Different strokes for different folks: untangling supply and demand shocks using survey-data to assess sectoral inflationary pressures in Croatia

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Article**
JEL: C32, D24, E32, J23
https://doi.org/10.3326/pse.50.1.2

* The opinions contained in this paper are the authors' exclusively and do not necessarily reflect those of the Croatian National Bank and the Bank of Italy. The authors would like to express their gratitude to two anonymous referees for their invaluable comments and suggestions, as well as to Marko Luketina, Vedran Šošić, Davor Kunovac, Milan Deskar-Škrbić, Ivana Čičak and Pave Rebić from the Croatian National Bank, to Ivan Žilić from the Institute of Economics, Zagreb and to the members of the ECB's Working Group on Forecasting for their constructive suggestions. Additionally, the authors acknowledge the use of ChatGPT to enhance the translation, readability, and overall language quality of the paper.

The article was judged the best regular article in the 2025 annual competition of the Hanžeković Foundation.

** Received: June 1, 2025
Accepted: November 17, 2025

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Abstract

While inflation has moderated across most of the euro area since its post-pandemic peak, some countries still face above-average price pressures. In Croatia, inflation has slowed but remains persistent, raising questions about its underlying origins. This paper analyses recent inflationary pressures in Croatia, using firm-level survey data on production constraints and capacity utilization to untangle supply and demand factors in services and manufacturing, considering sectoral inflation divergence. Unlike traditional approaches, our sectoral output gap captures both supply and demand side drivers of inflationary pressures. Findings show that post-pandemic inflation was mainly driven by supply factors, labour and intermediate input shortages, while ongoing demand pressures, especially in services, continue to fuel inflation. By examining structural and cyclical factors we offer new insights into how inflation behaves in smaller euro area economies, which could help policymakers refine their tools for managing inflation since one-size-fits-all solutions may fall short.

Keywords: sector-specific output gap, survey-data, inflation divergence, structural Phillips curve, Croatia

1 INTRODUCTION

The COVID-19 pandemic and the global energy crisis triggered a sharp spike in inflation worldwide. In the euro area, economists have identified several factors that drove this surge. Some believed inflation would ease as supply chains recovered and energy prices stabilized, especially after the disruptions caused by the pandemic and the war in Ukraine (ECB, 2022; IMF, 2022). Others argued that deeper demand-driven causes, such as strong post-pandemic consumer spending and a tight labour market could create longer-lasting price pressures (Ferreira, Abreu and Louçã, 2025).

By 2024, inflation in the euro area had largely cooled, with the average annual growth rate of the Harmonised Index of Consumer Prices (HICP) falling from 8.4% in 2022 to 2.4% – close to the European Central Bank's target. This decline was supported by a combination of tight monetary policy and targeted, temporary fiscal support. However, not all countries followed this trend. In Croatia, inflation remained stubbornly high, dropping from 10.7% in 2022 to 4% in 2024.

This paper seeks to shed light on why inflation in Croatia remains elevated and what this means for policymakers trying to bring it back to target. We explore whether the root causes are linked more to lingering supply issues, such as labour shortages and demographic challenges, or to ongoing demand pressures. To do this, we use sector-level survey data that track the extent to which businesses are using their capacity and what factors are limiting their output at a quarterly frequency. We use these data to build, to the best of our knowledge, an original output gap estimates by linking sector-level inflation to the incidence of each of the limiting factors across firms in a given sector.

We then break down inflationary pressures into supply-side and demand-side components and explore how Croatia's unique economic landscape, including an aging workforce and recent fiscal policies, helps explain these findings. Our analysis focuses on three key questions. First, can traditional ways of estimating economic slack, such as output gaps obtained by filtering aggregate output, accurately reflect inflationary trends in Croatia? Second, can a more advanced method, using a Bayesian VAR (BVAR) model with structured shocks, provide better insights, especially in the context of a small, open economy? And third, how do different shocks, whether temporary or long-lasting, influence inflation and output gaps?

Finally, we look at how these pressures play out across different sectors. We find that inflation in services remained high throughout 2022-2024, driven by both strong demand and persistent labour shortages. In contrast, inflation in manufacturing has eased more recently, although the sector still shows signs of inflationary pressures due to continued demand and limited labour availability. Survey-based results refute the output gap estimates for Croatia when using univariate filters (HP, one-sided HP, Hamilton). These methods capture demand-side pressures, thus omitting supply shocks by labelling them as permanent, which is misleading according to our novel approach. As we show, the fact that supply shocks were not negligible across sectors explains why traditional approaches to output gap estimates did not properly signal inflationary pressures in 2022-24. Also, we show that the Phillips curve in Croatia is not necessarily flat, contrary to previous domestic research. These insights are of added value for central bankers since the output gap is an important tool for monetary policy decisions, thus reflecting the need to take into account any potential temporary supply shock in the economy when formulating a monetary or macroprudential stance, where the latter could be a more effective tool in reducing inflation indirectly through increased demand because lending decisions are made independently at the national level.

The rest of the paper is structured as follows: section 2 examines the usefulness of traditional output gap measures and the BVAR approach in detecting inflationary pressures. Section 3 introduces a new, survey-based measure using firm-level data. Section 4 connects our findings to broader structural and cyclical forces at play in Croatia. Section 5 concludes.

2 DIFFERENT METRICS FOR ESTIMATING THE OUTPUT GAP AND WHY THE LATTER MATTERS FOR INFLATION

Price developments are primarily linked to economic slack, i.e., the intensity with which firms use resources such as equipment, technology, or the workforce in the production process, compared to their installed capacity (ECB, 2018).[1] When firms underutilize their productive capacity due to insufficient demand, they tend

[1] Inflation expectations also play a major role in price formation: if businesses expect high inflation, they will adjust their own prices accordingly in order to make up for the increased cost of their inputs and relative devaluation of their nominal profits. That is why central bank credibility and action is crucial in preventing inflationary spirals.

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to limit their production and decrease their prices to attract customers and minimize losses. Conversely, when demand is strong, the increase in the intensity with which they produce their goods and services can lead to increases in production costs due to higher capital depreciation and higher wage bills, pressing firms to increase their own prices.

In macroeconomics, the level of output firms would usually achieve in the absence of shocks and policy changes, given the installed production capacity of the economy, is known as potential GDP. Economic slack, i.e., the distance between actual observed GDP and potential GDP as a percentage of the latter, is called the output gap. The output gap is a measure of the state of the economy: a positive output gap means the economy is producing above its usual level, while the opposite occurs when it is negative. When the business cycle is mainly driven by demand shocks, a positive output gap leads to an increase in inflationary pressures, whereas a negative output gap decreases inflationary pressures and, if negative enough, can eventually lead to deflation. For central banks, the output gap is thus a crucial input for monetary policy decisions, as conceptualized by the Taylor rule (Mazelis, Motto and Ristiniemi, 2023). In an economy dominated by demand shocks, a positive output gap signals the need for a restrictive monetary policy stance and vice versa.

Following this view, policy institutions have traditionally measured the output gap using a combination of statistical filters on aggregate output and the production function approach (Havik et al., 2014; De Masi, 1997). One crucial assumption behind most traditional output gap estimates is that supply shocks are permanent and thus only affect potential output (see e.g. Blanchard and Quah, 1989). When the economy is hit by temporary negative supply shocks, as was the case during and after the pandemic across all European economies, an output gap measured with traditional methods would result in a negative estimate, as the temporary fall in output would not register as a shift in potential. The relationship between the estimated output gap and inflation would turn upside down: for example, a large increase in input prices, such as the price of imported energy, can oblige firms to increase their prices, while simultaneously reducing the amounts of goods and services they produce (González-Torres, Gumiel and Szörfi, 2023). The output gap would therefore not be signalling the presence of inflationary pressures, possibly depriving monetary policy makers of an important input in their decision process.[2] Furthermore, given that the output gap is traditionally estimated using

[2] On the flipside, the output gap measure we propose is one to measure inflationary pressures, but not necessarily to reflect the state of the business cycle: the state of the business cycle, i.e., the distance between the actual output of an economy and its potential, is well measured by traditional output gap estimates, if we believe that supply shocks affect potential output directly. We therefore don't advocate using our output gap estimate as a way to estimate potential output. The question of how temporary supply shocks are, and possibly more importantly, how large temporary supply shocks are compared to permanent ones, is still an important issue in terms of estimating potential output. As shown below, our data are agnostic concerning what level of supply factors affecting firms in our sample is temporary rather than permanent; however, what they do suggest, is that the magnitude of the temporary supply shocks that hit the EA during and after the pandemic was significantly larger than ever before. In that sense, it would suggest that potential output, at least during the pandemic, fell significantly more strongly than suggested by traditional estimates.

aggregate data, which are only available in their final version with considerable delay, its real-time estimate is highly uncertain and prone to large revisions.

Recent international literature has increasingly questioned the effectiveness of traditional output gap measures in explaining inflation dynamics during the post-pandemic period. In the euro area, the ECB's analysis highlights how conventional models, such as those based on univariate filters (e.g., HP, Hamilton), often failed to capture the complex interplay of supply and demand shocks that drove inflation after 2020. These models tended to underestimate the role of supply-side factors, such as energy price spikes and supply chain disruptions, which were critical in shaping inflationary pressures, particularly in small open economies (Giannone and Primiceri, 2024). Similarly, in the United States, studies using macroeconomic models (e.g., DSGE and BVAR) have shown that while demand-side factors (e.g., expansionary fiscal and monetary policies) contributed to inflation, supply shocks, such as labour market tightness, bottlenecks, and energy price volatility, played a dominant role in the initial surge. Traditional output gap measures, which primarily focus on demand-driven slack, were often misaligned with actual inflation trends, as they struggled to account for the persistent effects of supply disruptions (Faria-e-Castro, 2025; Brooks, Orszag and Murdock, 2024). The Federal Reserve's analysis further underscores the importance of global and regional supply frictions, which were not adequately captured by traditional models (Federal Reserve, 2025).

We follow the international literature by using various slack measures to illustrate the previous points: univariate filters (HP, one-sided HP, Hamilton), which have previously been applied in the domestic literature (Jovičić, 2017; Grgurić, Nadoveza Jelić and Pavić, 2021; Arčabić and Banić, 2021), as well as and the BVAR approach, which has not yet been applied in the domestic literature.

Figure 1 presents estimates for the Croatian output gap using the Hodrick-Prescott (1997), the one-sided Hodrick-Prescott (Wolf, Mokinski and Schüler, 2020) and the Hamilton (2018) filters alongside total inflation, measured with HICP, in Croatia (details regarding the methodology of univariate filters are in the appendix). Although all three output gaps seem to become positive as inflation starts to rise after the pandemic, only the Hamilton filter seems to fully capture the inflationary pressures in that period: the HP and the one-sided HP filter indicate a neutral output gap aside from the beginning of 2022, most likely reflecting the effects of the energy crisis, which pushed inflation up while keeping output low. Furthermore, Croatia has been experiencing persistently high core inflation, mostly due to services, whose slowdown has been significantly less pronounced than that of headline inflation. This is not reflected in either HP filter.

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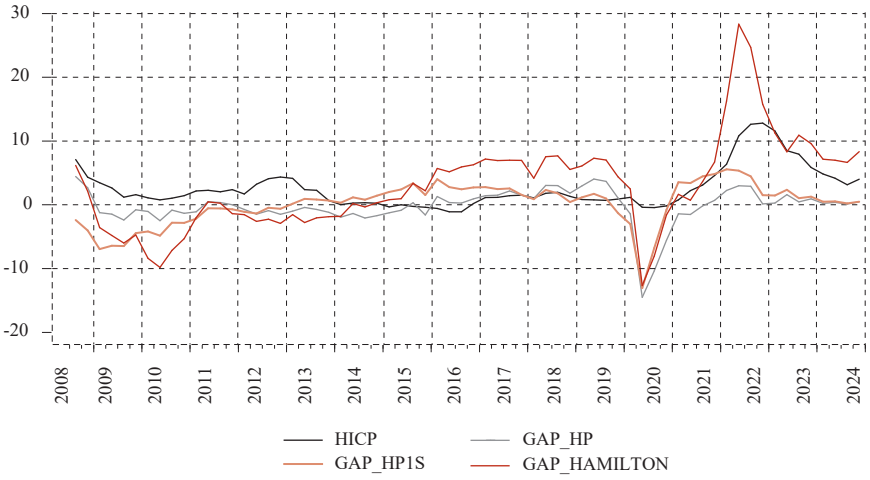
FIGURE 1

Output gaps (in % of potential GDP), total HICP inflation (YoY, %) in Croatia



Source: Eurostat, authors' calculations.

Going a step further, one could argue that the Hamilton filter does not correctly signal those pressures either: even though it does estimate a highly positive output gap in the latter period, the estimates are not very different from other periods like the mid-2000s or late 2010s, when inflation was relatively low. Overall, this would lead us to think the Hamilton filter is highly volatile over the entire sample, regardless of inflation. Also, none of these methods directly take into account price developments and rely only on real GDP.

Blanchard (2018) emphasizes that in times of strong shocks (demand and/or supply), the HP or any univariate filter cannot properly distinguish between the different natures of shocks, thus estimating potential GDP and an output gap that do not follow price developments. Also, univariate filters like HP have other statistical disadvantages, e.g., end-of-sample problem, making the estimates sensitive to each new data point (Jovičić, 2017). Additionally, univariate filters do not have economic meaning, as distinct from some other advanced approaches like the production function or structural models. However, Banić, Pripužić and Rebić (2024) show that the output gap estimated with a production function does not deviate much from that estimated with an HP filter.

Finally, we can conclude that traditional output gap measures mostly failed to signal inflationary pressures for the period 2021-2024 in Croatia. To find the relationship between inflation and the output gap in Croatia, we also use a more advanced econometric approach. We estimate the output gap for Croatia with accumulated domestic and external demand shocks (usually characterized as temporary) using a BVAR, which is also a novel approach in the domestic literature, following the approach by Coibion, Gorodnichenko and Ulate (2017). However, our

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identification of structural shocks also takes into account the block exogeneity assumption for a small open economy (Deskar-Škrbić, Kotarac and Kunovac, 2020; Jovićić and Kunovac, 2017; Barišić and Kovač, 2022; Arias, Rubio-RamÌrez and Waggoner, 2014).

In this case, we use quarterly data from 2006Q1 to 2024Q4 on real gross domestic product (GDP) and the Harmonised Index of Consumer Prices (HICP) from Eurostat. Firstly, we adjust the variables for the seasonal component with Census-X12 and then use the annual rate of change in real GDP and HICP.

The structural shocks within the Bayesian Vector Autoregressive model are obtained through sign and zero restriction identification (see the appendix for more methodological and technical details), which is a common empirical strategy in the domestic literature (Deskar-Škrbić, Kotarac and Kunovac, 2020; Jovičić and Kunovac, 2017; Nadoveza, 2025). Regarding the imposed shocks (appendix, table A2), a domestic (Croatian) aggregate demand shock increases both GDP and HICP in Croatia, with no effect on euro area variables, while a domestic aggregate supply shock increases GDP and decreases HICP in Croatia, with no effect on euro area variables either. Regarding external (euro area) shocks, aggregate demand increases economic activity and inflation in the euro area with indeterminate effects on domestic (Croatian) GDP and HICP, while a supply shock increases GDP and HICP in the euro area with unrestricted effects on domestic (Croatian) GDP and HICP.

During 2020-24, Croatia experienced various combinations of domestic and external shocks, which are depicted on historical decomposition of the annual inflation and real GDP growth rate (see appendix, figures A4-A7). A historical decomposition is usually used to decompose the contribution of a specific shock k to an observed variable j in a model in period t:

$$y_{jt}^{k} = \sum_{h=0}^{t-1} \psi_{jk,h} x\ \varepsilon_{k,t-h} \tag{1}$$

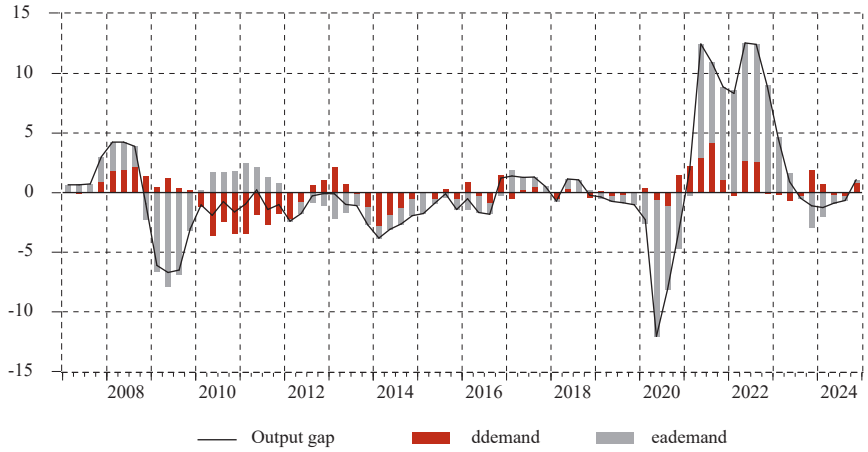
In the next step, we construct the output gap with accumulated domestic (Croatian) and external (euro area) demand shocks to real GDP:

$$y_{gdpt}^{demand} = \sum_{h=0}^{t-1} \psi_{gdp,h} x\ \varepsilon_{k,t-h} \tag{2}$$

Figure 2 shows that the output gap calculated as accumulated domestic and external demand shocks to GDP (like Coibion, Gorodnichenko and Ulate, 2017) explains demand-side inflationary pressures more accurately than univariate filters (figure 1), which only consider real GDP, while this model also captures external, euro area demand shocks (*eademand*), important for a small and open economy like Croatia.

Figure 2

Output gap in Croatia according to accumulated domestic and external demand shocks to real GDP (%, percentage points)



Note: ddemand corresponds to domestic (Croatian) demand shock, while eademand corresponds to euro area demand shock.

Source: Authors' calculations.

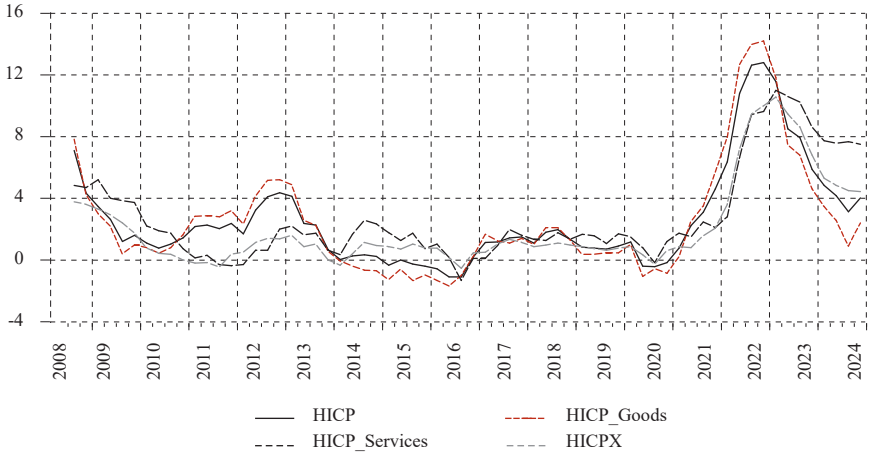
However, the approach by Coibion, Gorodnichenko and Ulate (2017) adheres to the premise that transitory supply shocks affect not the output gap but potential output. González-Torres, Gumiel and Szörfi (2023) show that including the effects of transitory supply shocks, such as supply bottlenecks during the pandemic and the energy market disturbances thereafter, in the output gap instead of potential output, helped the output gap comove significantly with inflation during those episodes. Regarding the pandemic supply shock, Granados and Parra-Amado (2024) highlight the importance of time adjustments to counteract the high degree of uncertainty and instability when using traditional approaches (univariate filters) for estimating the output gap. In Croatia, there were no scarring effects during the pandemic, mostly due to job retention schemes (Barišić and Kovač, 2022), which enabled a post-pandemic V-shaped economic recovery to some extent. The Next Generation EU programme also played a crucial part, both on the demand- and the supply side, through the fiscal and structural reform channels: demand-driven stimuli were channelled through higher government revenues and the supply side improved following the positive effects of structural reforms and investments (ECB, 2024).

Identifying supply shocks separately from demand shocks is crucial, as is estimating their duration. However, the literature, following Blanchard and Quah (1989), has usually used the duration of shocks to identify whether they came from demand (assumed to be temporary) or supply (assumed to be permanent). We instead propose the use of a sectoral-level survey to directly estimate the output gap. Our estimate lets us:

1) Construct sector-specific output gap estimates that take the price divergence in goods and services in Croatia into account (figure 3).
2) Derive a detailed decomposition of supply (labour, equipment and other) and demand factors, based on survey data.

FIGURE 3

Total HICP, Core HICP(X), HICP services, HICP goods for Croatia (YoY, %)



Source: Eurostat.

Namely, although inflation in Croatia is on a declining path in 2024, it is still above target and among the highest in the euro area, mostly due to the contribution of inflation in services. Thus, it is necessary to analyse which factors (demand and/or supply) are affecting the dynamics in services and manufacturing regarding inflationary pressures.

3 AN ALTERNATIVE OUTPUT GAP TO EXAMINE SURVEY-BASED SECTORAL INFLATIONARY PRESSURES IN CROATIA

Given that an aggregate output gap cannot signal neither (dis)inflationary pressures coming from a rich mix of shocks, nor divergent sectoral developments, especially when traditional measures of the output gap capture mostly demand shocks, we use a novel approach to estimate inflationary pressures. We construct a survey-based output gap in services and manufacturing using data from the European Commission's Business Surveys.[3] In particular, we take the responses on capacity utilization and the factors limiting production by sector. In any given quarter, firms indicate whether demand, supply or other factors are relevant in limiting production, as well as the percentage of their capacity they are using in

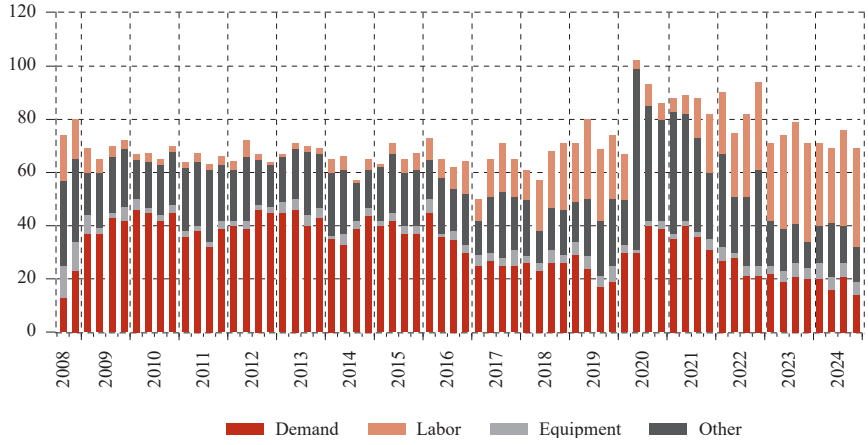
[3] The European Commission's business surveys gather information from firms across Europe regarding their rate of capacity utilization, i.e., a direct measure of economic slack, as well as the various factors that limit their production in a certain quarter, including insufficient demand, labour shortages, lack of equipment, materials, or space, and "other factors". Survey data for services includes three hundred companies and for manufacturing two hundred and forty companies in Croatia. The survey is available at: https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/business-and-consumer-surveys_en.

production at that time. Using the information regarding limiting production factors, we can properly assess whether inflationary pressures stem from supply or demand factors by correlating sector-level inflation to the percentage of firms limited by each of the factors shown below. Due to data availability, we cover the period between 2008Q3 and 2024Q4.

Figure 4 indicates the survey-based factors limiting production in services for Croatia, reflecting an impulse from demand once the pandemic restrictions were lifted in the aftermath of the COVID-19 crisis. However, the sharp increase in labour shortages (mismatch of demand and supply on the labour market) which had partly already started growing right before the pandemic stands out beyond the increased demand. Figure 4 also shows a temporary increase in the number of firms affected by other factors during the pandemic, which can be related to some of the pandemic-related health measures imposed on the services sector in Croatia. Service sector firms in Croatia instead did not seem to be significantly affected by equipment bottlenecks.

FIGURE 4

Factors limiting production in services for Croatia (% of firms claiming specific factors limiting production)



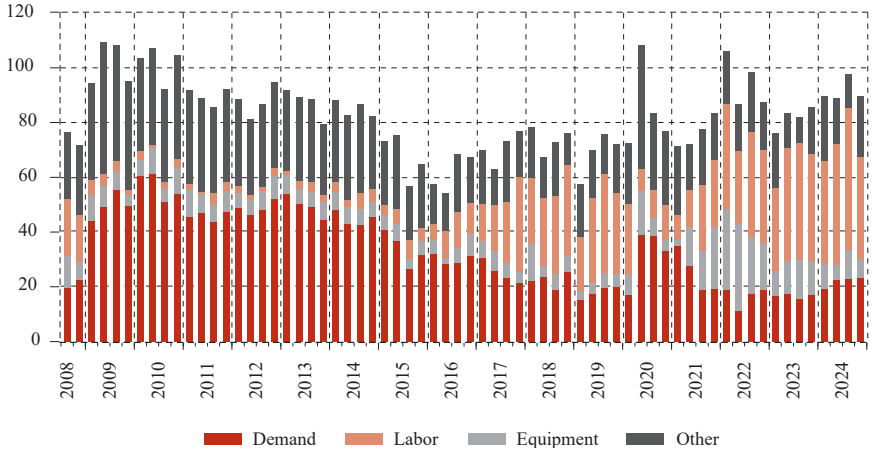
Note: The figure shows the percentage of firms claiming each factor limited their production in a given quarter. The sum of all firms claiming they were limited by some factor may add up to more than 100 percent, reflecting the fact that firms might identify more than one factor limiting their production.

Source: European Commission.

Turning to manufacturing, figure 5 shows an increase in demand post-pandemic analogous to that in services. Furthermore, the prevalence of firms facing labour shortages that started before the pandemic is also evident in manufacturing. However, contrary to what happened in the services sector, Croatian firms in the manufacturing sector reported a significant increased effect of equipment bottlenecks on their production after the pandemic. Other factors instead did not seem to limit manufacturing firms more significantly than before the pandemic.

FIGURE 5

Factors limiting production in manufacturing for Croatia (% of firms claiming specific factors limiting production)



Note: The figure shows the percentage of firms claiming each factor limited their production in a given quarter. The sum of all firms claiming they were limited by some factor may add up to more than 100 percent, reflecting the fact that firms might identify more than one factor limiting their production.

Source: European Commission.

We construct our alternative output gap measure in various steps. First, we use demeaned values of sectoral inflation and the factors limiting production to capture (dis)inflationary signals. On the one hand, we do so in recognition of the important role inflation expectations play in setting inflation, as illustrated, e.g., by Beaudry, Hou and Portier (2025). By using demeaned values, we abstract from inflation expectations in our estimates.[4] On the other hand, by using demeaned limiting factors, we try to approximate temporary shocks, thus recognizing that permanent shocks should by accounted variations of potential output as opposed to the output gap. Next, we extract the demand fluctuations from other and supply factors (labour and equipment) to address the potential issue of endogeneity: firms chose their inputs partly based on the demand they face. Demand levels might therefore directly affect whether firms claim to be limited by supply or other factors at any given time. We regress equipment (E), labour (L) and the other factors (O) on demand (D):

$$F_t = \gamma^F + \gamma_1^F D_t + \eta_t^F \tag{3}$$

where $F \in \{E, L, O\}$ and we construct the factors limiting production netted of demand using the residuals from equation (3) ($N_t^F = \eta_t^F$). Finally, we estimate the following equation (4), separately for services (with a linear trend) and manufacturing, where π represents demeaned inflation in services and manufacturing, respectively:

$$\pi_t = \alpha + \beta_1 D_t + \beta_2 N_t^E + \beta_3 N_t^L + \beta_4 N_t^O + \varepsilon_t \tag{4}$$

[4] We are implicitly assuming that inflation expectations are anchored throughout the sample. Introducing varying inflation expectations is the subject of forthcoming research.

Table 1

Survey-based sectoral factors limiting production regressions

	Manufacturing	Services
Demand	-0.102***	-0.220***
	(0.022)	(0.053)
Other factors	0.014	0.026
	(0.061)	(0.042)
Labour	0.086*	0.312***
	(0.042)	(0.072)
Equipment	0.208***	0.117
	(0.053)	(0.234)
Constant	1.402***	245.250
	(0.363)	(252.372)
Observations	64	64
Joint significance (chi2)	52.094	75.490
p	0.000	0.000

*Note: * p<0.10, ** p<0.05, *** p<0.010.*

Source: Authors' calculations.

Table 1 shows the results of estimating equation (4). Demand as a factor limiting production enters the regression with a negative coefficient, as a higher value signifies that firms have a harder time finding clients and thus suffer fewer inflationary pressures from demand. Supply factors enter the regression with a positive coefficient, as higher values reflect firms' finding it harder to employ the corresponding factors, thus raising their input prices, which they ultimately pass on to their final prices.

Finally, we construct our output gap by drawing an analogy between equation (4) and a Philips curve. Each of the factors limiting the production of firms simultaneously affect their pricing decisions, leading to various degrees of inflationary pressures. In traditional output gap estimates, which correctly reflect inflationary pressures created by demand shocks, an increase in demand should be positively correlated with price changes, thus leading to a positive output gap. However, when supply shocks (e.g. supply bottlenecks) hit firms, the shocks limit the production of firms, while still creating inflationary pressures, which can lead to dampening the slope coefficient of a traditional Philips curve. We therefore define our output gap measure as the fitted values of the regression (4) normalized to have the same volatility as capacity utilization in the data[5]:

$$\widehat{OG}_t = \left(\pi_t - \widehat{\varepsilon}_t\right)\frac{\sigma_{CU}}{\sigma_{\left(\pi_t - \widehat{\varepsilon}_t\right)}} \tag{5}$$

[5] We introduce the normalization for the purpose of making its magnitude comparable to a traditional output gap, to be able to overlay the two graphically. The normalization is innocuous as long as we limit our analysis to interpreting the time variation of the output gap compared to itself. We are careful, however, not to interpret its magnitude directly as the deviation of output from a level that would zero out inflationary pressures, as that would implicitly assume certain values for the elasticity of production with respect to the various shocks, which we don't estimate here. This latter point is the subject of ongoing research.

Table 2 emulates the Philips curve for our survey-based output gap, according to which we obtain the same regression coefficients as for equation (4). We find that a Philips curve estimated with the survey-based output gap does predict a significant slope, thus capturing all inflationary pressures present in Croatia.

Table 2

Survey-based sectoral output gap regressions

	Manufacturing	Services
Survey-based output gap	0.492***	0.788***
	(0.071)	(0.133)
Constant	1.402***	245.250
	(0.343)	(214.620)
Observations	64	64
Joint significance (chi2)	52.094	75.491
p	0	0

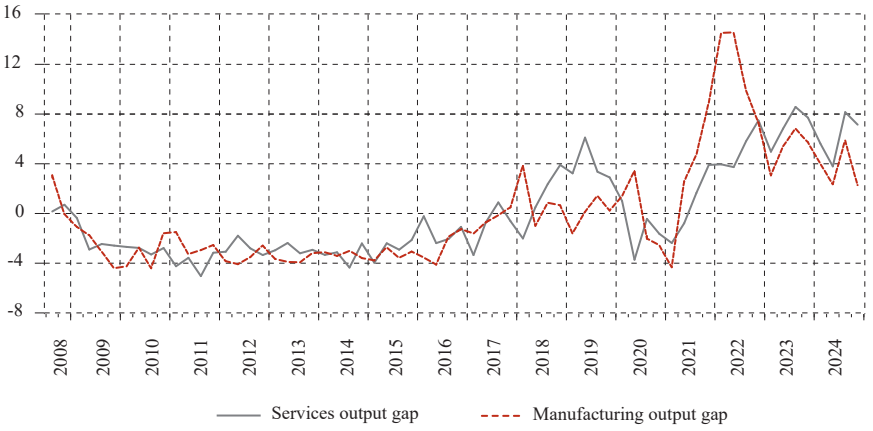
*Note: * p<0.10, ** p<0.05, *** p<0.010.*

Source: Authors' calculations.

Our sectoral output gap points to divergent inflationary pressures recently by indicating ongoing pressures in services and a downward path in manufacturing in 2024 (figure 6).

Figure 6

Output gap for services and manufacturing in Croatia (%)



Source: Authors' calculation.

We decompose the survey-based sectoral output gap based on equation (5) (figures 7 and 8) into the contributions of each factor:

$$\widehat{OG_t}^{(F)} = \frac{\sigma_{CU}}{\sigma_{\left(\pi_t - \widehat{\varepsilon_t}\right)}} \widehat{\beta}_F N_t^F \qquad (6)$$

whereby $F \in \{D, E, L, O\}$, $N_t^F = \begin{cases} D_t, & F = D \\ \eta_t^F, & F \in \{E, L, O\} \end{cases}$.

Our output gap shows that the bulk of ongoing inflationary pressures, both in services and manufacturing, come from demand. Labour shortages still play a minor role in pushing inflation up, but the post-pandemic related equipment shortages have been phased out by now. Compared to the aggregate output gap constructed with aggregate demand shocks in figure 1, we see that our measure once again converges to a similar inflationary signal, once the weight of supply shocks has fallen. This result points to the importance of both sector and supply-specific factors when estimating inflationary pressures with the output gap, as well as suggesting that the Phillips curve in Croatia is indeed positively sloped.

Our results are somewhat complementary to previous domestic research. Krznar (2011) concludes there is no relationship between economic slack and inflationary developments in Croatia, i.e. the traditional Phillips curve would appear to be flat. He arrives at this conclusion by estimating potential GDP and the output gap using an HP filter on GDP. As we argue, this is likely misleading in the post-pandemic period, since the HP output gap arguably only captures demand shocks. Krznar (2011) however argues in favour of the existence of a New Keynesian Phillips curve, by considering other variables such as foreign inflation, marginal production costs and inflation expectations. Marginal costs, in particular, reflect shocks to the supply factors present in our framework. Furthermore, our factors limiting production also pick up foreign prices, since a considerable share of inputs are imported. All in all, we can confirm the existence of a structural Phillips curve in Croatia. McLeay and Tenreyo (2020) emphasize that most research follows the approach proposed by Gordon (1981), using only demand shocks to correctly shape the Phillips curve, resulting in a flat slope. As they show on a structural Phillips curve, that is wrong. Yilmazkuday (2025) also highlights the importance of a shock-dependent approach to estimating the Phillips curve slope, which is flat if affected only by demand shocks and positive if affected by supply shocks, such as cost-push shocks and structural labour market disturbances.

Figure 7 shows our survey-based output gap in services in Croatia. From 2022 onwards, the output gap signals inflationary pressures, which can be explained both by increased demand and labour shortages. The output gap suggests firms are faced with severe labour shortages, which translate into higher costs and to some extent, spill over to final prices. However, this channel is highly seasonal and seems to have partly levelled off since a large portion of foreign workers work in services related to hospitality (Banić, Pripužić and Rebić, 2024). However, strong demand continues to contribute positively to the output gap in services, putting pressure on final prices. More specifically, demand in services related to hospitality is most likely based on foreign and domestic demand, which is also reflected in high inflation in services. Figure 7 also highlights a positive output gap in mid-2024, after a mild decrease in 2023Q1-Q2, which is a result of labour shortages during the summer tourist season, a time in which both foreign and domestic demand are substantial. However, the latest data show that Croatia could face a negative effect of price competitiveness in tourism,[6] which is expected to be reflected in the price formation in the upcoming years.

[6] See Box 5 in CNB (2016).

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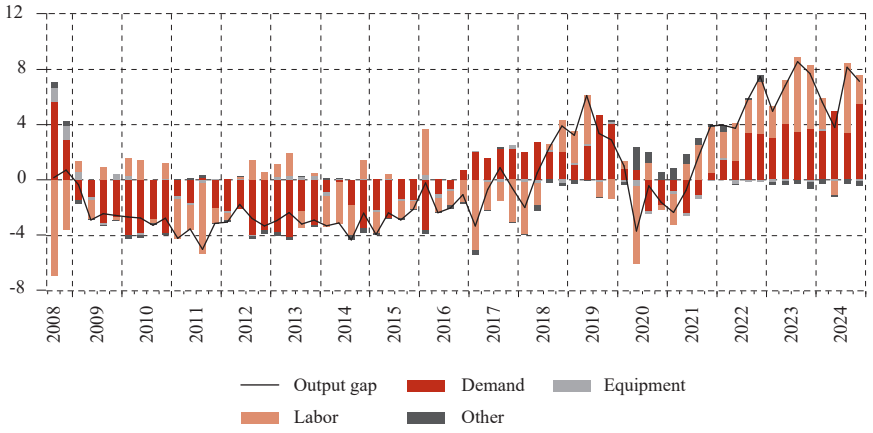
FIGURE 7

Survey-based output gap in services for Croatia (%, percentage points)

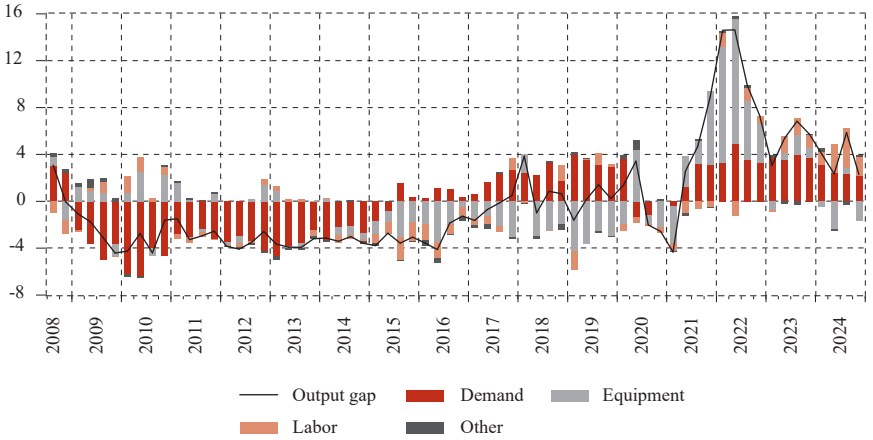


Source: Authors' calculation.

Turning to inflationary pressures in manufacturing, although strong demand explains a substantial part of the inflationary pressures since 2016, excluding 2020, figure 8 points to increased pressure on final prices in late 2021 and throughout 2022, mostly due to shortages in equipment and materials. Supply chain bottlenecks during the various lockdowns affected equipment and intermediate input prices globally, which, accompanied by strong demand, resulted in relatively high inflationary pressures in 2022. However, the inflationary effects of the bottlenecks phased out in 2023, while high demand persisted. Labour shortages, in contrast, did not seem to play a relevant role in manufacturing until 2024. At that point, demand contributed less to overall pressures than previously, while labour shortages recorded a higher annual contribution. Overall, in manufacturing, the inflationary pressures eased after 2022 and are currently below the post-energy crisis average.

FIGURE 8

Survey-based output gap in manufacturing for Croatia (%, percentage points)



Source: Authors' calculation.

As shown in figures 7 and 8, our survey-based sectoral output gap indicates precisely inflationary pressures in services and manufacturing in Croatia, contrary to traditional output gap estimates. This reflects the importance of accounting for supply factors, which are usually omitted when using univariate filters (HP, one-sided HP, Hamilton). In other words, our survey-based approach to estimating sectoral output gaps signals inflationary pressures more accurately than the aforementioned approaches.

4 DISCUSSION: STYLIZED FACTS ON RECENT STRUCTURAL AND CYCLICAL FACTORS IN CROATIA

After highlighting the pros of survey-based output gap as compared to traditional and more advanced econometric approaches, in this section we will point out some important structural and cyclical drivers of inflationary pressures in Croatia. Aside from other factors and equipment, which are mostly related to global cost-push situations during the Covid and energy crises, structural are mostly related to the tight labour market in Croatia, while cyclical drivers are related to economic policies.

Retrospectively, in the aftermath of the Global Financial Crisis, Croatia was faced with a negative output gap for almost a decade (figures 7 and 8). In manufacturing and services, these developments are mostly driven by demand side, followed by supply side, i.e. labour shortages (only in services). However, after the Croatian accession to EU in 2013, strict EU fiscal rules (Stability and Growth Pact), i.e. Corrective Arm of SDP, pushed fiscal policy makers towards restrictive procyclical stance (Banić and Žilić, 2024), which had negative and self-defeating economic effects (Deskar-Škrbić and Milutinović, 2021). However, when the relatively long recessionary episode in Croatia ended, demand in services (external to some extent) started to contribute positively to the output gap, while labour shortages operated in the opposite way due to structural factors after the EU accession in 2013, when a not negligible cohort of the working-age population emigrated to western EU economies. A similar pattern is observable in manufacturing, however, to a lesser extent. During the pandemic, the general escape clause of the SGP was activated, and countries were allowed to conduct expansionary countercyclical polices, which alongside the Next Generation EU programme helped countries (among which Croatia is considered as frontrunner, see appendix, figure A10) to economically recover from the pandemic on both the demand and the supply side (ECB, 2024).

Regarding cyclical drivers of inflationary pressures, we will analyse decomposition of change in the general government balance in % of GDP (Δggb_t) expressed as:

$$\Delta ggb_t = \Delta i_t + \Delta spb_t + \Delta cyc_t + \Delta of_t \tag{7}$$

which reflects changes in interest expenditures (Δi_t), cyclical component (the effect of business cycle, Δcyc_t), structural primary balance (Δspb_t, i.e. fiscal stance) and in one-off and temporary measures (Δof_t). A negative change in the structural

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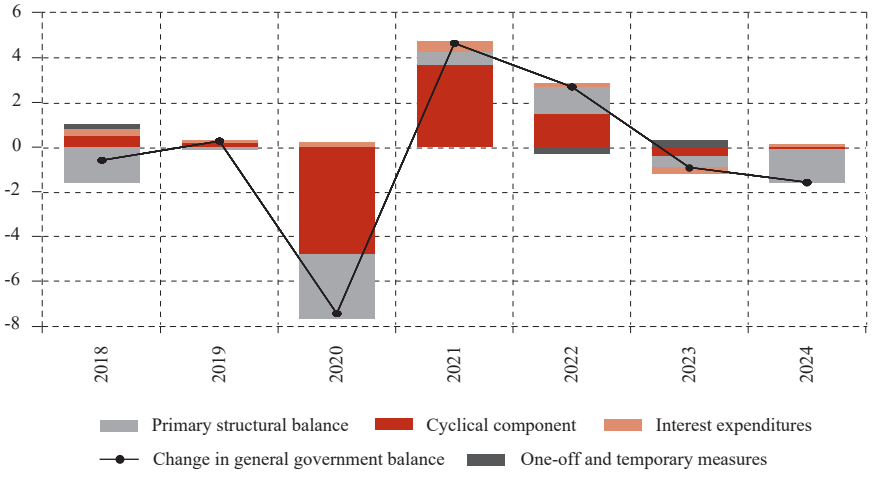
primary balance points to the expansionary fiscal stance in 2024 (figure 9), which is, in periods of positive aggregate output gap (2.2% of potential GDP in 2024, AMECO, 2025 – in line with our results), characterized as procyclical. Expansionary procyclical fiscal stance in 2024 is mostly due to the comprehensive wage-setting reform in Croatia (Nadoveza, 2025) (figures 10 and 11), as well as due to energy-compensatory measures and some other discretionary factors. Noteworthily, fiscal policy makers in Croatia due to a previously accumulated fiscal space did not breach deficit and debt reference values in 2024.

Figure 9

Decomposition of change in general government balance (% of GDP) in Croatia (percentage points)



Source: AMECO, authors' calculations.

Ivanac, Kunovac and Nadoveza (2024) concluded that wage spill-over on inflationary developments is possible in an environment characterized by demand shocks, which can be associated with positive output gap in Croatia. Hence, the contribution of domestic demand, especially in services can be associated to some extent with expansionary fiscal stance (light grey bars in figure 9). To mitigate inflationary pressures stemming from domestic demand, fiscal stance is expected to be restrictive, if the output gap is positive. Checherita-Westphal, Leiner-Killinger and Schildmann (2025) showed that fiscal policy can contribute to inflationary developments through the demand side, i.e. the output gap. Also, fiscal policy, in the light of the wage-setting reform in public sector (figures 10 and 11), apart from demand pressures, could have had negative effects on the private sector, i.e. on labour shortages (figures 7 and 8), thus generating inflationary pressures further, if workers shift to the public sector. Wage-setting reform in 2024 in the public sector (O, P, Q entities) resulted in substantial wage increase of more than 20% on average, while at the same time, the increase in other sectors like manufacturing and hospitality was much smaller, reflecting to some extent an increase in the minimum wage.

FIGURE 10

Average gross wages, annual %

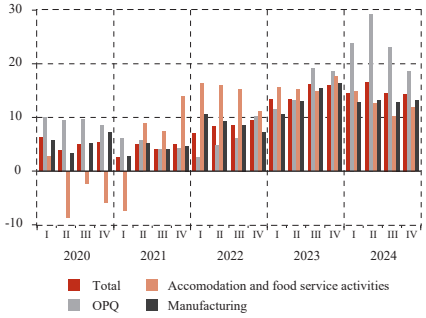
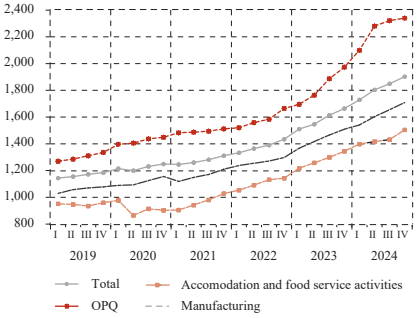


FIGURE 11

Average gross wages, levels (in euro)



Note: Data are seasonally-adjusted using X-12.

Source: CBS, authors' calculations.

When it comes to local Central Bank policy, the Croatian National Bank introduced on July 1st macroprudential measures to restrain consumption by limiting consumer lending, and consequently mitigate risks to financial stability.[7] Also, that part of the restriction related to new non-purpose cash loans could indirectly alleviate demand driven inflationary pressures (whereas tightening a year earlier would probably have been even more effective). In the upcoming years, both fiscal and macroprudential stances should be restrictive to absorb accumulated positive domestic demand contributions to inflationary pressures in the economy, which might not be enough considering structural factors on labour market, i.e. supply side of economics and external demand, especially in hospitality.

Regarding recent structural factors, the labour market is in the principal focus. In the aftermath of the pandemic, one can say that the demand in the labour market is largely satisfied by employing workers from third countries, but also pensioners according to the decomposition of employment changes (see appendix, figure A11). In 2023, a third of the increase in employment is related to foreign workers, part of the residual reflecting the contribution of foreign workers since the entrepreneurs do not record them correctly (Banić, Pripužić and Rebić, 2024).

In addition to the outflow of part of the working-age population to western EU countries, the continuation of a tight labour market is expected, which could additionally have an inflationary effect through the labour shortage (salmon bars on figures 7 and 8). Also, if demand on the labour market had not been met with foreign workers[8] and pensioners, the labour shortage would have made a stronger contribution to inflationary pressures.

[7] Macroprudential measures apply to all new housing and non-housing loans to consumers, and includes restrictions on the maximum monthly repayment ratio of the consumer's total debt to income (DSTI ratio), the maximum ratio of the amount of the housing loan to the value of the property pledged (LTV ratio), and the maximum loan maturity. For more details see Box 3.1. in CNB's publication "Macroprudential diagnostics" at: https://www.hnb.hr/en/analyses-and-publications/regular-publications/macroprudential-diagnostics.

[8] According to the Croatian Ministry of Internal Affairs (2025), from 1 January 2024 to 31 December 2024, 36% of the total residence and work permits issued to foreign workers were in construction, 27% in hospitality and 14% in industry.

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Some specific labour market measures like increasing the participation rate (which is lower than the EU average) or a more generous package for returnees should be implemented, to avoid the scenario in which wage growth exceeds productivity growth (lower productivity is expected with strong participation of pensioners and low-skilled foreign workers on the labour market), thus generating further inflationary pressures. Figure 12 points to potential inflationary risks in Croatia, especially since 2024, when real compensation per employee (deflated with households' final consumption) growth rate reached almost double digits (mostly due to comprehensive wage-setting reform in the public sector), while the real productivity growth rate is in negative territory (although before the pandemic these two were broadly aligned, i.e. there was no signal for inflation). Bobeica, Ciccarelli and Vansteenkiste (2019) found a strong relationship between labour cost and inflation in big euro area economies, also highlighting the importance of relationship if demand shocks dominate, which currently contribute to inflationary pressures in both services and manufacturing (figures 7 and 8).

Figure 12

Real compensation per employee and real productivity growth rate (YoY, %)

Source: Eurostat, authors' calculations.

Taking into account the high increase in real compensation per employee and drop in productivity, unit labour cost increased in 2024 substantially on an annual level, which should be corrected either in numerator (compensation per employee) or denominator (productivity) to mitigate further inflationary pressures in Croatia. One way to tackle the productivity and innovation issues is to further increase expenditures for education, which amount to around 5.3% of GDP in 2023, and are 0.7 p.p. higher than average EU-27 (4.7% of GDP).

5 CONCLUSION

Demand shocks, according to our results, have historically had a larger effect on the Croatian economy than supply shocks. The same applies to most western economies, where the last large recession caused by supply shocks before the pandemic came after the oil crises in the late 1970s. This historical fact has led economists, both in academia and in economic policy institutions, to rely on the traditional output gap, which correctly reflects inflationary pressures when demand shocks dominate, as a crucial input to the monetary policy decisions process. We have shown though that care needs to be applied in times like the current, in which large supply shocks affect our economy. Specifically, our analysis indicated that the survey-based sectoral output gap augmented with factors limiting production accurately signals inflationary pressures, especially when traditional approaches struggle to indicate the latter (on aggregate HICP average annual rate) in the aftermath of two recent crises (the pandemic and disturbances on energy markets after Russian invasion on Ukraine). These traditional approaches in terms of output gap usually capture only the demand side of the economy, while we have also shown the important role of supply shocks, which can also be temporary and not only permanent. Also, the proposed novel survey-based approach could be of added value in the forthcoming period regarding the intensified geopolitical tensions by tracking the effects of tariffs imposed by the US administration on specific supply factors like equipment and materials and consequently on a sector-specific output gap. Our method also suggests that relationship between economic slack and inflation is not broken, i.e. the Phillips curve in Croatia is alive when taking into account structural factors.

Looking at inflation targeting set by monetary authorities (e.g., ECB), one should bear in mind that monetary policy is a demand side instrument: it affects the economy by modifying interest rates, thus affecting firms' and households' incentives to consume and invest. By separately identifying the strengths of different shocks affecting firms' demand, labour shortages, and shortages in equipment, intermediates, and productive space, policy makers can design better economic policies to address the issues affecting the economy. Our measure suggests that the issues hitting manufacturing and services are currently different in Croatia: while demand might be strong in both sectors, the key difference seems to stem from larger (possibly foreign) demand in services and the consequent labour shortages. This means that restrictive monetary or macroprudential policy alone might not be enough to fight inflation, as long as supply shocks are prominent. On the positive side though, the persistently strong demand and the inflationary pressures could be a positive sign going forward: they might incentivize Croatian firms to invest in increasing their productive capacity, leading to further economic growth down the road. Also, from the perspective of the one-size-fits-all target of the ECB, inflation divergence, as recorded in services and manufacturing in Croatia might signal a further need to pursue restrictive fiscal and macroprudential stance, considering to large extent the currently strong demand domestic pressures.

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With respect to untangled supply and demand contributions to sector-specific inflationary pressures, we have also highlighted the role of cyclical factors, which have generated inflationary pressures to some extent regarding domestic demand, while structural factors pointed to a low labour supply compared to the strong demand, which resulted in high inflow of foreign workers and high participation of pensioners. However, in the medium term, if strong demand is balanced with a labour supply consisting of low-productivity workers (pensioners and foreigners from third countries), high unit labour costs (expressed as the ratio of compensation per employee and productivity) will continue to generate inflationary pressures in the economy. Therefore, it will also be important to further increase spending on education and to include foreign workers in high-value-added activities.

Disclosure statement

The authors have no conflicts of interest to declare.

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APPENDIX
DATA AND SOURCES

Table A1
Data and sources

Variable	Data	Source
Total HICP	Harmonized Index of Consumer Prices, seasonally adjusted using X-12, average annual change	Eurostat
HICP Services	Harmonized Index of Consumer Prices in Services, seasonally adjusted using X-12, average annual change	Eurostat
De-meaned HICP Services	Difference between annual growth rate and average growth rate in HICP Services	Authors' calculations
HICP Goods	Harmonized Index of Consumer Prices in Goods, seasonally adjusted using X-12, average annual change	Eurostat
De-meaned HICP Services	Difference between annual growth rate and average growth rate in HICP Industrial Goods	Authors' calculations
Gross domestic product	GDP, constant prices, seasonally adjusted using X-12, average annual change	Eurostat
De-meaned values of factors limiting productions	Difference between current and average factor (demand, labour, equipment, other)	European Commission, authors' calculations
General Government Balance	Annual change in General Government Balance (in % of GDP)	AMECO
Interest Expenditures	Annual change in Interest Expenditures of General Government (in % of GDP)	AMECO
One-off and temporary measures	Annual change in one-off and temporary measures of General Government (in % of GDP)	AMECO
Cyclical component	Annual change in cyclical component (multiple of output gap and budget-to-gap semielasticity) (in % of GDP)	AMECO

Source: Authors.

OUTPUT GAP ESTIMATES WITH UNIVARIATE FILTERS

Optimization procedure for Hodrick-Prescott (1998) filter:

$$\hat{\tau}_{t|t,\lambda} = \min_{\tau}\left(\frac{1}{T}\sum_{t=1}^{T}\left(y_t-\tau_t\right)^2+\lambda\frac{1}{T}\sum_{t=2}^{T-1}\left[\left(\tau_{t+1}-\tau_t\right)-\left(\tau_t-\tau_{t-1}\right)\right]^2\right) \quad \text{(A1)}$$

with λ as a smoothing parameter for business cycle that we set to 1600, usually for quarterly data (Arčabić and Banić, 2021), y_t is real GDP and T refers to observations. HP optimization procedure selects the τ_t series and then estimates trend by minimizing sum of squares, known as potential GDP.

Optimization procedure for one-sided Hodrick-Prescott (Wolf et al., 2020) filter:

$$\hat{\tau}_{t|t,\lambda} = argmin_{t_t}\left(\min_{\tau_1,\ldots,\tau_{t-1},}\left(\sum_{t=1}^{T}\left(y_t-\tau_t\right)^2+\lambda\sum_{t=2}^{T-1}\left(\tau_{t+1}-2\tau_t+\tau_{t-1}\right)^2\right)\right) \quad \text{(A2)}$$

which is similar to standard HP filter, which considers not only current but also earlier observations, thus is called a real-time potential GDP.

Potential GDP estimate with Hamilton (2018) filter:

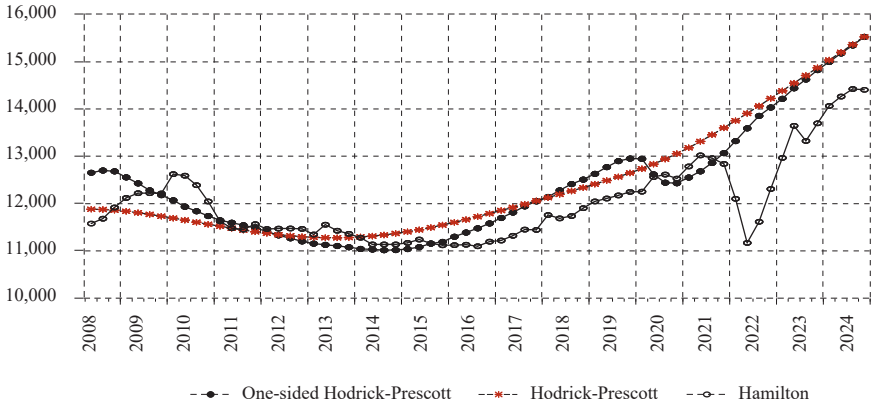
$$y_t = \Upsilon + \alpha_1 y_{t-8} + \alpha_2 y_{t-9} + \alpha_3 y_{t-10} + \alpha_4 y_{t-11} + c_t \quad \text{(A3)}$$

according to which Hamilton (2018) estimate the cycle (c_t) by regressing real GDP on constant (Υ) and four lags (k) of 2 years, addressing the end-of-sample problem in HP optimization procedure.

Output gap is then calculated as the difference between real GDP and potential GDP (HP, one-sided HP and Hamilton filters) in percentage of latter.

Figure A1

Potential GDP in Croatia with different filters (mil. euro)



Source: Authors' calculations.

OUTPUT GAP ESTIMATE USING BAYESIAN VECTOR AUTOREGRESSIVE MODEL WITH SIGN AND ZERO IDENTIFICATION OF STRUCTURAL SHOCKS

Following the procedure in Deskar-Škrbić et al. (2020), we estimate a BVAR model with k lags as follows:

$$A_0 y_t = \Omega + A_1 y_{t-1} + \ldots + A_k y_{t-k} + \varepsilon_t, \qquad t = 1,\ldots, T. \quad \text{(A4)}$$

where y_t is a vector of observable variables, Aj are $n \times n$ coefficients with invertible A_0, Ω is a vector of constants and ε_t, is a vector of structural shocks. The number of lags is set to four (k=4), which is common procedure when using quarterly data (Blake and Moomtaz, 2017) and in line with recent research (Barišić, Kovač and

Arčabić, 2023). Furthermore, we estimate a reduced-form model by multiplying the equation by A_0:

$$y_t = c + B_1 y_{t-1} + ... + B_k y_{t-k} + e_t, \qquad t = 1,.., T, \tag{A5}$$

where $B_j = A_0^{-1} A_j$, $c = A_0^{-1}\Omega$ and $e_t = A_0^{-1}\varepsilon_t$.

To impose the block exogeneity assumption through zero restrictions, vector y_t^1 represents external variables (real GDP and HICP for euro area), while vector y_t^2 represents domestic variables (real GDP and HICP) so $y_t' = \left[y_t^{1'}, y_t^{2'} \right]$.

Matrix A_j from (A4) have block lower triangular form:

$$A_j = \begin{bmatrix} A_{11}^j & 0 \\ A_{21}^j & A_{22}^j \end{bmatrix}, \; j = 0, ..., k \tag{A6}$$

where block exogeneity is derived form coefficients of matrices B_j

$$B_j = \begin{bmatrix} B_{11}^j & 0 \\ B_{21}^j & B_{22}^j \end{bmatrix}, \; j = 0, ..., k \tag{A7}$$

The block exogeneity assumes that (3) implies (4) but vice versa does not hold (Deskar-Škrbić, Kotarac and Kunovac, 2020). In order to derive (3) from (4) we need to add more assumptions on A_0 or $(A_0)^{-1}$, which represents short-term (on impact) impulse response function. For more details regarding the methodology, see Deskar-Škrbić, Kotarac and Kunovac (2020). Following the approach of Deskar-Škrbić, Kotarac and Kunovac (2020) and Nadoveza (2025), we conduct Gibbs sampler using Independent Normal Inverse Wishart prior, and also standard Minnesota priors, setting $\lambda_1 = 0.2$, $\lambda_2 = 0.5$, $\lambda_3 = 2$, and $\lambda_4 = 10000$, which is in line with Nadoveza (2025), who used tight priors.

Regarding imposed structural shocks, domestic (Croatian) aggregate demand shock increases both GDP and HICP in Croatia, with no effect on euro area variables, while domestic aggregate supply shock increases GDP and decreases HICP in Croatia, with no effect on euro area variables as well. Regarding external (euro area) shocks, aggregate demand increases economic activity and inflation in euro area with unknown effect on domestic (Croatian) GDP and HICP, while supply shock increases GDP and HICP in euro area with unrestricted effect on domestic (Croatian) GDP and HICP.

Table A2

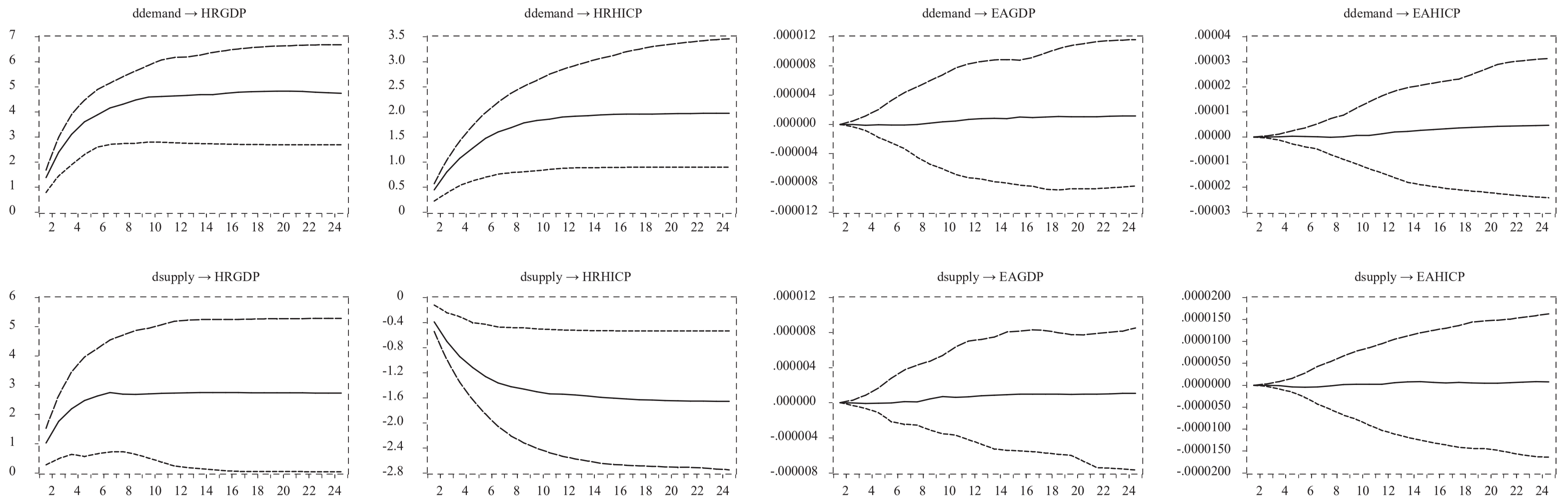
Restrictions for identification of structural shocks

Shock/variable	GDPHR	HICPHR	GDPHEA	HICPEA
Domestic demand	+	+	0	0
Domestic supply	+	-	0	0
External demand	?	?	+	+
External supply	?	?	+	-

Note: Positive reaction (+), negative reaction (-), unrestricted reaction (?), no reaction (0).

Figure A2

Cumulative impulse responses of annual change in real GDP and annual inflation rate (HICP) to domestic (Croatian) demand and supply shocks for Croatia and Euro area

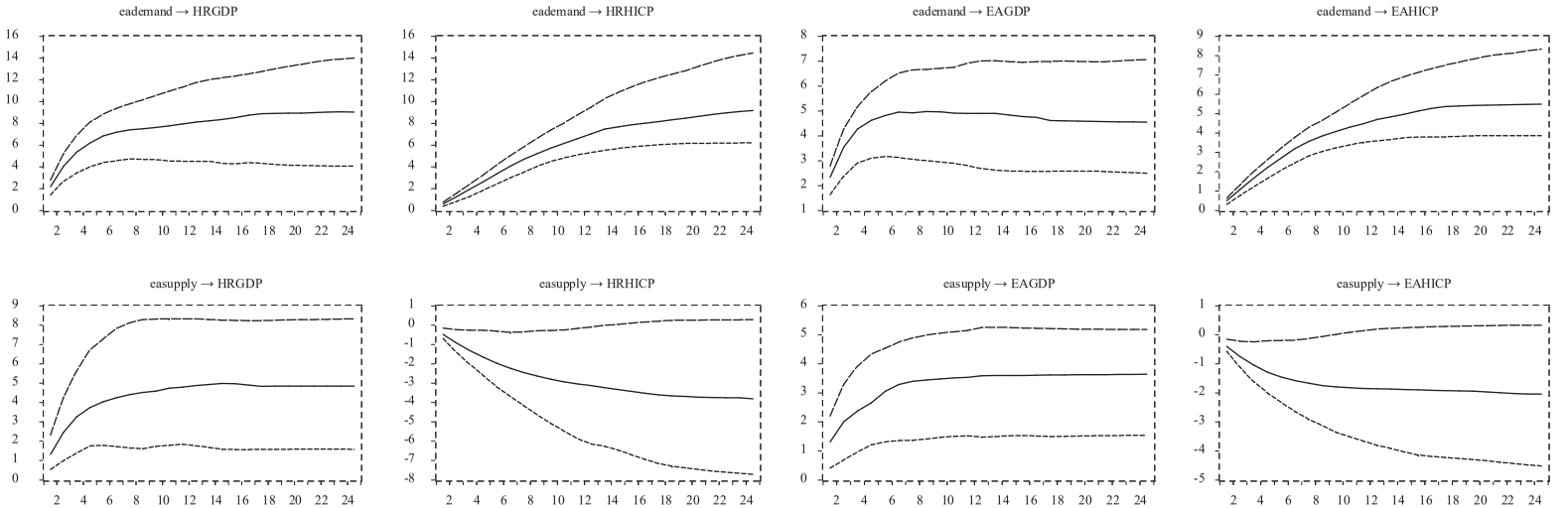


Note: Solid line represents the point-wise median and dashed lines represent lower and upper bounds to the 68% credible intervals. Abbreviation HR stands for Croatia, while EA for euro area. Ddemand corresponds to domestic demand shock, while dsupply to domestic supply shock. According to zero restrictions, there is no effect of domestic (Croatian), small open economy shocks to big (euro area) economy.

Source: Authors' calculations.

FIGURE A3

Cumulative impulse responses of annual change in real GDP and annual inflation rate (HICP) to external (euro area) demand and supply shocks for Croatia and Euro area

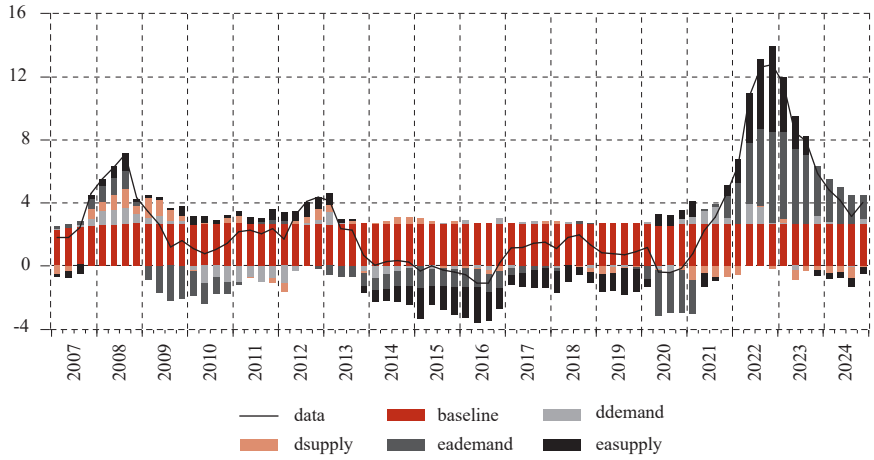


Note: Solid line represents the point-wise median and dashed lines represent lower and upper bounds to the 68% credible intervals. Abbreviation HR stands for Croatia, while EA for euro area. Eademand corresponds to external demand shock, while easupply to external (euro area) supply shock.

Source: Authors' calculations.

FIGURE A4

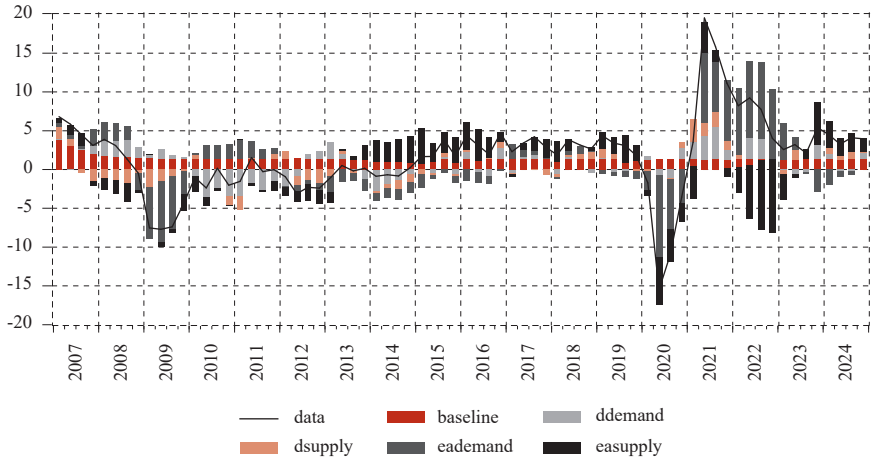
Historical decomposition of annual change in HICP for Croatia (%, percentage points)



Source: Authors' calculations.

FIGURE A5

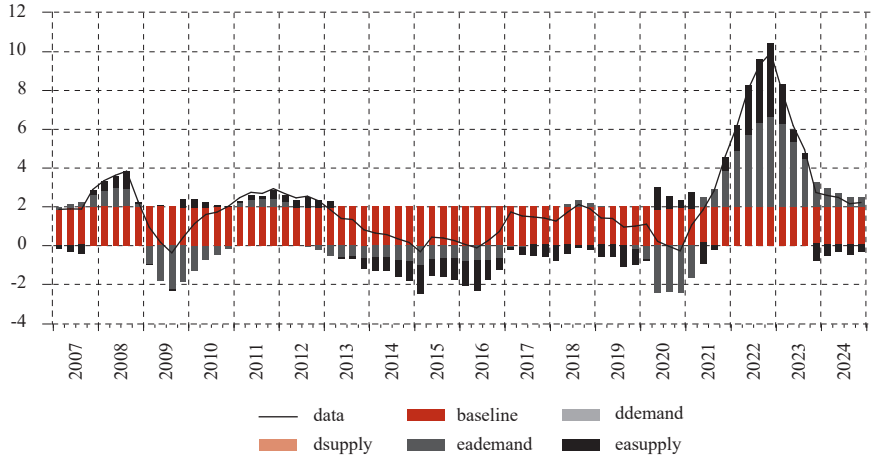
Historical decomposition of annual change in real GDP for Croatia (%, percentage points)



Source: Authors' calculations.

FIGURE A6

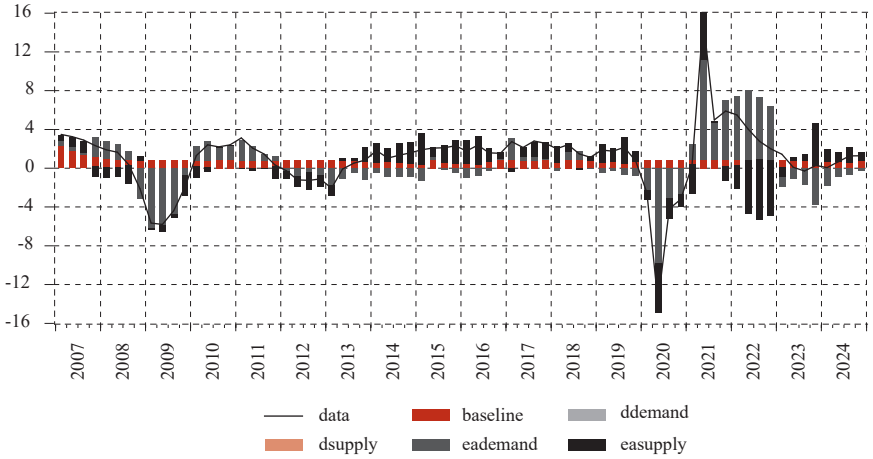
Historical decomposition of annual change in HICP for Euro area (%, percentage points)



Source: Authors' calculations.

FIGURE A7

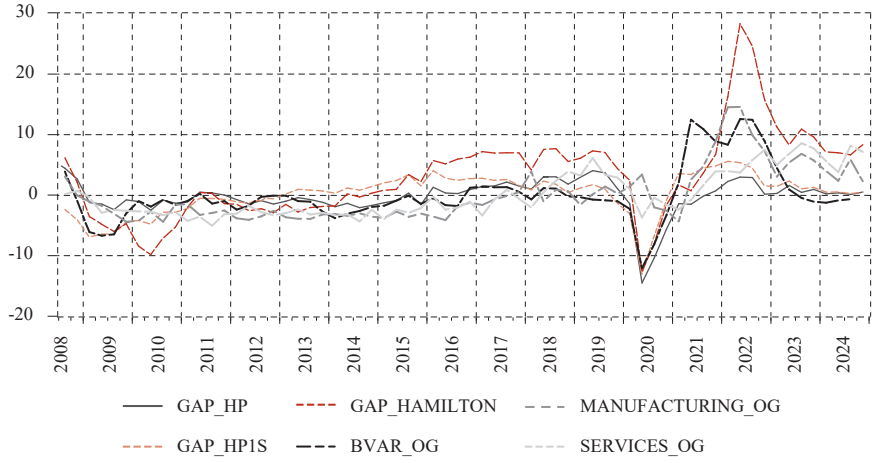
Historical decomposition of annual change in real GDP for Euro area (%, percentage points)



Source: Authors' calculations.

FIGURE A8

Aggregate and sectoral output gap in Croatia (% of potential GDP)



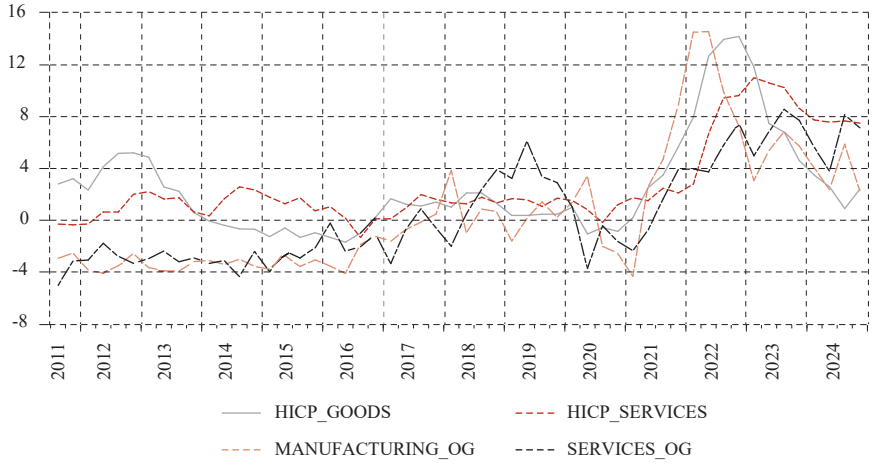
Source: Authors' calculations.

SECTORAL INFLATION RATE AND OUTPUT GAP IN CROATIA

Aside of period between 2011 and 2013 for manufacturing, sectoral output gap indicates inflationary pressures relatively accurate, especially in the aftermath of C-19 crisis and energy crisis. In more detail, strong mixture of different supply (C-19 and energy) and demand (Next Generation EU instrument, tourism, expansionary procyclical fiscal stance) reflected in positive output gap, in line with dynamics of sectoral price developments. Also, probably the increased quality of survey data to some extent contributed to more precise assessment of sectoral output gap, thus inflationary pressures in Croatia.

FIGURE A9

Sectoral inflation rate and output gap in Croatia (%)



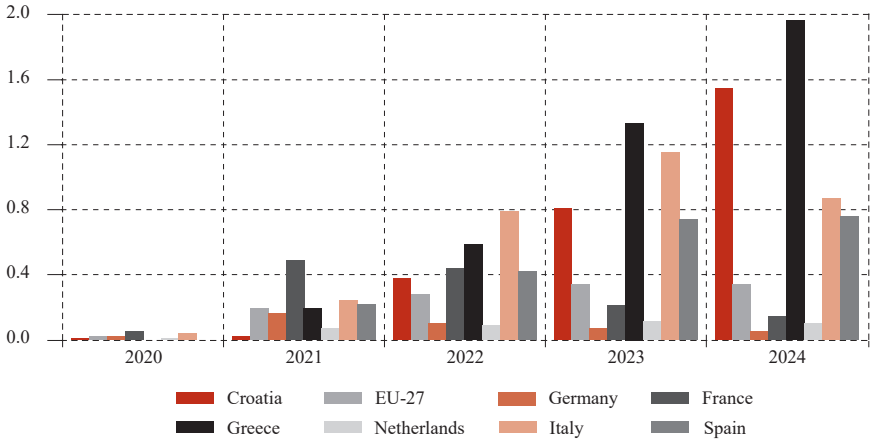
Source: Eurostat, authors' calculations.

USES OF RECOVERY AND RESILIENCE FACILITY (RRF) IN THE EU

According to Eurostat data, Croatia is one of frontrunners when it comes to RRF uses, reaching more than 1.5% of GDP in 2024, while EU average was below 0.5% of GDP. Consequently, as ECB (2024) analysis suggests, demand, i.e. fiscal and supply side, i.e. structural reforms both affected real GDP and potential GDP. However, in short-run, these demand side effects could affect output gap, if override supply side effects, which come at place with significant time lag, especially when it comes to structural reforms.

FIGURE A10

Uses of RRF in the EU (% of GDP)

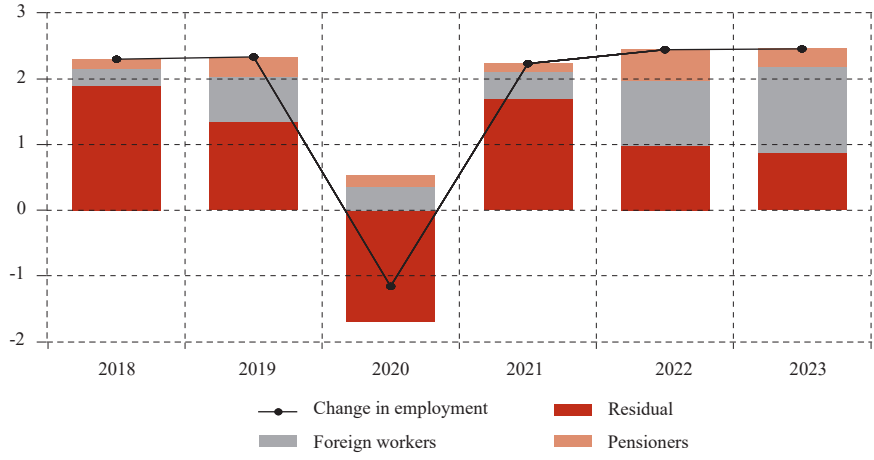


Source: Eurostat.

CHANGE IN EMPLOYMENT IN CROATIA

FIGURE A11

Decomposition of change in employment in Croatia (percentage points)



Note: Residual includes inactive persons, unemployed persons and other foreign workers which were not recorded properly.

Sources: CPII, Banić et al. (2024), authors' calculations.