Bachelor Thesis

Latvian Labour Market under the Microscope: Minimum Wage Impacts on Income Disparities Across Different Occupations

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Abstract

We analyse the impact of minimum wage increases on wage disparities and employment across occupations in Latvia, a country with significant income inequality, using data from the State Revenue Service from 2020 to 2023 and applying the difference-in-differences methodology. Findings indicate that while the 2021 minimum wage hike modestly improved wages for lower-paid occupations, the 2023 increase had a more significant positive effect on reducing wage disparities, with no negative effect on employment observed. The study highlights the importance of structured minimum wage adjustments in addressing the shadow economy and suggests the potential of sector-specific minimum wages. We conclude that progressive wage policies are viable tools for reducing income inequality and emphasize the need for broader economic and social reforms. Future research should explore long-term effects, cross-industry and international comparisons, as well as include qualitative insights.

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1. Introduction

According to Sowell (2015), "Unfortunately, the real minimum wage is always zero, regardless of the laws" (p.305). This opinion of a prominent American economist and writer is only one of the stances that economists take nowadays regarding the minimum wage.

Even today, the minimum wage remains one of the most debated and controversial topics and researchers have not yet come to a consensus regarding its effects on both income inequality and employment. Empirical evidence shows that increasing the minimum wage does play a role in reducing income inequality, however, according to Sodsriwiboon and Srour (2019), finding the right balance is crucial since an excessively high minimum wage may lead to job losses and reverse the intended aim of wage disparity reduction by displacing low-income workers. Another possible effect of minimum wage change could be compression of the wage difference between middle and low-income workers, thus lowering morale and possibly increasing dissatisfaction with a job.

The effect on employment also remains ambiguous despite decades of research. As previously mentioned, in competitive markets, a minimum wage exceeding current levels may provide incentives for some firms to cut jobs. Conversely, in a monopsony – a market in which a single company is the only employer, the minimum wage will raise the incomes of workers without having adverse effects on employment unless it is set too high (Congressional Budget Office, 2019).

Today, the global inequality outlook appears grim, with the wealthiest 10% of the world's population accumulating a staggering 52% of all income, leaving the poorest half with just 8.5% (Stanley, 2022). Furthermore, the portion of national income allocated to the top 10% has witnessed an increase in nearly every country. Over the past four decades, global income inequality has substantially surged, notably in advanced economies and major emerging economies, with the United States, China, India, and Russia seeing the most substantial spikes (Qureshi, 2023).

As recommended by the OECD (2023), wage policies, including minimum wage, are one of the key mechanisms through which losses in purchasing power can be mitigated.

Our research focuses on Latvia, which is notorious for its high income inequality in comparison to the rest of the EU member states. For illustration, Latvia ranked third among all EU Member States with a 34.3 Gini index, the first being Bulgaria (38.4 Gini)

and second – Lithuania with a Gini index of 36.2. In comparison, the Gini for the whole EU was 29.6 (Eurostat, 2023).

However, it is important to note that one of the key reasons for such a large Gini index value is that approximately 22% of Latvia's population are people aged 64 and over, meaning that they are eligible for pensions (Official Statistics Portal, 2023). In 2022, the average monthly old-age pension was EUR 530 gross (LSM, 2023). The fact that a sizable portion of the population relies on low pensions as their primary income source is likely to significantly contribute to the above-average Gini index.

Latvia is not only one of the countries with the highest inequality – it is also one of the countries with the lowest minimum wage. Over the past decade, Latvia has witnessed a more than twofold increase in its legal minimum wage. Despite sustaining an impressive average annual growth rate of 8%, it continues to rank among the lowest in the EU (LSM, 2023). The European Commission Directive suggests that the threshold for setting the minimum wage should be 60% of the gross median wage and 50% of the gross average wage (European Trade Union Institute, 2023). According to the Official Statistics Portal (2023), in 2022, the median gross wage in Latvia was EUR 1081, meaning that the minimum wage as a share of the median was 46.25%, whereas the average gross wage was EUR 1373 and the minimum wage as a fraction of average gross wages was 36.41%. Compared to the threshold proposed by the European Commission Directive, these values are low, which raises questions.

From the perspective of unemployment, in 2022, Latvia reached the historically lowest unemployment rate of 6.9% (Official Statistics Portal, n.d.). It is reasonable to assume that a minimum wage increase, given the undersaturated labor market, could pose challenges as businesses may face increased competition for workers. As a result of the minimum wage hike, firms with a significant number of low-wage workers will experience higher labor costs. Because the labor market is tight, businesses may have limited ability to absorb these increased costs without adjustments. Some companies may choose to pass on these costs to consumers by raising prices for goods and services, which is problematic since, according to the International Monetary Fund (2023), Latvia is already facing high inflation.

With these facts in mind, it is evident that the topic is relevant and there is substantial potential for research. The available empirical literature on other countries, on which we will expand in Section 2, provides evidence for the varying impact of minimum wage across industries and occupations, influencing both income and employment

dynamics. However, much of the existing literature on minimum wage effects draws from larger economies, often overlooking the dynamics of smaller or less-studied nations. By centering our research on Latvia, we contribute to a more comprehensive understanding of the distinct effect of minimum wage changes on different economies. It is important to note that current studies on minimum wage impact usually focus on a specific industry or a very wide group of occupations. Furthermore, prior research has predominantly relied on the analysis of EU-SILC survey samples, where information about professions is aggregated annually.

Gavoille and Zasova (2021) studied the 2014 and 2015 minimum wage increases using matched employer-employee data from the Latvian State Social Insurance Agency for the whole employed population of Latvia in the period from 2011 to 2015. Benkovskis et al. (2023) utilised joint EUROMOD and CGE-EUROMOD models to simulate changes in the minimum wage using SUT and EU-SILC data for the 2016-2025 period, using predicted variables for future values. We, in contrast, employ data on the average monthly wages by detailed profession classification in Latvia provided by the State Revenue Service, which allows us to perform a thorough examination of the possible effects. Our work aims to examine the transmission of minimum wage shocks at a more granular level – specifically, the detailed profession/sector level – and with a higher frequency, analyzing data on a monthly basis. Despite using not personal (as in the case of the EU-SILC) but aggregated data at the profession category level, this approach enables a more nuanced understanding of the dynamics at play, offering insights into the specific professions and sectors affected by minimum wage changes in Latvia.

The usage of monthly administrative State Revenue Data by professions has not been utilized for this purpose before, which leaves room for some interesting results to be explored. Furthermore, since at the time of our study, the most recent change in minimum wage was implemented in January 2023 – it increased from EUR 500 to 620, we are able to obtain the most recent data, which makes the topic even more exciting to look at.

With this study, we aim to evaluate the impact of the minimum wage change in two periods (2020-2021 and 2022-2023) on average hourly wages and employment of low-wage and high-wage occupation groups, as well as estimate the speed of transmission of minimum wage in average hourly wages of low-wage and high-wage occupation groups (monthly effect). Furthermore, we aim to explore the yearly effect of a minimum wage change on average hourly wages on the individual occupation level.

Therefore, we have identified the following research questions:

1. *What is the difference in the annual effect of a minimum wage hike on average wages and employment between low- and high-wage occupations in Latvia both at the aggregate level and individual occupation level?*
2. *What is the difference in the monthly effect of a minimum wage hike on average wages between low- and high-wage occupations and what is the speed of minimum wage transmission?*

To answer our research questions, we first use a difference-in-differences approach to identify and analyse the yearly effects of the minimum wage on wages and employment for low-wage and high-wage occupation groups. For the monthly effects analysis, we utilize the same model to examine the monthly transmission of minimum wage into average wages by occupation groups. Acknowledging the negligible effects that the minimum wage typically has on high-income individuals, we designate high-income occupations as our control group, contrasting it with our treatment group – low-income occupations. And finally, we modify our regression with an additional binary variable to explore the yearly effect of a minimum wage change on wages and employment at the individual occupation level.

To summarise, this work aims to contribute to the existing literature on minimum wage changes, bridging gaps in understanding the effects of minimum wage adjustments on average wages and employment at the occupation level. The speed of transmission of the minimum wage into average wages, the utilisation of the State Revenue Service data, the usage of the latest available (2023) data on minimum wage change, and the detailed occupation-level breakdown add a layer of novelty to the exploration, uncovering the potential for intriguing findings.

2. Literature review

2.1. Minimum wage research over time

Despite the extensive research conducted on the minimum wage and its aspects, scholars have yet to arrive at a consensus on how minimum wage affects employment and income distribution as empirical studies consistently yield different results. A considerable amount of academic literature comprised of both theory and empirical evidence is available in an attempt to explain the effect, nevertheless, a lack of unanimous agreement continues to dominate the field of minimum wage research.

Prior to the early 1990s, the dominating perspective in the minimum wage field was characterised by conventional neoclassical theory, which suggested that an increase in the minimum wage would result in firms reducing employment and substituting high-skilled workers for less-skilled ones (Giuliano, 2013).

However, a shift in perspective occurred in the 1990s with the emergence of a different view, known as the "new economics of minimum wage" (Brožová, 2018). The most influential empirical evidence for this view was provided by Card and Krueger (1993), who investigated the 1992 New Jersey minimum wage hike by conducting a telephone survey of fast-food businesses in New Jersey (the treatment group) and Pennsylvania (the control group) before and after the minimum wage rise. After analysing employer-provided data on staff levels, Card and Krueger observed a slight increase in employment in New Jersey following the minimum wage adjustment.

The "new economics of minimum wage" also brought attention to research methodologies that focused on the variations in the "bite" of the minimum wage across states, suggesting that a minimum wage hike would have a more pronounced effect on low-wage states, where a higher proportion of workers would qualify for the increase as opposed to high-wage states (Schmitt, 2015). In his research on the federal minimum wage, Card (1992) classified the U.S. states into three categories based on the proportion of their teenage workers that would be subject to the 1990 and 1991 changes in the minimum wage and found that a rise in the minimum wage resulted in higher teenagers' wages without any negative employment effects.

Card and Krueger elaborated on their initial research in a 1995 book Myth and Measurement: The New Economics of the Minimum Wage, where they employed various methods and datasets to examine restaurant workers, retail employment, and teenagers, concluding the following: "The weight of this evidence suggests that it is very unlikely that the minimum wage has a large, negative employment effect" (Card & Krueger, 1995, p. 389-390). Later, Neumark and Wascher reevaluated Card and Krueger's findings by examining administrative payroll records from a sample of prominent fast-food establishments. Their study indicated an adverse impact of the minimum wage hike on employment in New Jersey compared to Pennsylvania (Neumark & Wascher, 1996). Their conclusions were later refuted by Card and Krueger in a 2000 paper.

By the early 2000s, two distinct perspectives dominated the minimum wage research field. One side supported the "new minimum wage research", with Card and Krueger's contributions being particularly influential. Conversely, opponents criticised

both the minimum wage and the new approach, predicating their stance on Neumark and Wascher's work (Schmitt, 2015).

Over the past years, researchers have chosen to support either of these views, resulting in a continuous output of academic literature from both sides. Additionally, a new realm of study has surfaced – a "fourth generation of recent research that aims to make sense of the occasionally conflicting evidence" (Dube, 2011, p. 763).

Regarding the current perspective on the impact of minimum wage on employment, it is evident that a consensus has not yet been reached. In his 2021 paper, Alan Manning provides a brief overview of empirical studies with varying results and concludes: "Disagreement among economists persists: 25 years after the initiation of this research, there is no consensus on the employment effects of the minimum wage" (Manning, 2021, p. 3). The author suggests that the complexity of real-life labor markets, which are abundant with frictions and imperfections, contribute to the elusive nature of the minimum wage. While acknowledging that at a certain level of the minimum wage, a significant reduction in employment is inevitable, Manning emphasizes the idea that empirical research on minimum wage should refocus on exploring the determinants of this critical point. The proposed shift in focus from general employment effects towards investigating the factors that influence this critical threshold is likely to initiate a novel phase of minimum wage analysis.

2.2. Minimum wage effect on occupations

Empirical evidence regarding the impact of the minimum wage on occupations exists; however, much of the available literature is either focused on a specific industry or very broad categories of occupations. Moreover, some studies have utilised surveys as their data collection method, which may hinder the real situation of the labor market in some cases as there exists a possibility that respondents provide inaccurate answers to questions regarding their wage and employment status. In the following section, we will provide evidence from the US, the UK, and Europe.

Lang and Kahn (1998) examined occupations in the food service industry within eating and drinking establishments in the United States and found that the demographic composition of food service occupations shifted from adults to teenagers in states that were more prone to changes in minimum wages. Additionally, they observed an insignificant transition towards part-time employment. Nevertheless, they did not identify any impact of varying susceptibility to minimum wage on employment across states.

Their findings suggested that minimum wage laws may not significantly influence overall employment levels, however, they might play a crucial role in determining who occupies low-wage positions. Applying the same methodology to workers in retail sales, Lang & Kahn obtained modest results indicating that there is a possibility that minimum wage has influenced the employment structure in the retail industry in favour of women and part-time workers.

A study by Forsythe (2023) estimated the consequences of minimum wage increases for ten states in 2014 and 2015 by utilizing occupational establishment-level data. Her findings indicated that a minimum wage increase led to a reduction in employment within the lowest wage category (closest to the minimum wage). Conversely, in the second wage category, the author observed an increase in employment. It is important to note that the extent of this effect was more pronounced for establishments prone to the minimum wage increase, measured by the proportion of low-wage workers prior to the change or industry-based forecasted exposure. Overall, her study uncovered limited evidence suggesting that minimum wage increases resulted in decreased overall employment.

Regarding the distributional effects, Forsythe found that establishments adjusted wages to maintain the wage hierarchy between workers. Low-wage occupations earning below the new minimum such as home health aides, janitors, and cashiers experienced a notable fall in employment in the smallest wage category and a corresponding increase in the second wage category. Spillover occupations – those earning between the new minimum and a specified threshold, such as medical assistants, bank tellers, and supervisors of food service workers exhibited decreased employment in the second wage category together with a simultaneous rise in upper wage categories, whereas high-wage occupations like scientists, post-secondary teachers, doctors, and unclassified occupations demonstrated minimal differences.

Consistent with the aforementioned results, the author observed that minimum wage hikes resulted in lower wage inequality within establishments. As to which occupations experienced the greatest change following the minimum wage increase, the study found that service occupations ranked first, followed by sales/clerical workers, for whom the impact was lower. Interestingly, management or professional occupations did not experience any direct effects.

Lordan and Neumark (2018) explored the influence of minimum wage adjustments on automatable jobs in the United States using CPS data spanning from 1980

to 2015. Their findings revealed a notable decline in the employment of low-skilled workers in response to a minimum wage increase. The effect was more pronounced for older workers, particularly within the manufacturing industry. They also observed that the negative impact on the employment of low-skilled workers was partially counterbalanced by increased job availability for individuals with advanced skills. This balancing effect might be attributed to the fact that the automation of low-skilled jobs gives rise to other roles, such as machine maintenance positions. The study highlighted a statistically significant labor reallocation from automatable tasks in manufacturing, transport, and services following the minimum wage increases. However, the effects in construction, wholesale, retail, finance, and public transportation were statistically insignificant.

Evidence from other countries yields similar results. For instance, in the UK, several industry-specific studies have been conducted. Examples include case studies in hairdressing, textiles, hospitality, clothing, and horse racing (Dube, 2019). In the hairdressing sector, wages saw a significant rise after the implementation of the national minimum wage, particularly benefiting the lowest-paid workers. However, higher-paid stylists, especially those on commission, were less likely to see such advantages. Regarding employment effects, the studies yielded minimal evidence suggesting a decrease in employment for qualified workers after the minimum wage increase (Druker et al., 2002).

For the textiles industry, researchers found that the minimum wage positively affected homeworkers' wages and the employment effects were insignificant. Out of 91 people, only two revealed that they had transitioned from 'employed' to 'self-employed', whereas four reported the opposite (Heyes, 2001). Other industries also exhibited similar negligible effects on employment (Dube, 2019).

In a 2006 study of residential care homes, Georgiadis (2006) found that the national minimum wage raised wages in both 1999 and 2001, with the impact being more substantial in 2001. These findings contrasted with the results of Machin & Wilson (2004), who observed greater effects during the 1999 introduction. Additionally, Georgiadis identified a compression in the distribution of hourly wages, reinforcing the assertion that minimum wages contributed to a reduction in wage inequality within this sector. As for employment reductions, the effect was relatively modest for the 1999 period, whereas the 2001 period saw no discernible employment effects.

Other instances of notable changes in the minimum wage include Germany and Hungary. In 2015, Germany implemented a national minimum wage by law for the first time. Dustmann et al. (2019), using administrative data on hourly wages, discovered a significant increase in the wages of low-wage workers compared to high-wage workers. They observed no evidence suggesting that the minimum wage adversely affected the employment prospects of low-wage workers. In summary, their findings support the notion that the minimum wage contributed to a reduction in wage inequality without causing a decrease in employment, both for individuals and across different local areas. Their research also indicates that the introduction of the minimum wage increases the probability of low-wage workers relocation to companies with a higher average daily wage, larger size, greater stability, and a lower churning rate.

Harasztosi and Lindner (2019) assessed the impacts of Hungary's 1999 minimum wage policy using administrative data from companies' balance sheets. Their findings revealed that four years after the minimum wage hike, businesses employing solely minimum wage workers experienced a 10 percent reduction in employment relative to firms with no minimum wage workers. They also found that the average wage at firms that were more exposed to the minimum wage increased by 54% more than the average wage at companies that were not susceptible to the minimum wage. Additionally, they observed that the adverse impact on employment was more pronounced in tradable, manufacturing, and exporting sectors as they are more prone to foreign competitors unaffected by the minimum wage shock.

2.3. Research in the Baltics

Gavoille and Zasova (2021) investigated the impact of the 2014 and 2015 minimum wage increases in Latvia, utilising comprehensive employer-employee data for the entire Latvian workforce from 2011 to 2015. Their findings revealed that employees earning the minimum wage were more resilient to these hikes compared to those earning slightly above the minimum wage level. Furthermore, relative to their higher-earning peers, minimum-wage workers were more prone to transitioning to part-time positions within the same company. Additionally, the study indicated that minimum wage earners transitioning from small to large firms experienced a significantly greater increase in wages compared to workers whose wages were marginally above the minimum. All these effects were evident in the sample of small firms but were not observed in large firms. As

explained by the authors, this was due to the fact that small firms are more susceptible to tax evasion.

Benkovskis et al. (2023) simulated an increase in the minimum wage in Latvia, finding that wages increased the most for individuals who were earning wages around the previous minimum wage. The most substantial effects were noted for people whose wages were around or below the previous minimum. The study also revealed that the reduction in employment and the rise in the gross nominal wage for low-skilled workers was more pronounced in comparison to the high-skilled workers. This discrepancy arises as low-skilled workers become relatively costly due to a larger proportion of low wages subject to the minimum wage increase. Overall, the income inequality, measured by the Gini coefficient, was reduced by -0.71%, however, when considering legislation in a reduction in unreported payments, the effect was reduced to -0.16%.

Research on other Baltic countries yields similar results – Garcia-Louzao and Tarasonis (2023) found no negative employment effects following the 2012 minimum wage increase in Lithuania, although they noted that part-time workers were an exception. Factors like labor market concentration or the presence of envelope wages were linked with fewer job cuts, consistent with the evidence from Gavoille and Zasova (2021). Unsurprisingly, the minimum wage improved the income of low-wage workers. On an industry level, non-tradable industries experienced more pronounced positive wage effects.

For Estonia, Ferraro et al. (2018) explored spillover effects in response to the minimum wage in the 2001-2014 period using data on full-time employees from the Estonian Labour Force Survey. They identified significant spillover effects that were particularly prominent for the lowest percentiles and diminished as the wage approached the median, implying that the minimum wage most likely contributed to reducing wage inequality in Estonia.

2.4. Our contribution to the literature

In this study, we aim to fill several gaps in the existing literature on the impact of minimum wage increases, with a particular focus on Latvia.

Previous research on Latvia and the wider Baltic region has mainly relied on EU-SILC survey samples and matched employer-employee data, focusing on broad occupational groups or specific industries without high-frequency data. Our study is unique in using detailed monthly data from the State Revenue Service, which allows us

to conduct a granular analysis of the impact of minimum wages at annual and monthly intervals, as well as at the occupational and sectoral levels. This approach provides a more detailed understanding of how different occupations are affected by minimum wage changes. In addition, by analysing the most recent data at the time of our study, we provide timely insights into current economic conditions and policy effects.

Furthermore, while previous studies have shown mixed effects of minimum wage increases on employment and the wage distribution, our study applies a difference-in-differences methodology to explicitly measure these effects with a higher data frequency. This allows us to capture the immediate and gradual transmission effects of minimum wage changes across occupational groups, bringing a new perspective to the ongoing debate.

3. Data overview

3.1. Development of wages and employment over time

In the course of our analysis, we rely on secondary data sourced from the State Revenue Service (2024). We use monthly statistics on average wages and employment by detailed profession category provided by the State Revenue Service. To make the analysis technically more convenient, we separated the International Standard Classification of Occupations (ISCO) code from the long name in a separate column. The final dataset comprises data on 2626 distinct occupations in Latvia, where the number of employees exceeds 10. Occupations are split by the ISCO codes into a five-level hierarchy: major (10), sub-major (43), minor (128), unit groups (415), and occupations (International Labour Organization, 2012), allowing us to derive conclusions at various levels of granularity. As the data have already been aggregated for several reasons, including data protection and only include occupations with 10 or more employees, we avoid the problem of underrepresentation of the profession, however, the outlier problem can still be preserved since we do not have information on the extent to which outliers have been removed prior to the estimation of average values by profession by the State Revenue Service. To obtain more accurate average wage estimates and regression results, we use employment as weights.

The data include numerical information on several variables, such as total hours worked, the average number of hours worked per month, total monthly income, average hourly wage, number of employees, and share of employees with an average hourly wage

below 80% of the national average hourly wage. This data is compiled on a monthly basis and covers the period from January 2020 to December 2023, constituting a comprehensive dataset that covers 48 months.

As the number of individuals employed in various occupations experiences constant fluctuations (i.e. falls below 10 employees), for example, due to industry trends, demographics, seasonality, and technological advancements, one data limitation is that some monthly data on certain occupations is unavailable. However, this limitation is mitigated by the substantial dataset, consisting of 140,196 entries for each variable, enabling us to comprehensively analyse the data and draw meaningful conclusions.

Tables 1 & 2 illustrate summary statistics of the two main variables: hourly wages and the number of employees for the whole sample period; year-on-year statistics are included in Appendices 1-8. Table 1 shows that there is a noticeable increase in the average hourly wage for all groups between 2020 and 2023 (CAGR of 10.4%), reflecting an overall countrywide increase in wages which is in line with the economic and market trends. For example, managers saw an increase in hourly wage from EUR 9.65 to EUR 12.6 (31%) and professionals – from EUR 9.69 to EUR 13.2 (36%), suggesting that higher-skilled groups enjoyed a substantial wage increase. The armed forces, despite being one of the smallest groups, also showed a steady increase in average hourly wages from EUR 6.78 to EUR 9.43 (39%), which can partially be attributed to an increase in the country's defence budget due to a tense political situation in the region (The Ministry of Defence of the Republic of Latvia, n.d.).

In terms of the number of employees, the managers group showed a continuous increase in the median number of employees from 86,512 in 2020 to 89,944 in 2023 (4%), indicating potential growth in the sector or a thriving market for managerial positions. The number of professionals also increased significantly from a median of 143,872 in 2020 to 157,150 in 2023 (9%), possibly due to growing demand for professional services or technological advances creating new roles.

In addition, although lower-paid groups such as service and sales workers also experienced quite substantial wage growth, with their mean hourly wage increasing from EUR 4.62 to EUR 6.39 (38%), they remain at the lower end of the wage distribution in absolute terms, despite accounting for a significant proportion of the workforce. This may point to a persistent wage gap between lower- and higher-paid occupational groups within the economy, but the more realistic explanation for the region may be the particularly high prevalence of the shadow economy, as this group of occupations includes hospitality

and beauty service workers, such as waiters and nail artists, who receive at least a part of their income in cash, which leads to concealment of their actual income. We address this topic and discuss the results by sector in Section 5.3.

Table 1. Summary statistics for hourly wages (weighted by employment) by major groups, 2020-2023

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	6.07	13.5	8.03	7.43	1.59
1 – Managers	317	8.67	14.8	10.9	10.7	1.32
2 – Professionals	704	8.34	16.3	11.5	11.1	1.81
3 – Technicians and Associate Professioanls	553	7.09	12.5	9.12	8.97	1.14
4 – Clerical Support Workers	141	5.88	10.1	7.52	7.33	0.951
5 – Services and Sales Workers	168	4.33	7.38	5.47	5.34	0.724
6 – Skilled Agricultural, Forestry and Fishery Workers	62	4.50	7.43	5.58	5.43	0.707
7 – Craft and Related Trades Workers	318	5.94	9.93	7.27	7.06	0.916
8 – Plant and Machine Operators and Assemblers	246	5.51	9.65	6.99	6.68	0.980
9 – Elementary Occupations	102	3.94	6.79	5.09	4.98	0.657

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Table 2. Summary statistics for the number of employees by major groups, 2020-2023

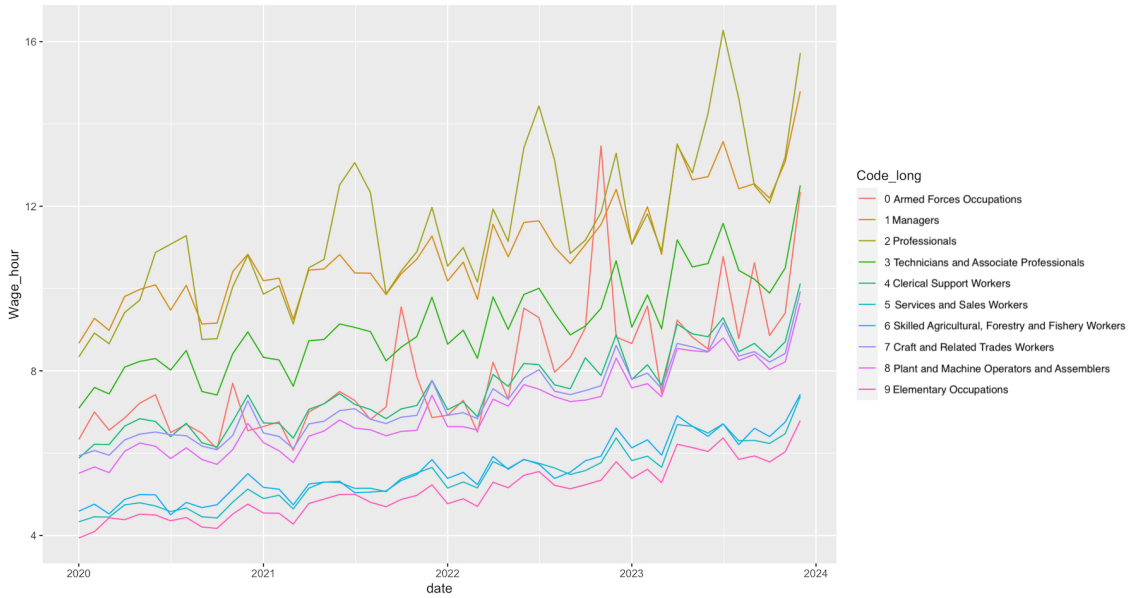
Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	4690	6850	6445	6525	320
1 – Managers	317	73389	93466	88459	89786	3253
2 – Professionals	704	113463	160613	147124	148887	10911
3 – Technicians and Associate Professioanls	553	96532	109378	105665	106323	2725
4 – Clerical Support Workers	141	42175	51815	47331	47923	1930
5 – Services and Sales Workers	168	85061	110604	102740	105055	6292
6 – Skilled Agricultural, Forestry and Fishery Workers	62	4343	5112	4804	4878	225
7 – Craft and Related Trades Workers	318	66221	73168	70330	70505	1936
8 – Plant and Machine Operators and Assemblers	246	65036	69823	67382	67254	1448
9 – Elementary Occupations	102	87498	103634	97658	98195	3752

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Figure 1 illustrates the monthly dynamics of average wages by major groups. The most evident spikes are for the Professionals group whose average hourly wages at peaks reach past the EUR 16 mark. For this group, we also see a significant seasonality in terms of hourly wages – around the middle of each year. This can be explained by the prevalence of seasonality in groups 231 and 233, both of which represent teachers. Generally, the academic year ends around the beginning/middle of the summer, and this is when most teachers go on holiday, so their working hours decrease significantly, thus pushing up the hourly wage.

Overall, all groups display certain kinds of movement dynamics, and it is not feasible to explain them all, however, two noticeable trends that we see are that all groups on average are at least a little upward sloping which is natural due to economic growth and a consequent boost in wages. Secondly, we generally see an increase (with a consequent decline) in hourly wages towards the end of the year due to bonuses paid on top of regular salaries which contribute to the increase in hourly earnings.

Figure 1. Monthly dynamics of average hourly wages by major groups, 2020-2023, EUR/h

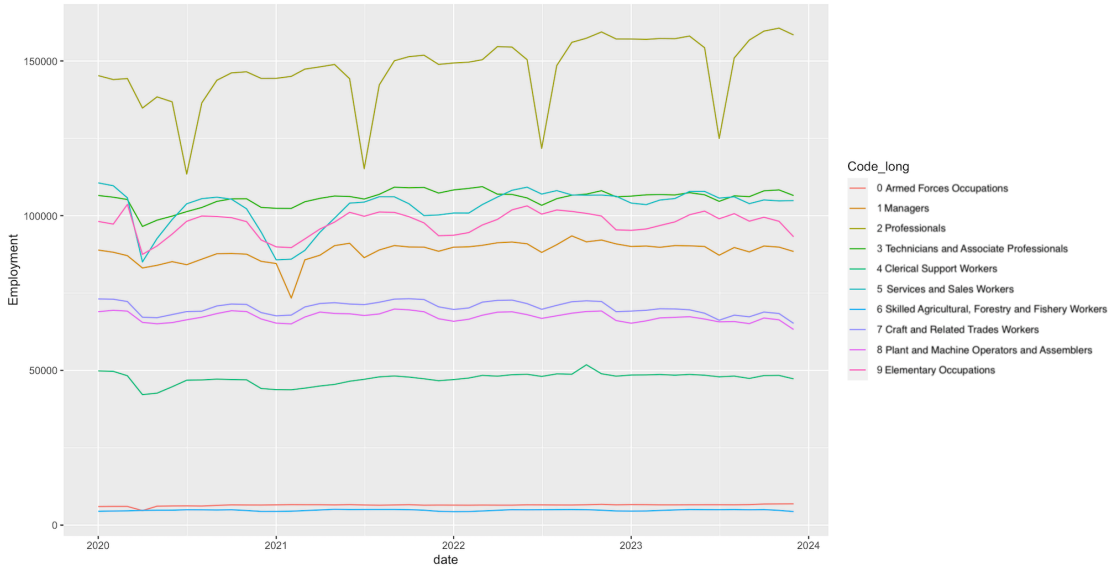


Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Figure 2 illustrates the monthly dynamics of employment expressed as the number of people employed within each major group. It is evident that on a large scale, while we observe no explicit seasonality and significant growth in employment as in hourly wages for the majority of groups, there are trends that are easily noticeable from this chart. One is that there is an evident seasonality for the Professionals group where we see sharp declines (close to 20%) in employment figures around the middle of each year. This again can be explained by the prevalence of seasonality in teaching professionals groups 231 and 233. The likely explanation of such employment dynamics is the specifics of the contractual agreements that are aligned with the academic schedule, i.e. workplace shifting usually happens after the end of the academic year.

Secondly, we notice two declines in employment (absolute number of employed people) in the first quarters of 2020 and 2021, specifically in groups 5 and 8. The first can be attributed to the effect of Covid-19, when many people were laid off due to the closure of many workplaces, but the second is due to several reasons – ongoing restrictions related to the pandemic (i.e. affecting service occupations) and the spread of remote work, resulting in people no longer needing to be employed in Latvia in order to perform their work duties, or vice versa, the inability to switch to remote work due to job specifics and the resulting layoffs, as well as the decline in youth employment (Official Statistics Portal, 2021).

Figure 2. Monthly dynamics of average number of employees by major groups, 2020-2023



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

3.2. Minimum wage in Latvia

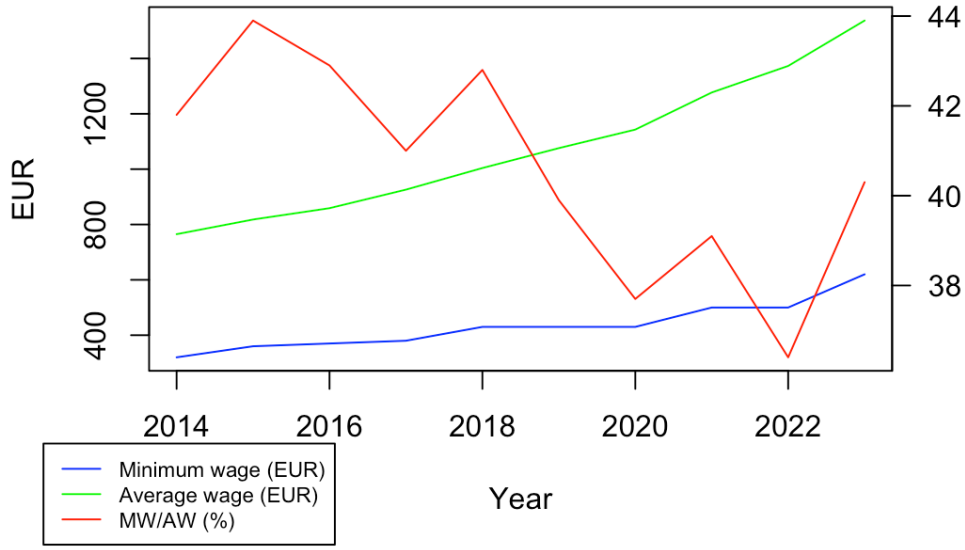
According to the Latvian Ministry of Welfare (2022), Latvia has a decentralized wage-setting system, but all employers are required to adhere to the state's minimum wage level. In compliance with the law, the wage for a full-time staff member must not fall below the minimum level set by the state, or else the employer is subject to an administrative fine.

Figure 3 summarizes the historical evolution of minimum and average wages for the last 10 years, using data from the National Statistical Bureau's database for the period between 2014 and 2023. Another variable added is the minimum wage as a percentage of the average wage to illustrate the increasing gap between the two. The ratio explicitly rises in response to increases in the minimum wage, thus reinforcing the effect of diminishing income inequality post minimum wage change.

The graph illustrates wages from a monthly perspective, as this is the way they are recognised by the law, but in our work, we stick to hourly wages, as they provide a more realistic view and eliminate the inconsistencies in working regimes (shifts, vacations, sick leaves, etc.) and make the data comparable. The legal minimum hourly wage, which we obtain by dividing the monthly wage by 160 hours, corresponding on average to a full-time working month, for our sample period is therefore EUR 2.69 in

2020, EUR 3.13 in 2021 (+16%), EUR 3.13 in 2022, EUR 3.88 in 2023 (+24%). We make frequent use of these figures further in our analysis.

Figure 3. Minimum and average wage in Latvia, 2014-2023, EUR



Notes: This graph is made using data from the Ministry of Welfare, together with average wage statistics from the Official statistics portal (2023a). The calculations are performed by the authors, based on the aforementioned information.

An important point to mention in this subsection is that some sectors have developed their own systems of minimum wages. For example, the construction sector introduced a sector-wise monthly minimum wage of EUR 780 (EUR 4.67/hour) in 2019, mainly to minimise the shadow economy (envelope wages) and attract more workers, as the sector is struggling to find talent due to the high migration of skilled workers in these occupations to Western Europe and the UK, where more attractive wages are offered (LBNA, 2023). We acknowledge this sector's deviation from the national minimum wage standard, but the minimum wage in construction did not change during the period of our review (the first change was implemented on 1 January 2024) and our study focuses on wage *changes*, so there are no limitations that would have arisen had we focused on absolute values, thus we analyse this sector together with others without any specific adjustments or distinctions.

The second sector with a sectoral minimum wage is health care, where doctors, nurses, and support staff have their minimum wage set according to their qualification category. According to the Cabinet of Ministers Regulation No. 851 (2018), this amendment was last introduced in 2019 to address the issue of underpayment in a way that recognises the importance of this sector and compensates for both the moral and

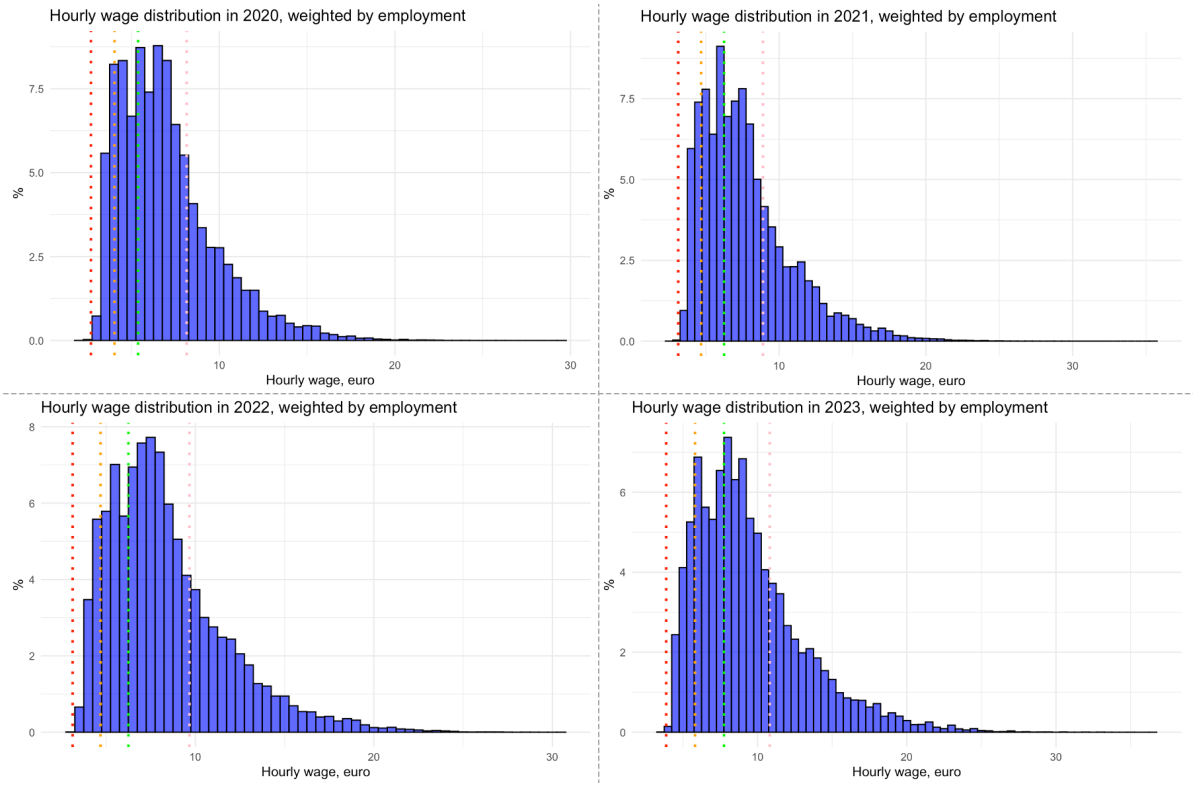
physical contribution of those employed in the sector. Minimum wages in the health care sector have not changed during the period of our study, so as with construction, we recognise this difference, but it does not impose any limitations on our work.

3.3. The distribution of hourly wage over time

In order to see how the distribution of hourly wage for all the occupations in our dataset has changed over the years, we opted for histograms to present the observations in a comprehensible way. Using the R software, we construct a histogram for each year with hourly wage in EUR on the x-axis and percent of the dataset on the y-axis (Figure 4). We also weigh the data by employment to make the distribution as representative of the true situation as possible.

Each histogram depicts the hourly wage distribution in euros for all occupations in our dataset. The vertical lines represent the following wage levels for the respective years: hourly minimum wage (red line), 1.5 times the hourly minimum wage (orange line), and 2 times the hourly minimum wage (green line), mean hourly wage (pink line).

Figure 4. Hourly wage distribution (2020-2023), in EUR, weighted by employment



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

We choose 1.5 times the hourly minimum wage as our threshold, for which all occupations under it are expected to experience the most significant change in hourly wage following the minimum wage hike relative to occupations at the higher end of the income distribution, who will most likely see a negligible effect. For all years, the threshold is the same – minimum wage times 1.5, however, it slightly changes depending on the minimum wage value in the respective year.

We choose this threshold because a very small, negligible number of average wages by occupation are directly at the minimum wage. To widen the scope of our analysis, we opted for a threshold that encompasses occupations in close proximity to the minimum wage as well since previous studies show that the minimum wage change affects not only those occupations that are directly at the minimum wage, but also those who earn slightly more. In the Ferraro et al. (2018) study on the impact of minimum wage adjustments in Estonia, the specific numerical threshold used to differentiate between the control and treated groups – based on the wage distribution – is not explicitly defined. Instead, the study employs a relative measure to assess the impact of the minimum wage across different segments of the wage distribution, focusing on the effective minimum wage, which is the minimum wage relative to a measure of centrality (such as the median wage) of the wage distribution in a given labour market. Our approach regarding the threshold could be seen as a simplified adaptation of this study, with a primary focus on occupations near the minimum wage level.

When looking at the distribution of hourly wages over the years, it is evident that the wage distribution is skewed to the right. There is a high concentration of workers at the lower end, implying wage disparity when compared to the relatively small number of high-wage earners. Using the R software, we estimate that around 73.6% of all people in our dataset receive a wage that is less than or equal to the mean hourly wage and approximately 11.3% of people received wages below or equal to minimum wage times 1.5 in the year 2020. For the year 2021, during which the minimum wage increased, approximately 13.1% of people received wages below or equal to our threshold. The shift in the threshold for the minimum wage due to an increase in the minimum wage justifies the rise in the percentage of occupations receiving a wage that is equal to or below the threshold, indicating that the effect of the minimum wage hike was yet to be fully experienced. The mean wage therefore also increased, and 80.1% of people earned a wage below or equal to the mean. The reasoning for this increase in the proportion of

occupations is the same as for our selected threshold – the true effect should be observed later since wages take some time to adjust to the changes.

Indeed, in 2022, the minimum wage hike effect settled in – only 8.26% of people were below or equal to the 1.5 times the minimum wage threshold. Furthermore, the percentage of occupations earning a wage less than or equal to the mean wage also fell– it was 72.1%, indicating that a larger percentage of people enjoy higher wages once the minimum wage change has settled in. In January 2023, the minimum wage increased again, and the effect was similar to the one in 2021 – respectively, the percentage of occupations with wages below or equal to the threshold increased again (it was 14%), whereas 71.9% earned a wage below or equal to the mean hourly wage.

Overall, when looking at the wage distribution over the years, it is evident that a larger percentage of people now enjoy higher wages, reflected by an increase in the percentage of people at the higher end of the distribution and a decrease at the lower end, as well as the shift of the mean hourly wage line, implying an increase in the mean hourly wage – for comparison, the mean hourly wage was EUR 8.13 in 2020, whereas in 2023, the mean hourly wage was EUR 10.81 in 2023.

4. Methodology

The main objective of this study is to identify the effects of minimum wage changes, with a particular focus on two key dimensions.

First, taking advantage of the granularity offered by monthly data, our study focuses on the timing of minimum wage changes, which always occurs on January 1. This timing precision as well as the monthly frequency of data allows for the clarification of whether the effect emerges as an abrupt and apparent spike or unfolds gradually over the subsequent months. In particular, we contrast the effects by wage income level, namely split the analysis into low- and high-wage occupational groups (treated and control) to observe the difference. This dimension seeks to explore the annual effect associated with the transmission of minimum wage changes to average wage changes across all occupations in the treated group, as well as identify potential employment effects following the minimum wage change.

Second, the analysis attempts to estimate the effect of minimum wage adjustments, looking at their impact on annual earnings within discrete occupations and occupation groups, as well as monthly earnings within occupation groups.

4.1. Empirical methods

In order to carry out such analyses, the difference-in-differences (DiD) methodology with two distinct phases is chosen as the most suitable methodology. DiD is a quasi-experimental research design that is widely used in different types of research, especially when authors want to discover the effects of some kind of event (treatment). To identify a causal effect, the research perimeter should be split into two groups - control and treatment. Our two control groups consist of high-wage occupations, as it is reasonable to assume that the change in the minimum wage will have little (almost no) effect on this group. Accordingly, the treatment group consists of occupations with low average wages. We define the exact cut points further in this section.

We split our analysis into two parts:

a) Looking at the average annual effect:

$$Y_{it} = \alpha_i D_i + \alpha_f D_f + \beta_1 D_f D_i + \varepsilon_{it}$$

where:

Y_{it} – logarithm of the average monthly wage or employment in occupation *i* at time *t*

D_f $\begin{cases} 0 - \text{year before minimum wage change (treatment)} \\ 1 - \text{year after minimum wage change (treatment)} \end{cases}$

D_i $\begin{cases} 0 - \text{if treated (close to minimum wage)} \\ 1 - \text{if control (high wage)} \end{cases}$

α, β - coefficients

ε_{it} – error terms.

b) Assuming transmission happens gradually (monthly):

$$Y_{it} = \sum_{j=-T,\ \neq -1}^{T} (\beta_j \times D_{jt} \times D_i) + D_i + D_{jt} + \varepsilon_{jt}$$

where:

Y_{it} – logarithm of the average monthly wage or employment in occupation *i* at time *t*

D_{ij} – Dummy for time (month) before or after the event at *j=-1*

D_i – occupation group *i* fixed effect

D_{jt} – time *t* fixed effect - coefficients before and after the event at *j=-1*

e_{it} – error terms.

$$j \begin{cases} -1 - \text{December of the year prior to treatment} \\ -12, \dots, -1 - \text{months prior to treatment} \\ 0, \dots, 11 - \text{months after treatment} \end{cases}$$

To investigate our research questions, we utilise the DiD model with the aim of identifying whether the minimum wage hikes are directly responsible for an overall increase in wages, especially for the occupations at the lower end of income distribution earning close to the minimum wage.

According to the theory, occupations whose wages are close to the minimum wage will experience the most significant percentage increase in wage relative to high-income occupations following a minimum wage change, as a minimum wage increase is mostly relevant for low-wage professions. Assuming that all wages in the economy are growing at a similar pace, we can estimate the effect of the minimum wage increase by comparing the speed of wage adjustment in the low-wage group to some control group. Our threshold for low-wage occupations will be all the occupations whose hourly wage is lower than 1.5 times the minimum wage, and this will be our treatment group for which we expect to observe the biggest effect. As for the control group – the one for which we expect to observe negligible effects, we select all occupations whose hourly wage is between hourly minimum wage times 4 and hourly minimum wage times 8. We do not select occupations at the very end of the distribution because they often represent rare or extreme cases which may lead to unreliable estimates and conclusions due to increased variability and uncertainty. We also add a second control group – for this one, we select professions with wages between hourly minimum wage times 3 and hourly minimum wage times 6.

We start with a simple regression as we regress the logarithm of hourly wage on independent variables "treated" and "time", as well as their interaction term "treated:time". The regression equation is:

$$Wage\_hour\_\log = \beta_0 + \beta_1 treated + \beta_2 time + \beta_3 treated \cdot time + \epsilon,$$

where "Wage_hour_log" is the dependent variable, which is the logarithm of the hourly wage, "treated" is a binary variable indicating whether an observation is in the treatment group (1) or the control group (0), "time" is a binary variable indicating whether the observation is in the post-treatment period (1) or the pre-treatment period (0), whereas

“treated:time” is the interaction term between “treated' and 'time,” capturing the differential effect of treatment over different time periods.

The coefficients are defined as follows:

β_0 – the estimated average log-transformed wage for the control group at the reference time

β_1 – the average difference in log-transformed wage between the treatment group and the control group

β_2 – the average change in the log-transformed wage between the pre and post-treatment period for all wages

β_3 – difference in the change in the logarithm of the hourly wage between the treated group and the control group (by how many percentage points on average the wage change in the treatment group differs from the control group)

ϵ – the error term, capturing unobserved factors affecting the dependent variable

4.2. Robustness check

Moreover, as part of the robustness check we are performing analyses with two control groups defined in Section 4.1. – the first control group is all occupations whose hourly wage is between hourly minimum wage times 4 and hourly minimum wage times 8, whereas the second control group is professions with wages between hourly minimum wage times 3 and hourly minimum wage times 6. By using different control groups based on multiples of the minimum wage, we ensure that the results are not sensitive to a specific definition of the control group.

Furthermore, in some parts of our analysis, we will both include and exclude relevant service occupations to account for the effect of the Covid-19 pandemic, thus mitigating potential factors that could yield spurious results.

5. Results

5.1. Annual effects, all occupations

We conduct separate regressions for two periods during which the minimum wage changes took place, respectively, 2020-2021 and 2022-2023. In the first period, our regression yields the output depicted in Table 3.

The primary coefficient of interest is the interaction term between “treated” and “time”, which captures the differential change in outcomes between the treatment and

control groups following the treatment (minimum wage change). The coefficient of the interaction term is positive and statistically significant at the 1-5% level, suggesting that on average in 2021, the increase in the wage for the treatment group – occupations below the 1.5 times the minimum wage threshold – was by 1.85% higher compared to the first control group (occupations earning a wage that is between 4 times the minimum wage and 8 times the minimum wage).

Table 3. The effects of a minimum wage increase on the change in hourly wage, the first control group, 2020-2021

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.4317	0.0025	984.656	< 2e-16	***
treated	-1.0535	0.0054	-194.010	< 2e-16	***
time	0.0893	0.0035	25.514	< 2e-16	***
treated:time	0.0185	0.0077	2.403	0.0163	*

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 21812 observations, and the R^2 value is 0.773.

It is important to note that the previously mentioned 2021 increase of 16% is only the January effect – the effect gradually diminishes over the months, resulting in a yearly effect of 1.85%. The "treated" coefficient represents the level effect – respectively, the treatment group wage level is lower than the control group by 1.05 log wage points. Moreover, the coefficient for "time" implies an 8.9% average wage growth for all wage groups during 2021 (the post-treatment period).

We repeat the regression with the second control group (Appendix 9) in which the occupations earn a wage that is between 3 times the minimum wage and 6 times the minimum wage. While the coefficients for "intercept" and "time" are now slightly lower, they remain on the same significance level, whereas the coefficients for "treated" and "treated:time" have increased. Notably, the coefficient for "treated" has become less negative (-0.86), indicating a smaller average difference in the logarithm of wage between the treated and control groups, i.e., the two groups are closer in value. The coefficient for "treated:time" is 0.0241, implying a 2.41% higher wage growth on average for the treatment group compared to the control group.

When comparing the two outputs, the disparity in the interaction term coefficients between the two control groups suggests varying rates of wage growth, potentially indicating stronger growth in the second control group. Consequently, these coefficients serve as low and high estimates of the minimum wage effect for the low-wage occupation group.

We also examine changes in employment for the 2020-2021 period by substituting the dependent variable wage_hour_log with employment_log (the logarithm of employment) for both control groups and find insignificant employment effects (Appendices 11-12), implying that the minimum wage adjustment in 2021 has not resulted in statistically significant employment changes, which is consistent with theory about the inconclusive effects of minimum wage on employment. Our results imply that Latvian firms have been able to absorb higher wage costs without significant layoffs or reductions in employment levels, which is consistent with the results of the Wage Dynamic Network survey discussed by Fadejeva (2016), who concludes that in response to a minimum wage increase, firms are more likely to increase output prices, reduce non-labour costs, and increase wages for employees earning above the minimum wage. Notably, such increases have a minimal direct impact on employment, as firms rarely resort to layoffs or restricting new hires in response to minimum wage increases - less than 10% of firms consider this a necessary measure.

The same analysis is repeated for the 2022-2023 period, during which the minimum wage increased from 500 EUR/month to 620 EUR/month. The regression results are presented in Table 4.

Table 4. The effects of a minimum wage increase on the change in hourly wage, the first control group, 2022-2023

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.5816	0.0024	1062.192	< 2e-16	***
treated	-1.0544	0.0057	-184.725	< 2e-16	***
time	0.1005	0.0034	29.189	< 2e-16	***
treated:time	0.0652	0.0081	8.065	0.00396	***

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 23179 observations, and the R^2 value is 0.7381.

The regression results reveal a more statistically significant coefficient for the interaction term, suggesting a more pronounced effect of the minimum wage changes on the treatment group compared to the control group. The value of the coefficient implies a 6.51% higher wage growth in the treatment group compared to occupations in the first control group – a notable increase relative to the 2020-2021 period when the first minimum wage change took place. This heightened impact of the average annual minimum wage growth coincides with the larger increase in the minimum wage during the 2022-2023 period (a 24% increase compared to a 16% increase in the 2020-2021 period). The wage level of the treatment group in comparison to the control group is still lower by 1.05 log wage points, indicated by the "treated" coefficient. This is because the yearly effect for 2021 wage growth for treated occupations relative to control occupations is very small, and, as the effect gradually diminishes, the wages for treated and control groups grow at approximately the same rate (see discussion on parallel trends in Section 5.2.). The average wage growth in 2023 (the post-treatment period) for all wage groups is now slightly higher – it is 10%. Similar to the previous period, all coefficients are statistically significant with very low p-values.

We repeat the same with the second control group, revealing a decreased coefficient for the interaction term which indicates an approximately 5.86% higher wage growth in the treatment group in comparison to the control group in 2023 – the year following the minimum wage change. As for the employment effects, we once again do not find any significant employment effects following the minimum wage change (Appendices 13-14).

Our results regarding wages are also consistent with theory – minimum wage increases can lead to wage compression, where the wage gap between low-wage workers and slightly higher-paid workers narrows. When the minimum wage rises, employers may adjust the wages of workers earning slightly above the new minimum to maintain wage differentials and internal equity within the organization. As a result, workers in low-wage professions may see relatively larger wage increases compared to those in higher-wage professions.

5.1.1. Removing service occupations

The Covid-19 pandemic has brought significant disruptions to economies worldwide, particularly affecting service occupations due to their reliance on in-person interactions and implementation of lockdowns and social distancing measures.

To minimise the potential influence of the pandemic on our analysis, we run the same difference-in-difference regressions on employment and wages, excluding those occupations that were unlikely to work during the Covid pandemic, such as travel guides, chefs, waiters and bartenders, hairdressers, nail artists and beauticians, vendors, ticket vendors and catering service vendors (codes 511, 512, 513, 514, 521, 522, 523001, 523002, and 5246). The regression results are depicted in Table 5.

Table 5. The effects of a minimum wage increase on the change in hourly wage (excluding relevant service occupations), the first control group, 2020-2021

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.4318	0.0025	979.749	< 2e-16	***
treated	-1.0407	0.0057	-181.092	< 2e-16	***
time	0.0894	0.0035	25.387	< 2e-16	***
treated:time	0.0150	0.0081	1.843	0.0653	.

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 21286 observations, and the R^2 value is 0.7538.

For the 2020-2021 period, we find that the value of the coefficient for the interaction term is 0.0150 – in other words, the increase in the wage for occupations below or equal to the 1.5 times the minimum wage threshold was by 1.5% higher compared to the first control group. For the second control group, the difference in wage growth for the treated and the control group is higher – it is now 2.06% (Appendix 15). When comparing these results with the results in Section 5.1., where no occupations were excluded, we see that taking Covid into account provides a lower estimate for wage growth for the treated group in comparison to the control groups, nevertheless, given the standard errors, we conclude that the difference is relatively small. The similarity in results despite the exclusion of occupations unlikely to work during Covid suggests that the minimum wage increase may have had a consistent effect across various occupational groups, regardless of their pandemic-related work patterns.

For the 2022-2023 period, when restrictions were already lifted, we presume that the economy has entered its recovery state and therefore do not expect to see any substantial differences between the initial results and Covid-adjusted results. Indeed, when relevant service occupations are excluded, we observe only a slight difference in

the interaction term – for the first control group, the wage growth for the treatment group is 6.48% higher than the first control group versus 6.52% if all occupations are included. The same is true for the second control group – when excluding relevant service occupations, the wage growth for the treatment group is 5.82% higher than the control group compared to 5.86% if all occupations are included. However, these differences are negligible. Furthermore, we do not find any significant employment effects in any of the periods.

The findings from the 2020-2021 period indicate that, even amidst the disruptions caused by the pandemic, minimum wage increases have had a discernible impact on wage growth, suggesting that despite the challenges posed by Covid-19, minimum wage policies continue to positively influence wage dynamics for low-wage occupations in Latvia. This implies that the pandemic had a relatively minor impact on wage changes during the specified period and suggests that other factors, such as the minimum wage policy itself or broader economic conditions may have played a more dominant role in shaping wage dynamics during the pandemic. Similarly, in the 2022-2023 period, where economic recovery was underway, there are no disparities observed between including and excluding relevant service occupations, emphasizing the notion that pandemic-related impacts on wage dynamics were negligible during this timeframe.

Table 6. The effects of a minimum wage increase on the change in hourly wage (excluding relevant service occupations), the first control group, 2022-2023

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.5816	0.0024	1055.908	< 2e-16	***
treated	-1.0472	0.0060	-173.872	< 2e-16	***
time	0.1005	0.0035	29.016	< 2e-16	***
treated:time	0.0648	0.0085	7.603	2.99e-14	***

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 22717 observations, and the R^2 value is 0.718.

5.2. Analysis of monthly effects (transmission through the year)

In order to delve deeper into the effects of minimum wage changes on average wages by occupation and to gain ever deeper insights into the transmission process, the

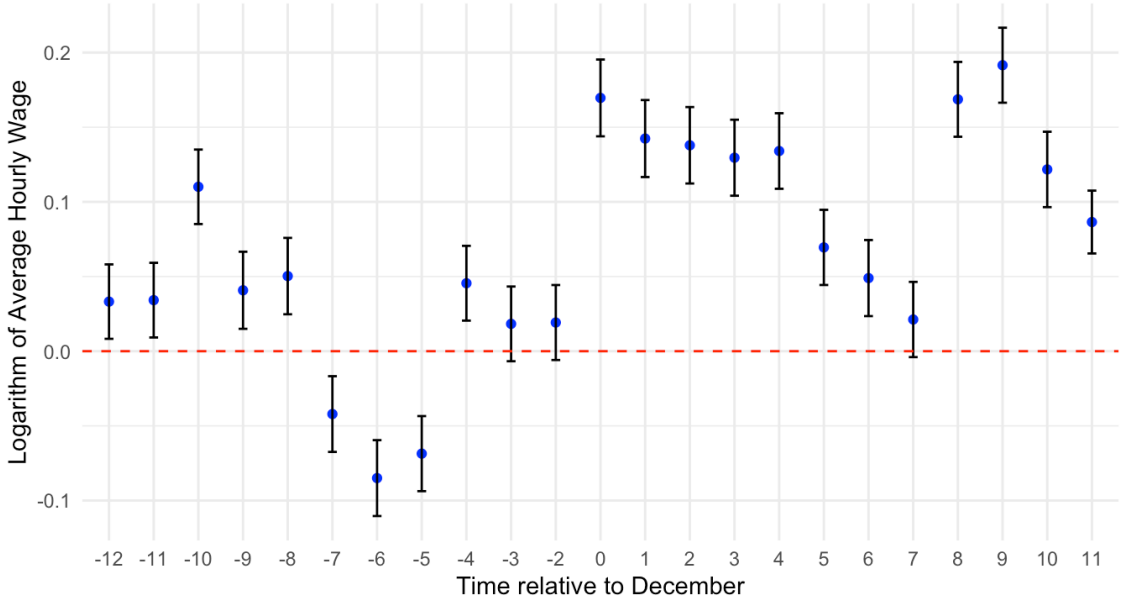
next step of our analysis focuses on the monthly effects of minimum wage transmission. To do this, we use the regression from the second phase of DiD model.

As mentioned above, the new minimum wage comes into effect on January 1, so it is quite straightforward to distinguish monthly effects. As a first step, we transform the monthly data to a numerical scale so that January has a value of 0 and all other months are given values relative to this reference point. In our regressions, however, we reset the reference point to December, just before the minimum wage change, in order to compare all other points in time with the pre-treatment period. We repeat the same steps for both the 2020-2021 and 2022-2023 series, as well as for both control groups, including and excluding the aggregate (general, unaffected by minimum wage changes) wage growth in all groups.

2020-2021

The regression results (Figure 5) show an evident pattern of wage adjustment immediately following the minimum wage increase without isolating the 2021 effect (which is done in further steps). First, in January, we observe an increase in hourly wages of around 16.9% in the treated group, slightly higher than the 16.3% increase by the law. This initial increase suggests an immediate response to the policy change. However, the magnitude of this effect shows a slight decline in the following months. This trend suggests that while the impact of the policy was most pronounced in the initial period following its implementation, the rate of wage growth relative to the December 2020 benchmark has moderated over time. Moreover, the differential impact across occupational categories indicates that the minimum wage policy does not uniformly affect all workers, highlighting the importance of considering sector-specific dynamics in policy evaluations.

Figure 5. Monthly DiD results for the first control group, 2021



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

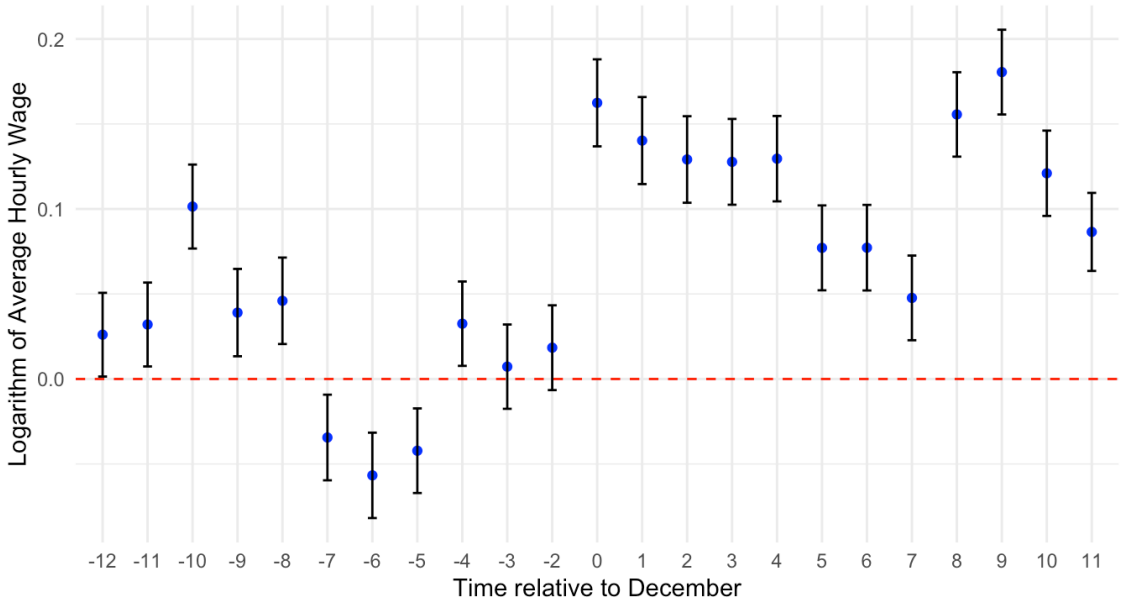
As a next step, we run the same regression for the first control group, however, in this case excluding the aggregate wage growth in all groups in 2021. The new regression incorporates a "time" variable in its equation. This variable is designed to capture overall temporal trends in wage changes, irrespective of the minimum wage policy. By accounting for these general trends, we aim to isolate the specific effect of the minimum wage increase from other concurrent factors that might also influence wage dynamics. The results reveal that the "time" variable is approximately 10% indicating the total effect, since wage growth continues over time and is not related only to the minimum wage growth, further suggesting that the direct impact of minimum wage policy change is 6% in January. As before, the most pronounced effect is in January, suggesting the immediate response by the labour market to the minimum wage change, as the following months exhibit less pronounced changes or insignificant results. Another 7% increase is in September, which is likely attributable to groups 231 and 233 which represent University and Higher Education Teachers and Secondary Education Teachers, respectively.

We then carry out the same analysis for the second control group, again by first looking at the results without and then including the total effect isolation. Not including the "time" variable leads to a 16.2% increase in January which is almost the same as the 16.3% imposed by the law, which again is the highest result after which the rest of the

months have a less pronounced effect (Figure 6). However, in this case, we see a much more gradual decline, which can be explained by the underlying control group which includes a larger sample of occupations. When we do include the "time" variable separating the total effect it is 9.5% for 2020-2021. As a result, the average difference between the treated and control group is 6.6% in January and it diminishes over time.

To underpin the validity of our DiD regression results i.e. the key assumption that before the treatment, the treated and control groups should follow similar trends in the outcome variable, which, in this case, is the logarithm of hourly wages, we perform a parallel trends check. The coefficient for the interaction term "trend:treated" is negative and statistically significant, suggesting that the slope of the wage trend for the treated group was slightly less steep compared to the control group in 2020. In 2021, however, we observe no difference in slopes as the coefficient for the interaction term is not significant. Although it is commonly accepted that changes in slopes should be evident post-treatment, we attribute this inconsistency to the timing, which coincides with the middle of the pandemic when the labour market was generally distorted (with the addition of employer bonuses and government support for different social groups). Therefore, we conclude that the assumption of parallel trends after treatment holds (as the effect is still there), and the DiD coefficients remain valid.

Figure 6. Monthly DiD results for the second control group, 2021



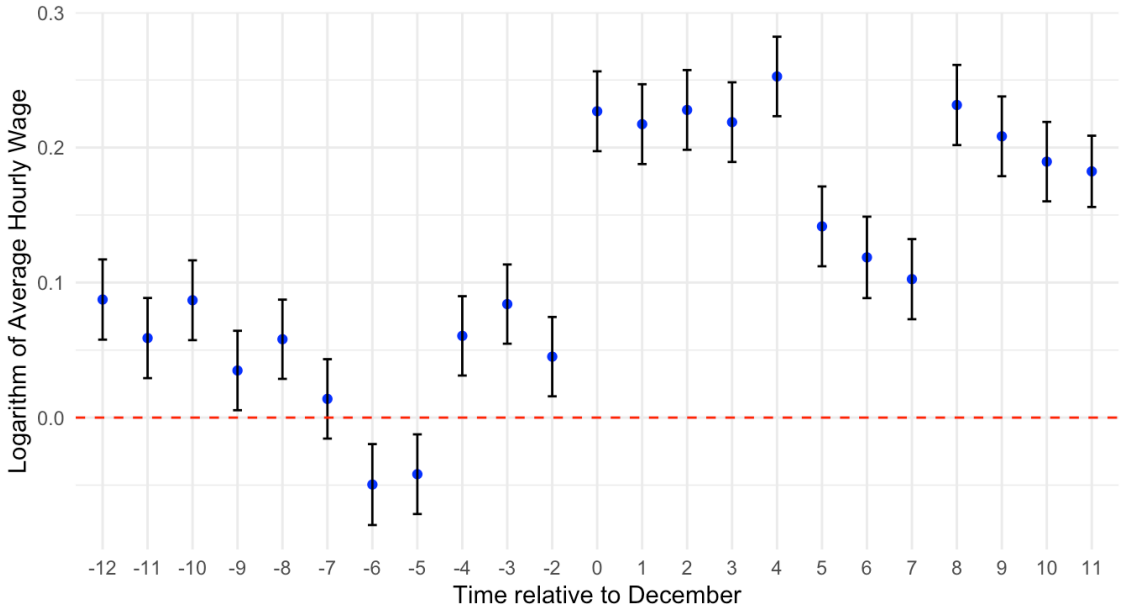
Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

2022-2023

We also carry out the above steps for the 2022-2023 change. The increase by law is from 500 to 620 EUR/month, which is 24% in relative terms.

The first regression, the same as in the previous case, is carried out for the first control group and excludes the effect of aggregate wage growth for 2023 (Figure 7). It shows that, although there is a significant adjustment of 22.6% in January, it continues in the following months, with all the effects being highly significant and with percentage increases between 10 and 25% relative to December. If we add the time variable to the same equation, we find that the total wage growth in 2023 is 10.2%, which again indicates that wages continue to grow over time independently of changes in the minimum wage. The average difference between the treated and control groups was 12.6% in January, with a rather stable effect in the following 5 months, where it remained at the same level and then decreased during the rest of the year.

Figure 7. Monthly DiD results for the first control group, 2023



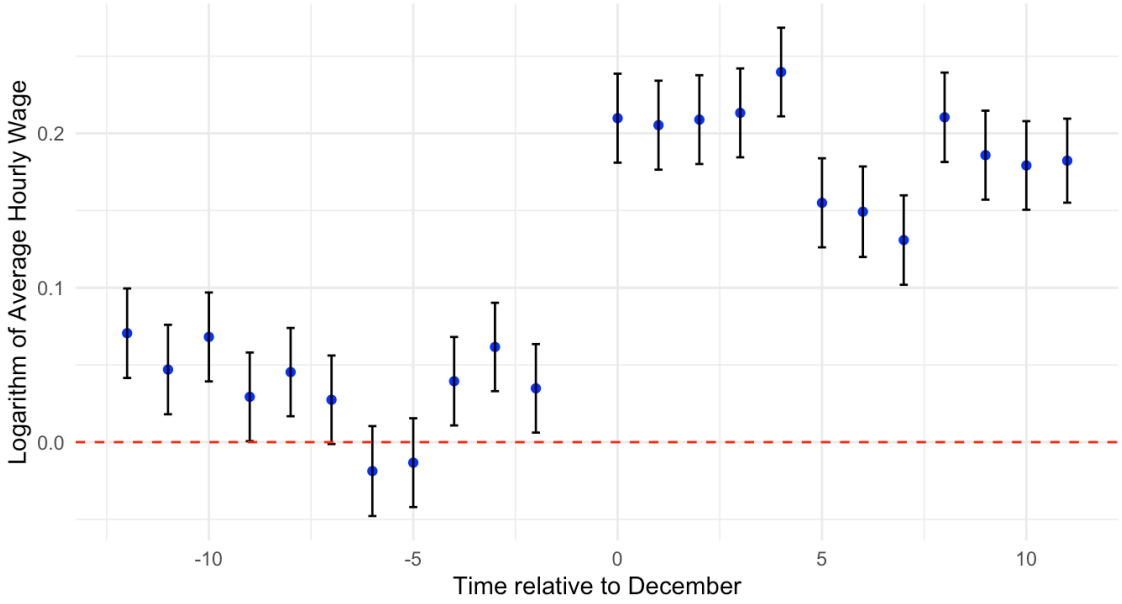
Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Repeating the same procedure for the second control group gives similar results (Figure 8). The January effect is strong and significant at almost 21%, but the transmission here is more gradual - it continues throughout the rest of the year, with all coefficients being significant. When the time variable is reintroduced, it absorbs 10.9% of the effect. The effect in January remains at 10.1% and is fairly stable until around the

middle of the year, when it starts to fall, with a spike in September, the effects of which are explained above. The September effects are due to the fact that we have not included the cross-effects between occupations and months, as some occupations, due to their specific nature, change their wages mainly in September.

The parallel trend check for 2022-2023 shows that in 2022 the interaction term between trend and treated is negative and significant (-0.0069046). In 2022, there is almost no difference in the slopes, while in 2023 the slopes are different, suggesting that the parallel assumption holds.

Figure 8. Monthly DiD results for the second control group, 2023



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

5.3. Analysis by sector

We examine another, more detailed layer of our database, respectively, specific sectors. As a first step of sector analysis, we look at the annual changes in weighted (by employment) average hourly wages for all sub-major groups. We do this for two periods: 2020 to 2021 and 2022 to 2023, as these are the time points for changes in minimum wages (Appendices 17-20).

The notably largest increase in average wages in 2021 compared to 2020 was in groups 22, 32, and 53, which represent health care professionals, health care associate professionals, and personal care workers. This is very much in line with the ongoing situation in the world at that time, taking into account the global context of the Covid-19

pandemic. This period highlighted the issue of inadequate compensation within medical occupations. In response, several measures were promptly implemented to address these disparities and acknowledge the critical role these professionals played during the health crisis, including raising the pay (which in this case does not necessarily mean wages, as the dataset captures bonuses in the same way as regular salaries). At the same time, in terms of employment, the above groups experienced small fluctuations, with the change in employment being close to 0 for all.

We perform the same set of actions for the second minimum wage change that happened in 2023. Here we can see the highest increase in the hourly wage for groups 63, 96, and 91, which represent Subsistence farmers, Fishers, Hunters, and Gatherers, Food preparation Assistants, and Sales and Services Elementary Occupations. However, it remains difficult to attribute these increases directly to the change in the minimum wage, as the underlying factors are not clearly identifiable, and the results are subject to interpretation.

In terms of employment, the most notable changes are in groups 22 and 32, which represent health professionals and health associate professionals respectively. These polar opposite trends in employment are quite interesting when considering the growth (negative or close to zero, as in the previous figure) of their average wage over the same reference period. The observed effects are clearly segment-specific, influenced by niche dynamics within each occupational group. Despite belonging to the same sector, the contrasting trends in these groups highlight the need for a more detailed investigation of the causal factors in order to disentangle the underlying events that led to such changes.

While this sector analysis provides valuable insights into wage dynamics within specific occupational categories over time, a difference-in-differences regression allows us to isolate the causal effect of minimum wage adjustments on wage changes. Therefore, building upon our sector-level analysis, we now modify our existing regressions in the following way:

$$Wage\_hour\_\log = \beta_0 + \beta_1 treated + \beta_2 time + \beta_3 code + \beta_4 treated \cdot time + \beta_5 time \cdot dummy\_code + \epsilon$$

The dependent variables remain the same, and we also add another binary variable "dummy_code". Unlike the previous yearly effects analysis that focused on broader groups, this approach delves into the most detailed level of occupational categorization

as each unique six-digit code represents a distinct occupation. This enhanced level of detail allows us to thoroughly examine the occupational dynamics in the context of the minimum wage increase. Therefore, our binary value takes the value "1" if an observation belongs to a unique six-digit code occupation, and "0" if it does not. Furthermore, we select only the six-digit occupations that are in the treatment group (equal to or below 1.5 times the minimum wage) to precisely capture the differences in wage growth between these specific one-digit occupations compared to the occupations in the control group, allowing us to identify whether wages in occupations within the treatment group increase at a faster rate than those in the control group and draw inferences regarding the impact of the minimum wage increase on these specific occupations.

Similar to the previous regressions, in this case, we also focus on the interaction term – respectively, the interaction term between "dummy_code" and "time". Our results for the 2020-2021 period yield the following:

Table 7. The effects of a minimum wage increase on the change in hourly wage for the individual occupation level, the first and second control group, 2020-2021

Code	Occupation	Coefficient	Pr(>|t|)	Significance	Code	Occupation	Coefficient	Pr(>|t|)	Significance
522301	Retail shop clerk	0.0180	0.03756132	**	522301	Retail shop clerk	0.0223	0.02087421	**
832205	Taxi driver	0.0684	0.06921018	*	832205	Taxi driver	0.0727	0.09805438	*

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels.

We observe significant effects in only two cases, respectively, for codes 522301 (retail shop clerks) and 832205 (taxi drivers). Specifically, in 2021, retail shop clerks experienced an approximately 1.80% higher wage growth on average compared to the first control group, whereas taxi drivers saw a 6.84% higher wage growth on average. The differences in wage growth for both occupations are slightly higher for the second control group, however, the statistical significance remains the same.

However, it's important to note that these findings are relevant for the pandemic period. To ensure the robustness of our analysis, we once again exclude occupations that were unlikely to work during Covid-19. Consequently, the significance of the results for retail shop clerks diminishes – these results become statistically insignificant, whereas the relative wage growth for taxi drivers compared to both control groups remains unchanged.

Overall, these results suggest that the minimum wage did not exert a substantial effect on annual wage growth at the individual occupation level within the treatment group in 2020-2021, since the difference in annual wage growth between the occupations from the treated group and the control group was relatively small. This aligns with the previous group-level yearly effect analysis in Section 5.1., where the average annual wage increase for the treatment group in comparison to the control group was relatively minor, therefore, wage changes at the individual level may not be as pronounced.

Looking ahead to the 2022-2023 period, our regression reveals a broader range of occupations with significant wage effects, depicted in Table 8.

Table 8. The effects of a minimum wage increase on the change in hourly wage, the first control group, 2022-2023

Code	Occupation	Coefficient	Pr(>|t|)	Significance
513202	Bartender	0.0817	9.616861e-03	***
514101	Hairdresser	0.1144	3.392204e-02	**
521102	Market salesperson	0.0939	6.268674e-02	*
531201	Teachers' assistant	0.0552	4.658803e-03	***
541405	Security guard	0.0566	2.513614e-02	**
541911	Protective services person on duty	0.0649	8.525555e-02	*
818204	Steam generator operator	0.0770	8.520684e-02	*
911201	Cleaner	0.0538	3.643378e-07	****
941202	Kitchen worker	0.0527	2.649370e-02	**
961301	Sweeper	0.0507	1.247172e-03	***
962904	Building overseer	0.0902	1.218053e-02	**
962905	Building person on duty	0.0703	1.054495e-02	**
962907	Building & territory person on duty	0.0603	3.000211e-02	**

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ****, ***, ** and * denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels.

For the 2022-2023 period, it is apparent that service providers (identified by codes beginning with "5") and elementary occupations (identified by codes beginning with "9") represent the majority of the occupations with statistically significant effects regarding the minimum wage increase. The interpretation of the coefficients for interaction term is the same as in the regression for the 2020-2021 period, for instance, in 2023, bartenders experienced an approximately 8.17% higher wage growth on average than occupations in

the first control group. The most substantial wage growth difference is observed for hairdressers – on average, their wage growth is approximately 11.44% higher compared to the occupations in the control group following the minimum wage hike. The results vary in significance levels – bartenders, teachers' assistants, cleaners, and sweepers have the highest significance, indicating a more reliable estimate of the effect of minimum wage on wage changes in individual occupations. Nevertheless, our analysis also incorporates results with significance levels of 1-5% and 5-10%.

Regarding the second control group, some occupations demonstrate decreased significance, with coefficients experiencing slight alterations (Table 9), however, there are no substantial variations between the results for the first control group and the second control group, except for the fact that results for market salespersons become insignificant.

We do not exclude service occupations in this case, operating under the assumption that by the 2022-2023 period, the economy has commenced its recovery from the impact of the pandemic. Furthermore, our earlier findings in Section 5.1.1., which showed negligible differences between results that incorporated or omitted service occupations for the 2022-2023 period reinforce our decision to include them in this analysis.

We observe a notable increase in wage growth in occupation categories commonly linked with the shadow economy, where the prevalence of envelope wages is high. In 2022, the services sector accounted for 28.6% of the overall shadow economy size in Latvia (Putnins and Sauka, 2023). The significant wage growth observed in these sectors could be attributed to the fact that employers are now incentivised to adjust wages in response to minimum wage changes – essentially, employers who previously paid wages off the books are now required to formalize a larger portion of these payments due to a higher official minimum wage.

This link between significant wage increases and occupations in the shadow economy underscores the importance of enforcing labour regulations and maintaining consistent minimum wage increases. While minimum wage adjustments aim to improve wage standards and reduce income inequality, their effectiveness may be undermined if envelope wage employment practices persist. One solution could potentially include the implementation of sector-specific minimum wages for those occupations in which envelope wages are prevalent. This approach could help reduce the size of the shadow economy sector and boost tax revenue since employers paying minimum wages would

need to formalize a larger proportion of their payments and adhere to tax regulations based on the updated minimum wage standards.

Table 9. The effects of a minimum wage increase on the change in hourly wage (2022-2023), the second control group

Code	Occupation	Coefficient	Pr(>|t|)	Significance
513202	Bartender	0.0734	3.080694e-02	**
514101	Hairdresser	0.1061	6.846427e-02	*
531201	Teachers' assistant	0.0469	2.466425e-02	**
541405	Security guard	0.0484	7.546321e-02	*
911201	Cleaner	0.0455	4.012986e-05	****
941202	Kitchen worker	0.0445	8.171170e-02	*
961301	Sweeper	0.0425	1.128927e-02	**
962904	Building overseer	0.0819	3.468394e-02	**
962905	Building person on duty	0.0621	3.601740e-02	**
962907	Building & territory person on duty	0.0521	8.198523e-02	*

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ****, ***, ** and * denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels.

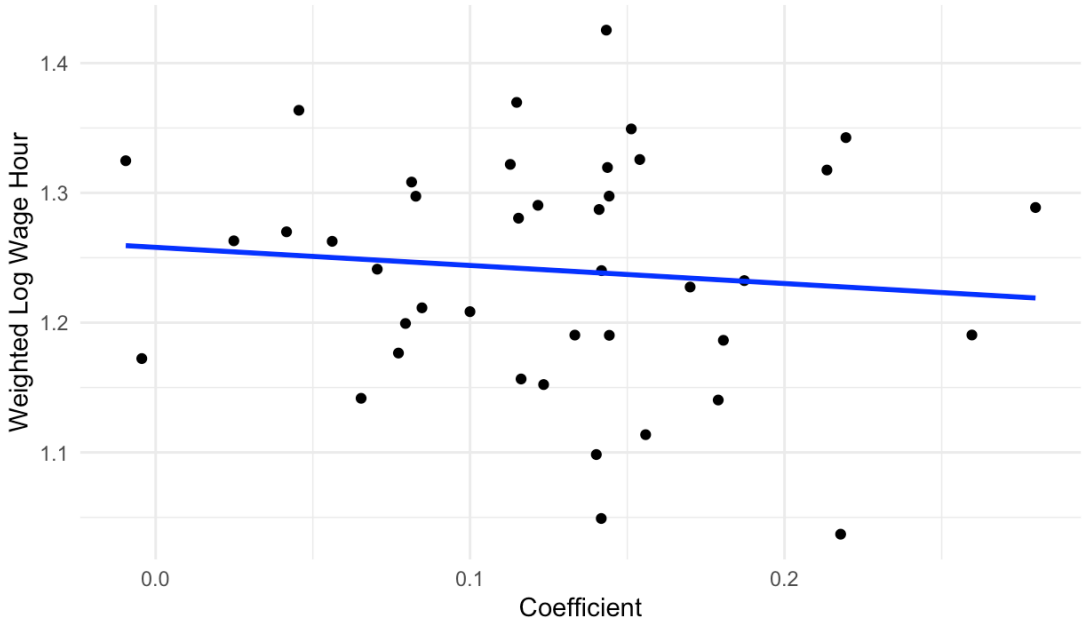
To complement the analyses in the previous sections, we ran regressions to examine the 'January effect' (% change in average wage from December to January) on hourly wages for different occupations for the 2020-2021 and 2022-2023 periods. While the results do not show a significant impact for most occupations, likely due to the limited number of observations per occupation, it is evident that the January effect varies considerably across the treated occupations (e.g. wages do not rise by the same percentage for all occupations).

One potential explanation for this variance is the proximity of an occupation's average wage to the minimum wage threshold; occupations closer to this threshold are more sensitive to wage increases following a minimum wage change and therefore show a more pronounced effect (higher coefficient on the x-axis in Figure 9), which explains the downward slope (or negative relationship between the change in the average wage and the logarithm of the wage) and supports our hypothesis that the closer the occupation's average wage is to the minimum wage, the greater the effect of transmission.

Another possible factor is the influence of the shadow economy. Employers in industries where cash payments are prevalent (with a higher potential for shadow

economy) often already compensate workers at rates that meet the new minimum wage threshold through unofficial payments (the official minimum wage plus additional cash payments as envelope wages). Following the legislative changes, these compensation practices may simply be transferred to official channels without changing the actual remuneration received by employees.

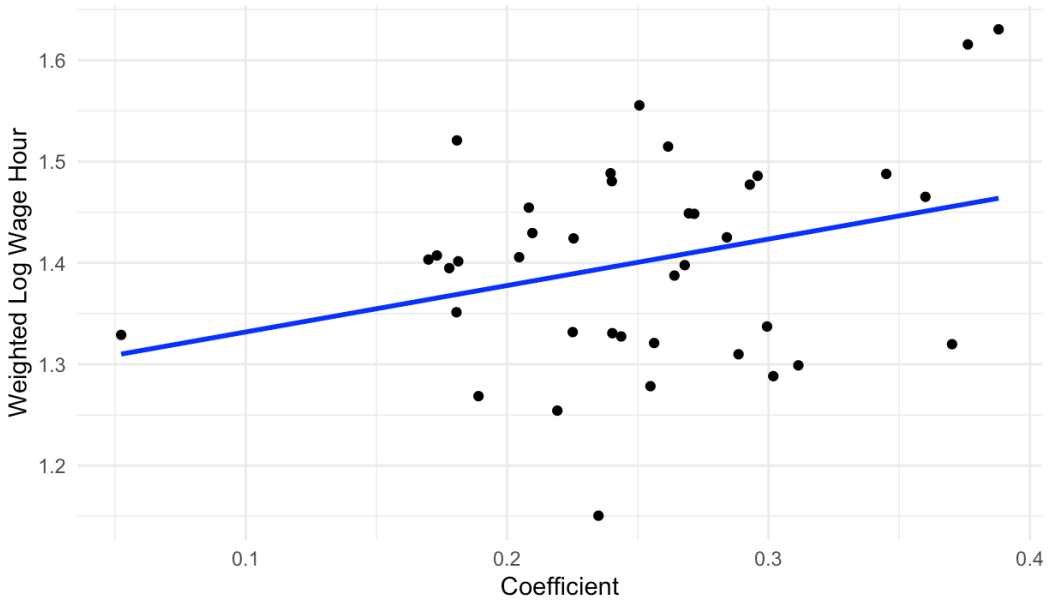
Figure 9. January effect between the change in average wage and the pre-treatment wage, 2020-2021



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

In Figure 10, we see the opposite trend (upward-sloping dynamics), which suggests that while the above hypotheses may still be a partial explanation for the trends, there were other factors that affected the dynamics in a different way in 2022-2023. For example, high inflation in the region was one of the main factors that could have fuelled such dynamics, as it led to general wage increases for all groups to maintain purchasing power, thus distorting the regular explanation of the trends (Finance Latvia Association, 2023).

Figure 10. January effect between the change in average wage and the pre-treatment wage, 2022-2023



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

6. Conclusion and implications

To conclude, our paper provides important insights into the impact of minimum wage changes on the Latvian labour market. Based on the comprehensive data from the State Revenue Service, the study delves into the complexities of how these changes affect different occupational groups in a country known for its high levels of income inequality compared to other EU member states.

The conclusions drawn from the research suggest a mixed impact of the minimum wage increases in 2021 and 2023. The 16% increase in January 2021 led to a small but positive yearly change in the earnings of lower-paid occupations, suggesting a slight improvement in the living standards of individuals in these occupations. However, the impact on income inequalities remained modest due to the relatively uniform wage growth across all occupational groups. In contrast, the January 2023 increase of 24% had a more substantial and rapid impact on the wages of lower-paid groups. Altogether, the primary shifts in wage growth are most pronounced in the initial months following the introduction of the minimum wage, however, the total effect of the minimum wage becomes more widespread, resulting in a smaller yearly wage growth effect.

We also do not find substantial differences between wage changes when omitting service occupations in the 2020-2021 period to factor in the effects of the Covid

pandemic, implying that other factors or dynamics may have primarily influenced wage fluctuations during that time frame and emphasizing the resiliency of the labour market during economic turbulence. The same holds for the 2022-2023 period, for which there were no discrepancies between including and excluding relevant service occupations.

Additionally, the study addresses a common concern about the negative impact of minimum wage increases on employment by showing that there was no significant impact on employment levels following the wage hike. These results imply that the Latvian labour market is resilient in adapting to wage adjustments without resorting to substantial layoffs of workers.

Finally, we find that occupations in service and elementary occupations sector experience the most significant wage growth relative to the control group. Since service and elementary occupations are commonly associated with the prevalence of shadow economy, we conclude that the wage growth in these occupations can be attributed to the formalisation of wages by employers as they adjust their officially reported wages in accordance with the new minimum.

These findings have significant implications for economic policy. One of the main concerns in Latvia is the shadow economy, which is particularly prevalent in lower-paid groups such as service and sales workers. The data suggest that regular, structured increases in the minimum wage could facilitate a transition from unreported cash payments to formal earnings. Additionally, the introduction of sector-specific minimum wages could further reduce the prevalence of the shadow economy and increase tax revenues by formalising previously underreported incomes, altogether increasing the transparency and efficiency of the labour market.

The study also points to the need for systematic and regular adjustments to the minimum wage with a particular focus on occupation-level data to promote equitable growth across all professions. Furthermore, ongoing monitoring of both local and global trends is necessary to ensure that wage increases keep pace with broader economic developments.

These findings support the argument for progressive wage policies as effective tools for reducing wage disparities. The evidence that minimum wage increases do not affect employment levels provides policymakers with a solid empirical basis for pursuing such reforms with confidence.

While the study sheds light on the immediate impacts of minimum wage changes, it emphasizes the importance of long-term evaluations to understand the sustained effects

of such policies on economic trajectories and individual career paths. Moreover, it hints at the complexity of addressing income inequality, suggesting that adjustments to the minimum wage need to be part of a comprehensive strategy that would also include broader economic reforms, improved social policies, and adjustments to the tax system.

Finally, this thesis contributes valuable knowledge to the discussion on wage effects and income inequality, with potential applications that extend beyond academia into the realms of policy formulation and socio-economic development in Latvia. As the country continues to grapple with these issues, the findings of this research could inform the design of future initiatives aimed at building a more equitable and prosperous economy.

6.1. Limitations

One of the limitations of this paper is the lack of comparative analysis with other countries. By focusing exclusively on Latvia, we do not examine how similar minimum wage policies have affected income disparities and employment in economies with comparable labour market structures. This omission limits the generalisability of the findings and the ability to draw broader conclusions about the effectiveness of minimum wage adjustments relative to other countries.

Furthermore, the analysis does not include the most recent minimum wage changes that occurred in 2024 due to the lag in data availability at the time the regressions were run. This temporal limitation potentially omits relevant developments that could influence the understanding of the impact of the minimum wage over a longer period.

As already mentioned, another important limitation stems from the unclear methodology of the SRS regarding the treatment of outliers in their data. Without precisely knowing how outliers were treated and more specifically how many were excluded from the presented database, there is an underlying uncertainty about the robustness of the dataset and, consequently, the findings based on it. The timeframe of the study is also a limitation; the relatively short period covered by the analysis (again due to the unavailability of relevant data) may not capture the long-term effects of minimum wage changes, especially those effects that unfold gradually over time. Also, the methodology used by the SRS for posting the data only on occupations exceeding 10 employees (incl. to prevent data protection issues) introduces a potential inconsistency in the data. This approach may exclude important information from smaller occupations or

those with fluctuating employment numbers, potentially biasing the analysis towards larger and more stable occupations.

In addition, the paper lacks a detailed consideration of external factors (quantitative effects of the pandemic, migration, etc.), mainly due to the unavailability of relevant data. This omission means that the analysis may not fully account for the complex interplay between minimum wage policies and external economic events or trends, which may have a significant impact on income disparities and employment dynamics.

6.2. Suggestions for future research

Taking into account the limitations we have encountered in the course of our work, we outline recommendations for future research.

Subsequent research could extend this study by seeking additional data from the SRS, which would allow for a longitudinal examination of the lasting effects of minimum wage changes. Such data would allow researchers to construct a more detailed narrative of the long-term effects on both individuals and the overall economy. Furthermore, industry-specific analysis reveals a promising potential for further exploration; while current datasets may not provide sufficient granularity, targeted data collection efforts could shed light on how minimum wage adjustments spill over into different sectors (Manufacturing, Education, etc.) of the economy, each of which is likely to respond uniquely to policy changes.

Moreover, despite the current lack of directly comparable data, cross-country analysis is a compelling frontier. It would require the collection of harmonised datasets or the development of a methodology to compare the effects of minimum wage policies across different economic systems. This could provide valuable insights into the transferability and adaptability of the policy across different economic landscapes.

In addition, the inclusion of a qualitative component would greatly enrich the quantitative evidence. By conducting interviews with workers, employers, and policymakers affected by minimum wage changes, researchers could capture the distinct social and economic impacts that numbers alone may not fully convey. Surveys could further detail the personal and community impact of these changes (e.g. on specific reasons for employment fluctuations), providing a vivid portrayal of the real-life experiences behind the statistics. This mix of quantitative and qualitative research could

offer a comprehensive understanding of the role of minimum wage policy in shaping macroeconomic patterns.

7. Appendix

Appendix 1. Summary statistics for hourly wages weighted by employment by major groups, 2020

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	14	6.10	7.70	6.78	6.63	0.459
1 – Managers	306	8.67	10.8	9.65	9.64	0.619
2 – Professionals	654	8.34	11.3	9.69	9.57	1.01
3 – Technicians and Associate Professioanls	519	7.09	8.95	7.95	8.06	0.531
4 – Clerical Support Workers	133	5.88	7.41	6.51	6.53	0.398
5 – Services and Sales Workers	159	4.33	5.13	4.62	4.62	0.214
6 – Skilled Agricultural, Forestry and Fishery Workers	61	4.50	5.50	4.84	4.78	0.267
7 – Craft and Related Trades Workers	305	5.94	7.27	6.33	6.37	0.344
8 – Plant and Machine Operators and Assemblers	234	5.51	6.72	5.96	5.96	0.330
9 – Elementary Occupations	99	3.94	4.76	4.35	4.40	0.213

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 2. Summary statistics for number of employees by major groups, 2020

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	14	4690	6535	6112	6178	486
1 – Managers	306	83106	88887	86230	86512	1892
2 – Professionals	654	113463	146501	139520	143872	9194
3 – Technicians and Associate Professioanls	519	96532	106532	102906	103650	3239
4 – Clerical Support Workers	133	42175	49832	46365	46932	2483
5 – Services and Sales Workers	159	85061	110604	101673	104584	7550
6 – Skilled Agricultural, Forestry and Fishery Workers	61	4414	4951	4737	4781	190
7 – Craft and Related Trades Workers	305	67031	73100	70086	69976	2178
8 – Plant and Machine Operators and Assemblers	234	65066	69417	67534	67770	1681
9 – Elementary Occupations	99	87498	103634	96520	98115	4624

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 3. Summary statistics for hourly wages weighted by employment by major groups, 2021

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	6.07	9.55	7.22	7.06	0.827
1 – Managers	304	9.26	11.3	10.4	10.4	0.477
2 – Professionals	662	9.14	13.1	10.9	10.6	1.15
3 – Technicians and Associate Professioanls	519	7.63	9.79	8.7	8.75	0.523
4 – Clerical Support Workers	135	6.37	7.77	7.06	7.07	0.345
5 – Services and Sales Workers	160	4.64	5.65	5.19	5.15	0.258
6 – Skilled Agricultural, Forestry and Fishery Workers	61	4.74	5.84	5.22	5.21	0.253
7 – Craft and Related Trades Workers	304	6.11	7.76	6.81	6.80	0.386
8 – Plant and Machine Operators and Assemblers	238	5.77	7.41	6.5	6.53	0.377
9 – Elementary Occupations	99	4.28	5.23	4.80	4.84	0.241

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 4. Summary statistics for number of employees by major groups, 2021

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	6429	6622	6536	6356	69.5
1 – Managers	304	73389	91086	87186	88709	4806
2 – Professionals	662	115186	151860	144806	147732	9797
3 – Technicians and Associate Professioanls	519	102348	109208	106195	106277	2351
4 – Clerical Support Workers	135	43731	48191	46144	46582	1641
5 – Services and Sales Workers	160	85730	106123	98260	100136	7655
6 – Skilled Agricultural, Forestry and Fishery Workers	61	4428	5112	4838	4942	260
7 – Craft and Related Trades Workers	304	67630	73168	71158	71536	1814
8 – Plant and Machine Operators and Assemblers	238	65036	69823	67844	68271	1538
9 – Elementary Occupations	99	89675	101199	96646	97796	4301

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 5. Summary statistics for hourly wages weighted by employment by major groups, 2022

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	6.51	13.5	8.58	8.27	1.76
1 – Managers	303	9.74	12.4	11.1	11.0	0.702
2 – Professionals	665	10.2	14.4	11.9	11.5	1.25
3 – Technicians and Associate Professioanls	521	8.31	10.7	9.34	9.25	0.633
4 – Clerical Support Workers	135	6.88	8.88	7.78	7.77	0.539
5 – Services and Sales Workers	160	5.15	6.37	5.63	5.63	0.320
6 – Skilled Agricultural, Forestry and Fishery Workers	56	5.23	6.61	5.71	5.67	0.340
7 – Craft and Related Trades Workers	304	6.84	8.62	7.51	7.51	0.473
8 – Plant and Machine Operators and Assemblers	236	6.56	8.31	7.26	7.30	0.466
9 – Elementary Occupations	100	4.70	5.79	5.22	5.23	0.299

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 6. Summary statistics for number of employees by major groups, 2022

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	6434	6715	6516	6494	80.3
1 – Managers	303	88130	933466	90886	90898	1315
2 – Professionals	665	121760	159376	150756	152445	9836
3 – Technicians and Associate Professioanls	521	103357	109378	106891	106910	1648
4 – Clerical Support Workers	135	47032	51815	48581	48496	1165
5 – Services and Sales Workers	160	100841	109210	105842	106640	2707
6 – Skilled Agricultural, Forestry and Fishery Workers	56	4343	5031	4782	4874	254
7 – Craft and Related Trades Workers	304	68975	72724	71295	71818	1326
8 – Plant and Machine Operators and Assemblers	236	65875	69201	67773	67929	1186
9 – Elementary Occupations	100	93681	103168	99070	100200	3169

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 7. Summary statistics for hourly wages weighted by employment by major groups, 2023

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	7.45	12.4	9.43	9.05	1.24
1 – Managers	299	10.8	14.8	12.6	12.6	1.03
2 – Professionals	634	10.9	16.3	13.2	13.0	1.61
3 – Technicians and Associate Professioanls	512	9.02	12.5	10.4	10.5	0.946
4 – Clerical Support Workers	132	7.65	10.1	8.67	8.69	0.646
5 – Services and Sales Workers	157	5.66	7.38	6.39	6.39	0.444
6 – Skilled Agricultural, Forestry and Fishery Workers	54	5.95	7.43	6.54	6.51	0.371
7 – Craft and Related Trades Workers	307	7.57	9.93	8.46	8.45	0.593
8 – Plant and Machine Operators and Assemblers	231	7.37	9.65	8.29	8.33	0.575
9 – Elementary Occupations	100	5.28	6.79	5.95	5.98	0.395

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 8. Summary statistics for number of employees by major groups, 2023

Major group	Occupations	Min	Max	Mean	Median	Standard deviation
0 – Armed forces	15	6545	6872	6650	6598	121
1 – Managers	299	87225	90339	89530	89944	993
2 – Professionals	634	124955	160613	154353	157150	9581
3 – Technicians and Associate Professioanls	512	104636	108335	106739	106730	943
4 – Clerical Support Workers	132	47266	48697	48229	48410	469
5 – Services and Sales Workers	157	103569	107850	105362	105076	1375
6 – Skilled Agricultural, Forestry and Fishery Workers	54	4374	5037	4823	4920	231
7 – Craft and Related Trades Workers	307	65199	69927	68356	68665	1482
8 – Plant and Machine Operators and Assemblers	231	63219	67343	66030	66180	1153
9 – Elementary Occupations	100	93181	101482	98026	98210	2434

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 9. The effects of a minimum wage increase on the change in hourly wage, the second control group, 2020-2021

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.2386	0.00203	1105.042	< 2e-16	***
treated	-0.8604	0.00589	-146.128	< 2e-16	***
time	0.0838	0.00287	29.185	< 2e-16	***
treated:time	0.0241	0.00836	2.882	0.00396	*

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 38165 observations, and the R^2 value is 0.7694.

Appendix 10. The effects of a minimum wage increase on the change in hourly wage, the second control group, 2022-2023

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.3930	0.00198	1207.210	< 2e-16	***
treated	-0.8658	0.00607	-142.469	< 2e-16	***
time	0.1070	0.00281	38.091	< 2e-16	***
treated:time	0.0586	0.00860	6.811	9.82e-12	***

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 38430 observations, and the R^2 value is 0.5015.

Appendix 11. The effects of a minimum wage increase on the change in employment, the first control group, 2020-2021

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	4.2140	0.01480	284.721	< 2e-16	***
treated	0.4390	0.03254	13.489	< 2e-16	***
time	0.0325	0.02099	1.547	0.122	
treated:time	-0.0237	0.04623	-0.513	0.608	

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 21812 observations, and the R^2 value is 0.01553.

Appendix 12. The effects of a minimum wage increase on the change in employment, the second control group, 2020-2021

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	4.3179	0.01045	413.266	< 2e-16	***
treated	0.3351	0.03037	11.035	< 2e-16	***
time	0.0266	0.01481	1.793	0.073	.
treated:time	-0.0178	0.04314	-0.413	0.680	

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 38165 observations, and the R^2 value is 0.006.

Appendix 13. The effects of a minimum wage increase on the change in employment, the first control group, 2022-2023

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	4.2969	0.01411	304.583	< 2e-16	***
treated	0.2694	0.03313	8.130	4.52e-16	***
time	0.0198	0.01999	0.991	0.322	
treated:time	-0.0170	0.04690	-0.362	0.718	

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 23179 observations, and the R^2 value is 0.005.

Appendix 14. The effects of a minimum wage increase on the change in employment, the second control group, 2022-2023

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	4.3602	0.01018	428.296	< 2e-16	***
treated	0.2060	0.03121	6.601	4.14e-11	***
time	0.0140	0.01444	0.970	0.332	
treated:time	-0.0112	0.04419	-0.253	0.801	

Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 39430 observations, and the R^2 value is 0.002.

Appendix 15. The effects of a minimum wage increase on the change in hourly wage (excluding relevant service occupations), the second control group, 2020-2021

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.2388	0.0020	1100.502	< 2e-16	***
treated	-0.8477	0.0063	-135.463	< 2e-16	***
time	0.0838	0.0029	29.053	< 2e-16	***
treated:time	0.0206	0.0089	2.323	0.0202	*

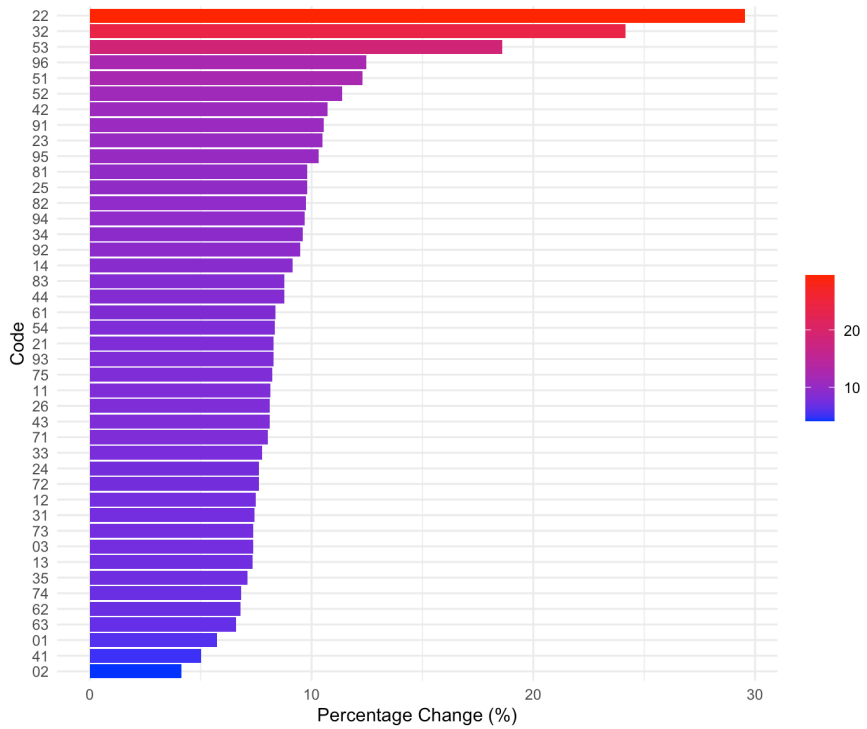
Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 37615 observations, and the R^2 value is 0.4934.

Appendix 16. The effects of a minimum wage increase on the change in hourly wage (excluding relevant service occupations), the second control group, 2022-2023

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	2.3938	0.0019	1202.182	< 2e-16	***
treated	-0.8594	0.0064	-133.814	< 2e-16	***
time	0.1071	0.0028	37.938	< 2e-16	***
treated:time	0.0582	0.0091	6.402	1.55e-10	***

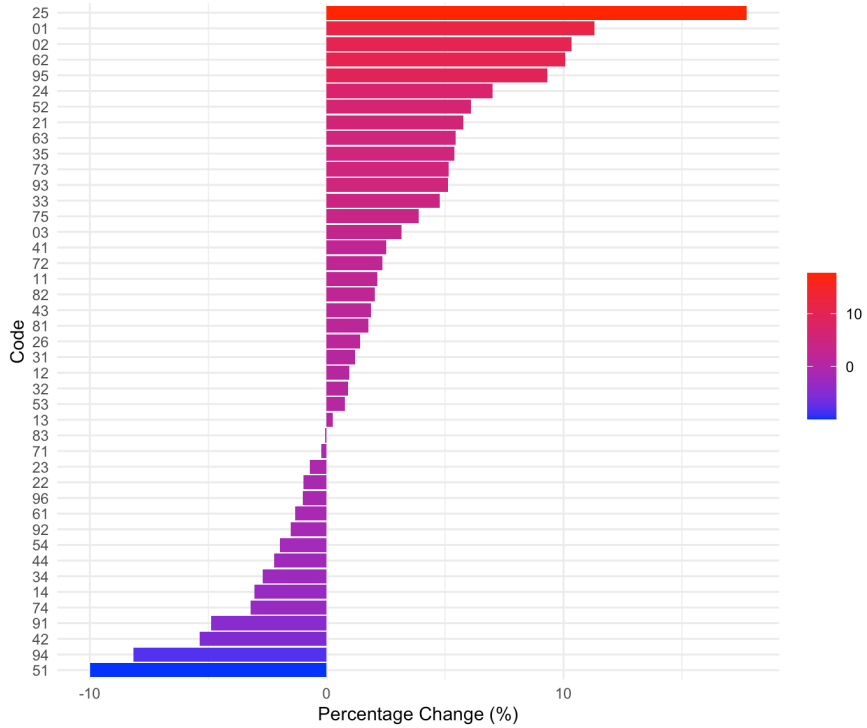
Notes: This table is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information. ***, **, *, and . denote statistical significance at 0-0.1%, 0.1-1%, 1-5%, and 5-10% levels. This regression includes 38875 observations, and the R^2 value is 0.4748.

Appendix 17. Percentage Change in Weighted Average Wage by Code, 2020-2021



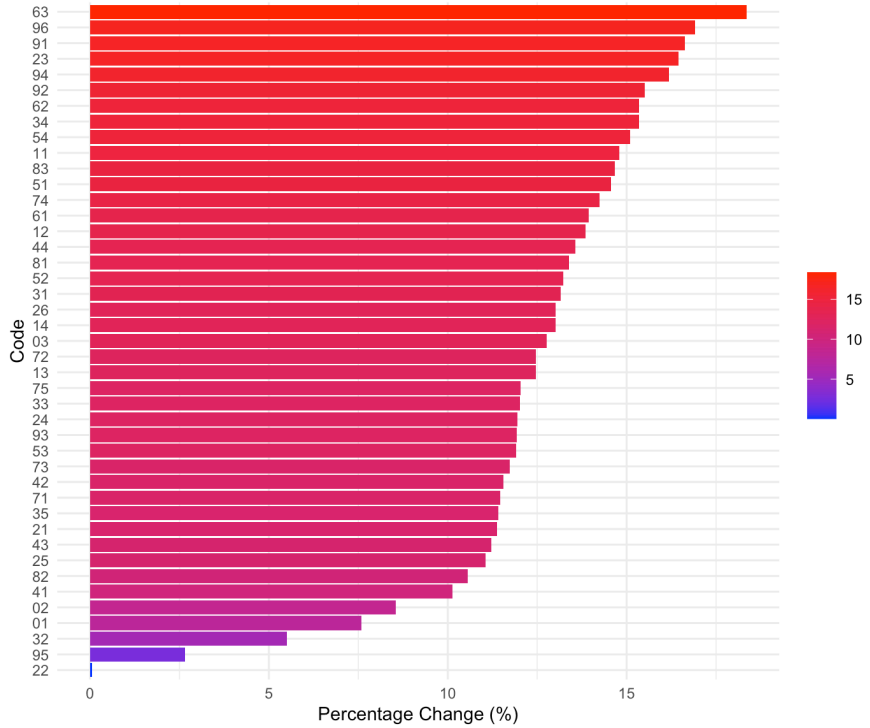
Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 18. Percentage Change in Average Employment by Code, 2020-2021



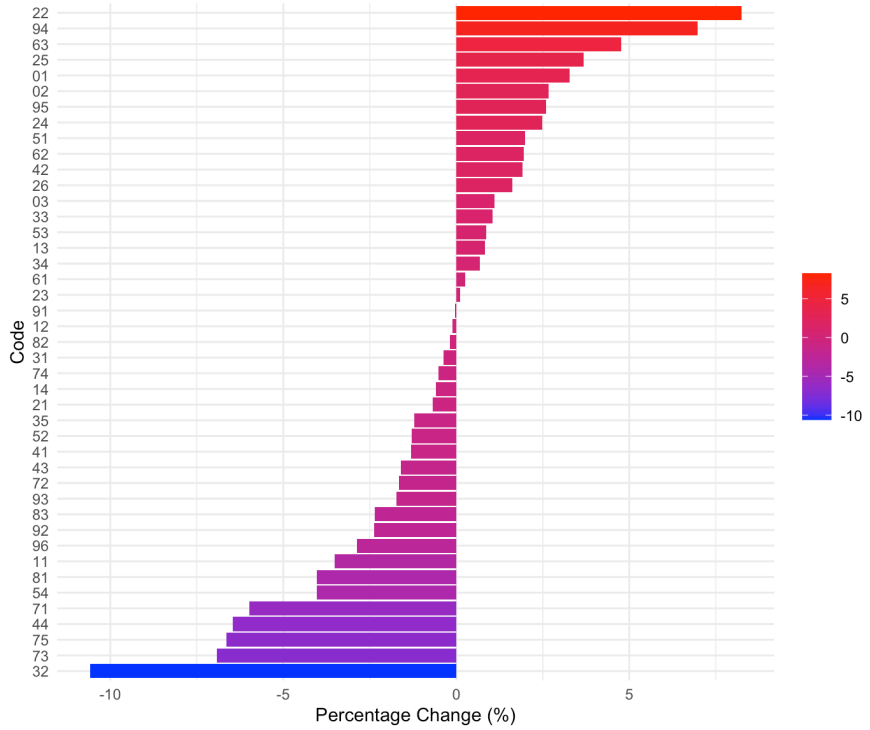
Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 19. Percentage Change in Weighted Average Wage by Code, 2022-2023



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

Appendix 20. Percentage Change in Weighted Average Employment by Code, 2022-2023



Notes: This graph is made using data from the State Revenue Service. The calculations are performed by the authors, based on the aforementioned information.

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