SECTORAL WAGE DYNAMICS AND THEIR DETERMINANTS IN A SMALL OPEN ECONOMY: EVIDENCE FROM LITHUANIA

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Abstract
This study investigates the evolution and determinants of employee wage and salary expenditures in Lithuania's manufacturing (C), wholesale and retail trade (G), transport and storage (H), and information and communication (J) sectors over the period 2001–2023. Using annual data from the Lithuanian State Data Agency, the research explores how sectoral wage developments are shaped by microeconomic factors (enterprise turnover), macroeconomic conditions (unemployment rate), and institutional determinants (minimum wage policy). The econometric analysis employs panel cointegration techniques, specifically the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimators, to capture long-run equilibrium relationships and correct for endogeneity and serial correlation. The empirical findings reveal sector-specific sensitivities to macroeconomic fluctuations and institutional adjustments, indicating that wage dynamics in Lithuania's economy are influenced not only by productivity and market conditions but also by policy-induced wage interventions. These results provide evidence-based insights relevant for wage policy design and macroeconomic stabilization in small open European economies.

Key words: *wages and salaries; minimum wage policy; unemployment rate; enterprise turnover; panel cointegration.*

JEL Classification: *J31, J38, C23, E24, O52.*

I. INTRODUCTION

Expenditures on wages and salaries represent one of the largest components of firms' operating costs and are closely linked to macroeconomic conditions, institutional frameworks, and labor market developments. In the context of globalization, labor market flexibility, and ongoing social policy reforms, the determinants of wage-related expenditures have attracted growing attention from both scholars and policymakers. This issue is particularly relevant for small open economies, where business cost structures are highly sensitive to external shocks and institutional interventions such as minimum wage adjustments.

Previous research has demonstrated that labor costs are driven by both internal (microeconomic) and external (macroeconomic and institutional) factors. However, most empirical studies have focused on wage dynamics in relation to productivity, unemployment, inflation, or income inequality, while sector-specific analyses of wage and salary expenditures remain relatively scarce. Moreover, few studies integrate microeconomic, macroeconomic, and institutional determinants within a unified analytical framework to explain the long-run behavior of labor costs across industries.

This study addresses these gaps by examining how firm turnover, the minimum wage, and the unemployment rate affect wage and salary expenditures in Lithuania's non-financial sectors—manufacturing (C), wholesale and retail trade (G), transport and storage (H), and information and communication (J)—over the period 2001–2023. The analysis employs panel cointegration techniques, specifically the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimators, to capture long-run equilibrium

relationships and correct for endogeneity and serial correlation.

The research pursues the following objectives: (1) to estimate the long-run impact of firm turnover on wage and salary expenditures; (2) to evaluate the role of minimum wage policy in shaping labor cost developments; and (3) to assess the effect of unemployment on firms' wage expenditure behavior. Accordingly, three hypotheses are tested: (H1) a positive long-run relationship exists between wage and salary expenditures and firm turnover; (H2) a positive long-run relationship exists between wage and salary expenditures and the minimum wage; and (H3) a negative long-run relationship exists between wage and salary expenditures and the unemployment rate. The remainder of this paper is organized as follows. Section 2 reviews theoretical and empirical studies on the determinants of labor costs. Section 3 describes the data and research methodology. Section 4 presents and discusses the empirical findings, while Section 5 concludes with key insights and policy implications.

II. LITERATURE REVIEW

As defined by the Lithuanian State Data Agency, wage and salary expenses (excluding the employer's social security contributions) refer to all types of wages and salaries payable to company employees during the reporting period, including various allowances, compensations, per diem allowances, and all forms of benefits in kind (State Data Agency, 2025). These costs depend on various economic factors, which can be divided into macroeconomic and microeconomic. Macroeconomic factors encompass gross domestic product, inflation rate, unemployment rate, labor mobility, and institutional aspects of the labor market (such as minimum wage policies, collective agreements, etc.). These factors shape the conditions and determine the level and trend of wage and salary developments. Microeconomic factors encompass the company's internal decisions and traits, including profitability, labor productivity, activity sector, competitive environment, employee skills, technology level, and work nature. These factors determine the extent to which a particular company is able and willing to spend on wages. The interaction between these macro and micro determinants affects wage and salary expenses.

The study examines the connection between expenditure on wages and salaries and companies' revenues (turnover). This connection is important in examining wage policy and company performance because it helps determine if the rise in wage and salary expenses aligns with the growth in corporate revenue. For this purpose, the elasticity of wages relative to turnover is assessed as a coefficient that shows the percentage increase in spending on wages and salaries when a company's revenue rises by 1%. This analysis provides insight into how companies allocate generated income to their employees and how closely wages are tied to financial outcomes.

The literature emphasizes that a decrease in company revenues could restrict their capacity to offer competitive salaries. As per Žaptorius (2005), increasing competition can exert pressure on companies: "competition might compel companies to lower their product prices, thereby decreasing their revenues. This reduces the employer's ability to pay higher wages" (p. 54). This indicates that salaries in companies are closely connected to overall financial outcomes and are affected by both market fluctuations and business cycles.

The literature examines the connection between company profits and wages within the framework of rent-sharing theory. The first empirical studies were presented by Blanchflower, Oswald and Sanfey in 1992. The theory of rent-sharing suggests that employees may obtain a portion of the extra value generated by the company, referred to as economic rent. This rent pertains to the portion of profits that surpasses the standard profit required to cover all the company's expenses, including the anticipated return on capital (i.e., what investors would anticipate earning under typical market conditions, ceteris paribus). This surplus value can emerge due to various factors: the company's market power, technological edge, innovation, operational efficiency, or other competitive advantages.

According to rent-sharing theory, workers are active participants in the labor market and may possess bargaining power that enables them to claim a portion of the surplus economic value (rents) created by the company, which can be distributed as higher wages (Blanchflower, et al., 1992).

Unlike the neoclassical approach, which determines wages based on a worker's marginal productivity, rent-sharing theory highlights that wages depend on the company's profits and the bargaining power of employees (Blanchflower et al., 1992). Research indicates that rent sharing occurs more frequently in companies with strong trade unions or other types of collective employee representation, highlighting the significance of institutional factors in determining wage levels (Blanchflower et al., 1992). These authors estimate that the elasticity of wages with respect to company profits is positive but relatively small, varying between (0.02) and (0.05). This means that a minor portion of profits is allocated to employees, whereas a larger portion of rents is directed at capital owners, investments, or other business objectives.

Card, Devicienti, and Maida (2014) offer comparable insights by examining data from Italian companies regarding how wages respond to profit fluctuations. The findings indicate that as company profits rise, employee wages also rise, but this relationship is not proportional, with wages growing significantly slower than profits. The

average wage elasticity concerning profits was 4–5% (Card et al., 2014), indicating that a 10% rise in profits corresponds to merely a 0.4–0.5% rise in wages. Furthermore, the authors highlight that elasticity is influenced by the bargaining power of employees. The study (Card et al., 2014) also highlights a "hold-up" effect, where employers refrain from sharing excess profits with employees, even when objective economic conditions, such as increasing profits, are present. The existence of collective bargaining and trade union activity becomes important institutional factors in this case, encouraging the distribution of economic rents to workers (Card et al., 2014).

Budd, Konings, and Slaughter (2005) discovered a positive and statistically significant link between the profit per employee of a corporation's parent company and its spending on employee compensation. This relationship suggests that wages in a given company depend not only on the company's performance but also on the financial situation of the group as a whole. The empirical findings indicate that the elasticity of employee wages in relation to corporate profits is approximately (0.03). This means that a 1% increase in profits per employee is on average associated with a 0.03% increase in employee wages. These results support the theoretical assumptions of rent-sharing because multinational corporations and capital mobility can significantly influence wage formation across various countries.

Kauhanen and Piekkola (2002) point out that the profit-sharing effect in Finland is significantly related to the skills of employees. Highly skilled professionals working in innovative sectors are more likely to have a higher profit share because they have a significant impact on company performance, are less easily replaced, and have stronger bargaining power. The results show that employees involved in profit sharing have, on average, 8% higher wages than those who are not. Furthermore, these companies have a 6–13% higher productivity compared to those without profit-sharing. This suggests that rent-sharing can be an important factor in promoting efficiency and employee motivation (Kauhanen & Piekkola, 2002).

In academic literature, some authors observe that the effect of rent-sharing has significantly decreased over recent decades. Bell et al. (2020) found that the long-run elasticity of wages with respect to profits was around 0.043 between 1983 and 2000 but fell to 0.012 between 2001 and 2016. This downward trend is empirically identifiable not only in the United Kingdom or the United States, but also in most European Union countries, despite differences in the volume of data or regional differences. Theoretical models and empirical research both indicate that an increase in corporate revenues or profits can result in higher wages. This relationship is intricate and relies on various factors, including the company's profit margin, market structure, the impact of trade unions, the strictness of labor market regulation, and companies' strategic choices regarding profit distribution (Bell et al., 2020).

The dynamics of wage and salary costs are closely linked to minimum wage regulation, which has a significant impact on reducing social exclusion. However, increases in the minimum wage often lead to wage increases for higher-skilled workers, which can lead to additional financial burdens for companies.

The debate on the impact of the minimum wage on the economy and on businesses remains intense, both in academia and among policymakers. The academic literature highlights two primary research directions: one stresses the positive effects of the minimum wage on workers' well-being and reducing income inequality, while the other focuses on potential negative outcomes related to increased labor costs, decreased competitiveness of companies, and changes in the regulatory environment along with the adjustment challenges they bring.

According to Lacasa-Cazcarra (2025), from 2001 to 2021, the ongoing rises in Spain's minimum wage significantly affected income distribution, leading to a relative wage increase for lower income earners and a reduction in the gap between the lowest and highest income deciles. The findings showed that increasing the minimum wage did not have a negative impact on employment, as it did not result in fewer jobs. There was no notable rise in the average price level, which is frequently cited as a potential risk of raising the minimum wage. The authors observed that improvements in labor productivity and higher domestic consumption might have played a role in positively affecting corporate profitability.

Higher pay has a significant impact on employee motivation, and companies that pay higher wages tend to have higher levels of employee engagement and work intensity (Storm et al., 2007). This positively influences company performance (Hellebrandt et al., 2015). Nevertheless, expenses for wages and salaries are an essential component of a company's operating costs and are factored into the production cost. To avoid excessive cost increases, these costs must be managed responsibly and efficiently (Fulmer et al. 2023).

Liang (2024) examined the effects of Germany's minimum wage policy on the financial health of companies and discovered that a rise in the minimum wage leads companies to reduce borrowing by an average of 0.5–0.9%. To maintain financial stability, companies are more inclined to avoid new loans, restrict expansion investments, and concentrate on ensuring operational sustainability. These trends could restrict companies' growth prospects and their competitiveness in global markets.

In a study on China's hotel sector, Hao et al. (2024) discovered that raising the minimum wage negatively affected traditional, less digitalized companies, which struggled to adjust to higher labor costs and were frequently compelled to shut down.

Alexandre et al. (2022), in their analysis of the Portuguese labor market, discovered that raising the minimum wage adversely affected financially vulnerable companies, decreasing their profitability and heightening the risk of bankruptcy.

Gorjon et al. (2024) note in their study that the increase in the minimum wage in Spain in 2019 led to job losses and shorter working hours. According to these studies, raising the minimum wage should be evaluated comprehensively, considering the national context and sector specifics, as its effects on the labor market are varied and influenced by economic conditions, institutional regulations, and structural market characteristics.

Currently, the interaction between wages and unemployment rates is most often analysed on the basis of the wage curve concept, which indicates that there is an inverse relationship between real average wages and the unemployment rate in a region (Blanchflower & Oswald, 2005). According to the authors' estimates, the elasticity of wages with respect to unemployment is around (-0.1).

Nijkamp and Poot (2005) discovered that a 1% change in the unemployment rate typically results in a wage change of about (–0.07). The authors state that this relationship is more pronounced in developed countries with flexible labor markets, whereas the effect is less intense in countries with strict labor market regulations.

Baltagi et al. (2008) analysed data covering 326 regions in West Germany for the period 1980–2004 and confirmed that wages are statistically significantly and negatively correlated with regional unemployment rates. The estimated wage elasticities with respect to unemployment ranged from (–0.02) to (–0.04). The authors also noted that the short-run wage elasticity of unemployment for younger men (–0.02) is higher than for older men (–0.012), although the long-run elasticity is similar for both groups at around (–0.03). In contrast, the short-run wage elasticity of unemployment for young women (–0.013) is more than twice as high as for older women (–0.006), while the long-run elasticities are (–0.024) and (–0.019) respectively. The relatively low wage elasticity of unemployment in West Germany can be attributed to the country's centralised wage-setting system. In addition, wages are observed to be more elastic to changes in unemployment in demographic groups with lower bargaining power, including younger workers, women, and foreign nationals.

The conducted literature analysis showed that most existing empirical studies focus on the analysis of the impact of minimum wage (Lacasa-Cazcarra, 2025; Storm et al., 2007; Hellebrandt et al., 2015; Fulmer et al., 2023; Liang, 2024; Hao et al., 2024; Alexandre et al., 2022; Gorjon et al., 2024) and unemployment rate (Blanchflower & Oswald, 2005; Nijkamp & Poot, 2005; Baltagi et al., 2008) on wages, but significantly less attention is given to the relationship between sales revenue (turnover) dynamics and wage costs.

III. METHODOLOGY AND DATA SOURCES

The study examines statistical data for four key sectors of the Lithuanian economy—manufacturing (C), wholesale and retail trade (G), transport and storage (H), and information and communication (J)—covering the period 2001–2023. These sectors were selected because they jointly account for over 60% of national value added, employ the largest share of workers in non-financial activities, and generate more than three-quarters of total turnover, thus representing the core of Lithuania's productive economy. The dependent variable is employee wage and salary expenditure (excluding employers' social security contributions), while the explanatory variables include enterprise turnover, the statutory minimum wage, and the national unemployment rate. All data are drawn from the Lithuanian State Data Agency, ensuring consistency and methodological comparability across years. The dataset forms a balanced panel suitable for long-run econometric analysis (Baltagi, 2005).

Given the data's mixed aggregation structure—sectoral (wages, turnover) and national (minimum wage, unemployment)—standard fixed- or random-effects panel estimators were found inappropriate, as confirmed by the Hausman (1978) test. Therefore, the study employs panel cointegration methods, specifically the Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) estimators, which allow consistent inference under such conditions (Wooldridge, 2010).

Prior to applying longitudinal methods, preliminary tests for stationarity and cointegration of the panel data were performed. Stationarity was assessed using Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) panel unit root tests (Levin et al., 2002; Im et al., 2003), complemented by ADF-Fisher and PP-Fisher Chi-square tests to account for heterogeneity (Maddala & Wu, 1999; Choi, 2001). Results indicate that most variables are non-stationary at levels but become stationary after first differencing, satisfying the conditions for cointegration analysis.

Subsequently, the Pedroni (1999, 2001, 2004) cointegration test confirmed the existence of long-term equilibrium relationships among the variables. Fixed and random effects models were deemed unsuitable due to the variables' characteristics; therefore, fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) were employed (Phillips & Hansen, 1990; Stock & Watson, 1993; Kao & Chiang, 2000). These methods address potential endogeneity, serial correlation, non-stationarity, and small sample size (Mark & Sul, 2003). DOLS incorporates lagged and lead values of independent variables to adjust for short-term dynamics,

while FMOLS accounts for error structure to provide unbiased and consistent estimates under heteroskedasticity or serial correlation (Pedroni, 2001; Hansen, 1992).

For clarity, the general DOLS equation is presented to illustrate its structure and logic, showing how incorporating lags and leads of dependent and independent variables mitigates serial correlation and endogeneity (Stock & Watson, 1993).

The DOLS model's general equation (Stock, Watson, 1993) can be expressed as:

$$Y_{i,t} = \alpha_i + \beta X_{i,t} + \sum_{k=-q}^{q} \delta_k \Delta X_{i,t-k} + \varepsilon_{i,t} \quad (1)$$

$Y_{i,t}$ - dependent variable,
$X_{i,t}$ - a cointegrated independent variable,
$\Delta X_{i,t-k}$ - lags and leads to remove the effect of short-term dynamism,
δ_k- the corresponding coefficients for the short-run dynamic effects,
α_i - individual fixed effects,
$\varepsilon_{i,t}$ - error term,
q - the number of selected lags and leading values,
β - the coefficient of long-term dependence (cointegration).

In contrast to DOLS, the FMOLS method modifies the regression estimates to account for the error structure.

FMOLS general equation:

$$Y_{i,t} = \alpha_i + \beta X_{i,t} + u_{i,t} \quad (2)$$

$Y_{i,t}$ p – the dependent variable,
$X_{i,t}$ – the cointegrated independent variable,
α_i – the individual effect (in the case of a panel data model),
β i – the long-run cointegrated coefficient,
$u_{i,t}$ – the error term.

Empirical calculations and model estimates were performed using Eviews *12 soft*ware, which supports both DOLS and FMOLS methods and enables efficient analysis and interpretation of the obtained results (QMS, 2021).

IV. SURVEY RESULTS AND ANALYSIS

Manufacturing (C), wholesale and retail trade, repair of motor vehicles and motorcycles (G), transport and storage (H), and information and communication (J) play a significant role in the Lithuanian economy. In 2023, they contributed the largest portions of value added: manufacturing (C) — 21.87%, wholesale and retail trade, repair of motor vehicles and motorcycles (G) — 18.76%, transport and storage (H) — 16.09%, and information and communication (J) — 7.76% . In 2023, the value added per hour worked decreased compared to 2022 in manufacturing (C), wholesale and retail trade, repair of motor vehicles and motorcycles (G), and transport and storage (H), with the most significant drop of 22.61% occurring in wholesale and retail trade, repair of motor vehicles and motorcycles (G).

Employees in the sectors of manufacturing (C), wholesale and retail trade, repair of motor vehicles and motorcycles (G), transport and storage (H), and information and communication (J) made up the largest percentage of all employees in companies involved in non-financial activities. The information and communication sector was among the fastest-growing in terms of employee numbers, making up 4.62% of all employees in 2023. In 2023, the value added per hour worked in this sector rose by 19.57% compared to 2022.

The turnover trends in the sectors of manufacturing (C), wholesale and retail trade, repair of motor vehicles and motorcycles (G), transport and storage (H), and information and communication (J) were nearly identical during the analyzed period. Since the sectors' turnover accounts for a significant portion of the total turnover of Lithuanian companies engaged in non-financial activities (76.4% in 2023) (manufacturing (C) — 21.65%, wholesale and retail trade, repair of motor vehicles and motorcycles (G) — 38.14%, transport and storage (H) — 12.44%, information and communication (J) — 4.16%), the trends in these industries' turnover aligned with the changes in sector turnover. The quickest decrease in turnover happened during the 2009 global economic crisis. The manufacturing (C) sector saw a turnover decrease of over 30%, similar to the drop in non-financial activities. In 2009, this sector's turnover made up nearly a quarter (24.87%) of the turnover from non-financial activities. The 10.29% turnover decline in 2023 (while turnover in other selected sectors was rising) might have contributed to the reduction in turnover of non-financial activities.

Wage and salary expenditure trends (excluding the information and communication (J) sector) from 2001 to 2023 were aligned across the chosen sectors and non-financial companies. Across all sectors, these expenses decreased during 2009–2010 (after a decline in turnover in 2009). The information and communication (ICT) (J) sector experienced the slowest decline rate (1.56% in 2009, 1.26% in 2010). From 2018 to 2022, the growth rate

of wages and salaries in this sector significantly surpassed that of other selected sectors and Lithuanian enterprises involved in non-financial activities.

In 2023, spending on wages and salaries rose across all four sectors compared to 2022. The transport and storage sector (H) experienced the highest growth rate at 26.83%, despite a 6.22% decrease in value added. The information and communication sector (J) had the lowest growth rate at 11%, yet the expenditure per hour worked was the highest among the sectors analyzed, making up 29.45% of turnover.

In 2019, with a 38.37% rise in the minimum hourly wage, the rate of increase in wages and salaries was the highest and surpassed the turnover growth rate the most across all sectors — manufacturing (C) by 8.19 times, wholesale and retail trade, repair of motor vehicles and motorcycles (G) by 5.26 times, transport and storage (H) by 3.9 times, and information and communication (J) by 3.33 times. While the increase in wage and salary expenses in the information and communication (J) sector was the smallest compared to the turnover growth rate, the expenditure per hour worked exceeded the minimum hourly wage the most throughout the analyzed period, being 4.66 times higher in 2018 (2.63 times for manufacturing (C), 2.41 times for wholesale and retail trade, repair of motor vehicles and motorcycles (G), and 2.81 times for transport and storage (H)). As a result, in 2019, the information and communication (J) sector saw the largest increase in expenditure on wages and salaries (45.65%) as a percentage of sector turnover. In the information and communication (J) sector, these expenses accounted for the highest percentage of turnover after the global economic crisis (2010–2023). Between 2001 and 2009, the manufacturing (C) sector was in the leading position among the selected sectors.

From 2001 to 2023, the average monthly spending per employee on wages and salaries has significantly risen in certain sectors: wholesale and retail trade, motor vehicle and motorcycle repair (G) by 9.03 times, manufacturing (C) by 7.48 times, information and communication (J) by 7.19 times, and transport and storage (H) by 6.98 times.

Expenditure on wages and salaries per employee has exceeded the minimum monthly wage throughout the period, but it has only surpassed the average monthly wage in the information and communication sector, and only during 2001–2003 and 2015–2023. A positive trend is observed as the gap between these indicators is decreasing. Between 2006 and 2023, the gap between average monthly wage expenses per worker and the average monthly wage in manufacturing (C) decreased from 48.85% to 18.04%. In the wholesale and retail trade, repair of motor vehicles and motorcycles (G), it fell from 54.01% to 26.36%, and in transport and storage (H), from 45.37% to 18.50%. In the information and communication (J) sector, the average worker's wage in 2023 was 50.59% higher than the national average, while in 2006, it was 23.50% lower.

To quantify the relationship between spending on wages and salaries (dependent variable) and company turnover (independent variable), a linear regression analysis was conducted using MS Excel statistical methods. In order to identify sectoral characteristics, the analysis was carried out for each business sector. In the manufacturing sector (C), the Pearson correlation coefficient (R=0.92) indicates a strong positive linear relationship between wage expenses and turnover, while the coefficient of determination (R2=0.85) indicates that 85% of the variation in wage expenses can be attributed to changes in turnover. The equation's coefficient (0.133Y=0,1339X-555579) indicates that a €1,000 increase in turnover results in an average rise of €134 in wage costs within the sector.

A strong positive correlation exists between wage costs and business turnover in the sectors of wholesale and retail trade, motor vehicle and motorcycle repair (G), transport and storage (H), and information and communication (J). However, the strongest correlation is found in the information and communication sector (J) (R=0.99 and R2=0.99). A linear relationship was determined between wage costs and sector turnover, and the maximum increase in wage costs relative to turnover growth was identified, meaning that a €1,000 increase in turnover results in a €346 increase in wage costs in the sector. This is a profitable sector and company managers need to ensure that wage increases are sufficient to retain skilled workers.

In the transport and storage sector (H), there is a strong linear correlation between wage and salary expenses and turnover (R=0.97 and R2=0.94) and average wage growth: wages rise by approximately €169 for every €1,000 increase in earnings. The sector with the least sensitivity of wages and salaries to turnover is wholesale and retail trade, repair of motor vehicles and motorcycles (G): for every €1,000 increase in turnover, wages and salaries rise by an average of €73. Even though the correlation coefficient (R=0.98) and the coefficient of determination (R2=0.95) are quite high, the wage policies in this sector are more conservative, and employers are less inclined to share benefits with employees.

The study examines the four primary sectors of the Lithuanian economy: manufacturing (C), wholesale and retail trade, repair of motor vehicles and motorcycles (G), transport and storage (H), and information and communication (J). The survey period covers the years 2001–2023. The aim of the research is to evaluate how turnover, minimum wage, and unemployment rate affect spending on wages and salaries in specific sectors of the Lithuanian economy.

Hypotheses: H1: A positive long-term connection exists between expenditure on wages and salaries and

company turnover. The greater the turnover of companies, the greater the spending on wages and salaries. H2: There is a positive long-term connection between expenditure on wages and salaries and the minimum wage. When the minimum wage increases, the cost of wages and salaries in the sectors also goes up. H3: a negative long-term relationship exists between expenditure on wages and salaries and the unemployment rate. The higher the unemployment rate, the lower the expenditure on wages and salaries.

The variables of the study and their labels are presented in Table 1.

Table 1. Study variables and their labels

Variable	Abbreviation
Expenditure on wages and salaries of employees (excl. social security)	$WageExp_{i,t}$
Turnover	$Turnover_{i,t}$
Minimum wage	$MinWage_t$
Unemployment rate	$Unemployment_t$

Source: Study variables explanation

To evaluate the long-term relationship between spending on wages and salaries and key macroeconomic and sector-specific variables, the study employs two econometric methods: dynamic least squares (DOLS) and fully modified least squares (FMOLS). The DOLS equation is written as follows:

$$WageExp_{i,t} = \alpha_i + \beta_1 Turnover_{i,t} + \beta_2 MinWage_t + \beta_3 Unemployment_t + \sum_{k=-q}^{q} \delta_{1k} \Delta Turnover_{i,t-k} + \sum_{k=-q}^{q} \delta_{2k} \Delta MinWage_{t-k} + \sum_{k=-q}^{q} \delta_{3k} Unempoyment_{t-k} + \varepsilon_{i,t} \quad (3)$$

The FMOLS equation is given as follows:

$$WageExp_{i,t} = \alpha_i + \beta_1 Turnover_{i,t} + \beta_2 MinWage_t + \beta_3 Unemployment_t + u_{i,t} \quad (4)$$

Unlike DOLS, the FMOLS model focuses on long-term dependencies rather than short-term dynamic effects.

Table 2 shows descriptive statistics for four logarithmic economic variables: spending on wages and salaries (LnWageExp), turnover (LnTurnover), minimum wage (LnMinWage), and unemployment rate (LnUnemployment). The mean and median values are fairly similar, indicating that the distribution of the variables is not significantly skewed (i.e., the distributions are not highly asymmetric). The turnover variable has the highest average (15.94), while the unemployment rate has the lowest (2.21). The results of the standard deviation (Std. Dev.) show that the dispersion of the data is most pronounced for turnover (1.15) and least pronounced for the unemployment rate (0.39). The asymmetry coefficients (skewness) indicate that the distributions of spending on employee wages and salaries and turnover are slightly negatively skewed, whereas the distributions of the minimum wage and unemployment rate are slightly positively skewed. However, the asymmetry is not pronounced in either case. The kurtosis values for all variables are below 3, indicating that their distributions are flatter than a normal distribution, particularly for turnover (1.90) and unemployment rate (1.93). The Jarque-Bera (JB) test was used to test the normality of the distribution. The p-values of the JB tests for three variables — expenditure on wages and salaries, minimum wage and unemployment rate — exceeded the significance threshold ($p > 0.05$), so the hypothesis of a normal distribution of these variables cannot be rejected. The sole exception is the turnover variable, with a JB p-value of 0.0447, leading to the rejection of the normality hypothesis at the 5% significance level. Nonetheless, considering the number of observations, this does not critically affect the reliability of the analysis (Gujarati & Porter, 2009).

Table 2. Descriptive statistics of variables

	LnWageExp	LnTurnover	LnMinWage	LnUnemployment
Mean	13.66163	15.94431	5.630845	2.207180
Median	13.80634	16.21885	5.471009	2.138536
Maximum	15.37152	17.90960	6.733402	2.879985
Minimum	11.58903	13.69697	4.824306	1.446919
Std. Dev.	0.945057	1.153293	0.577358	0.391182
Skewness	-0.373726	-0.320052	0.317739	0.049359
Kurtosis	2.463089	1.899376	2.054608	1.933468
Jarque-Bera	3.246675	6.214235	4.974130	4.397734
Probability	0.197239	0.044730	0.083154	0.110929

Source: The author's own calculations: eViews.

Table 3 presents the Pearson correlation coefficients indicating the strength and direction of linear relationships among the variables. A very strong positive correlation exists between wage and salary expenses

(LnWageExp) and company turnover (LnTurnover) ($r = 0.896$, $p < 0.001$), and a strong positive link with the minimum wage (LnMinWage) ($r = 0.739$, $p < 0.001$). Wage and salary expenses are weakly and negatively correlated with the unemployment rate (LnUnemployment) ($r = –0.391$, $p < 0.001$). Company turnover is moderately correlated with the minimum wage ($r = 0.458$, $p < 0.001$) and weakly and negatively correlated with unemployment ($r = –0.253$, $p = 0.015$). The minimum wage and unemployment rate are moderately and inversely related ($r = –0.452$, $p < 0.001$).

Table 3. Correlation matrix of variables

Variable	LnWageExp	LnTurnover	LnMinWage	LnUnemployment
LnWageExp	1.000			
LnTurnover	0.896***	1.000		
LnMinWage	0.739***	0.458***	1.000	
LnUnemployment	−0.391***	−0.253**	−0.452***	1.000

Note: ***p < 0.01, **p < 0.05. All correlations are statistically significant at conventional levels.
Source: Authors' calculations based on EViews output.

The risk of multicollinearity has been assessed using the Variance Inflation Factor (VIF). The maximum value of the VIF is set at 3.30 for the expenditure on wages and salaries (LnWageExp). This value is considered acceptable as it stays within the boundary indicating a strong correlation between variables (Kutner et al., 2005). For the other variables, such as turnover (LnTurnover), minimum wage (LnMinWage), and unemployment rate (LnUnemployment), the VIF values were approximately 2, suggesting a weak correlation (Wooldridge, 2016). Since the VIF values for all variables in the study are significantly below 10, and for most even below 5, it can be stated that multicollinearity is not a significant issue in the study and will not impact the reliability of the results.

Before conducting the cointegration analysis, the stationarity of all variables in the model was evaluated using four unit root tests on panel data: Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), ADF-Fisher Chi-square, and PP-Fisher Chi-square. Stationarity was evaluated at the first-differenced logarithmic level (DLn). The empirical findings indicate that all variables — expenditure on wages and salaries (DLnWageExp), minimum wage (DLnMinWage), turnover (DLnTurnover), and unemployment rate (DLnUnemployment) — have become stationary at the first-difference level, meaning they are integrated at I (1). This means that the unit root tests did not support the null hypothesis of a unit root, as the p-values (Prob.) of all tests are statistically significant ($p < 0.05$). This outcome permits a logical conclusion that the variables satisfy the assumptions of cointegration analysis since they are of the same integration order (I (1)).

The selection of the four unit root tests is founded on the varying methodological principles of these tests. For example, the LLC test (Levin et al., 2002) is based on the assumption of a common stationarity coefficient for all units in the panel (common unit root process), while the IPS test (Im et al., 2003) allows for the existence of heterogeneous autoregressive coefficients between the different sections (individual unit root processes). In the meantime, the ADF-Fisher and PP-Fisher Chi-square tests merge the outcomes of the univariate ADF and Phillips-Perron tests conducted on each panel unit individually and subsequently summarize the results using Fisher-type test statistics (Maddala & Wu, 1999; Choi, 2001). Using these methods enables the evaluation of both the general and specific characteristics of variable dynamics.

Table 4 presents the results of panel unit root tests. Since all p-values are below 0.05, the null hypothesis of a unit root is rejected, indicating that all variables become stationary after first differencing. This confirms the suitability of the data for subsequent cointegration analysis.

Table 4. Results of panel unit root tests (first differences)

Variable	LLC t-stat	IPS t-stat	ADF χ^2	PP χ^2	Stationarity
DLnWageExp	–4.11***	–2.77***	21.25***	31.42***	Stationary
DLnMinWage	–5.75***	–5.25***	40.52***	52.01***	Stationary
DLnTurnover	–4.89***	–4.10***	32.08***	37.06***	Stationary
DLnUnemployment	–6.48***	–4.63***	35.49***	16.97**	Stationary

***p < 0.01, **p < 0.05
Source: Authors' calculations based on eViews output.

This suggests that all the variables in the study — expenditure on workers' wages and salaries (DLnWageExp), minimum wage (DLnMinWage), companies' turnover (DLnTurnover), and unemployment rate (DLnUnemployment) — are stationary in the first difference, meaning they are integrated in I (1). The characteristics of these variables necessitate the application of cointegration methods to prevent misleading regressions and to guarantee dependable assessments of long-term relationships.

The Pedroni (1999, 2004) cointegration test was applied to determine whether a long-run relationship exists between the variables analysed. This test is among the most commonly applied panel cointegration methods and enables the evaluation of both within-dimension (i.e., the overall effect across the panel) and between-dimension (i.e., between individual units) cointegration. The results show that several test statistics are statistically significant at the 1% significance level ($p < 0.01$). This includes Panel PP-Statistic and Panel ADF-Statistic (within-dimension) along with Group PP-Statistic and Group ADF-Statistic (between-dimension) (Table 5). The importance of these indicators enables us to reject the null hypothesis of no cointegration and confirms a long-term, stable relationship between the dependent variable, which is expenditure on employee wages and salaries (DLnWageExp), and the independent variables (DLnMinWage, DLnTurnover, and DLnUnemployment). The within-dimension results reflect the panel's overall behavior, while the between-dimension results emphasize the heterogeneity among the studied sections/sectors. Significant findings at both levels confirm the existence of cointegration and the reliability of the results.

Table 5. Results of Pedroni Residual Cointegration Test

Dimension	Test Statistic	Prob.	Weighted Statistic	Prob.
Within-dimension	Panel v-Statistic	-0.730	0.767	-1.295
	Panel rho-Statistic	-1.434	0.076	-1.516
	Panel PP-Statistic	-3.382***	0.0004	-3.703***
	Panel ADF-Statistic	-3.425***	0.0003	-3.721***
Between-dimension	Group rho-Statistic	-0.865	0.194	—
	Group PP-Statistic	-3.737***	0.0001	—
	Group ADF-Statistic	-3.791***	0.0001	—

* Note: No deterministic trend. Lag length and bandwidth selected automatically using SIC and Bartlett kernel.
Source: Author's calculations in EViews.

Kao's (1999) residual cointegration test, based on the ADF statistic ($t = –2.959$, $p = 0.0015$), allows rejecting the null hypothesis of no cointegration. This pooled regression test assumes equal cointegration coefficients across panel units and provides additional confirmation of a long-term relationship between wage and salary expenditures and the independent variables. Using multiple cointegration tests (Pedroni, 1999, 2004; Baltagi, 2005; Breitung & Pesaran, 2008) enhances the robustness of the results and confirms their reliability.

The first-order error correction term (RESID(–1)) is negative and statistically significant (–0.787, $p < 0.0001$), indicating stationary regression residuals (I(0)) and confirming a long-run equilibrium between the variables (Table 6). The Durbin-Watson statistic (1.93) shows no autocorrelation, supporting the reliability of the results. These findings demonstrate the suitability of the econometric model for the dynamic characteristics of the data.

Table 6. Augmented Dickey-Fuller test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-0.787288	0.108328	-7.267614	0.0000
Durbin-Watson stat	1.926752			

Source: The author's own calculations: eViews.

The summary of Pedroni (1999, 2004) and Kao (1999) residual cointegration tests (Table 7) further confirms the existence of a long-term relationship between the variables, with all reported statistics being statistically significant ($p < 0.01$ for Pedroni; $p = 0.0015$ for Kao).

Table 7. Summary results of Pedroni and Kao Residual Cointegration tests

Test	Significant results	Proof of cointegration
Pedroni Residual Cointegration Test	Panel PP-Statistic, Panel ADF-Statistic, Group PP-Statistic, Group ADF-Statistic ($p < 0.01$)	Confirms cointegration
Kao Residual Cointegration Test	ADF-Statistic ($p = 0.0015$)	Confirms cointegration

Source: Authors' results.

The findings from the FMOLS and DOLS models indicate (Table 8) consistent and empirically supported long-term relationships among the variables. The models revealed statistically significant parameters confirming

a long-term relationship between companies' wage and salary expenditures (DLnWageExp) and turnover (DLnTurnover) in the four sectors, the national minimum wage (DLnMinWage), and the unemployment rate (DLnUnemployment).

Table 8. Comparison of FMOLS and DOLS methods

Indicator	FMOLS	DOLS
DLnTurnover	0.277962 (p = 0.0007)	0.275772 (p = 0.0021)
DLnMinWage	0.796876 (p = 0.0000)	0.735595 (p = 0.0000)
DLnUnemployment	-0.113143 (p = 0.0017)	-0.125590 (p = 0.0014)
R-squared	0.725245	0.700048
Adjusted R-squared	0.703835	0.677829
S.E. of regression	0.060254	0.061766
Sum squared resid	0.279551	0.309015
Long-run variance	0.003548	0.004496

Source: The author's own calculations: eViews.

At first, both models show a very similar impact of company turnover on wage and salary expenses (DLnWageExp): the coefficient in the FMOLS model is 0.278 (p = 0.0007), while in the DOLS model it is 0.276 (p = 0.0021). This indicates that a 1% rise in turnover results in approximately a 0.28% increase in spending on wages and salaries. This outcome aligns with the rent-sharing theory, which suggests that companies distribute the increased revenues (profits) with their employees ((Blanchflower et al., 1992), Card et al., (2014), Du Caju et al., (2011), Bell et al., 2020, etc.). According to the results, it can be inferred that Lithuanian companies with higher revenue are inclined to raise employee salaries. This could be linked to the aim of retaining skilled employees in a competitive job market or adhering to social responsibility principles.

Secondly, the results suggest that changes in the minimum wage have the greatest and most statistically significant impact on employee wage and salary expenses in both models. In the FMOLS model, the coefficient is 0.797 ($p < 0.0001$), while in the DOLS model, it is 0.736 ($p < 0.0001$), indicating that a 1% increase in the minimum wage leads to a 0.74–0.80% rise in companies' expenditure on wages and salaries. This outcome aligns with theoretical assumptions (Lacasa-Cazcarr (2025), Liang (2024) et al.)

Third, the unemployment rate has an adverse, statistically significant effect on wage and salary expenditure: in the FMOLS model it is (–0.113) (p = 0.0017) and in the DOLS model it is (–0.126) (p = 0.0014), indicating that a higher actual unemployment rate in a country is associated with less upward pressure on wages, which is supported by wage curve theory. This situation in the labor market is primarily attributed to the diminished bargaining power of employees.

The study results possess a high enough explanatory power to analyze the dependence of wage and salary expenditures (DLnWageExp) on economic factors. In the FMOLS model, the coefficient of determination (R^2) is 0.725, while in the DOLS model, it is 0.700. This indicates that 72.5% and 70.0% of the variation in spending on wages and salaries is accounted for by the independent variables of company turnover, minimum wage, and unemployment rate. In comparing the two models based on accuracy criteria, FMOLS shows a lower standard error of regression (S.E. = 0.0603) and a lower sum of squared residuals (S.S.R. = 0.2796) than the DOLS equivalents (S.E. = 0.0618; S.S.R. = 0.3090). This demonstrates the superior predictive accuracy of the FMOLS model and its improved alignment with existing data, particularly in evaluating long-term relationships within the context of panel data (Pedroni, 2001; Kao & Chiang, 2000). Furthermore, the reduced long-run variance in the FMOLS model (0.0035) indicates increased model stability with fewer shocks in the time series structure (Phillips & Hansen, 1990). These differences are methodologically justified because the FMOLS method corrects for both heteroskedasticity and endogeneity issues without extra equations, while DOLS includes additional lag and lead values of first-difference level variables in the model to minimize potential biases (Stock & Watson, 1993). As a result, the FMOLS model is frequently regarded as more suitable for capturing long-term cointegrating relationships with fewer specification errors (Mark & Sul, 2003). Regarding diagnostic performance, it can be stated that both models are appropriate for analyzing the problem under investigation, though FMOLS offers marginally greater analytical precision. This is crucial for shaping policy recommendations, as the precision of the models directly affects how the results are interpreted and their reliability in a practical decision-making context.

To sum up, the three variables examined significantly affect long-term wage and salary expenses. The most significant impact is on the minimum wage, which not only directly increases wage and salary expenditure but also affects the overall structure of wage and salary expenditure. Turnover has a positive impact on wage and salary expenditure, allowing for rent sharing mechanisms, while higher unemployment reduces wage growth. The resemblance in the results of the two models — FMOLS and DOLS — strengthens the reliability of the conclusions and suggests stable cointegration between major labor market and economic indicators.

V. CONCLUSIONS

The research utilizes panel data from 2001 to 2023, encompassing four major sectors of Lithuanian non-financial activities: manufacturing (C), wholesale and retail trade, repair of motor vehicles and motorcycles (G), transport and storage (H), and information and communication (J). The findings validate the hypotheses and reveal statistically significant connections between spending on wages and salaries (excluding employers' social security contributions) and three variables: business turnover, minimum wage, and unemployment rate. The FMOLS and DOLS methods show that there is a statistically significant long-run relationship between these variables.

The results show that the minimum wage has the biggest impact on wage and salary costs. A 1% rise in this variable results in an average 0.7% increase in wage and salary expenses. The findings indicate that the Lithuanian government's minimum wage policy directly affects the cost structure of companies in four sectors (C, G, H, J), irrespective of the sector's specifics. The effect of turnover, as a primary measure of company performance, on wage and salary expenses is also statistically significant and positive in sectors C, G, H, and J. A 1% increase in turnover leads to about a 0.28% rise in wage and salary costs. This suggests that employee salaries are strongly connected to company earnings, and that wage increases may be associated with revenue growth. This is especially true in sectors where employee contributions are crucial for productivity and where wage levels and qualification requirements are distinctly differentiated, particularly in the manufacturing (C) and information and communication (J) sectors.

In Lithuania, the effect of the real unemployment rate on wages and salary expenses moves in the opposite direction. The findings indicate that a 1% rise in the unemployment rate in the country results in a reduction of approximately 0.11–0.13% in wage and salary expenses in sectors C, G, H, and J. The impact of this variable is less significant than that of the other variables, meaning that a rise in the unemployment rate cannot be seen as the primary cause of the decrease in wages and salaries. The lower sensitivity to changes in the unemployment rate is particularly pronounced in sectors with a predominantly high-skilled workforce, such as information and communication (J).

The study's findings could be significant for optimal national minimum wage regulation, offer a quantitative foundation for developing sectoral labor market strategies, and serve as an objective basis for companies' wage policy decisions based on identified elasticities. Additionally, they lay the groundwork for further studies on the interplay of wages, productivity, capital, and social factors across various business sectors.

The study's limitations are attributed to various factors. To begin with, the data analyzed are compiled at the sector level, preventing the assessment of the influence of company size, geographic location, or ownership type. Second, the study focused on three factors, excluding other potential variables like labor productivity, technological investment, or skill structure. Third, the research focuses on long-term effects, which means short-term fluctuations, particularly in reaction to economic shocks (such as the COVID-19 pandemic or the energy crisis), might not have been fully captured.

Future research directions might encompass a more in-depth sectoral analysis, incorporating company size, regional structure, and labor productivity metrics. Extending the study to include an analysis of social factors, such as migration coverage, trade union influence, or the role of teleworking, would also be valuable. In conclusion, international comparisons could be conducted to evaluate how similar factors influence wage and salary expenses across various EU nations.

VI. REFERENCES

1. Alexandre, F., Bação, P., Cerejeira, J., Costa, H., & Portela, M. (2022). *Minimum wage and financially distressed firms: Another one bites the dust*. *Labour Economics, 74*, 102088. https://doi.org/10.1016/j.labeco.2021.102088
2. Baltagi, B. H. (2005). *Econometric Analysis of Panel Data* (3rd ed.). Wiley. https://library.wbi.ac.id/repository/27.pdf
3. Baltagi, B. H., Blien, U., & Wolf, K. (2008). *New evidence on the dynamic wage curve for Western Germany: 1980-2004* (Center for Policy Research Working Paper No. 103). Syracuse University. The German Wage Curve: Evidence from the IAB Panel
4. Bell, B., Bukowski, P., & Machin, S. (2020). *The decline of rent sharing*. King's Business School, Centre for Economic Performance, LSE. COMPNET & NBS. Pawel_Bukowsky_-_Rent_Sharing.pdf
5. Blanchflower, D. G., Oswald, A. J., & Sanfey, P. (1992). *Wages, profits and rent-sharing* (NBER Working Paper No. 4222). National Bureau of Economic Research. https://www.nber.org/papers/w4222
6. Breitung, J., Pesaran, M. H. (2005). *Unit Roots and Cointegration in Panels* https://www.ifo.de/DocDL/cesifo1_wp1565.pdf
7. Budd, J. W., Konings, J., & Slaughter, M. J. (2002). *International rent sharing in multinational firms*. Review of Economics and Statistics, 84(3), pp. 560–576 https://www.nber.org/system/files/working_papers/w8809/w8809.pdf
8. Card, D., Devicienti, F., & Maida, A. (2014). *Rent-sharing, Hold-up and Wages: Evidence from Matched Panel Data*. Review of Economic Studies, 81(1), 84–111. https://davidcard.berkeley.edu/papers/RESTUD-2014.pdf
9. Choi, I. (2001). *Unit root tests for panel data*. Journal of International Money and Finance, 20(2), pp. 249–272. https://doi.org/10.1016/S0261-5606(00)00048-6
10. Eurostat. *Wages and labour costs.* https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Wages_and_labour_costs

11. Fulmer, I. S., Gerhart, B., & Kim, J. H. (2023). *Compensation and performance: A review and recommendations for the future. Personnel Psychology, 76*(2), pp. 123-150. https://doi.org/10.1111/peps.12583
12. Gorjón, L., Martinez de Lafuente, D., & Romero, G. (2024). *Employment effects of the minimum wage: Evidence from the Spanish 2019 reform*. SERIEs - Journal of the Spanish Economic Association, 15(1), pp. 1-55. https://doi.org/10.1007/s13209-023-00291-1
13. Gujarati, D. N., & Porter, D. C. (2009). *Basic econometrics (5th ed.)*. McGraw-Hill/Irwin. https://ucanapplym.s3.ap-south-1.amazonaws.com/RGU/notifications/E_learning/0nline_study/Basic-Econometrics-5th-Ed-Gujarati-and-P.pdf
14. Hao, C., Feng, X., & Guo, X. (2024). *Minimum wage and the survival of hotel industry: Evidence from China. International Journal of Hospitality Management, 120*, 103757. https://thuvienso.hoasen.edu.vn/server/api/core/bitstreams/f36ac2e9-2fb5-413b-8652-e5ccec1775c3/content
15. Hansen, B. E. (1992). *Efficient Estimation and Testing of Cointegrating Vectors in the Presence of Deterministic Trends. Journal of Econometrics,* 53(1–3), pp. 87–121. https://www.researchgate.net/publication/222441772_Efficient_Estimation_and_Testing_of_Cointegration_Vectors_in_the_Presence_of_Deterministic_Trends
16. Hausman, J. A. (1978). *Specification Tests in Econometrics*. *Econometrica*, *46*(6), pp. 1251–1271. https://doi.org/10.2307/1913827
17. Hellebrandt, T., Jarand, M., Kirkegaard, J. F., Moran, T., Posen, A. S., Wolfers, J., & Zilinsky, J. (2015, April). *Raising lower-level wages: When and why it makes economic sense* (PIIE Briefing 15-2). Peterson Institute for International Economics. Raising Lower-Level Wages: When and Why It Makes Economic Sense | PIIE
18. Im, K. S., Pesaran, M. H., & Shin, Y. (2003). *Testing for unit roots in heterogeneous panels. Journal of Econometrics,* 115(1), pp. 53–74. https://doi.org/10.1016/S0304-4076(03)00092-7
19. Kao, C., & Chiang, M.-H. (1999). *On the estimation and inference of a cointegrated regression in panel data.* Advances in Econometrics, 15, pp. 179–222. https://surface.syr.edu/cgi/viewcontent.cgi?article=1144&context=cpr
20. Kao, C. (1999). S*purious regression and residual-based tests for cointegration in panel data. Journal of Econometrics, 90*(1), pp. 1–44. https://doi.org/10.1016/S0304-4076(98)00023-2
21. Kauhanen, Antti; Piekkola, Hannu (2002). Profit sharing in Finland: Earnings and productivity effects, ETLA Discussion Papers, No. 817, The Research Institute of the Finnish Economy (ETLA), Helsinki https://www.econstor.eu/bitstream/10419/63864/1/35367429X.pdf
22. Kutner, M.H., Nachtsheim, C.J., Neter, J. and Li, W. (2005) *Applied Linear Statistical Models.* 5th Edition, McGraw-Hill, Irwin, New York.https://users.stat.ufl.edu/~winner/sta4211/ALSM_5Ed_Kutner.pdf
23. Lacasa-Cazcarra M. (2025). *Machine Learning Analysis of the Impact of Increasing the Minimum Wage on Income Inequality in Spain from 2001 to 2021*. *Recent Prog Sci Eng* 1(1): 005; doi:10.21926/rpse.2501005
24. Liang, Y. (2024). *Firms' risk adjustments to minimum wage: Financial leverage and labor share trade-off*. arXiv. 2408.03659
25. Levin, A., Lin, C.-F., & Chu, C.-S. J. (2002). *Unit root tests in panel data: asymptotic and finite-sample properties.* Journal of Econometrics, 108(1), pp. 1–24. https://doi.org/10.1016/S0304-4076(01)00098-7
26. Maddala, G. S., & Wu, S. (1999). *A comparative study of unit root tests with panel data and a new simple test*. Oxford Bulletin of Economics and Statistics, 61(S1), pp. 631–652. https://doi.org/10.1111/1468-0084.0610s1631
27. Mark, N. C., & Sul, D. (2003). Cointegration vector estimation by panel DOLS and long-run money demand. Oxford Bulletin of Economics and Statistics, 65(5), pp. 655–680. https://www.researchgate.net/publication/4778353_Cointegration_Vector_Estimation_by_Panel_DOLS_and_Long-run_Money_Demand
28. Nijkamp, P., & Poot, J. (2005). The last word on the wage curve? *Journal of Economic Surveys, 19*(3), pp. 421–450. https://research.ebsco.com/c/q3he5j/viewer/pdf/nykbgacgd5?route=details
29. Oficialiosios statistikos portalas https://osp.stat.gov.lt/statistiniu-rodikliu-analize?indicator=S8R036#/
30. Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxford Bulletin of Economics and Statistics, 61(1), pp. 653–670. https://web.williams.edu/Economics/wp/pedronicriticalvalues.pdf
31. Pedroni, P. (2001). Fully modified OLS for heterogeneous cointegrated panels. Advances in Econometrics, 15, pp. 93–130. https://web.williams.edu/Economics/wp/pedroniaie.pdf
32. Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econometric Theory, 20(3), pp. 597–625. https://econpapers.repec.org/article/cupetheor/v_3a20_3ay_3a2004_3ai_3a03_3ap_3a597-625_5f20.htm
33. Phillips, P. C. B., & Hansen, B. E. (1990). Statistical inference in instrumental variables regression with I(1) processes. The Review of Economic Studies, 57(1), pp. 99–125. https://www.researchgate.net/publication/4995412_Statistical_Inference_in_Instrumental_Variable_Regression_with_II_Processes
34. QMS. (2021). Eviews 12 Users Guide I. IHS Global Inc. https://www.eviews.com/home.html
35. Storm, S., & Naastepad, C. W. M. (2007). *Why labour market regulation may pay off: Worker motivation, co-ordination and productivity growth*. https://www.ilo.org/publications/why-labour-market-regulation-may-pay-worker-motivation-co-ordination-and
36. Stock, J. H., & Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. Econometrica, 61(4), pp. 783–820. https://users.ssc.wisc.edu/~bhansen/718/StockWatson1993.pdf
37. Valstybės duomenų agentūra (n.d.). *Verslo struktūros rodikliai*. https://osp.stat.gov.lt/documents/10180/5118910/Metiniai+verslo+strukt%C5%ABros+rodikliai++%5BLT%5D+630.html
38. Wooldridge, J. M. (2010). Wooldridge, J. M. (2010). Econometric analysis of cross section and panel data (2nd ed.). MIT Press. https://ipcid.org/evaluation/apoio/Wooldridge%20-%20Cross-section%20and%20Panel%20Data.pdf
39. Wooldridge, J. M. (2016). Introductory Econometrics. A Modern Approach (6th ed.). Cengage Learning.https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ECO/2.pdf
40. Žaptorius, J. (2005). *Darbo rinka: darbo užmokesčio tendencijų barometras*. Filosofija. Sociologija, 16(4), pp. 53-61. https://mokslozurnalai.lmaleidykla.lt/publ/0235-7186/2005/4/Fil_053_061.pdf