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How Minimum Wage Increases Affect Catering Service Firms: the case of Estonia and Latvia

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Abstract

In this Bachelor Thesis we investigate the financial and employment impacts of minimum wage increases on catering service firms in Estonia and Latvia during 2014–2023. We specifically evaluate the effects on gross profit margins, revenues, labour productivity, employment levels, and labour costs, employing administrative firm-level data and econometric methods, such as Propensity Score Matching and Difference-in-Differences regressions. Our findings indicate that minimum wage increase modestly improved gross profit margins for Estonian firms, whereas it slightly reduced them in Latvia. While operating revenues estimates were largely negative but insignificant in both countries, we identified statistically significant employment reductions, increased labour costs, and notable gains in labour productivity. Our research extends the existing literature by confirming a negative employment impact at the firm level while also exploring financial outcomes. Using micro-level firm data, we highlight country-specific variations in firm impacts and show the role of informal economic practices.

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1. Introduction

Minimum wage regulation is one of the most prominent tools for improving the welfare of low-income earners. However, its implementation raises important questions about potential adverse consequences on businesses - especially in low-wage, labour-intensive sectors. Existing literature has produced mixed results regarding the effects of minimum wage increases on performance of firms, employment, and productivity.

In Estonia and Latvia, the catering services industry plays a vital role in the economy, providing employment opportunities for a large number of low-wage workers. Over the past decade, both countries have experienced considerable growth in the statutory minimum wage. Between 2014 and 2023, the minimum wage increased by 350 EUR in Estonia and 300 EUR in Latvia (Country Economy, n.d.). Given the high concentration of low-paid labour in the catering sector, these changes provide an ideal setting to examine the effects of minimum wage policy at the firm level (Central Statistical Bureau of Latvia, n.d.).

Previous studies on minimum wage increases have largely focused on employment effects (Card & Krueger, 1994; Ferraro et al., 2018; Hinnosaar & Rõõm, 2003), with fewer examining firm-level indicators like gross profit margins and revenues (Draca et al., 2011; Harasztosi & Lindner, 2019). This research addresses the gap using administrative firm-level data from Estonia and Latvia, evaluating how catering service firms respond to minimum wage hikes.

This thesis aims to analyse the effect of minimum wages increase on catering service firms in Estonia and Latvia from 2014 to 2023. Using administrative firm-level data and combining Propensity Score Matching (PSM) and Difference-in-Differences (DiD) estimation, we assess the causal effects of minimum wage increases on five key outcome variables: revenue, employment, gross profit margin, labour costs, and labour productivity. Firms are grouped into treatment and control groups based on the inverse Kaitz index - a measure that captures firms most exposed to minimum wage increases (Doh & Van der Meer, 2023).

Accordingly, we aim to answer the following research questions:

1. How does the minimum wage increase affect profitability, revenues, labour productivity, employment and labour costs of catering service firms in Estonia?

2. How does the minimum wage increase affect profitability, revenues, labour productivity, employment and labour costs of catering service firms in Latvia?

Our thesis contributes to the existing literature by examining both the employment and financial effects of minimum wage increases on catering service firms in Estonia and Latvia - an area that has received limited attention. While the impact of minimum wage rise on catering sector firms has been studied elsewhere - for example, in Hungary, where firms partly absorbed higher labour costs and adjusted prices to maintain profitability (Harasztosi & Lindner, 2019) - research in Estonia and Latvia has mainly focused on other sectors such as manufacturing, wholesale and retail, construction, and transport (Gavoille & Zasova, 2023; Hinnosaar & Rõõm, 2003; Fadejeva, 2016). The impact on the catering industry specifically remains unexplored, which our study aims to address.

The thesis is structured as follows: Section 2 reviews the relevant academic literature and theoretical background. Section 3 outlines the methodological approach and Section 4 - data, sources and descriptive statistics. Section 5 presents and discusses the empirical results. Section 6 discusses limitations, and Section 7 concludes by summarizing key findings and policy implications.

2. Literature review

The literature review provides context for answering the research questions and a theoretical foundation to identify gaps in previous research. The structure of this chapter is organised to first provide a general background on minimum wage policies, followed by a discussion of their effects across various dimensions, including enterprise performance and labour markets. It explores earlier studies about minimum wages in the Baltic States. Finally, it explains how this study contributes to the existing research.

2.1. Background about Minimum Wages

As defined by the International Labour Organization (2016), minimum wages are the lowest amount of remuneration that employers are obliged to pay employees for their work during a specific time period. The minimum wage cannot be lowered through collective agreements or individual contracts. The primary goal of minimum wages is to protect workers from excessively low compensation and to help guarantee fair economic benefits for society. Globally speaking, minimum wages are a component of broader strategies aimed at reducing poverty and inequalities, including gender disparities. Minimum wages have evolved from targeting specific low-wage sectors to becoming a policy with wide-ranging impact.

According to Matsaganis (2020), minimum wage policies originated in the late 19th century, with the first laws enacted in New Zealand in 1894 and in the US in 1938. Post-World War II, these policies expanded globally, reaching Eastern Europe (Lithuania, Latvia, and Estonia) during the 1990s market transition. By July 2024, 22 of 27 EU countries had national minimum wages, varying significantly from €477 in Bulgaria to €2,571 in Luxembourg (Eurostat, 2024). Denmark, Italy, Austria, Finland, and Sweden remain without national minimum wages.

Minimum wage rates are established through several approaches, such as formulas, expert committee recommendations, and consultations with social partners. Most countries review their minimum wage levels every 1-2 years (Koester & Wittekopf, 2022). The EU Minimum Wage Directive suggests that member states should set minimum wages to ensure a basic standard of living. It considers the cost of essential goods and services, allowing each country to adapt these criteria based on local costs and conditions (Vacas-Soriano & Aumayr-Pintar, 2024).

2.2. **Minimum Wage Changes in Estonia and Latvia**

Between 2014 and 2023, both Latvia and Estonia saw noticeable increases in their minimum wages. However, the pace and consistency of these changes were quite different in each country, which could suggest different economic strategies or priorities when it comes to wage policy.

In Estonia, minimum wages increased steadily year after year without any breaks. This steady growth shows that the country followed a consistent and planned approach to raising the minimum wage. Over the 10-year period, Estonia's minimum wage grew from around €355 in 2014 to approximately €725 in 2023, which is an average increase of about €41 per year. Latvia, on the other hand, had a more uneven path. Although there were some increases early on, the minimum wage stayed the same from 2018 to 2020 and again from 2021 to 2022. Latvia's minimum wage rose from roughly €320 in 2014 to about €620 in 2023, averaging a €33 increase per year, but with larger jumps in certain years like 2023 which may have been a way to catch up after a few years of little to no change (Country Economy, n.d.).

As a result, the gap between the two countries grew over time. While the difference in minimum wages was small in 2014, Estonia pulled ahead more and more each year. By 2023, the gap had widened to over €100, with Estonia's minimum wage

being around 16% higher than Latvia's. A graph showing these trends in more details can be found in Appendix A.

2.3. The effects of minimum wage

The section 2.3 examines the various effects of minimum wage increases, focusing on their impact on firms' financial performance and employment. It explores how enterprises respond to rising labour costs through changes in profitability, employment levels, and productivity. It also reviews empirical findings from different economic contexts.

2.3.1. Firms' Performance and Financial Effects

This section reviews how minimum wage increases impact firm profitability and adjustment strategies across countries and industries. Studies from Romania (Heemskerk et al., 2018), Germany (Kühn, 2021), the UK (Draca et al., 2005), Poland (Babiak et al., 2019), and Hungary (Harasztosi & Lindner, 2019) reveal mixed outcomes. Typically, research suggests that increases in minimum wages generally have a negative impact on firm financials, primarily by reducing profitability. Firms predominantly absorb higher labour costs through reduced profit margins, though some successfully transfer costs to consumers via price increases.

Heemskerk et al. (2018) investigate the effects of minimum wage increases in Romania, with a focus on firm-level outcomes such as profitability. Their findings show that, although firm productivity remains largely unchanged, companies experience a significant decline in profitability after wage hikes. This decline is mainly due to increased labour costs that firms struggle to offset through price increases or productivity improvements. The impact is especially pronounced among smaller and less productive firms, which have limited flexibility to adjust.

In contrast, Kühn (2021) examines the introduction of a national minimum wage in Germany and finds no significant drop in profitability across the most affected industries. German firms appeared more resilient, likely due to their ability to make internal adjustments - such as cutting non-wage benefits, reducing working hours, or improving efficiency. While German companies could absorb the added costs, Heemskerk et al. (2018) suggest that Romanian firms faced greater structural and financial challenges, making similar adjustments more difficult.

Draca et al. (2005) find that UK firms largely responded to national minimum wage increases by reducing profit margins rather than raising prices. This trend was especially evident in low-wage sectors such as retail and hospitality, where firms absorbed the additional labour costs internally. The study shows little evidence of significant price increases, even in industries with a high share of low-paid workers like catering. Instead of passing costs on to consumers or making structural changes such as layoffs or closures, firms managed the impact by accepting lower profit margins.

Other studies also highlight how sharp increases in minimum wages can put financial strain on firms. In Poland, for instance, a 20.3% minimum wage hike in 2008 led to an 8.5 percentage point increase in average wages among low-wage firms, but also resulted in a statistically significant 4.5 percentage point decline in their profit margins (Babiak et al., 2019). This decline, which was found to be statistically significant, was attributed to higher labour costs that firms struggled to offset through labour adjustments or price increases. These findings align with Draca et al. (2005), reinforcing the view that firms often absorb wage shocks internally rather than passing them on to consumers.

A contrasting case is presented by Harasztosi & Lindner (2019) in Hungary, where firms responded to higher labour costs by passing around 75% onto consumers through higher prices, leading to increased revenue, while only 25% was absorbed through reduced profits. However, firms in export-intensive and manufacturing sectors faced greater competition and struggled to raise prices, often resulting in profit declines.

Luca & Luca (2017) investigate how minimum wage hikes affect restaurant profitability and closures rates. The authors found that a 10% increase in the minimum wage leads to approximately 2% reduction in restaurant profits, given that labour costs constitute a significant portion of total expenses. Their research finds that lower-rated restaurants are more likely to close after a wage increase, while higher-rated restaurants can better absorb the costs and remain open.

2.3.2. Employment Effects

Understanding the impact of minimum wage increases on employment has long been a fundamental topic in labour economics. While traditional models predict negative employment effects, recent empirical studies and theoretical advancements suggest more complex and varied outcomes, particularly in sectors with a big share of low-wage workers such as catering services.

Card & Krueger's (1994) study examines the impact of minimum wage increases on employment in the fast-food industry. Using a difference-in-differences approach, they compared fast-food restaurants in New Jersey, where the minimum wage was increased, to those in Pennsylvania, which saw no wage change. Data was collected through surveys measuring employment levels, wages, and hours worked before and after the policy change. Contrary to traditional economic theory, they found no significant reduction in employment in New Jersey; in some cases, employment even increased relative to Pennsylvania. These findings suggested a more nuanced relationship between minimum wage policy and employment levels.

Supporting these results, Lynn & Boone (2015) also found that minimum wage increases do not significantly harm employment in the restaurant industry. Focusing on full-service dining establishments across multiple U.S. states from 1995 to 2014, they used state-year level analysis while controlling for regional economic trends. Their findings showed no job losses or decline in the number of restaurants. Instead, the study reported reduced employee turnover, increased worker productivity, and stable employment, reinforcing the idea that higher minimum wages can benefit workers without severely affecting employment.

A number of studies offer broader insights into how firms respond to minimum wage increases, particularly in terms of employment and productivity outcomes. Riley & Bondibene (2013) examined the effects of the national minimum wage during the 2008 financial crisis in the UK and found that, despite economic pressures such as reduced demand and limited credit access, firms did not significantly reduce employment. Companies may adapt by reallocating resources or improving efficiency rather than cutting jobs. Similarly, Draca et al. (2005, 2011) found no substantial decline in employment following minimum wage hikes in the UK, although they did not observe notable productivity gains, pointing to mixed outcomes in this area. Harasztosi & Lindner (2019), focusing on Hungary, also observed that firms absorbed higher wage costs without major job losses. Like Riley & Bondibene, they suggest that firms may prioritise workforce stability, even under increased cost pressures.

The mixed empirical findings - where minimum wage increases did not lead to significant job losses - can be better understood through alternative labour market models. These go beyond perfect competition and account for frictions and employer wage-setting power, offering more realistic explanations for firm behaviour.

Traditional economic theory, based on perfect competition, predicts that setting a minimum wage above the market equilibrium leads to job losses, as low-productivity workers are priced out (Demekas, 1990). However, more realistic models, such as monopsony, suggest different outcomes. In monopsonistic markets, where firms have wage-setting power, minimum wage increases can raise both wages and employment by correcting underpayment (Brown, 1999).

Bhaskar et al. (2002) extend the monopsony perspective by introducing a model of monopsonistic competition, where multiple firms compete for workers but still retain some wage-setting power due to labour market imperfections. In this setting, raising the minimum wage can push wages up across firms, but the effect on employment is less predictable - it depends on how firms adjust to increased labour costs and how workers respond to higher wages.

The model by Dickens et al. (1994) adds further depth by focusing on labour market frictions - such as job search costs, imperfect information, and limited mobility - that reduce workers' ability to move freely between jobs. These frictions, common in sectors like catering, allow firms to pay below-market wages without losing staff. As a result, minimum wage increases in such markets may not lead to job cuts and could even increase employment by correcting these imbalances.

Overall, the evidence challenges the traditional view that raising the minimum wage always leads to job losses. Empirical findings suggest that the impact on employment is often limited, and in some cases, firms even maintain or increase employment levels. This suggests that minimum wage increases show mixed effects on employment and that outcomes largely depend on how firms adapt and the specific conditions of the labour market.

2.4. Previous Research in the Baltic States

Previous research on the impact of minimum wage increases in the Baltic States presents a mixed picture. In Estonia, Hinnosaar & Rõõm (2003) found that around 10.1% of workers directly impacted by wage hikes lost their jobs within three months. However, Ferraro et al. (2018) analyzed a later period (2013-2016) and found minimal impact on employment retention, suggesting improved adaptability in the labour market. In Latvia, Gavoille & Zasova (2023) observed that tax-evading firms managed to adjust to the minimum wage increases by formalizing undeclared wages, while fully compliant firms faced difficulties due to rising labour costs. Additionally, Fadejeva

(2016) noted that businesses often responded to increased labour costs by reducing non-wage expenses, laying off workers, and adjusting prices. While minimum wage policies in the Baltics impacted profitability, business compliance, economic conditions, and industry-specific factors also influenced how firms managed increased labour costs.

Hinnosaar & Rõõm (2003) examined employment outcomes in the Estonian labour market in the context of increased minimum wages. The authors use Labour Force Survey data and divide workers into wage groups based on their position relative to the minimum wage before and after an increase, analysing their employment probabilities and likelihood of earning below the legal minimum. About 10.1% of workers directly affected by wage hikes lost their jobs within three months. A significant portion remained under the new legal minimum despite efforts to comply. Non-compliance with the new wage laws was especially common in sectors like agriculture, hospitality, services, and in regions with lower average wages. Raising minimum wages can help reduce wage inequality; however, it risks job losses.

Another research was conducted in Estonia to assess how the increases in the minimum wage from 2013 to 2016 influenced the probability of Estonian workers retaining full-time employment. Ferraro, et al. (2018) took two periods into account for the Difference-in-Difference methodology: reference period (2009–2011) - when the minimum wage remained constant and treatment period (2013–2016) - when annual minimum wage hikes of about 10% were implemented. The study also uses Labour Force Survey data and classifies workers into groups based on their income before the minimum wage increase. After applying a Probit regression to determine the probability of being employed after the intervention, the authors conclude that there is minimal impact on employment retention. This implies that raising the minimum wage during the treatment period did not significantly alter the probability of workers staying employed compared to the control period. These results are not in line with the findings of Hinnosaar & Rõõm (2003), which might be due to the fact that Hinnosaar & Rõõm (2003) use an earlier data period, namely 1995-2000. However, the authors note that there might be potential long-term or broader employment effects, such as challenges for job market entry or shifts in employment composition that were not captured in their analysis.

Regarding Latvia, Gavoille & Zasova (2023) analysed the effects of significant wage hikes in 2014 and 2015, when the nominal minimum wage rose by a cumulative 26%. Their research used administrative data, such as tax records, alongside survey data

to examine effects on businesses. The methodology employed by the authors involved a supervised machine learning algorithm to classify firms as either tax-compliant or tax-evading, relying on firm-level financial data and patterns of wage reporting. A central focus was on "envelope wages" - unreported cash payments supplementing official salaries. They found that tax-evading firms were largely unaffected by the wage increases, as they adjusted by converting some of their undeclared payments into formal wages. In contrast, companies that fully complied with tax laws faced greater difficulties, as they had to absorb higher labour costs directly.

While raising the minimum wage can provide a safety net for low-income workers, it also presents challenges for businesses, particularly concerning labour costs and competitiveness. In the responses of 557 firms regarding their adjustments following the minimum wage increase in Latvia on January 1, 2014, most employers reported various strategies to mitigate increased labour expenses, including reducing non-wage costs, laying off employees, and adjusting product prices. Notably, about 25% of surveyed firms employed workers earning minimum wage, with a higher concentration in sectors such as manufacturing and services. This suggests that the effects of minimum wage policies are felt more acutely in industries with a significant portion of low-wage workers, raising concerns about potential job losses or reduced hiring in these sectors. The findings suggest that an effective minimum wage policy should carefully balance improving conditions for low-wage workers with maintaining firms' ability to operate sustainably (Fadejeva, 2016).

Garcia-Louzao & Tarasonis (2023) analysed the labour market effects in Lithuania in the context of a historically large minimum wage increase covering the period from 2010 to 2020. The authors focused on the 17.7% minimum wage increase in 2013 and how this change impacted wages and employment compared to the pre-intervention period (2010-2011). The minimum wage hike in Lithuania led to significant wage growth for workers at the lower end of the income distribution. The policy had a direct and immediate positive effect for the targeted group - workers earning less than the new minimum wage of 373 EUR experienced an 11.5% increase in their earnings. The study identified spillover effects on wages for workers earning slightly above the new minimum wage which implies a broader effect of the policy. Small and medium enterprises (SMEs) and public sector firms showed resilience in maintaining employment, possibly due to internal adjustments like cost-cutting and absorbing labour costs without layoffs.

2.5. Our Contribution to The Literature

Understanding the impact of minimum wage increases on businesses is essential for achieving a balanced approach that supports worker welfare while maintaining firms' stability and financial performance. Many past studies have looked at how changes in the minimum wage impact businesses, especially in big countries. For example, research by Card and Krueger (1994) has established a theoretical foundation on the employment effects of minimum wages, while more recent work by Harasztosi and Lindner (2019) explored how these changes influence a company's profitability and cost dynamics. These studies have helped shape our understanding of what happens with firms when the minimum wage increase, mainly in large, developed economies**.**

Research on how minimum wage changes affect businesses in smaller countries like Estonia and Latvia remains limited. Most existing studies in these contexts focus on labour market outcomes, such as employment levels, rather than examining the impact on firm profitability - especially in industries that depend heavily on low-wage workers. Our study addresses this gap by analysing how minimum wage increases influence both profits and employment in the catering sector of Latvia and Estonia, offering new insights into this topic.

3. Methodology

We use a combination of Propensity Score Matching (PSM) and Difference-in-Difference methods, which is aligned with previous research in this field (Heckman et al., 1997; Draca et al., 2011). PSM helps find similar catering service firms in Estonia and Latvia based on key characteristics. After matching, Difference-in-Difference regressions measure how minimum wage increases specifically impact profitability, revenues, employment, and labour costs by removing effects from unrelated factors or trends over time. The whole empirical analysis was performed in R Studio and this combination of methods directly helps us to answer both research questions.

3.1. Propensity Score Matching

The propensity score matching (PSM) concept was introduced by Rosenbaum & Rubin (1983). The authors define the propensity score as the conditional probability of being assigned to a treatment, given a set of observed covariates. It is a useful tool in observational studies, because it allows researchers to mimic the conditions of a

randomized controlled trial. Propensity score matching is a statistical matching technique that addresses selection bias in observational studies by creating a quasi-experimental design.

For the propensity score matching we have to obtain a propensity score p(x) for each firm in our sample:

$$p(X)_i = \Pr\,(D_i = 1|X_i),$$

where D_i represents the treatment indicator - a binary variable that identifies whether a firm crosses the Kaitz index threshold, thereby belonging to the treatment group. The vector X_i includes the covariates used to model treatment assignment. Using a logit model, we estimate the propensity score, which ranges from 0 to 1 and reflects the likelihood that a firm is classified as low-wage. This approach conditions on observed characteristics and aims to ensure a systematic estimation process that preserves the assumption of randomness and mitigates potential selection bias.

A key requirement for applying Propensity Score Matching is the underlying Conditional Independence Assumption (CIA). It asserts that, after controlling for a set of observable characteristics (X), the assignment to the treatment groups is independent of the potential outcomes. We need to adequately account for all the factors that influence both the minimum wage increase and the outcome (dependent variable) of interest. The CIA is expressed as

$$(Y_1, Y_0) \perp D|X,$$

Where Y_1 and Y_0 represent the potential outcomes with and without treatment, and D indicates treatment status. Once matched on the propensity score (a summary of X), untreated individuals can serve as a valid counterfactual for the treated. The relies on the inclusion of all relevant covariates that influence both treatment and outcome (Heinrich, Maffioli, & Vázquez, 2010).

We apply PSM to match firms affected by minimum wage increases (treatment group) with similar firms not significantly impacted (control group) based on a vector of covariates. Austin (2011) defines covariates as pre-treatment variables that are associated with both the treatment assignment and the outcome of interest. It is recommended to include all variables that are predictive of the treatment assignment and potential outcomes, even if their relationship with the outcome is weak. Covariates represent specific characteristics of firms that may affect their exposure to minimum wage changes (treatment) as well as their financial and employment outcomes. In our study, we include firm size (measured by number of employees), revenue, debt-to-

equity ratio, capital-to-sales ratio, and capital-to-labour ratio. The chosen covariates capture key structural and financial characteristics that influence both a firm's exposure to minimum wage changes and its financials and employment.

To match treatment and control firms, we use the Kernel matching method, which estimates the average treatment effect on the treated (ATT) by computing a weighted average of control outcomes. Weights are based on the proximity of propensity scores, allowing for smoother, more efficient use of data compared to nearest-neighbor matching (Heckman et al., 1997). The matched control group of firms will ensure that treated and comparison firms are similar in characteristics before the wage hike. Soares (2004) uses a kernel-based propensity score matching method within a difference-in-differences (DiD) framework to estimate the causal impact of minimum wage increases on employment transitions. The author used individual data for workers and for each treated worker, the counterfactual outcome is estimated using a weighted average of outcomes from comparison group individuals.

For our case, control firms will not only differ in minimum wage exposure (as proxied by the inverse Kaitz index) but also have similar structural features to the treated firms. This way, we aim to reduce selection bias and improve the internal validity of the further Difference-in-Differences regression analysis, ensuring that our estimates of the impact of minimum wage policies on the profitability of catering service firms in Estonia and Latvia are as robust and credible as possible.

3.2. Difference-in-Difference

In order to answer our Research questions, we are focusing on the Difference-in-Difference regression analysis, since the majority of the previous research in the field uses exactly this approach. This methodology allows us to estimate the causal effect of an intervention using treatment and control groups. Similarly to Draca et al. (2011) we will be comparing the treatment group (T=1) to the control group (T=0) to analyse Estonian and Latvian firm profitability by observing the chosen indicators.

The DiD approach is typically used for observing the treatment effect for two time periods: pre-treatment and post-treatment years. Researchers studying minimum wages have observed either the introduction of a minimum wage in a country or an increase in an existing minimum wage after remaining unchanged for a specific period. Ferraro, et al. (2018) observed a reference period (2009–2011) - when the minimum wage remained constant and a treatment period (2013–2016) - when annual minimum

wage hikes of about 10% were implemented. Draca et al. (2011) observed the impact of minimum wage changes over the period from 1996 to 2002. This includes three years before and three years after the introduction of the UK National Minimum Wage in 1999. That way the authors analysed both immediate and slightly longer-term effects of the policy change.

Angrist & Pischke (2009) propose a staggered Difference-in-Differences (DiD) approach, which is an extension of the traditional DiD approach. This method is commonly used when the treatment is introduced at different times across different groups or regions rather than simultaneously. It accommodates variations in treatment timing, which is often the case in real-world policy implementations or economic reforms such as minimum wage increases. The staggered approach relies on two-way fixed effects, which control for both unit-specific effects (like region or individual fixed effects) and time-specific effects (like year fixed effects). This helps to account for unobserved heterogeneity across units and over time. The model looks the following way:

$$Y_{it} = a_i + \lambda_t + \beta D_{it} + \epsilon_{it}$$

Where Y is the outcome, α are unit fixed effects (time-invariant characteristics), λ are time fixed effects (capturing shocks common to all units), D is a treatment indicator that equals 1 if unit i is treated at time t and 0 otherwise, β is the DiD estimator capturing the average treatment effect, and ϵ is the error term.

3.3. Treatment and Control Groups

Doh & Van der Meer (2023) describe the Kaitz index as the ratio of a region's minimum wage to the region's median wage which is used to measure the relative intensity of minimum wage policies within a given wage distribution. The index helps to compare countries or companies because it normalises the average wage and provides an indication of how impactful the minimum wage can be.

$$\text{Kaitz index} = \frac{\text{Minimum Wage}}{\text{Average Wage}}$$

It is also a good indicator for the degree to which a firm is impacted by the minimum wage. A more intuitive way to assess this is to calculate the inverse of the Kaitz index in terms of average labour costs per employee per month for better comparability:

$$\text{Inverse Kaitz index} = \frac{\text{Average Labour Cost}}{\text{Minimum wage (converted into labour cost for EE)}}$$

To accurately compare the minimum wage with the average labour costs of firms in Estonia and Latvia, it is essential to consider the comprehensive labour expenses incurred by employers, including gross wages, social taxes, and other mandatory contributions. In Estonia, employers are required to pay a social tax of 33% on top of the gross salary, which covers social security and health insurance. Additionally, they must contribute an 0.8% unemployment insurance premium of the gross salary to fund unemployment benefits (Invest in Estonia, n.d.). For Latvia, since we have obtained employee wage data, it is comparable to the state minimum wage.

Firms with an inverse Kaitz index around 1 have labour costs close to the minimum wage. By setting a Kaitz index threshold, we can effectively divide the firms of our sample into treatment and control groups based on their level of exposure to minimum wage increases.

According to Chorna (2021), the treatment group should consist of firms that are most affected by the new higher minimum wage meaning that the treatment will most likely lead to an increase in the current wages (labour costs) of the said firms. To identify the control group, we need to consider only the firms whose labour costs were not affected or affected to a much lesser extent after the treatment. A common approach to dividing data into treatment and control groups is to use a single threshold, distinguishing firms based on whether their labour cost per worker is above or below the minimum wage. The firms in our chosen industry are divided into 2 groups based on the inverse Kaitz index value. To determine appropriate thresholds, the inverse Kaitz index was first calculated for each firm and each year. Annual distributions were then examined, and threshold values were computed separately for Estonia and Latvia to control for structural differences between the data of both countries.

The lower bound was determined by averaging the first quartile across all years, ensuring that the threshold is consistent and applicable throughout the 2014-2023 period. This approach also avoids including firms with very low index values which signals that those firms employ a large share of part-time workers and can lead to biases in the empirical analysis. The upper bound corresponds to the average of the mean across all years. For Estonia - firms with inverse Kaitz index below and close to 1 ($0.8 <$ index < 1.2) form the treatment group. For Latvia - firms with inverse Kaitz index

between 0.7 and 1.1 were allocated to the treatment group. These firms are directly impacted by minimum wage increases, since their monthly labour costs or average wages are near to the minimum wage threshold. They are likely sensitive to minimum wage changes since a large portion of their wage expenses is close to the legal minimum.

For Estonia and Latvia - firms with high inverse Kaitz index values serve as the control group (index >1.2 for Estonia; index >1.1 for Latvia) as they are less affected by changes in the minimum wage. These firms have high average labour costs or wages relative to the minimum wage. They are less likely to be affected by minimum wage changes, making them a good proxy for comparison.

To make the treatment and control groups truly comparable, we focus on firms within the same sector, which reduces differences in business models and cost structures. These firms operate under similar market conditions, are subject to the same regulations, and share comparable labour intensity. Additionally, we use Propensity Score Matching to match firms based on key financial and structural characteristics. This approach helps balance the groups and supports the assumptions required for the Difference-in-Differences method to produce credible causal estimates. As a result, firms with different wage levels can be considered comparable in our analysis, as they face similar economic environments and structural conditions.

3.4. Model Specification

To answer both of our research questions we construct a universal Difference-in-Difference regression model. The base of our model with the help of which we aim to measure the impact of minimum wage changes on various financial and employment characteristics in firms is the following:

$$[Dependent\ variable]_{it} = \alpha + \gamma * treatment_i + \delta * \text{min}\_wage\_dose_t + \lambda(treatment_i * min\_wage\_dose_t) + controls_{it}$$

- Dependent variable$_{it}$:
    - Gross Profit Margin$_{it}$ – calculated as gross profit over sales for firm i at time t
    - Revenue$_{it}$ – operating revenue for firm i at time t
    - Labour Productivity$_{it}$ – calculated as operating revenue minus COGS over number of employees for firm i at time t
    - Number of Employees$_{it}$ – number of workers for firm i at time t
    - Costs of Employees$_{it}$ – labour costs for firm i at time t
- γ * treatment$_i$ – a binary variable that indicates whether firm *i* is in the treatment group. The treatment groups are created separately for Estonia and Latvia based on the criteria specified in Section 3.2.
- δ * min_wage_dose$_t$ – variable that equals the minimum wage increase (percentage change YoY) for the year after the minimum wage increase and 0 before in the staggered regression. Robustness checks for individual year pair were conducted with the standard dummy variables that equals 1 in the treatment year. In those regression the variable is treatment_year$_t$.
- λ(treatment$_i$ * min_wage_dose$_t$) – the key interaction term between the treatment group indicator and minimum wage increase variable. The sign of the coefficient indicates the direction of the impact of the minimum wage increase on the dependent variable.
- controls$_{it}$ – various (financial) control variables for firm *i* at time *t*: Total Liabilities, Capital-to-Labour ratio, Debt-to-Equity ratio, Capital-to-Sales ratio, Net Income etc.

The general DiD model for profitability implies normalising gross profit by sales revenue. Draca et al. (2011) provide the unconditional DiD calculation which shows the extent to which profit margins decline in low-wage firms relative to high-wage firms without controlling for any firm-specific or industry-specific characteristics.

$$\left[\left(\frac{\Pi}{S}\right)_{\text{Post}}^{T=1} - \left(\frac{\Pi}{S}\right)_{\text{Pre}}^{T=1}\right] - \left[\left(\frac{\Pi}{S}\right)_{\text{Post}}^{T=0} - \left(\frac{\Pi}{S}\right)_{\text{Pre}}^{T=0}\right]$$

This model compares raw averages before and after the policy change. However, there are multiple other factors that impact firm profitability. The Conditional DiD

model provides a more precise causal estimate of the minimum wage increase and reduces biases by controlling for external factors.

A range of studies also support the use of revenue, number of employees, labour productivity, and labour costs as dependent variables when analysing the effects of minimum wage policies. Papers such as Draca et al. (2011), Harasztosi & Lindner (2019), and Riley & Bondibene (2013) analyse firm-level profitability, employment, productivity, and labour costs. Some studies (Gavoille & Zasova, 2023; Babiak and Chorna, 2019; Garcia-Louzao & Tarasonis, 2023) examine employment and wage responses, while other works (e.g. Brown, 1999; Card & Krueger, 1994; Dickens et al., 1994) focus on employment effects. Estonian-specific research (Ferraro et al., 2018; Hinnosaar & Rõõm, 2003) further reinforces the relevance of these outcomes.

The Difference-in-Differences (DiD) regressions enabled us to compare changes in firm outcomes across groups matched using the Kernel method of Propensity Score Matching (PSM). Specifically, we conducted Kernel matching followed by DiD regressions for each consecutive year pair (2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2022-2023). This step acts as a robustness check, capturing precise short-term effects. Furthermore, our primary DiD regression will utilize a staggered dataset, combining individual year-pair datasets into one comprehensive set. As an additional robustness check, we will also apply the Kernel matching procedure to this aggregated staggered dataset.

3.5. Measures

To properly answer the research questions, the analysis involves a comprehensive set of dependent variables that capture both firm financial metrics and employment. To assess the impact of minimum wage increases (treatment) with the DiD approach, we will evaluate the effect on profitability, revenue, labour productivity, employment and labour costs (see Table 1). The full list of all dependent and independent variables that are included in our datasets for Estonia and Latvia can be found in Appendix B.

Table 1. Dependent variables from the literature review for DiD methodology.

Variable	**Description**	**Sources**
Profitability	Gross profit margin calculated as gross profit over sales	Draca, Machin, & Van Reenen (2011); Harasztosi & Lindner (2019); Riley & Bondibene (2013); Gavoille & Zasova (2023); Babiak and Chorna (2019); Kühn (2021)
Revenue	Total revenue generated by the firm per year	Harasztosi & Lindner (2019); Heemskerk et al. (2018)
Labour Productivity	(Revenue minus COGS) over number of employees	Draca, Machin, & Van Reenen (2011); Riley & Bondibene (2013)
Employment	Number of employees	Draca, Machin, & Van Reenen (2011); Harasztosi & Lindner (2019); Riley & Bondibene (2013); Gavoille & Zasova (2023)
Labour costs	Total costs of employees	Riley & Bondibene (2013)

Note. Created by the authors.

Profitability is measured by the gross profit margin which is a common measure in firm-level studies and is a fair approximation. Revenue includes the whole operating turnover of a firm. Labour productivity measures how much value each employee adds to the business before accounting for other operating expenses. Labour costs (cost of employees) measures how much firms "spend" on their employees. For Estonia the cost of labour includes not only wages but also employer social security contributions and non-cash employment benefits.

4. Data Overview

Our analysis uses Estonian and Latvian firm list operating within the catering service sector, listed under NACE code I56. This classification includes the following sub-sectors:

- I56.1. - Restaurants and mobile food service activities
- I56.2 - Event catering and other food service activities
- I56.2.1 - Event catering activities
- I56.2.9 - Other food service activities
- I56.3 - Beverage serving activities

This study utilizes 2 primary data sources:

- A comprehensive international company database - Orbis from Bureau van Dijk, that provides detailed financial, ownership, and employment information for most of the firms.
- Corporate and business Latvian database - Lursoft that offers access to detailed financial records of firms. For this analysis, Lursoft data will supplement missed labour cost data for Latvian firms from Orbis. Data from Lursoft was ordered and gathered by special request.

4.1. Estonia

For the analysis of the impact of minimum wage changes on Estonian firms, all the data was gathered from the Orbis database for the period 2014 - 2023, excluding the period 2020-2021. The reason for it is that the COVID-19 pandemic that started in 2020 caused an economic recession, putting pressure on the revenues of food and beverage companies. Out-of-home consumption, which traditionally generated the highest profit margins, experienced a sharp decline as restaurants, bars, cafes, and most shops were forced to close (Deloitte, 2020). The pandemic created exceptional circumstances that make financial data for the years 2020-2021 unreliable for long-term performance evaluation.

The dataset includes firm-level financial information, various ratios and minimum wage dose that were calculated manually. Initially, after retrieving the data we have obtained 3930 firms operating in the catering service industry. Then we filtered

out completely empty companies with no data, companies that do not generate revenue, as well as companies with zero number of employees.

Regional data shows that certain areas in Estonia host a significantly higher number of catering service firms. Harju County, which includes the capital Tallinn, dominates the business landscape, accounting for 60.9% of all firms in the country. This is due to more advanced infrastructure, higher population density, tourism and economic activity. The second-largest share belongs to Ida-Viru County, comprising 15% of firms. Tartu County, known for its vibrant student population and cultural scene, follows with 17.7%, reflecting its strong presence in the food service sector (Appendix C).

4.2. Latvia

To analyse the impact of minimum wage changes on Latvian firms, multiple datasets were combined. The majority of firm-level financial data was sourced from Orbis database for the period 2014–2023, with the exception of 2019-2021, which were excluded for the same reason as outlined for Estonia.

However, for Latvian firms, Orbis database does not include labour cost data and for some firms' number of employees information. To address this, the variables "State Mandatory Social Insurance Contributions" and "Number of Employees" were gathered separately from Lursoft. By utilizing information on firms' social insurance contributions, we estimated how much approximately each firm spend on employee wages. All the information from Orbis database was manually combined with the Lursoft data.

After retrieving the data and filtering out completely empty companies with no data, companies that do not generate revenue, as well as companies with zero number of employees, we have obtained a sample of 1883 firms operating in the catering service industry during the years under the review.

The distribution of food and catering industry firms across Latvian regions shows a significant concentration in Riga, which accounts for 47.7% of all firms in this sector. Riga as a capital has high population density, tourism, and a strong hospitality sector, making it the dominant location for food service businesses. Vidzeme follows with 25.5% of firms, other regions such as Kurzeme (12.6%), Zemgale (7.7%), and Latgale (6.4%) show considerably lower shares, suggesting a more limited concentration of firms in those areas (Appendix C).

4.3. Descriptive Statistics

To conduct the further analysis, the data was first transformed into a long format to obtain a separate column for years (2014-2023). To analyse the effect of a one-time minimum wage increase, separate datasets were created for each consecutive year pair, retaining only firms with consistent data across both years. For the staggered Difference-in-Differences analysis, these individual datasets were then merged into a single dataset.

Firms were assigned to treatment and control groups based on the inverse Kaitz index within each dataset for both countries. Appendix D presents the distribution of the inverse Kaitz index in final data set, illustrating the overall composition of firms in each group throughout the study period.

For Estonia and Latvia, the overall sample of the staggered data consist of 10416 and 8016 observations respectively (specific firm in t year is one observation). Firms are divided into two groups: the treatment group (N=4820 for Estonia; N=2564 for Latvia), which is more affected by minimum wage increases, and the control group (N=5596 for Estonia and N=5452 for Latvia), which is less or not affected.

The descriptive statistics presents clear differences in financial indicators between the treatment and control groups, highlighting the effectiveness of the group classification in Estonia and Latvia. In both countries, firms in the control group have much higher averages for key financial indicators like operating revenue, net income, and cost of goods sold. This suggests that these firms are generally larger and financially stronger compared to those in the treatment group. For example, in both Estonia and Latvia, control group firms have more employees on average and also much higher labour costs, showing that they are more likely to have a larger workforce and higher wage. Labour productivity, calculated as revenue per employee, is also higher in the control group across both countries, which means these firms are likely more efficient in how they use their labour. These patterns are consistent in both datasets and show that the treatment and control groups differ in important ways, especially in terms of firm size, labour structure, and overall financial capacity. Summary tables for both countries with key figures are presented in Appendix E.

To validate whether the above-mentioned descriptive differences between treatment and control groups are statistically meaningful, we performed t-tests on key financial variables. This step helps determine whether the differences in firm characteristics reflect robust disparities rather than random variation. The results

indicate that majority of observed differences are statistically significant at least at the 1% level. These statistically significant distinctions support the application of chosen causal inference methods - specifically Difference-in-Differences and Propensity Score Matching - which were outlined in section 3.

5. Empirical Results and Analysis

This section presents the analysis and interpretation of Difference-in-Differences regressions for Estonia and Latvia, before describing propensity score matching process, along with several robustness checks conducted for each country. The robustness checks include estimations using individual year pairs data sets and model where propensity score matching (PSM) was made within staggered data set. Finally, we compare the results across both countries and highlight the key takeaways from the analysis.

Before conducting regression analysis, it's essential to check for multicollinearity, meaning that two or more independent variables are highly correlated with each other. This was done using a correlation matrix, which displays the pairwise correlations between all variables. Multicollinearity can distort the estimated coefficients in a regression, inflate standard errors, and make it difficult to assess the individual effect of each predictor. To mitigate this, we keep only those variables that have correlations below 0.8, excluding those that are strongly correlated with others. We have found that COGS, Shareholders' funds and Liabilities and Gross Profit tend to overlap heavily with revenue-related metrics. Additionally, we exclude any dependent variable from appearing as an independent variable in other models. For instance, when analysing the effect on employment (number of employees), we do not include it as an independent variable in regressions where the outcomes are profitability, revenue, labour productivity, or labour costs.

5.1. Propensity Score Matching

Following the main difference-in-differences (DiD) framework, we begin by estimating the treatment effect without applying any matching technique to the treatment and control groups. This preliminary step serves as a baseline to assess the internal validity of the design and the comparability between treatment and control firms. Without matching, the estimation typically suffers from selection bias due to

systematic differences in observable characteristics between the groups, potentially leading to biased or insignificant results (Rosenbaum & Rubin, 1983).

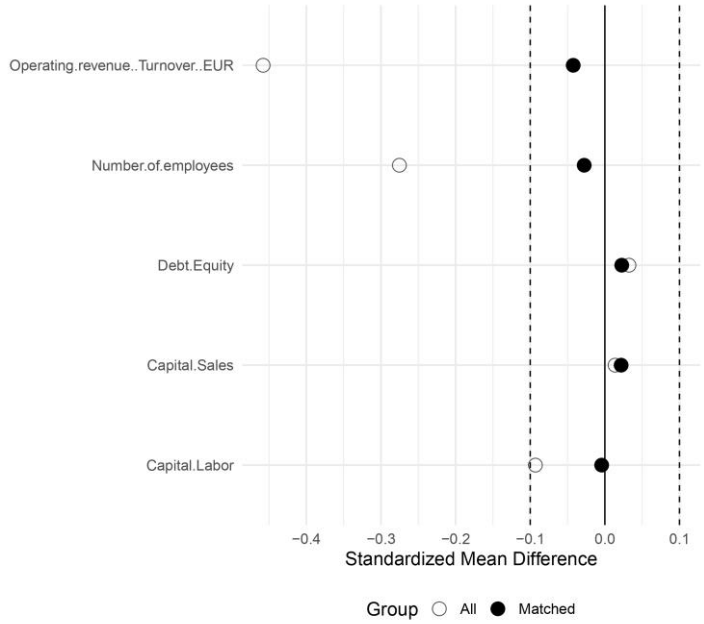
As discussed by Soares (2004), when evaluating the impact of minimum wage hikes, combining DiD with kernel PSM provided a more robust and reliable framework by addressing both heterogeneity and the lack of common support between treated and untreated observations. The application of PSM is expected to improve covariate balance and thus enhance the internal validity of the DiD estimates. In our case, the initial regressions yield largely insignificant treatment effects, suggesting that the treatment and control groups are not sufficiently balanced. This shows the necessity of implementing propensity score matching (PSM), specifically using the Kernel matching method, to improve covariate balance.

We then apply propensity score matching in our empirical analysis of Estonia and Latvia. The matching procedure is initially done in the individual datasets for each year pair and the matched datasets are then combined into a staggered dataset using the "bindrows" function in R Studio. Since we conduct separate regressions for each country, we implement the PSM procedure individually for both countries in order to account for potential differences in firm characteristics and policy environments.

5.1.1. Estonia

Figure 1 presents a plot that visually assesses the balance of covariates between treatment and control groups before and after propensity score matching, using standardized mean differences (SMD). The open circles represent the unmatched (pre-matching) sample, while the filled circles indicate the matched (post-matching) sample.

Figure 1. Plot of SMD Before and After Kernel matching for Estonia.

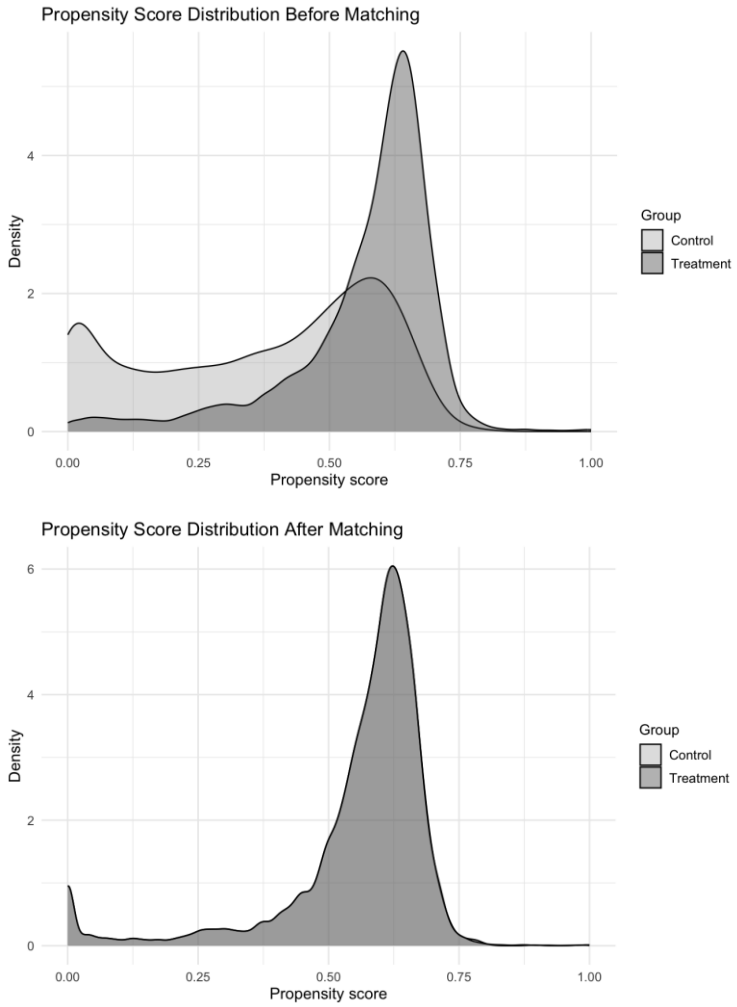


Note. Created by the authors.

Before matching, substantial imbalances are evident for several covariates, particularly Operating revenue and Number of employees, with SMDs exceeding the conventional 0.1 threshold. Post-matching, all covariates move closer to the zero line, indicating improved balance. The standardized mean differences for all listed covariates - including now fall within the acceptable range of ±0.1, suggesting that the matching procedure has successfully balanced the observed characteristics between the groups. Notably, Capital-to-labour shows the largest improvement, while Debt-to-equity and Capital-to-sales demonstrate only marginal changes due to their already balanced nature in the unmatched sample.

Examining the distribution of propensity scores before and after Kernel matching is used to assess how closely the treated and control groups align. Figure 2 illustrates the overlap in propensity scores, revealing a notable improvement following the matching process since the previous distribution. This suggests that treated and control firms now have more comparable scores, indicating that the distribution of observed characteristics is similar between low-wage and high-wage firms. By matching in the pre-treatment period, we help ensure the validity of the Conditional Independence Assumption and confirm the effectiveness of the matching procedure.

Figure 2. Distribution of Propensity Scores Before and After Kernel Matching in Estonia.

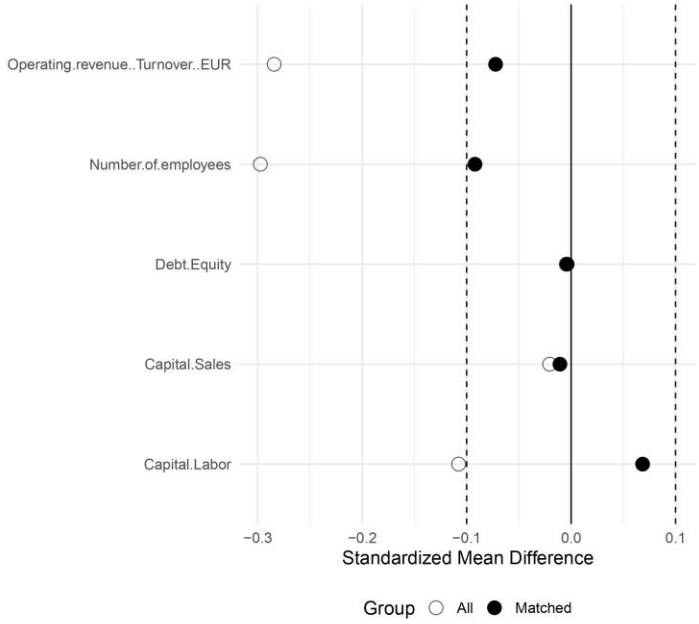


Note. Created by the authors.

5.1.2 Latvia

Figure 3 illustrates the covariate balance between the treatment and control groups by displaying standardized mean differences (SMD) before and after propensity score matching. Open circles denote the SMDs in the unmatched sample (prior to matching), while filled circles show the SMDs after matching has been applied.

Figure 3. Plot of SMD Before and After Kernel matching for Latvia.



Note. Created by the authors.

Prior to matching, clear imbalances are present, particularly for Operating revenue, Number of employees, and Capital-to-labour, with SMDs exceeding the ±0.1 threshold. These differences show the necessity of applying the Kernel matching method to reduce bias in treatment effect estimation. Following matching, all covariates fall within the ±0.1 range, demonstrating a significant improvement in balance. Most notably, Capital-to-labour and Number of employees show considerable reductions in SMDs, while Debt-to-equity and Capital-to-sales were already relatively balanced and have maintained their proximity post-matching. Operating revenue also displays a marked improvement, though it remains slightly closer to the -0.1 threshold.

To ensure a good match between treated and control groups, it is important to assess the distribution of propensity scores before and after applying the Kernel matching method. As shown in Figure 4, the overlap in scores improves considerably post-matching, compared to the distribution before matching. This indicates that low-wage and high-wage firms are now more comparable in terms of observed characteristics. Conducting the matching in the pre-treatment period helps maintain the credibility of the Conditional Independence Assumption and supports the robustness of the matching strategy.

Figure 4. Distribution of Propensity Scores Before and After Kernel Matching in Latvia.

Note. Created by the authors.

5.2. Staggered Difference-in-Difference regression analysis

The impact of minimum wage increases is assessed using a Difference-in-Differences model. We estimate the effect on five key financial and employment variables: gross profit margin, operating revenue, labour productivity, number of employees, and labour costs. The results of the staggered regression covering the full period from 2014 to 2023 (excluding 2019-2021) are presented in Table 2 for Estonia and Table 3 for Latvia.

The central coefficient for addressing our research questions is represented by the interaction term *treatment:min_wage_dose*, where treatment equals 1 for treated firms. The *min_wage_dose* variable reflects the increase of minimum wage in a

particular year. The average minimum wage increase was 9.11% in Estonia and 9.18% in Latvia during the study period. In the Table 2 and Table 3 the interaction term coefficients are shown for a minimum wage increase of 1 (100%). For the sake of clearer interpretation, we express the estimated effects as the change in each dependent variable for treated firms in response to a 10% increase in the minimum wage – dividing by 10. This standardization allows for easier comparison and more intuitive understanding of the results across both countries.

Table 2. Difference-in-Difference Estimators Using the Staggered Model for Estonia.

Indicator	Gross Profit Margin	Operating Revenue	Labour Productivity	Number of Employees	Costs of Employees
treatment	-0.0422***	83231.94***	-4647.59***	2.54***	-34582.56***
min_wage_dose	-0.0448	45347.81	-7285.79	-2.72*	37387.21*
treatment: min_wage_dose	0.1294*	-105831.99	29195.25***	-6.52***	91038.55***

Note. This table is made using data from Orbis database and authors' own calculations. Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1 Table shows estimates for min_wage_dose = 1 (100%). Created by the authors.

Table 3. Difference-in-Difference Estimators Using the Staggered Model for Latvia.

Indicator	Gross Profit Margin	Operating Revenue	Labour Productivity	Number of Employees	Costs of Employees
treatment	-0.0137.	45149.05***	-706.46***	2.45***	-44483.32***
min_wage_dose	-0.2269***	-90594.90	6570.17***	-8.39***	53033.67*
treatment: min_wage_dose	-0.2002*	-112847.35	7973.31***	-7.47*	150165.83***

Note. This table is made using data from Orbis database, Lursoft database and authors' own calculations. Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1 Table shows estimates for min_wage_dose = 1 (100%). Created by the authors.

5.2.1 Gross Profit Margin

In Estonia, for treated firms, a 10% increase in the minimum wage is associated with a 1.29 percentage point increase in gross profit margin, a result that is statistically significant at the 5% level. This suggests that firms subject to the policy were able to slightly improve their profitability despite higher wage costs. However, the effect is

relatively small and can be considered negligible, implying that profitability remained largely stable in the long run. This finding is in line with Kühn (2021), concluded no significant decrease in profit margins was observed in highly affected industries compared to less-affected ones, and in some cases even observed weakly positive effects.

In contrast, the results for Latvia show a modest negative effect: a 10% increase in the minimum wage for treated firms is associated with a 2.0 percentage point decrease in gross profit margin, also statistically significant at the 5% level. This indicates that Latvian firms may have faced more difficulty adjusting to increased labour costs - either due to limited pricing power or lower internal efficiency. This result aligns with earlier research. Draca et al. (2011) found that firm profitability in the UK significantly declined after the National Minimum Wage (NMW) was introduced; similarly, Harasztosi & Lindner (2019) observed reduced profits relative to revenues in Hungary, and Riley & Bondibene (2013) reported a small but negative effect on profitability for low-paying UK firms.

Despite the differences in direction of the estimate between Estonia and Latvia, the magnitude of the effect in both countries is minimal, indicating that the overall impact of minimum wage increases on profitability remains modest. This finding is consistent with other studies that highlight limited effects of minimum wage increases on gross profit margins, especially in transitional economies. For example, Card & Krueger (1994) observed that while some firms in the U.S. fast-food industry experienced a decline in profitability after minimum wage increases, the overall impact was relatively small and varied across regions and sectors. This suggests that the minimal effects in Estonia and Latvia may be attributed to similar industry structures and market dynamics, where firms are able to offset some of the increased labour costs through pricing adjustments or improved efficiency.

5.2.2 Operating Revenue

The interaction coefficient for operating revenue in Estonia suggests a decrease of approximately €10 583 per firm in response to a 10% increase in the minimum wage. However, this effect is not statistically significant, indicating there is no strong evidence that the wage hike systematically influenced treated firm revenues. While this estimate may point to a slight decline in revenue, it is also possible that firms were able to offset potential losses through price adjustments, increased operational efficiency, or demand-

side factors. This aligns with the findings of Heemskerk et al. (2018), who discovered that firm revenues were not negatively affected by minimum wage increases. In fact, sectors with a higher share of minimum wage workers saw growth in both employment and turnover, suggesting that increased wages may have stimulated domestic demand, thereby counteracting any negative revenue effects.

In Latvia, a similar pattern is observed, where a 10% increase in the minimum wage is associated with a reduction of about €11,285 in operating revenue per treated firm. Like in Estonia, this result is also not statistically significant, meaning the observed revenue decline could be a result of random variation rather than a true underlying effect. The lack of statistical significance across both countries suggests that while the minimum wage increase may have slightly impacted revenues, the effects were marginal and not robust, supporting the notion that firms may have managed the higher labour costs through other operational strategies.

The non-significant revenue response to minimum wage increases in Estonia and Latvia can be interpreted within the context of tax evasion and wage underreporting strategies. Firms in both countries often engage in envelope wage practices, where part of the employees' wages is paid unofficially in cash to minimize tax liabilities (Putniņš & Sauka, 2015). Non-compliant firms absorb minimum wage shocks by reallocating payments from unofficial channels into official wage declarations without substantially increasing total labour costs (Gavoille & Zasova, 2023). Consequently, the marginal and statistically insignificant decline in operating revenue aligns with evidence from Latvia, where minimum wage hikes did not largely decrease employment or revenue among tax-evading small firms, due to their ability to adjust envelope wage structures (Gavoille & Zasova, 2023).

5.2.3 Labour Productivity

In Estonia, treated firms experienced a significant increase in labour productivity of approximately €2 919 following a 10% increase in the minimum wage, with the effect being highly statistically significant. Kim & Jang (2019) found the similar effect that in the restaurant industry, increases in minimum wages lead to higher firm productivity. Their research suggests that firms were able to capitalize on enhanced employee motivation and customer satisfaction, helping mitigate the impact of rising labour costs. This aligns with the idea that higher wages can drive firms to improve service quality, efficiency, and overall firm performance. Additionally, Alexandre et al.

(2022) posits that minimum wage hikes can trigger a "cleansing effect," where less productive firms exit the market, reallocating resources toward more efficient ones and boosting aggregate productivity.

In Latvia, the increase in the minimum wage by 10% resulted in a €797.3 increase in productivity, which was also statistically significant at the 0.1% level. Although the effect was smaller compared to Estonia, it suggests that firms in Latvia, like their Estonian counterparts, adapted to the higher labour costs by enhancing output per worker. This supports the notion that firms, regardless of size, can adjust to wage hikes by boosting productivity, even when the effect is less pronounced. However, these findings diverge from some earlier studies, such as Draca et al. (2011), who found no significant productivity effects from minimum wage increases.

The results from both countries suggest that rather than causing a decline in productivity, minimum wage increases can encourage firms to adapt through efficiency improvements and motivated employees, leading to an overall increase in labour productivity.

5.2.4 Employment

Following a 10% increase in the minimum wage, treated firms in Estonia and Latvia reduced their workforce by approximately 0.65 and 0.75 employees on average, respectively. These effects were statistically significant - at the 0.1% level in Estonia and 5% level in Latvia - which aligns with standard economic models predicting employment reductions in response to rising wage floors, particularly when labour demand is elastic. In Estonia, this finding is consistent with Hinnosaar & Rõõm (2003), who reported that minimum wage increases led to lower employment among directly affected workers. Although the reduction in workforce is modest, it still reflects an adjustment in firm behaviour and is in line with previous evidence from the Estonian context.

In Latvia, the employment decline similarly suggests that firms responded to cost pressures by reducing the number of employees. However, this adjustment was coupled with observed productivity gains, implying that firms may have been able to improve efficiency and produce more with fewer workers. These results are in line with the findings of Gavoille & Zasova (2023), who found that Latvian firms more exposed to minimum wage hikes experienced slower employment growth. While the reductions in staff were statistically significant, the overall effect remained modest, which aligns

with findings in other studies, such as Lynn & Boone (2015), who reported that in the restaurant industry, employment levels did not show significant reductions following minimum wage increases. Instead, restaurants adapted by adjusting prices or improving operational efficiency rather than cutting staff.

This pattern complements the observed productivity gains, suggesting that firms in both Estonia and Latvia may have made efforts to improve efficiency by producing more with fewer employees. Despite the modest reductions in workforce, the results imply that firms were likely attempting to manage rising labour costs through operational adjustments, rather than making substantial cuts to staffing levels.

5.2.5 Labour Costs

The results reveal that treated firms in Estonia and Latvia faced significant increases in employee costs - approximately €9 104 and €15 017, respectively - following a 10% increase in the minimum wage. These effects are highly statistically significant and confirm the expected direct impact of the policy on labour expenses. The magnitude of the increase reflects the direct financial burden that firms face when wage floors are raised, highlighting the pressure on companies to manage escalating payroll costs.

This finding aligns with the work of Van Reenen (2011), who observed that rising wage floors tend to increase average wages, which directly raises labour costs even as firms may experience a decline in profitability. In line with this, Harasztosi & Lindner (2019) found that treated firms saw a 32.5% increase in labour costs in the short term, with costs remaining elevated at 23.8% higher even two years after the minimum wage increase. These findings underscore the long-term financial strain that such wage policies can place on businesses, particularly those that rely heavily on low-wage workers.

The results clearly demonstrates that minimum wage increases in Estonia and Latvia resulted in significantly higher labour costs for treated firms, highlighting the immediate financial pressures associated with wage policy adjustments. While these findings align with previous studies emphasizing increased labour expenses following wage hikes, the broader economic implications remain nuanced.

5.3. Robustness checks

We conduct additional robustness checks to assess the reliability and stability of our estimated treatment effects. Our main analysis uses a staggered difference-in-differences (DiD) approach, where we match firms within each consecutive year-pair using propensity score matching (PSM) and then combine these matched samples. This method assumes that the treatment effects and match quality are consistent across all years. To ensure that our estimated effects are not driven by unobserved shocks, we perform robustness checks in two ways: we perform the matching process within the staggered data frame; and we replicate the full PSM and DiD procedure separately for each consecutive year pair.

5.3.1. Matching within the staggered dataset

As part of our robustness checks, we also implement matching within the combined staggered dataset to ensure that our main findings are not influenced by inconsistencies across specific year-pairs. To do this, we merge all individual year pair datasets without matching into a single dataset and carry out the matching procedure within it. Table 4 and Table 5 summarise the outputs for Estonia and Latvia respectively.

Table 4. Difference-in-Difference Estimators Using the Matching within Staggered Model for Estonia.

Indicator	Gross Profit Margin	Operating Revenue	Labour Productivity	Number of Employees	Costs of Employees
treatment	-0.0290***	84542.20***	-3596.60***	2.84***	-30588.36***
min_wage_dose	0.0211	191458.78***	-6746.31**	1.46	-5815.90
treatment: min_wage_dose	-0.0220	-277800.85***	21876.74***	-7.96***	95682.33***

Note. This table is made using data from Orbis database and authors' own calculations.
Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1
Table shows estimates for min_wage_dose = 1 (100%). Created by the authors.

Table 5. Difference-in-Difference Estimators Using the Matching within Staggered Model for Latvia.

Indicator	Gross Profit Margin	Operating Revenue	Labour Productivity	Number of Employees	Costs of Employees
treatment	0.0241**	57771.77***	-282.13*	2.49***	-57344.93***
min_wage_dose	-0.1280.	-110695.94	4056.49***	-8.01*	46502.37
treatment: min_wage_dose	-0.3332**	73595.67	8150.61***	-14.05**	235469.20***

Note. This table is made using data from Orbis database, Lursoft database and authors' own calculations. Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1 Table shows estimates for min_wage_dose = 1 (100%). Created by the authors.

To maintain comparability, we enforce exact matching on the year variable by setting exact = year in the matching function. This ensures that treated and control units are only matched if they belong to the same year, thereby avoiding any cross-year comparisons that could bias the estimates. If no exact match is found within a year, the observation is dropped. This is the essence of the exact function in R. This helps confirm that our main findings are not sensitive to how treatment and control groups are distributed over time.

Based on this analysis, we find that the overall direction of the treatment effects in Estonia remains consistent with the results presented in Table 4. However, there is a notable difference in the revenue estimate: in the matched sample, the estimated effect on revenue is approximately twice as large as in the main regression and is statistically significant at the $p < 0.001$ level. This suggests that the main model may have somewhat underestimated the revenue impact. For Latvia, revenue is also a problematic case. While Table 5 reports a positive coefficient, the results from the matched sample are statistically insignificant. Given the lack of statistical significance in both regression models, it is challenging to draw conclusions regarding the revenue effects in Latvia.

One possible explanation for the observed difference in revenue estimates between Estonia and Latvia relates to differences in the size and structure of the shadow economy in the two countries. In 2022, the shadow economy as a percentage of GDP was estimated to be 8.5% lower in Estonia compared to Latvia. Additionally, the average percentage of revenues concealed from the government was reported to be approximately 5% lower in Estonia (Putniņš & Sauka, 2022). This discrepancy suggests that Latvian firms might have greater incentives and opportunities to conceal actual

revenue, making it more challenging to accurately estimate revenue effects using publicly available data. Consequently, the higher degree of informality and revenue concealment in Latvia may contribute significantly to the observed inconsistencies and the lack of statistical significance across regression specifications. Therefore, the differences in shadow economy characteristics between Estonia and Latvia may partially explain the divergence in the robustness and significance of the revenue estimates derived from our analysis. These findings highlight the importance of robustness checks in identifying where results are stable and where they may be more sensitive to model specifications or sample composition.

5.3.2. Analysis within each consecutive pair of years

Initially, we applied the Propensity Score Matching (PSM) method separately within each individual year-pair dataset. This approach - regressions by separate year pairs combined with PSM - was used to more accurately capture the immediate short-term effects of the policy changes.

This approach serves as a robustness check because it allows us to test whether the estimated effects hold consistently across different time periods, rather than being driven by specific year-pair combinations. By applying Propensity Score Matching (PSM) within each individual year-pair, we isolate the immediate short-term impact of the treatment in a more controlled and precise manner. This is captured in Table 6 for Estonia and Table 7 for Latvia.

This robustness analysis confirms that the effect of minimum wage increases on employment, employee costs, and productivity in Estonia are consistent across time. However, revenue and profit margin estimates in both countries exhibit considerable volatility in both coefficient values and their statistical significance.

Table 6. Regression Coefficients for *treatment:treatment year* Interaction Term for Different Year Pairs for Estonia.

Year pairs	Gross Profit Margin	Operating Revenue	Labour Productivity	Number of Employees	Costs of Employees
2014 - 2015	0.0127	4476.36	-298.02	-1.29***	9426.09***
2015 - 2016	0.0287*	13017.21**	2437.68***	-0.76***	7385.60***
2016 - 2017	0.0043	35552.95*	3300.86**	-0.38	3981.74
2017 - 2018	0.0086	-45492.31***	982.58.	-0.58*	8816.56**
2018 - 2019	-0.0069	-21960.62	1532.01**	-0.62*	7264.70.
2022 - 2023	-0.0049	-27492.83.	3295.23***	-0.31.	6295.75*

Note. This table is made using data from Orbis database and authors' own calculations. Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1. Created by the authors.

Table 7. Regression Coefficients for *treatment:treatment year* Interaction Term for Different Year Pairs for Latvia.

Year pairs	Gross Profit Margin	Operating Revenue	Labour Productivity	Number of Employees	Costs of Employees
2014 - 2015	-0.0152	-13717.35.	161.40	-2.05***	10578.75***
2015 - 2016	0.0141	-4278.20	966.18.	-0.85*	5810.85**
2016 - 2017	0.0242	-16161.05	246.97	1.89	-38954.34*
2017 - 2018	0.0449*	41252.18	-89.60	-3.76**	37275.02**
2018 - 2019	0.0191	138394.27***	-665.46.	-3.48**	46027.69***
2022 - 2023	-0.1105*	25913.39***	151.87	-0.53***	6984.33***

Note. This table is made using data from Orbis database, Lursoft database and authors' own calculations. Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1. Created by the authors.

The coefficients for gross profit margin and operating revenue show considerable fluctuation in both sign and statistical significance across year-pairs, indicating instability in these financial performance metrics. In Estonia, the gross profit margin changes from positive to negative with only weak significance, while operating revenue ranges from significantly positive to significantly negative, highlighting sensitivity to time-specific factors. Similarly, Latvia's results are highly variable, with

revenue estimates swinging dramatically - sometimes negative, sometimes strongly positive and significant. These patterns suggest that financial outcomes such as revenue and profitability may be influenced by broader economic conditions or firm-level heterogeneity, making them less reliable as indicators of the causal impact of minimum wage changes.

These findings align with the insights of Gavoille & Zasova (2023), who highlight differential firm-level responses depending on compliance behavior, indicating that tax-evading firms utilize wage underreporting as an adjustment margin following policy shocks, thus adding to variability in observed financial outcomes. The variability in Latvian outcomes is consistent with the analysis by Putniņš & Sauka (2015). Approximately 34% of total wages in Latvia were paid as envelope wages, which significantly distorts firms officially reported financial metrics and complicates the interpretation of the true economic performance.

Unlike financial indicators, labour-related outcomes display more stable and consistent patterns over time, especially in Estonia. Labour productivity in Estonia shows a generally positive and often significant response to minimum wage changes, suggesting some degree of efficiency gains or selection effects among firms. The number of employees consistently decreases, with significant negative coefficients across most years in both countries, pointing to a potential reduction in employment levels as a response to increased labour costs. Additionally, the costs of employees are predominantly positive and statistically significant, particularly in earlier years, which aligns with expectations following minimum wage hikes. These consistent signs and significance levels enhance the credibility of the treatment effects for labour market outcomes.

The comparison between Estonia and Latvia reveals notable differences in the strength and consistency of treatment effects. Estonia exhibits more stable and significant improvements in labour productivity, whereas Latvia's productivity results remain largely insignificant. On the other hand, both countries show similarly negative employment effects and increases in employee costs, indicating that these core labour responses to minimum wage hikes are shared across contexts. The larger swings in revenue and profit margin in Latvia - especially the extreme positive revenue effect in 2018–19 - suggest that firm-level financial responses may be more volatile or context-dependent.

6. Limitations and Further Research

It is crucial to specify the key limitations inherent to our research, namely how these may affect the interpretation and generalizability of our findings. Our analysis faces limitations related to data availability, specifically concerning the absence of firm-level information on employee working hours, because of that our analysis relies exclusively on monthly minimum wage. As a consequence, we could not incorporate hourly minimum wage calculations into our methodology, nor could we precisely account for the share of part-time employees within the firms. We recognize that this limitation likely affects the accuracy of labour cost measurements, as firms employing part-time workers inherently have lower labour expenses compared to those employing predominantly full-time staff. Furthermore, some firms exhibited an inverse Kaitz index significantly below 1, suggesting that these companies either have substantial proportions of part-time workers or potentially underreport actual wages, commonly referred to as "envelope wages."

A second notable limitation arises from differences in the reported labour costs between Estonia and Latvia, complicating direct comparisons across these two countries. In Estonia, the calculation of labour costs includes full employee compensation, bonuses, allowances, cash benefits, and other related expenses. Latvian reported labour costs assume a standardized workforce, excluding special cases such as pensioners, who are subject to varying social tax rates. These differences across national contexts introduce additional complexities, potentially influencing the accuracy and comparability of the findings.

The catering services industry in Estonia and Latvia is particularly vulnerable to biases related to tax evasion and wage underreporting. As highlighted in the analysis, informal economic activities, including undeclared wages - often referred to as "envelope wages" - pose significant challenges in accurately assessing firm-level labour costs. Research by Gavoille & Zasova (2023) and Putniņš & Sauka (2015) identified extensive shadow economy activities as widespread phenomena within the Baltic region, contributing further to measurement biases and limiting the reliability of official statistical data used in empirical research.

The abovementioned limitations reveal several opportunities for further research. Future studies could enhance data accuracy and robustness by incorporating more detailed firm-level information on employee working hours, differentiating clearly between part-time and full-time employees, and explicitly considering firms'

compliance levels with wage regulations. Given the prevalence of informal wage arrangements, such as envelope wages, especially in Latvia, incorporating these aspects would significantly improve understanding of the true labour cost burden and economic resilience among firms.

Extending the analysis to other low-wage, labour-intensive sectors, notably construction, could reveal insightful comparisons. In Latvia, construction is the largest sector where shadow economy practices and tax evasion persist significantly, accounting for approximately 34% of the economic activity (Putniņš & Sauka, 2022). Exploring similar dynamics in other small economies, such as Lithuania, would enrich the comparative framework, helping to identify common trends and country-specific responses to minimum wage increases. Furthermore, qualitative methodologies, like case studies and interviews with firm managers, could offer deeper managerial insights and reveal strategic decisions in response to minimum wage hikes.

7. Conclusions

The purpose of this research was to analyse the impacts of minimum wage increases on the profitability, revenues, employment, and labour costs of catering service firms in Estonia and Latvia. Throughout our study, we aimed to answer two research questions: firstly, how minimum wage increases affect firm-level financials and employment in Estonia, and secondly, how these increases influence firms in Latvia.

We leverage firm-level financial data and employ an econometric methodological framework by combining propensity score matching with difference-in-differences regression analysis. Specifically, we first match treatment and control firms based on key financial covariates to ensure comparability and then apply staggered DiD regressions to capture the causal effects of minimum wage increases over the whole time period from 2014 to 2023. Our regression models estimate impacts on profitability, revenue, labour productivity, employment, and labour costs, distinguishing between treated and control groups. To validate our findings, we perform robustness checks, including replicating analyses within individual consecutive year pairs and matching directly within the staggered data frame.

Our analysis provides nuanced insights into how minimum wage increases impact catering service firms in Estonia and Latvia. In Estonia, we found that a 10% increase in the minimum wage is associated with a statistically significant, though

modest, improvement of 1.29 percentage points in gross profit margins for affected firms. However, in Latvia, the same policy adjustment led to a 2.0 percentage-point decrease in gross profit margins, also statistically significant, suggesting that Latvian firms faced greater challenges in adapting to increased labour costs. Regarding revenues, neither country showed statistically significant responses to minimum wage hikes. The lack of significant revenue effects suggests that firms may have offset increased labour costs through other adjustments, potentially including informal wage practices.

Labour market outcomes presented more consistent results across both countries. Treated firms in both Estonia and Latvia experienced a statistically significant reduction in the number of employees. Despite this, labour productivity increased significantly in both countries - by approximately €2 919 per employee in Estonia and €797 in Latvia - implying that firms enhanced operational efficiency in response to rising wages. Furthermore, labour costs increased substantially and significantly in both countries, showing the direct financial impact of the minimum wage policy. Robustness checks confirmed the stability of these labour-related findings, although financial indicators like revenues and gross profit margins demonstrated greater volatility and sensitivity across different year-pair analyses.

Our research offers valuable insights by providing detailed empirical evidence on the financial and employment effects of minimum wage increases on catering service firms in Estonia and Latvia - a previously underexplored area in the literature. By employing econometric methods, we clarify how firms' financial indicators react to wage hikes, highlighting both country-specific differences and common responses. These insights are particularly important for policymakers and businesses, as they demonstrate how firms respond to higher labour costs, adjust productivity, and make employment decisions within a sector with considerable exposure to minimum wage policy changes.

The study also opens opportunities for further research. Future analyses could extend the analysis to other labour-intensive industries, such as construction, to examine whether there are similar patterns. Additionally, incorporating individual-level data, such as employee working-hours, would further enhance the precision of minimum wage impacts and provide even better policy implications.

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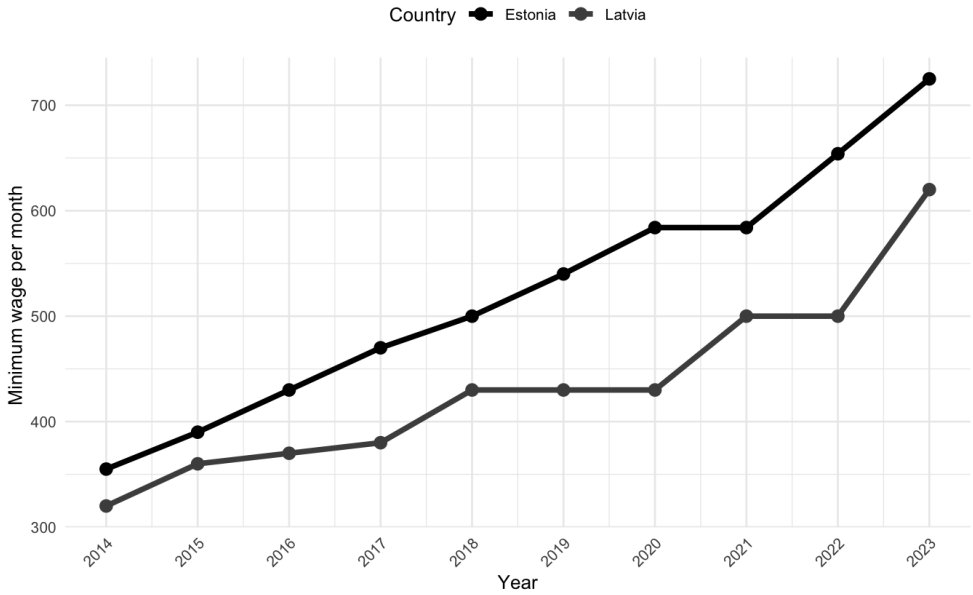
AI-based tool, specifically ChatGPT from OpenAI, was used selectively in some sections to improve the text's clarity. ChatGPT helped by offering suggestions for sentence structure and word choice. Also, ChatGPT was used as a supportive tool to correct errors in the R code.

9. Appendices

Appendix A. Comparison of Latvia and Estonia over the years.



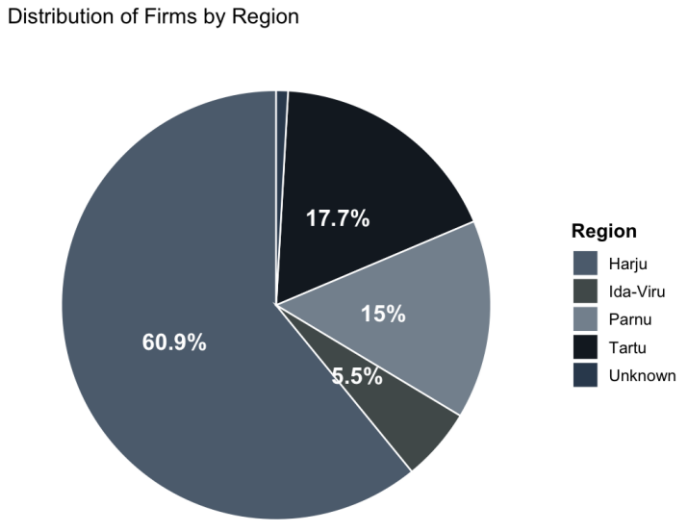
Note. Data from Country Economy. Created by the authors.

Appendix B. Full list of variables in the datasets for Estonia and Latvia

Measure	**Description**
Operating revenue	Total revenue generated by the firm per year
Number of employees	Employment level reflecting firm size
Costs of goods sold	Total direct costs incurred to produce goods sold by the firm per year
Shareholders funds and liabilities	Total equity and liabilities per year
Shareholders funds	Total funds invested by shareholders, equivalent to equity per year
Liabilities	Total liabilities per year, calculated as (shareholders funds and liabilities) - (shareholders funds)
Gross profit	Revenue minus Costs of Goods Sold
Cost of employees monthly	Average labour costs in the firm per month, expressed as total costs of employees adjusted by the number of employees in monthly terms.
Capital to labour ratio	Measure of capital intensity, calculated as the ratio of total capital to the number of employees
Capital to sales ratio	Capital intensity
Labour productivity	Value added (Revenue - COGS) over number of employees
Debt to Equity ratio	Financial leverage
Inverse Kaitz index	Cost of employees monthly over minimum wage
Gross profit margin	Profitability indicator expressed as Profit divided by Sales

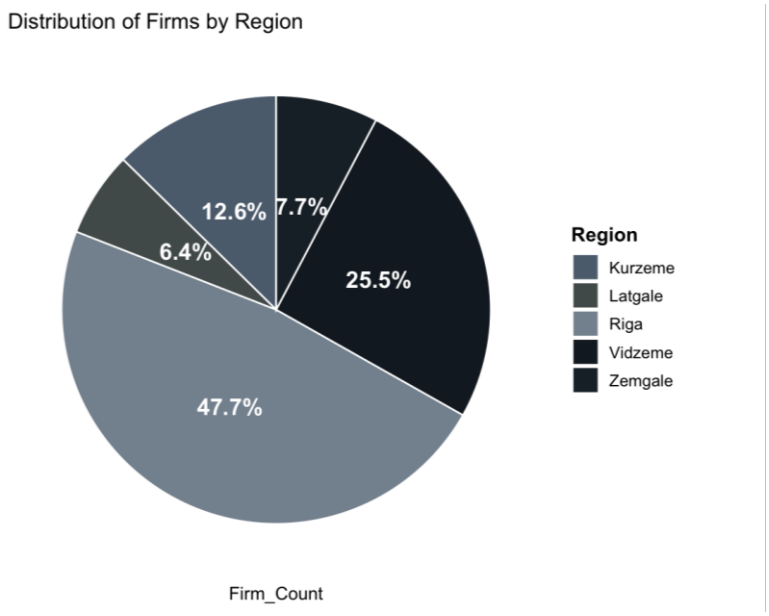
Appendix C. Regional distribution of firms in Estonia and Latvia.

Figure C.1. Regional distribution of firms for Estonia.



Note. Data from database Bureau van Dijk. Created by the authors.

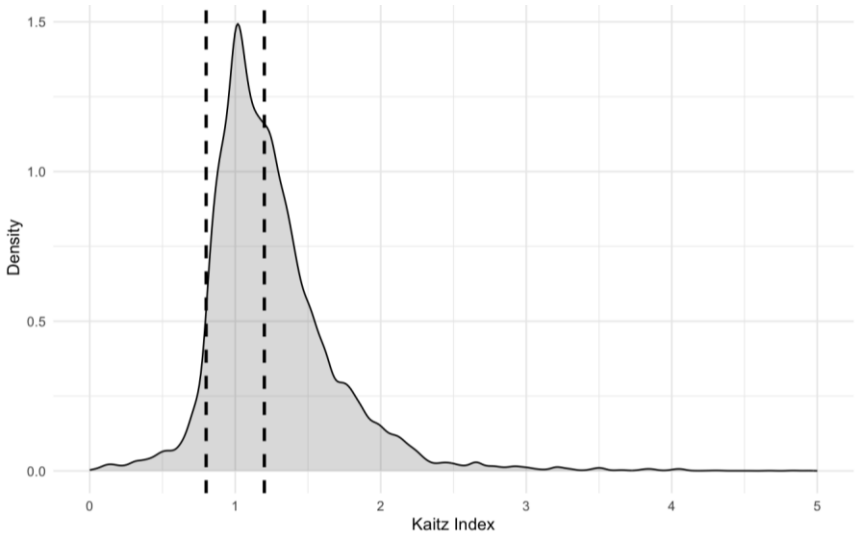
Figure C.2. Regional distribution of firms for Latvia.



Note. Data from Lursoft. Created by the authors.

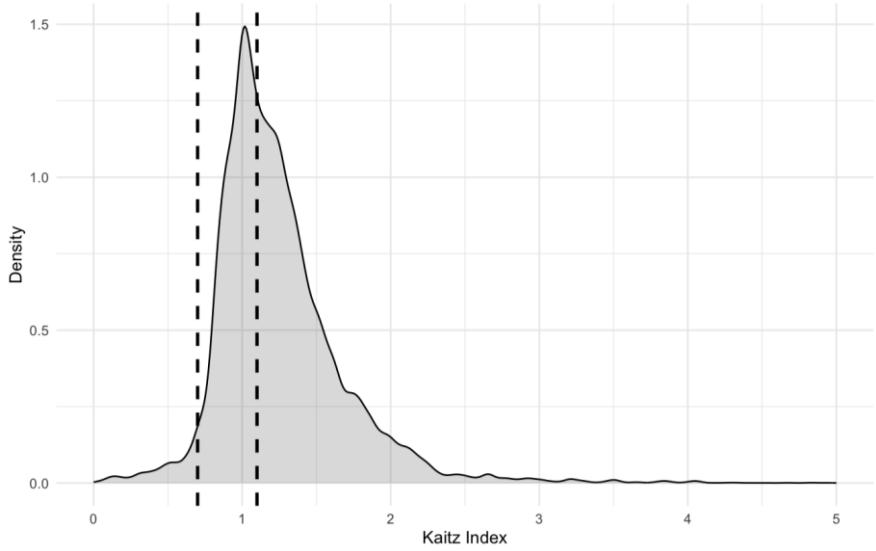
Appendix D. Density Plots of Inverse Kaitz Index in Estonia and Latvia.

Figure D.1. Density plot of the Inverse Kaitz Index for Estonia.



Note. Created by the authors.

Figure D.2. Density plot of the Inverse Kaitz Index for Latvia.



Note. Created by the authors.

Appendix E. Descriptive Statistics for Treatment and Control Firms.

Table E.1. Descriptive Statistics for Treatment and Control Firms in Estonia.

Variable	Treatment *Mean*	Control *Mean*	*t-test*
Operating Revenue	210759	608623	***
Net Income	6153	18701	***
Costs of Goods Sold	100013	264418	***
Equity and Liabilities	93765	261516	***
Capital per Worker	9293	15643	***
Labour Productivity	17218	27070	***
Debt/Equity Ratio	8.23	4.57	
Capital/Sales Ratio	0.39	0.33	
Gross Profit Margin	0.52	0.55	***
Employees	7.03	14.76	***
Labour Costs	59167	200225	***

Note. This table is made using data from Orbis database and authors' own calculations. Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1. Treatment group: 4820 observations. Control group: 5596 observations.
Created by the authors.

Table E.2. Descriptive Statistics for Treatment and Control Firms in Latvia.

Variable	Treatment *Mean*	Control *Mean*	*t-test*
Operating Revenue	175970	832823	***
Net Income	1729	21538	***
Costs of Goods Sold	119494	586139	***
Equity and Liabilities	51122	301137	***
Capital per Worker	-4127	-1707	***
Labour Productivity	5222	8355	***
Debt/Equity Ratio	-0.51	-0.13	
Capital/Sales Ratio	0.46	0.11	
Gross Profit Margin	0.19	0.21	
Employees	10.16	27.04	***
Labour Costs	50227	279596	***

Note. This table is made using data from Orbis database, Lursoft database and authors' own calculations. Statistical significance: *** p-value < 0.001; ** p-value < 0.01; * p-value 0.05; . p-value 0.1. Treatment group: 2564 observations. Control group: 5452 observations.
Created by the authors.