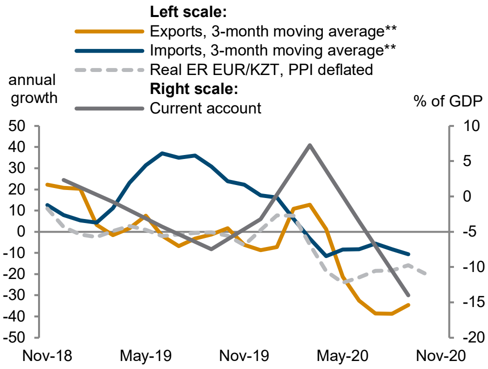

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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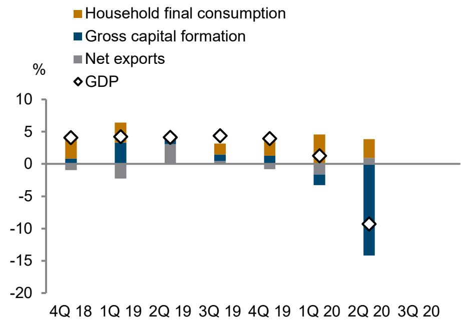
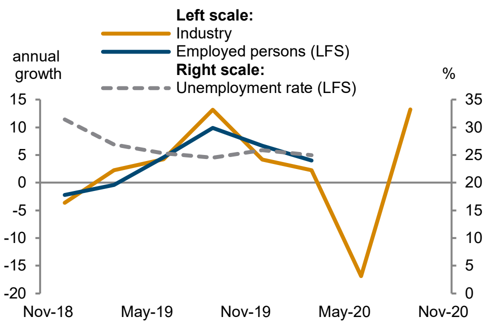
# Kosovo

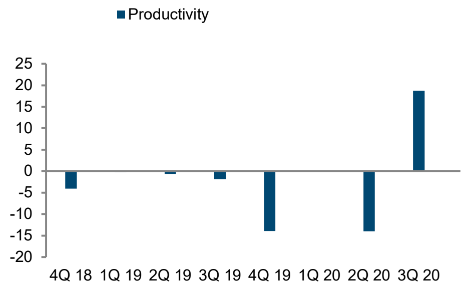
**Real GDP growth and contributions**
year-on-year



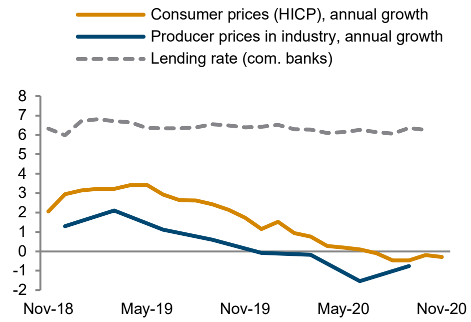

**Real sector development**
in %



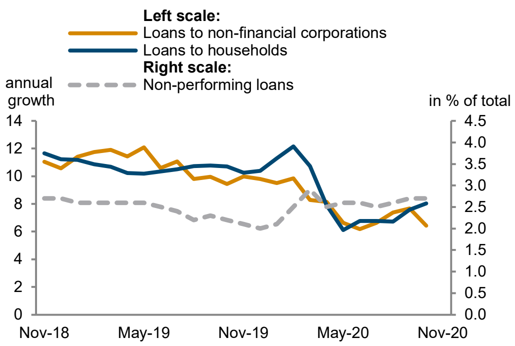

**Productivity in industry**
annual growth rate in %



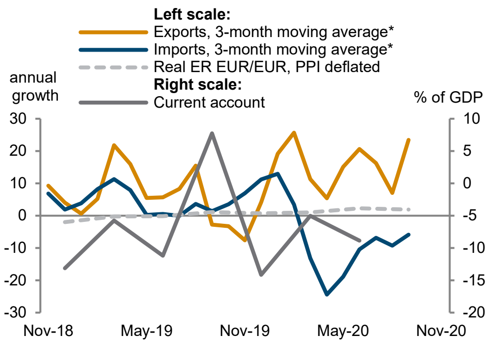

**Inflation and lending rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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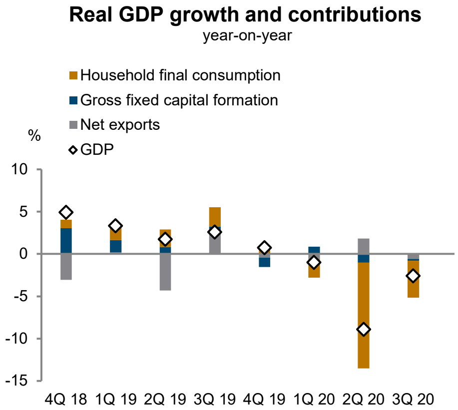
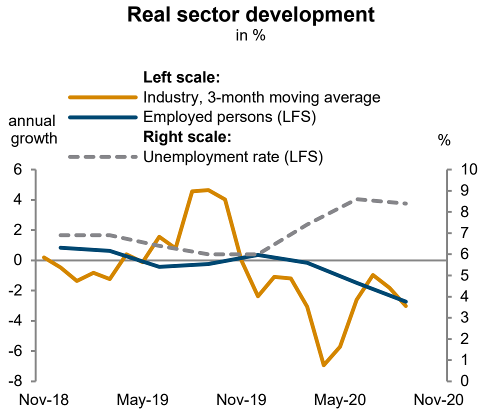
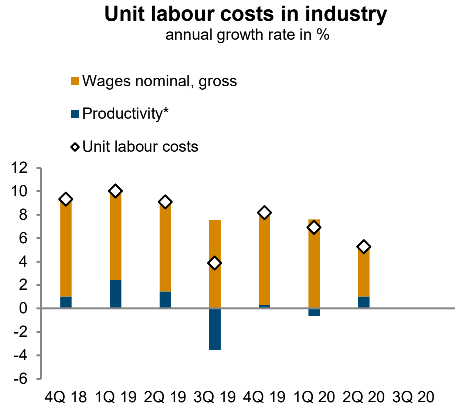
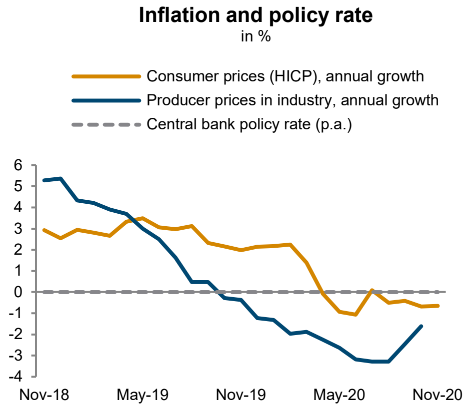
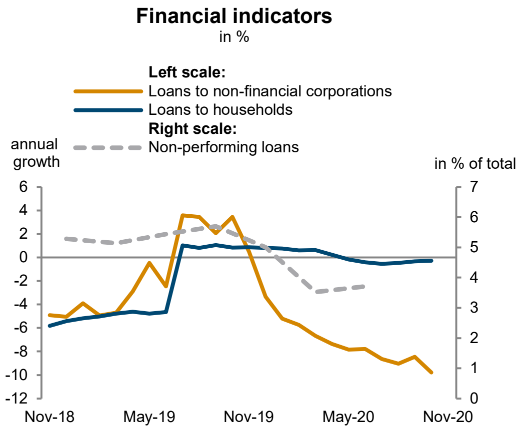
# Latvia

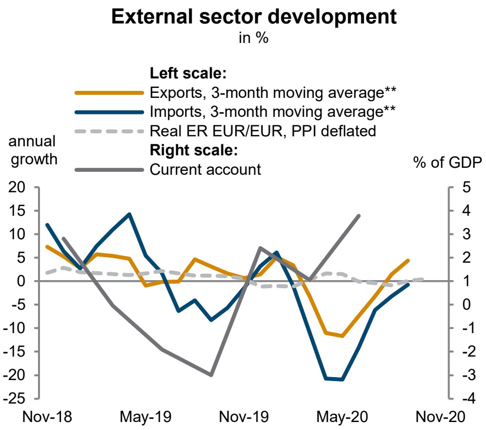
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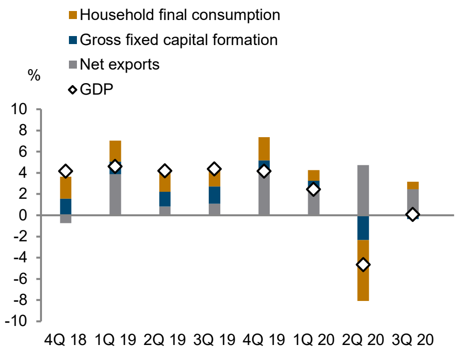
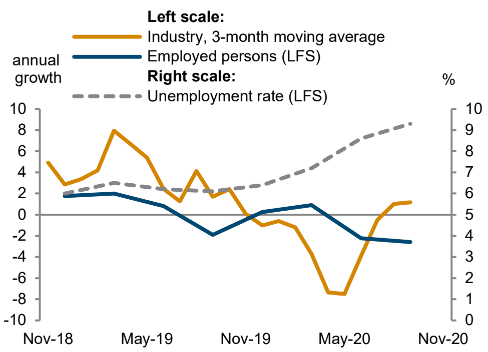
# Lithuania

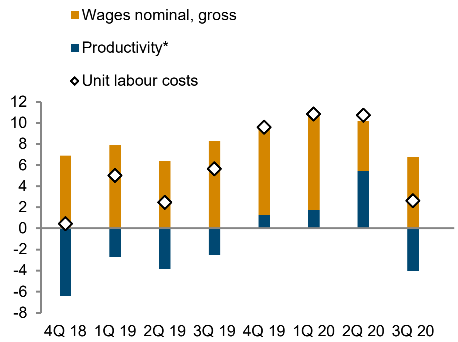
**Real GDP growth and contributions**
year-on-year



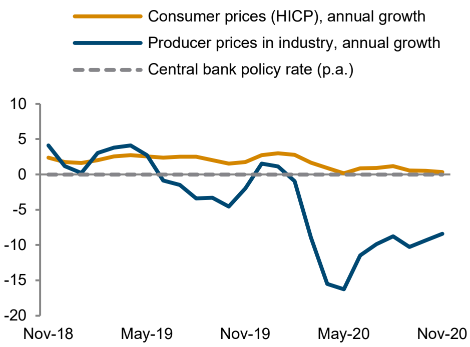

**Real sector development**
in %



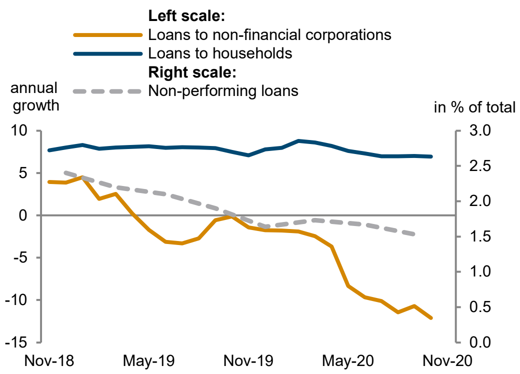

**Unit labour costs in industry**
annual growth rate in %



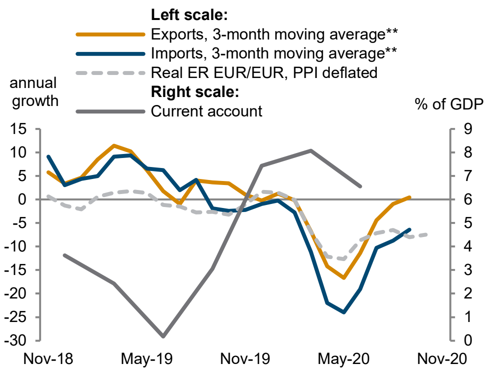

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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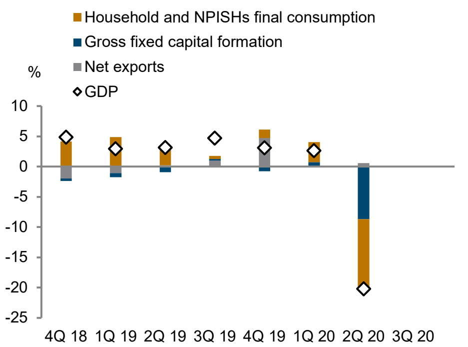
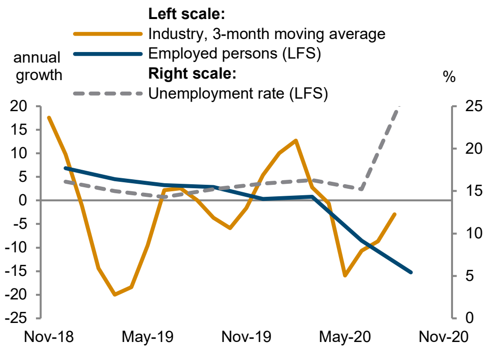
# Montenegro

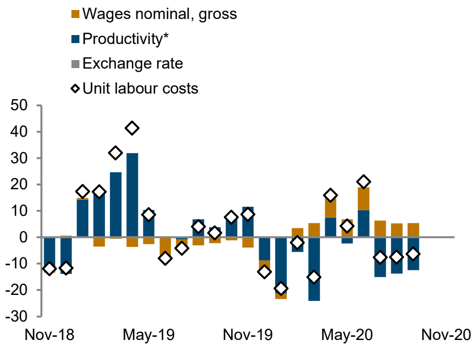
**Real GDP growth and contributions**
year-on-year



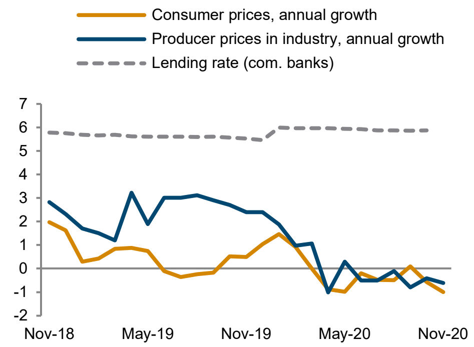

**Real sector development**
in %



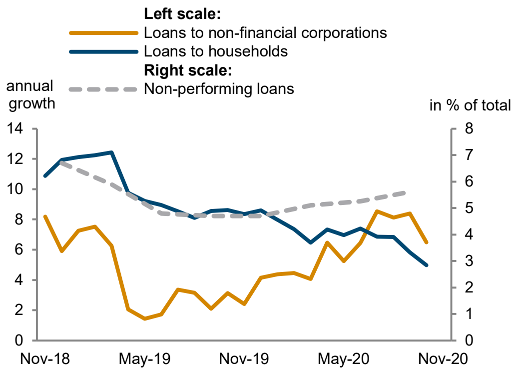

**Unit labour costs in industry**
annual growth rate in %



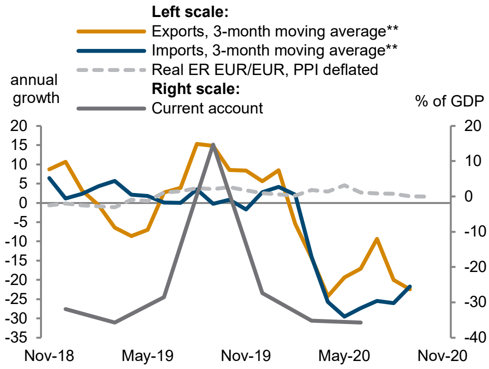

**Inflation and lending rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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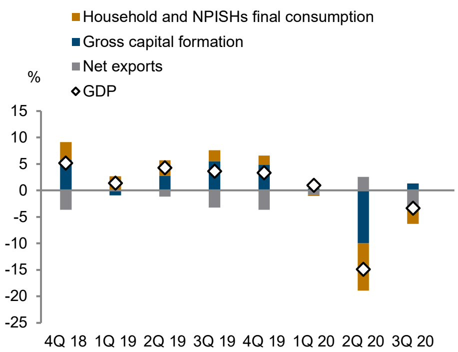
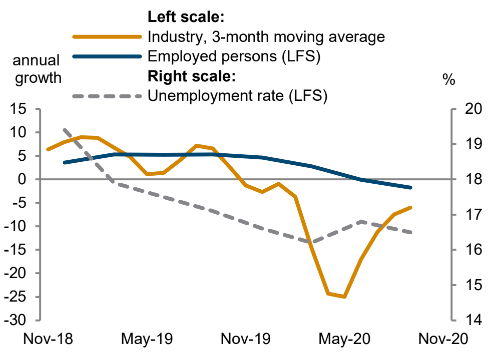
# North Macedonia

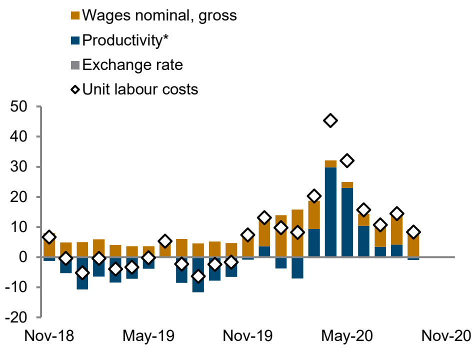
**Real GDP growth and contributions**
year-on-year



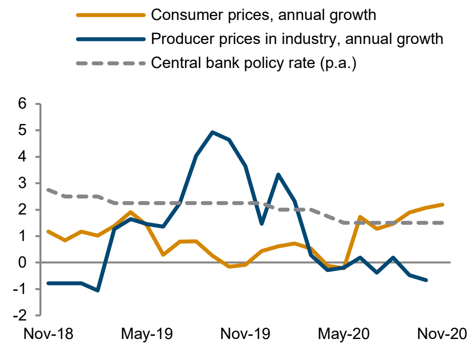

**Real sector development**
in %



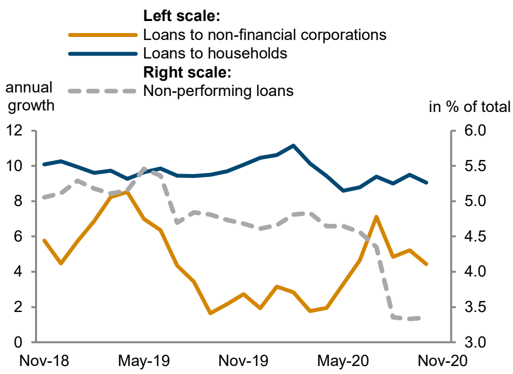

**Unit labour costs in industry**
annual growth rate in %



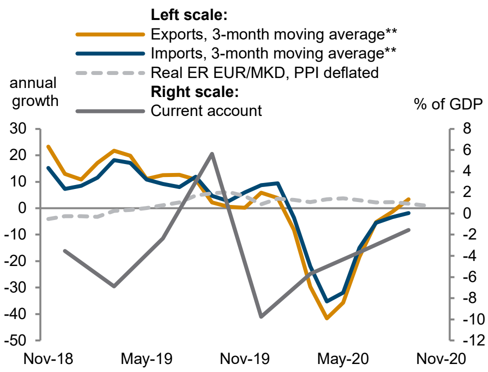

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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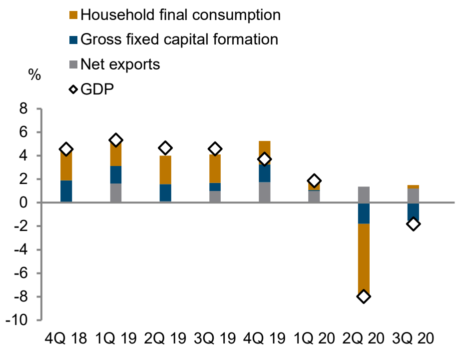
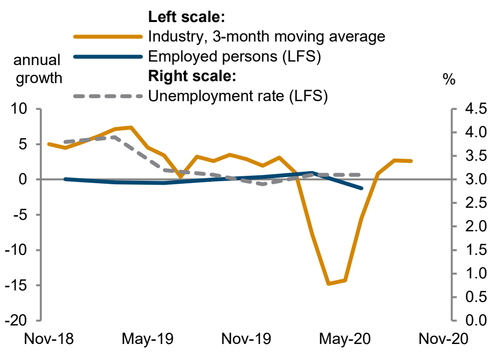
# Poland

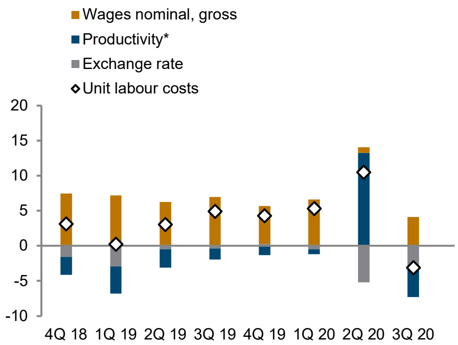
**Real GDP growth and contributions**
year-on-year



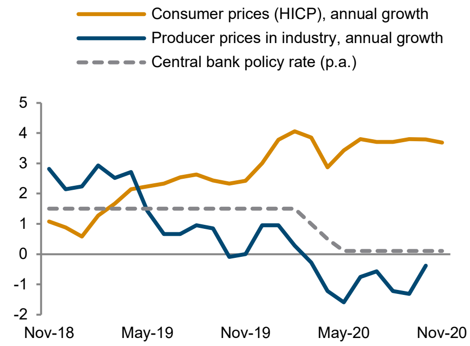

**Real sector development**
in %



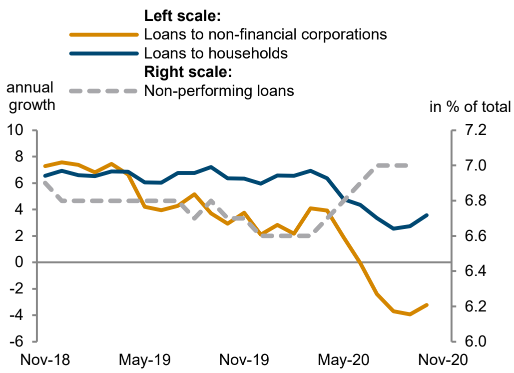

**Unit labour costs in industry**
annual growth rate in %



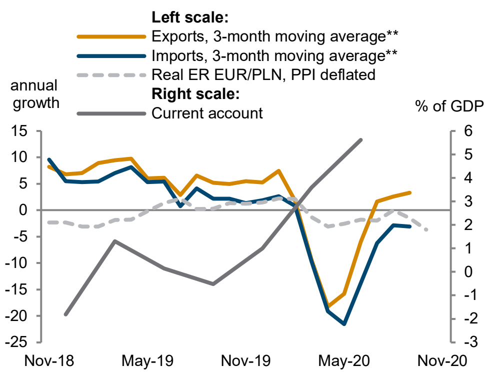

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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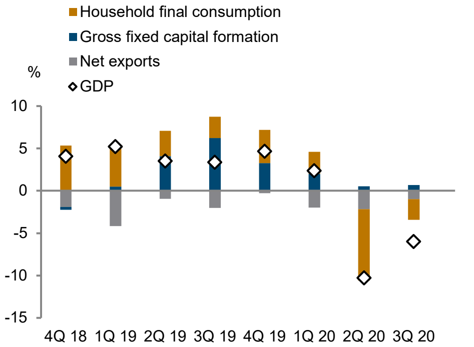
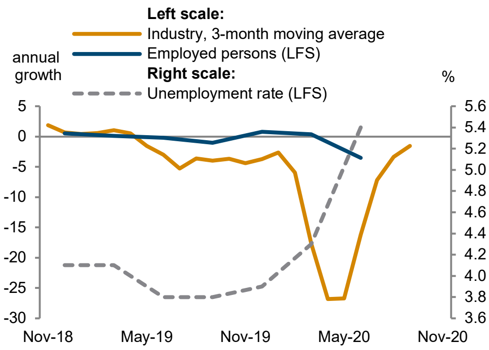
# Romania

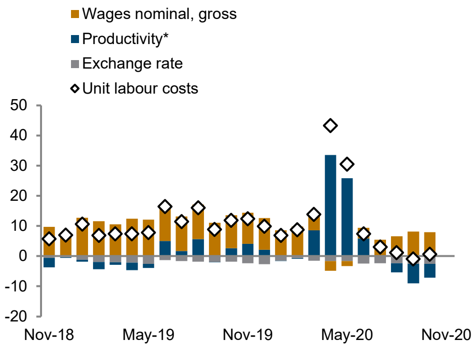
**Real GDP growth and contributions**
year-on-year



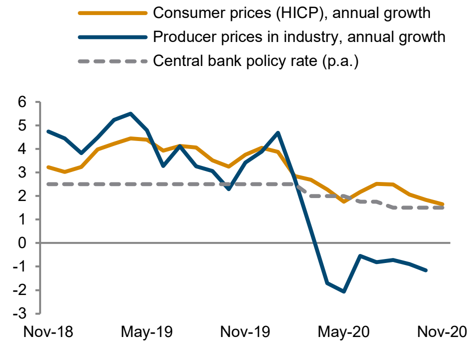

**Real sector development**
in %



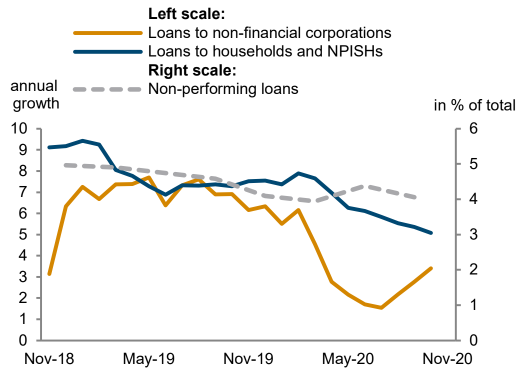

**Unit labour costs in industry**
annual growth rate in %



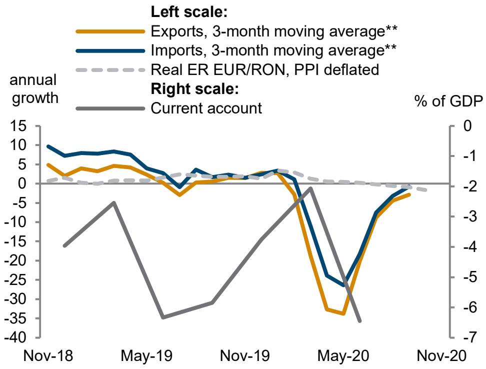

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %




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

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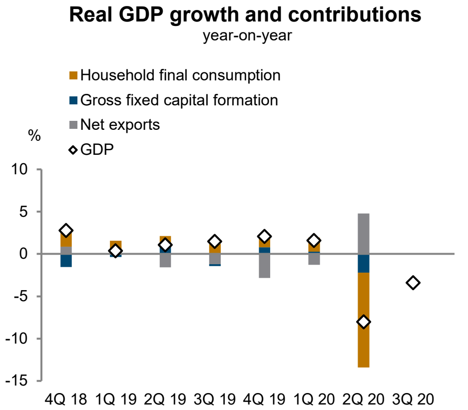
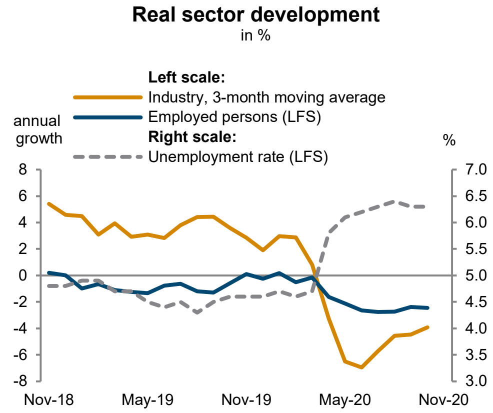
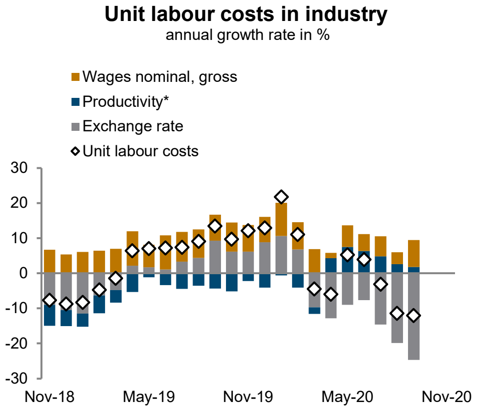
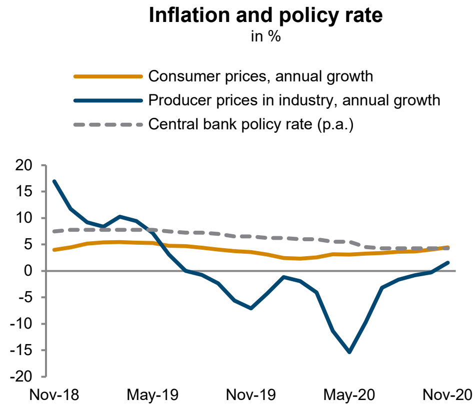
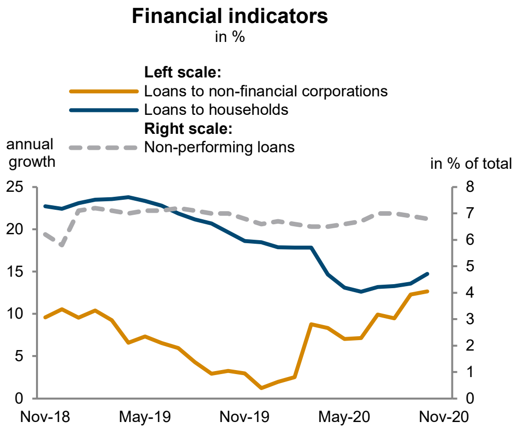
# Russia

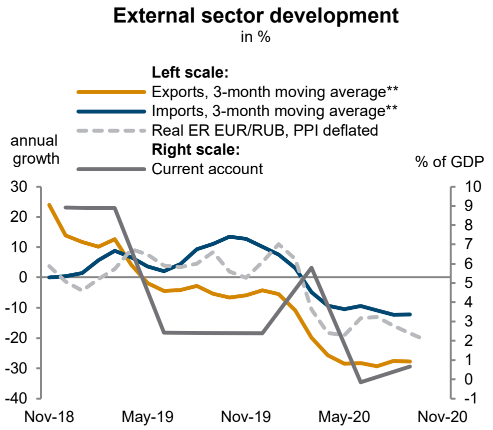
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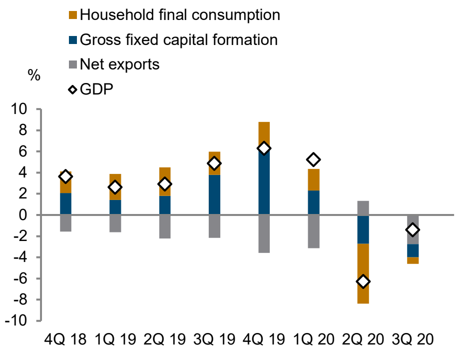
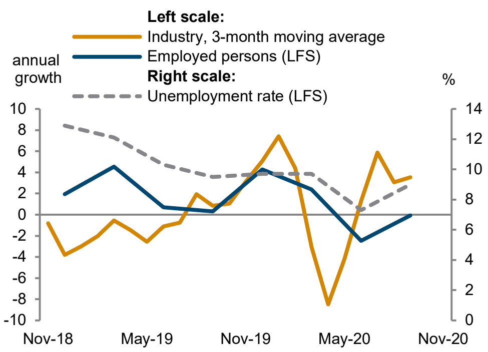
# Serbia

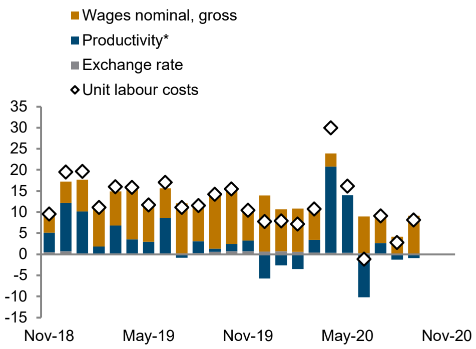
**Real GDP growth and contributions**
year-on-year



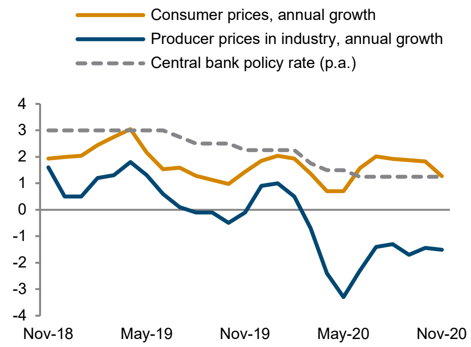

**Real sector development**
in %



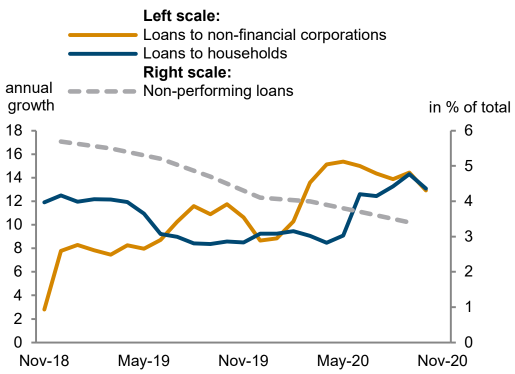

**Unit labour costs in industry**
annual growth rate in %



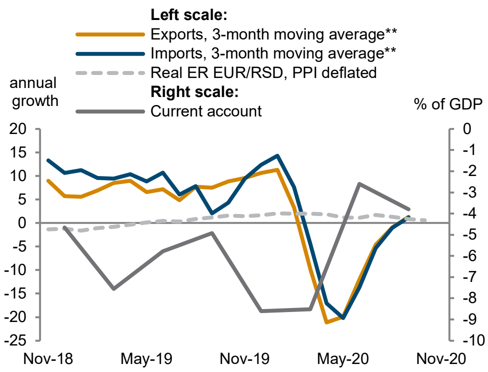

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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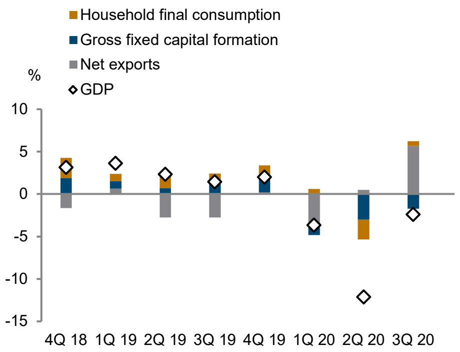
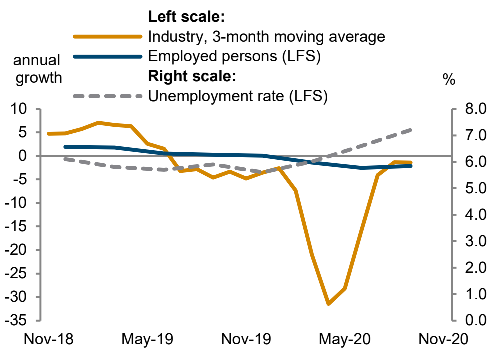
# Slovakia

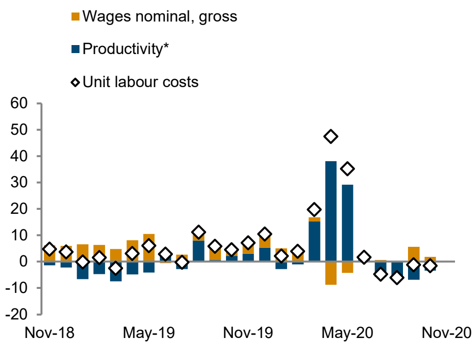
**Real GDP growth and contributions**
year-on-year



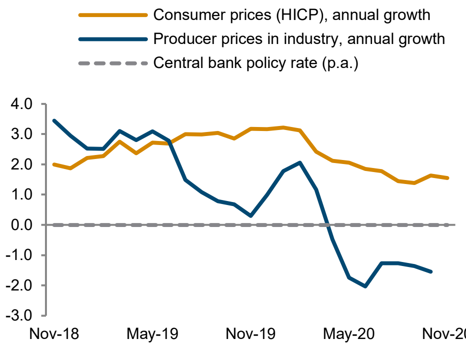

**Real sector development**
in %



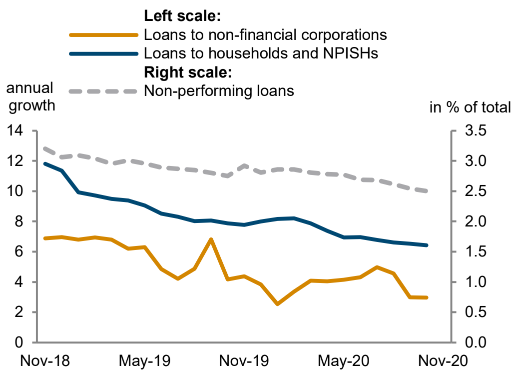

**Unit labour costs in industry**
annual growth rate in %



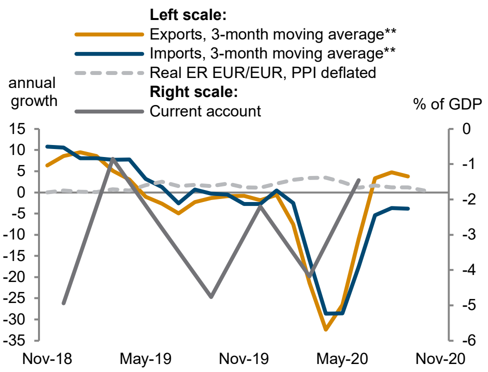

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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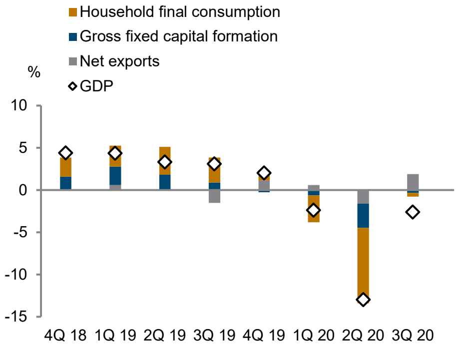
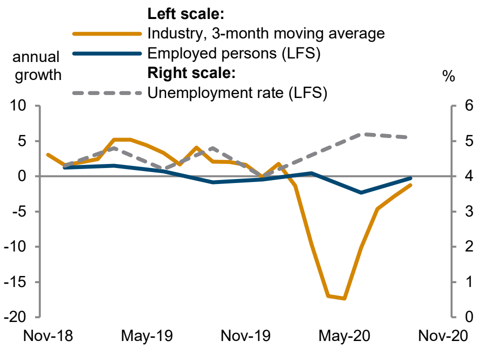
# Slovenia

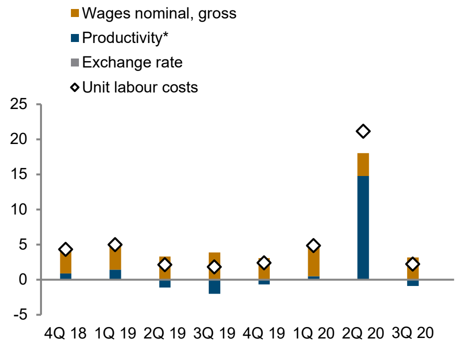
### Real GDP growth and contributions
year-on-year



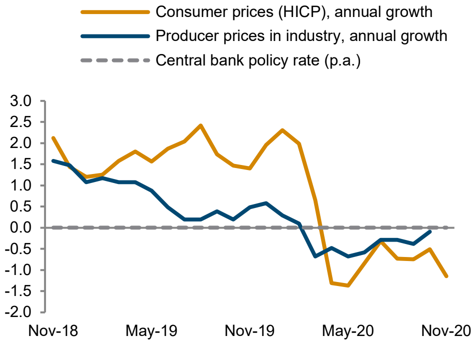

### Real sector development
in %



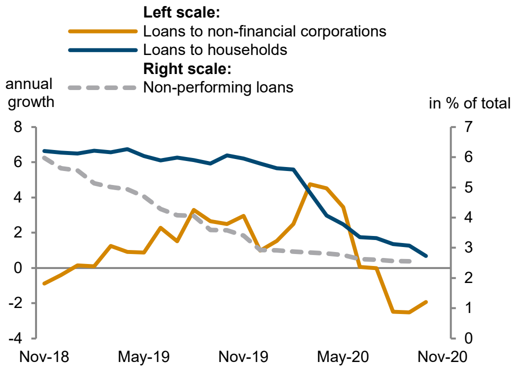

### Unit labour costs in industry
annual growth rate in %



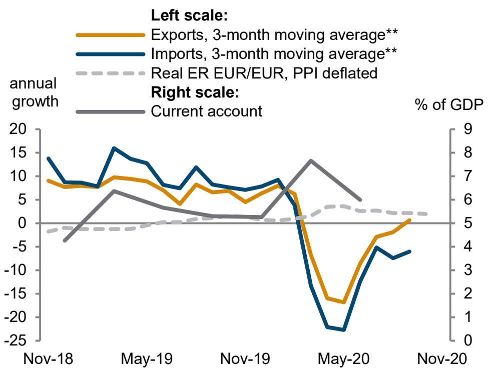

### Inflation and policy rate
in %




### Financial indicators
in %




### External sector development
in %

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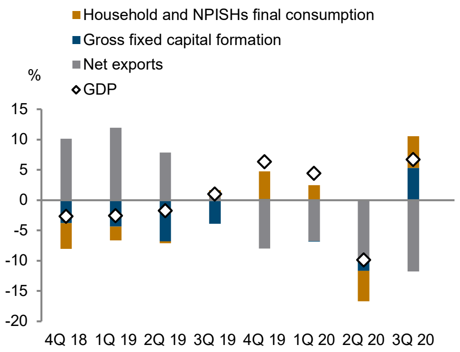
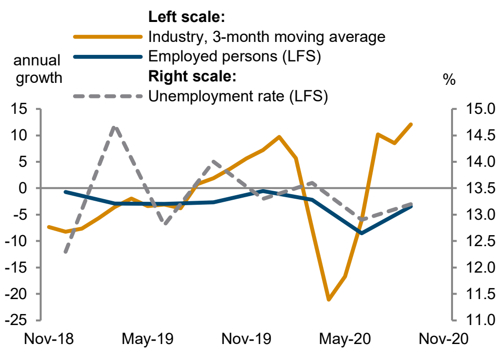
# Turkey

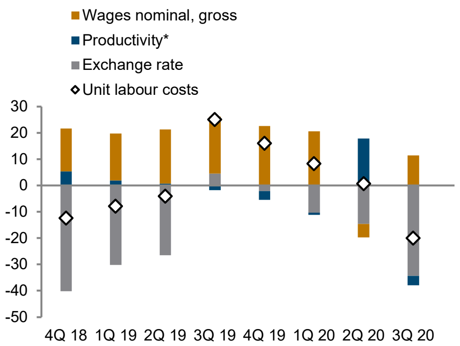
**Real GDP growth and contributions**
year-on-year



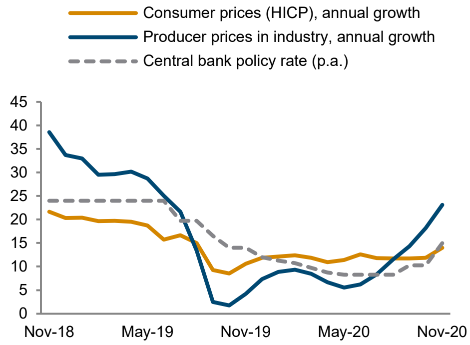

**Real sector development**
in %



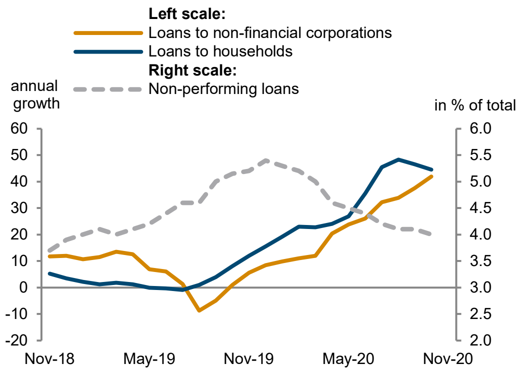

**Unit labour costs in industry**
annual growth rate in %



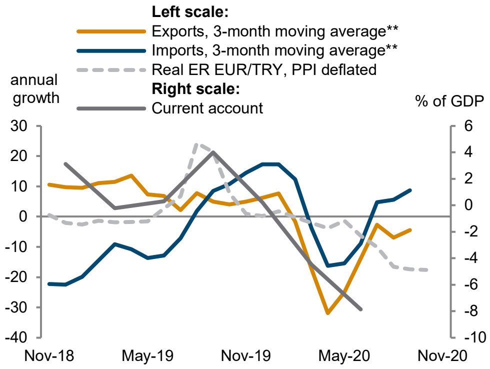

**Inflation and policy rate**
in %




**Financial indicators**
in %




**External sector development**
in %

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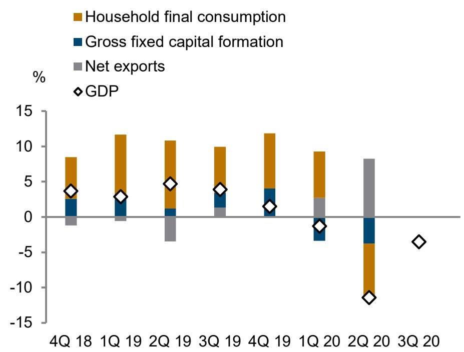
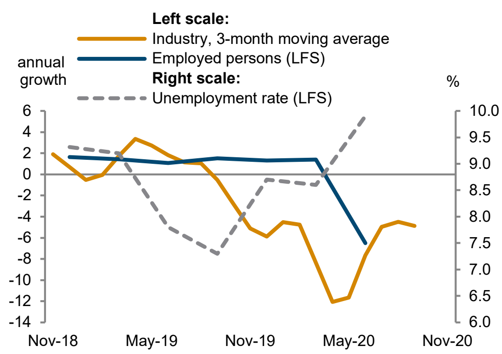
# Ukraine

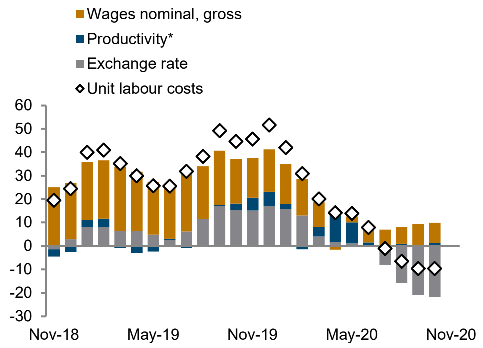
### Real GDP growth and contributions
year-on-year



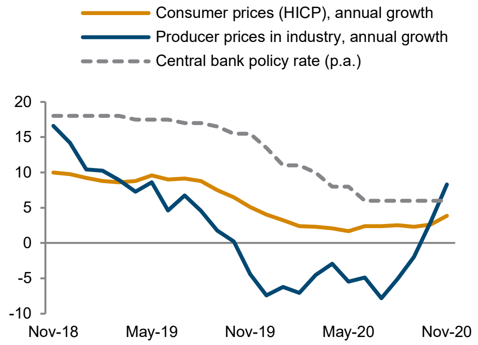

### Real sector development
in %



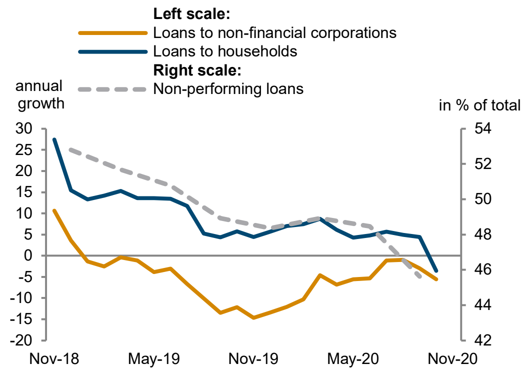

### Unit labour costs in industry
annual growth rate in %



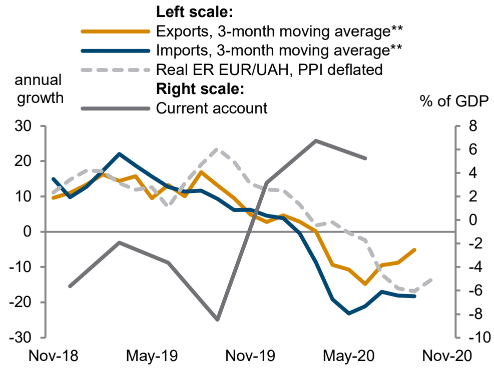

### Inflation and policy rate
in %




### Financial indicators
in %




### External sector development
in %

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