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# SALARY INCREASE AS A DRIVER OF PRODUCTIVITY

## ABSTRACT

**Purpose:** The paper analyzes the relationship between wages and labor productivity across Croatian sectors (2019–2023), focusing on sectoral and temporal specificities. The main goal is to confirm the positive relationship between wage growth and productivity and highlight sectoral differences. The study is based on theories of efficiency wages, human capital investment, and sectoral heterogeneity. A review of previous research emphasizes the importance of technological innovation and sector-specific characteristics in productivity.

**Methodology:** Data from the FINA database were used for descriptive statistics, correlation analysis, and a fixed-effects panel regression model, allowing for control of sectoral and temporal influences.

**Results:** A 1% wage increase is associated with a 0.738% productivity growth. The highest effects were observed in sectors C (Manufacturing) and J (Information and Communication), while sectors I (Accommodation and Food Services) and R (Arts and Entertainment) showed weaker impacts. Significant productivity growth was recorded in 2022 and 2023. The results confirm the theoretically expected positive relationship between wages and productivity and emphasize the need for sector-tailored policies—technological modernization for more productive sectors and human capital investments for less productive ones.

**Conclusion:** The positive relationship between wages and productivity calls for targeted policies addressing sector-specific needs. Study limitations include potential data constraints, while future research should focus on cross-country comparisons and additional productivity factors.

**Keywords:** Average wage, productivity, industries, human capital

## 1. Introduction

The connection between wage levels and labor productivity is one of the central issues in labor economics and management. This topic becomes particularly significant in the context of economic growth, labor market changes, and the specificities of individual sectors, where the extent to which wage increases can drive employee efficiency is often debated. Labor productivity plays a crucial

role in ensuring the competitiveness of companies and the stability of the economy. Therefore, understanding the relationship between wages and productivity is essential for designing effective business strategies and economic policies.

This paper examines the relationship between average monthly net wages and labor productivity across different sectors of the Croatian economy during the period from 2019 to 2023. The observed period includes several critical phases: stable eco-

conomic growth before the COVID-19 pandemic, the economic shock during the pandemic, and recovery in the post-pandemic years. The research aims to answer whether wage growth stimulates an increase in labor productivity and whether there are significant differences between sectors in this regard.

This research deals with the study of labor productivity and considers whether there are differences between economic sectors in the way this productivity is linked to the level of wages. The starting point of the analysis is found in the theories of labor economics, especially in the theory of human capital, which emphasizes the importance of investing in employees. Investments such as wage increases can encourage greater employee motivation, reduce workforce turnover, and improve work efficiency. However, previous research from different countries indicates that the effects of wage increases are not the same in all sectors and depend on the level of technological development, labor market conditions, and the wider macroeconomic environment.

The aim of this paper is to determine whether there is a relationship between average wage and labor productivity, and to examine whether this relationship differs between sectors and in different time periods. To achieve this, a multi-level analysis was applied, which includes basic statistical indicators, correlation analysis, and a panel regression model with fixed effects. This approach allows for a more precise analysis because it takes into account the specificities of each sector and the changes that occur from year to year.

Based on theoretical assumptions and existing research findings, a hypothesis is proposed that an increase in average wages has a positive and statistically significant impact on labor productivity in various sectors. The hypothesis is tested using association analysis and regression models that include sectoral and temporal differences.

The value of this research is reflected in a detailed analysis at the level of individual sectors over several years, which provides a deeper understanding of the relationship between wages and productivity in the context of the Croatian economy. The results obtained can serve as a basis for the development of public policies that encourage productivity growth through a better payment system and targeted investment in employees.

The paper is structured into several sections. The introductory section is followed by an overview of

the relevant literature and theoretical frameworks dealing with the relationship between wages and productivity. The third section describes the data sources and the methodological approach to the research. Section four presents the research results, while the fifth section interprets these results and compares them with previous findings. Finally, the conclusion brings a summary of the most important findings, recommendations for application in practice and suggestions for future research.

## 2. Theoretical background

One of the fundamental concepts in analyzing the relationship between wages and productivity is the theory of human capital developed by Gary Becker (1964). According to this theory, employees represent the company's key assets, and investments in them through education, training, and wage increases directly contribute to productivity growth.

Efficiency wage theory (Solow, 1979; Shapiro & Stiglitz, 1984) has been expanded to include models that view salaries as a tool to reduce employee turnover and increase employee engagement. A similar contribution is made by the agency theory developed by Jensen and Meckling (2019), according to which increasing salaries can reduce moral hazard problems and better align employees' interests with the organization's goals. Kato and Kodama (2015) confirm this claim through empirical research in Japanese industry, where higher wage levels were associated with a reduction in work errors and an increase in accountability.

In modern management, psychological factors are increasingly gaining importance in the analysis of the relationship between wages and productivity. According to Herzberg's two-factor theory (Giroux, 1960), wages are a "hygienic factor" that eliminates dissatisfaction, but do not necessarily serve as motivators themselves. Mehta (2012) confirms this thesis, pointing out that non-material factors such as interpersonal relationships and the intrinsic value of work are stronger predictors of employee satisfaction and, indirectly, their efficiency. Nițescu (2021) complements this perspective by emphasizing the importance of a reward system that combines a fixed salary, bonuses, and non-financial benefits, especially when aligned with individual and organizational goals.

Empirical research over the last decade has revealed complex relationships between wages and

productivity, often depending on regional and sectoral circumstances. In advanced economies, such as OECD countries, the findings show a strong correlation between wage increases and productivity growth. Bloom and Van Reenen (2007) analyzed over 10,000 companies and showed that companies that invest in wages record lower turnover and higher investments in human resources. By contrast, in developing countries, connectivity is weaker due to institutional deficiencies and a lack of investment in human capital.

In parallel, Bildirici and Alp (2008) point out that high tax burdens on labor, including contributions and other fiscal obligations, erode the link between net wages and real productivity, especially in countries with strong informal economies. Piketty and Saez (2014) warn that high economic inequality makes it even more difficult to achieve the positive impact of wage increases, especially in low-tech sectors.

Sectoral approaches further confirm the heterogeneity of the effects of wage growth. Kline and Moretti (2014) find that in high-tech sectors, such as IT and science, wage increases are associated with exponential productivity growth, while in more traditional industries this effect is more moderate. Knar (2025) proposes non-linear models of wage determination in highly specialized sectors, where the optimal salary is defined as an emotionally satisfactory threshold that encourages employee cooperation, motivation, and self-realization in the long run.

### **3. Data and methodology**

This study analyses two key variables: labor productivity and average net wages. Productivity is defined as value added per employee expressed in euros, while wages are observed through the average monthly net earnings by sector in the period from 2019 to 2023.

The database includes 85 observations, covering 17 economic sectors over five years. The data include key financial indicators by sector—in addition to wages and productivity, indicators such as profitability and liquidity are also included. All data were taken from FINA, based on the annual financial statements of Croatian companies, which ensured methodological consistency and sectoral comparability. The classification of activities is based on

the NKD 2007, Croatia's National Classification of Activities.

Although the analysis primarily focuses on the relationship between wages and productivity, it is recommended to include in future research additional factors such as the level of investment, the educational structure of employees, or R&D expenditures.

To improve the interpretation of the results and reduce possible statistical deviations, the variables were transformed into natural logarithms. This allows the coefficients to take on the meaning of elasticity, i.e. to estimate how the percentage change in wages reflects the change in productivity.

Initially, descriptive analysis was carried out to describe the basic characteristics of the data, including means, ranges and deviations. The results were also presented graphically—scatter diagrams with regression lines provided the first insights into the correlation of the observed variables, while trend graphs enabled the monitoring of their changes over time and sectors.

After that, correlation analysis was carried out using the Pearson coefficient, which showed a positive correlation between average wages and labor productivity.

The main statistical tool used in the study was a panel regression model with fixed effects. This approach makes it possible to remove specific characteristics of sectors that remain unchanged over periods (e.g., workforce structure, technological equipment), while additional time variables control wider economic impacts such as the pandemic or legislative changes.

The validity of the model was confirmed by a series of diagnostic tests: White's test excluded heteroscedasticity, Durbin-Watson statistics (value 2.14) showed that there was no autocorrelation, and an analysis of the variance inflation factor (VIF) did not indicate the presence of multicollinearity.

To further ensure reliability, robust standard errors were used. The regression results are presented in tables, with graphical representations of coefficients that give a clearer insight into specific effects by sector and year.

Data processing was carried out in the Python programming language, which ensured the accuracy of the calculation and high-quality visualization of the results. Such an approach allows for a detailed

and reliable analysis of changes in productivity and wages over time and different economic activities.

#### 4. Research results

The results of this study provide insights into the relationship between average monthly net wages and labor productivity across various sectors of the Croatian economy during the 2019-2023 period. The findings are presented in several stages, starting with descriptive statistics, followed by correla-

tion analysis, and concluding with the results of the fixed-effects panel regression model.

##### 4.1 Descriptive statistics

This part presents a basic overview of data related to the two main variables of the research, namely average monthly net earnings and labor productivity. Key statistical indicators, such as mean, deviations from the average, minimum and maximum recorded values, and quartile distribution, were calculated. For better clarity and easier understanding, all results are summarised in Table 1.

*Table 1 Descriptive analysis results*

Statistic	Average Net Salary (€)	Labor Productivity (€)
Count	85.00	85.00
Mean	907.04	43,305.21
Std	198.84	24,715.78
Min	605.61	15,907.45
25%	765.01	27,439.17
50%	871.65	34,221.72
75%	1,033.75	49,679.42
Max	1,603.21	120,603.30

Source: Authors' calculation

On average, net salaries in the analyzed activities amount to slightly more than 900 euros, but there are quite large differences between individual sectors. This is confirmed by the fact that salaries range from about 600 to over 1,600 euros, and the deviations from the average are significant.

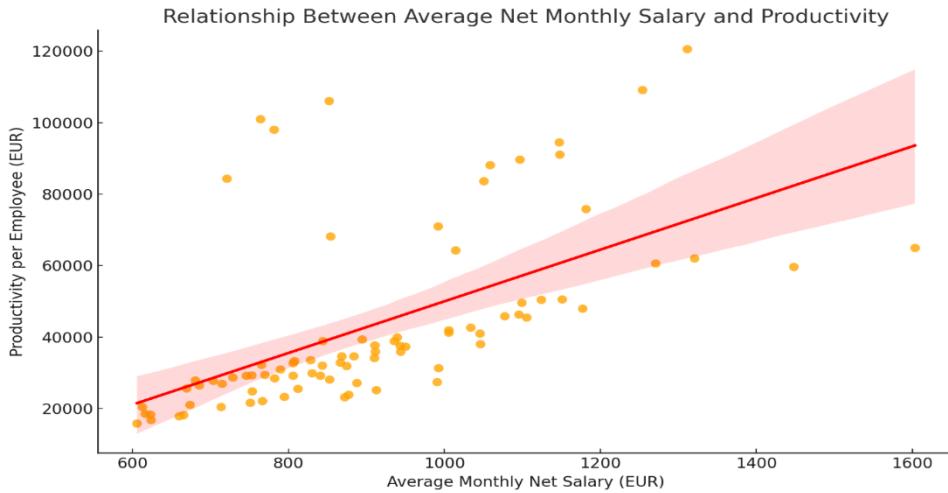
For example, in industrial sectors such as manufacturing, employees generally earn higher wages. Salaries in these activities are well above average, which can be linked to higher investments in knowledge and equipment. In contrast, in tourism and hospitality, salaries are more modest, which also reflects the lower total value generated by these activities.

A similar pattern is observed when examining productivity. In some sectors, especially those dealing with technology and industry, employees generate significantly higher value per person, while in other sectors, such as services, productivity remains considerably lower.

These data indicate that it is not only about different salaries, but also about different levels of efficiency and investment in people and technology. This can be an important starting point for understanding the causes of sectoral disparities and for further analysis of the relationship between wages and productivity.

##### 4.2 Correlation analysis results

To determine the strength and direction of the relationship between average net wages and labor productivity, a correlation analysis was conducted using Pearson's correlation coefficient. The calculated value of the correlation coefficient is **0.581**, indicating a moderately strong positive relationship between these two variables. This means that an increase in average wages is generally accompanied by an increase in labor productivity. However, the relationship is not perfect, suggesting the presence of other factors that also influence productivity.

**Graph 1 Relationship between average net salary and labor productivity**

Source: Authors

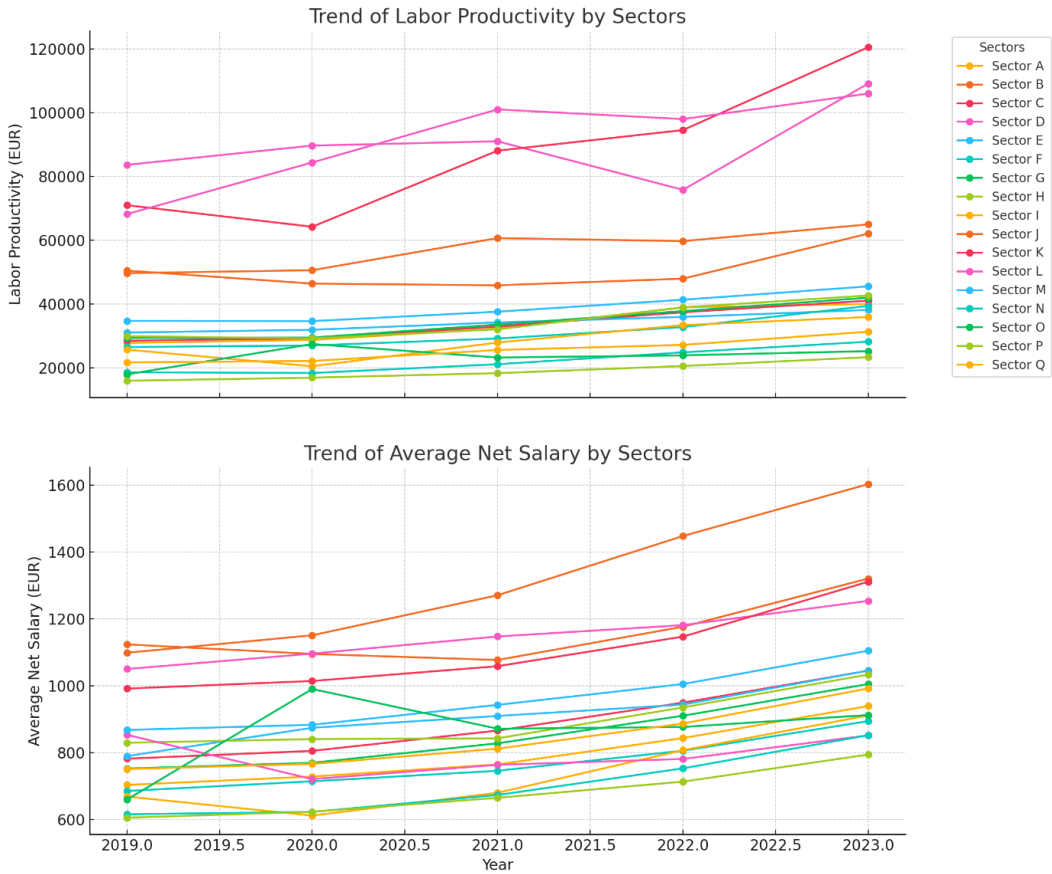
Graph 1 depicts the relationship between average net wages and labor productivity for all sectors during the observed period. Each point on the graph represents a specific sector in a particular year. The red regression line illustrates the overall trend in the relationship between these two variables.

The positive slope of the regression line clearly indicates that labor productivity increases as average net wages rise. In other words, sectors with higher wages, such as C (Manufacturing) and J (Information and Communication), tend to achieve higher labor productivity. Conversely, sectors with lower

wages, such as I (Accommodation and Food Services) and R (Arts and Entertainment), are positioned in the lower part of the graph, suggesting weaker performance in terms of productivity.

These findings confirm the calculated correlation coefficient value (0.581) and provide visual evidence of the positive relationship between the variables. However, the distribution of points around the regression line also indicates some variability—certain sectors deviate from the general trend. This opens up opportunities for further analysis of factors influencing this relationship.

Graph 2 Trend of labor productivity and average net salary by sectors over the years



\*\*Sectors by letters.<sup>1</sup>

Source: Authors

Graph 2 shows the trends in labor productivity and average net wages by sector over the observed years (2019-2023). Special emphasis is placed on the dynamics within individual industries to identify patterns over time.

Most sectors exhibit an upward trend in labor productivity and wages, suggesting a general positive development during the observed period. However, there are significant differences between sectors:

- Industrial sectors (C) and technological sectors (J) consistently show growth in both vari-

ables, indicating investments in human capital and technological advancements.

- Sector I (Accommodation and Food Services) demonstrates lower growth rates, with a noticeable decline in the COVID-19 pandemic year, reflecting its seasonal nature and reduced operations.
- Sectors H (Transportation and Storage) and F (Construction) exhibit more unstable trends, likely due to fluctuating market conditions and a lack of technological investments.

<sup>1</sup> Sectors by letters: A - Agriculture, Forestry, and Fishing; B - Mining and Quarrying; C - Manufacturing; D - Electricity, Gas, Steam, and Air Conditioning Supply; E - Water Supply; Sewerage, Waste Management; F - Construction; G - Wholesale and Retail Trade; Repair of Motor Vehicles; H - Transportation and Storage; I - Accommodation and Food Service Activities; J - Information and Communication; K - Financial and Insurance Activities; L - Real Estate Activities; M - Professional, Scientific, and Technical Activities; N - Administrative and Support Service Activities; O - Public Administration and Defense; P - Education; Q - Human Health and Social Work Activities; R - Arts, Entertainment, and Recreation; S - Other Service Activities

These results point to positive dynamics in certain industries, particularly in the industrial and technological sectors, where wage increases are accompanied by productivity growth. The increases in these sectors are likely linked to greater investments in workforce training, modernization of production processes, and the adoption of new technologies.

The correlation analysis results confirm a positive relationship between average wages and labor productivity, supporting the assumption that wage growth can act as an incentive for increased work efficiency. However, the differing growth dynamics across sectors indicate that additional factors, such as technology investments and workforce structure, play a significant role in shaping this relationship. Sectors with higher wages and productivity, such as C and J, represent examples of a positive trend, while sectors like I and R lack the necessary drivers for stronger productivity growth.

#### 4.3 Panel regression analysis results

The main objective of this research was to determine the extent to which average wages influence labor productivity, taking into account sector-specific characteristics and temporal changes. To measure the impact of wages on productivity as accurately as possible, a fixed-effects panel regression model (FEM) was employed. This model is particularly suitable as it allows for the elimination of the influence of sectoral characteristics that remain constant over time, while simultaneously controlling for shared changes specific to individual years.

The study utilized panel data that combined two dimensions: the sectoral dimension (industries) and the temporal dimension (the period from 2019 to 2023). The main advantage of this approach compared to classical analyses (such as cross-sectional or time series) lies in its ability to control for unchanging characteristics specific to each sector, such as workforce structure, technological level, or organizational specificities.

The model was log-transformed to reduce heteroskedasticity and ensure linearity in the relationship between the variables. Model specification is as follows:

$$\ln(\text{Productivity}_{it}) = \beta_0 + \beta_1 \ln(\text{Net\_Pay}_{it}) + \mu_i + \gamma_t + \varepsilon_{it},$$

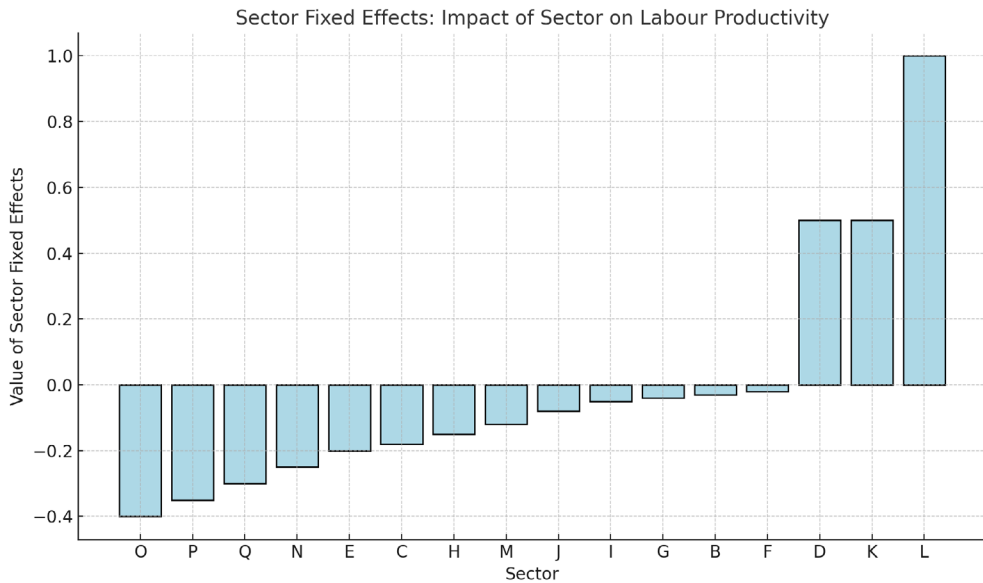
where the variables are defined as follows:

- $\ln(\text{Productivity}_{it})$ : log-transformed labor productivity for sector *iii* in year *t*,
- $\ln(\text{Net\_Pay}_{it})$ : log-transformed average net wage for sector *iii* in year *t*,
- $\mu_i$ : sectoral fixed effects that control for time-invariant sector characteristics,
- $\gamma_t$ : temporal dummy effects that control for changes common to all sectors during specific years,
- $\varepsilon_{it}$ : random error.

The transformation of variables into logarithmic form allows the coefficients to be interpreted as elasticities—that is, a 1% change in average wages can be understood as a certain percentage change in labor productivity.

The results of the panel regression analysis showed a positive and statistically significant relationship between average net wages and labor productivity. The coefficient for the variable  $\ln(\text{Net\_Pay})$  is 0.7381, with a p-value of less than 0.01, confirming its high statistical significance.

An increase in the average net wage by 1% leads to a 0.738% increase in labor productivity, assuming that sector-specific characteristics and temporal effects are controlled for. This result supports the hypothesis that wage growth acts as an incentive for improving employee productivity.

**Graph 3 Sector fixed effects: Impact of sectors on labor productivity**

Source: Authors

In addition to the main coefficient measuring the relationship between wages and labor productivity, the analysis also examined sectoral fixed effects. These effects provide deeper insights into the specific characteristics of individual industries by isolating the influence of time-invariant sectoral characteristics, such as workforce structure, business organization, or technological advancement, which are not directly captured by wages.

As shown in Graph 3, the results reveal significant differences across sectors:

### 1. Sectors with positive fixed effects

Sectors like D (Electricity, Gas, Steam and Air Conditioning Supply), K (Financial and Insurance Activities), and L (Real Estate Activities) exhibit positive fixed effects. This suggests that even after accounting for wage levels, these sectors achieve higher-than-expected labor productivity. Such outcomes can be attributed to factors including:

- Greater investments in new technologies and automation,
- A higher proportion of skilled labor,
- Strong organizational structures and continuous innovation efforts.

### 2. Sectors with negative or low fixed effects

Certain service sectors demonstrate negative or low fixed effects, indicating below-expected productivity levels even when average wages are considered. Possible reasons include:

- Limited technological adoption,
- Predominance of labor-intensive activities,
- Seasonality of work (especially in hospitality),
- Lower value-added production processes,
- A higher share of low-skilled workforce, hindering substantial productivity improvements.

These findings emphasize the structural strengths of high-performing sectors and highlight areas where targeted investments and policy interventions are necessary to boost productivity growth in lagging industries.

### 5. Discussion and limitations

The results of this study confirm the existence of a positive and statistically significant relationship between average wages and labor productivity. These findings provide empirical support for key theoretical frameworks, such as efficiency wage theory (Shapiro & Stiglitz, 1984) and human capital theory (Becker,

1964). According to these theories, wage increases can serve as a strong motivator for employees, reduce workforce turnover, and encourage greater engagement and more efficient work.

The regression analysis results support the proposed hypothesis (H1), confirming that wage growth significantly contributes to labor productivity improvements across different sectors.

The empirical analysis revealed that the benefits of wage increases are most pronounced in industrial and technological sectors (C - Manufacturing and J - Information and Communication). The key reasons for these outcomes likely include:

- Investments in technological modernization,
- Greater application of innovations,
- Highly skilled workforces that enable better adaptation to the modern market demands.

In contrast, service sectors (I - Accommodation and Food Services and R - Arts and Entertainment) show a limited impact of wage increases on labor productivity. These results suggest that service industries are often burdened by:

- Lower levels of technological development,
- Labor-intensive processes that hinder efficiency improvements,
- Seasonal fluctuations in operations (particularly in hospitality).

These insights suggest that sector-specific policies may play a crucial role in enhancing labor productivity. For instance, service industries could benefit from investments in business digitalization, workforce skill development, and fostering technological innovations. Such measures could reduce their dependence on labor-intensive processes and improve overall efficiency.

#### *Limitations of the study*

Although the results provide valuable insights, the research has several limitations that should be considered when interpreting the findings:

#### **1. Temporal limitation**

The data covers the period from 2019 to 2023, which represents a relatively short time frame. While this period includes significant economic changes such as the COVID-19 pandemic and post-pandemic

recovery, it is insufficient for analyzing long-term trends in the relationship between wages and labor productivity.

#### **2. Sectoral data aggregation**

The data were analyzed at the aggregated sector level, meaning that intra-sectoral differences were not captured. For example, within the same sector, there may be significant variations between:

- Small and large enterprises,
- Companies with different levels of technological development,
- Companies with highly skilled and low-skilled employees.

Future research should aim to address these limitations by extending the time frame and incorporating more granular data to account for intra-sectoral variations and long-term trends.

Moreover, the simplified model specification, using only wages and productivity, was chosen to maintain a clear focus on the primary relationship. Nevertheless, future research should expand the model by including variables like sectoral investments in innovation, technological adoption rates, and workforce skill levels, to build a more robust explanatory framework.

#### **6. Conclusion**

This study examined the relationship between average wages and labor productivity in Croatian sectors during the period from 2019 to 2023. By applying a fixed-effects panel regression model, the influence of time-invariant sectoral characteristics and common yearly changes was removed, yielding reliable and precise results.

The main conclusions show that wage increases have a positive effect on labor productivity growth, with industrial (C - Manufacturing) and technological sectors (J - Information and Communication) reaping the greatest benefits. This can be attributed to higher investments in technology, innovation, and a highly skilled workforce. On the other hand, service sectors (e.g., I - Accommodation and Food Services and R - Arts and Entertainment) exhibit weaker effects, suggesting that their productivity is constrained by a lack of technological modernization, lower added value, and the seasonal nature of their operations.

To improve productivity in sectors with lower performance, structural reforms are needed to encourage investments in technology, business digitalization, and workforce training.

For future research, it is recommended to extend the time frame of analysis to observe long-term trends in the relationship between wages and productivity. Additionally, using more detailed micro-economic data at the firm level and including ad-

ditional factors such as innovation, investment, and human capital development would enable a deeper understanding of the mechanisms influencing labor productivity.

These findings provide a foundation for policy-making aimed at steering economic development toward higher productivity through targeted investments and the promotion of innovation, particularly in sectors currently lagging behind.

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