YES YOUNG ECONOMISTS SEMINAR

HRVATSKA NARODNA BANKA
EUROSUSTAV

19th YOUNG ECONOMISTS' SEMINAR
TO THE 32nd DUBROVNIK ECONOMIC CONFERENCE

May 28 – 29, 2026, Dubrovnik, Croatia

Frane Banić and Valentin Lovrić

Hitting the Brakes? Recent Labour Market Adjustment in Croatia

Draft version

Please do not quote

Hitting the Brakes?
Recent Labour Market Adjustment in Croatia

Frane Banić* Valentin Lovrić†

Abstract

This paper analyses labour market dynamics in Croatia, with a particular focus on the post-pandemic period, using a Bayesian VAR (BVAR) model with sign restrictions to identify structural shocks. Motivated by empirical regularities, including deviations from Okun's law, shifts in the Beveridge curve, and instability in the wage Phillips curve, the analysis identifies and disentangles the relative roles of demand and supply-side shocks in shaping employment developments. The findings indicate that the initial post-pandemic recovery was predominantly demand-driven, supported by labour hoarding. Over time, these dynamics gradually shifted. Rising nominal wages, combined with modest productivity growth, led to increasing unit labour costs and a significant rise in the labour income share, weakening firms' incentives to hire. Overall, the results point to a transition from demand-supported labour market resilience to cost-constrained normalization. This interpretation is consistent with recent low employment elasticity to output, declining vacancy rates, pointing to a normalization of labour demand. The findings suggest that demand-side policies may have limited effects on employment, highlighting the importance of productivity growth, labour supply conditions, and efficient matching.

Keywords: Employment Dynamics, Beveridge Curve, Wage Phillips Curve, Structural VAR, Croatia

*Croatian National Bank, Research Area. Email: frane.banic@hnb.hr

†Croatian National Bank, Research Area. Email: valentin.lovric@hnb.hr

1 Introduction

The Croatian labour market has undergone profound structural and cyclical transformations over the past quarter century, reflecting the interplay of macroeconomic shocks, institutional changes, and evolving demographic constraints. This paper situates recent labour market developments within a broader historical and analytical framework, with a particular focus on the period following the COVID-19 pandemic. By combining a descriptive historical overview with a structural VAR analysis, the study seeks to disentangle the relative contributions of demand and supply-side drivers in shaping employment dynamics in Croatia, and to assess whether the most recent slowdown in employment growth reflects cyclical moderation or a more structural adjustment driven by rising labour costs.

A defining feature of the post-pandemic period has been the emergence of strong labour demand in an environment of constrained labour supply. This imbalance has been driven by a combination of demographic trends, prior emigration, and sustained economic recovery. As a result, firms increasingly relied on foreign workers and higher participation rates among underrepresented groups, such as older individuals and women, to meet labour needs. At the same time, the period was marked by significant inflationary pressures, initially driven by global supply chain disruptions and subsequently intensified by the energy price shock following the Russian invasion of Ukraine in 2022.

These inflationary developments had important implications for labour market dynamics. In particular, nominal wages adjusted more slowly than prices, leading to a decline in real wages in 2022. This phenomenon can be partly explained by institutional features of wage-setting mechanisms, including the prevalence of collective bargaining and the limited role of automatic wage indexation. The resulting decline in real labour costs, combined with rising costs of capital inputs such as energy and equipment, created incentives for firms to substitute labour for capital in the short run. This substitution effect, together with labour hoarding behavior in a context of long run labour shortages, contributed to a period of exceptionally strong employment growth between 2022 and 2024.

However, this phase of rapid employment expansion was not sustained. As workers sought to restore lost purchasing power, nominal wage growth accelerated in 2023 and 2024, leading to a significant increase in the labour income share. As wage growth began to outpace productivity gains, unit labour costs rose, gradually weakening firms' incentives to hire. By 2025, employment growth began to moderate, despite continued expansion in economic activity. This decoupling between output and employment suggests a shift in the underlying drivers of labour demand.

To formally analyze these dynamics, the paper employs a Bayesian structural vector au-

toregression (SVAR) model with sign restrictions to identify key macroeconomic shocks and decompose the observed dynamics of output, employment, wages, inflation and labour productivity into their underlying shock contributions. The empirical framework distinguishes between demand shocks and three types of supply-side shocks: productivity, i.e. neutral technology, factor-substitution and labour market shocks. This approach allows for a nuanced interpretation of macroeconomic fluctuations, recognizing that similar movements in output and inflation may arise from fundamentally different underlying mechanisms with distinct implications for employment.

The empirical results highlight several key findings. First, the contraction in employment during the pandemic was primarily driven by a negative demand shock, but the magnitude of the decline was limited due to widespread labour hoarding and policy support. Second, the subsequent recovery was largely demand-driven, with strong positive contributions to both output and employment. Third, the energy crisis introduced adverse supply-side shocks, but employment remained resilient due to robust demand and tight labour market conditions.

Most importantly, the analysis reveals a gradual transition in the nature of labour market adjustment. While the initial post-pandemic recovery was characterized by demand-driven expansion, the more recent period reflects increasing constraints arising from rising labour costs. The slowdown in employment growth in 2025 does not appear to be driven by a sharp decline in demand, but rather by a combination of less expansionary demand conditions and increasing cost pressures associated with higher wages and limited productivity growth. This interpretation is further supported by evidence of declining vacancy rates, stable unemployment, and a normalization of the relationship between employment and output.

In addition, several complementary empirical regularities, including the Beveridge curve, Okun's law regression equation, and alternative Wage Phillips curve specification analyzed trough structural break regression, suggest that the Croatian labour market is undergoing a gradual correction following a period of exceptionally tight conditions. While labour demand remains relatively strong by historical standards, its intensity has moderated, and the adjustment appears to be occurring primarily through reduced hiring rather than increased layoffs. At the same time, recent policy changes affecting the inflow of foreign workers introduce additional complexity, as they may further constrain labour supply and interact with demand-side dynamics. But results imply relatively weak effect of the mentioned negative labour market shock.

Overall, the findings of this paper point to a shift from demand-supported labour market resilience toward a phase of cost-constrained normalization. This transition has important implications for macroeconomic policy. In an environment where rising labour costs are becoming a binding constraint, policies aimed at stimulating demand may have limited effects

on employment while potentially exacerbating inflationary pressures. Instead, sustaining employment growth will increasingly depend on improvements in productivity, more efficient labour market matching, and policies that enhance labour supply flexibility.

By placing recent developments within a historical and structural context, this paper contributes to a deeper understanding of the evolving dynamics of the Croatian labour market. It highlights the importance of distinguishing between different types of macroeconomic shocks and underscores the need for policy frameworks that are responsive to the changing nature of labour market constraints.

The paper is structured as follows. Chapter 2 describes the data, the historical context, and, in particular, the recent state of the Croatian labour market in the post-pandemic period within broad theoretical framework. Chapter 3 presents and explains mentioned recent state through an explanation of the labour market based on the identified deviations in the estimation of the Okun's law equation, the Beveridge curve, and the Wage Phillips curve. Chapter 4 provides description of the Bayesian VAR model employed in this study, while Chapter 5 gives a detailed presentation of the results of the Bayesian VAR analysis and offers their interpretation, as well as discusses the results and presents the main conclusions of the paper. Chapter 6 concludes.

2 Historical Context and Recent Developments in the Croatian Labour Market

Prior to examining recent developments in the Croatian labour market, which we assess using an econometric framework, we first document its historical evolution over the period 2000–2025. This evolution can be understood in terms of four macroeconomic phases, each marked by changes in economic structure, the international environment, and the domestic institutional setting. These phases are: (i) the post-transition expansion (2000–2008); (ii) the prolonged recession and stagnation associated with the Global Financial Crisis (2008–2014); (iii) the post-EU accession recovery (2015–2019); and (iv) the period characterized by the COVID-19 pandemic (2020) and the subsequent post-pandemic expansion (2021–2025), which constitutes the primary focus of this paper.

Following the period of economic transition from a socialist planned system to a market-oriented liberalized environment in the 1990s, as well as the phase of post-war recovery after the destruction caused by the Croatian War of Independence, the Croatian economy entered a phase of expansion in the post-transition period from 2000 onward. This expansion was supported in particular by the stabilization of the monetary environment and increased

inflows of foreign direct investment from European countries[1], which contributed to a marked improvement in labour market conditions.

This period was characterized by structural shifts in sectoral employment, consistent with the broader process of tertiarization associated with economic development. Employment in service sectors, particularly hospitality and tourism, expanded significantly, while employment in manufacturing also increased in absolute terms, albeit with a declining share in total employment. In addition, the period saw strong growth in the construction sector and substantial infrastructure development, leading to a pronounced acceleration in labour demand, supported by a relatively abundant working-age population.

Prior to the onset of the Global Financial Crisis in 2008, total employment in Croatia reached approximately 1.6 million, according to data from the Croatian Pension Insurance Institute (CPII) (Figure 1). However, despite robust growth, the period was also marked by a relatively low labour force participation rate - partly reflecting the prevalence of the informal economy - and a comparatively high share of long-term unemployment.

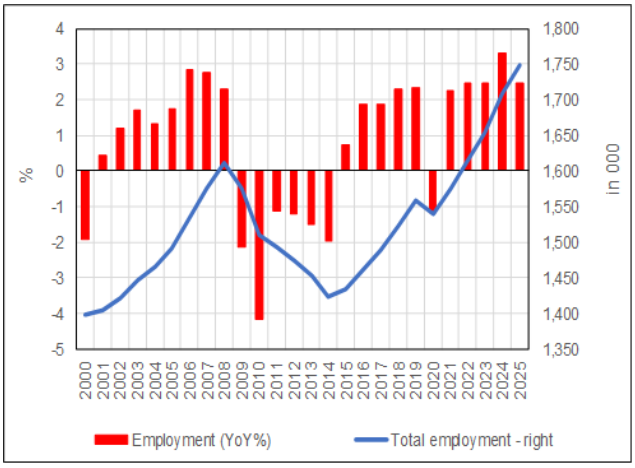


Figure 1: Total Employment and Year-on-Year Growth Rate
Source: Croatian Pension Insurance Institute (CPII).

[1]In the international context, this period is characterized by global credit expansion and growth in the European Union economy, which stimulated an investment cycle in Central and Eastern Europe.

The period of the Croatian labour market beginning in 2008 was marked by the onset of the Global Financial Crisis, followed by the European sovereign debt crisis in the subsequent years. Under these conditions, Croatia was particularly affected due to its macroeconomic characteristics, including being a small open economy, highly financially integrated with the European Union, with a large share of sectors dependent on foreign demand, and partial dependence on the credit cycle. These factors contributed to a decline in GDP lasting nearly six consecutive years, until 2014. This downturn was strongly reflected in the domestic labour market, as the negative exogenous shock led to a contraction in aggregate demand, a decline in investment, credit tightening, and reduced external demand. A significant additional negative procyclical effect stemmed from fiscal consolidation measures implemented during this period, following budget deficits in preceding years and substantial accumulation of public debt.

As economic activity contracted, total employment fell to approximately 1.45 million, resulting in an unemployment rate reaching extremely high levels (around 20%) and a marked increase in the number of unemployed persons. Sectors particularly affected included construction, tourism-related services, and manufacturing. The manufacturing sector was especially vulnerable due to inefficiencies stemming from incomplete reforms during the privatization process in the 1990s, which left the industry undercapitalized and uncompetitive, thereby increasing its sensitivity to exogenous shocks.

From 2015 onward, the economy began a gradual recovery, driven in part by a key institutional milestone, namely Croatia's accession to the European Union in 2013. This facilitated a substantial inflow of capital investment through EU development funds, contributing to an acceleration of economic activity. Economic growth was further supported by the recovery across all major sectors and by strengthening external demand. Consequently, labour demand also began to recover. However, EU integration also gave rise to increased emigration of the domestic workforce, driven by the liberalization of labour mobility and the opening of EU labour markets. This led to outflows of working-age population to more developed member states (notably Germany, Austria, and Ireland), thereby reducing labour supply, particularly in the context of long-term demographic challenges such as population ageing and low fertility rates.

The emergence of the pandemic and the spread of COVID-19 in the first half of 2020 led to a sharp contraction in economic activity in Croatia due to restrictive containment measures. However, a more pronounced wave of layoffs and a rise in unemployment were mitigated by government subsidies to employers aimed at preserving jobs, as well as by broadly expansionary fiscal policy. These measures contributed to a rapid economic recovery in 2021, further supported by the inflow of capital investment funds from the European

Union's NextGenerationEU instruments.

Together, these factors sustained strong labour demand, which had to be increasingly met through the inflow of foreign workers from third countries (including neighboring countries in Southeast Europe, as well as Southern and Southeast Asia), alongside increased labour force participation among older individuals and women, in the context of prior emigration flows and ongoing demographic challenges.

However, the post-pandemic period in Croatia was characterized by strong inflationary pressures. The initial trigger for this development was severe disruptions in global supply chains, which were subsequently outpaced by a strong positive shock to aggregate demand that had been previously suppressed, resulting in an uncoordinated and rapid economic recovery. In other words, the pronounced surge in aggregate demand outstripped aggregate supply, leading to accelerated price growth. Furthermore, the Russian invasion of Ukraine in the first half of 2022 generated an energy price shock, which further intensified the inflationary episode.

Such strong and sudden inflationary developments could not be matched by nominal wages in the economy. This ultimately led to a decline in real wages in 2022 and slower growth in total compensation of employees relative to the growth of aggregate income. The explanation for the lagging growth of nominal wages compared to prices likely lies in the structural features of the institutional mechanisms that determine wages in the economy. Empirical research suggests a higher degree of downward real wage rigidity in the presence of widespread indexation schemes in employment contracts (Babecký et al., 2010). It is also generally concluded that in countries where a larger share of employees is covered by indexation schemes (where wages are fully or partially adjusted for expected inflation), downward real wage rigidity is more pronounced, with union membership also contributing positively to such rigidity (Dickens et al., 2007).

Furthermore, earlier evidence from employer surveys in the Croatian labour market indicates that a substantial share of firms indexed workers' contracts to inflation, amounting to one-third of firms in 2010 (Kunovac and Pufnik, 2015). However, recent labour market trends point to a decline in the prevalence of employment contracts with automatic wage indexation. For instance, only 3% of private-sector employees in euro area countries have wages automatically indexed to inflation (Koester and Grapow, 2021). A higher share of such employees is observed only in Belgium, Cyprus, Malta, and Luxembourg. By contrast, for about 60% of private-sector employees in the euro area, inflation does not play a formal role in wage-setting processes.

Similarly, Checherita-Westphal (2022) reports that in the public sector across the euro area, only 19% of wages are covered by indexation, concentrated mainly in Belgium and

Luxembourg (where all public sector wages are backward-looking indexed), while in Italy such wages are automatically indexed without taking energy prices into account. In other countries, such practices are not observed. These findings suggest that the prevalence of automatically indexed wages in Croatia is also very low and has likely declined relative to the levels reported by Kunovac and Pufnik (2015). Comparable views on the declining share of such wage-setting mechanisms are also reported by Koester and Grapow (2021) for the euro area, where the prevalence of automatic indexation has decreased compared to the period preceding and during the Global Financial Crisis.

Furthermore, widespread collective bargaining at the firm and industry levels (i.e., the limited prevalence of individualized employment contracts) is typically introduced to simplify the wage-setting process when a large number of acters are involved. However, this also makes it more difficult to align changes in negotiated nominal wages with macroeconomic developments. This difficulty primarily arises from coordination problems among a large number of acters involved in renegotiating collective agreements. In addition, downward real wage rigidity may emerge in cases where collective agreements incorporate automatic indexation mechanisms linking nominal wages to inflation (Babecký et al., 2010).

Accordingly, given the relatively widespread use of collective wage bargaining in Croatia[2], alongside the limited prevalence of wage indexation, it can be concluded that these institutional features largely explain the slow adjustment of nominal wages to the inflationary shock and the resulting decline in their purchasing power in 2022.

This situation led to a decline in the ratio of nominal compensation of employees to GDP in 2022, 2023, and part of 2024, bringing it below its long-term average (2000–2025). This period also coincided with a continuation and strengthening of the post-pandemic employment growth cycle, as labour became relatively cheaper for employers compared to capital inputs, resulting in a substantial increase in hiring beyond equilibrium levels.

In other words, in the context of recent inflationary pressures, general nominal wage rigidity led to a decline in the real cost of labour, while the cost of capital inputs (energy, machinery, technology, and system maintenance) increased significantly. Firms faced rising energy prices, which made capital investments in equipment and technology considerably more expensive. Moreover, the maintenance of such systems also became substantially costlier. As a result, employers may have postponed or reduced capital investment (e.g., in machinery and automated systems) and instead increased labour input to perform the same tasks, given the relatively lower real wages.

[2]According to data from the Croatian Ministry of Labour, Pension System, Family and Social Policy, at the beginning of 2026 approximately 65% of employed persons in Croatia were covered by collective agreements (https://kolektivni.gov.hr//contracts).

In addition, in many service sectors, workers can be trained relatively quickly and assigned to multiple functions within firms, providing flexibility in business operations. Firms can thus employ more workers to perform a broader range of tasks, whereas the use of capital-intensive technologies would require specialized skills and long-term training, which, under conditions of declining real wages, becomes relatively less attractive [3].

This substitution can be illustrated in a stylized manner using an example from the service sector. Restaurants, cafés, and hotels may employ automated or digital systems for ordering and payment; however, even in such cases, their scope for full automation remains limited (e.g., personnel are still required for service, cleaning, and customer interaction). When the costs of energy (e.g., heating and cooling) or capital equipment (e.g., machinery) increase significantly due to inflation, firms in this sector may reduce investment in capital resources, such as new kitchen technologies or automated ordering systems, and instead hire additional workers to maintain service levels.

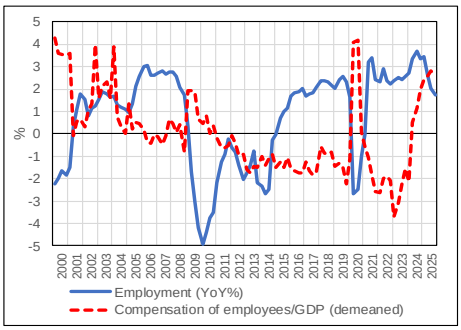
A similar mechanism applies in retail and logistics, where firms must handle large volumes of goods and process a high number of orders. Employers may choose to hire additional workers for tasks such as warehousing, packaging, or delivery, even though these tasks could, in principle, be automated. Due to rising energy prices and the higher cost of acquiring new capital solutions, investment in automated systems (e.g., robotics or AI-based warehouse systems) may become more expensive than hiring additional workers, who, given relatively lower real wages, allow firms to sustain operational throughput. Empirical findings suggest the existence of short-run substitution of capital with labour under conditions of high energy prices (Polgreen and Silos, 2008, 2009). In other words, when energy prices are elevated, firms tend to reduce the use of capital and substitute it with labour, particularly low-skilled labour performing tasks that can be automated. This, in turn, leads to a short-term decline in the skill premium due to increased demand for low-skilled workers. Consequently, employment effects under such conditions become heterogeneous, as demand for highly skilled workers, who are complements to capital and advanced technologies, may decline simultaneously. Consolo et al. (2026), using a BVAR approach, show that during the recent inflationary episode in the euro area, real wages adjusted downward, supporting strong labour demand and leading to a temporary tightening in the relationship between economic activity and employment, i.e., higher elasticity between the two. Short-term downward adjustment in real wages can thus facilitate labour-capital substitution in production at the level of firms' microeconomic decisions (Antoszewski, 2019; Baccianti, 2013).

[3] Although substitution between capital and labour is indeed possible in the short run, in practice it is often imperfect and subject to numerous technological and institutional constraints. However, when labour becomes relatively cheaper than capital (e.g., due to a decline in real wages), employers may, in the short run, increase labour hiring in response to higher relative capital costs.

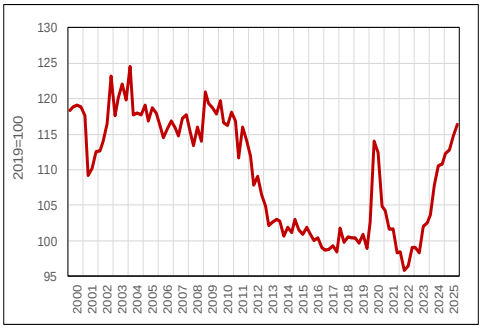
An important phenomenon is labour hoarding, driven by long-term demographic challenges and tight labour market conditions in Croatia. This aspect is crucial for understanding why firms, in the context of declining real wages, tend to retain existing workers and increase employment rather than reduce it. Demographic factors such as population ageing and migration trends exert pressure on the labour market by reducing the working-age population and intensifying competition for labour. This creates structural labour shortages and complicates firms' ability to meet their labour needs, particularly in sectors requiring workers with special skills. In tight labour market conditions, employers anticipate difficulties in recruiting new workers and are therefore incentivized to retain current employees and, where possible, expand their workforce. Given the risk of foregone future hiring opportunities, many firms opt for a short-term increase in labour input above the equilibrium level, expecting this to contribute to long-term business stability. Labour retention thus becomes a strategy to reduce long-term uncertainty, especially in the case of specialized skills that are scarce in the labour market. This behavior can be economically rational in the short run, particularly in periods of declining real wages.

However, in 2023 a gradual upward adjustment in real wages began to take place, driven by workers' demands for stronger nominal wage growth in order to restore the lost real value of their incomes. Blanchard and Galí (2007) show that, according to New Keynesian monetary policy theory, flexibility in real wages in response to inflation leads to automatically lower inflationary pressures, a phenomenon referred to as the 'divine coincidence,' under which the stabilizing role of central banks becomes less pronounced. Nonetheless, this framework often overlooks a feedback mechanism that may operate in the opposite direction, namely the compensation for previously lost real wages.

Although the prevalence of automatic wage indexation to inflation is limited, such delayed wage compensation mechanisms may still arise, particularly in the context of persistently tight labour markets. This, in turn, may contribute to the persistence of inflationary episodes. Moreover, these dynamics led to accelerated growth in the wage bill following the initial inflationary shock, with wage growth outpacing economic growth. As a result, the share of employee compensation in total income increased in 2024 and 2025, rising above its long-term average, which in this context can be interpreted as an approximation of the equilibrium level of that share. We hypothesize that this strong increase in the wage bill contributed to a downward adjustment in labour demand, leading to a recent gradual slowdown in total employment growth in Croatia, as reflected in year-on-year quarterly growth rates (Figure 2).



(a) Employment growth and compensation-to-GDP ratio (demeaned)



(b) Real unit labour costs

Figure 2: Employment Growth Rate, Demeaned Ratio of Total Compensation of Employees to GDP, and Real Unit Labour Costs

Note: Average of compensation-to-GDP ratio is removed over 2000–2025. Real ULC is deflated using CPI.
Source: CBS, CPII, Eurostat; authors' calculations.

A predominantly negative relationship between employment growth and the ratio of compensation to GDP is evident (Figure 2a). During periods when the ratio was below its long-term average, employment growth reached relatively high levels, indicating a rapid expansion in labour demand in a context of relatively low labour costs. At the same time, a slowdown in year-on-year employment growth is observed in 2025, coinciding with a peak in the compensation-to-GDP ratio, which stands well above its long-term average. This peak is also among the highest in the historical context (since 2000), whereas the peak observed in 2020 can be disregarded, as it was mechanically driven by a sharp contraction in GDP alongside relatively stable employee compensation, which was supported by job-retention measures during the COVID-19 crisis. Consequently, the ratio declined sharply in 2021 due to the rapid economic recovery.

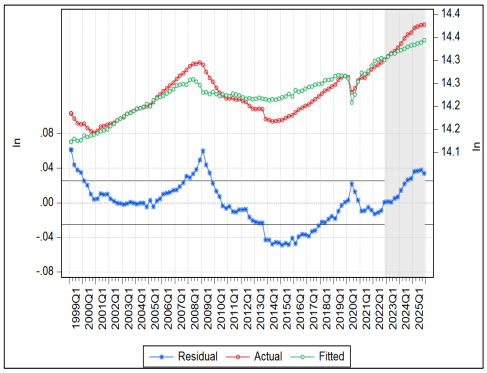
Overall, the prior accumulation of labour and the subsequent increase in the relative cost of labour led to a slowdown in employment growth towards the end of 2025, reflecting a downward adjustment in labour demand.

In theory, firms' demand for labour should increase as long as labour productivity exceeds real wages, provided that there are no barriers to firm entry into the market (Consolo et al., 2026). In other words, a positive gap between productivity and real wages should translate into higher employment growth driven by firm demand, and conversely in the case of a negative gap. A useful indicator of this relationship is real unit labour cost (RULC), defined as the ratio of real total compensation per employee to real productivity in an economy. Declining values of this ratio should therefore be associated with relatively stronger labour demand, as the real value generated per unit of labour (per employee) exceeds its cost.

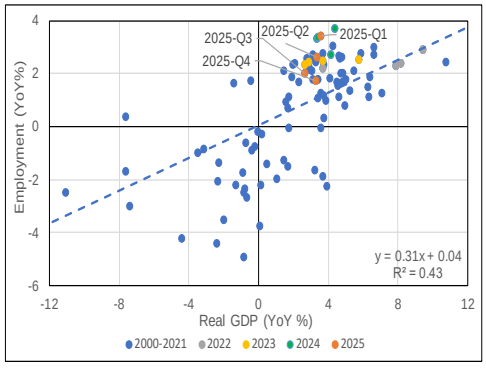
RULC indicates a positive gap between productivity and real wages in 2022 and 2023, when its value declined (panel b). It was precisely during this period that stronger labour demand began to emerge. Furthermore, its value increased sharply in 2024 and 2025, implying a more pronounced negative gap between real productivity and the cost of labour. For employers, this made it more difficult to hire additional workers, as wages rose faster than productivity, which likely contributed to the slowdown in employment growth observed in 2025.

3 Dead or Alive? Standard Empirical Regularities

Relatively strong labour demand in the period 2022–2024, followed by a subsequent slowdown in 2025, can be illustrated in the context of Okun's law, which posits a long-run positive relationship between these total employment and real GDP (during expansions in aggregate demand, the need for labour increases, thereby raising labour demand). However, this relationship may deviate in the short run, where the value of employment may be higher or lower than its implied long-run equilibrium value. Such deviations typically arise from processes such as labour hoarding, fluctuations in productivity, changes in labour costs, or variations in hours worked, among others. Accordingly, we examine the long run relationship between GDP and total employment in Croatia through implicit employment estimated with Okun's law regression equation (Figure 3a).



(a) Okun's law implicit employment



(b) Scatter plot of the relationship

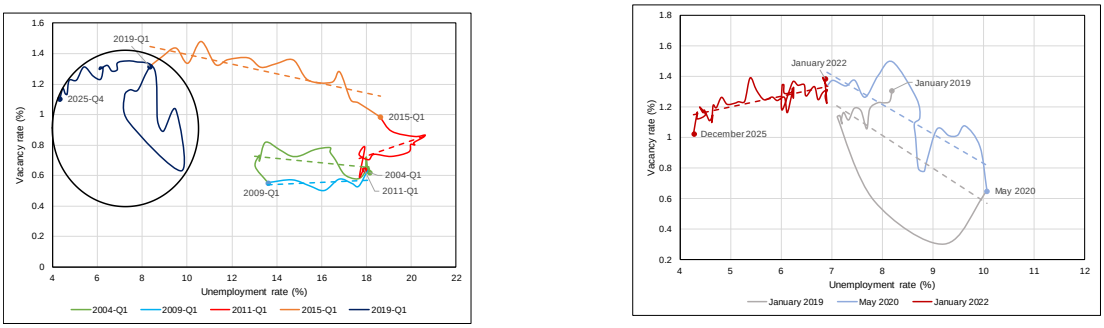
Figure 3: The Relationship between Employment and Real GDP

Note: Residual and fitted series are based on the regression $emp_t = \alpha + \beta gdp_t + e_t$. Both variables are expressed in logs. Shaded area refers to 2022Q1–2025Q4 period. In panel (b), R^2 denotes the coefficient of determination.
Source: CBS, CPII; authors' calculations.

Post-pandemic period exhibits a sharp increase in the value of employment (shaded area), exceeding the implied long-run equilibrium of employment by Okun's law equation. This indicates that employment expanded at a rate relatively higher than usual given the level of economic activity. Labour hoarding during this period, driven by relatively low labour costs, provides a potential explanation for the observed increase. In the end of 2025, an initial reversal toward the long-run implied employment is observed (residual is decreasing), suggesting a gradual correction in labour demand.

Additionally, examining the scatter plot of GDP growth and employment growth (panel b), a more pronounced deviation of employment is evident in 2023, and especially in 2024, relative to the values implied by the long-run average relationship estimated by the regression line. However, in 2025 a clear convergence toward the regression line is observed, with the final quarter of 2025 lying very close to the implied long-run relationship.

In order to provide some further evidence supporting the hypothesis of a slowdown or correction in labour demand in 2025, Beveridge curves for Croatia are estimated over several intervals corresponding to different cyclical phases. Constructed using scatter plots of the unemployment rate and the vacancy rate (as a proxy for labour demand), these curves allow us an assessment of how the relationship between these variables has evolved over time, as well as their relative positioning across different periods. Their recent dynamics indicate signs of a correction in labour demand (Figure 4).



(a) 2004–2025 (b) 2019–2025

Figure 4: Estimated Beveridge Curves in Croatia

Note: Each color denotes the beginning of a specific period (cycle). Linear lines represent estimated regression relationships over defined periods. Data in panel (a) are quarterly, while data in panel (b) are monthly. Source: CBS, Croatian Employment Service (CES); authors' calculations (seasonal adjustment using ARIMA X-13 RSA3 method).

In the period toward the end of and following the recession caused by the Global Financial Crisis, a pronounced outward shift of the curve away from the origin is observed, implying a deterioration in the efficiency of matching between labour supply and demand in the labour market. This suggests that, in the years following the recession, the labour market required a period of adjustment to return to equilibrium (with a deterioration observed between 2015 and 2018, which contributed to more pronounced structural unemployment that declined from 2019 onward).

Following this adjustment period, the set of lines estimated for the period from 2019 to the present show a shift closer to the origin of the graph, suggesting an improvement in matching efficiency (panel b). With the onset of the COVID-19 crisis, there was a sharp decline in the vacancy rate alongside an increase in the unemployment rate, indicating a movement along the curve driven by a negative aggregate demand shock (grey curve). This was followed by an outward shift of the curve (light blue), although the deterioration in efficiency during and immediately after the crisis was relatively mild and transitory.

During the recovery period (the third period beginning in January 2022), an atypical slope of the curve is observed. This is driven by a gradual decline in the vacancy rate through December 2025, accompanied by a simultaneous decrease in the number of unemployed persons registered with the CES, which continuously reduced the unemployment rate. However, this decline in the unemployment rate does not necessarily imply a higher outflow from unemployment into employment, as in 2024 and 2025 an increase is observed in the number of individuals removed from the unemployment register for reasons unrelated to employment. As a result, official registered unemployment declined without a corresponding increase in employment.

At the same time, the decline in the vacancy rate reflects a moderation in labour demand following a period of intensive hiring and possible labour hoarding. Employers appear to have gradually reduced their need for new hires as the economic cycle evolves. While the estimated Beveridge curves indicate a noticeable easing in labour demand, the vacancy rate remains relatively high compared to historical levels, suggesting that the position of the latest curve is still somewhat elevated relative to earlier periods.

Such developments, as well as the hypothesis of a correction in labour demand, are partially supported by a simple decomposition of net inflows into unemployment by source, distinguishing between transitions from employment and other reasons (Figure 5). In 2025, an increase is observed in net outflows from the CES register due to non-employment-related reasons. Conversely, in the second half of 2025, net inflows from employment into the unemployment register recorded positive values for two consecutive quarters, a pattern not observed since 2020, when strong positive net inflows were recorded in the first two quarters amid employers' precautionary behavior during the recession. These developments provide additional evidence consistent with a slowdown in labour demand.

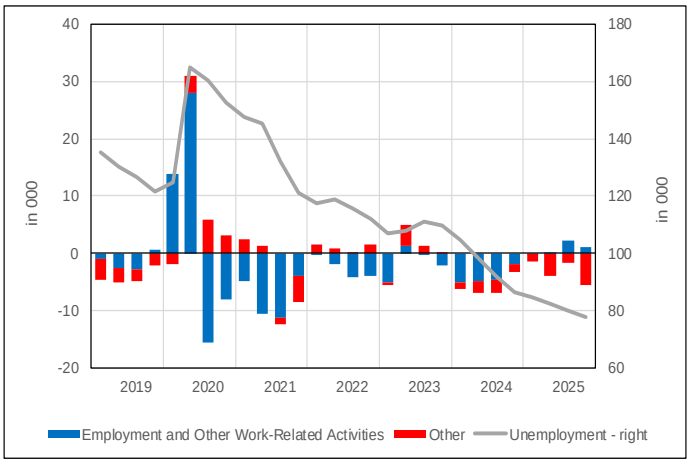
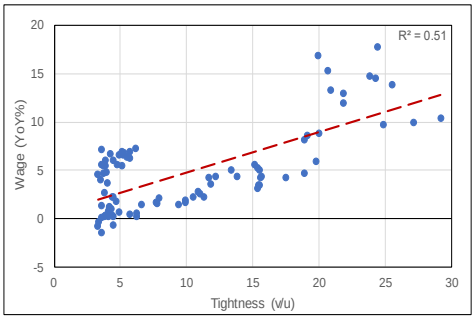


Figure 5: Total Unemployment and Decomposition of Net Inflows into Unemployment

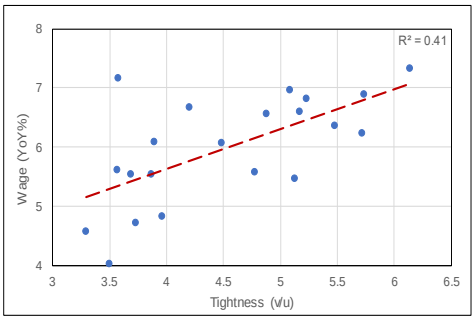
Note: An increase in net inflows indicates a rise in the number of individuals registered with the Croatian Employment Service (CES), according to the specified categories.
Source: CES; authors' calculations (seasonal adjustment using ARIMA X-13 RSA3 method).

Implied changes in labour demand can also be captured through a Wage Phillips-curve-type relationship across different periods. Such curves are estimated in an alternative form by relating the growth rate of nominal wages to labour market tightness, which is calculated as ratio of vacancy rate and unemployment rate (Figure 6). In particular, adjustments in labour demand should, to some extent, be reflected in nominal wage dynamics, which would be expected to grow more slowly once labour has entered a phase of high relative factor cost. The relationship between wage growth and labour market tightness is, in the long run and across the full sample, positive, which is consistent with theoretical predictions. Similarly, in most sub-periods, this relationship remains positive. However, between 2023 and 2025, the relationship turns negative, with the coefficient of determination declining sharply relative to the recent periods.

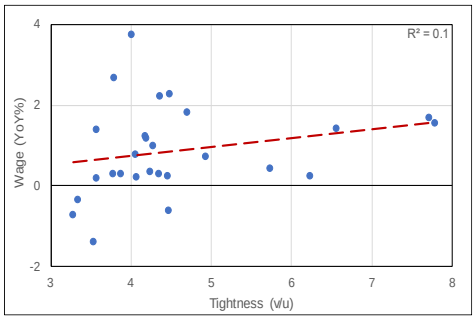
A possible explanation for this pattern lies in the persistently high levels of labour market tightness, which continued to increase through 2025, while nominal wage growth moderated somewhat. This distorted relationship is largely driven by the continuous decline in the unemployment rate, the denominator of the tightness measure, while the vacancy rate declines at a slower pace, leading to further increases in labour market tightness. As noted earlier, the recent decline in the unemployment rate does not necessarily reflect stronger employment growth or increased labour demand, but rather a reduction in the number of individuals registered with the CES for reasons unrelated to employment.



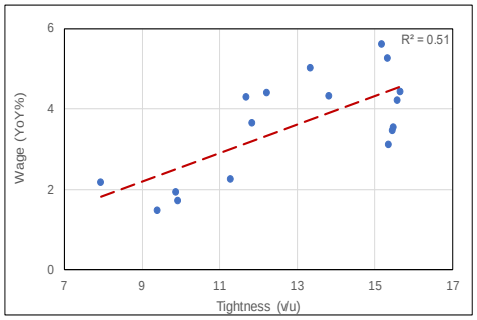
(a) 2004Q1 2025Q4



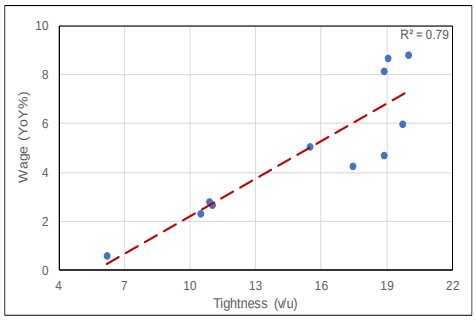
(b) 2004Q1 2009Q1



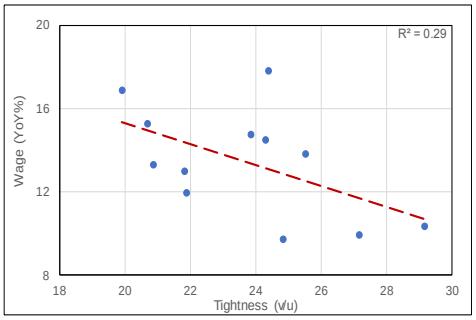
(c) 2009Q2 2015Q4



(d) 2016Q1 2020Q1



(e) 2020Q2 2022Q4



(f) 2023Q1 2025Q4

Figure 6: Alternative Wage Phillips Curves Across Periods

Accordingly, the atypical negative slope observed of the Wage Phillips curve suggests unusual conditions in the Croatian labour market. The slowdown in nominal wage growth could partially reflect a moderation in labour demand.

The most recent Wage Phillips curve is further supported by the recent divergence between the proxy for labour market tightness and the year-on-year growth of nominal wages, whose relationship has historically been largely positive and aligned (Figure 7). This decoupling provides additional support for the hypothesis of a potential correction in labour demand.

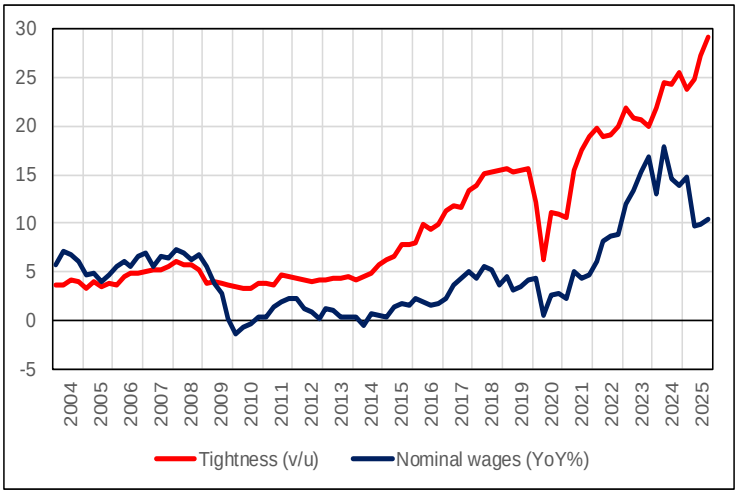


Figure 7: Labour Market Tightness and Nominal Wages

Source: CBS, Croatian Employment Service (CES); authors' calculations (seasonal adjustment using ARIMA X-13 RSA3 method).

To formally identify a structural change in the slope of the wage Phillips curve in the recent period, we estimate a regression model with structural breaks. Specifically, such model is a partial structural break regression model with unknown break dates, where the slope on labour market tightness is allowed to change, while the coefficient on additional covariate inflation is assumed to be stable. Let w_t denote gross nominal wage (YoY%), θ_t is labour market tightness and π_t is inflation rate (HICP). Suppose there are $_m$ unknown break dates $T_1,\ldots,T_m$. Then, partial structural break model can be written as:

$$w_t = \alpha_j + \beta_j \theta_t + \gamma \pi_t + u_t, \quad t \in (T_{j-1}, T_j], \quad j = 1, \ldots, m+1 \tag{1}$$

where α_j is a regime-specific intercept, β_j is the coefficient on labour market tightness, and γ denotes the inflation coefficient, assumed constant across regimes, while u_t is the error term. For each time partition defined by break dates, coefficients are estimated using Ordinary Least Squares (OLS) method. Since break dates are under assumption unknow, we estimate

them using Bai-Perron (1998, 2003) methodology. First, we define sum of squared residuals:

$$SSR(T_1, \ldots, T_m) = \sum_{j=1}^{m+1} \sum_{t=T_{j-1}+1}^{T_j} \hat{u}_t^2 \tag{2}$$

where

$$\hat{u}_t = w_t - \hat{\alpha}_j - \hat{\beta}_j \theta_t - \hat{\gamma} \pi_t \tag{3}$$

Given the m partitions, coefficients and break dates are jointly determined as the global minimizers of the sum of squared residuals:

$$(\hat{T}_1, \ldots, \hat{T}_m) = \arg \min_{T_1, \ldots, T_m} SSR(T_1, \ldots, T_m) \tag{4}$$

For break point estimation, we chose Bai-Perron tests of $L + 1$ vs. L sequentially determined breaks procedure. First, maximum number of breaks L are chosen that are considered for test. Then, for $l = 0, 1, \ldots, L$ model is estimated with l breaks minimizing sum of squared residuals over all possible break combinations. Since computational burden of estimating both optimal break locations and period-specific coefficients is quite large, Bai and Perron (2003) use dynamic programming algorithm that is based on the concept of the Bellman´s principle (Perron, 2006). Next step is to compute test statistics for sequential determination. Standard test statistic is Supremum F test that determine whether $l + 1$ breaks improve the fit compared to $_l$ brakes. Test is repeated sequentially until adding another break is not statistically significant or maximum number of optimal breaks are chosen. Data for model estimation is in monthly frequency (description and data sources are in Table A1).

Results of the estimated model formally indicate statistically significant structural slope change in the recent period, as shown previously on the periodic graphs (Table 1).

By observing the estimated coefficients with the Tightness variable, a positive, significant, and stable relationship between tightness and the growth rate of nominal wages is evident in the regime up until the first significant structural break (August 2009) and in the regime up to October 2022. In both regimes, the coefficient associated with the tightness variable remains very stable, allowing the first significant break to be attributed to substantial changes in the constant term. This is further supported by the model estimated using the standard OLS method, which suggests a positive and significant coefficient for the Tightness variable over the entire available sample. Additionally, the inflation control variable, both in the structural break model and the standard model, shows a significant and positive impact on wage growth. However, the statistically significant structural break estimated in October 2022 marks a change in the slope coefficient of the alternative Wage Phillips curve, which now loses significance in the last 39 observations of the third regime. This indicates that

Table 1: Regression with structural breaks (inflation as non-breaking variable)

	Constant	Tightness	Inflation	R^2	Observations
Jan 2004 – Jul 2009	1.344	2.776***			67
	(1.552)	(1.026)			
Aug 2009 – Sep 2022	-3.467***	2.761***			158
	(0.464)	(0.226)			
Oct 2022 – Dec 2025	17.07	-1.574			39
	(27.13)	(8.6)			
Non-Breaking			0.156*	0.86	264
			(0.094)		
OLS	-2.78**	2.82***	0.674***	0.56	264
	(1.17)	(0.6)	(0.166)		

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels. R^2 denotes the coefficient of determination. Robust standard errors are reported in parentheses. Variable Tightness is transformed using natural logarithm. In the structural break model, a trimming percentage of 15% and a maximum of 5 breaks are used. Significant breaks are identified in August 2009 and October 2022.
Source: Authors.

recent deviations in the relationship between tightness and wage growth have been formally observed through the structural break model. Furthermore, the structural break model demonstrates a higher coefficient of determination compared to the standard OLS model (0.89 vs. 0.56), suggesting a better model fit that accommodates the structural breaks in the slope of the Wage Phillips curve.

An additional estimation of the model with the control variable for inflation expectations of consumers estimated for Croatia (information in Table A1) yields a similar robust result, which corresponds to the first model with inflation included (Table 2).

Table 2: Regression with structural breaks (inflation expectations as non-breaking variable)

	Constant	Tightness	Inflation exp.	R^2	Observations
May 2005 – May 2009	-0.557	3.231***			49
	(3.231)	(0.872)			
Jun 2009 – Nov 2022	-5.189***	2.994***			162
	(0.647)	(0.238)			
Dec 2022 – Dec 2025	36.473*	-8.151			37
	(20.28)	(6.511)			
Non-Breaking			0.129***	0.89	248
			(0.026)		
OLS	-6.575***	3.577***	0.286***	0.55	248
	(1.631)	(0.556)	(0.07)		

Notes: See the notes below Table 1. Significant breaks are estimated at June 2009 and December 2022.
Source: Authors.

Therefore, the results obtained from the structural break model estimation indicate a formal and significant change in the slope of the Wage Phillips curve, resulting from a potential correction in labour demand, which we previously suggested with periodic Wage Phillips curve graphs and with identified deviations in Okun´s law relationship and Beveridge curve estimates.

Conversely, wage growth rates still remain relatively elevated, which may be attributed to the persistence of unanchored inflation expectations, thereby sustaining robust wage increases within an environment of persistent inflation. This assertion is further substantiated by the results from estimated structural break models, which demonstrate a significant and positive relationship between inflation rates, inflation expectations, and wage growth across the entire data sample.

However, it is also important to note that amendments to the Aliens Act in March 2025 and early 2026 introduced certain restrictions on the inflow of foreign workers from third countries into Croatia. This development is not unexpected, as the abolition of the quota system for employing such workers in 2021 led to a sudden liberalization of labour inflows from outside the European Union. These changes resulted in a substantial increase in the inflow of foreign workers into the Croatian labour market, that contributed substantially to the employment growth seen in 2022-2024, as shown in Banić and González-Torres (2026). Such a strong influx of foreign workers was not accompanied by the institutional regulation of the Croatian labour market, which was not prepared for such a socio-cultural shock. (e.g., limited accessibility of Croatian language learning systems for foreigners and underdeveloped mechanisms for the social integration of immigrants). For these reasons, recent legislative changes have introduced a need to regulate the domestic labour market in order to facilitate the integration of newly arrived immigrants into their working environments. Nevertheless, such policy measures further complicate the analysis of total employment dynamics in Croatia, as a reduction in labour supply due to regulatory changes may also contribute to the recent slowdown in employment growth (negative labour market shock). In other words, in 2025 the Croatian labour market is characterized by simultaneous pressures stemming from a weakening of labour supply through the immigration channel and a possible moderation in labour demand amid rising labour costs and prior labour hoarding.

This raises the question of which of these effects is more dominant and whether both play a role in the recent slowdown in employment growth. The evidence and arguments presented thus far suggest the importance of the demand side in explaining the recent slowdown in employment. However, this paper aims to formally test these relationships using a structural VAR (SVAR) approach to determine specific demand and supply shock contributions to economic activity, employment, real wages, inflation and labour productivity.

4 Modelling Strategy

In the model we use four variables for Croatia, i.e. annual growth rates (YoY%) at quarterly level for real GDP, HICP inflation, employment and real wages for the period from 2000Q1 to 2025Q4. We use data from Eurostat, aside for the employment, for which we rather use administrative data from Croatian Pension Insurance Institute data since the survey data for employment are more sensitive to revisions and less confident, while for the real wages we use the data from Croatian Bureau of Statistics (more detail in Appendix). Following the procedure in Deskar-Škrbić et al. (2020), Nadoveza (2025), Arias et al. (2014), we estimate a Bayesian VAR model with k lags as follows:

$$A_0 y_t = \alpha + A_1 y_{t-1} + \cdots + A_k y_{t-k} + \varepsilon_t, \quad t = 1, \ldots, T \tag{5}$$

where yt is a vector of observable variables, Aj are nxn coefficients with invertible A_0, α 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, 2015). Furthermore, we estimate a reduced-form model by pre-multiplying the equation (5) by A_0:

$$y_t = c + B_1 y_{t-1} + \cdots + B_k y_{t-k} + e_t, \quad t = 1, \ldots, T \tag{6}$$

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

The main feature of structural VAR analysis is the calculation of the impulse response function (IRF) to capture the reaction of the endogenous variable to the specific shock:

$$\psi_h = \frac{\partial y_{t+h}}{\partial \varepsilon_t}, \quad h = 0, 1, 2, \ldots \tag{7}$$

where element $\psi_{jk,h}$ represents median response of variable j to shock k after h periods. The historical decomposition is used to decompose the contribution of a specific shock k to an observed variable j in a model in period t:

$$y_{j,t}^k = \sum_{h=0}^{t-1} \psi_{jk,h} \cdot \varepsilon_{k,t-h} \tag{8}$$

Following the approach of Deskar-Škrbić et al. (2020) and Nadoveza (2025), we apply the Gibbs sampler using Independent Normal Inverse Wishart prior, and at each iteration we derive a set of structural models that satisfy the sign restriction used to identify shocks. Hyperparameters are set to $\lambda_1 = 100$, $\lambda_2 = 100$, $\lambda_3 = 1$, and $\lambda_4 = 10000$, which is in line with domestic literature (Deskar-Škrbić et al., 2020) implying relatively loose prior shrinkage,

i.e. we let the data play a more prominent role in the empirical framework. The posterior distribution is based on 1000 draws after discarding the first 1000 as burn-in to ensure convergence of the Markov chain.

To identify the structural model in equation (6), we impose structural shocks on impact, i.e. short-run restrictions, following to large extent the identification scheme from Consolo et al. (2026) for aggregate demand and three specific labour market supply shocks (Table 3). In more detail, an expansionary demand shock affects positively economic activity, employment and inflation, which are determined by expansionary fiscal and/or monetary policy, as well as by risk premium shocks. Real wages are left unrestricted in order to allow the data to determine their response considering positive demand effect on both activity and inflation, which is in line with Consolo et al. (2026). However, unlike Consolo et al. (2026), we did not separately identify the monetary policy shock from demand shock given that Croatia has been a member of the euro area since 2023, thus the period related to supranational monetary policy (guided by the European Central Bank) is relatively short.

As previously mentioned, we impose three distinct structural supply-side shocks that generate a negative co-movement between output and prices. Although these shocks share similar reduced-form implications for inflation and real activity, they differ fundamentally in their transmission mechanisms and factor allocation effects on labour market. Distinguishing among them is essential for structural identification and for understanding the appropriate policy response.

We consider: (i) a productivity shock, i.e. neutral technology shock, (ii) a factor-substitution shock, and (iii) a labour market supply shock. First supply shock is a neutral technology shock or productivity shock, interpreted as an exogenous increase in total factor productivity (TFP). In the tradition of Real Business Cycle (RBC) models, productivity shocks constitute a primary driver of macroeconomic fluctuations (Kydland and Prescott, 1982). In its canonical form, a neutral technology shock is Hicks-neutral: it augments the productivity of capital and labour proportionally, leaving the capital-labour ratio unchanged in the absence of adjustment frictions. The immediate effect of such a shock is a decline in firms' marginal costs. With higher productivity, a given level of inputs yields greater output, reducing unit production costs and exerting downward pressure on inflation. In New Keynesian environments with price rigidities, the reduction in marginal cost translates into lower inflation dynamics, thereby producing the negative co-movement between output and prices that characterizes supply-driven expansions. At the same time, the marginal product of labour rises. Firms increase labour demand, leading to higher employment and rising real wages. Output expands due to both improved efficiency and increased factor utilization. Importantly, employment and real wages move in the same direction, reflecting

the symmetric improvement in factor productivity. Empirical identification of technology shocks has been extensively debated. Galí (1999) shows that under sticky prices, hours worked may decline temporarily following a positive technology shock, complicating the empirical mapping between productivity and labour input. Basu et al. (2006) further argue that measured TFP innovations may partly reflect endogenous cyclical utilization. Nonetheless, within structural DSGE frameworks, neutral technology shocks remain the benchmark mechanism through which aggregate supply expansions reduce inflation while raising output. From a policy perspective, such shocks typically represent "good disinflation." Since output rises while inflation falls, monetary policy faces no conventional stabilization trade-off. The welfare implications are therefore fundamentally different from demand-driven fluctuations.

The second supply shock is a factor-substitution shock that alters the relative productivity or cost of capital and labour. Unlike the productivity shock, this one is not symmetric across production factors. Instead, it induces endogenous reallocation between capital and labour, consequently affecting the capital-labour ratio. A rise in the relative productivity of capital, for example, due to capital-embodied technological change encourages firms to substitute capital for labour. Hiring declines, employment contracts, and capital deepening or capital utilization intensifies. Conversely, if labour becomes relatively cheaper, due to falling real wages or increased borrowing and energy costs that raise the user cost of capital, firms may expand employment at the expense of investment. In both cases, the defining feature is a change in relative factor intensity rather than a uniform productivity gain. This mechanism is closely related to the literature on investment-specific technological change. Greenwood et al. (1997) show that improvements in the efficiency of new capital goods can drive capital deepening and reshape labour demand. More broadly, Acemoglu (2002) develops a theory of directed technical change in which relative factor supplies and prices influence the direction of innovation, potentially generating capital-biased or labour-biased technological progress. Factor-substitution shocks can also capture energy price disturbances. Hamilton (1983) demonstrates that oil price shocks raise production costs and depress output, with heterogeneous effects across sectors. Capital-intensive industries are disproportionately affected when energy inputs complement capital. In a multi-sector setting, Acemoglu and Guerrieri (2008) show that capital-intensive sectors drive aggregate output volatility, whereas labour-intensive sectors dominate employment fluctuations. This sectoral asymmetry has important macroeconomic implications. Following an adverse aggregate supply shock, output may be primarily driven by developments in capital-intensive sectors, while employment adjusts through labour-intensive industries responding to wage movements. As a result, output and employment dynamics may temporarily decouple, generating deviations from the standard Okun's law relationship. Such episodes can manifest as periods in which

employment remains resilient despite weak output, or vice versa (Consolo et al., 2026).

The third supply shock originates directly within the labour market, which increase output and employment while simultaneously reducing wage and price inflation. Conceptually, this shock includes both labour supply shocks and wage bargaining shocks. A positive labour supply shock, arising from demographic changes, migration, or increased participation, shifts the labour supply curve outward. The equilibrium real wage declines, reducing firms' marginal costs. Lower labour costs compress inflationary pressures and stimulate labour demand. Firms expand employment and output, generating an expansion accompanied by declining inflation.

Similarly, wage bargaining shocks that reduce workers' mark-ups have comparable macroeconomic effects. In search-and-matching models of the labour market (Mortensen and Pissarides, 1994), lower bargaining power reduces wages and increases vacancy posting, leading to higher job creation and employment. In New Keynesian DSGE models with wage rigidities, wage mark-up shocks generate expansions in output and employment alongside disinflationary pressures (Smets and Wouters, 2007). Importantly, the expansion in this case does not arise from improved technological efficiency but from reduced production costs due to labour market conditions. Unlike neutral technology shocks, real wages decline or grow more slowly, even as employment rises. The capital–labour ratio may also adjust endogenously depending on firms' relative input decisions. Distinguishing empirically between labour supply shocks and wage bargaining shocks often requires incorporating additional labour market variables, such as unemployment or participation rates (Foroni et al., 2018). Without such information, these mechanisms may be observationally similar in aggregate time-series data.

From a stabilization perspective, labour market shocks pose distinct challenges. Although inflation declines, the welfare implications depend on whether wage compression reflects improved labour supply conditions or weakened bargaining power.

While all three supply shocks generate a negative co-movement between output and prices, their structural signatures differ markedly. These distinctions are central for economic policy makers, especially for monetary policy. A productivity-driven disinflation may warrant accommodation, as it reflects improved supply conditions. By contrast, a labour market shock associated with wage compression may have distributional consequences that complicate policy assessment. Factor-substitution shocks may require careful monitoring of sectoral imbalances and investment dynamics. Structural identification is therefore not merely an econometric exercise but a prerequisite for coherent macroeconomic interpretation and policy design. Also, a key requirement for structural interpretation is that the identified shocks are mutually orthogonal, ensuring that each shock captures a distinct source of economic fluctuations without contamination from other shocks. This property will be assessed

using the correlation matrix of the structural shocks.

Table 3: Restrictions for identification of structural shocks

Shock/variable	Demand	Neutral technology/ Productivity	Factor substitution	Labour market
Real GDP	+	+	+	+
Inflation	+	-	-	-
Employment	+	+	-	+
Real wages	?	+	+	-

Notes: Positive reaction (+), negative reaction (-), unrestricted reaction (?). Sign restriction is imposed on impact ($h = 0$).

5 Empirical Results

The empirical analysis covers the 25-year period (2000-2025), placing particular emphasis on 2019-2025, a period marked by two major adverse shocks, i.e. the pandemic and the energy crisis, which allows for an assessment of labour market resilience under markedly different macroeconomic conditions. Overall, the results provide a structural explanation for the observed breakdown of standard empirical regularities from Section 3. Croatia experienced a severe pandemic recession, followed by an energy price shock and a pronounced inflationary episode, yet employment performance remained comparatively robust. However, employment growth begins to moderate in 2025 despite continued output expansion, raising the question whether this reflects cyclical weakness or structural adjustment.

Using a Bayesian VAR framework with sign restrictions for structural shock identification, this section interprets macroeconomic developments through historical decompositions of demand, neutral technology, factor substitution and labour market shocks, building on the empirical regularities documented in Section 3 (Beveridge and Wage-Phillips Curve and Okun's law). The analysis jointly considers evidence from employment, real GDP, real wages, inflation and labour productivity to distinguish between demand-driven fluctuations and cost-constrained normalization dynamics.

Figures 9-13 summarise the empirical evidence. Figure 9 presents the historical decomposition of annual real GDP growth, Figure 10 the corresponding decomposition for employment growth, Figure 11 for real wages, Figure 12 for inflation, and Figure 13 for labour productivity.

Three stylised facts emerge:

1. Since 2021, shocks have contributed asymmetrically to output and employment.

2. Real wage and productivity developments have increasingly shaped the transmission of shocks to employment dynamics.

3. Real wages exhibit a positive reponse to demand shocks, even in the absence of an imposed sign restriction, consistent with procyclical wage dynamics and strong labour demand (Figure 8). In more detail, median response of real wages is positive but in first five quarters credibility intervals include zero. However, the response becomes statistically significant at medium and long horizons, suggesting a gradual transmission of demand conditions to wage dynamics. Other impulse reponse functions are presented in Appendix.

Pairwise correlations between the structural shocks are close to zero, confirming that the orthogonality condition is well satisfied (see Table A2 in Appendix).

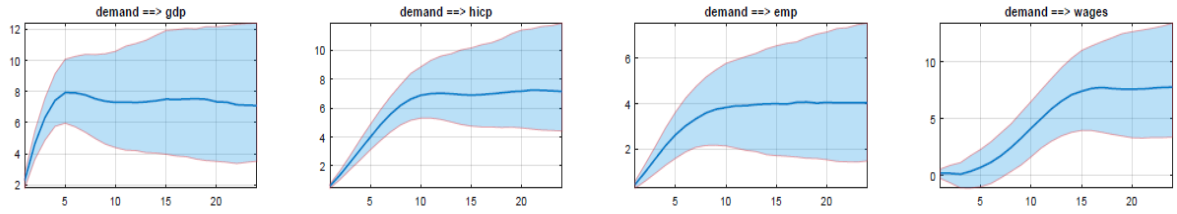


Figure 8: Effects of demand shock on real GDP, inflation, employment and real wages in Croatia

Note: Results are represented with median posterior and 68% credibility intervals. Impulse responses correspond to a one-standard-deviation structural demand shock.
Source: authors.

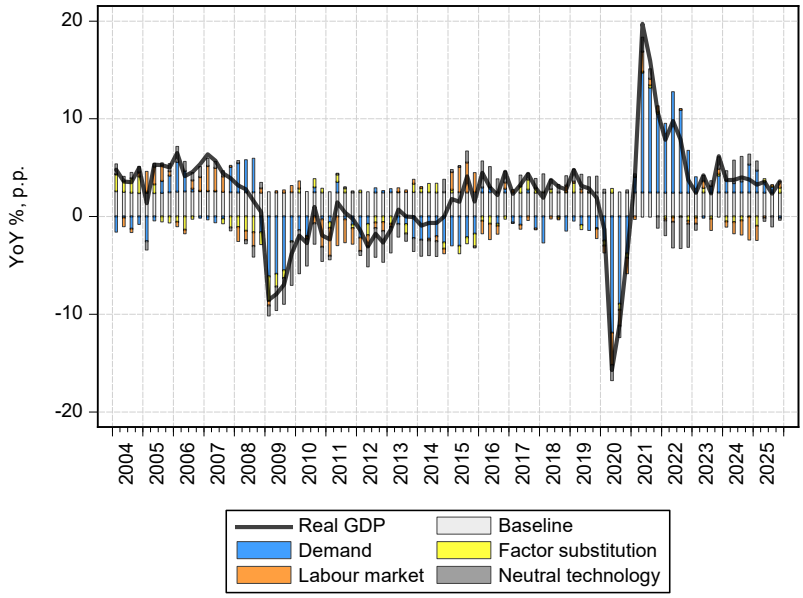


Figure 9: Historical shock decomposition for real GDP (YoY%) for Croatia

Note: Bars show median contributions over 1000 admissible draws.
Source: authors.

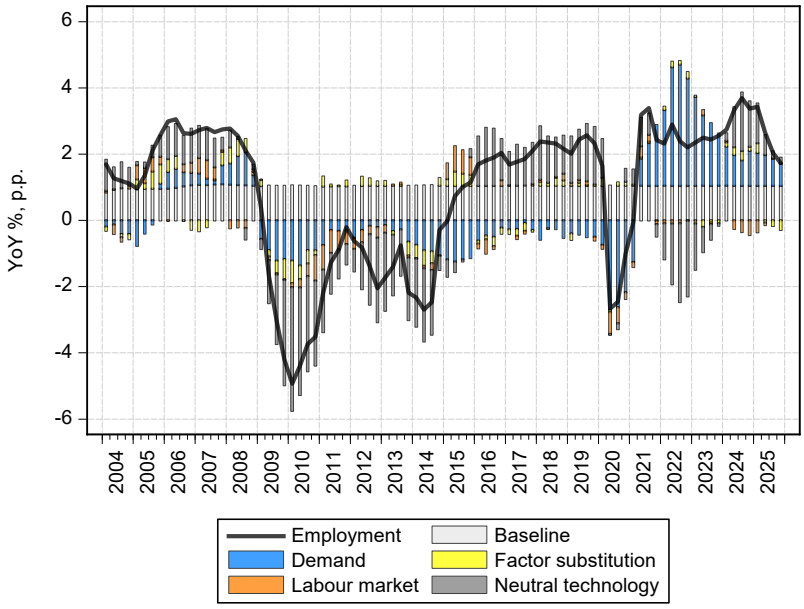


Figure 10: Historical shock decomposition for employment (YoY%) for Croatia

Note: Bars show median contributions over 1000 admissible draws.
Source: authors.

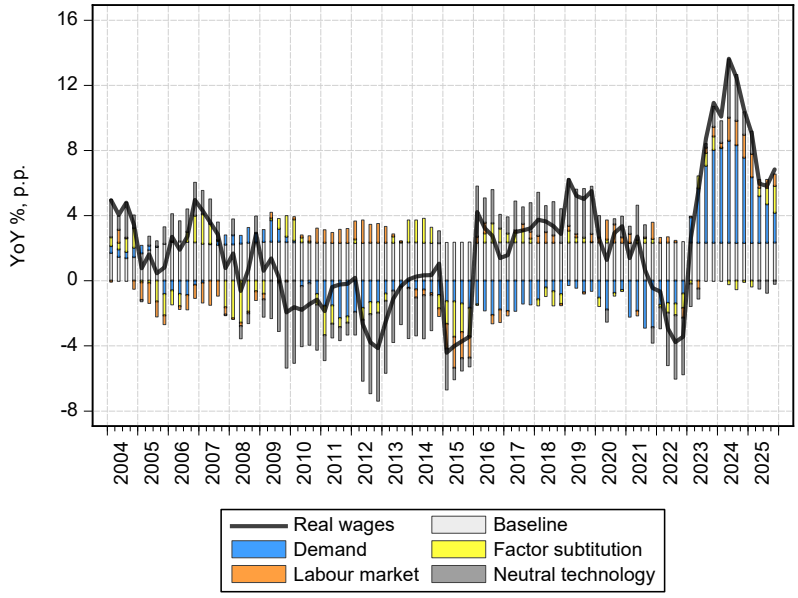


Figure 11: Historical shock decomposition for real wages (YoY%) for Croatia

Note: Bars show median contributions over 1000 admissible draws.
Source: authors.

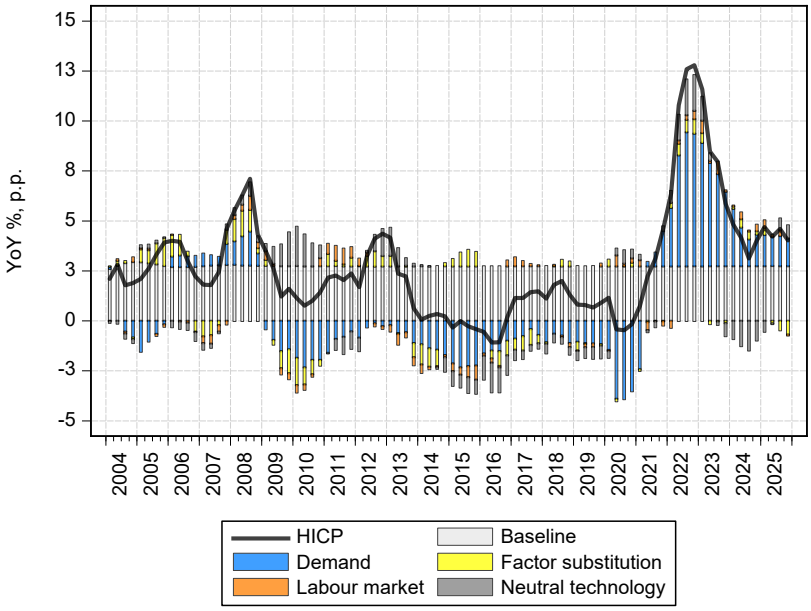


Figure 12: Historical shock decomposition for HICP inflation (YoY%) for Croatia

Note: Bars show median contributions over 1000 admissible draws.
Source: authors.

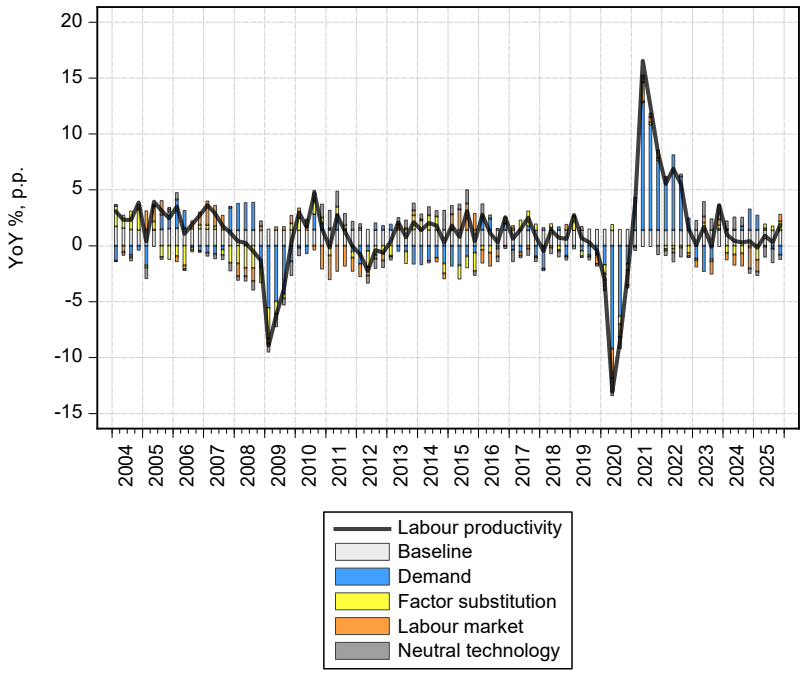


Figure 13: Historical shock decomposition for labour productivity (YoY%) for Croatia

Note: Bars show median contributions over 1000 admissible draws. Labour productivity is not included as a separate variable in the model, but is implicitly derived from the historical shock decomposition as the difference between real GDP and employment growth rates and corresponding shock contributions.
Source: authors.

5.1 Pandemic contraction and rapid recovery

The 2020 contraction in employment (Figure 10) is primarily explained by a negative demand shock, consistent with mobility restrictions and the collapse of contact-intensive sectors. The labour market contribution also turns negative, capturing matching frictions and temporary sectoral dislocations. However, the magnitude and duration of the employment contraction remain limited relative to output losses (Figure 9).

This asymmetry suggests labour hoarding behaviour. Firms appear to have retained workers in anticipation of reopening, supported by fiscal measures and wage subsidy schemes. The decline in labour productivity (Figure 13) during 2020 reflects this mechanism, as output fell more sharply than employment.

Employment rebounded rapidly once demand recovered in 2021. The 2021–2022 expansion phase is characterised by strong positive demand contributions to both employment and output. Productivity also recovers, largely reflecting cyclical normalization. Wage growth accelerates (Figure 11), while inflation pressures remain initially contained before intensifying during the energy crisis (Figure 12). The close alignment between employment and output growth confirms the cyclical responsiveness of labour demand. Importantly, no persistent negative labour market shock is observed in the recovery phase, indicating limited structural scarring.

5.2 Energy shock and sustained labour market tightness

The energy price shock of 2022 introduces significant supply-side disturbances, reflected in negative contributions of neutral technology contributions in both employment and output. Inflation rises sharply, driven initially by supply factors and later reinforced by demand pressures.

Despite these adverse shocks, employment growth remains positive and comparatively robust. This suggests that domestic demand strength partly offset supply headwinds. However, productivity developments remain relatively weak during this period, implying that wage growth is not fully supported by efficiency gains.

Wage growth accelerates markedly in 2023-2024, reflecting tight labour market conditions and high vacancy rates. Labour supply adjustments, including foreign worker inflows and increased participation, likely mitigated even stronger wage pressures. Nevertheless, sustained nominal wage growth becomes visible in the rising labour income share, pointing to increasing unit labour costs.

5.3 Rising wage share and firm adjustment

From 2022 onwards, the labour income share increases significantly and remains above its long-run average through 2025, as documented on Figure 2a. This implies margin compression unless offset by sustained productivity gains. Productivity growth during this period appears largely cyclical rather than technology-driven. The absence of strong neutral technology contributions suggests that wage growth increasingly exceeds underlying productivity improvements. As a result, hiring incentives gradually weaken. Wage growth peaks in 2024, while employment growth begins to moderate in 2025, while a slight growth by the end of 2025 could be interpreted with caution, as it may partly reflect one-off factors, including the timing of bonus payments and non-taxable compensation components (non-taxable payments grew by 3% in 2025 after annual decline of 8% in 2024 according to Croatian Bureau of Statistics).Vacancy rates decline, indicating adjustment primarily along the hiring margin rather than through layoffs.

5.4 Moderation on labour market in 2025: demand slowdown or cost constraint?

By 2025, employment growth slows to around 1.5-2 YoY%. Historical decomposition shows a weaker annual contribution of demand shocks, but not a persistent negative impulse. Real GDP growth remains positive, inflation moderates gradually, and wage growth decelerates but remains elevated. While labour productivity increases towards the end of the sample (Figure 10), this development largely reflects a mechanical effect of slowing employment growth relative to output, rather than a broad-based improvement in efficiency. As such, it is consistent with cost-driven adjustment in hiring rather than a productivity-led expansion. The decline in vacancy rates suggests reduced hiring intensity. Output continues to expand while employment growth slows, implying a temporary flattening of short-run employment responsiveness, as shown in Okun's law figures previously.

Additional output gains appear increasingly achieved through higher capacity utilization (de-meaned values in Figures A2 and A3 in Appendix) rather than proportional employment expansion. The evidence does not point to a broad demand recession. Instead, the configuration is more consistent with normalization under elevated labour costs. Employment growth in 2025 appears constrained not only by lower demand, but by rising unit labour costs and reduced hiring incentives in a tight labour market. Recent wage developments indicate some easing by late 2025, suggesting gradual moderation of cost-push pressures.

Compared with euro area evidence, where employment moderation coincides with broader output deceleration, Croatia exhibits a distinct pattern: employment slows while output

remains comparatively resilient. This suggests that the binding constraint has shifted from demand to labour costs.

5.5 Discussion

The results point to a gradual transformation in the underlying drivers of Croatia's labour market dynamics. First, labour market resilience during the pandemic and immediate recovery phase was predominantly demand-supported. Temporary shocks did not generate persistent structural scarring, and employment rebounded quickly once demand normalized. The relative importance of shocks appears to be state-dependent, with demand shocks dominating during the contraction phase and supply-side constraints becoming more binding in the later stages. This pattern is strongly consistent with the empirical relationships documented in Section 3. In particular, the Okun's law relationship weakens in the recent period, indicating a reduced responsiveness of employment to output. At the same time, The Beveridge curve has changed its slope since 2022, indicating a combination of declining job vacancy rates and a somewhat artificially lowered unemployment rate due recent reduction in the number of individuals registered with the CES for reasons unrelated to employment, wich indicates this correction in demand. Finally, the wage Phillips curve exhibits substantial instability, including a flattening and even reversal in the most recent period, suggesting that wage dynamics is decreasing because of cost employment normalization.

Second, consistent with the increasing role of supply-side constraints, the post-2022 increase in the labour income share represents a structural shift in the adjustment mechanism. Sustained nominal wage growth, combined with only moderate productivity improvements, resulted in rising unit labour costs. As noted above, part of the increase in real wages may reflect one-off compensation effects rather than underlying structural improvements. Historical decompositions of labour productivity indicate that post-crisis gains were largely cyclical and not supported by persistent neutral technology shocks. As wage growth increasingly exceeded productivity growth, hiring incentives gradually weakened.

Third, the moderation in employment growth in 2025 reflects a change in the binding constraint. The historical decomposition confirms that this shift reflects a combination of less expansionary demand impulses and gradually binding cost pressures. The absence of a sharp contraction in output supports the interpretation of normalization under tight labour market conditions rather than a demand-driven recession. Further, adjustment has occurred mainly through reduced hiring intensity rather than layoffs, consistent with declining vacancy rates and stable unemployment. At the same time, productivity gains remain moderate, limiting the scope for further employment expansion without generating additional cost pressures.

These findings have important policy implications. In an environment of elevated wage shares and moderate productivity growth, additional demand stimulus may yield diminishing employment effects while amplifying cost pressures. Sustainable employment growth will increasingly depend on productivity-enhancing investment, labour supply flexibility and improved matching efficiency. Wage-setting policies, including minimum wage adjustments or public sector wage increases, should therefore consider potential spillovers to private sector labour costs and price dynamics.

Several limitations of the analysis are subject for future research. Namely, the identified demand shock could be further refined by explicitly incorporating monetary and fiscal demand-side shocks within the modelling framework, in line with Ascari et al. (2024) and Consolo et al. (2026). Also, the labour supply dimension could be extended to account for migration dynamics, which have played an increasingly important role in recent labour market developments.

6 Conclusion

This paper analyses recent developments in the Croatian labour market, focusing on the slowdown in employment growth observed in 2025 despite continued economic expansion. The findings point to a clear shift in the underlying drivers of employment dynamics in the post-pandemic period.

While the initial recovery from the COVID-19 shock was predominantly demand-driven and supported by labour hoarding and policy measures, more recent developments reflect the increasing importance of supply-side constraints. In particular, the acceleration of nominal wages, following earlier declines in real wages, has led to a rise in unit labour costs and the labour income share, gradually weakening firms' incentives to hire.

The empirical evidence suggests that the recent slowdown in employment growth does not reflect a sharp deterioration in aggregate demand. Instead, it is consistent with a process of adjustment in an environment where demand remains positive but moderates, while rising labour costs become increasingly binding. This interpretation is supported by declining vacancy rates, stable unemployment, and a normalization of the relationship between employment and output.

Additional evidence from Okun's law, the Beveridge curve, and the wage Phillips curve indicates that the Croatian labour market is undergoing a gradual correction following a period of exceptionally strong labour demand. Importantly, this adjustment appears to be taking place primarily through reduced hiring rather than increased layoffs, suggesting a normalization of labour market conditions rather than a cyclical downturn.

From a policy perspective, these findings imply that demand-side stimulus may have limited effects on employment in the current environment and could instead amplify cost pressures. Sustaining employment growth will increasingly depend on productivity enhancing investment, improved labour market matching, and policies that expand effective labour supply. Overall, the Croatian labour market appears to be transitioning from a phase of demand-supported expansion to one of cost-constrained adjustment. Recognizing this shift is essential for the design of effective macroeconomic and labour market policies.

A Appendix

Table A1: Data description

Variable	Definition	Source
Real GDP	Chained link volume, million of euros	Eurostat
Total HICP	Harmonized Index of Consumer Prices	Eurostat
Employment	Annual change in number of employment	Croatian Pension Insurance Institute
Real wages	Nominal wages deflated with CPI	Croatian Bureau of Statistics
Nominal wages	Nominal wages growth rate	Croatian Bureau of Statistics
Unemployment rate	Ratio of unemployed persons to labour force	Croatian Bureau of Statistics
Vacancy rate	Ratio of vacant posts to total employment	CES, CPII, authors
Tightness	Vacancy rate / unemployment rate	Authors

Table A2: Correlation matrix of structural shocks from Bayesian (S)VAR model

	Demand	Neutral technology	Factor substitution	Labour market
Demand	1.00	0.05	-0.04	0.04
Neutral technology	0.05	1.00	0.02	-0.01
Factor substitution	-0.04	0.02	1.00	0.00
Labour market	0.04	-0.01	0.00	1.00

Source: authors

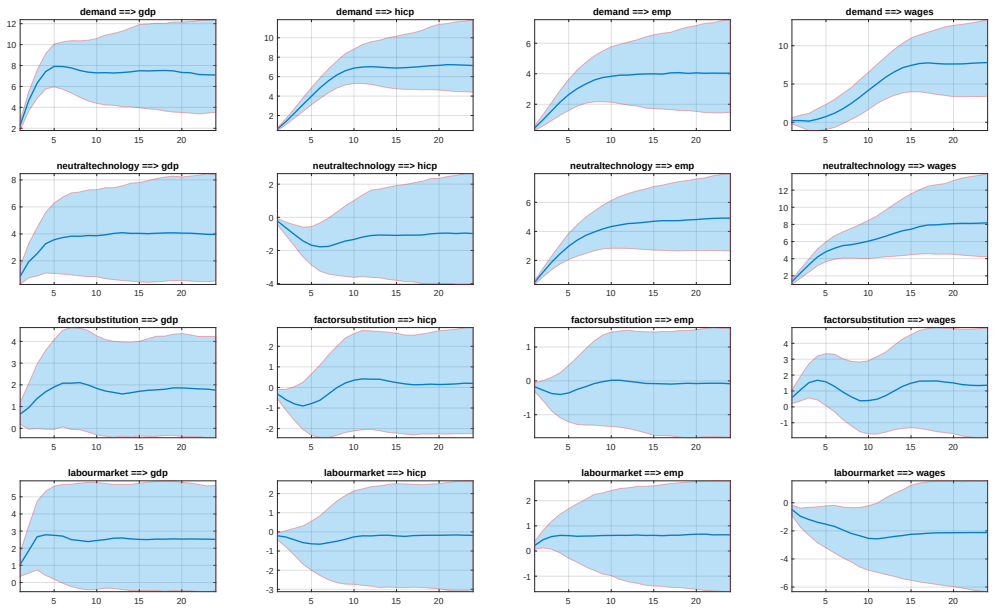


Figure A1: Impulse response functions from Bayesian (S)VAR model of real GDP, HICP, employment and real wages to demand, neutral technology, factor substitution and labour market supply shock

Note: Results are represented with median posterior and 68% credibility intervals. Impulse responses correspond to a one-standard-deviation structural shock (demand, neutral technology/productivity, factor substitution and labour market supply).

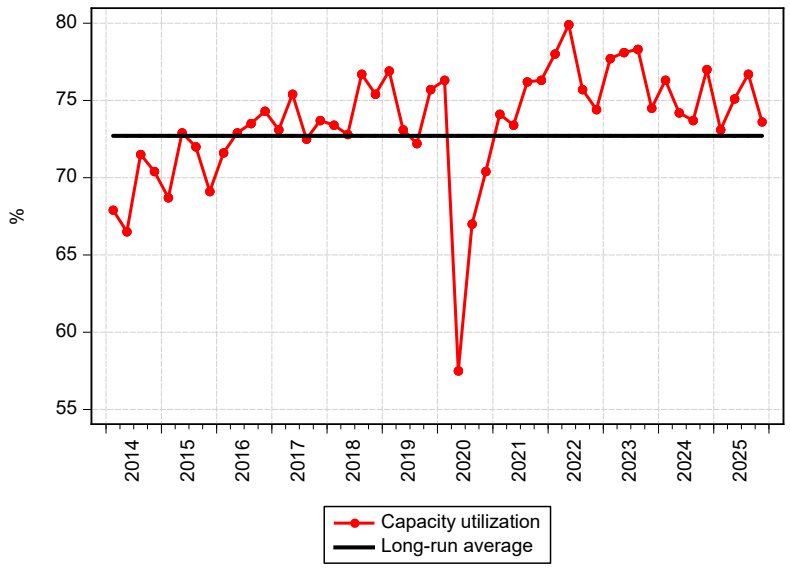


Figure A2: Capacity utilization in manufacturing for Croatia

Source: EC, authors.

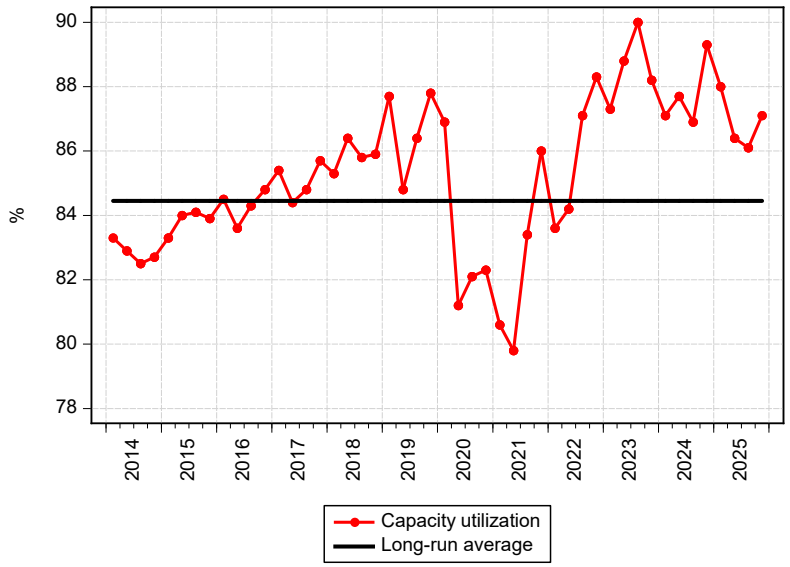


Figure A3: Capacity utilization in services for Croatia

Source: EC, authors.

References

Acemoglu, D. (2002). Directed technical change. *Review of Economic Studies*, 69(4):781–809.

Acemoglu, D. and Guerrieri, V. (2008). Capital deepening and nonbalanced economic growth. *Journal of Political Economy*, 116(3):467–498.

Antoszewski, M. (2019). Wide-range estimation of substitution elasticities for ces production functions. *Energy Economics*, 83.

Arias, J., Rubio-Ramirez, J., and Waggoner, D. (2014). Inference based on svar identified with sign and zero restrictions. Technical Report 1100, International Finance Discussion Papers.

Ascari, G., Bonam, D., Mori, L., and Smadu, A. (2024). Fiscal policy and inflation in the euro area. Technical Report 820, DNB Working Papers.

Babecký, J., Du Caju, P., Kosma, T., Lawless, M., Messina, J., and Rõõm, T. (2010). Downward nominal and real wage rigidity. *Scandinavian Journal of Economics*, 112:884–910.

Baccianti, C. (2013). Estimation of sectoral elasticities of substitution. Technical Report 13-092, ZEW Discussion Papers.

Bai, J. and Perron, P. (1998). Estimating and testing linear models with multiple structural changes. *Econometrica*, 66:47–78.

Bai, J. and Perron, P. (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 6:72–78.

Banić, F. and González-Torres, G. (2026). Different strokes for different folks. *Public Sector Economics*, 50(1):5–37.

Basu, S., Fernald, J., and Kimball, M. (2006). Are technology improvements contractionary? *American Economic Review*, 96(5):1418–1448.

Blake, A. and Mumtaz, H. (2015). Applied bayesian econometrics for central bankers. Technical report, Bank of England.

Blanchard, O. and Galí, J. (2007). Real wage rigidities and the new keynesian model. *Journal of Money, Credit and Banking*, 39:35–65.

Checherita-Westphal, C. (2022). Public wage and pension indexation in the euro area. Technical report, ECB Economic Bulletin.

Consolo, A., Foroni, C., and Hjelm, G. (2026). The labour market in the euro area. Technical Report 3180, ECB Working Paper Series.

Deskar-Škrbić, M., Kotarac, K., and Kunovac, D. (2020). The third round of euro area enlargement. *Journal of International Money and Finance*.

Dickens, W., Goette, L., Groshen, E., Holden, S., Messina, J., Schweitzer, M., Turunen, J., and Ward, M. (2007). How wages change. *Journal of Economic Perspectives*, 21(2):195–214.

Foroni, C., Furlanetto, F., and Lepetit, A. (2018). Labor supply factors and economic fluctuations. *International Economic Review*, 59(3):1491–1519.

Galí, J. (1999). Technology, employment, and the business cycle. *American Economic Review*, 89(1):249–271.

Greenwood, J., Hercowitz, Z., and Krusell, P. (1997). Long-run implications of investment-specific technological change. *American Economic Review*, 87(3):342–362.

Hamilton, J. (1983). Oil and the macroeconomy. *Journal of Political Economy*, 91(2):228–248.

Koester, G. and Grapow, H. (2021). Private sector wage indexation in the euro area. Technical report, ECB Economic Bulletin.

Kunovac, M. and Pufnik, A. (2015). Labour market and wage setting in croatia. Technical report, Croatian National Bank.

Kydland, F. and Prescott, E. (1982). Time to build and aggregate fluctuations. *Econometrica*, 50(6):1345–1370.

Mortensen, D. and Pissarides, C. (1994). Job creation and job destruction. *Review of Economic Studies*, 61(3):397–415.

Nadozeva, O. (2025). Public sector wages and inflation. *Public Sector Economics*, 49(1):1–44.

Perron, P. (2006). Dealing with structural breaks. In *Palgrave Handbook of Econometrics*. Palgrave Macmillan.

Polgreen, L. and Silos, P. (2008). Capital-skill complementarity. *Review of Economic Dynamics*, 11.

Polgreen, L. and Silos, P. (2009). Crude substitution. *Journal of Monetary Economics*, 56.

Smets, F. and Wouters, R. (2007). Shocks and frictions in us business cycles. *American Economic Review*, 97(3):586–606.