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Macroeconomic determinants of labour costs in the EU: a comprehensive panel and cluster analysis

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Abstract. *Labour costs are a fundamental component of production expenses, significantly impacting both the quantity and quality of output. This study explores the determinants of labour costs within EU member states that have implemented minimum wage policies over the past two decades. The research technique includes a comprehensive panel analysis of EU member states to identify significant variables influencing labour costs, as well as cluster analysis to discover underlying patterns across the nations under examination. Our findings reveal that higher minimum wage levels, higher employment rates, increased labour productivity, and greater trade openness are positively correlated with higher labour costs. Specifically, increases in these variables lead to higher wages and a broader tax base, while greater trade openness results in elevated labour costs due to expanded market opportunities. Conversely, gross fixed capital formation negatively affects labour costs, as investments in production assets tend to reduce labour requirements or hours worked. The cluster analysis led to the identification of three distinct groups. The first cluster consists of well-developed economies with modest labour cost increases and average minimum wages. The second cluster includes countries with substantial labour cost increases, low minimum wages, and significant productivity gains. The third cluster features nations with high minimum wages and high employment rates. This paper contributes to the field by highlighting the complex interplay between labour costs and economic factors, offering insights for decision-makers to tailor macroeconomic and company-level strategies to specific local conditions. The findings emphasise the importance of balancing wage policies with sustainable economic development to enhance competitiveness while ensuring fair labour conditions.*

Keywords: labour cost, minimum wage, employment, labour productivity, panel data, cluster analysis, European Union.

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Introduction

The cost of labour plays a key role in the functioning of the labour market and, implicitly, in the functioning of an economy. For employers, the cost of labour is seen as a financial burden, because it includes, in addition to salary costs, non-salary costs determined by social contributions, labour taxation, and the minimum wage. Thus, the cost of labour represents a key determinant of the competitiveness of companies, together with the cost of capital and other nonprice elements, such as innovation and promotion.

Over the past two decades, across European states, labour costs have been recognised as a critical factor influencing labour demand, particularly in the context of the economic-financial crisis and the pandemic crisis. The reduction of non-salary costs, particularly for employers, has been a key component of employment growth policies. In practice, providing subsidies and incentives for hiring new workers, alongside reducing non-salary costs, were the primary measures implemented following each crisis that impacted the labour market across European states.

Higher labour costs can improve the welfare level of workers, but they can at the same time reduce the profits of companies if there is no estimate of the impact of possible labour cost increases on the level of the labour market and the economy in general. Thus, while they may appear to benefit employees at first, policies that raise labour costs can have an impact on both employment by eliminating jobs and keeping enterprises on the market due to increased compensation expenses. In any economy, decision-makers face a trade-off between imposing higher wages (increasing the cost of labour) – for example, by raising the minimum wage – and reducing the profits of the firms that will pay these wages. For this reason, it is very important to know how employers react to higher labour costs to understand how jobs are created and to forecast the economic and social impact of such changes on the labour market.

In general, higher labour costs unaccompanied by technological changes to increase labour productivity reduce the employment rate in any economy. Thus, policymakers must know that there will also be negative economic consequences if they raise the minimum wage or impose increases in labour taxation without additional measures to stimulate employment.

Identifying the factors that influence labour costs can represent a crucial step in developing effective policies for both the labour market and the broader economy. Labour costs can be a key driver of job creation in any economy if policies are in place to support employers. In conditions where high labour costs are not accompanied by increases in productivity, increased demand for goods in domestic or foreign markets, or other government incentives to create jobs, the labour market may be affected by informal employment (informal labour). To compensate for a potential increase in labour costs, which can arise from wage increases or increased labour taxation, policymakers can provide a range of incentives either to create new jobs or to maintain existing ones. These measures were adopted in some EU member states during both the economic-financial recession following

the 2007-2008 crisis and the COVID-19 pandemic crisis, aiming to mitigate some negative transitory shocks that affected the labour market.

In the current economic context, characterised by economic uncertainties and accompanied by high inflation, rising unemployment, strong fiscal pressures, and low economic growth, the decision-makers of the EU states are trying to identify some political reforms, including on labour taxation, which would support employment growth and, implicitly, economic growth.

The purpose of the paper is to investigate the macroeconomic determinants that influence labour costs by examining the interaction between labour market characteristics (such as employment rates and minimum wage levels), corporate factors (including labour productivity and capital investments), and broader economic conditions (notably the degree of trade openness). The study also seeks to understand how these factors contribute to variations in labour costs and identify best practices for policy development.

Therefore, our research questions are the following:

H1: How do minimum wage levels, employment rates, labour productivity, capital investment, and trade openness affect labour costs in EU member states?

H2: What patterns of labour cost and influencing factors can be identified across EU member states?

The novelty of this research lies in the investigation of specific macroeconomic factors affecting the salary component of labour costs at the level of EU Member States that have adopted minimum wages. The relevant literature indicated the existence of several studies on the non-salary components of labour cost. Practically, through our analysis, we tried to identify other variables that directly or indirectly impact labour costs, variables that can be considered in the formulation of labour market policies. Economic growth with effects on the increase in wages and implicitly in labour productivity, the increase in the employment rate, and the increase in commercial openness, implicitly also leads to the increase in the labour costs. Thus, our analysis may indicate that it is recommended to apply policies on the non-salary component to reduce labour costs or for its sustainability by companies (for example, reducing labour taxation, reducing social contributions or providing incentives or subsidies for companies).

This article is organised as follows: Section 2 provides a review of the literature on factors that influence labour costs. Section 3 describes the data and the methodological framework used in this study. Section 4 presents the empirical results. The concluding section summarises the principal findings and implications of the research.

Literature review

Macroeconomic theories highlight that higher wages not only increase labour costs for employers but also increase consumer demand among wage earners and their families. Assuming that there are no significant negative effects on external competitiveness (and here we can consider the degree of trade openness) or investment, these positive "effects" on consumption can lead to an increase in aggregate demand and implicitly to employment. Macroeconomic perspectives show that even if some low-productivity firms cut jobs or exit the market, this does not necessarily mean that aggregate employment will be reduced. Employment may spread to other firms, and higher wages may attract more people to the labour market. Some research has pointed out that productivity gains may be the result of a decrease in employment due to the minimum wage, as businesses will substitute capital

for labour and adopt more capital-intensive production technologies (Marin-Pantelescu & Albastroiu Nastase, 2024; Pavelescu et al., 2024). Although such a situation can also be created, especially when the minimum wage is set at too high a level, there is also research that shows that productivity increases in enterprises can be the result of organisational changes, employee training, and effective wage responses to increasing labour costs as a result of the increase in the minimum wage (ILO, 2019).

Increases in the minimum wage can lead to an increase in unemployment, but also to an increase in information employment, a fact that could have negative effects on labour productivity, through the loss of productive employees or by reducing companies' investments in employee training. These effects appear especially when companies are forced to fully absorb these increases in the minimum wage in labour costs, without the possibility of transfer in the selling price, the demand being elastic (Del Carpio and Pabon, 2017; Dima et al., 2022).

Thus, an increase in labour costs will immediately be reflected in either a reduction in the number of hours worked or a reduction in the number of employees. Later, these costs will be able to be transferred to the sale price, or they will be able to be mitigated by investments in technical (machines, buildings) and technological capital that will increase the efficiency and productivity of businesses.

Hamermesh (2014) identified the so-called "3 for 10" rule, by which he demonstrated that a 10% increase in labour costs leads to a 3% decrease in the number of employees. To mitigate these effects, it is necessary that policies to increase wages, and especially the minimum wage, be accompanied by compensatory measures, especially for groups of vulnerable employees.

Companies often avoid raising wages because it lowers the company's bottom line, but they often seek to increase turnover to reduce the cost of goods sold. Stundziene and Baliute (2022) showed that increased staff costs do not necessarily mean lower profitability. The increase in personnel costs increases the gross operating rate if the turnover per employed person is stable. Turnover growth has a positive effect on labour productivity but a negative impact on the gross operating rate. Thus, the impact of turnover on labour productivity is significantly lower than the impact of personnel costs on labour productivity. The panel analysis of EU countries in the period 1995-2018 highlighted for the manufacturing industry the fact that there is a positive long-term relationship between personnel costs and labour productivity and there are no significant differences between EU states.

Riley and Bondibene (2015) analysed the effects of the introduction of the national minimum wage in the UK, as well as its subsequent increases, to identify the effects of the minimum wage on productivity. They found that companies responded to these increases in labour costs by increasing labour productivity. These changes in labour productivity were not caused by a reduction in the labour force of the company or the replacement of labour for capital, but by an increase in the total factor productivity, consistent with organisational changes and increased competitiveness of the company, including foreign markets.

Mayneris, Poncet, and Zhang (2014), using data from more than 160,000 firms in China's manufacturing sector, found that increases in city-level minimum wages led to a lower probability of survival of poorly productive firms. For the surviving firms, wage costs increased without negative repercussions on employment. They explain this finding by the fact that productivity in surviving firms improved significantly, allowing firms to absorb

higher labour costs without affecting their employment or profitability. They concluded that raising the minimum wage allows more productive firms to displace less productive firms and forces existing firms to strengthen their competitiveness.

In the Eurofound report (2017) an analysis of EU countries' policies on the non-salary aspects of labour costs (social security contributions per employee, payroll tax, other deductions, etc.) was carried out, the results indicating that a decrease in non-salary costs has a positive impact on the employment level in less than 60% of the analysed cases, and sometimes the impact is quite low. The meta-analyses carried out in this report, but also in Aldea (2024) indicated the existence of heterogeneous and much lower effects of labour costs on employment compared to the theoretical models and simulations existing in the specialised literature.

Martes (2019) researched the impact of the degree of trade openness on the labour market (unemployment rate) in 28 OECD countries over the period 2000-2016. The results obtained from the panel analysis indicated that there is a negative relationship between trade openness and the unemployment rate both in the short-term and long-term. Thus, we can say that the degree of commercial openness positively influences the employment rate and implicitly labour costs.

Trade openness can significantly influence wages, particularly benefiting high-skilled workers through wage increases (World Trade Organisation, 2017; Miron et al., 2023). Furthermore, when coupled with technological advancements, trade liberalisation has been shown to contribute to wage growth, especially for skilled workers in technology-intensive sectors (Bloom et al., 2016). Consequently, the increase in wages resulting from trade openness translates into higher labour costs.

Destefanis and Rehman (2023) showed that gross fixed capital formation and investment in R&D can contribute to reducing labour costs by enhancing total productivity through technological innovation. Additionally, Bogliacino and Pianta (2010) concluded that companies use gross fixed capital formation expenses to introduce new machines to reduce labour costs. Dosi et al. (2021) found evidence of a negative relationship between gross fixed capital formation and labour costs, with the initial displacement of workers due to new technologies leading to an excess labour supply, thus exerting downward pressure on wages and, consequently, reducing associated labour costs.

Methodology and data description

After examining the scholarly literature, we managed to identify a series of indicators that may influence the evolution of labour costs (e.g., labour productivity, gross fixed capital formation, GDP per capita, foreign direct investment, employment rate, or trade openness). After building the database with all relevant indicators, we decided to carry out our analysis using several of them, based on data availability across European Union countries and statistical significance in the regression. The period under investigation is 2000-2023. In the following, we describe the indicators that have been found to be relevant to the analysis.

First, we look at the labour cost index, our dependent variable in the regression model. Considering the base year 2015, for all countries, the labour cost index increased in 2023. The largest increases are recorded for Romania, Bulgaria, Hungary, and Lithuania. The labour cost index increased the least in Italy and Finland. The evolution over time shows that, in general, labour costs rose at a relatively small pace.

The wage is one of the main factors contributing to the evolution of labour costs. In our research, we analysed the minimum wage as a determinant for the cost of labour, which is in place in 21 members of the EU (Austria, Cyprus, Denmark, Finland, Italy, and Sweden do not have a minimum wage in the analysed period). Additionally, Croatia began reporting a minimum wage in 2009. During the analysed period (2000-2023), the most impressive increase in the real minimum wage was recorded for Bulgaria and Romania, with an increase of more than 300%. In contrast, the minimum wage in Malta dropped in real terms by 0.8%. In Greece, the Netherlands, France, and Belgium, the minimum wage increased by no more than 6%. Another interesting fact is that the minimum and maximum values for the minimum wage are recorded at both ends of the period for Bulgaria, respectively, Luxembourg. The gap between the lowest and the highest values of the minimum wage remained almost the same (more than 1600 euros in real terms).

The employment rate also influences the evolution of labour costs. In this analysis, we considered the employment rate for all persons older than 15 years. In 2023 the highest rate was recorded in the Netherlands (66.1%). During 2000-2023, the highest employment rates were also recorded in Denmark (2000, 2004-2006), Ireland (2007), and Sweden (2016-2017). The lowest employment rate was recorded half of the time in Greece, but also in Italy, Bulgaria, Croatia, and Poland. According to the data, Greece was affected by the late effects of the 2008 economic crisis (2011-2021), while Italy suffered from the early 2008 economic crisis and the Covid-19 pandemic (2007-2010 and 2022-2023). Regarding the evolution of the employment rate, unfortunately, the employment rate decreased for Denmark (2.2pp), Portugal (2.9pp), and Romania (11.3pp). At the opposite end, the highest increases were recorded for Malta (17.1pp), Hungary (12.2%), Bulgaria (11.3pp), and Estonia (11.1pp).

For labour productivity, the Eurostat indicator is expressed as an index, with 2015=100. The highest figure was recorded in Romania (133.5), while Luxembourg had the lowest (93.3).

Gross fixed capital formation (GFCF) is considered a proxy for private investment. According to Eurostat, GFCF 'consists of investments of resident producers, deducting disposals, in fixed assets during a given period' (Eurostat, 2023). We used an indicator expressed as % of the gross domestic product. In 2023 the highest values were recorded in Czechia (27.3%), Romania (26.9%), and Estonia (26.6%), while the lowest was recorded in Greece (13.9%), Bulgaria (17.3%), and Poland (17.8%).

To identify how these indicators influence the cost of labour, we decided to estimate a panel data model. Such a regression model has the following form (Baltagi, 2008):

$$y_{it} = a + X_{it} * b + u_{it}$$

where $u_{it} = \alpha_i + \varepsilon_{it}$; i=1, 2, …, N; t=1, 2, …, T.

The i subscript refers to the 21 countries included in the analysis, based on the availability of data for the minimum wage. The t subscript refers to the period under investigation, namely 2000-2023. The individual effect of the model is the α_i component, while the ε_{it} is the idiosyncratic error of the model.

When working with linear panel data models, the first question to answer is whether to estimate a fixed-effects model or a random-effects model. In this regard, the decision is based on how the individual effects are treated: random or fixed. In fixed effects models (or FE models) the individual errors (α_i) can be correlated with the independent variables (X_{it}), while X_{it} are uncorrelated with the idiosyncratic error. Instead, in the random-effects

model (or RE model) the individual effects are uncorrelated with the regressors X_{it}, hence considered random (Baum, 2001).

Usually, the decision between the two panel data models (FE or RE) can be based on several econometric tests and/or economic grounds. Because our sample of countries is insufficient to sustain the randomness of the individual effects, and in the light of the Hausman test results, we proceeded to estimate a fixed-effects model.

In addition, after estimating the fixed effects model, the properties of errors should be checked. The error ε_{it} must be independent and identically distributed (Cameron and Trivedi, 2009). When the errors are autocorrelated and/or heteroskedastic, the standard errors of the estimates are biased. When this happens, robust standard errors are needed. To test the autocorrelation of the errors, we ran the Wooldridge test (Wooldridge, 2002). For the homoskedasticity evaluation, we employed a modified Wald test. Both tests indicated that we need robust standard errors, and therefore we decided to run the panel data estimation with Driscoll-Kraay standard errors (Drukker, 2003).

The research also included a cluster analysis, aiming at systematically grouping the EU member states based on shared characteristics across the evaluated indicators. This methodological approach facilitated the identification of homogenous subgroups within the dataset, thereby revealing underlying patterns among the member states in relation to the variables analysed.

When using a partitioned clustering algorithm, the number of clusters must be known at the beginning of the analysis. The most common partitioning algorithm is the K-Means proposed by Forgy (1965), which assumes the following steps:

Step 1: Based on the number of clusters identified (k), the same number of observations or objects are selected from the dataset. These objects represent the initial centroids of the classes.

Step 2: The remaining observations will be assigned to one of the k classes by minimising the distance between the observation and the centroid of the class. The Euclidean distance is used.

Step 3: After allocating all the observations, the centroids for the new classes are re-computed. Steps 2 and 3 are performed iteratively until the solution becomes stable.

Choosing the optimal number of clusters can be achieved using different methods.

One frequently used approach in practice is the Elbow method (Thorndike, 1953). This graphical method implies the representation of the number of clusters on the x-axis along with the accumulated within-class variance on the y-axis. The optimum number of clusters is chosen at the point when the additional variance resulting from the addition of a new cluster is reduced.

The quality of a cluster solution is measured using Silhouette coefficients (Rousseeuw, 1987) calculated based on:

$$s(i) = \frac{b(i)-a(i)}{\max[a(i),b(i)]} = \begin{cases} 1-\frac{a(i)}{b(i)}, \ if\ a(i) < b(i) \\ 0, if\ a(i) = b(i) \\ \frac{b(i)}{a(i)} - 1, if\ a(i) > b(i) \end{cases},$$

where:

- a(i) represents the cluster cohesion, and it is the average measure of distances between object i and all the other objects allocated in the same cluster.

- b(i) represents the cluster separation, and it is calculated as the minimum of the average distances between object i and all the other clusters, the cluster that includes the i object is excluded.

The values of the Silhouette coefficients range from -1 to 1. A negative value shows an imprecise allocation in the cluster. On the contrary, a positive value displays a good or poor placement in the cluster depending on proximity to the value 1. A value of 0 shows that the object cannot be allocated in one cluster, and it is placed between two clusters.

Findings

The first part of our empirical analysis consists of panel data estimation. Our starting point in this approach was to test the multicollinearity of the independent variables considered for the econometric estimation. The results indicated that we do not face such a situation. Consequently, using STATA17 for the tests and estimates, we obtained the results presented in Table 1 below. All the coefficients are statistically significant and were obtained by estimating the panel data model using Driscoll-Kraay standard errors, as we had to deal with the errors' autocorrelation and homoskedasticity.

Table 1. Estimation results

Explanatory variables	**Coefficient**	**Driscoll-Kraay standard errors**	***p<0.01, **p<0.05**
Minimum wage	0.5795	0.1238	***
Employment rate, 15+ years	0.7747	0.1909	***
Gross fixed capital formation	-0.1603	0.0681	**
Trade openness	0.2623	0.0852	***
Labour productivity per person	0.9775	0.2744	***
Constant	-10.8296	0.5613	***

Source: Authors' computations using STATA17.

The minimum wage has a positive influence, hence a rise in it leads to an increase in the labour cost. The link between the two indicators is straightforward since the wage (either minimum or other form) is a component of the costs of firms with labour. An increase in the minimum wage automatically induces an increase in the cost of labour by increasing its wage component. European states that have implemented the minimum wage have considered the fact that the minimum wage is a key tool for reducing poverty and income inequality, as it benefits low-income workers, in particular. At the same time, increasing the minimum wage is also considered a means of increasing labour productivity. Under these conditions, it is recommended that the policymakers on the labour market come and counterbalance these increases in the labour cost on the salary component by measures to reduce the cost of labour on the non-salary side (e.g., labour taxation) to maintain sustainable values of the labour cost which does not affect employment (see also Del Carpio and Pabon, 2017).

The employment rate is positively influencing labour costs, with a 1% increase in it leading to a 0.7% increase in labour costs. The positive connection between employment rates and labour costs is explained by the fact that the increase in employment rates implicitly leads to the increase in labour costs caused by the increase in the number of employees. At the same time, in most situations, to attract new workers, companies are forced to increase wages and, implicitly, labour costs (see also Hamermesh, 2014).

Regarding labour productivity, we can say that it has an indirect positive impact on the cost of labour by the fact that, in general, the increase in labour productivity is determined by wage increases that implicitly lead to increases in the cost of labour. Therefore, increasing labour productivity can cause an increase in labour costs. Employer-related problems can arise in the situation of increasing the cost of labour, without productivity increases. In this situation, employers' options are either to reduce the number of employees (which leads to unemployment), or to transpose part of the cost into the selling price of the products/services offered, if the type of demand allows it (see also Mayneris, Poncet, and Zhang, 2014).

The degree of commercial openness of each state also has a positive impact on the cost of labour, in that an increase in the volume of goods and services exposed to international trade will implicitly lead to an increase in demand that must be covered by an increase in supply/production. This can be achieved by increasing the level of employment or the productivity; thus, an increase in the cost of labour is also produced. The increase in the degree of commercial openness also causes an increase in income at the national level, a fact that can also be reflected in an increase in wages and implicitly in labour costs (see also Martes, 2019).

In our analysis, only gross fixed capital formation (GFCF) had a negative impact on labour costs in European countries. Our results indicate that if the GFCF increases by 1%, then the labour cost will eventually decrease by 0.1%. Practically, through the investments made in fixed capital, companies manage to reduce their labour costs, but as the results of the panel analysis indicate, the impact is quite low.

The analysis carried out at the level of EU member states that implemented the minimum wage in the last two decades led to the identification of some factors with an impact on the cost of labour. The results indicate that increases in wages (including the minimum wage), productivity, employment rates, and the volume of internationally traded goods cannot occur without considering their corresponding effects on the rising cost of labour.

For the second part of our research, we used Cluster Analysis to classify the 21 EU countries into several groups based on similar characteristics represented by factors that impact the labour cost corresponding to the 2023 data. Using the K-Means algorithm, we aimed to classify the analysed countries into different groups according to their similarities manifested among remuneration, actively working persons and their productivity, investments, and trade liberalisation in the analysed countries. The data used for the clustering algorithm were standardised due to the various measures for the indicators used. The analysis was performed in RStudio 4.1.

To identify the optimal number of groups, we used the Elbow method (Figure 1) and the NbClust package developed in R by Charrad et al. (2014), in order to propose the best partition using 30 different indices. Using both approaches, we concluded that the optimal number of clusters is three.

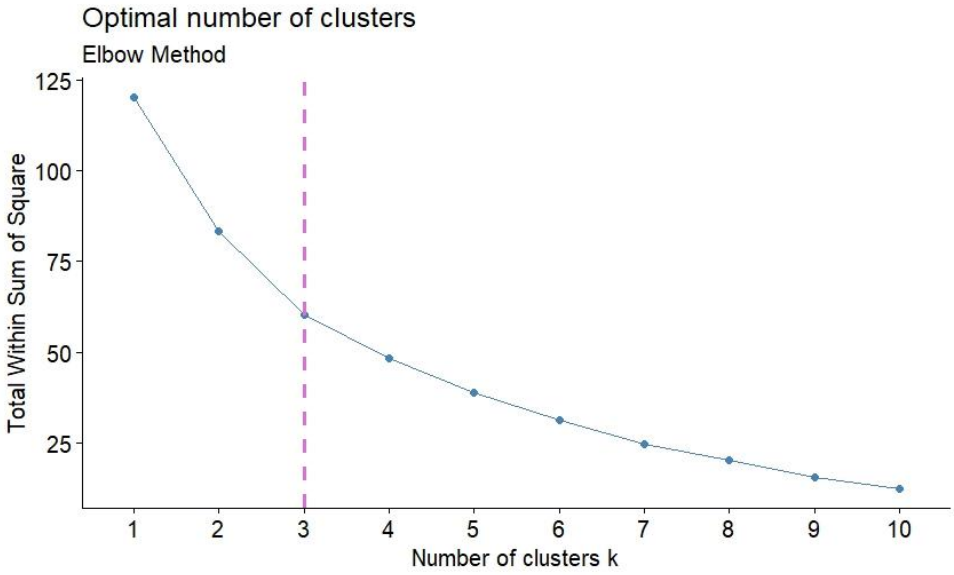

Figure 1. Choosing the optimal number of clusters

Source: Authors computation in RStudio 4.1.

After deciding on the optimal number of clusters and applying the K-Means algorithm, the next step was to verify the quality of the cluster solution obtained using the Silhouette plot, which aims to measure the quality of the cluster solution by identifying the degree of appropriate classification in the corresponding cluster.

Figure 2 shows the classification of EU countries in 3 clusters using the K-Means algorithm. The classes are composed of 8, 9 and, respectively, 4 countries. Overall, the average Silhouette width is equal to 0.29 and, based on the class, the values range from 0.17 (corresponding to cluster 3) to 0.33 (corresponding to cluster 2). The countries are well classified in the first and the second clusters, while the countries in the third cluster are relatively poorly allocated compared to the first two clusters due to the lower Silhouette width value.

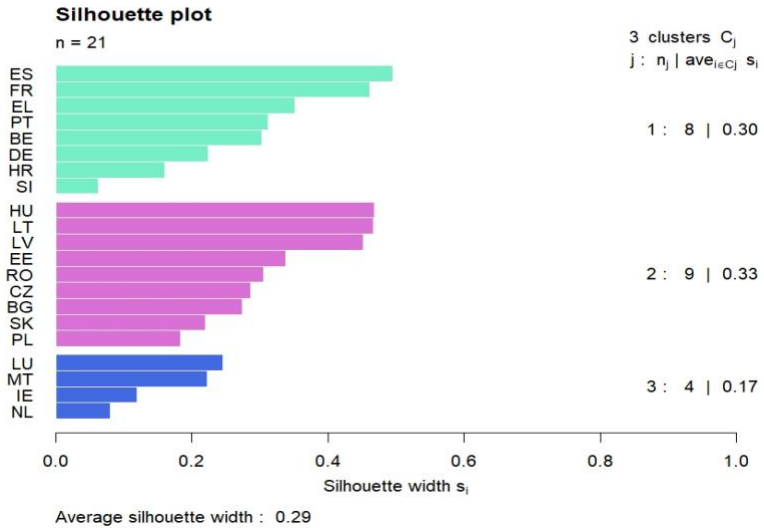

Figure 2. Silhouette plot

Source: Authors computation in RStudio 4.1.

The EU countries are classified into three groups based on similar characteristics, which can be visualised in Figure 3. The composition of the clusters is as follows:

- **Cluster 1**: Belgium, Germany, Croatia, France, Greece, Portugal, Slovenia, and Spain
- **Cluster 2**: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia
- **Cluster 3**: Luxembourg, Ireland, Malta, and the Netherlands

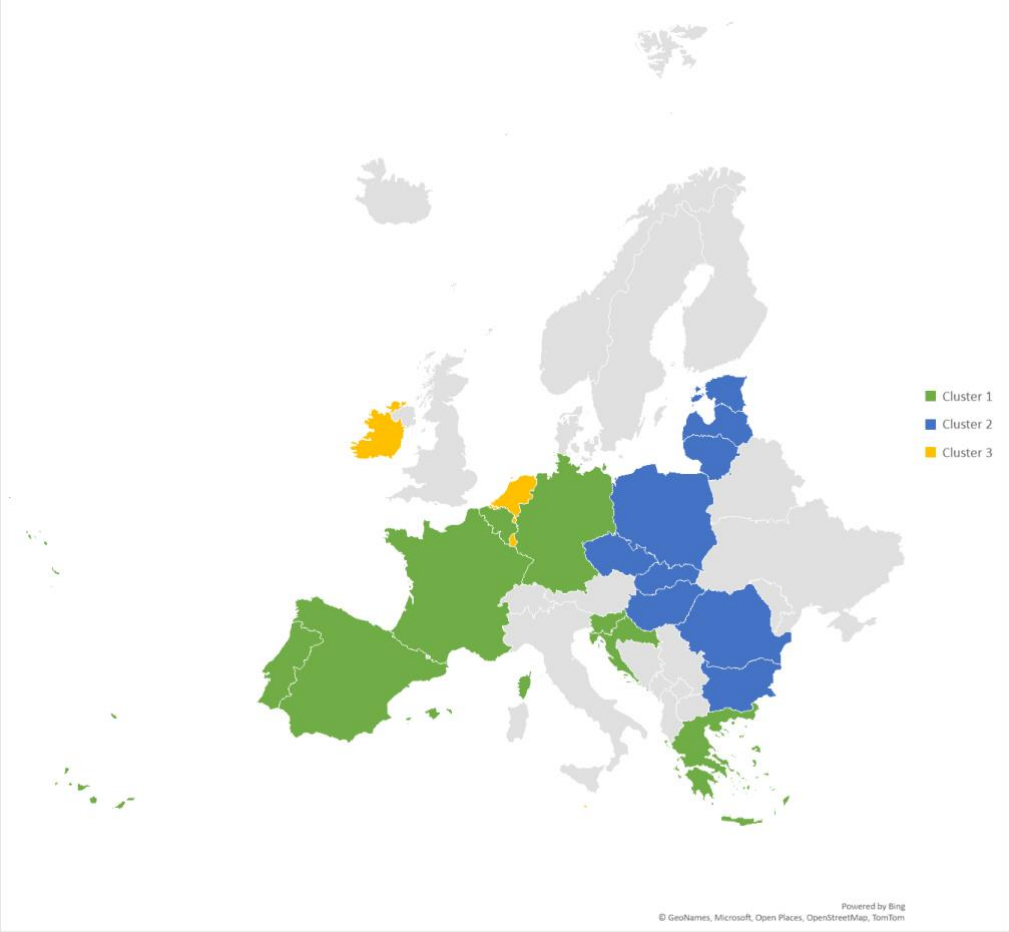

Figure 3. *Distribution of countries on the 3 groups according to the cluster analysis*

Source: Authors computation.

Table 2 presents the centroids corresponding to each cluster. The countries belonging to each cluster have some traits in common.

Table 2. Centroids

Cluster	Labour Cost Index	Minimum wage	Employment rate, 15+ years	Gross fixed capital formation	Trade openness	Labour productivity per person
Cluster 1	-0.71	0.37	-0.70	-0.33	-0.55	-0.59
Cluster 2	0.97	-0.82	0.08	0.50	-0.21	0.72
Cluster 3	-0.76	1.12	1.23	-0.47	1.57	-0.44

Source: Authors computation in RStudio 4.1.

The countries in the first cluster are characterised by relatively modest increases in labour costs in 2023 compared to the reference year, 2015. Additionally, these countries exhibit average minimum wage levels relative to the other states analysed. Regarding employment rates, the countries in this group reported lower values in 2023 compared to the other countries included in the study. Labour productivity in these states shows very minimal increases or even slight decreases in 2023 relative to 2015, which is not particularly concerning given that these are generally well-developed economies with stable economic conditions, where further sharp productivity gains are less likely. Capital investment levels, measured by gross fixed capital formation as a percentage of GDP, were around the average, while trade openness in these countries falls within the middle to lower range when compared with other clusters.

The countries in Cluster 2 (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia) experienced substantial increases in labour costs in 2023 compared to the reference year, 2015. This cluster is also distinguished by relatively low minimum wage levels compared to other EU member states analysed. The employment rates in these countries were approximately average, while the labour productivity exhibited significant growth compared to 2015. Furthermore, the countries in this cluster are characterised by moderate levels of trade openness and intermediate to high values of gross fixed capital formation as a percentage of GDP.

The third cluster comprises countries that experienced average increases in labour costs in 2023 compared to 2015. This group is distinguished by notably high minimum wages, with Luxembourg and Ireland ranking at the top among the analysed EU member states. Additionally, these countries exhibit elevated employment rates, significantly exceeding the average and similarly high levels of trade openness. Capital investments within this cluster are placed in the average range relative to the analysed states.

The results obtained from the cluster analysis were useful to us in establishing certain characteristics of the EU member states, and thus we resumed the panel analysis on the 3 groups of countries highlighted by clustering.

Table 3. Estimation results for each cluster

Explanatory variables	Cluster 1	Cluster 2	Cluster 3
Minimum wage	0.29318**	0.27172***	0.37205***
Employment rate, 15+ years	1.13693**	0.59739*	1.52380***
Gross fixed capital formation	-0.32702**	-0.04707	-0.20124***
Trade openness	0.17292**	-0.31151**	0.70689***
Labour productivity per person	0.99098***	2.17135***	-0.12246
Constant	-9.96632***	-13.68506***	-8.29352***
****p<0.01, **p<0.05, *p<0.1*			

Source: Authors' computations using STATA17.

Panel estimation for the first cluster revealed results similar to the panel analysis on the group of 21 EU states, a fact that highlights that developed countries (Central and Western Europe) had a more important influence on the overall panel results.

In cluster 2, where we find Eastern European countries, mostly emerging economies, the results of the panel analysis indicated that the gross fixed capital formation (GFCF) does not have a significant influence on the labour cost, and the increase in the degree of trade openness causes a decrease in the labour cost. This situation can also be explained by the fact that in cluster 2, except for Romania and Latvia, all other states have registered a trade surplus in recent years, but in most states the export is based on the economic sectors that use low-skilled labour (agriculture, tourism, manufacturing industry, etc.).

For cluster 3, the panel analysis highlighted that labour productivity is not a factor that influences the labour cost, the employment rate, and even the minimum wage, having a higher influence, in the conditions of some developed countries with high wages.

Conclusions

Labour costs are an essential part of the production process. The level of labour costs can directly affect the quantity and quality of production. If labour costs are high, a company may choose to limit the number of employees or the hours they work, thereby reducing the amount of goods or services produced.

Labour costs directly impact the general expenses of a company, often representing a significant portion of business expenses, particularly in the service sector, where human input is crucial. Elevated labour costs can erode profit margins, especially if a company is unable to transfer these costs to consumers through higher prices. On the contrary, reduced labour costs can enhance profit margins, although this must be balanced against potential effects on employee morale and productivity.

The relationship between labour costs and income is more nuanced. High labour costs can lead to higher prices for goods or services, potentially boosting income if demand is inelastic. However, if demand is elastic, higher prices may reduce the quantity demanded, thus diminishing revenue. Conversely, lower labour costs can enable a company to set competitive prices, thereby increasing market share and revenue. However, this approach may not be sustainable in the long term if it results in low wages, poor working conditions, and high staff turnover. Effective management of labour costs is, therefore, crucial to a company's financial health and success. At the same time, the cost of labour impacts the labour market, the social security budget, and implicitly the entire economy.

The panel analysis within this research has highlighted several factors that have impacted the level of labour costs in the EU states with a minimum wage implemented in the last two decades.

The variables with a positive impact, in the sense of increasing the cost of labour, were the minimum wage, the employment rate, the labour productivity, and the degree of trade openness. Thus, the cost of labour implicitly increases when the economy and the labour market grow. As an important part of the wage component, any increase in the minimum wage will certainly cause an increase in the cost of labour. The increase in the employment rate will also lead to an increase in the cost of labour, if only because of the increase in the number of employees (increase in the tax base for the cost of labour). Labour productivity has also been shown to positively impact labour cost, indicating that an increase in productivity can also be reflected in wages and implicitly in the cost of labour. In practice, the productivity-salary correlation is respected. The cost of labour is also positively influenced by the degree of commercial openness, which indicates that the more open the macro-economy is in international trade relations, the more at the micro-level the production and

incomes of companies increase, which can lead to an increase in wages and subsequently of labour costs.

The only variable with a negative impact on labour cost entering our panel model was gross fixed capital formation. In practice, companies' investments in assets intended for use in production processes help to reduce labour costs, either by reducing the number of hours worked or by involving a smaller number of employees.

The panel analysis carried out at the level of the EU member states focused mainly on the factors with direct and/or indirect impact on the salary component of the labour cost. The non-salary components should also be considered, as they play a significant role in labour market policy decisions aimed at reducing overall labour costs. It is obvious that any wage increase also implies an increase in the cost of labour. One of the roles of the minimum wage is precisely to reduce inequalities and increase the standard of living (poverty reduction), so it is difficult to implement policies to reduce the cost of labour on the wage component. Thus, for a reduction in the cost of labour or for the establishment of sustainable values of this cost at the company level, values that do not lead to informal work, unemployment, or bankruptcy, it is necessary to create policies aimed at reducing labour taxation (the main non-salary component of labour cost) or offering compensatory subsidies.

Cluster analysis revealed three distinct groups among EU member states based on labour costs and related indicators. The first cluster, consisting of well-developed economies, shows modest increases in labour costs, average minimum wages, lower employment rates, and minimal changes in labour productivity since 2015. These states also have average capital investment levels and moderate trade openness. The countries in the second cluster experienced substantial increases in labour costs and low minimum wages, with average employment rates but significant gains in labour productivity. This group is characterised by moderate trade openness and intermediate to high levels of capital investment. The third group features countries with average labour costs, notably high minimum wages, high employment rates, and increased trade openness, with Luxembourg and Ireland being prominent examples. Capital investment levels in this group are generally average.

The panel analysis carried out on the 3 groups of countries resulting from clustering, highlighted important elements in terms of developed economies (central and western Europe) and emerging economies with a centralised economic history (Eastern Europe, including the Baltic countries). Developed countries are the ones that have the greatest influence at the level of the overall panel analysis, cluster 1 being the one in which all the independent variables kept their significance and the type of influence on labour cost like the total panel. Within these states we are talking about developed labour markets, unionised, with predictable taxation policies, with strong influences between economic sectors, etc.

The panel analysis carried out for cluster 2 corresponding to emerging economies highlighted some differences compared to the total panel, in the sense that the investments made by companies (GFCF) are not significant in the model and thus have no influence on the labour cost. Furthermore, the panel analysis indicated that an increase in the level of trade openness of these countries leads to a reduction in labour costs. This aspect occurs against the background of trade surpluses in almost all countries in this cluster, a surplus that generally comes from the export of intermediate products, with low added value from sectors that use low-skilled labour and that does not automatically lead to increased wages, which also involve the increase in the labour cost.

The diverse characteristics of the analysed EU member states underscore the necessity of tailoring macroeconomic policies – such as minimum wage regulations – and company-level strategies to the specific local economic conditions. Within each cluster, examples of best practices can be identified, which can serve as a foundation for the formulation or refinement of public policies. The goal is to enhance the competitiveness and profitability of firms as drivers of economic growth while ensuring that this progress is achieved through sustainable and inclusive development, characterised by fair wages and decent working conditions.

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