ISSN 2443-8014 (online)

Inflation Differentials in Europe and Implications for Competitiveness

Thematic Note to Support In-Depth Reviews

INSTITUTIONAL PAPER 198 | APRIL 2023

EUROPEAN ECONOMY

Economic and Financial Affairs

This paper represents work underpinning in-depth reviews under the Macroeconomic Imbalance Procedure (MIP), work that is still ongoing at time of this paper's publication. On 22 November 2022 in its Alert Mechanism Report (AMR), the Commission concluded that in-depth reviews (IDRs) are warranted for 17 Member States. These in-depth reviews are country-specific, with results due to be published in late Spring 2023. In the AMR the Commission stated that it "*will carry out in-depth thematic assessments on three issues of key relevance at the current juncture. […] This will inform the country-specific IDRs in the spring package of the European Semester.*"

As a consequence, three thematic notes had been prepared in early 2023, among which "*An in-depth thematic note on competitiveness dynamics will assess the extent and impact of the pass-through of energy costs to inflation, and the evolution of wages. This note will focus on Czechia, Estonia, Hungary, Latvia, Lithuania, Romania and Slovakia.*" This note had been discussed at the Economic Policy Committee on 6 March 2023. The content of that note is being reproduced in this paper, adjusted only for minor clerical errors. The original note also contains country-specific text, which is not reproduced in this paper, but whose content underpins the IDR reports due late Spring 2023.

This paper has been prepared by Leonor Coutinho, Christine Frayne, Aron Kiss, Mirko Licchetta, and Stefan Zeugner
Secretarial and editorial support by Eleftherios Kalogerakis and Giuseppe Palladino
Comments and requests should be sent to: ECFIN-B1@ec.europa.eu

Luxembourg: Publications Office of the European Union, 2023

PDF ISBN 978-92-76-61647-4 ISSN 2443-8014 doi:10.2765/395710 KC-BC-23-005-EN-N

European Commission
Directorate-General for Economic and Financial Affairs

Inflation Differentials in Europe and Implications for Competitiveness

Thematic Note to Support In-Depth Reviews

EUROPEAN ECONOMY

Institutional Paper 198

CONTENTS

1. INTRODUCTION

This note analyses inflation and competitiveness developments in selected EU countries, as input to the 2023 In-Depth Reviews under the Macroeconomic Imbalance Procedure. It aims to provide the analytical basis for the assessment of potential imbalances linked to competitiveness for Czechia, Estonia, Hungary, Latvia, Lithuania, Romania and Slovakia.[1] These countries were selected after the first screening for imbalances in the 2023 Alert Mechanism Report on the basis of the evolution of their rates of inflation, unit labour costs and real effective exchange rates. Out of these Member States, only Romania has been considered to experience an imbalance in the 2022 assessment. This note considers the impact of common factors affecting inflation differentials and competitiveness, particularly of commodity price developments, to provide context to the forthcoming In-Depth Reviews under the Macroeconomic Imbalance Procedure. The analysis to anticipate the evolution of potential risks by relying on the most recent data and available forecasts, and places recent developments in the context of changes that have taken place within and before the pandemic period.[2] The analysis provided is not exhaustive. At the time of publication of the In-Depth Reviews, more up to date data will inform the assessments that will be made, and the existence or not of imbalances will take on board developments across countries' economies and additional country-specific factors.

Since 2019, the EU economies have been faced with a combination of supply and demand shocks that have affected both relative prices and inflation. Throughout the pandemic and after, various bottlenecks have constrained supply. At the same time, containment measures during the acute phase of the pandemic and uncertainty constrained demand, particularly for contact intensive services, affecting relative prices. In the recovery phase, the rapid surge in demand, while supply was still facing constraints, pushed prices up. Price pressures for energy and commodities, but especially for natural gas, were aggravated significantly by Russia's invasion of Ukraine and the disruption of supplies, particularly to Europe.

The outcome of this combination of shocks is that European economies have been left with a significant increase in the rate of inflation, which reached levels not seen since the 70s oil shocks. A few considerations are warranted:

The energy price shocks are the most important component of the inflation surge. However, they are not the only aspect. The pandemic and subsequent strong recovery set other forces at play that may also be driving inflation.

Inflation is not just historically high, but divergent. This is true both within the EU and the euro area, and related both to overall and core inflation. A part of this divergent inflation is related to the differential impact of the energy price shock on different countries, relating to their economic structure. However, in parallel, for a number of countries it is accompanied by increases in unit labour costs.

The depreciation of the euro exchange rate kept effective real exchange rates from appreciating in a number of euro area countries in the first three quarters of 2022. Nonetheless, intra-euro area inflation differentials are significant enough to be reflected in cost-competitiveness indicators, notably REERs, and affect relative price dynamics vis-à-vis the euro-area average.

[1] Hungary, Latvia, Lithuania, Romania and Slovakia have also been selected for a horizontal analysis of external sustainability in the Alert Mechanism report 2023 (see Note to the EPC LIME working group "External sustainability analysis: thematic note to support In-Depth Reviews", February 2023). Czechia, Estonia, Hungary, Latvia, Lithuania and Slovakia have been included for a deeper horizontal analysis of housing market developments (see Note to the EPC LIME working group "Housing market developments: thematic note to support In-Depth Reviews under the Macroeconomic Imbalance Procedure", February 2023).

[2] The note mainly relies on data from Eurostat and AMECO, with the cut-off date on 30 January 2022, and on the Commission's forecast from the Autumn 2022 forecast round.

In parallel with other monetary authorities, including non-Eurosystem EU Central Banks, the euro area monetary policy authority has reacted to the surge in inflation by starting to normalise its policy stance, which was accommodative during the pandemic.

The current inflation shock raises the concern that while the shock itself could be temporary, its economic and social impact may be very heterogeneous across the EU, with longer-lasting effects in some cases. In the presence of a short-lived negative supply shock, higher inflation and lower output growth would be a temporary phenomenon, lasting until normal supply conditions, including energy prices, are restored. However, price competitiveness could be easily eroded following an episode of high, even if temporary, inflation in the case of large, generalised increases in wages to fully compensate for purchasing power losses and higher costs for other inputs. Excessive and generalised wage increase can erode profit margins and can result in wage price spirals and persistently higher inflation. This can then (further) negatively impact external competitiveness, resulting in increased external indebtedness over time. In this scenario, the monetary authority may need to intervene more aggressively, through higher interest rates, to push inflation back to target (see Cecchetti and Schoenholtz, 2015). However, in a monetary union, divergent inflationary effects will make the task of the monetary authority particularly difficult. Taken together, these mechanisms raise the possibility of stronger competitiveness effects setting in within the euro area. Addressing these could require other policies to contain the rate of inflation in individual member states.

The current high inflation rates could hold particular challenges for countries with pre-existing economic and labour market vulnerabilities. In theory, if economies are flexible and competitive with well-functioning credit markets, efficient firm exit and entry frameworks and flexible labour markets amid low nominal friction, they should adjust smoothly to shocks without generating major disruptions. However, the very large inflationary effect underway could bring challenges. Vulnerable firms may not be able to pass-through all their increased costs to consumers and fail, leading to an increase in unemployment and a stronger slowdown in growth. In cases where the affected country has also pre-accumulated or is accumulating macroeconomic imbalances, including large stocks of private and public debt, high unemployment, overvalued real exchange rates, or past credit misallocation, the costs of a decline in growth could be high. Even without an abrupt disruption, particularly high levels of inflation could require a prolonged adjustment period of lower growth to unwind.

The aim of this note is to disentangle whether the countries under consideration are experiencing a normal and necessary adjustment to a large shock or whether there may be specific features of the economy that may delay the adjustment and exacerbate the shock. The note is focussed on the countries that are flagged in the AMR, with the results to inform their forthcoming IDRs. **These countries are Czechia, Estonia, Hungary, Lithuania, Latvia, Romania and Slovakia.** This note investigates how much of the ongoing inflationary process is directly attributable to the energy price increases, and it looks at wage dynamics over time. It aims to provide evidence about the extent to which the developments at play are attributable to one-off factors that can be expected to correct, or whether there are additional factors that may pose risks and need to be corrected. Wage developments are also analysed from the perspective of whether recent changes point to growing competitiveness pressures. For this, the note is organised as follows:

The reminder of this section will describe **the overall magnitude of the 2021-2022 inflation** shock and its relationship with the energy price surge.

Section 2 will look at the implications of the inflation surge for **real effective exchange rate developments and price competitiveness measures**. The aim of this section is to provide context about the magnitude of the competitiveness effects that these countries are facing, which may affect their economies in the near future, without supportive relative price developments.

Section 3 looks at the role of the economic structure to assess the pass-through of energy prices to inflation from an input-output perspective and try to understand the extent to which inflation is the result of the pass-through of energy prices, and how much is due to domestic price pressures. In countries where inflation results to a large degree from energy pass-through, the normalisation of energy prices should be sufficient to bring down inflation, and any competitiveness losses should be unwound as long as energy prices return to lower levels. Where inflation results more from domestic price pressures, related to wages, profits or taxes, there may be more difficulties in swiftly unwinding any competitiveness losses as energy prices normalise, particularly if these domestic price dynamics are rooted in structural factors.

Section 4 digs into labour market developments across the countries in question, which could be important in identifying the main determinants of a possible impaired adjustment process. In particular, high and generalised wage growth, combined with downward wage rigidity or other structural factors such as labour shortages driven by demographics and low labour mobility, may imply permanently higher costs even after energy prices go down to long-term equilibrium levels, particular in the case of euro area countries, where changes in the nominal exchange rate will not be available to offset the effect of permanently higher production costs.

Section 5 concludes with country-specific considerations and Annex 1 provides country specific charts.

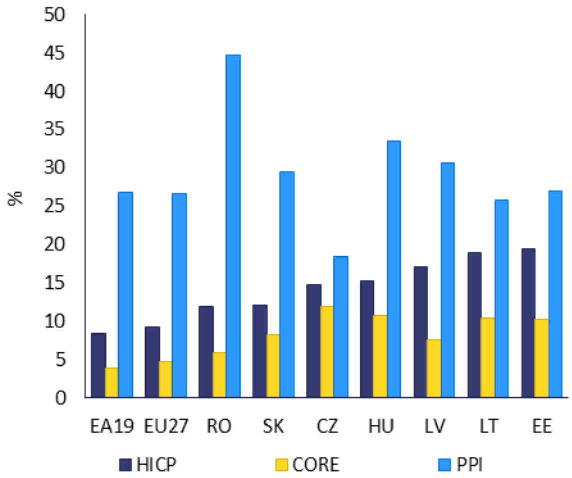
1.1 INFLATION AND THE ENERGY PRICE SHOCK

Inflation started rising with the rapid recovery from the COVID-19 crisis, and then accelerated substantially with the Russian invasion of Ukraine. High household savings supported a rapid recovery of demand when pandemic restrictions were lifted, particularly in services, but also in industrial goods, giving rise to a number of input shortages and supply chain disruptions, which pushed prices up. Inflation in Estonia, Czechia, Hungary, Lithuania, Latvia, Romania and Slovakia was considerably higher than in the Euro Area in 2022 (Graph 1.1a). Specifically, year-on-year HICP inflation peaked in the second half of 2022, at 25,2% in Estonia (August); 22.0% in Latvia, 22.5% in Lithuania, and 17.8% in Czechia (September) 14.6% in Romania and 15.1% in Slovakia (November). In Hungary it continued to increase in 2022, reaching 25% in December. These figures are well above the peak of the EU average of 11.5% and the EA average of 10.6% registered in October.

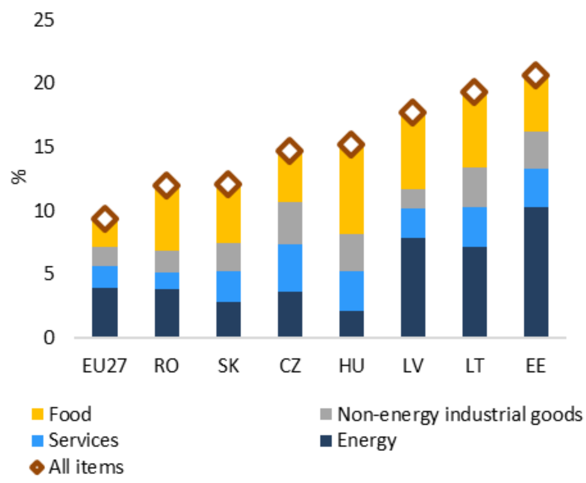
Energy and food were the main contributors to inflation in 2022 in most Member States. Energy is an important component of the overall HICP basket (Graph 1.1b). Energy prices started to increase already in 2021, but Russia's invasion of Ukraine led to their further sharp increase in the first half of 2022. Although energy prices began to decline towards the end of 2022, energy inflation contributed strongly to overall inflation in the course of the year. This is particularly true for Latvia, Lithuania and Estonia, which also recorded the highest inflation among the seven countries in focus.

Graph 1.1: **Inflation measures and contributions**

a) Inflation measures, 2022



b) HICP inflation and contributions, 2022



Source: Commission's calculations based on Eurostat.

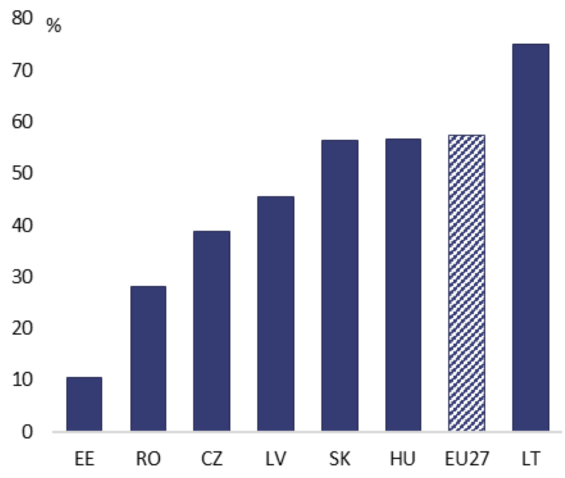
The extent of energy import dependency and energy intensity can only partly explain the inflation differentials among the seven countries (Graph 1.2a and 1.2b). Lithuania is most reliant on energy imports overall, although in all countries except from Lithuania the share of gas imports from Russia in percent to total gas imports was particularly high (see country fiches). The energy intensity is largest in Czechia and Estonia. These factors will affect how energy price changes work their way through the different economic structures.

Food inflation also contributed to the high inflation in 2022, for the seven countries in focus. Food inflation has also increased significantly since 2019 and more significantly since Russia's invasion of Ukraine. Commodity price pressures, together with energy prices have also passed through the food supply chain. Food inflation in 2022, averaged 18% in Czechia, 20% in Estonia, 22% in Latvia, 26% in Lithuania, 29% in Hungary, 17% in Romania and 19% in Slovakia. As Graph 1.1.b shows, both energy and food price inflation have contributed to HICP rising, over 2022, with food prices playing an important role in all seven countries in comparison to the EU27, with a particularly important contribution observed in Hungary (Graph 1.1b).

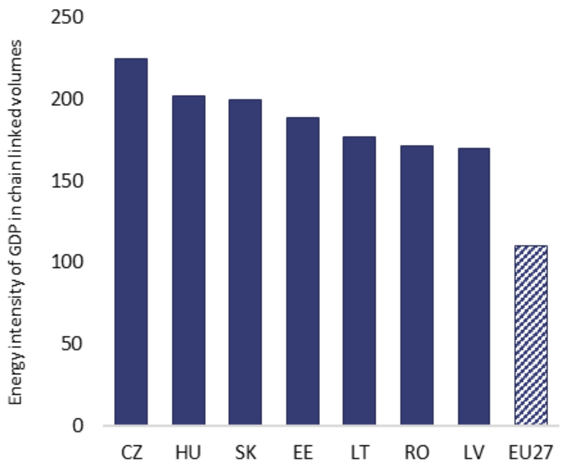
High inflationary pressures have broadened beyond energy, with divergent core inflation dynamics that may be difficult to unwind. Increasing energy and food prices, along with wage increases, have also contributed to push up other measures of inflation, with core inflation and producer price indices showing substantial increases (Graph 1.1a)). The differences in core inflation among the seven countries were sizeable in 2022. Year-on-year, it peaked at 14% in Czechia and 13% in Estonia (October); and 10.7% in Lithuania (November). In four countries, it continued to increase in December, to 10.7% in Latvia and 15.4% in Hungary, 8.4% in Romania, 9.8% in Slovakia, highlighting the delayed pass-through to core inflation. Core inflation also continued to increase in the EU and EA in December, to 6.2% and 5.2%, respectively. Such large divergences in inflation are not easy to unwind and may lead to competitiveness issues in some countries.

Graph 1.2: **The role of energy and energy imports in inflation**

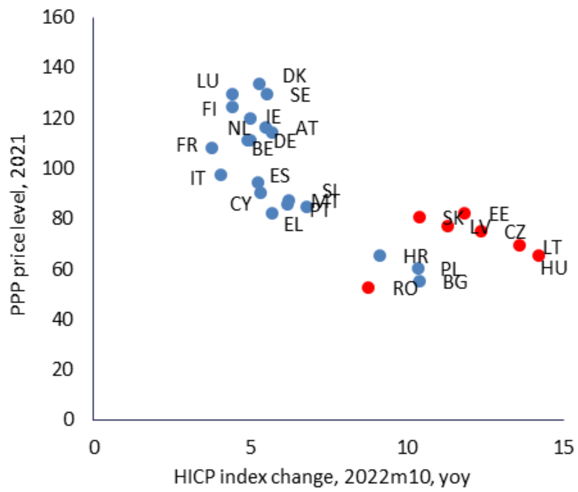
a) Energy import dependency, 2020



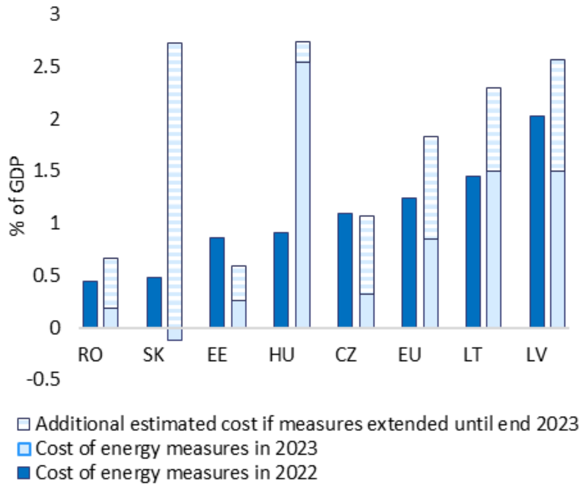
b) Energy intensity



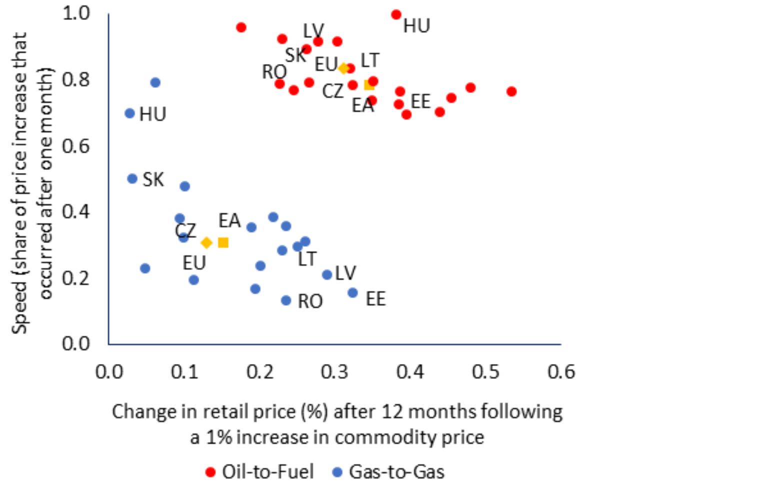
c) Inflation dynamics and association with the overall price level



d) Energy measures, in % of GDP



e) Pass-through of crude oil to retail fuel prices and of natural gas to retail gas prices



Note: The dependency rate measures the share of net imports (imports - exports) in gross inland energy consumption (meaning the sum of energy produced and net imports).

Sources: a, b, c: Commission's calculations based on Eurostat; d: Adapted from Buelens C. And V. Zdarek (2022), e: European Commission (2022), European Economic Forecast, Institutional Paper, No.187, NOVEMBER 2022.

There is a negative correlation between inflation in 2022 and price levels in 2021, which could be explained by the weight of non-wage costs in countries with lower price levels (Graph 1.2c). This negative correlation can be explained by the fact that wage costs tend to have a lower weight in total costs in countries with lower price levels. Moreover, countries with lower price levels are likely to have been more affected by the absolute increase in energy prices, which was broadly the same across EU countries. In addition, Balassa-Samuelson effects can also be expected to be present, but as these are related to productivity growth differentials, they can be expected to be a much less significant component of the differences in inflation, given the current economic conditions.[3]

[3] The literature finds a limited role for Balassa-Samuelson effects in explaining inflation differentials (see Beck et al. 2009, Angeloni and Ehrmann, 2007 and Honohan and Lane, 2003).

In addition, government policy measures could also be important in explaining inflation differentials among the seven countries. Since the start of the pandemic, there has been a range of policy measures to support firms and households, which have been heterogeneous across countries and had a heterogeneous impact on aggregate demand and therefore on inflation. In addition, the increase in energy prices has prompted most Member States to implement fiscal measures to limit the rise in retail energy prices or mitigate their social and economic impact on households and firms. Graph 1.2d provides an estimate of the net budgetary cost of discretionary measures to mitigate the impact of high energy prices, as accounted for in the European Commission Autumn Forecast 2022. The estimates for 2023 are in line with the Commission's customary 'no-policy-change assumption' and only take into account measures that have been credibly announced and specified in sufficient detail by the forecast cut-off date (see Box I.2.4, European Commission Autumn Forecast 2022).[4] For some countries the estimates may underestimate the measures that will be actually implemented. Most of the measures implemented in 2022 are not targeted to households or firms most vulnerable to price hikes. Also, most of the measures are price measures, which may distort the price signal and reduce incentives to contain energy consumption and increase energy efficiency.

There is some evidence that the pass-through of changes in commodity prices to retail prices varied across countries, but policy measures would have affected these relationships in 2022. Buelens and Zdarek (2022) provide estimated of the pass-through strength and speed from commodity prices to retail prices, using an auto-regressive distributed lag model (ARDL) estimated on monthly inflation data covering the period 1996-2021.[5] The pass-through from crude oil to fuel prices at the consumer level is found to be strong and immediate. Most of the increase, about 80%, would already have occurred after one month. By contrast, the transmission of natural gas prices to retail prices of gas has in the past been somewhat slower, also due to policy settings (Graph 1.2e). In 2022, these estimated relationships have been affected by policies. For instance, the oil price pass-through in Hungary in 2022 was affected by a price cap on motor fuel, in force between November 2021 and December 2022.

[4] European Commission (2022), "European Economic Forecast – Autumn 2022", European Commission.

[5] Buelens C. And V. Zdarek (2022) "Euro area inflation shaped by two years of COVID-19 pandemic, Quarterly Report on the Euro Area (QREA), European Commission, vol. 21(1), pages 7-20, May.

Box 1: **Determinants of inflation differentials**

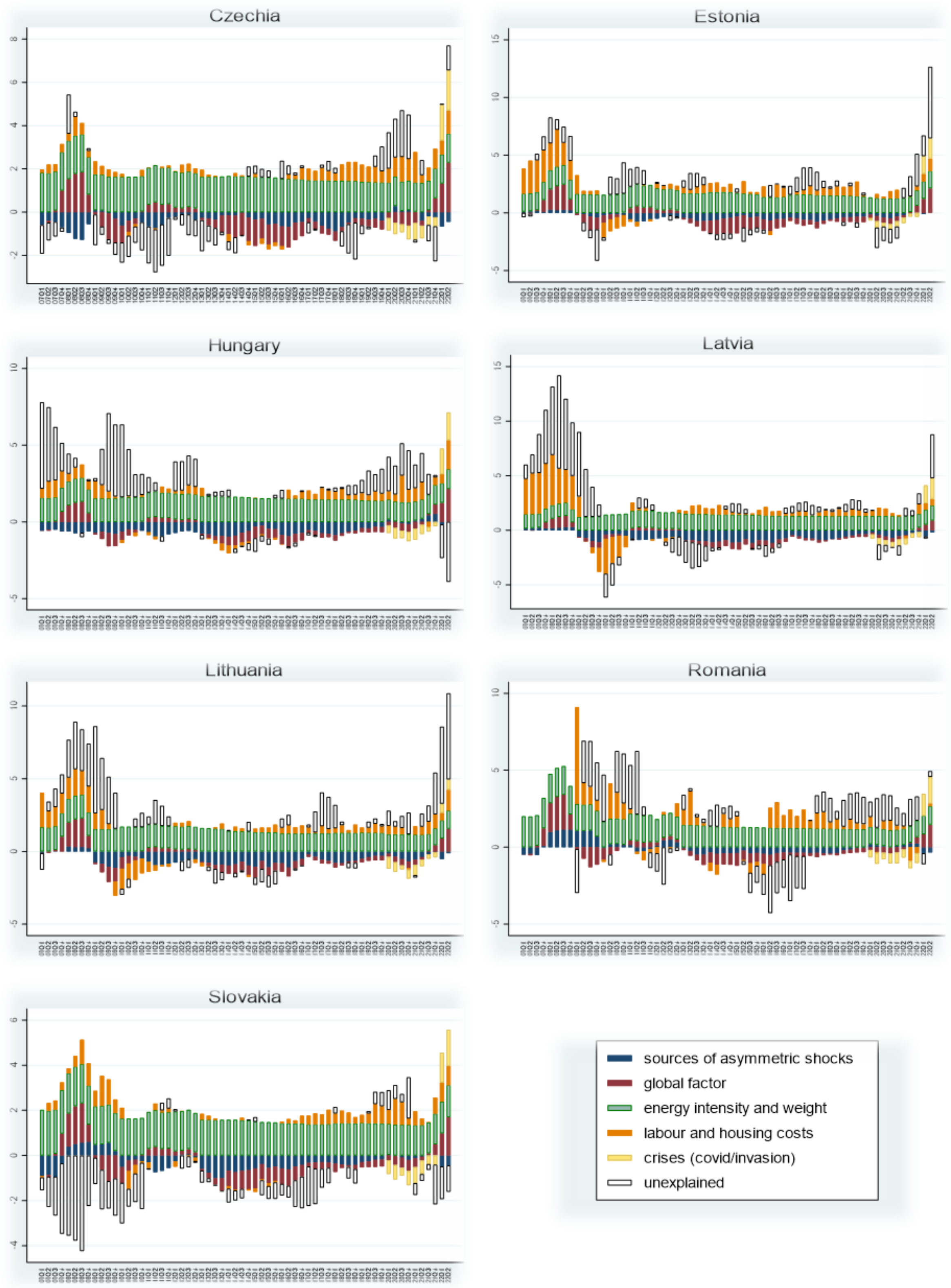
This box undertakes a preliminary investigation of the determinants of inflation differentials with particular attention on the seven countries that are the focus of this note, based on an econometric panel analysis. It draws on existing literature (Honohan and Lane, 2003, Beck et al., 2009) to select a set of potential drivers of inflation differentials for inclusion in a panel regression, estimated with quarterly data from 2000Q1 to 2022Q2, for the EU-27 Member States. To control for the common drivers of inflation, a global EU factor, estimated with factor analysis, is included in the regressions (see Annex 3). Heterogeneity in the responses of countries' inflation to this global inflation shock is taken into account using interactions of the factor with country characteristics. Country characteristics and macroeconomic variables affecting inflation differentials are grouped according to whether they may reflect adjustment to asymmetric shocks, Balassa-Samuelson effects, costs of local non-traded inputs, or price rigidities. Among the variables reflecting sources of asymmetric shocks, nominal effective exchange rate changes have been identified as an important source of asymmetric shocks; also asynchronous or more volatile cycles may be a reflection of asymmetric shocks or asymmetric responses to common shocks. In addition, different economic structures, including higher energy intensity, different sectoral weights (e.g. services and construction) are sources of asymmetry. Inflation differentials caused by different economic structures should in principle fade as the origin of the shock dissipates. However, there could be distortions that cause economies to specialise in less productive sectors, as observed with the excessive growth of the construction sector in some EU economies in the run-up to the global financial crisis, as a result of very low real interest rates and the absence of macro-prudential policies (see Coutinho and Turrini, 2019). Table 1 shows regression results on the determinants of EU differentials.

Table 1: Drivers of headline inflation differentials in the EU

Dependent variable = Deviation from EU HICP All Item index	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Unemployment rate (4-quarter average lagged)	-0.024***	-0.027***	-0.036***	-0.037***	-0.038***
Nominal effective exchange rate (y-o-y% lagged) lagged)	-0.068***	-0.055***	-0.066***	-0.066***	-0.067***
Volatility of real GDP (12-month)	0.136***	0.162***	0.123***	0.118***	0.109***
Russian invasion dummy X gas imports from Russia (%)	0.038***	0.026***	0.021***	0.020***	0.020***
Energy intensity	0.004***	0.004***	0.004***	0.004***	0.004***
Energy weight in HICP	0.046***	0.033***	0.045***	0.045***	0.047***
Service share in GVA	-0.010**	-0.013***	-0.011**	-0.013***	-0.013***
Construction share in GVA	0.084***	0.090***	0.087***	0.089***	0.088***
Wage bargaining coordination dummy	-0.160***	-0.121**	-0.209***	-0.209***	-0.206***
Unit labour costs (y-o-y % change lagged)	0.123***	0.127***	0.127***	0.126***	0.125***
House price overvaluation	0.019***	0.015***	0.013***	0.013***	0.013***
Stringency index	-0.017***	-0.015***	-0.011***	-0.011***	-0.010***
Common factor		0.176***	-0.725***	-0.092	-0.366
Common factor X energy intensity			0.006***	0.006***	0.006***
Common factor X service share				-0.008*	-0.007*
Common factor X construction share					0.039**
Constant	-0.472	-0.283	-0.340	-0.224	-0.238
Number of observations	2130	2130	2095	2095	2095
Number of countries	27	27	27	27	27
R2	0.43	0.41	0.48	0.48	0.48
Root mean squared error	1.29	1.30	1.24	1.24	1.23
Time Dummies	Yes	No	No	No	No

Note: Dependent variable: inflation differential to the EU-27. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01. Panel corrected standard error estimations. House price overvaluation (difference of price to income from long-term average) used to proxy for local cost pressures. Similar results for rent overvaluation. Signs agree with found in the literature (see Honohan and Lane (2003) and Beck et al. (2009). Data sources: Eurostat. OECD-AIAS ICTWSS Database for wage bargaining coordination index and Oxford University for the stringency index. For some of the countries, the residuals are relatively large in the period around the global financial crisis, but it is important to note that some of the factors that might have been important then (e.g. share of non-performing loans and indicators of bank distress), have not been accounted for in the model. Balassa Samuelson effects captured by lagged GDP per capita in PPS were not found significant; while the coefficient or the lagged price level had the wrong sign.

Graph Box 1: **Marginal impact of global factor on differentials 2007Q1-2022Q2 – selected countries**



Note: The variables of the model are grouped as follows. **Sources of asymmetric shocks contribution** include the unemployment effect, the output volatility effect, the NEER effect, the share of services and construction effects; the **global factor contribution** includes the combined effect of the global factor and interactions; **the energy intensity and weights contribution** combines the effects from energy intensity (not interacted) and energy weights in HICP; the **labour and housing costs contributions** combines the effects of the costs of local inputs and the bargain coordination effect (zero for this set of countries); **crises contribution** captures the effect of the pandemic (Oxford Stringency Index) and the Russia invasion (accounting for gas imports from Russia); the differential not explained by the model is reported as **unexplained**.

Box 1 (cont.)

Graph 1 illustrates the contributions to their inflation differential vis-à-vis the EU-27 for the seven countries in focus. In summary, for the most recent inflation shock in 2022, the results of this model show:

- A country's energy intensity and the share of energy in the inflation basket are particularly relevant for the seven countries in scope of this assessment, with five countries (Czechia, Estonia, Hungary, Lithuania and Slovakia) having production structures about twice the energy intensity of the EU27 and the remaining two (Latvia and Romania) still larger energy intensity than the EU27. Similarly, for the Baltic states and Slovakia the energy weight in the HICP inflation basket is larger than for other EU countries.
- Czechia: responded significantly to the global inflation shock and there is a significant contribution from the effects of the Russian invasion shock; local input shocks have played a role but appear small relative to other factors, and lower than in previous years.
- Estonia: a significant share of the inflation differential in 2022 cannot be explained by the model; local input costs seem to have little impact on differentials compared to its energy intensity and response to the global inflation shock.
- Hungary: Local input cost pressures seem to contribute in explaining the recent inflation episode. This effect appears higher than in previous inflation episodes. There is though a considerable negative residual.
- Latvia: a significant share of the inflation differential in 2022 cannot be explained by the model; local input costs play a relatively small role according to the estimates, while the biggest contribution comes from exposure to the Russian invasion shock.
- Lithuania: Local input costs pressures seem to play a relatively larger role in this inflation episode; still a significant share of the inflation differential in 2022 cannot be explained by the model.
- Romania: responded significantly to the global inflation shock there is a significant contribution from the effects of the Russian invasion shock; local input shocks have played a very limited role in this period according to the estimates.
- Slovakia: responded significantly to the global inflation shock there is a significant contribution form the effects of the Russian invasion shock; local input shocks have played a role but small relative to other factors, and lower than in previous years.
- According to our results, inflation differentials decrease with the degree of wage coordination above a certain level mitigating inflationary pressure. However, all countries in scope have a degree of coordination below this threshold (see also section 4).

2. INFLATION DIFFERENTIALS AND THEIR IMPACT ON PRICE COMPETITIVENESS

Persistent inflation differentials have the potential to adversely affect competitiveness in higher inflation countries if not matched by productivity gains. This can occur if current inflation differentials become entrenched, particularly in the presence of price-wage spirals. Within a currency union, unwinding inflation differentials may require a structural adjustment process that can be difficult. While non-euro area countries have the option of currency depreciation, it also entails risks, such as further inflationary pressure, an increase in the national currency cost of foreign-currency denominated debt and, possibly a higher risk premium on issuing sovereign debt.[6]

Differences in inflation rates are reflected in real exchange rates, with different measures capturing the impact of different price changes. Real exchange rates aim to compare the relative price of goods in the domestic country and abroad, expressed in the same unit of account. HICP-based measures, for instance, compare the price of consumption baskets and are immediately available. Core inflation-based measures compare the prices of consumer baskets excluding volatile components such as energy and food and can provide an understanding of how broad price pressures may be.[7] In the past, these two measures followed similar patterns, also because commodity price shocks eventually feed through to other inflation components, but the persistence of core inflation can also hint at the presence of second-round effects.

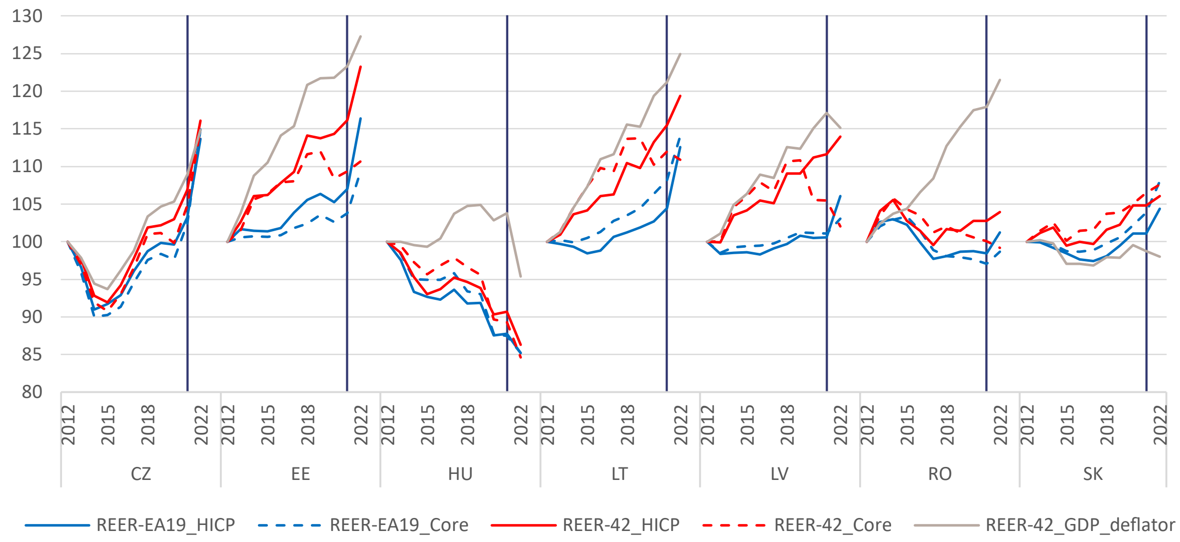
Over the last decade, Czechia, Estonia, Lithuania, and Latvia have seen a marked HICP-based REER appreciation, with more muted increases in Romania and Slovakia and a depreciation in Hungary. Graph 2.1 shows HICP and core REER developments from 2012 to 2022 for the seven countries covered in this note, against both the 42 main trading partners and the euro area. When compared with the 42 trading partners, Czechia, Estonia, Lithuania and Latvia have seen a considerable appreciation over the last decade – in Czechia's case this has been very pronounced in recent years following a real depreciation. Romania and Slovakia have seen more muted increases in their REERs, while Hungary has been marked by nominal and real exchange rate depreciation.

During 2022, the HICP-based REER of Baltic countries and Slovakia appreciated vis-à-vis their euro area trade partners. While over time HICP-based REERs have appreciated more against main 42 trading partners than against euro area partners, this effect was reversed over the last year for the euro area countries. Graph 2.1 shows that, for most of the countries in focus, the HICP-based REER relating to 42 trading partners has appreciated more than the HICP-based REER relating to EA trading partners since 2012. This suggests that competitiveness losses with respect to some non-euro area trading partners were more pronounced. This is particularly the case for Estonia, Latvia, and Lithuania and, to some extent, Romania. However, during the first three quarters of 2022 the opposite effect was true for euro area countries. The nominal depreciation of the euro in the first three quarters of 2022 shielded euro area countries from real exchange rate appreciation against external trade partners. However, internal divergence was visible in rising REERS with respect to euro area partners for Estonia, Latvia, Lithuania, and Slovakia.

[6] Currency depreciation increases the national currency price of imported goods priced in foreign currency, contributing to imported goods inflation. At the same time, it makes domestic exports relatively less expensive in foreign currency, helping to cushion the impact of cost-push pressures on competitiveness. In the short-term, the terms-of-trade effect tends to dominate, leading to a deterioration of the trade balance, while in the medium-to-long-term, it is more likely that substitution effects lead quantities to adjust and to an improvement of the trade balance following the currency depreciation (Marshall-Lerner condition). The Marshall-Lerner condition requires export and import demand to be sufficiently elastic with respect to the real exchange rate (see Krugman, Obstfeld and Melitz, 2023, International Economics: Theory and Policy, Global Edition, Pearson). Currency depreciation also entails other short-term risks, such as increasing the national currency cost of servicing foreign-currency denominated debt and increasing cost of issuing sovereign debt as risk-premia tend to increase.

[7] Energy and food components of the overall price indexes can be quite volatile, and are relatively unaffected by monetary policy decisions, as they are typically strongly influenced by international markets. As a result, central banks use measures of core inflation to better capture the underlying inflation trend (European Commission, 2022).

Graph 2.1: **Real effective exchange rate developments until 2022, Index 2012=100**



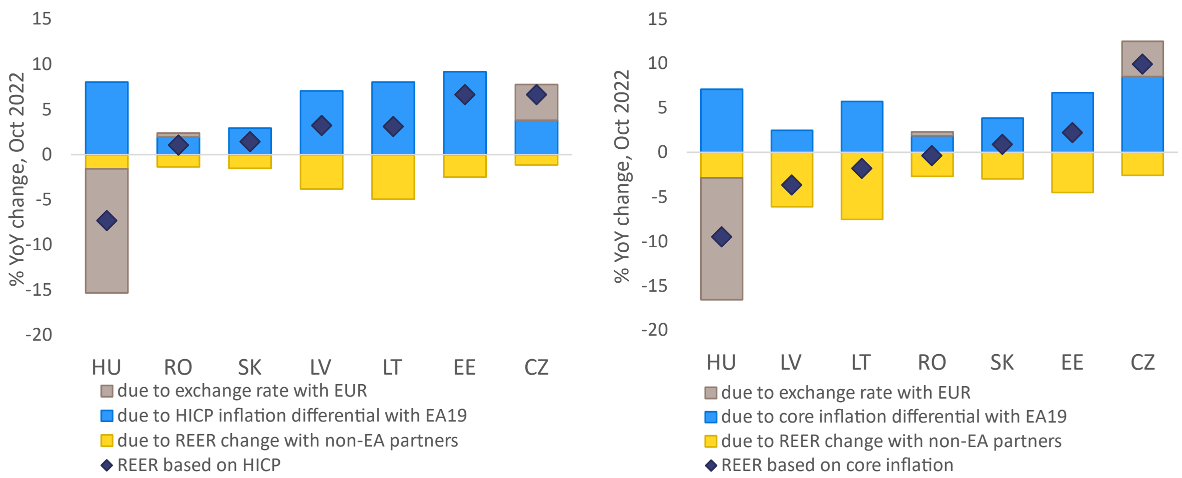
Source: Eurostat.

Notes: The vertical blue line marks 2021.

Vis-à-vis all trading partners, the HICP-based REER increase in 2022 was stronger in Czechia and Estonia (Graph 2.1). Among the seven countries, the HICP-based REER appreciated the most in Czechia and Estonia in 2022; and it continued to depreciate in Hungary, despite strong inflation in 2022, with little differences between the REERs based on overall HICP and core inflation (Graph 2.2). A mild nominal appreciation in Czechia contributed to the relatively strong appreciation of its HICP-based REER. Instead, a strong nominal exchange rate depreciation in Hungary led to a comparatively strong HICP-based REER depreciation, supporting cost competitiveness. However, this depreciation is also likely to fuel inflation dynamics through more expensive imports. The higher inflation in these countries than in the euro area pushed the HICP-based REER upwards, particularly in Hungary, Lithuania, Estonia and Czechia (in blue). The exchange rate developments vis-à-vis non-euro area trading partners (in yellow) supported cost competitiveness in euro area countries, reflecting a weakening of the euro. Changes in nominal exchange rates, had a sizeable impact on the HICP-based REER of the non-Euro Area countries Hungary and Czechia (in grey). REER relative to EU trading partners based on HICP is forecast to appreciate in all seven countries in 2023.

Graph 2.2: **Real Effective Exchange Rate, year on year change, 42 trading partners, 2022**

a) REER based on core inflation b) REER based on HICP



Source: Commission services calculations.

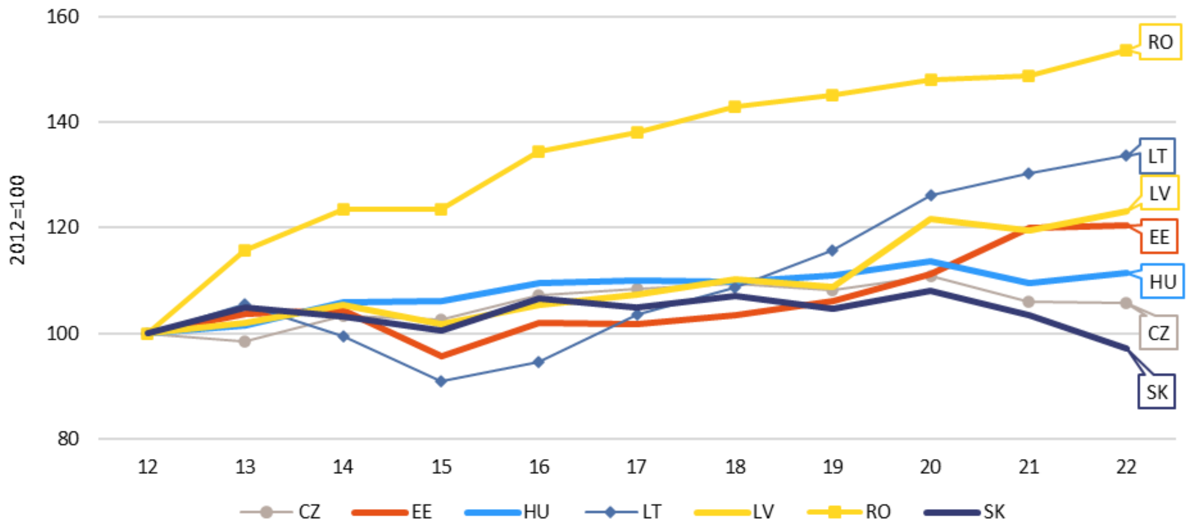
Note: Diamonds represent year-on-year % change in Oct 2022.

Benchmarking HICP-based REERs against fundamentals indicates possible overvaluation in Czechia, Estonia, Slovakia and Romania.[8] Recent research suggests possible overvaluation gaps for the HICP-based REERs of Czechia, Estonia, Slovakia and Romania (Cubeddu et al., 2018). Coutinho et al. (2021) find a significant overvaluation gap for Estonia, Romania and Slovakia in 2018, using REER benchmark models estimated both for REER indexes and REER levels.[9] More recently, the IMF's current account model also points to an overvaluation of Romania's HICP-based REER by 13% in 2021, while for Slovakia, the IMF's HICP-based REER assessment only points to a moderate overvaluation gap. For Estonia, the IMF estimated the HICP-based REER to be overvalued in 2021 when compared to fundamentals, but undervalued by about 8 percent based on their current account model, combined with positive non-price competitiveness developments. Czechia's HICP-based REER was assessed by the IMF to be broadly in line with fundamentals in 2021, based on the current account model, but to be substantially overvalued based on the REER level model. Overall, the HICP-based REERs of Hungary, Latvia and Lithuania's have not been assessed as overvalued, all metrics combined (see IMF article IVs 2022).

[8] Differentials in REER developments across countries that have built up can be absorbed if newly appreciated REERs were undervalued before. The possible misalignment of relative prices can be obtained from "behavioural" empirical models of the real effective exchange rate, which yield measures of relative prices in line with fundamentals. Divergences of actual REERs from such benchmarks indicate a possible misalignment (Mano et al., 2019).

[9] Their REER assessments based on the deviations of the current account from fundamentals only found some overvaluation for Romania. Cubeddu et al. (2018) include in their model the share of administered prices as an explanatory variable. This variable, which was published by the EBRD and has been discontinued, with no close substitute available. This variable was pushing down the REER benchmarks of these group of countries in 2018. The IMF published a more recent analysis, excluding administrative prices from the model.

Graph 2.3**: Export market shares, current prices, 2012=100**



Source: MIP Scoreboard, Eurostat.

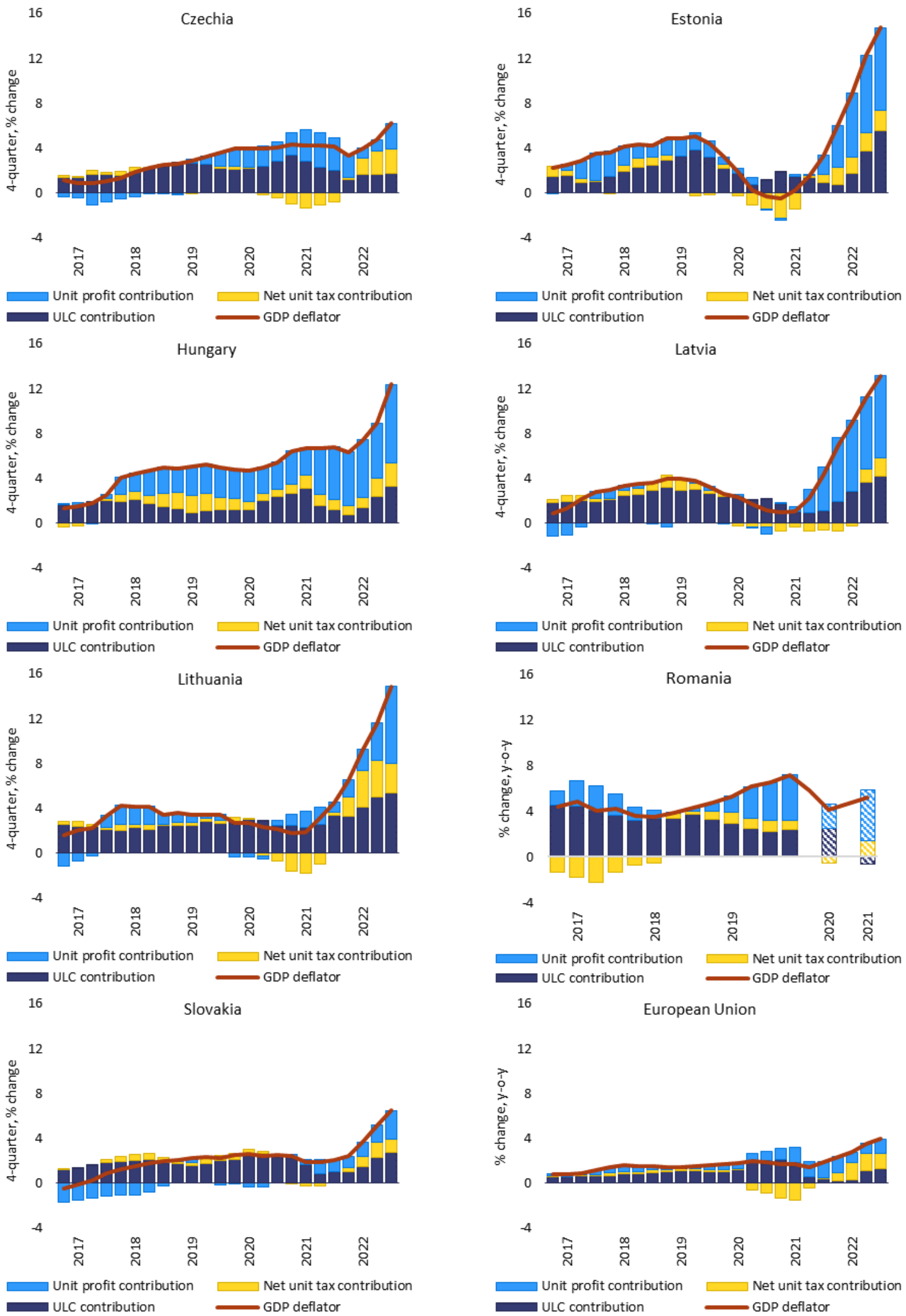
Notes: nominal world export market share.

Despite a trend HICP-based REER appreciation in some countries, export market shares evolved favourably over the past decade. As graph 2.3 shows, export market shares in current prices have increased in most of the seven countries since 2012, with a particularly strong increase in Latvia, Lithuania and Romania. In Hungary these have been accompanied by price competitiveness gains. Instead, in Lithuania and other countries the increase in export market share has taken place despite price competitiveness losses, possibly indicating non-price competitiveness gains amid a successful catching up process and convergence from a low price level (see previous section). However, in some countries export market shares declined in 2022 when measured in volume terms, including in Estonia, Latvia, Lithuania and to a much lesser extent Slovakia.

ULC and GDP-deflator-based REERs are used as alternative measures of price competitiveness and are useful to compare domestic price pressures across countries. ULC based-REERs compare unit labour costs expressed in the same currency. These are analysed in section 4, together with wage developments.[10] GDP-deflator based REERs essentially compare the price of domestic value added measured in the same currency (abstracting from the impact of net taxes). These remain imperfect measures of competitiveness in the sense that they do not differentiate between domestic price pressures affecting tradables and non-tradables, but they purge the effect of import prices from the price comparison. Estimates of GDP-deflator-based REERs are shown in Graph 2.1 and an analysis of recent GDP deflator developments follows below. The largest GDP-deflator based real appreciation since 2012 was recorded in Romania, due to sustained growth in the GDP deflator of 4% or above since at least 2017, as shown in Graph 2.4, but this country started out from a low wage share as analysed in section 4.

[10] Ahn et al. (2020) show that, empirically, ULC based REER are the measures of competitiveness mostly linked with expenditure switching effects following labour productivity shocks, since wage rigidity implies immediate pass-though of productivity shocks to ULC, while the effect on HICP and GDP deflators lag and are more muted due to the presence of non-tradables.

Graph 2.4: **GDP deflator change and decomposition**



Source: DG ECFIN calculations based on Eurostat.

Note: For Romania, quarterly data is only available until 2019Q4; 2020 and 2021 are from annual statistics.

Changes in GDP deflators reveal that local price pressures in some countries, including Estonia, Latvia, Lithuania and Hungary, have been important in 2022. The GDP deflator reflects the cost a unit of domestic value added adjusted for net unit taxes on production. From an income approach to national accounts, changes in the GDP deflator reflect changes in unit labour costs, unit profits and unit (net) taxes. Graph 2.4 shown the percentage change in the GDP deflator and contributions to it, over time, for the seven focus countries and the EU 27. The increase in the GDP deflator has been most noticeable in Estonia, Latvia, Lithuania, and Hungary and although this measure of domestic inflation has started to increase since 2021, it has reached more significant values in 2022.

Changes in unit labour costs seem to play a smaller role in explaining domestic value-added inflation in 2022 in most of the focus countries, when compared to changes in unit profits. Historically, changes in unit labour costs tend to be the most persistent component of changes in the GDP deflators, with profit margins being much more volatile and also playing a cushioning role to increases in unit labour costs during recessions.[11] Since the pandemic, though, there has been a positive correlation in most countries between changes in unit labour costs and margins. This may be the reflection of several factors. One is that inflation has been higher, distorting price signals and enabling firms to increase markups without losing market share. This effect may be more pronounced in countries where firms face lower domestic competition (Graph 2.5a shows the percent change in unit profits in 2022 against the number of firms in industry per thousand persons as a measure of concentration in industry). Another possible explanation is that given the large shocks and uncertainty, firms are building financial buffers. Graph 2.5b the percent change in unit profits in 2022 against the change in NFC debt in 2020, as a measure of the financial buffers accumulated during the pandemic, but there is no clear pattern. Finally, windfall gains by mining, energy producing companies and agricultural producers could also be sufficiently large to explain profit developments in some countries. Some of these profits are being taxed under the EU energy prices emergency regulation and if used to improve energy efficiency could help reduce the exposure of countries to energy price shocks.[12]

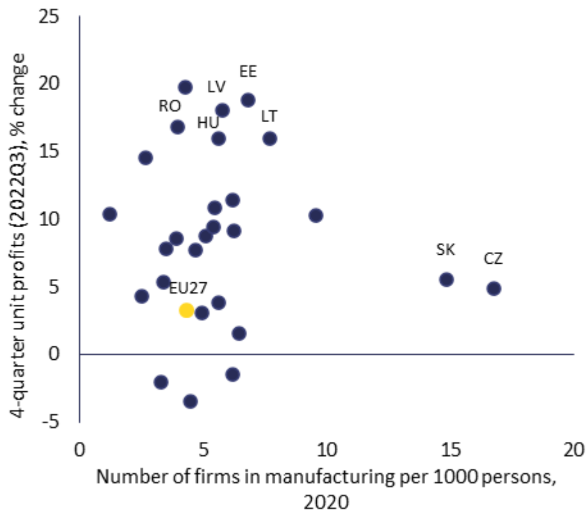
The effect of domestic value-added inflation can be different for export and consumer prices. The next section uses input-output data to analyse in how far consumption, investment and export prices are affected by local versus foreign price pressures.

[11] See analysis of unit profits in the EU in "Inflation in the euro area and the EU", Note to the EWG, February 2023.

[12] https://data.consilium.europa.eu/doc/document/ST-12999-2022-COR-1/en/pdf.

Graph 2.5: **Unit profit growth, firms' concentration, and NFC debt**

a) Unit profit growth and firm concentration in industry



b) Unit profit growth and change in NFC debt

Source: Commission's calculations based on Eurostat, Ameco.

Note: The Unit profit % growth in 2022 has been calculated as the average y-o-y unit profit growth in the first three quarters of 2022 and the fourth quarter of 2021. For Romania, the European Commission's Autumn Forecast was used in the calculations.

3. THE ROLE OF THE ECONOMIC STRUCTURE: THE INFLATION IMPACT OF TERMS-OF-TRADE PASS-THROUGH IN INPUT-OUTPUT-BASED ESTIMATES

A country's productive structure is a key factor affecting how import prices work their way into its inflation rates. Import prices affect national inflation rates directly, as imports form part of the consumer spending. This direct effect can be observed by looking at the components of price indices used to construct different measures of inflation. However, import prices also affect inflation indirectly as they act as inputs into the production process. The extent to which they do so, and the impact this has on inflation, is linked to the productive structure of different countries. Estimating how much of domestic price growth can be explained by changes in imported prices, by sector, is important in order to better understand how imported inflation feeds through to domestic prices. The part of domestic price growth that is explained by changes to import prices can be expected to correct once import prices normalise. However, domestic-origin inflation could be more persistent. These domestic dynamics may be linked to wage growth, expanding profits, or other domestic price pressures. This section presents estimates of the import content of inflation for different expenditure aggregates (private and government consumption, investment and exports) in order to gauge to what extent the high inflation rates seen in the countries covered in this note can be attributed to imported or domestic origin inflation.

Input-output tables can be used to estimate the contribution of imported price increases to domestic inflation. The gross output of any sector or product in an economy is the sum of that sector's value added, plus the cost of domestic inputs, and of imports.[13] The output of an industry in turn may serve one of three purposes: either it is used as an input into the production of other domestic industries, or it is exported, or destined for domestic final demand such as consumption or investment. The formulation of Ghosh (1958) enables output cost to be decomposed into the contribution of import costs and the prices for domestic value added, which consist of domestic wages, operating surplus and mixed income, and taxes. This can be obtained by iteratively feeding the effect of import costs through the production process, following the impact of import costs through the production chain in a country until its final impact of various measures of inflation are estimated. Box 2 describes the data used to undertake this analysis, and Annex 2 provides technical details on the approach used.

Box 2**: using available data to account for industry and country-specific factors in import price pass-though**

Input-output tables can exhaustively explain price growth caused by import price changes and industry-specific value-added deflators. Newly available data can be used to produce good quality estimates of these impacts. Eurostat Figaro input-output tables are available for 64 industries (and product groups) for 2011-2020 for Eurostat Member States. As Figaro tables are in nominal terms ([1]), data on prices and price growth have to be obtained from other sources: for goods imports, trade deflators for specific product groups can be constructed from Eurostat Comext trade statistics (with those product groups accounting for more than 80% of total imports in the EU). The Euklems database provides good-quality data for industry-specific value-added deflators for the period until 2018. For the period 2019-2022, only aggregate value-added deflators are available for the analysis. Annex 1 presents an example of how these data can be combined to produce estimates of the contributions of difference factors to personal consumption expenditure inflation.

[13] The input cost also includes the net effect of indirect taxes and subsidies, which is present in the computation but not mentioned in the text for the sake of brevity.

Import costs and domestic prices have very distinct effects on different measures of inflation. Decomposing import and domestic contributors of inflation shows how import and domestic-origin price changes affect different deflators, such as private consumption and exports deflators. Graph 3 depicts the decomposition of the contribution of different components of import price inflation (energy, food, and other goods) to the percentage change of different price measures for the years 2019-2022. The overall price change is also determined by the contribution of an assumed import-price mark-up and by a residual effect attributed to the contribution of domestic-origin inflation.[14]

The contribution of domestic-origin inflation explains a significant part of the change in domestic consumption prices in the countries covered in the note, as compared with France, Italy, Spain and Slovenia. Graph 3.1a shows the decomposition into the various components for the cumulative increase over 2019-2022 of private consumption expenditure (PCE) prices, for the seven countries that are the focus of the note and France, Italy, Spain and Slovenia. These four countries are included by way of comparison: France, Italy and Spain are included as large euro area countries with high quality data,[15] while Slovenia is included as a peer country within the euro area. The three-year span allows to use 2019 as the base year, but it covers both the effects of the pandemic and of the 2022 energy price shock. The graphs show that while import prices contributed substantially to private consumption inflation in all eleven countries shown in the graphs, the contribution of domestic-origin inflation is greater in Czechia, Estonia, Latvia, Lithuania, Hungary, Romania and Slovakia, than it is in France, Italy, Spain and Slovenia.

While import prices contribute somewhat to observed inflation differentials, the contribution of domestic inflation plays a particular role for Czechia and Romania. In the cases of Czechia and Romania, the impact of import prices does not differ substantially from the impact seen in France, Italy or Spain; the large difference in private consumption inflation is driven by the domestic component of inflation. In the cases of Estonia, Latvia, Lithuania, Hungary, and Slovakia, import prices coupled with an energy-intensive industrial structure contribute more to inflation than in the reference Member States and the import content of production also plays a role. This is particularly the case for Hungary and Slovakia, but also plays a strong role in Estonia, Latvia and Lithuania. However, despite the stronger role of imported inflation, it is the contribution of the domestic part of inflation rather than of imported inflation that explains most of the inflation differentials. The estimated impact of the contribution of domestic-origin inflation varies strongly among focus countries too: the non-EA countries of Czechia, Hungary and Romania display a high contribution from domestic-origin inflation, while the domestic content of inflation is relatively high in Lithuania and rather low in Slovakia, with Estonia and Latvia in between. The estimates suggest that in all focus countries but Slovakia, the contribution from cumulated domestic-origin inflation to PCE price growth exceeds 10 pp, compared to less than 4 pp in the rest of the euro area.

In Czechia, Lithuania and to some extent Hungary, the increase in export prices is directly related to import prices, while domestic factors appear to contribute more to export price inflation in Estonia and Romania, and especially in Latvia. Graph 3.1 c) shows how the contribution of import prices impact the export deflator. In the cases of Czechia, Lithuania and Slovakia, export price increases can be almost exclusively attributed to the contribution of imported inflation, and they also play a role in the case of Hungary.[16] The effect for these countries is likely linked to their integration in European manufacturing supply chains, producing goods exports with a very high import content. In these cases, the dynamics of local wages and mark-ups only play a small role in overall prices and thus do not appear to be significant for export prices.

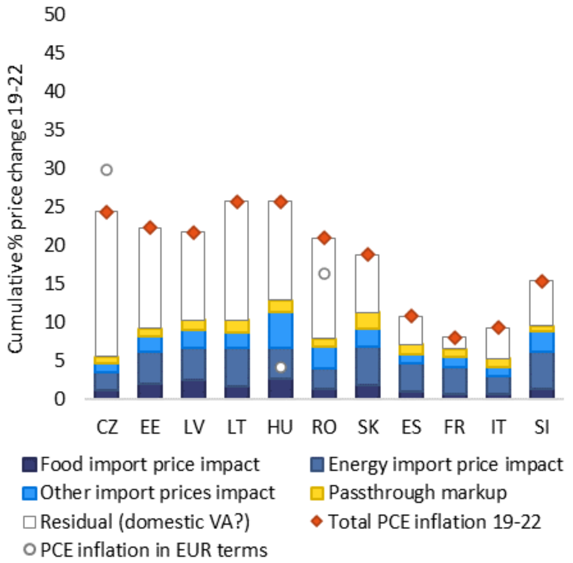
[14] Firms may also differ in their abilities to pass on extra costs on to their customers. With data available so far, it is hard to identify such heterogeneity in 2022 data so far. In the interest of robustness in view of limited observation points, the estimation used here abstracts from such factors and estimates a common pass-through parameter for all industries.

[15] Specifically, Germany does not provide data on gas import prices to Comext, and keeps some other product groups confidential, which limits the ability to provide comparable estimates at this point.

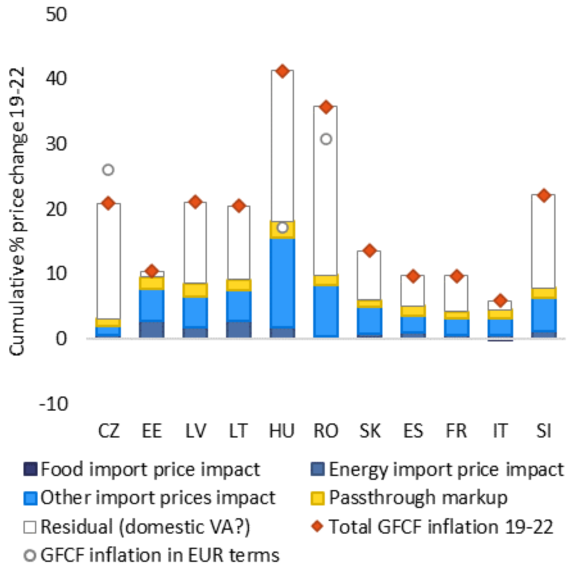
[16] In the case of Lithuania, Graph 3.1c suggests that export prices have increased by less than what can be expected due to the impact of import prices, which also reflects weighting issues in trade data due to the strong role of hydrocarbon imports and exports. Comext data suggest that gas and crude oil imports in Lithuania 2022 had a much stronger weight than for the EU average.

Graph 3.1: **Contribution of import prices to the change of various deflators 2019-2022**

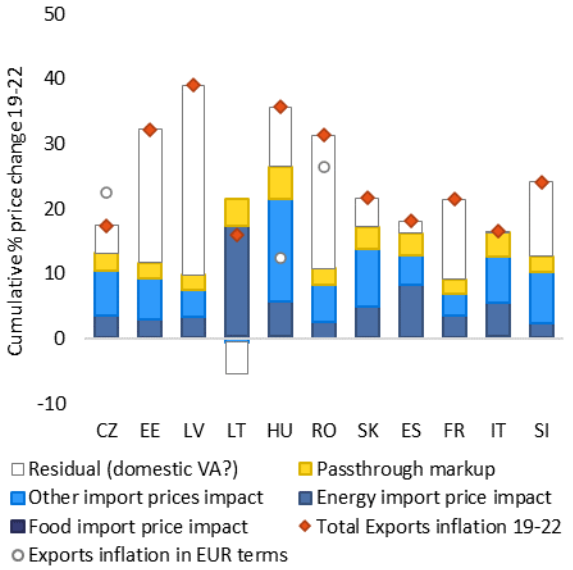
a) Impact of import prices on personal consumption expenditure, 2019-2022



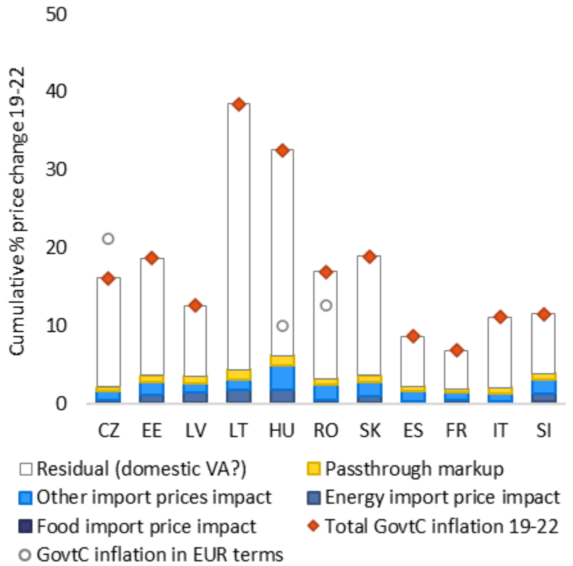
b) Impact of import prices on the investment deflator, 2019-2022



c) Impact of import prices on the export deflator, 2019-2022



d) Impact of import prices on government consumption prices, 2019-2022



Source: Commission's calculations based on the Ameco database

Much of the differential between consumer inflation and export price dynamics can be explained by the differing importance of domestic factor costs to exporting and non-exporting firms. In the cases of Czechia, Hungary and Lithuania export prices mainly reflect import cost, whereas consumer inflation has a relatively strong local component. This is likely linked to the low domestic content of exports, while their consumer price inflation is more related to domestic-origin inflation, indicating a higher domestic value-added content of consumer goods.[17] In Slovakia the contribution of domestic-origin inflation to export price

[17] The annex shows how to account for differing input costs by factoring in local value-added inflation: In both Czechia and Hungary, considering local value added inflation on top of import prices over-explains export inflation 2019-22 by some 9 pp, while it under-

inflation was also negligible, but this component contributed relatively less to consumer price inflation than in the other countries. Conversely, for Estonia, Latvia and Romania, both consumer and export inflation are determined by the contribution of domestic value-added inflation. Better understanding of domestic cost pressures will help judge how lasting these effects may be. To that end, the next section will analyse the growth of wages and unit labour costs.

Investment price increases in Hungary, Romania, Czechia and to a lesser extent Latvia and Lithuania, can be mainly attributed to domestic origins; whereas in Estonia and Slovakia imported inflation seems to mainly drive domestic investment prices. Investment price increases in Estonia and Slovakia are only somewhat higher than for their euro area peers, but in the former, investment inflation seems mainly driven by the contribution of imported inflation (graph 3.1 b)). Price increases for gross fixed capital formation 2019-2022 in Hungary, Romania, Latvia, Czechia, and Lithuania have been among the highest in the EU, most of which cannot be explained by the contribution of import price shocks. When import prices normalise, it can be expected that Estonia and Slovakia will see their investment costs fall, while in Hungary, Romania and Czechia, and to some extent Latvia and Lithuania, an additional adjustment may be needed to bring investment costs back down. Finally, imports play only a minor role for government consumption, which mainly reflects public-sector wages. The government consumption deflator increased strongly during 2019-2022 for six out of the seven countries highlighted in this note, mostly due to the contribution of domestic-origin inflation (with a large weight of public sector wages) rather than to the contribution of changes in import costs. ([18])

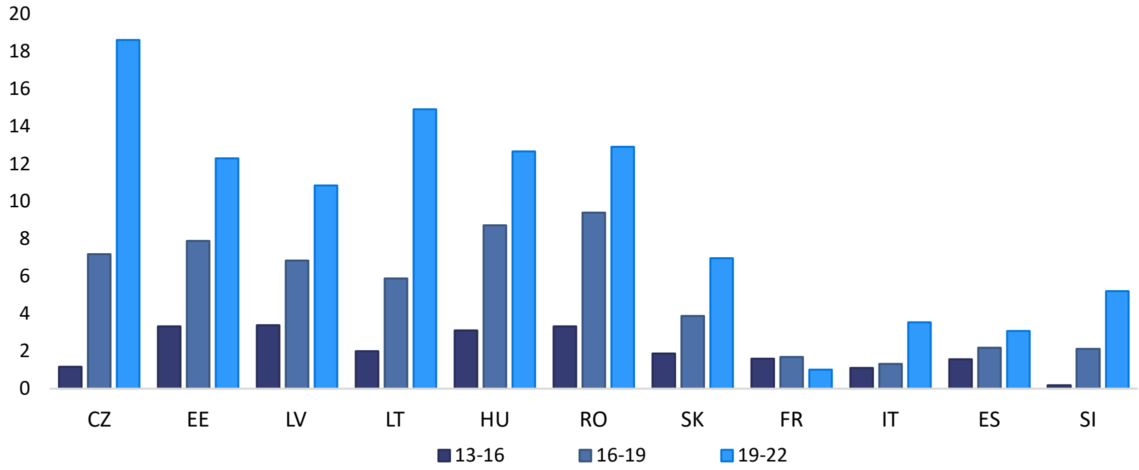
The domestic contribution to inflation has increased markedly for some countries since 2019. Graph 3.2 displays the residual component attributed to the contribution of domestic-origin inflation (shown in Graph 3.1a) for 2019-2022), for the different countries over the time periods 2013-2016, 2016-2019 and 2019-2022. It shows that for all the countries that are the focus of this note, the contribution to inflation that cannot be explained by the contribution of imported inflation has risen in recent years. This unexplained part has increased very strongly in Czechia and Lithuania since 2019. In Estonia, Latvia, Hungary, and Romania, it had already been elevated between 2016-2019, and has continued to rise. While consumer inflation in the other five countries did not accelerate as fast as in Czechia and Lithuania since 2019, the dynamic still exceeds what can be observed in the rest of the euro area and may leave the contribution of 'domestic-origin' inflation at a substantial level going forward.

---

explains PCE inflation. The discrepancy is less strong for other countries except Latvia, where export inflation is under-explained by some 10 pp.

[18] It is important to note that the government consumption deflator is the most difficult to measure due to the presence of non-market and collective services. Such services differ from market services in that they are not sold at a market price and their value at current prices is calculated as the sum of the costs incurred. Those costs are: intermediate consumption, compensation of employees, other taxes less subsidies on production and consumption of fixed capital (Eurostat, ESA 2010).

Graph 3.2: **Private consumption price inflation not accounted for by import costs plus margin**



Source: MIP Scoreboard, Eurostat.

Notes: the bars for 2019-2022 correspond to the gap between the sum of bars and actually observed PCE inflation in Graph 3.1a. The other bars implement the same concept for earlier periods.

Bringing together the results from this analysis enables some tentative conclusions, subject to caveats about the data. Specifically, the analysis presented in this section relies on national accounts data, and the prices used come from trade data. This means that they do not take on board how national policies or structures may change the way that import prices, particularly for energy, translate into actual cost increases faced by firms. Government subsidy schemes can reduce the effective cost increase that firms face. In addition, private expenditure inflation can be understated if governments directly reduce the price faced by consumers. With these caveats in mind, the following tentative conclusions can be drawn**:**

Domestic factors are estimated to contribute significantly to consumer and investment inflation in Czechia, Estonia, Latvia, Lithuania, Hungary and Romania. For these countries, the contribution of import price inflation can explain much less of consumer and investment inflation than in the rest of the euro area. In Czechia and Lithuania, the domestic-origin contribution to inflation increased strongly during the pandemic. In Estonia, Latvia, Lithuania, Hungary, and Romania, the domestic-origin inflation contribution also rose faster than in the euro area and leaves them with a substantial part of inflation that is due to domestic factors.

In Czechia, Lithuania and to some extent Hungary, domestic price pressures seem to have not fed through to export prices so far, while in Slovakia there is limited domestic price pressure for both exports and consumer prices. The limited impact of domestic price pressures on exports of Czechia, Lithuania and Hungary is likely linked to a high import content of exports. In these countries, cost competitiveness concerns are not yet apparent in export prices. For Lithuania, export prices seem not to have risen as fast as what factor costs suggest. In the case of Slovakia, domestic price increases play only a small role for both export and consumer prices. **Conversely in Estonia, and especially Latvia and Romania**, **domestic-origin inflation seems to have contributed to export price inflation to a much larger extent.**

4. LABOUR MARKET AND WAGE DEVELOPMENTS ACROSS THE EU

4.1 DEVELOPMENTS IN WAGES AND UNIT LABOUR COSTS ACROSS THE EU

After a long period of moderate developments, wages started to grow somewhat more rapidly in 2022 in the wake of the inflationary shocks which started in 2021. Wage developments in the EU were generally moderate in the aftermath of the global financial crisis in 2008, including during the labour market recovery of 2013-2019. Wage data were fraught with statistical issues during the pandemic period of 2020-2021, but underlying wage growth remained modest, as suggested by data on base wages and negotiated wages. An acceleration of wage growth, starting from relatively slow rates, started in 2022 in the wake of a strong economic recovery from the pandemic-induced restrictions and a surge in inflation caused by increasing energy and other commodity prices.

Growth differentials in Unit Labour Cost (ULC) matter for competitiveness divergences and the build-up of possible imbalances. Assessing the determinants of the differences in (ULC) developments across the EU helps the assessment of challenges in this respect. ULC measures how much a business pays its workers to produce one unit of output. At aggregate level, it is defined as the ratio between the compensation per employee and the GDP or gross value added per employment. Comparing countries using the same currency, countries with faster wage growth, and/or slower productivity growth, will experience a faster ULC growth, an indication of a loss of cost competitiveness. In turn, comparing countries using different currencies, the impacts of differential ULC growth may be dampened (or exacerbated) by exchange rate developments.

ULC developments can also be decomposed into an inflation component (measured by the GDP deflator) and a component reflecting the change in the wage share (the share of national income paid out as wages).[19] This breakdown is useful to assess whether ULC have risen above inflation due to increases in the wage share, i.e. whether differential ULC developments between countries mostly track inflation differentials or are related to the fact that the real wage growth exceeded productivity growth in one country by more than in its peers. Increase in unit labour costs above inflation are more likely to lead to wage-price spirals as firms have incentives to increase prices further to recover their margins.

Over 10 years to 2022:

- **ULC increased faster in the countries covered in this note than in the EU or euro area aggregates.** In particular, ULC increased strongly in Estonia, Lithuania, Latvia (between 6% and 8%) and Romania (about 6%), followed by Czechia, Hungary, and Slovakia (around 4%). These growth rates are significantly faster than the average annual ULC growth of about 2% in the EU and the euro area (Graph 4.1a).
- **The differential ULC developments can for the most part be associated with inflation differentials, as wage shares have remained relatively constant.** The countries with the fastest ULC growth were also among the countries with the fastest inflation (as measured by the GDP deflator) over the 10 years to 2022. In particular, in Hungary and Romania, prices increased by an average of about 6% between 2012-2022 as compared to an average annual inflation of about 2% in the EU and the euro area (Graph 4.1a). Annual average inflation was close to or above 4% also in Estonia, Lithuania, and Latvia, between 3-4% in Czechia, but close to the euro area average in Slovakia.

[19] As ULC=w*(L/Y), where w denotes nominal wages, L labour inputs, Y real GDP (so that Y/LY is labour productivity) ULC can also be expressed as ULC=p*wageshare where wageshare=(w*L)/(p*Y) and p is the GDP deflator. This means that the percentage change in ULC is approximately equal to the sum of inflation (as measured by the GDP deflator) and the percentage change in the wage share.

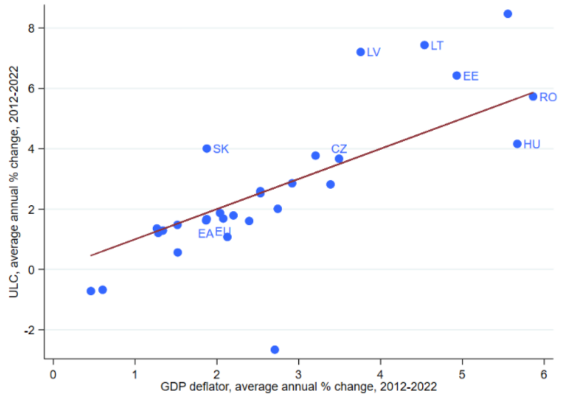
- **In some cases, increases in the wage share implied ULC growth above inflation, particularly for countries with a low initial wage share.** In particular, an increase in the wage share could be observed in Estonia, Latvia and Lithuania, which also displayed the fastest ULC growth (Graph 4.1b), as well as in Slovakia. The wage share in these countries was among the lowest in the EU 2012; below 50% in all of these cases, as compared to an EU and euro area average close to 55% (Graph 4.1e). In contrast, the wage share fell in a majority of Member States as well as in the EU and euro area aggregates (Graph 4.1b).

For what concerns developments observed over the last three years:

- **Differentials in ULC growth are proportional to inflation differentials for the countries covered in the note.** Over period 2019 to 2022, ULC growth has been fastest in Latvia (by about 9% on average per annum), followed by Estonia, Hungary and Latvia (between 6% and 8%), as compared to EU and euro area averages between 2% and 3% (Graph 4.1c). Fast ULC growth was accompanied by fast inflation in all cases, ranging from around 6.5% in Latvia to about 8.5% in Lithuania, as compared to the EU average close to 3.5% (and a euro area average of about 3%).
- **Changes in the wage share between 2019 and 2022 displayed more mixed effects, and were not associated with ULC growth in the same way as in previous years.** The relationship between ULC growth and changes in the wage share has become weaker over the last three years (Graph 4.1d) than over the longer time frame (Graph 4.1b). Latvia and Slovakia continued to display increases in the wage share over the last three years, following rises over the ten-year time horizon. In turn, the wage share remained stable in Lithuania and fell in Estonia and Hungary (Graph 4.1d). The most significant increases in the wage share occurred in countries where it started out at a low level, such as Slovakia. Romania, which also started out with a low level, saw its wage share decrease (see Graph 4.1f).

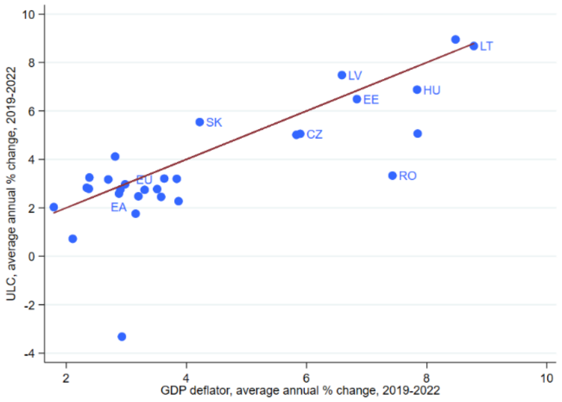
Graph 4.1: **ULC, wage share and inflation**

a) ULC, % change and inflation (% change in GDP deflator), 2012-2022

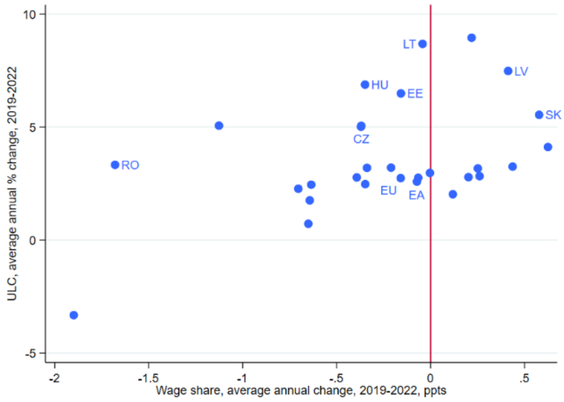


b) ULC, % change and change in wage share, 2012-2022

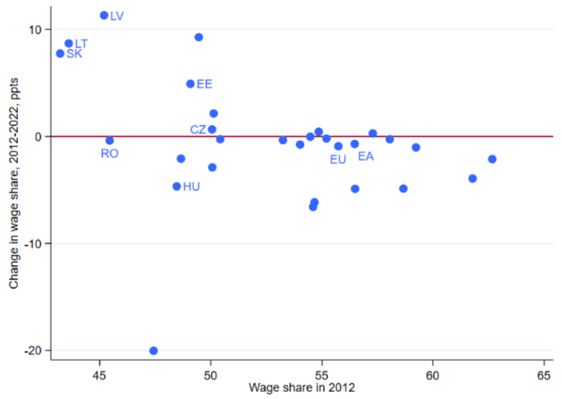
c) ULC, % change and inflation (% change in GDP deflator), 2019-2022



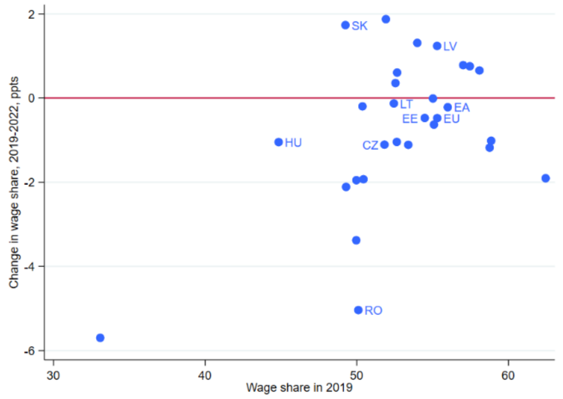
d) ULC, % change and change in wage share, 2019-2022



e) Wage share in 2012 and its change between 2012-2022



f) Wage share in 2019 and its change between 2019-2022



Note: a, c: The diagonal line reflects a situation in which ULC growth is equal to inflation.

Source: DG ECFIN calculations based on data from the AMECO database.

4.2 INSIGHTS FROM COMPARING ACTUAL WAGE GROWTH WITH BENCHMARKS

Comparing actual wage growth to benchmarks help processing information in a consistent manner. In particular, comparing actual wage growth to these benchmarks can help one to answer questions such as whether wage growth contributes to an improvement or deterioration of certain indicators of external competitiveness; or by showing whether wage growth is faster or slower than would be expected based on economic fundamentals. Wage benchmarks presented in this section are not normative; they do not represent an optimal rate of wage growth, but wage growth that reflects certain hypotheticals.

Two benchmarks are considered: the first is related to external competitiveness. This "external wage growth benchmark" is the hypothetical rate of wage growth which would leave the real effective exchange rate (REER) constant.[20]

Some Member States have experienced wage growth above the rate that would have kept their real effective exchange rate (REER) constant, resulting in a real appreciation. Comparing the external benchmark to actual wage growth shows that countries including Czechia and Lithuania experienced the most significant real appreciation (deviation from the benchmark of constant REER) both over the pre-pandemic (2018-2019) and the pandemic (2020-2021) periods (Graph 4.2a). In contrast, Hungary experienced a moderate real depreciation over both periods. Going forward, the continuation of significant real appreciation is forecast for a number of countries. In particular, over the three years 2022-2024, a real appreciation of at least 10 ppts is forecast for Czechia, Estonia and Latvia (Graph 4.2b).

The second benchmark reflects expected wage growth based on fundamentals of the domestic economy. These fundamentals include the inflation rate, economic growth and unemployment. This domestic wage growth benchmark is calculated based on a panel regression analysis of wage developments across EU Member States over the period 1995-2021.[21]

Some countries exhibited wage growth above the rate that can be explained by developments in the domestic economy over both the pre-pandemic (2018-2019) and the pandemic (2020-2021) periods. The cumulative gap is highest for Estonia, Latvia and Lithuania (Graph 4.2c). However, in 2022 and 2023, wage growth is expected to fall short of the domestic benchmark since it is expected to make up for only part of the inflationary shock.[22]

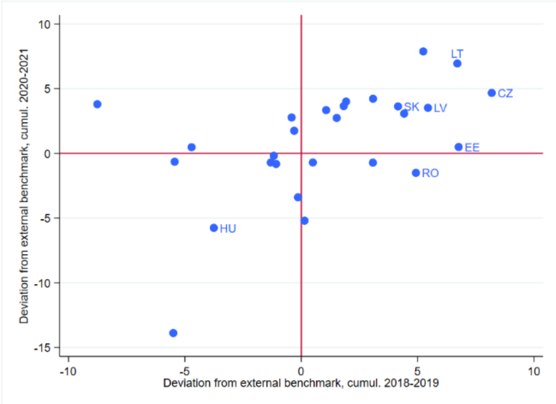
[20] The REER used in this analysis is based on unit labour costs (ULC), and is calculated in comparison to the EU-27. The ULC-based REER is an auxiliary indicator in the MIP scoreboard, while the REER calculated based on consumer inflation is among the headline indicators. Wage benchmarks, including the external one, have been presented in European Commission (2013), "Benchmarks for the assessment of wage developments", European Economy, Occasional Papers, No. 146, URL: http://ec.europa.eu/economy_finance/publications/occasional_paper/2013/pdf/ocp146_en.pdf, revised and updated by European Commission (2015), "Benchmarks for the assessment of wage developments: Spring 2015", Analytical Web Note 2/2015, URL: http://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=7799.

[21] This domestic benchmark has been proposed by European Commission (2018), "Labour market and wage developments in Europe: Annual Review 2018", URL: https://ec.europa.eu/social/BlobServlet?docId=20229&langId=en.

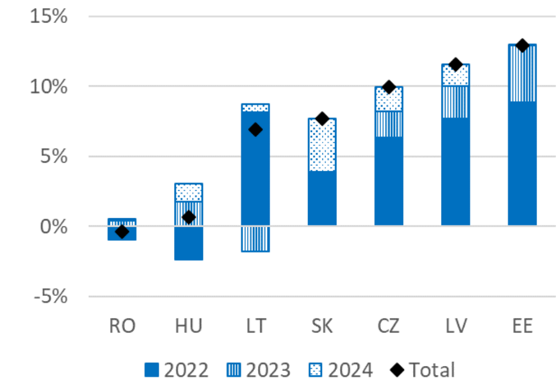
[22] See also: European Commission (2022), "Labour market and wage developments in Europe, Annual Review 2022", Chapter 2, Directorate-General for Employment, Social Affairs and Inclusion.

Graph 4.2: **Wage benchmarks**

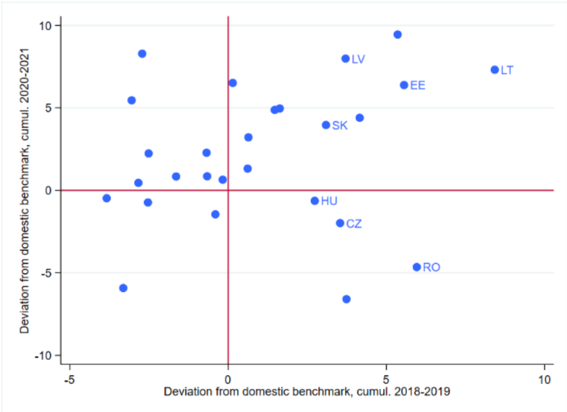
a) Cumulative deviations from the external benchmark, pre-pandemic versus pandemic period



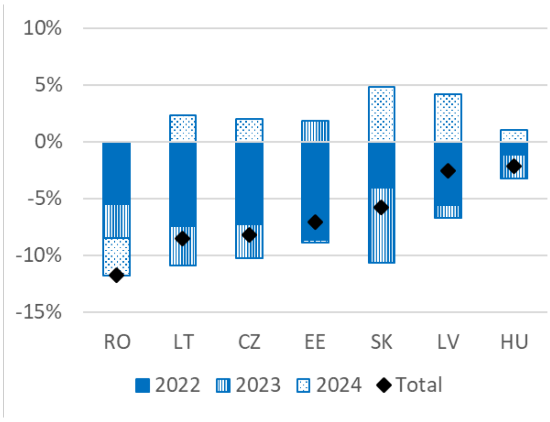
b) Cumulative deviations from the external benchmark, 2022-2024, forecast



c) Cumulative deviations from the domestic benchmark, pre-pandemic versus pandemic period



d) Cumulative deviations from the domestic benchmark, 2022-2024, forecast



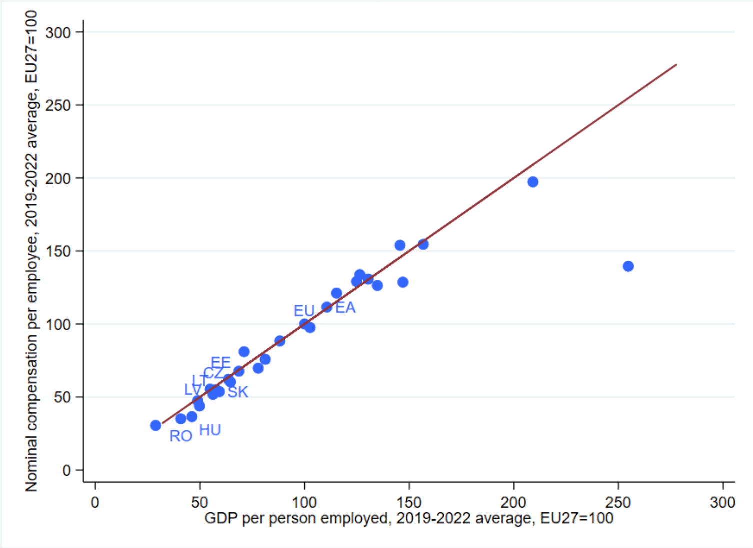
Source*:* DG ECFIN calculations based on data from the AMECO database.

Some differences in wage growth between countries may reflect long-term convergence. While wage benchmarks compare wage growth to contemporaneous inflation and other indicators, they may not take into account some aspects of long-term convergence. Member States vary in terms of wage levels from about 30% of the EU average to about 200% (Graph 4.3).[23] These differences closely reflect differences in income per capita and therefore productivity (which range from about 30% of the EU average to over 200%). These gaps also partly reflect differences in the cost of living between countries. In countries that registered the fastest ULC growth in the last ten years (including Estonia, Latvia and Lithuania), the wage level relatively closely corresponds to productivity (both expressed relative to the EU average). In some countries with volatile wage growth in recent years, relative wage levels are behind relative productivity (notably by about 20% in Hungary and 14% in Romania). Faster productivity and wage growth in some countries with relatively low levels has resulted in some economic and wage convergence in recent years.[24]

[23] These figures are based on the average of the years 2019 to 2022, with the comparison made in current euro, not corrected for differences in purchasing power.

[24] See, e.g., European Commission (2018): "Labour market and wage developments in Europe: Annual Review 2018", Chapter II.2.

Graph 4.3: **Nominal compensation and productivity, as % of EU average, 2019-2022 (average)**



Source*:* Commission services based on the AMECO database.

4.3 THE RELATIONSHIP BETWEEN PAST WAGE GROWTH AND WAGE-SETTING INSTITUTIONS

Wage developments are affected by wage setting institutions, which show a significant variety across countries. This section surveys how collective bargaining institutions, and developments in public wages and minimum wages may have contributed to recent wage developments.

There is a significant variety of collective bargaining frameworks and institutional settings across Member States, which may affect wage outcomes.[25] Collective bargaining systems can be described along multiple dimensions.

- One crucial dimension is the dominant level of wage negotiations, i.e. whether collective bargaining takes place overwhelmingly at the central (national), industry (sectoral), or enterprise (company) level. While there is a range of different levels at which wage negotiations take place in the EU, the countries covered in this note are characterised by the dominant level of collective bargaining being either the company level or the company and industry levels (see rows of Table 4.1).
- Bargaining frameworks can differ also with respect to the degree of coordination. Generally, collective bargaining tends to be more coordinated the more it is centralised, but the relationship is not one-to-one (Table 4.1). Bargaining coordination matters especially in periods of high inflation, as a coordinated bargaining framework helps social partners in their ability to take into account trade-offs between wage growth and employment.[26] Countries with relatively fast recent wage growth are generally characterised by a low degree of bargaining coordination (i.e., “fragmented wage bargaining” or, as in the case of Estonia and Slovakia, “some coordination”; see columns of Table 4.1).
- Finally, another very important indicator of national systems is collective bargaining coverage, i.e., the share of workers covered by collective wage agreements. EU Member States show a wide variety

[25] For an overview of collective bargaining systems and their labour market impacts, see OECD (2019): “Negotiating Our Way Up: Collective Bargaining in a Changing World of Work”, OECD Publishing, Paris.

[26] Coordinated systems, including those characterised by “organised decentralisation”, have been found to be linked with higher employment and lower unemployment (also for young people, women and low-skilled workers) than fully decentralised systems, while predominantly centralised systems with no co-ordination appear to be somewhat in between. See OECD (2018): “OECD Employment Outlook 2018”, esp. Chapter 3, OECD Publishing, Paris.

also in terms of collective bargaining coverage, while in the Member States in the focus of this note collective bargaining coverage remains below the EU median (see Graph 4.4).

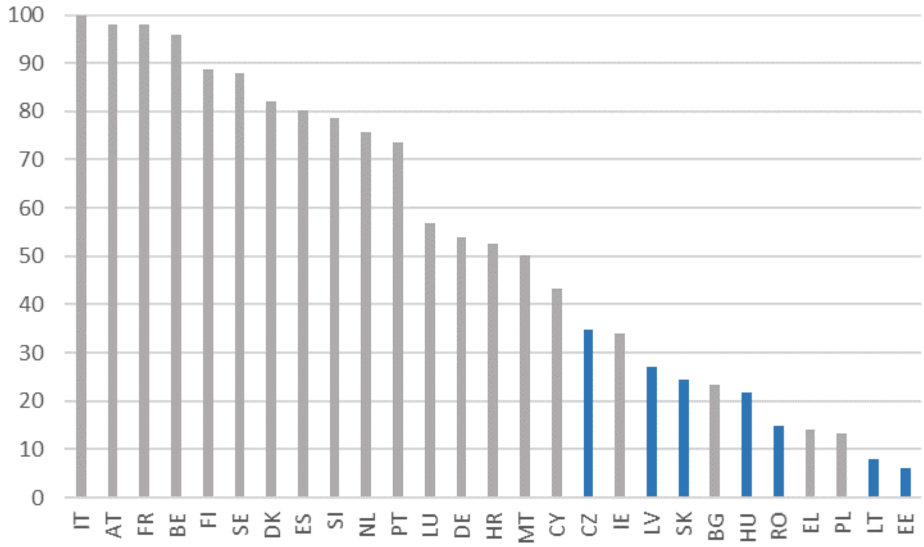
Table 4.1: **The predominant level at which wage bargaining takes place, 2019**

		Coord: Coordination of wage setting				
		5	4	3	2	1
Level: The predominant level at which wage bargaining takes place		Binding norms	Non-binding norms and / or guidelines	Procedural negotiation guidelines	Some coordination	Fragmented wage bargaining
5	Central					
4	Central and industry	BE				
3	Industry (sector)		AT, DE, DK, NL, SE	ES, FI, IT	FR, PT, SI	
2	Industry and enterprise				CY, HR, LU, **SK**	BG, **CZ,** EL**, RO**
1	Enterprise (company)				**EE,** IE	**HU, LT, LV,** MT, PL

Note*:* The dominant level of collective bargaining over wages is defined in terms of the coverage of agreements negotiated, i.e., the level at which agreements cover most workers. **Source***:* OECD-AIAS ICTWSS Database, variables *Level* and *Coord*.

Institutional factors do not seem to explain fast wage growth in these seven countries. As underlined in the previous section, macroeconomic fundamentals, including high inflation, partly explain fast wage growth. At the same time, it is unlikely that the features of collective bargaining would have been a main contributor to the high wage growth. In these economies, most wages are set by private contracts and, to a smaller degree, company-level collective agreements. In particular, in Estonia, Hungary, Latvia, and Lithuania, collective bargaining predominantly takes place at the company level, while in Czechia, Romania and Slovakia, the company and sectoral levels share the dominant role. Collective bargaining coverage remains below 40% in all of these countries and in a number of cases below 20% (see Graph 4.4).

Graph 4.4: **Collective bargaining coverage in the EU, 2019 (or latest available year)**



Note: Collective bargaining coverage is defined as the number of employees covered by collective (wage) agreements in force as a proportion of all employees with the right to bargain (in turn defined as the proportion of employees who are not excluded from collective bargaining). Information reflects 2019 or the latest available year (oldest information from 2015).

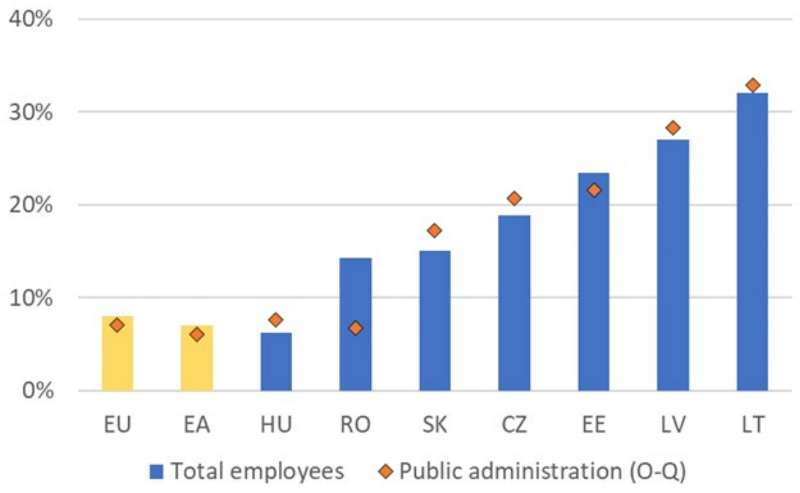
Source: OECD-AIAS ICTWSS Database, AdjCov (or, if not available, AdjCov_s) variable.

Over the pandemic period, public wage growth fell somewhat short of that of average wages in the EU. Rapid increases in public wages can exert a pressure on wages in the rest of the economy as well, thus having potential implications for competitiveness.[27] Between 2019-Q2 and 2022-Q2, nominal compensation per employee increased in the public sector by about 7%, as compared to 8% for the whole economy in the EU (Graph 4.5). While in the past, public wages were found to be a factor driving general wage developments in Romania,[28] over this period, public wages grew significantly below general wage developments. Among the other countries in the focus of this note, public wages kept pace with general wage developments in Czechia, Hungary, Latvia, Lithuania, and Slovakia, while they lagged slightly behind general wage developments in Estonia (Graph 4.5).

[27] See, e.g., Marzinotto, B. and A. Turrini (2017): "Co-movements between public and private wages in the EU: what factors and with what policy implications?" *IZA Journal of European Labor Studies* 6, 2.

[28] See European Commission (2022): "In-depth review for Romania", SWD(2022) 638 final.

Graph 4.5: **Change in nominal compensation per employee, total and public employees, 2019-Q2 to 2022-Q2**



Source: Eurostat. Compensation of employees [namq_10_a10], current prices, million euro. Per capita adjustment by, respectively, total and public employment [namq_10_a10_e]. Compensation seasonally and calendar adjusted where possible. Public employment as O-Q in NACE Rev. 2: "Public administration, defence, education, human health and social work activities".

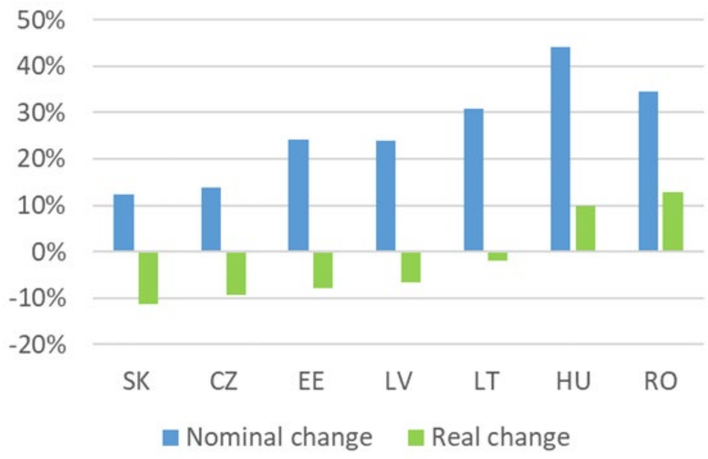
Minimum wages rose significantly in nominal terms in the two years to January 2023 but in real terms they fell in many Member States. While the share of minimum wage earners may be relatively low, minimum wage developments may affect the wages of a broader set of workers through spill-over effects.[29] Member States with a statutory national minimum wage raised their rates between January 2021 and January 2023 by an average of about 19%.[30] About two-thirds of this average increase occurred in the second half of the period when inflation was higher. Despite significant nominal increases, real minimum wages fell in a majority of Member States including a number of countries with rapid overall wage growth (Graph 4.6). This means that minimum wage increases were in many cases not sufficient to protect the real incomes of low-wage earners, which are those suffering the biggest reduction of purchasing power because their consumption basket is more affected by energy and food.[31]

[29] The share of people earning close to the minimum wage was estimated to be close to 12% in EU Member States in 2017, ranging from below 5% to around 20% (e.g. in Romania) among countries with a statutory national minimum wage. See European Commission (2020): Impact assessment accompanying the proposal for a Directive on adequate minimum wages in the European Union, SWD (2020) 245 final, see in particular Annex 7.

[30] Calculations based on Eurostat data of monthly gross minimum wages in local currency [earn_mw_cur].[31] See, e.g., D. Villani, and G. Vidal Lorda, (2022): "Whom does inflation hurt most", European Commission, JRC-129558. See also: European Commission (2022), "Labour market and wage developments in Europe, Annual Review 2022", Chapter 2, Directorate-General for Employment, Social Affairs and Inclusion.

[31] See, e.g., D. Villani, and G. Vidal Lorda, (2022): "Whom does inflation hurt most", European Commission, JRC-129558. See also: European Commission (2022), "Labour market and wage developments in Europe, Annual Review 2022", Chapter 2, Directorate-General for Employment, Social Affairs and Inclusion.

Graph 4.6: **Minimum wage increases, nominal and real terms, Jan. 2021 to Jan. 2023**



Note: Rate of change between January 2021 and January 2023. Change is calculated based on monthly gross minimum wage figures and the Eurostat HICP monthly index (2015 = 100).

Source: Eurostat [earn_mw_cur, prc_hicp_midx], DG ECFIN calculations.

4.4 DETERMINANTS OF THE RISK OF WAGE-PRICE SPIRALS

Wage-price spirals are generally defined as situations in which an inflationary shock becomes entrenched because higher price inflation feeds higher wage inflation, which in turn fuels price inflation via second-round effects.[32] Wage-price spirals are likely to be set in motion when inflation expectations become de-anchored.[33] The fact that observed wage increases are generally significantly below current inflation suggests that the wage outcomes reached in most recent wage agreements so far reflect the expectation that the current spike in inflation is temporary. If new wage contracts continue incorporating the expectation of falling inflation, wage growth is set to moderate over time. The fact that collective wage agreements, where present, are often concluded for multiple years and not all agreements are negotiated at the same time implies that wages can react to changing economic circumstances with a time lag, gradually, and with persistent dynamics. This also means that wages are expected to become a factor that contributes to the dynamics of underlying inflation in the coming years.

Recent assessments conclude that the risk of wage-price spirals setting is limited in the current context.[34] Wage-price spirals have become less likely events over time, thanks to the more effective anchoring of inflation expectations and the more limited use of ex-post wage indexation. Currently, wage setting across the euro area takes place mostly on the basis of expected inflation, while ex-post automatic indexation to inflation plays a relevant role only in a handful of countries.[35] Going forward, the weakening of

[32] Wage-price spirals are of particular concern when inflation shocks coincide with terms of trade shocks, the typical case when inflation shocks originated from higher prices of imported energy. In such cases, real income losses are inevitable, despite the attempts to recover purchasing power losses via a sequel of price and wage increases.

[33] E.g., IMF (2022): "Word Economic Outlook", October 2022, Chapter 2.

[34] See, e.g., European Commission (2023): "Euro area labour markets – Recent developments and challenges ahead", Technical note to the Eurogroup. See also: ECB, "The prevalence of private sector wage indexation in the euro area and its potential role for the impact of inflation on wages", Economic bulletin, issue 7/2021; F. Boissay, F. De Fiore, D. Igan, A. Peirres Tejada, and D, Rees, "Are major advanced economies on the verge of a wage-price spiral?", BIS Bulletin 53, 2022; IMF, *op. cit.*; European Commission (2022), "Labour market and wage developments in Europe, Annual Review 2022", Chapter 2, Directorate-General for Employment, Social Affairs and Inclusion.

[35] See the database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (ICTWSS) by the Amsterdam Institute for Advanced Labour Studies (AIAS) and the OECD. Wage contracts subject to ex-post indexation are estimated to

the economic situation, reduced labour market tightness, and the difficulties for firms to square high energy prices with wage hikes, is expected to contribute to moderate wage bargaining outcomes. Nonetheless, demands for compensation of past purchasing power losses may increase as cumulative losses mount.[36]

In countries which have experienced the fastest wage growth recently, some institutional factors may limit the risk of wage-price spirals. Decentralised collective bargaining limits the role of potential large wage increases in individual collective bargaining agreements on overall wages developments. At the same time, the limited extent of coordination of wage bargaining may partly explain the strong response of wages to the inflationary environment despite possible negative employment effects. In addition, wage setting arrangements in these Member States do not include automatic indexation clauses. At the same time, in some cases, de-anchoring inflation expectations might affect wage developments, especially in Member States not using the euro. Hungary and Romania are among those with the highest inflation recorded in the last three years (Graph 4.1c), although in both cases, compensation growth remained below inflation between 2019 and 2022, resulting in a reduction of the wage share (Graph 4.1d).

The mechanisms to set wages in the public sector and minimum wages may also affect the temporal profile and persistence of the reaction of wages to the current inflationary shocks. While wage growth in the public sector lagged behind wage developments in the total economy in the EU average, it was somewhat ahead of general wage developments in some countries with the fastest wage growth observed in recent years, including in Czechia, Hungary, Latvia and Lithuania. This does not indicate that wage growth is driven by public wages in these countries. Minimum wage increases may also contribute to general wage developments. In Romania, minimum wage increases have been found to be volatile, decided based on mechanisms not based on objective criteria.[37] While minimum wages significantly increased in most countries, the increases remained below inflation in all seven countries in the focus of this note except Hungary and Romania between January 2021 and January 2023.[38] All in all, it does not appear that public wages and minimum wages have contributed so far to risks of wage-price spirals.

---

be around 20% of the total across the euro area (See also ECB, 2021, *op. cit.*, and ECB (2022), "Public wage and pension indexation in the euro area", Economic Bulletin, Issue 1/2022).

[36] The prevalence of wage contracts including ex post indexation in the US rose from about to 20% of the total in the 1960s to about 60% after the oil shock in the 1970s (see Boissay et al., *op. cit.*). The ECB June 2022 Staff Projections sees wage growth falling over the forecast horizon in a baseline scenario, while in an alternative scenario characterised with a higher degree of ex-post wage indexation wage growth and HICP growth would be more persistent.

[37] See, e.g., European Commission (2022): "In-depth review for Romania", SWD(2022) 638 final, European Commission (2018): "Country Report Bulgaria 2018", SWD(2018) 201 final. The Directive 2022/2041 of 19 October 2022 on adequate minimum wages in the EU requires Member States to have clear criteria to set and update their statutory minimum wages. In its RRP, Romania has committed to introduce a formula based on objective criteria for setting and updating its statutory minimum wage.

[38] Minimum wage updates take place according to a formula-based way in almost half of the countries with statutory minimum wages. See Eurofound (2019): Minimum wages in 2019: Annual review (europa.eu).

5. CONCLUSIONS

This note analyses the sources of EU inflation differentials and possible implications for competitiveness. It has a particular focus on Czechia, Estonia, Latvia, Lithuania, Hungary, Romania and Slovakia, which were highlighted in the Alert Mechanism report as potentially having developed vulnerabilities linked to price competitiveness in view of pronounced inflation differentials.

The analysis shows that the recent surge in inflation is to a significant extent driven by the increase in commodity prices, namely energy and food. The focus countries are particularly exposed to energy and food price shocks, due to their higher energy intensity and in some cases higher weights for energy and food in their HICP baskets. As energy and food inflation tend to be higher and more volatile, these characteristics explain in part inflation differentials with respect to the euro area and the large responsiveness to commodity price shocks. In this context, the transition to greener economies is important to reduce vulnerability to fossil fuel price shocks, which are likely to be more frequent and persistent. Furthermore, ensuring the continuous implementation of Recovery and Resilience plans and notably of investments and reforms focused on facilitating the green transition, as well as rapid agreements on complementary reforms and investments under the RePowerEU chapter are of particular importance.

However, domestic price pressures have also played a role in increasing inflation. Some domestic factors could be persistent and may result in competitiveness losses. In some cases, domestic cost pressures affect domestic and export prices in different ways, with lower risks to export competitiveness, but leading to higher import substitution. Assessing the overall impact on external competitiveness is difficult, not least because the impact of the energy price shock is still unfolding and there no clear view as to the duration and magnitude of the shock. With these caveats in mind, the analysis presented in the note allows for a few tentative conclusions.

Input-output analysis indicates that domestic-origin inflation contributed to consumer price inflation in Czechia, Estonia, Latvia, Lithuania, Hungary and Romania, and to a lower extent in Slovakia. For these countries, import price dynamics can explain less of consumer and investment price inflation than in the (rest of the) euro area. The estimated domestic contribution to consumer inflation, which from an income perspective reflects compensation of employees, profits and net taxes, rose in all seven countries over recent years, and had exceeded that of euro area peers already before the pandemic. In the period 2019-2022 the domestic contribution to consumer inflation rose faster than in other euro-area countries, and particularly strongly in Czechia and Lithuania.

In Czechia, Hungary and Lithuania, domestic price increases play a substantial role in explaining consumer inflation, but do not seem to have fed through to export prices so far. This may indicate a substantial import content in their exports. Therefore, cost competitiveness concerns are not yet apparent in export prices. In the case of Slovakia, domestic price increases play only a small role in the increase in export prices, but this is also the case for domestic consumer prices.

Among Czechia, Hungary and Lithuania, positive gaps to wage benchmarks have been observed both pre- and post-pandemic for Czechia and Lithuania. Despite wage increases not standing out for Czechia, they are in excess of those consistent with external cost competitiveness and a ULC-based REER appreciation that has been underway recently and is forecast over the near future. For Slovakia, recent wage growth has been above that consistent with the external competitiveness, and the UCL-based REER has started to appreciate. With some analysis pointing to the existence of REER overvaluation for both Czechia and Slovakia, the possibility of domestic price increases feeding into external prices cannot be excluded and could entail competitiveness effects that do not appear to be there at present. Finally, Lithuania has had the strongest increase in unit labour costs over the last decade. The increases in wages in Lithuania have exceeded those required to maintain ULC-based REERs constant, as well as what can be explained by developments in the domestic economy over both the pre-pandemic and the pandemic periods, and are forecast to continue to generate a ULC-based REER appreciation. While REERs have appreciated consistently over the last decade, Lithuania did not appear to have an overvalued HICP-based REER by 2021. Taken together, these factors point to the ability of the Lithuanian economy to absorb these increases, so far. It is important to note that the developments seen in these countries should be considered alongside developments in housing markets and trade balances, as strong domestic price increases reflecting domestic demand can result in widening trade deficits and a build-up of external debt. Export market shares for these countries have been increasing in value terms since 2012, but in volume terms have declined in 2022 in the case of Lithuania.

In Estonia, Latvia and Romania, the contribution of domestic-origin inflation to changes in export prices is stronger. Wages have been growing strongly in Estonia and Latvia, but have been more in line with fundamentals in Romania. Estonia and Latvia have seen strong unit labour cost growth both over the last few years, and the last decade. Both have shown wage growth in excess of that consistent with constant external ULC-based competitiveness and this is forecast to continue at a strong rate this year. In the case of Romania, unit labour cost growth had been sustained over the last decade, but not to the detriment of export market success so far, despite some evidence of REER overvaluation.[39] Although prices and expected future price changes may likely have a stronger impact on medium-term export prospects, the risks to export price competitiveness seem to be contained so far in the focus countries of this note. Instead, risks seem rather tilted to the import side, as local price dynamics may feed into demand exceeding growth underpinned by export prospects over the medium term. Export market shares for these countries have been increasing in value terms since 2012, but in volume terms have declined in 2022 in the cases of Estonia and Latvia.

[39] Annex 1 shows that in the case of Romania, the domestic contribution to inflation seems mainly due to operating surplus increases.

REFERENCES

Ahn, J., R.C. Mano, & J. Zhou (2020). Real exchange rate and external balance: How important are price deflators?. Journal of Money, Credit and Banking, 52(8), 2111-2130.

Altissimo F., M. Ehrmann M., & F.R. Smets (2006). Inflation persistence and price-setting behavior in the euro area: a summary of the IPN evidence. ECB occasional paper 46.

Duarte M., & Wolman AL. (2008). Regional inflation in a currency union: fiscal policy vs. fundamentals. Journal of International Economics 74(2): 384–401.

Beck, G.W., K. Hubrich, & M. Marcellino (2016). On the importance of sectoral and regional shocks for price-setting. Journal of Applied Econometrics, 31(7), 1234-1253.

Beck, G.W., K. Hubrich, & M. Marcellino (2009). Regional inflation dynamics within and across euro area countries and a comparison with the United States. Economic Policy, 24(57), 142-184.

Beck, G.W., K. Hubrich, & M. Marcellino (2006). Regional inflation dynamics within and across euro area countries and a comparison with the US. ECB Working Paper No 681, October.

Carriere-Swallow, Y., P. Deb, D. Furceri, D. Jimenez, and J.D. Ostry (2022). Shipping Costs and Inflation. CEPR DP 17259.

Cecchetti, S., & K. Schoenholtz (2021). *Money, Banking and Financial Markets*, 6th Edition, McGraw-Hill.

Coutinho, L., & A. Turrini (2019). Convergence and macroeconomic imbalances. Quarterly Report on the Euro Area (QREA), 18(1), 37-51.

Coutinho, L., N. Mata Garcia, A. Turrini & G. Vukšić (2021). "Methodologies for the Assessment of Real Effective Exchange Rates," European Economy - Discussion Papers 2015 - 149, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Cubeddu, L., S. Krogstrup, G. Adler, P. Rabanal, M.C. Dao, S. Ahmed Hannan, L. Juvenal, N. Li, C. Osorio Buitron, C. Rebillard, D. Garcia-Macia, C. Jones, J. Rodriguez, K. Suk Chang, D. Gautam, & Z. Wang (2018), External Sector Report - Refinements to the External Balance Assessment Methodology - Technical Supplement. International Monetary Fund.

European Commission (2022). 2023 Report on the euro area accompanying the Recommendation for a Council Recommendation on the economic policy of the euro area. Commission staff working document SWD(2022) 382.

Favero, C., M. Marcellino & F. Neglia (2005). Principal components at work: The empirical analysis of monetary policy with large data sets. Journal of Applied Econometrics, 20, 603–20."

Ghosh, A. (1958). Input-Output Approach to an Allocation System, Economica, 25, 58-64.

Honohan, P., & P.R. Lane (2003). Divergent inflation rates in EMU. Economic Policy, 18(37), 357-394.

Karadi P., & A. Reiff (2014). Menu costs, aggregate fluctuations, and large shocks. CEPR discussion paper DP10138.

Kilian L. (2009). Not all oil price shocks are alike: disentangling demand and supply shocks in the crude oil market. American Economic Review 99(3): 1053–1069.

Kose M.A., C. Otrok, & C.H. Whiteman (2003). International business cycles: world, region and country-specific factors. American Economic Review 93(4): 1216–1239.

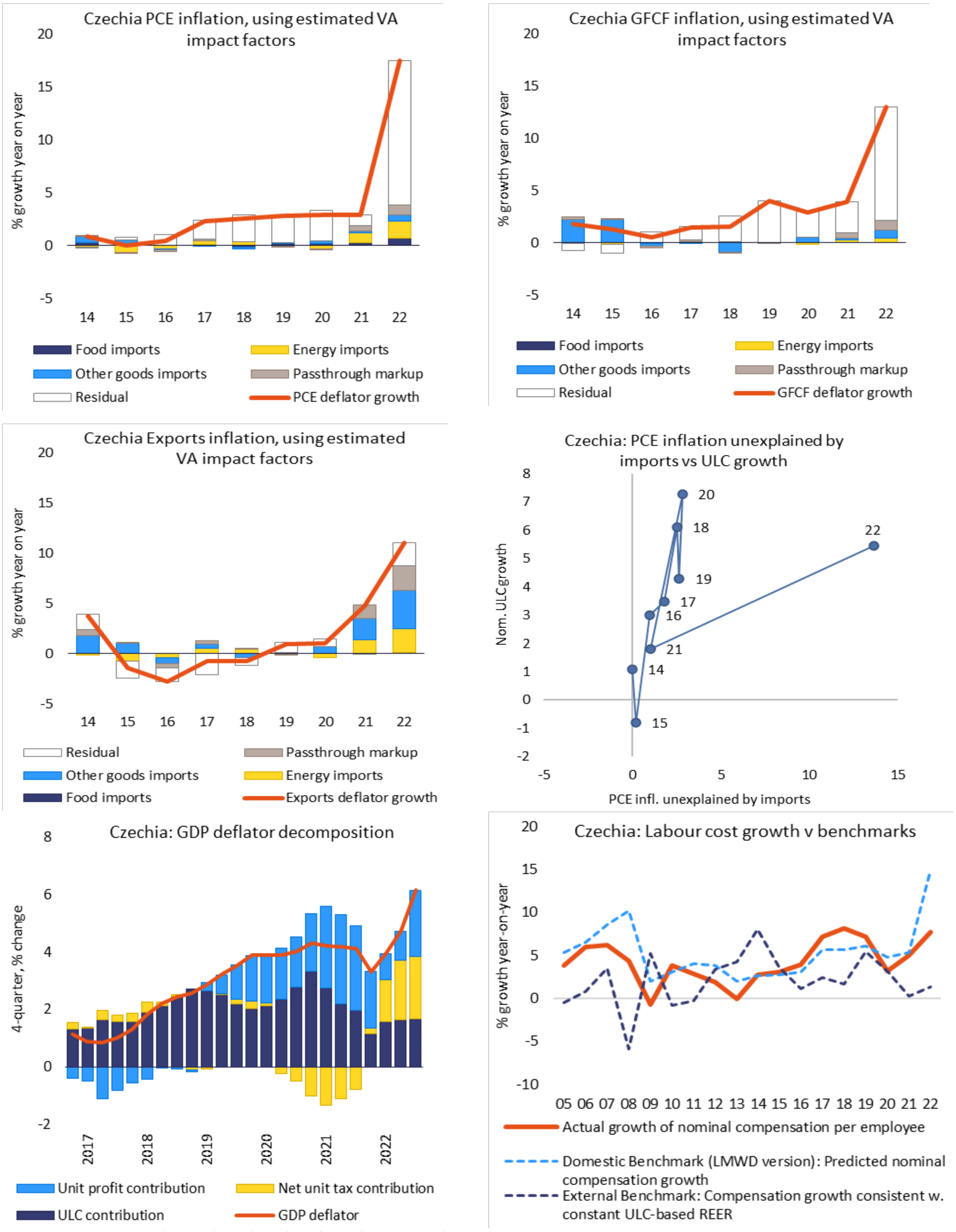
Mackowiak B., E. Moench, & M. Wiederholt (2009). Sectoral price data and models of price setting. Journal of Monetary Economics 56: 78–99.

Mano R. C., C. Osorio-Buitron, L. Antonio Ricci, & M. Vargas (2019). The Level REER model in the External Balance Assessment (EBA) Methodology. IMF Working Paper WP/19/192.

ANNEX 1: COUNTRY FICHES

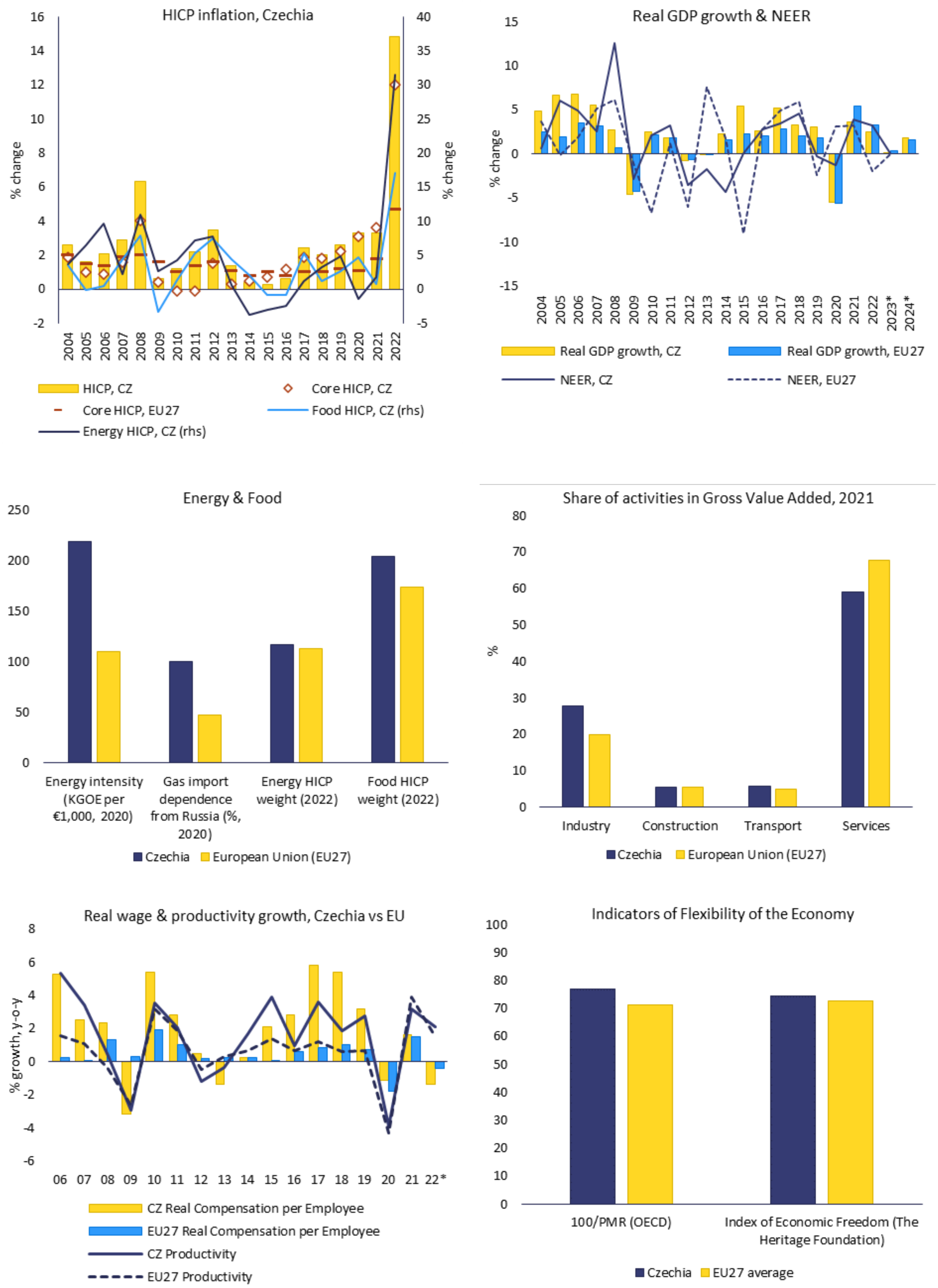
1. CZECHIA

Graph 1.1: **Czechia**



Source: DG ECFIN calculations based on data from the AMECO database.

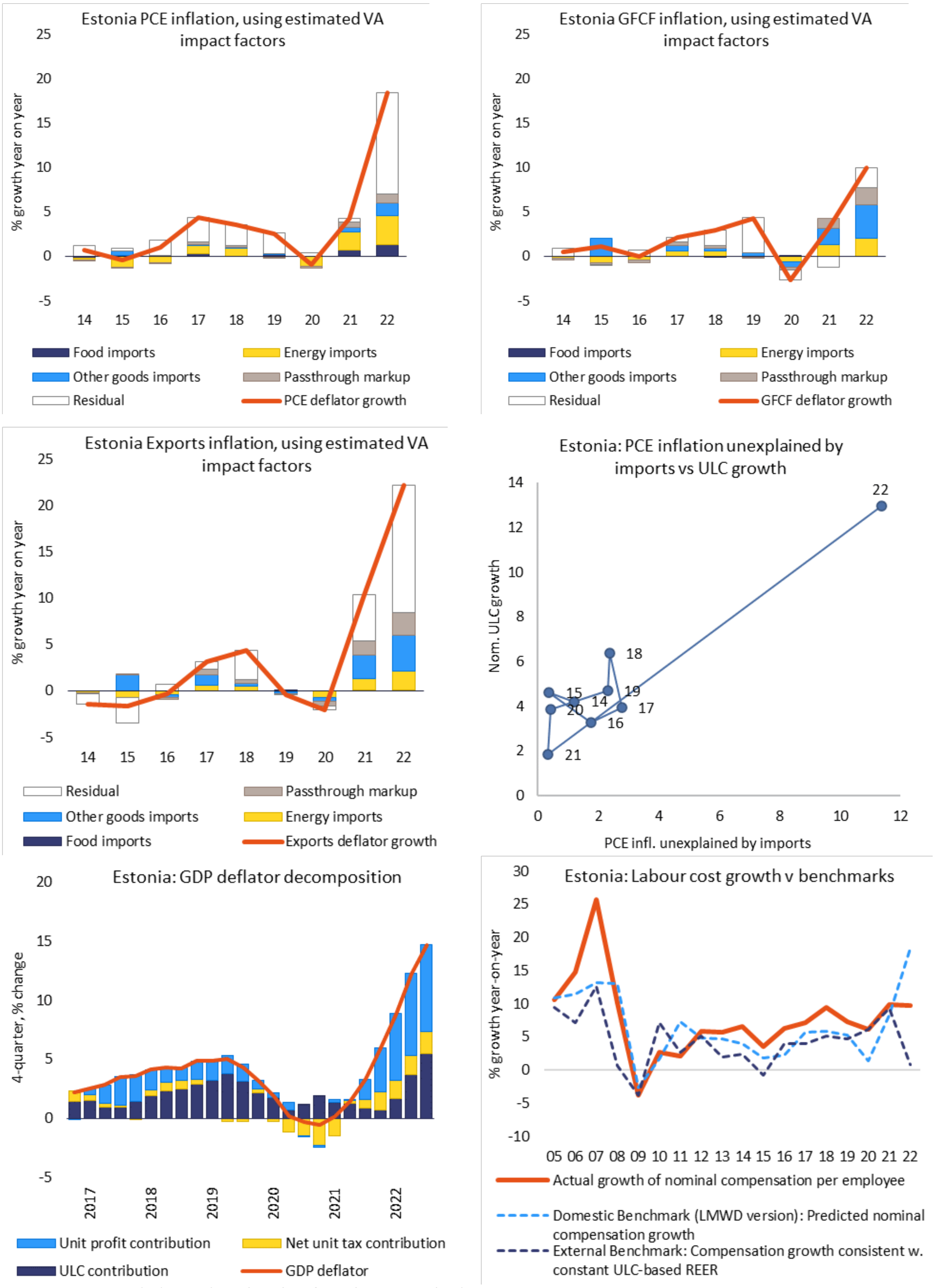
Graph 1.2: **Czechia**



Source: DG ECFIN calculations based on data from Eurostat, Ameco, OECD, The Heritage Foundation.

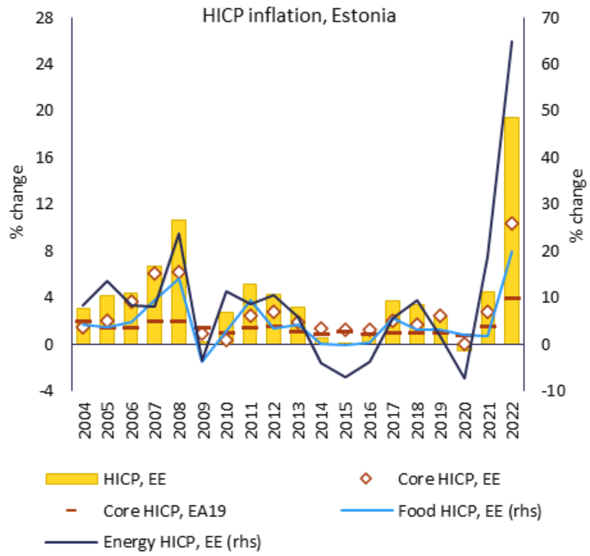
2. ESTONIA

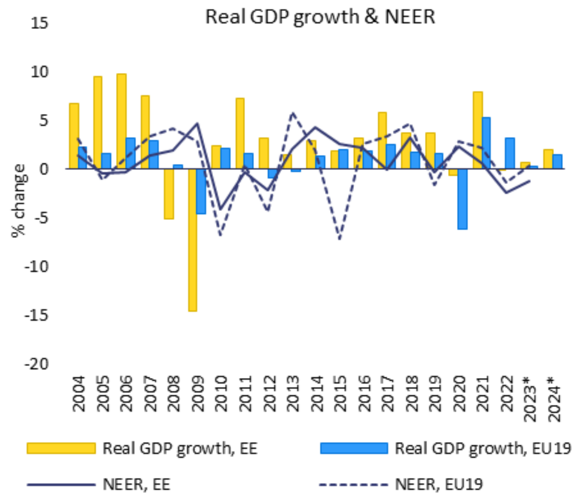
Graph 2.1: **Estonia**

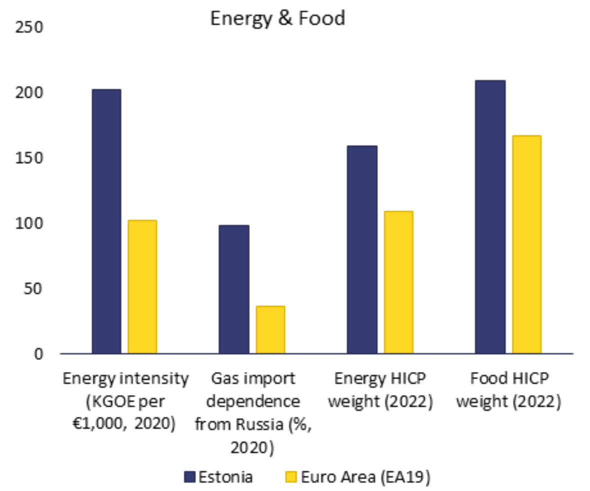


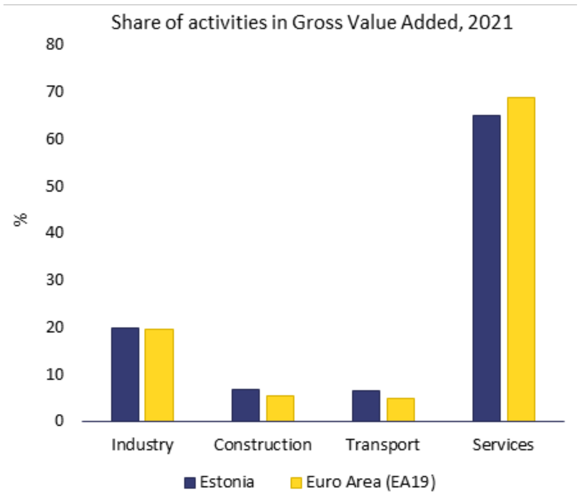
Source: DG ECFIN calculations based on data from the AMECO database.

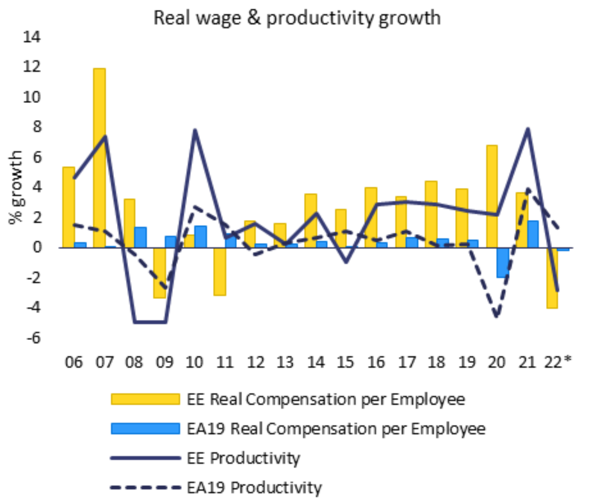
Graph 2.2: **Estonia**

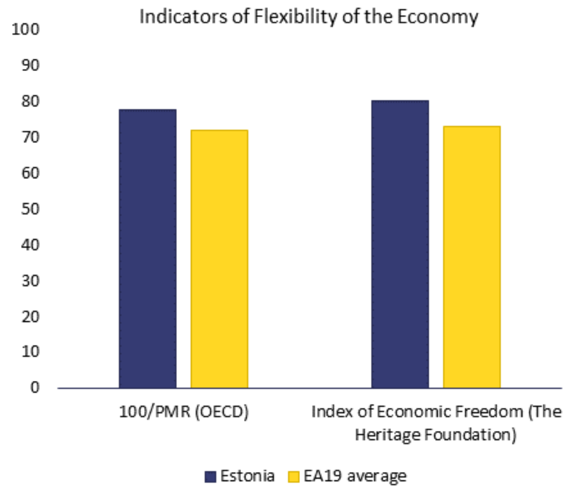








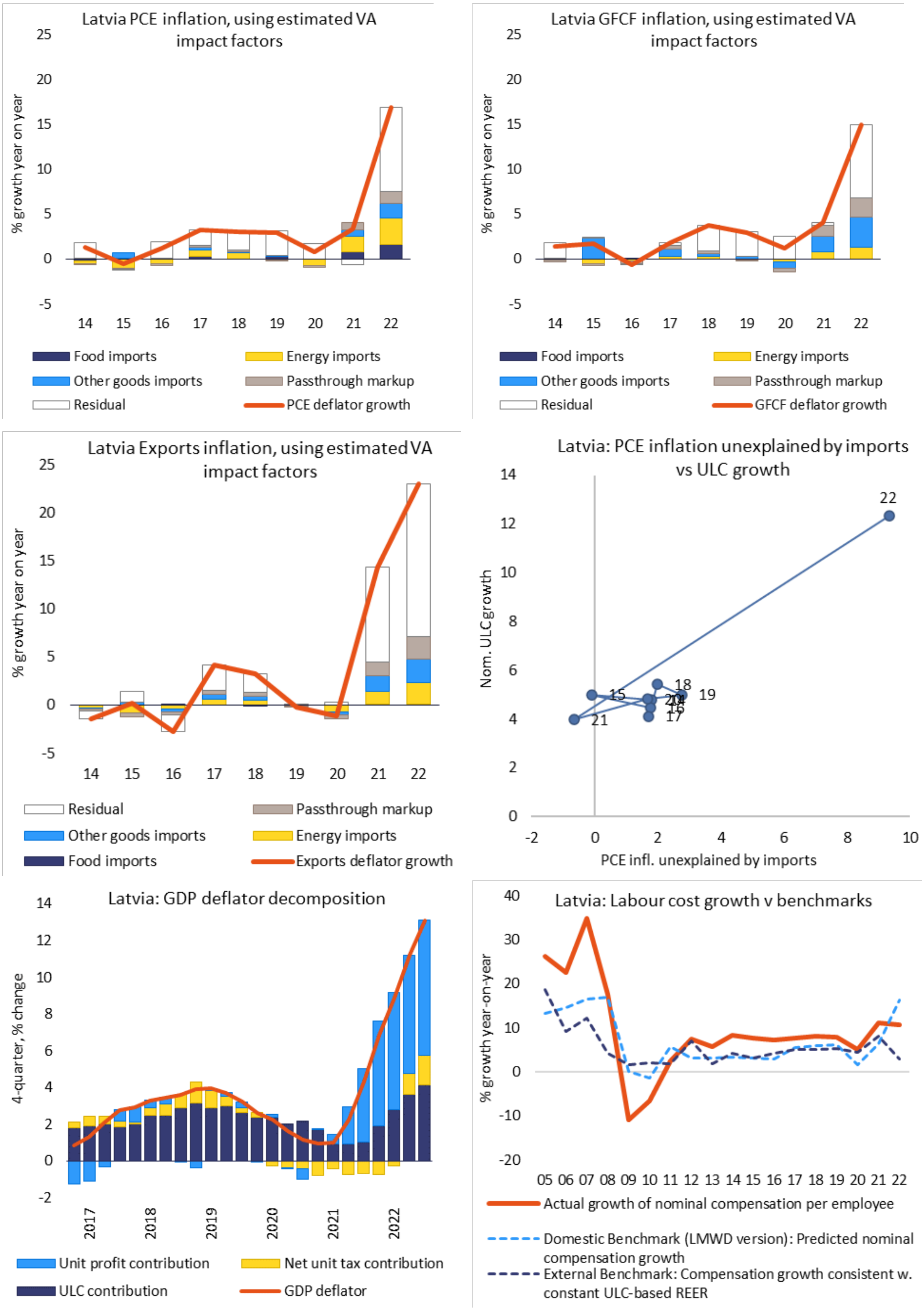




Source: DG ECFIN calculations based on data from Eurostat, Ameco, OECD, The Heritage Foundation.

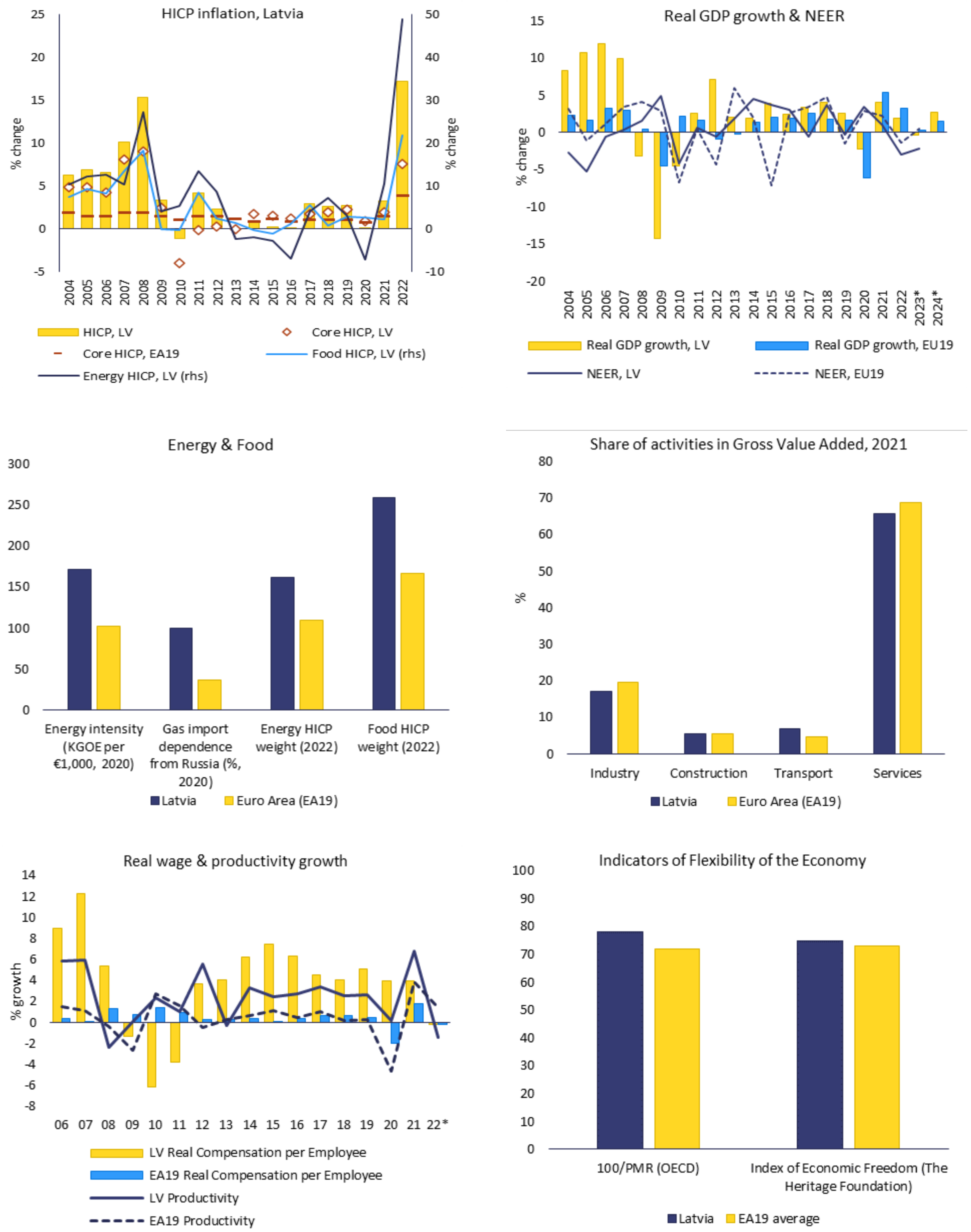
3. LATVIA

Graph 3.1: **Latvia**



Source: DG ECFIN calculations based on data from the AMECO database.

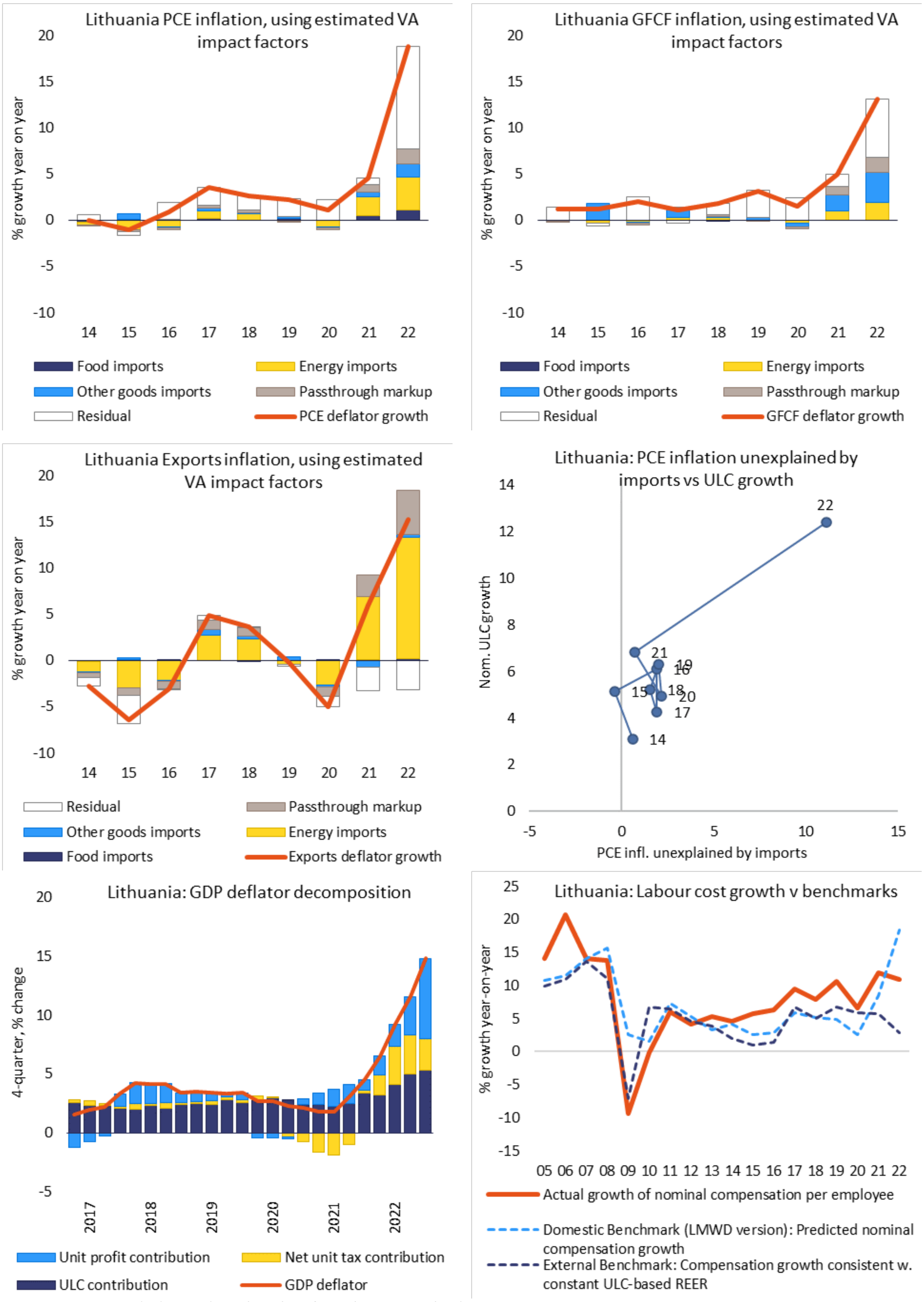
Graph 32: **Latvia**



Source: DG ECFIN calculations based on data from Eurostat, Ameco, OECD, The Heritage Foundation.

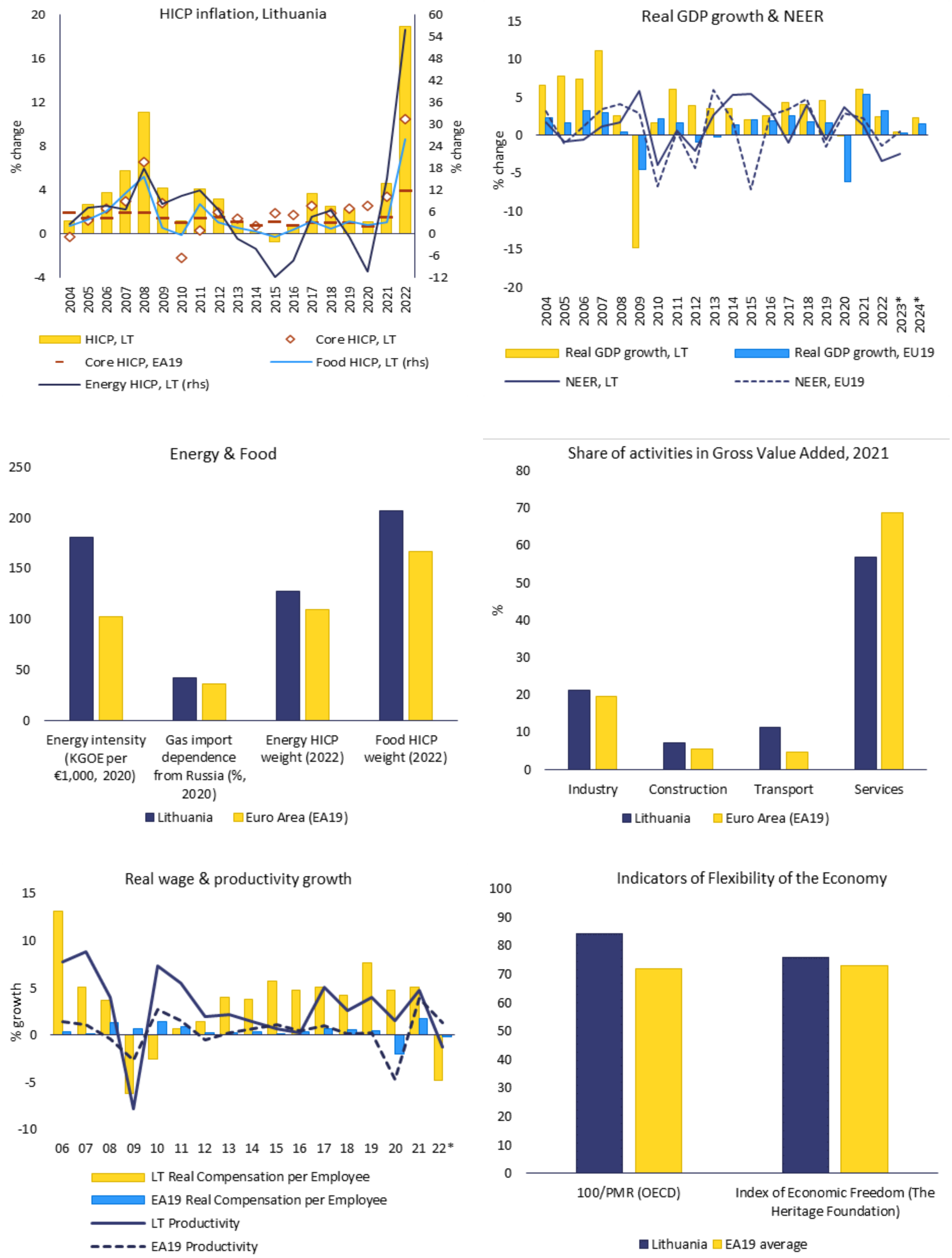
4. LITHUANIA

Graph 4.1: **Lithuania**



Source: DG ECFIN calculations based on data from the AMECO database.

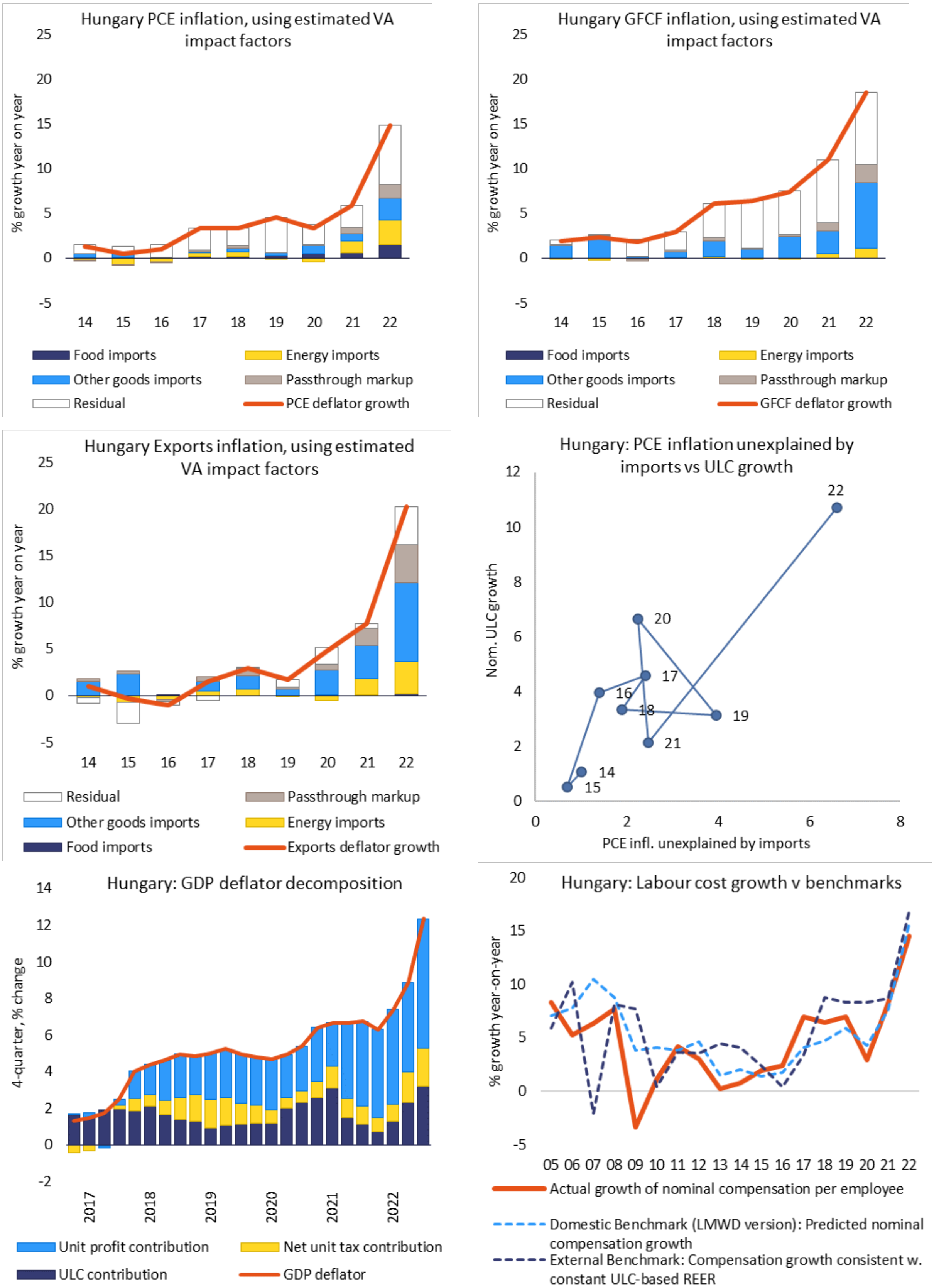
Graph 4.2: **Lithuania**



Source: DG ECFIN calculations based on data from Eurostat, Ameco, OECD, The Heritage Foundation.

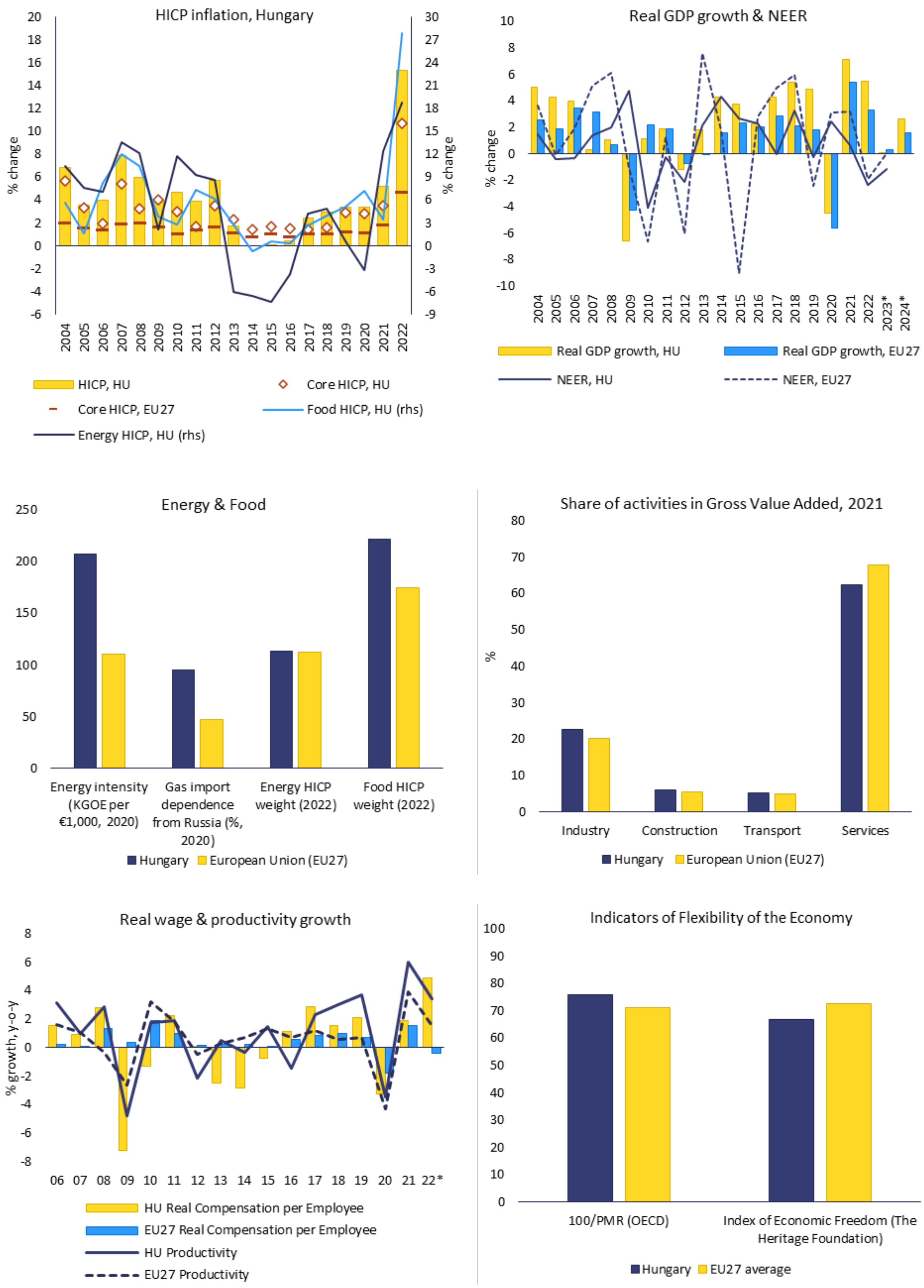
5. HUNGARY

Graph 5.1: **Hungary**



Source: DG ECFIN calculations based on data from the AMECO database.

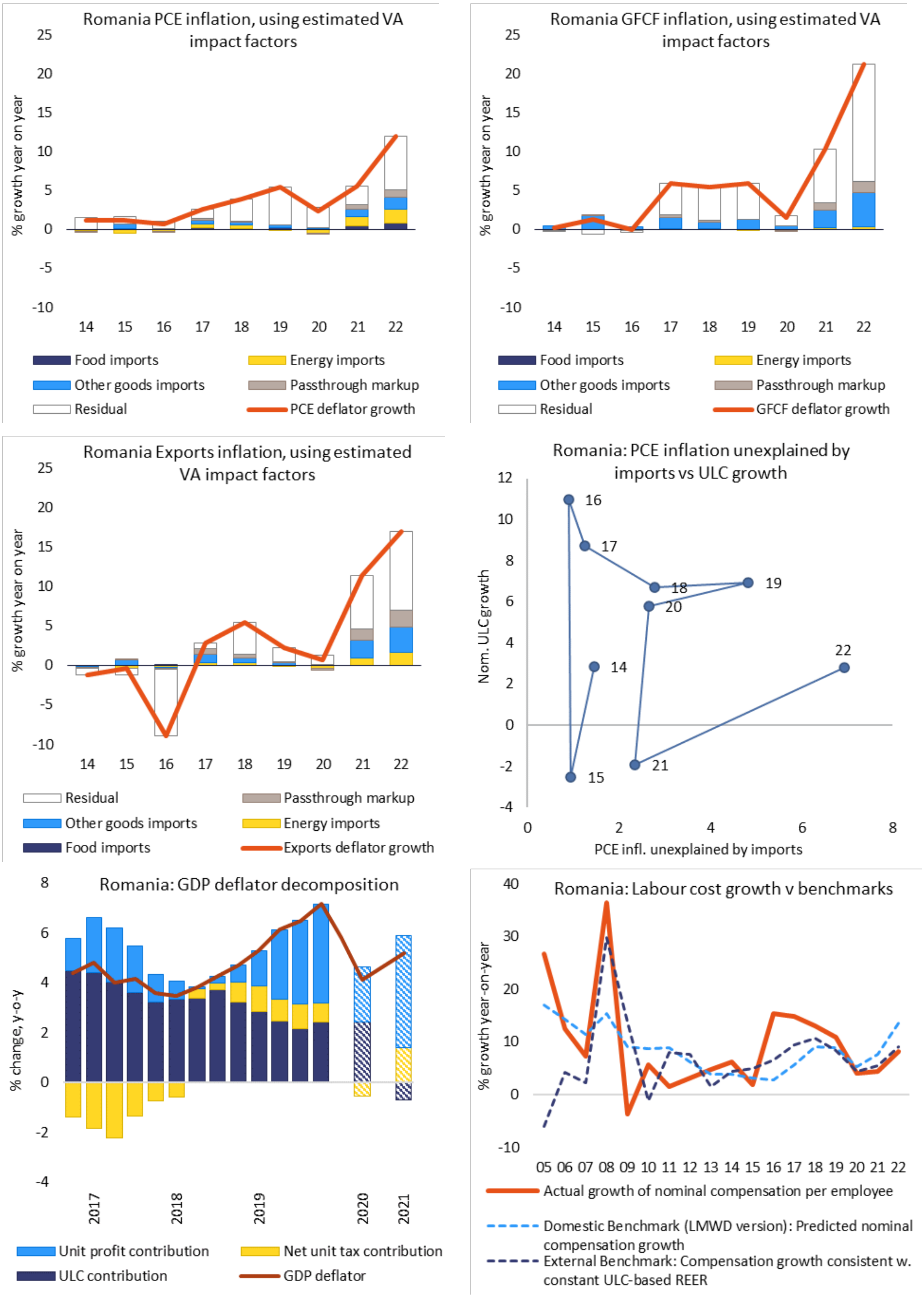
Graph 3.2: **Hungary**



Source: DG ECFIN calculations based on data from Eurostat, Ameco, OECD, The Heritage Foundation.

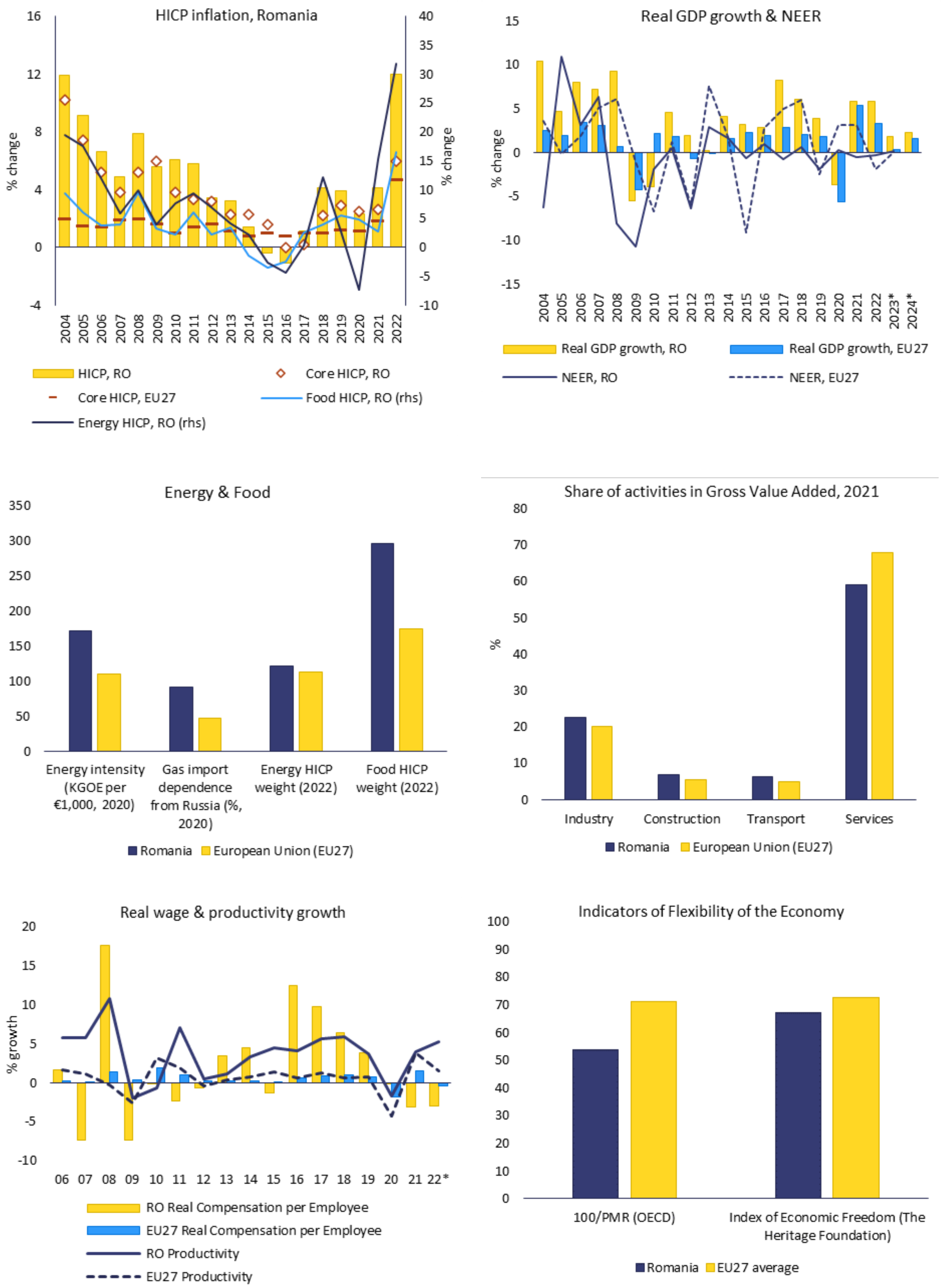
6. ROMANIA

Graph 6.1: **Romania**



Source: DG ECFIN calculations based on data from the AMECO database.

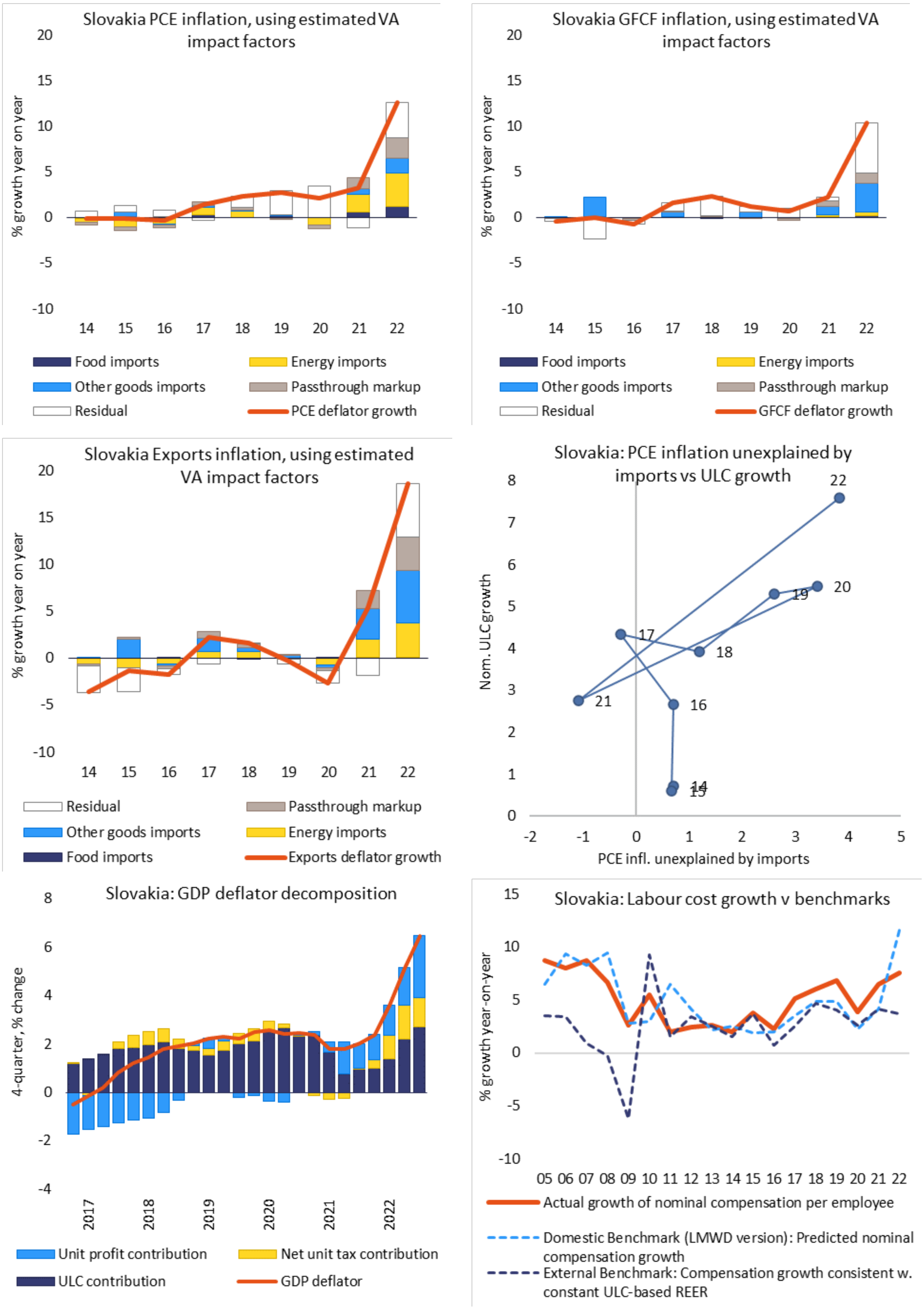
Graph 6.2: **Romania**



Source: DG ECFIN calculations based on data from Eurostat, Ameco, OECD, The Heritage Foundation.

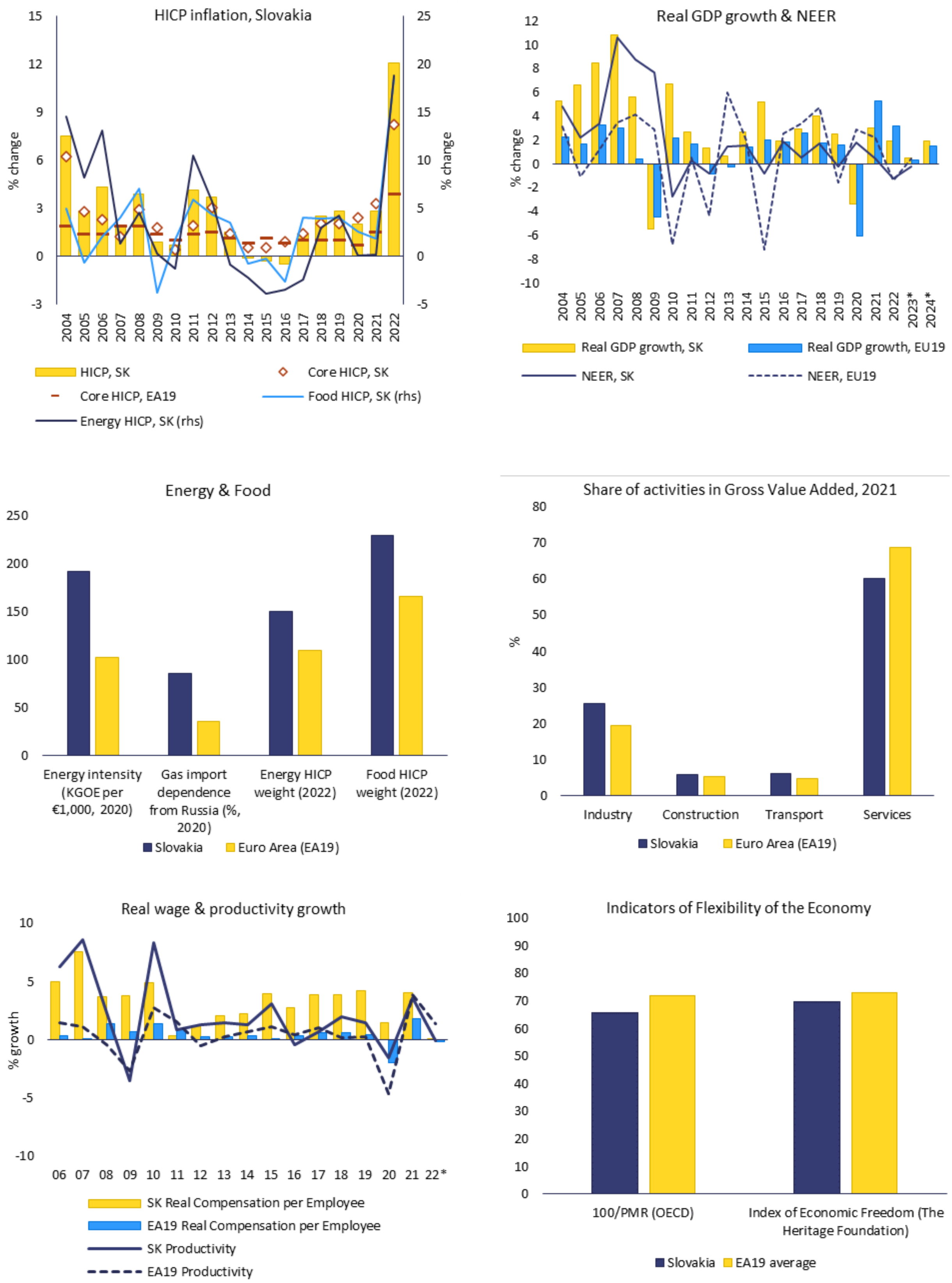
7. SLOVAKIA

Graph 7.1: **Slovakia**



Source: DG ECFIN calculations based on data from the AMECO database.

Graph 7.2: **Slovakia**



Source: DG ECFIN calculations based on data from Eurostat, Ameco, OECD, The Heritage Foundation.

ANNEX 2: THE INPUT-OUTPUT METHODOLOGY IN A NUTSHELL

Input-output tables can, in principle, attribute how much of export and consumer inflation is due to the pass-through of import prices vs domestic factor cost, notably wages and operating margins. The first part of this annex shows how such a framework allows to exploit detailed trade data available for the periods until 2022Q3, and to assess how the heterogenous change of import prices across product groups has fed through the industrial structure of individual EU Member States. The following section reviews the data sources and also discusses the limitations of this approach. The next section of this annex shows that import prices are likely passed through to final demand with a small markup that contributes to value-added prices. Any consumer, investment, or export inflation that is not due to import prices must in principle be due to price change in domestic factor cost. The annex concludes by using aggregate (rather than industry-by-industry) data for domestic value-added prices in order to tentatively attribute inflation to such domestic price drivers.

METHODOLOGY

By definition, any output price growth that cannot be explained by the pass-through of import price growth must be due to changes in the domestic value-added deflator. Input-output tables can exhaustively attribute output to value-added and imports. In this way they can explain price growth caused by import price changes and industry-specific value-added deflators. For EU countries, Eurostat Figaro input output tables are available for 64 industries (and product groups) for 2011-2020 for Eurostat Member States. As complete Figaro tables are available only in nominal terms,[40] data on prices and price growth have to be obtained from other sources: for goods imports, trade deflators for specific product groups can be constructed from Eurostat Comext trade statics (with those product groups accounting for more than 80% of total imports in the EU). For further analysis, the Euklems database provides good-quality data for industry-specific value-added deflators for the period until 2018. For the period 2019-2022, only aggregate value-added deflators are available.

The input-output tables for 64 industries in a typical country can be considered in a typical use table arrangement (Graph A.2.1). The matrix *Z* denotes, in EUR terms, how much intermediate input domestic industry in row *i* produces for use by domestic industry in column *j*. The matrix M details the inputs industry *i* imports from foreign industry *j*.[41] The matrix *Y* captures the value-added block, which can be decomposed into gross operating surplus, compensation of employees, and taxes minus subsidies per industry. Summing the columns of those three matrices *Z*, *M* and *Y* provides all intermediate inputs into industry j, as well as its value added.[42] This sum is equivalent to gross output per industry, represented by the vector *O*. On the final use side, *D* denotes the provision of industry output for 5 components of domestic final demand, namely the consumption of (i) households, (ii) general government, and (iii) *NPISH*, as well as (iv) gross fixed capital formation and (v) change in inventories. *X* denotes exports to 64 foreign industries and 5 components of foreign final demand. Adding the row-sums of *Z*, *D*, *X* yields gross output for each of the 64 domestic industries. Table A.1.6 at the end of this annex details how those quantities relate to each aggregate for the focus countries of this note.

[40] Input-output tables in real terms are only available for a subset of countries.

[41] Note that Figaro is much richer and actually denotes the imports industry by industry from source countries. Here, all foreign countries are aggregated into one, because the available data makes it infeasible to construct detailed trade prices per industry and origin for 2022. The formulation presented here relies on trade deflators by industry/good only, and does not distinguish between origin countries.

[42] Note that the use table here assumes (the change of) net taxes to be zero.

Graph A.2.1: **Structure of country-specific input-output table used in this note**

Z (64x64): intermediate demand/ domestic intermediate inputs	D (64x5): domestic final demand	X (64x69): exports to foreign sectors	O (64x1)
M (64x64): imports of intermediate inputs	M_D (64x5): imports for final demand		
Y (3x64): Value added			
O' (1x64): Gross output			

The input-output formulation à la Ghosh (1954) looks at a technology matrix that represents each input as a share of the gross output of an industry. Denote the matrix of such shares as G_s: it describes how a change in a specific input translates into a change in output (see equation (1)).[43] I.e. if for industry *i* the price of input from industry *j* changes such that the overall amount devoted to that input increases, it suggests the overall output of industry *i* to also increase.[44] Describing the relationship in the of equation (2) directly leads to the Ghosh inverse $(I - G_s{}')^{-1}$ in equation (3), which helps to express output as function of import cost and value added cost.

$$G_s \coloneqq Diag(O)^{-1} Z \tag{1}$$

$$O = G_s' O + M'\vec{1} + y \quad where\ y \coloneqq Y'\vec{1} \tag{2}$$

$$O = (I - G_s{}')^{-1}\left(y + M'\vec{1}\right) \tag{3}$$

$$\Delta O = (I - G_s{}')^{-1}\left(Diag(\pi_M)M\vec{1} + Diag(\pi_Y - \bar{\pi}_Y)y + \bar{\pi}_y y\right) \tag{4}$$

$$\Delta O_M = (I - G_s{}')^{-1}\left(Diag(\pi_M)M\vec{1}\right) \tag{4b}$$

Deflator data is denoted as follows: π_M is a vector containing 64 values of product-group specific weighted averages of import price change for product groups of goods defined along CPA codes. These product groups are aligned with NACE codes and thus are taken to represent industry-specific import deflators. [45] π_Y is a similar vector with industry-specific rates of change of value-added deflators. $\bar{\pi}_Y$ is the

[43] Here and elsewhere, Diag(A) represents a diagonal matrix having as its diagonal elements the vector A. and $\vec{1}$ represents a column vector containing an appropriate number of ones.

[44] Note that this mechanistic relationship does not allow for reaction function or substitution, but is suitable for decomposition. If there had been significant substitution between different inputs in year t, then the Figaro use matrix for that year should have reflected that, in principle.

[45] Note that actually, Comext data relates to goods trade and thus only allows to construct deflators for 21 product groups from the primary and secondary sector. Combined, these account for the vast majority of imports, though, whereas imports from foreign utilities, construction, and services industries are considerably less important. Moreover, note that the distinction between product groups and industries is a fine one: For instance, the vast majority processed food is imported from the foreign processed food sector, but some is imported from other sectors. This annex assumes the price growth of imported processed food to be the same as output price growth of the foreign processed food goods sector.

rate of change for aggregate value added (from Ameco). Equation (4) shows thus how the various deflators affect output. Dividing the result from equation (4) by the departing value of gross output O thus provides industry specific output price inflation. Equation (4) thus shows how a given vector of industry-specific import and value-added price changes directly yields output price changes.[46] The graphs in section 3 of the main text concentrate on the impact of import prices only, and thus just the partial effect of import prices ΔO_M as represented by equation (4b).

DATA SOURCES AND LIMITATIONS

The analysis presented in this section assumes a stable input-output production function and thus that key economic relationships do not change within a year. Most notably, the approach therefore induces zero elasticity of substitution across inputs and industries: The approach attributes observed deflator changes into import and domestic contributions by relying on input-output identities, which assumes the industrial structure for a given year to remain broadly stable. The approach uses simple mechanics and therefore does not take into account price elasticities and substitution effects, and thus any notion of partial or general equilibrium. The analysis presented tries to assess the extent of the pass-through: that is, in how far import price increases 'infect' value added and thus entail some increase in the value-added deflator. Modelling this enables the analysis to assess the extent to which import prices are passed through to domestic and export prices, and whether this pass-through relationship may have changed over time (see below).

Inferring price changes for individual goods from trade statistics is a challenge. The Comext database provides both the nominal value and the weight of each import category. In principle, this suffices to deduce a price per kg. Yet putting this into practice is not straightforward, as large parts of major goods categories may have been labelled as confidential, and (ii) even in case of full reporting, goods categories are not necessarily fine-grained enough to adjust for quality changes in the trade data. Using Comext to construct goods-specific deflators thus only can go so far. In principle, the data allows for country – and goods-specific deflators, but with strongly heterogeneous results. Notably using such country-specific heterogenous Comext results often does not at match well what is reported under aggregate trade deflators. The grey elements of Graph A.2.2 show that constructing goods deflators based on implicit country-specific price changes as reported in Comext leads to results that can differ substantially from the goods imports deflator in national accounts.[47] This note therefore computes implicit price growth per product group for all EU countries, and assumes the median of those product-specific growth rates to represent world market prices. When these are aggregated with country-specific import weights, the result closely matches aggregate trade deflators from national accounts (see blue elements in Graph A.2.2).

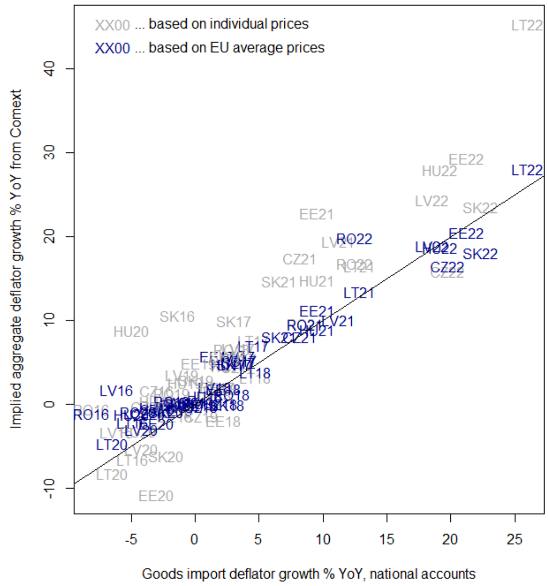
Three caveats relate to the price deflator data: i) prices for specific goods imports from trade statistics are not exactly the same as deflators for industry-specific imports; [48] ii) The approach above does not take into account service import deflators (services typically account for 10%-20% of EU imports); iii) where EUKLEMS deflators are used, one has to keep in mind that those may be based on national account revision vintages that are not fully in line with those used for input-output tables.

[46] Note also that ΔO refers to nominal output changes and not specifically to a deflator change: While ΔO has been constructed from price rather than quantity changes, the distinction is not relevant for the computations that follow thereafter, which are based on nominal (rather than real) data.

[47] The trade and national accounts data in Graph b are based on Eurostat figures, with 2022 representing data for 2022Q1-Q3.

[48] The import data in the Figaro input-output table used here shows the input of foreign industry j into domestic industry i. The trade deflator is based on product groups instead. For instance, in Figaro the domestic hospitality industry imports a certain amount from the foreign processed food industry. From Comext, we compute the prices for imported processed food. But imported processed food is not necessarily the same as imports from the foreign processed food industry.

Graph A.2.2: **Comparing Comext-derived goods import deflators to those reported in national accounts**



Notes: The points mark the country acronym and year of each combination. The horizontal axis shows the year-on-year % change of goods import deflator from national accounts (in EUR). The vertical axis takes implicit deflator growth that results from multiplying the country-specific import weights for 21 tradable goods categories with the implicit price change for each year. Grey markers denote when such price changes are derived from import data for the individual country. Blue markers denote the same concept but using the median price change across all EU Member States.

Another set of limitations relates to the industrial structure presumed by input-output tables. The existing tables are used to determine, for each industry, which percentage of output stems from i) 64 domestic input industries/products, ii) 64 import product groups and iii) domestic value added, industry by industry. Following Ghosh (1954), this paper assumes such percentages to remain stable in the short term and represent the industrial structure of a country. Yet in practice, i) input output tables are only available until 2020, thus input output tables for 2021 and 2022 are presumed to resemble the pre-pandemic industrial structure and thus are based on the tables of 2019. ii) In theory, such an approach rests on industrial input-output quantities to be defined in real terms. Yet, only tables in nominal terms are available for most Member States and are thus being used to define the matrix embodying industrial structure.

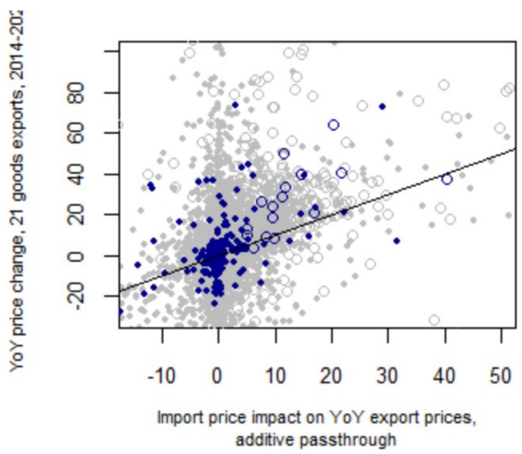
USING EXPORT PRICES TO ESTIMATE PASS-THROUGH MARKUPS

Observed import and export prices allow for a rough estimate of the extent of the import cost markup. In the small open economies of EU Member States, goods' import costs matter for all kinds of final demand, but in particular for export prices. On an industry level, a country's export prices depend on import prices and on domestic value-added deflators, and are product or industry specific. [49] However, the data show that value-added deflators are much more correlated across industries within a country than export and import deflators are. This difference in correlations enables to estimate whether import prices themselves affect value added, by using input-output tables to assess the pass-through from import to export deflators, and comparing the results with actual data available as of end-2022.

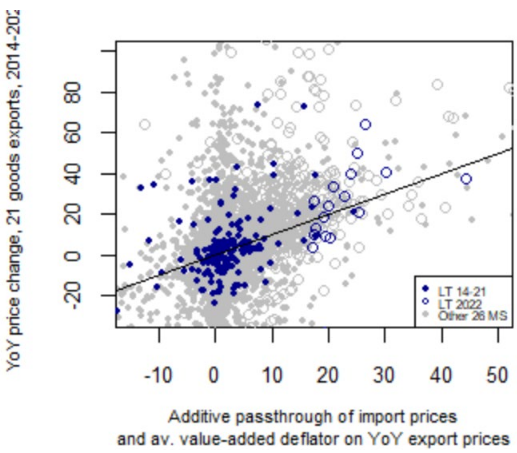
[49] The approach here uses industry-by-industry input-output tables for assessment. Preliminary trials with product-by-product matrices suggest similar results.

Graph A.2.3: **Relating import prices to export prices through input-output, with various assumptions for value-added effects**

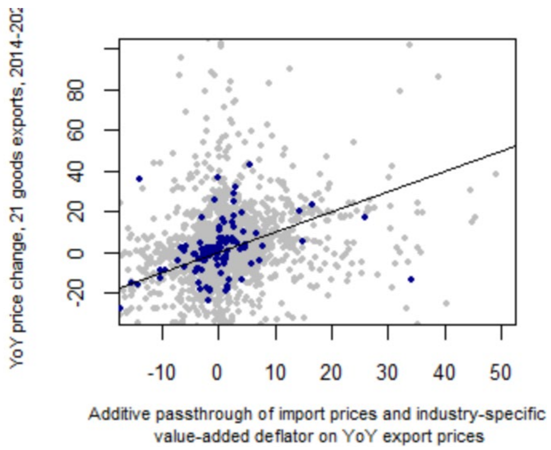
a) Naïve pass-through of import prices only



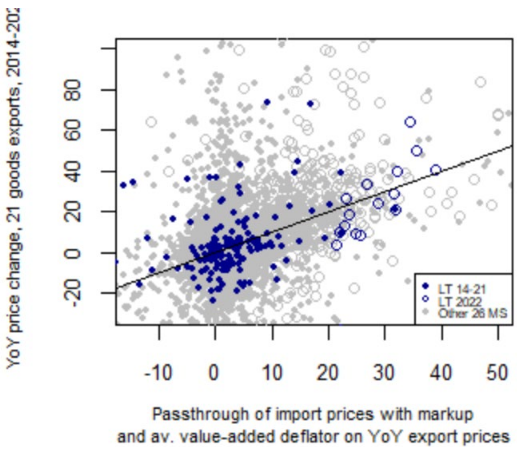
b) pass-through of import prices and average VA deflator



c) pass-through of import prices and industry-specific VA deflators (data until 2018)



d) pass-through of import prices with a margin parameter of 15%, plus pass-through of average value added



Notes: Vertical axis shows year-on-year export price changes (in EUR, as per Comext data) for 21 tradable goods categories. Blue dots highlight Lithuania 2014-2021, grey dots all other EU Member States. Large circles denote 2022 data. The horizontal axis displays differing variants of passing through observed YoY goods import price changes (as per Comext data) to export prices.

Graph A.2.3 tries to assess how import costs are being passed through to final demand, and whether the pass-through relationship has changed in the 2020s. Over the years, export prices vary much more than a direct pass-through of import prices would suggest, indicating that import prices spill over into increased value added deflators. Graph A.2.3 a) shows how export prices would change if import prices were passed through in a 'naïve' additive manner as in equation (4) and compares this to actual changes in export prices. It shows that export prices vary much more than what the naïve pass-through suggests, with a fairly steep slope visible for the highlighted data points. The 2022 observations stand out with high values, but broadly can be seen to fit the pattern of earlier data. Graph A.2.3 b) adds the impact of observed aggregate value-added deflator changes, which do not change by industry, to the estimates of how export prices change. As might be expected, this shows a greater correlation of the estimated with the observed data, but does not improve the dispersion between them

Changes in value added deflators appear to be not just industry-specific, but related to import prices. Adding industry-specific value-added deflators to the estimated export deflators reduces the dispersion between estimated and observed export prices, as shown in graph A.2.3 c. [50] However, the dispersion – and therefore accuracy of the estimates – is further improved by applying a value-added mark-up to the import cost, that is by definition industry-specific, as well as aggregate country-level value added increases. This is shown in graph A.2.3, which augments equation (4) by adding a markup parameter. One may assume all industries to stabilise their margins as % of output by adding a markup of λ on top of the input cost change (which is expressed as a share of total revenue).[51] Computing the impact of Equation (4) then becomes

$$\Delta O_M^* = (I - \lambda I - G_s')^{-1} \left(Diag(\pi_M) M\vec{1}\right) \tag{5}$$

This mark-up could be the result of firms smoothing their operating surplus and protecting the labour share of industry-specific revenue. Its presence indicates that firms are not just able to pass on their increased costs, but that they are able to safeguard their profits by increasing their margins. Modelling the pass-through of import costs with a value-added mark-up enables an estimation that is more precise, and analysis shows that a 15% [52] markup parameter reduces the dispersion around that line. For all Member States observed here, the R-squared from panel 3d) surpasses that of all other panels.

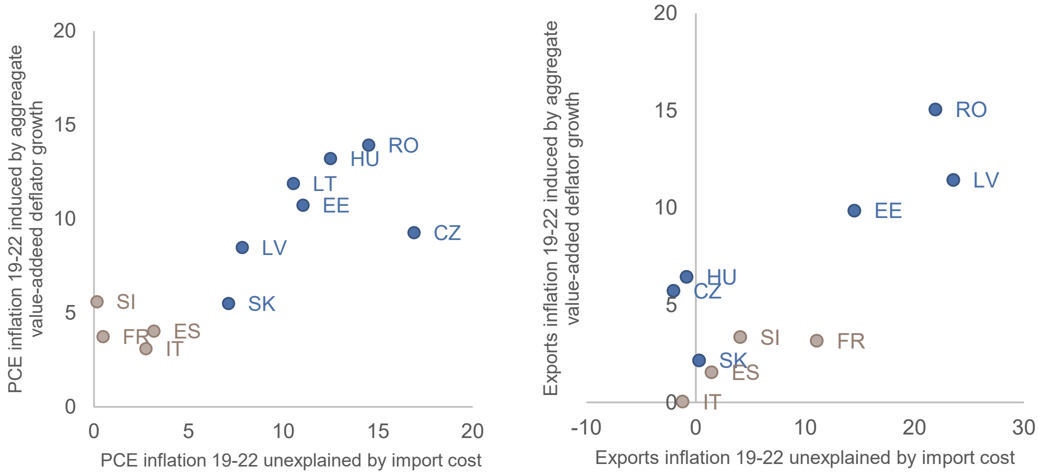
Graph A.2.4 demonstrates that the 'unexplained' inflation can indeed be attributed to domestic factors. Ghosh's input-output formulation suggests that any price changes not explained by import cost (and the associated markup) must be due to domestic value-added deflators (adjusted for the import price markup) in the relative industries. The annex shows that much of the latter can be explained by an economy's aggregate value-added deflator growth. Ameco deflator data (which is a nowcast for 2022) may thus be used to estimate a good part of domestic inflation: Graph A.2.4 compares this computational impact from this aggregate value-added deflator increase to the 'unexplained' bit of inflation, and finds them to be quite aligned.

[50] Country-by-country for all Member States assessed in this note bar Czechia, the r-squared of observations in Graph A.2.3 c is higher than in Graph A.2.3 b), which is in turn higher than in Graph 3a).

[51] Note that if $\pi_M > 0$ and $\lambda = 0$ then changing import prices would simply raise the import content of output, but value added would not change. Therefore the share of value added in total output would decline, thus reducing the aggregate value-added margin of domestic production.

[52] The parameter of 15% reflects the 14.2% that optimises the simple mean of R-squared across countries between explained (as in panel 3d) and observed year-to-year for product-group-specific export price changes.

Graph A.2.4: **Domestic content of PCE inflation 19-22: Part that imports cannot explain vs. estimated impact from VA deflator forecast**



Notes: Left-hand panel displays PCE inflation unexplained y import cost on the horizontal axis. The vertical axis shows what PCE inflation would arise if over 2019 to 2022 purely the aggregate value-added deflator would have increased as observed by Ameco. Right-hand panel presents a similar exercise for export price inflation. Note that too many export price data was missing for Lithuania to be included in the chart. Note moreover that these rates of change are displayed in national currency. The depreciation of the HUF over the 2019-22 period means that Hungarian prices should have declined in EUR terms.

FROM OUTPUT TO CONSUMER INFLATION, AS WELL AS DOMESTIC CONTRIBUTIONS

Converting to final demand and export prices is straight forward considering that the Ghosh inverse can be transformed into the classic 'Leontief inverse' by multiplying and then dividing the rows and columns of the former: Equation (7) shows how output for final use obtains in this manner, and equation (8) displays how final use is then allocated to domestic demand and export categories along the shares observed at departure levels (equation (5) when $\Delta O = 0$).

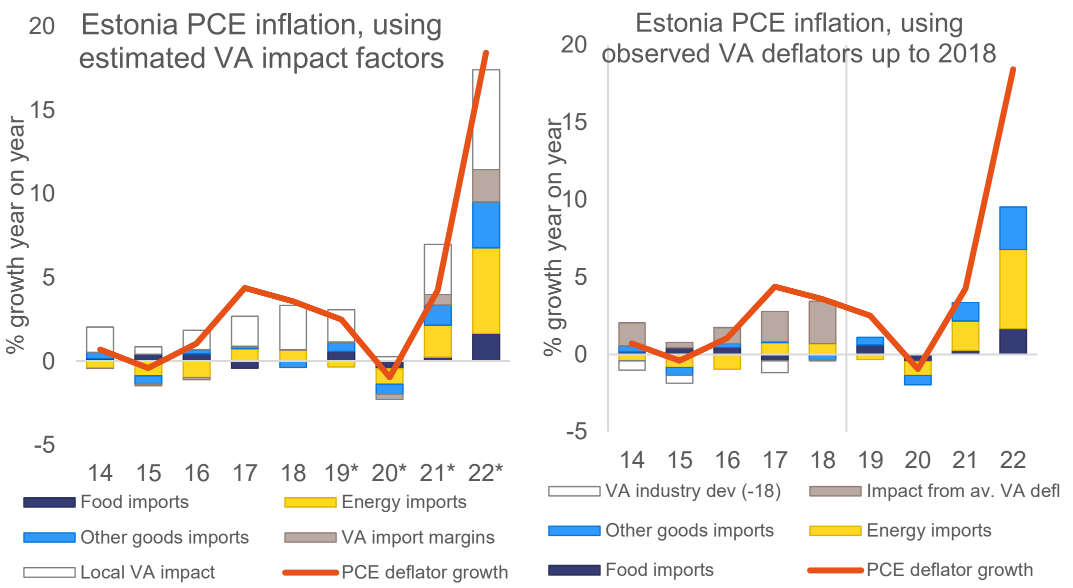
$$Let\ O^*(\pi_M, \pi_Y) = \Delta O + O \tag{6}$$

$$f^* = (I - Diag(O^*)\ G_s Diag(O^*)^{-1})O^* \tag{7}$$

$$D^* = Diag(f^*)Diag(O)^{-1}\mathrm{D}\,,\ X^* = Diag(f^*)Diag(O)^{-1}X \tag{8}$$

The impact of domestic value-added prices can be explored with available data. Graph A.2.5 displays how the data can be combined, illustrating the case of the personal consumption expenditure (PCE) deflator in the case of Estonia. The graph shows how the impact from import price changes of food (unprocessed and processed), energy (including mining products), and other goods, contribute to domestic personal consumption inflation, if the impact from those price changes is fully passed through the industrial structure in an additive manner. The red line shows the overall change in the price level. Graph A.2.5 shows the results of two different estimates of the price increase of domestic value added. On the right-hand side, industry-specific value-added deflators are used as in equation (5). These are available until 2018, and explain a large part of the remainder of consumption expenditure deflator. (Note that here, there is no import price markup, as these are implicitly reflected in the industry-level VA deflators.) The graph on the left uses data that are available for the whole period until 2022 but where value-added deflator data are available only at an aggregate level (i.e. equation where each element $\pi_{Y,i} = \bar{\pi}_{Y,i}\ \forall i$). A comparison of the two shows that using aggregate level produces results that are comparable to the more granular approach.

Graph A.2.5: **Import content of inflation in Estonia, using alternate methods of accounting for value added deflators**



Notes: Decomposition of private consumption expenditure deflator growth for Estonia. Left hand panel shows final results, with observed impact from import prices, an estimated mark-up on import price pass through, and the estimated impact from aggregate value-added deflator change. The right-hand panel shows the same import price impact, but also uses industry-specific value added deflators for the period 2014-2018. The impact of the latter is decomposed into an aggregate impact, and the industry-specific deviation from aggregate value-added deflator growth rates. In Estonia as in other Member States, the impact from industry-specific value-added deflator deviations from the aggregate (white bars) pales in comparison to aggregate VA deflator change impact (grey bars) in the right-hand-side panel.

Technically, the graphs in the country sections of Annex 1 are thus computed as follows: consumer, GFCF and exports inflation derive as the column sums of ΔD^* of equation (8) divided by the column sums of D a period earlier. This is computed for the contribution of energy and commodities where π_M^l represents the commodity and refined fossil sector (B & C19) and is set to zero for imports from all other foreign industries.

$$\Delta D_l^* = Diag(f^*(O^*))Diag(O)^{-1}\mathrm{D} \quad O^* = O + (I - G_s{}')^{-1}\left(Diag(\pi_M^l)M\vec{1}\right)$$

The same process repeats for food prices and other goods prices. Finally, the contribution from the pass-through markup parameter is computed by using equation (5) with $\lambda = 0.15$, and substracting the result of equation (4) from it.

Table A.2.6: **supply-use items as a % of gross output, 2019**

	CZ	EE	LV	LT	HU	RO	EA20
Inputs and factors:							
Intermediate consumption	37.9	34.2	36.5	30.5	26.7	37.8	37.5
Energy imports	1.0	1.5	1.5	4.8	1.5	0.6	1.2
Other imports	19.1	18.6	12.3	13.7	26.9	11.0	11.7
Comp of employees	20.2	24.7	26.8	26.1	21.0	20.7	25.8
Gross oper. surplus & mixed inc.	20.8	19.2	21.5	24.5	21.7	27.5	21.8
Net taxes/subsidies, res.	3.5	6.2	6.0	5.7	6.6	5.6	5.8
Final demand:							
Government consumption	8.8	9.9	10.6	9.5	10.1	9.4	11.0
Household consumption	20.8	24.3	31.2	33.8	24.1	33.0	28.0
NPISH consumption	0.4	0.9	0.7	0.1	1.0	0.5	0.7
gross fixed capital formation	12.2	12.9	12.7	12.1	13.7	12.0	11.9
Inventory change	0.2	0.5	0.0	-2.2	0.7	0.5	0.4
Exports	28.7	29.1	23.2	31.7	36.4	19.4	20.2
Import content of gross output:							
Energy imports	2.4	3.3	3.7	7.9	3.0	1.7	2.6
Other imports	37.9	35.1	25.4	25.6	42.5	23.7	24.1

ANNEX 3: COMMON EU FACTOR ANALYSIS

Table A.3.1 associates the estimated global EU factor to observed common factors using monthly data from Jan 2000 to Sep 2022 to understand what global variables may be associated with it. It relates the factor to EU and global variables, including the EU unemployment rate as a measure of the common cycle, the dollar-euro exchange rate, the prices of oil, gas and wheat, the EA short-term interest rate and the US inflation rate. [53]

Table A.3.1: **Correlations with the common EU factor**

Dependent variable: Estimated common factor for EU27	**(1)**	**(2)**	**(3)**
Unemployment rate (EU27)	-0.061***	-0.067***	-0.077***
EA interest rate	0.224***	0.197***	0.226***
USD to Euro	-1.364***	-1.846***	-1.287***
US inflation	0.182***	0.274***	0.177***
Oil price brent	0.002	0.004*	0.006***
Gas benchmark	0.053***		0.059***
Wheat price	0.003***	0.007***	
Constant	0.374	0.617*	0.590**
Number of observations	273	273	273
R2	0.88	0.81	0.87
Root mean squared error	0.34	0.42	0.34

Standard errors in parentheses * p<0.10, ** p<0.05 *** p<0.01

[53] Worth noting that several other global variables including VIX, Baltic Dry Index, some survey measures of labour shortages, monetary variables (i.e.M3) and various commodity and metal price were tested but they resulted neither statistically nor economically significant.

EUROPEAN ECONOMY INSTITUTIONAL PAPERS SERIES

European Economy Institutional Papers series can be accessed and downloaded free of charge from the following address: Publications (europa.eu).

.

Titles published before July 2015 can be accessed and downloaded free of charge from:

- http://ec.europa.eu/economy_finance/publications/european_economy/index_en.htm
  (the main reports, e.g. Economic Forecasts)

- http://ec.europa.eu/economy_finance/publications/occasional_paper/index_en.htm
  (the Occasional Papers)

- http://ec.europa.eu/economy_finance/publications/qr_euro_area/index_en.htm
  (the Quarterly Reports on the Euro Area)

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct Information Centres. You can find the address of the centre nearest you at: http://europa.eu/contact.

On the phone or by e-mail

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696 or
- by electronic mail via: http://europa.eu/contact.

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: http://europa.eu.

EU Publications

You can download or order free and priced EU publications from EU Bookshop at: http://publications.europa.eu/bookshop. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see http://europa.eu/contact).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu.

Open data from the EU

The EU Open Data Portal (http://data.europa.eu/euodp/en/data) provides access to datasets from the EU. Data can be downloaded and reused for free, both for commercial and non-commercial purposes.

Publications Office
of the European Union