



SSE RIGA

Bachelor Thesis

**Minimum Wage Policy and Its Historical Effect on
Envelope Wages in Latvia**

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April 2017

Riga

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Abstract

This paper examines the impact of historical minimum wage hikes on informal salaries of employees, often called envelope wages. The research studies a period in Latvia from the beginning of 2010 to the end of 2015 during which a total of three minimum wage changes were implemented: in 2011, 2014, and 2015. Minimum wage – the lowest boundary for a legal monthly salary that a full-time employee receives – is set and regulated by a country’s governing policymakers. When applied with proper caution, this instrument can be an effective tool for reducing economic inequality, raising national average wage levels, and tackling shadow economy, which, however, is not always the case. A misplaced minimum wage is likely to increase the level of informality in the labour market. As of 2015, approximately 42.9% of the shadow economy of Latvia comes from envelope wages. This paper investigates the impact that the minimum wage hikes of 2011 and 2015 had on net total, formal, and informal wages, determining whether those changes were successful in tackling shadow economy or not. Using a dataset of yearly company survey results, we apply a difference-in-differences model to estimate the pure quantitative effect of those minimum wage changes. We find that the level of wage informality had increased due to the minimum wage hike of 2011, whereas the hike of 2015 effectively reduced the extent of envelope wages. These findings should be of interest to policymakers in Latvia, as well as other European countries with similar shadow economy problems.

1. Introduction

In times of globalisation, close trading relations, and relatively open access to information, countries across the globe are still unlike each other – both culturally and economically. While cultural differences can be explained by exogenous reasons, the evolution and growth of a country's economy or wealth are subject to more clearly defined factors; governance and policy implications being some of them. The decisions made by the governing entities can often be value-creating and efficient; however, if they are not approached with certain caution, some policy implications or imposed regulations can cause more harm than good. One of such policy instruments is the minimum wage (Leonard, 2000).

1.1. Background on Minimum Wages

Minimum wage and topics surrounding it is a popular research subject due to its uncertain and sensitive nature (Rutkowski, 2003; Baker, Benjamin, & Stanger, 1999; Meer & West, 2013). Minimum wage is often wrongly perceived as the ultimate instrument for reducing inequality, decreasing the level of shadow economy as well as increasing the national average wage. Partly this is true, if the minimum wage hike is appropriate. However, practice shows that a misplaced hike in the minimum wage might as well actually decrease the real average wage and even lower the employment, which might cause an increase in the shadow economy (Nataraj, Perez-Arce, Srinivasan, & Kumar, 2014, as cited in International Labour Organization, n.d.). In the worst-case scenario, the negative impact could exceed the possible benefits; hence minimum wage possesses a rather complex trade-off.

Current literature has led to a conclusion that minimum wage policy is a very country-specific issue; thus, there are no guidelines or situations for imposing any changes in the minimum wage that will guarantee success for all countries (IMF, 2016). Nevertheless, many researchers have established some provisional boundaries or recognised possible consequences of certain actions. For example, Rutkowski (2003) argues that minimum wage normally should not exceed 40% of the average wage in developing countries, especially if unemployment is high, adding to a joint estimate of 25–35% by ILO, IMF, OECD, and World Bank (International Labour Organization, 2012).

Williams and Padmore (2013) find that in the entire European Union approximately one in 18 formally employed workers receive a fraction of their salary informally. This undeclared (thus, untaxed) fraction of the salary is often known as the “envelope wage” and it accounts for up to 25 per cent of the gross salary on average in the European Union (Williams & Padmore, 2013). Williams and Padmore (2013) argue that the minimum wage is often set at around half of the average wage level in Central and Eastern European countries. Although a small minimum wage helps to prevent an undesired switch to an informal employment, it also provides more room for envelope wages. Hence, the argument is that raising the minimum wage increases the proportion of wage that is paid out legally (Williams & Padmore, 2013).

1.2. Relevance of Minimum Wage in Latvia

The history of recent minimum wage changes in Latvia is summarised in Table 1. It has been adjusted five times so far during the 2010s: from 256 EUR at the start of the decade to 380 EUR in 2017 (Ministry of Welfare of Latvia, n.d.). During this period, the new minimum wage has always been implemented on the 1st of January of each of the corresponding years. Sharp increases were mostly agreed as necessary and supported by many economists at the time (Krasnopjorovs, 2011; Purviņš, 2010).

Minimum wage in Latvia in the 2010s		
<i>Year</i>	<i>LVL</i>	<i>EUR</i>
2009	180	256.12
2011	200	284.57
2014	224.90	320
2015	253.01	360
2016	260.04	370
2017	267.07	380

Table 1. Minimum wage in Latvia in the 2010s.

Made by authors, data from Ministry of Welfare of Latvia (n.d.).

As for the latest data for the 4th quarter of 2016, the minimum wage in Latvia stands at 42.5% of the average wage (Central Statistical Bureau of Latvia, n.d.-a). This number is slightly above the European Union average (Fadejeva & Krasnopjorovs, 2016) and exceeds the desired boundaries estimated by Rutkowski (2013) and IMF (2016). Raising the minimum wage frequently surfaces as a subject of discussion and is often a politically very sensitive one. Economists at the Bank of Latvia have recently warned against any significant hikes in the minimum wage (Fadejeva & Krasnopjorovs, 2016; Krasnopjorovs, 2016). Due to the sharp increases in the previous years, it is argued that companies might not be able to maintain a growth in their efficiency and productivity as fast as the minimum wage grows, thus options for optimizing any non-labour-related expenses would become limited. Fadejeva and Krasnopjorovs (2016) also state the significantly unequal distribution of income among regions of Latvia as one of the reasons to maintain the minimum wage at current levels.

Shadow economy as such can be split into three main categories: envelope wages, unreported business income, and unreported employees (Putniņš & Sauka, 2015). Putniņš and Sauka (2015) report that approximately 42.9% of the Latvian shadow economy comes from envelope wages. They also find that approximately 17% – a number rather high even for Central and Eastern European countries – of the employees in Latvia receive an envelope wage. In compliance with the empirical findings by Williams and Padmore (2013), the excessive shadow economy indicators could be reduced with a proper minimum wage policy. The fact that the high level of envelope wages is ignored can come along with undesired consequences: (1) workers may have restricted access to credit due to their unreported income; (2) their social security (including pensions) may be limited; (3) employers who pay more envelope wages foster unfair competition which can cause a general labour market chaos; (4) less fiscal income prevents government from ensuring more effective welfare and social protection (Williams & Padmore, 2013). Hence, the problem of such high informality must be tackled.

What makes the case of Latvia research-worthy is the inevitable presence of the previously described contradicting arguments. Latvia lacks its own in-depth research that would produce any valuable conclusions or suggestions regarding the policy. An empirical analysis of historical minimum wage hikes and their impact on the level of

shadow economy will provide a valuable contribution on assessing the relation between the two factors. Battling informality is an issue many countries face. This research contributes to the general literature of labour economics by providing additional knowledge on policy implications. The case of Latvia is an interesting target for research due to its relatively high level of shadow economy among other developed countries. To the best of our knowledge, there are no explicit quantitative studies on this topic neither for Latvia, nor other countries with similar attributes in Central and Eastern Europe. Most of the past literature in this field mostly considers developing countries or the impact of minimum wage on other economic factors such as employment or average wage.

We also believe that findings of this paper could be of assistance to policy makers in making more grounded policy decisions both in Latvia and countries with similar market structure for using minimum wage as one of the tools to decrease the extent of the shadow economy. To achieve that we formulate the following research question:

What has been the impact of minimum wage changes on the formal, informal, and total wages in Latvia?

The structure of the remainder of the paper proceeds as follows. Section 2 describes previous academic studies in the field. We distinguish separate sections for the impact of minimum wage on three different variables: employment, wages, and wage distribution. Each subsection considers relevant theoretical frameworks, provides notable existing findings, and discusses methods used in other studies. Section 3 introduces the dataset and described the data sorting process. We also describe mechanics of our methodological model and justify its use. The results of the analysis are further presented in section 4. The paper continues with a more analytical and thorough discussion of the results in section 5; we distinguish three sub-sections in which we consider the implications of our results, the novelty of our study, and the limitations that we faced. The main conclusions of our study are drawn in section 6.

We study the minimum wage changes of 2011 and 2015. We find that both hikes have had a different impact on net total, informal, and formal salaries. The total and informal wages had increased, but the formal wage had decreased following the

minimum wage hike of 2011. Whereas, after the minimum wage hike of 2015, the total and formal wages had increased contrary to a drop in the informal wage.

2. Literature Review

Numerous attempts have been made by economists to establish models covering the labour markets and therefore predict the impact of minimum wage policy implications on the employment and salaries in the market, such as Harris and Todaro (1970). Despite the efforts by previous authors, models often tend to be oversimplified due to a simple practical reason – government interventions are hardly predictable; moreover, the possible effects of predicting relationship between minimum wage and economic factors become more ambiguous if we consider both the formal and informal sectors of a labour market. Some of the most commonly used models are introduced below.

In addition to models, we link those theoretical frameworks to empirical evidence to gain a more valuable insight. However, empirical evidence on the impact of minimum wage is rather scarce, in particular with regards to the impact of minimum wage on the informal labour sector (Lemos, 2009). This ambiguous relation has lately become a more popular subject to research, especially in the past ten years. Since then multiple authors have attempted to identify how minimum wage hikes might affect the wage distribution and the size of the informal sector.

Because the extent of the shadow economy and the wage distribution in the informal sector cannot be captured by official data, it must be estimated based on data from anonymous surveys, in which the respondents have little to no incentives to lie. Data from such surveys have been used in several studies to determine the impact of minimum wage changes on the informal sector. For this reason, we also examine different methods used in previous researches. The literature review is split into separate sections for each different factor – employment, wage levels, and income distribution.

2.1. Impact on Employment

2.1.1. Theory. The Harris–Todaro model was first developed and presented in 1970 by Harris and Todaro (1970). Although some assumptions that the model is based on are considered faulty, the main idea is crucial in understanding the labour markets. The

model introduces the dual-labour market idea, meaning that there exist two labour markets – the formal and the informal (Harris & Todaro, 1970). Before the introduction of any legal or formal limitations (e.g., the minimum wage) the model predicts no unemployment and that the wage on both sectors is equal. However, after a minimum wage is imposed, part of the formally employed workers will lose their jobs, which in turn will increase the wage in the formal sector. Some of the displaced workers will remain unemployed, but a fraction of them will join the informal labour market instead, causing the informal wage to go down as labour supply increases (Harris & Todaro, 1970). In short, the Harris–Todaro model predicts an opposite impact on both employment and wages in both sectors: minimum wage will increase the informal labour employment, but decrease the formal employment. However, the model does not consider the level of the minimum wage that could cause discrepancies. The effects could differ substantially if the wage is set either above or below the initial equilibrium wage.

2.1.2. Empirical evidence. Jones (1997) studied the effects of minimum wage changes in Ghana. The main reason for choosing Ghana is the bad state of the labour market. It has remained rather “incomplete”, meaning that the fraction of people working in the informal sector is very large. Jones (1997) considers a data sample that stretches through three decades starting in the 1970s up to 1990s. Results show that minimum wage has a negative impact on formal employment. However, Jones (1997) shows that firms that complied with the changes in legislation fired far more people than those that did not, leading to a conclusion that employment in informal sector has, in fact, risen due to hikes in the minimum wage. The main argument is that many displaced workers from the formal sector simply end up in the informal sector (Jones, 1997).

Hohberg and Lay (2015) attempted to find the impact of minimum wage changes on the employment in both formal and informal sectors in Indonesia, yet another developing state. Contrary to the previous paper, they find that a minimum wage hike in Indonesia has a small, but statistically significant positive impact on formal sector employment. Hohberg and Lay (2015) argue that employers use different adjustment channels besides simply laying off the labour force to absorb the increasing costs.

Gindling and Terrell (2002) conducted an analysis from household surveys in the period from 1980 to 1996 in Costa Rica, another country with a significant informal sector. They find that minimum wage hikes have a positive impact on the employment in the informal sector; however, contrary to Jones (1997), Gindling and Terrell (2002) show that the formal employment is left unchanged. Instead the average number of working hours per worker has increased. They explain this bizarre result as a consequence of employers switching their employees from part-time workers to full-time workers. This is in compliance with Hohberg & Lay (2015) as authors suggest that different adjustment channels are more popular amongst employers.

A paper by Lemos (2009) provides more empirical evidence from Brazil. This article shows results on the impact of minimum wage on employment estimated with different methodological methods and multiple robustness checks. However, unlike any of the other papers, Lemos (2009) states that minimum wage changes have no impact on both the number of workers and the number of hours worked.

2.1.3. *Methods used in other studies.* Alatas and Cameron (2003) used the difference-in-differences (DID) method to analyse the impact of minimum wage on employment in Indonesia in 1990–1994. Two of the country’s regions, Botabek and Jakarta, were used as the treatment group and control group respectively; in the beginning of the period the minimum wage was 36% higher in Jakarta, but by 1994 the two regions had the same minimum wage (Alatas & Cameron, 2003).

2.2. Impact on Wages

2.2.1. *Theory.* In addition to Harris and Todaro (1970) model that predicts a positive relation between minimum wage and formal sector wages, Harrison and Leamer (1997) introduce a theoretical framework that links capital, labour, and output. The model also considers both the formal and informal (covered and uncovered) sectors. Harrison and Leamer (1997) argue that a minimum wage hike is likely to cause a capital reallocation to the uncovered sector, especially to the labour-intensive uncovered sector. This would cause the informal wages to appreciate; however, the framework does not predict the impact on employment.

In addition to the previous frameworks, Fiszbein (1992) presents a model to analyse the impact that minimum wage changes might have on wages in the informal sector. Fiszbein (1992) opposes the general view in the literature that a reduction in minimum wage will increase employment in the formal sector due to a fall in effective supply of labour in the informal sector. A decrease in the effective supply of labour in the informal sector would also cause an increase in informal wages. Instead, the model proposed by Fiszbein (1992) introduces a new approach – the formal and informal sectors are linked not only through labour markets, but also by goods markets. Hence, a change in the minimum wage will affect informal sector earnings through two channels: changes in labour productivity and changes in relative prices. Considering this argument, Fiszbein (1992) concludes that, due to the negative impact of minimum wage on formal employment, minimum wage has a positive impact on informal wages.

2.2.2. Empirical evidence. Khamis (2013) conducted a thorough research on the impact of minimum wage hikes on both formal and informal sector salaries in Argentina. This paper makes robust conclusions that informal sector wages are more sensitive to any changes in the minimum wage than formal sector wages are. It is concluded that informal workers experience significant increases in their salaries contrary to no effect for formal workers, when minimum wages are raised (Khamis, 2013). An earlier paper by Kostzer (2006, as cited in Khamis, 2013) analyses a similar dataset that includes minimum wage hikes in Argentina in the period from 1993 to 2004. The conclusions drawn by Kostzer overlap with the ones by Khamis (2013) despite the different approaches in methodology.

Gindling and Terrell (2002) in their paper on Costa Rica find direct evidence for the impact of minimum wage on salaries in both sectors. Authors argue that a hike in minimum wage will increase wages in the formal sector, but decrease the average wage in the informal sector. However, Gindling and Terrell (2002) argue that this might come from the deviations in employment allocation. As explained in the previous section, Gindling and Terrell (2002) also noted that informal employment increases along with hikes in the minimum wage; thus, increased labour supply could drive down the average salary.

Indonesia, a popular subject for labour economists, was examined by Chun and Khor (2010). Their findings indicate that minimum wage hikes in Indonesia are strongly

associated with significant increases in the formal sector wage; no evidence for any wage changes in the informal sector is found. The findings of this paper are in compliance with Rama (2001), despite the differences in datasets. Rama (2001) uses a dataset from the first half of 1990s, when Indonesia's minimum wage was commonly revised. Author concludes that doubling the minimum wage would cause a 10 per cent increase in the average wage.

2.2.3. *Methods used in other studies.* Khamis (2013) used the DID method; in this case, it was used to analyse the impact of minimum wage changes in Argentina in 1993 and 2004. The author used data from household surveys and constructed a regression model including wage as the dependent variable. In the model, the treatment group included observations in regions with lower average wage, while the control group consisted of regions with a relatively high average wage. The regressions were run three times, once for the formal wage, once for the informal wage, and once for the total wage, thus allowing to compare the impact for the various components of wage.

2.3. Impact on Wage Distribution

2.3.1. *Empirical evidence.* Maloney and Mendez (2003) studied wage distributions in both formal and informal sectors for eight Latin American countries. They find evidence in all countries for an interesting phenomenon – also known as the *lighthouse effect*. This means that the informal sector is influenced by outer factors (such as the minimum wages) that technically are not bound to it. Moreover, the influence of the minimum wage seems to have a much stronger effect on the informal sector (Maloney & Mendez, 2003). Using density plots for all countries, authors show that changes in the minimum wage cause significant distortions in the wage distribution in the informal sector whereas the effects in the formal sector are barely noticeable. This is a cornerstone argument to be considered when analysing possible consequences of minimum wage policies.

A paper on Costa Rica by El Hamidi and Terrell (2001) examines the impact of minimum wage on income distribution. They find that an increase, at the median, by a unit in the minimum wage relative to the average wage reduces wage inequality by 0.9 per cent in the formal sector. The effect is even larger in the informal sector – 1.7 per cent.

Lemos (2009) tests the impact of minimum wage hikes on the wage distribution in Brazil. This paper shows that increases in the minimum wage associate with improved income equality. Wages in the formal sector become more “compressed”, with the spike being more apparent in the low-income tail. Moreover, wages in the informal sector also become more concentrated with outliers moving closer to the spike. The mode in the informal sector wage distribution increases in compliance with the minimum wage. As previously argued, Lemos (2009) also showed that minimum wage hikes have no impact on employment in Brazil. Both findings combined indicate that minimum wage policy can be an effective tool in decreasing economic inequality with little sacrifice.

2.3.2. *Methods used in other studies.* Rani et al (2013) used survey data from 11 countries to measure compliance with the minimum wage. The authors of the paper used labour survey data to calculate the percentage of the working population that earns less than the minimum wage. In addition to Lemos (2009), they also used kernel density estimation to plot the logarithm of the difference between actual wage and the minimum wage and checked for spikes in the distribution; a more prominent spike at point 0, which shows the amount of people receiving minimum wage, indicates the country has more binding minimum wage regulations (Rani et al, 2013).

2.4. Conclusions from Literature Review

Some of the countries from the articles, which we consider in the literature review, might seem irrelevant for a comparison with Latvia at the first glance. However, we believe that looking at developing countries such as Brazil, Argentina or even Indonesia, is a more reasonable choice than taking, for instance, countries such as Germany or the UK. We aim to base our empirical background on countries as close as possible to Latvia in terms of labour market informality and overall economic development. Western European countries where approximately 5-6% of employees (Williams & Padmore, 2013) are engaged in a quasi-formal employment does not even approach the scope of shadow economy in Latvia, thus making little sense to compare such countries. On the other hand, we would be gladly interested in considering other Eastern European countries, but, to the best of our knowledge, this field of study lacks high quality articles on the topic from highly rated economic journals.

Summary of theoretical frameworks

<i>Article</i>	<i>Proposed change</i>	<i>Impacted variable</i>	<i>Effect</i>
		Formal wage	Increase
<i>Harris and Todaro (1970)</i>	Minimum wage increase	Informal wage	Decrease
		Informal employment	Increase
<i>Harrison and Leamer (1997)</i>	Minimum wage increase	Informal wage	Increase
		Formal employment	Increase
<i>Fiszbein (1992)</i>	Minimum wage decrease	Informal wage	Increase

Table 2. Summary of theoretical frameworks from past literature.

Made by authors.

Theoretical models like Harris–Todaro (1970) and Fiszbein (1992) predict that a minimum wage hike is more likely to decrease employment in the formal sector and, thus, increase employment in the informal sector (Table 2 summarises predictions of theoretical models). At the same time, empirical evidence from different countries has provided contradicting and ambiguous results. Only Jones (1997) found empirical evidence from Ghana that complies with the theoretical framework of Harris and Todaro (1970). Papers like Hohberg and Lay (2015), Gindling and Terrell (2002), and Lemos (2009) argued that an increase in minimum wage most often causes either a small positive impact on the formal employment or none, at all (Table 3 summarises predictions of empirical findings from previous papers). It is argued that employers have a wide variety of different adjustment channels through which they can adjust their labour costs.

As for the minimum wage impact on wages, Harrison and Leamer (1997) and Fiszbein (1992) both argue that minimum wage hikes are likely to cause an increase in informal sector wages; no conclusions about formal wages. Gindling and Terrell (2002) and Chun and Khor (2010) both show contradicting empirical evidence. Their findings indicate that formal sector wages are positively associated with minimum wage hikes; however, no clear evidence of the impact on informal wages is found. In addition,

Khamis (2013) argues that informal wages are sensitive to changes in minimum wage, but the impact is unpredictable. Nevertheless, wage distribution seems to be one of the factors where empirical evidence does not differ as substantially as for other factors. The impact of minimum wage hikes is proven to mostly have a positive impact on income equality.

Summary of empirical findings

<i>Article</i>	<i>Proposed change</i>	<i>Impacted variable(s)</i>	<i>Effect</i>
<i>Jones (1997)</i>	Minimum wage increase	Formal employment	Decrease
		Informal employment	Increase
		Total employment	Increase
<i>Hohberg and Lay (2015)</i>	Minimum wage increase	Formal employment	Increase
<i>Lemos (2009)</i>	Minimum wage changes	Both formal and informal employment	Unchanged
<i>Gindling and Terrell (2002)</i>	Minimum wage increase	Informal employment	Increase
		Formal employment	Unchanged
		Formal wage	Increase
		Informal wage	Decrease
<i>Khamis (2013)</i>	Minimum wage increase	Informal wage	Increase
<i>& Kostzer (2006)</i>		Formal wage	Unchanged
<i>Chun and Khor (2010)</i>	Minimum wage increase	Formal wage	Increase
<i>& Rama (2001)</i>		Informal wage	Ambiguous

Table 3. Summary of empirical findings from past literature.

Made by authors.

The effects and aggregate impact of any minimum wage policy substantially differs from country to country. Employing workers without official contracts,

manipulating with employee working hours or underreporting salaries – these different channels give managers a wide variety of options through which they can optimise their own costs. Thus, theoretical models developed by labour economists are inapplicable due to their low plausibility; their frameworks are appropriate for perfect labour markets with very high transparency, which is highly unlikely in reality. Until now researchers have been enriching the existing minimum wage literature providing more and more empirical evidence that commonly belies theoretical expectations. Hence, a thorough research about the impact of historical minimum wage changes in Latvia on the level of shadow economy can supplement to the broader knowledge.

For the purposes of our research, we will use the difference-in-differences approach which has been chosen as a relevant model in past studies in this field. This method has previously been used by Khamis (2013) and Alatas and Cameron (2003) for studies concerned with the impact of minimum wage changes on variables of interest.

Based on the results of past research, we introduce the following hypotheses:

H₁: Minimum wage changes in Latvia have had a positive impact on the informal wages.

H₂: Minimum wage changes in Latvia have had no significant impact on the formal wages.

H₃: Minimum wage changes in Latvia have had a positive impact on the total wages.

3. Methodology

In this section, we introduce the dataset used for the analysis and elaborate on the process of data selection, sampling, and sorting. We introduce the model itself. The second subsection provides ground for the use of this model; thus, we explain the underlying mechanics and benefits of our model in the research context. Lastly, we substantiate the choice of these data and their compliance with the model.

To determine the effect of a minimum wage increase on the average wage, it is necessary to separate the direct impact on the lowest-earning individuals from other factors that cause the average wage to surge. To the best of our knowledge, the most appropriate method is the difference-in-differences approach. Using this method,

observations are separated into two groups: the treatment group, which was exposed to a certain treatment, and the control group, which was either unaffected by the same treatment, or affected to a lesser extent. Because the minimum wage is the same in all regions and industries of Latvia, it was impossible to choose such a control group that had not been affected by the minimum wage hike at all. For this reason, the control group contained observations from regions that had a smaller proportion of minimum wage earners.

Firm survey data provided by the Centre for Sustainable Business at SSE Riga were used for the purposes of the research.

3.1. Data Description

3.1.1. Overall description of the data. Since 2010, the Stockholm School of Economics in Riga has commissioned an annual company owner and manager survey in the Baltic States to determine the extent of shadow economy and envelope wages (Stockholm School of Economics in Riga [SSE Riga], n.d.). The survey is conducted between January and March of each year; at least 500 firms are surveyed in each country every year (SSE Riga, n.d.). A representative sample of companies is constructed by randomly selecting an equal amount of companies from each quintile of the active firms, where the quintiles are calculated using the book value of assets (SSE Riga, n.d.). Survey data are available for years from 2010 to 2015, though minimum wage changes in Latvia during this period were observed only in years 2011, 2014, and 2015 (Table 1).

Of these three minimum wage hikes we only analysed the ones that happened in 2011 and 2015. We had several concerns regarding the 2014 minimum wage change that led us to believe the results might be severely biased. Of these three years, 2014 was the only one where the minimum wage change coincided with changes in tax policy that had a significant impact on net wages for many people, assuming gross wages stay constant, as explained further in section 3.3. Moreover, in 2014, Latvia underwent a change in national currency and joined the euro area. This is likely to have been another factor that influenced wages in Latvia in 2014. It is particularly likely that the part of the wage that is paid informally was affected, because it is more flexible and employers are

not forced to adhere to the official exchange rate during the early phase of the switchover, unlike employers who pay wages legally.

Ultimately, we concluded that the treatment effect estimate would be inaccurate, as it would be impossible to separate the effect of the minimum wage change from other effects, namely changes in tax policy and currency. These factors do not jeopardise our analysis of 2011 and 2015 minimum wage hikes: the currency remained the same during those years, and changes in tax policy had a negligible impact on net wages. Regression results for the 2014 minimum wage change are still included in Appendix A, but for the reasons listed previously we did not base any conclusions on these results.

The data include the net average wage in euros for each firm in the sample, number of employees, proportion of unregistered employees, proportion of wage paid out unofficially for registered employees, and region. Since the monthly average wage serves as an intrinsic variable in our calculations, it is important to mention that this figure comprises all income for the given observation, i.e. including bonuses, awards, and any other additional payments by the employer. The net average wage takes into account differences in monthly hours worked, and represents the average remuneration per full-time equivalent.

3.1.2. Data sorting. Using the data collected in this survey, we created three company samples: one for each of the minimum wage changes analysed. Samples were created by matching observations by company name and retaining only the observations that are featured both in the year before the minimum wage adjustment and the year after it. After creating the initial samples, we went through a multiple step process to drop erroneous observations. We removed all observations from companies which failed to indicate at least one of the key indicators necessary for wage estimation: either average wage or number of employees.

Because the proportion of unregistered employees was reported in tens of percent, there were cases where the number of unregistered employees was not an integer. For this reason, we rounded the proportion of unregistered employees to the nearest multiple of $\frac{1}{n}$, where n is equal to the number of employees in that company. In cases where a firm had not reported the average proportion of net total wage that was paid informally, due to lack of evidence suggesting otherwise, we assumed that it had

been the same as the proportion of unregistered employees, effectively meaning that in such companies, unregistered employees received the same net total wage as registered employees, and that registered employees did not receive any amount informally.

Based on this, a sample of individuals was created for each year. Each observation in the original dataset containing a firm with n employees with an average wage of a was converted into n observations in the new dataset. Each firm-level observation had a percentage b denoting the proportion of unregistered employees and a percentage c denoting the proportion of wage received unofficially by employees. To represent this in the new dataset, b per cent of a firm's employees were set to be receiving no official wage and a unofficially, and the remaining $(100 - b)$ per cent of the same firm's employees were set to be receiving $(\frac{1-c}{1-b} * a)$ officially and $(\frac{c-b}{1-b} * a)$ unofficially. In doing so, we were working under the assumption that the total wage of unregistered and registered employees was the same and was equal to a .

If the proportion of unregistered employees b exceeded the proportion of wage received unofficially c , we would assume the registered employees would receive their entire wage officially. The formal and total wage for the registered employees was set to be $(\frac{1-c}{1-b} * a)$, while the informal and total wage for the unregistered employees was set to be $(\frac{c}{b} * a)$. In this case, the assumption that unregistered and registered employees are receiving the same total wage was ignored, but the reported company average wage remained true in the generated sample. The final step was to remove observations for companies for which the total wage for at least one of the employees was below the net minimum wage for a full-time employee. We set the threshold slightly below the actual net minimum wage to account for rounding errors. The threshold was 170 euros in 2011, 190 euros in 2014, and 210 euros in 2015.

Companies that were dropped during this step either indicated an implausibly low average wage in the survey or the total wage for unregistered employees turned out to be implausibly low due to inaccurate proportions of informal wage and unregistered employees. After this step, the 2011 sample included data from 120 companies, the 2014 sample included data from 131 companies, and the 2015 sample included data from 151 companies. Summary statistics can be seen in Table 4.

For the newly created sample of individuals, two dummy variables were added. The first dummy variable denotes whether the observation is in the year leading to the particular minimum wage hike that is being analysed or the year following it. The second dummy variable denotes whether the observation is in a region with a relatively high proportion of minimum wage earners (treatment group) or a region with a relatively low proportion (control group). An interaction term between the two dummy variables was created.

Since 2011, which is the earliest year the Central Statistical Bureau of Latvia provides the data for, the percentage of the working population that is receiving minimum wage has consistently been several percentage points lower in the Riga Planning Region than in any of the other planning regions of Latvia (Central Statistical Bureau of Latvia, n.d.-b). For this reason, observations related to firms that are operating mainly in Riga were included in the control group, while all other observations were included in the treatment group.

Summary statistics

Hike	Firms	Year	Number of employees			Average total wage		
			Riga	Other	Total	Riga	Other	Total
1	120	2010	2542	2351	4893	574.23	498.59	537.59
		2011	2484	2204	4688	422.52	389.31	406.73
2	131	2013	1712	2459	4171	394.55	676.55	597.30
		2014	1441	2579	4020	709.79	610.87	646.32
3	151	2014	1546	840	2386	693.23	624.50	668.95
		2015	1317	793	2110	630.00	618.91	625.32

Table 4. Summary statistics.

Made by the authors.

3.2. Regression Model

3.2.1. The mechanics of the model. The main underlying idea behind the DID method is the ability to examine the impact before and after a certain change is employed. The DID method requires a treatment group and a control group to be specified in order to estimate the effect of the treatment on the outcome. Data are necessary on both the

control and the treatment groups in two periods: before and after. A very simple graphical explanation of DID is shown in Figure 1. Two time periods before and after are denoted with t_1 and t_2 respectively; lines C and T represent the changing dynamics of control and treatment variables respectively. In period 2, after the treatment has been received, two essential outcomes can be measured: the total difference ($T_2 - C_2$) and the treatment effect ($T_2 - D$). The line T_1D shows the difference between the control and treatment group if neither one of them encountered any treatment effect. The DID method aims to capture this pure impact, which in the context of minimum wage changes is what we were looking for.

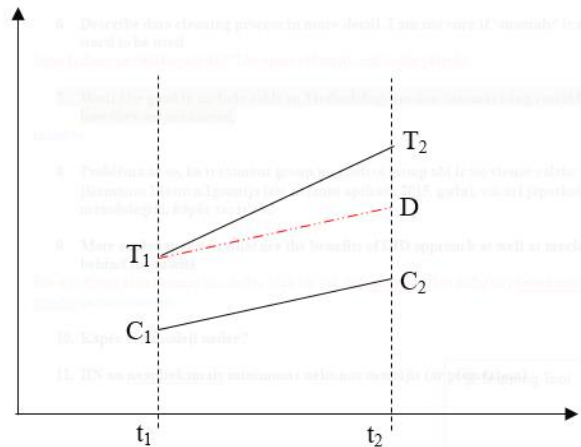


Figure 1. DID graphical explanation.

Made by authors.

Determining variables to be chosen as the treatment and control groups was a critical step in creating a properly working model. Hypothetically, the control group should serve as a sole source of information without being a subject to major impacts. In other words, control group can also be considered as the *low impact* group contrary to treatment group being the *high impact* group.

In our case, because the data specified the region where the surveyed company was located, it was possible to apply it to determine whether it came from a region with a relatively high or a relatively low proportion of minimum wage earners. The regions were then separated into two groups: the treatment group contained the observations in the regions with more minimum wage earners (i.e. Kurzeme, Latgale, Vidzeme, and Zemgale), while the remaining observations (i.e. Riga) were placed in the control group (Central Statistical Bureau of Latvia, n.d.-b).

Traditionally, the control group in the difference-in-differences method is chosen so that it would not be affected by the treatment at all. In this case, the control group does get affected by the minimum wage change, but has less direct exposure due

to a smaller proportion of minimum wage earners. This is a valid implementation of the DID method; a similar approach has been taken in papers such as Khamis (2013).

The mean treatment effect shows the impact of the minimum wage change on the treatment group, when the treatment effect on the control group is removed. Considering our *low-* and *high-proportion* regions, the mean treatment effect is estimated as the following difference-in-difference estimator θ :

$$\hat{\theta}_{DID} = (\bar{Y}_{at} - \bar{Y}_{at-1})_{high\ proportion} - (\bar{Y}_{at} - \bar{Y}_{at-1})_{low\ proportion} \quad (1)$$

Both brackets represent the difference of the mean wage \bar{Y} for the treatment group between time t which represents the period after the treatment and period $t - 1$ which represents the period before the treatment. The first bracket represents the difference for the treatment group, and the second bracket represents the difference for the control group.

The following ordinary least squares (OLS) regression was then conducted to obtain the DID estimator θ :

$$Wage_{at} = \beta_0 + \beta_1 Treatment_a + \beta_2 Time_t + \theta Treatment_a Time_t + \varepsilon_{at} \quad (2)$$

The *treatment* dummy variable takes the value 1 if the employee is in a region with a relatively high proportion of minimum wage earners (high impact) and 0 if they are in a region with a relatively low proportion (low impact). The *time* dummy variable takes the value 1 if the observation was made after the minimum wage increase and 0 if it was made before the minimum wage increase. However, the last and most important dummy variable $Treatment_a Time_t$ – also called the interaction term – takes value 1 only for high impact observations after minimum wage changes.

Five dummy variables denoting the different sectors were included as control variables, but left out of this equation. They are included in appendices A.1, A.2, and A.3. All variables with their respective explanations are compiled in Table 5.

Variables included in the regressions

<i>Variable</i>	<i>Explanation</i>
Wage	Dependent variable that shows the average net monthly wage in EUR. Depending on the regression, it is either total wage, formal wage, or informal wage.
Treatment	Binary variable that is equal to 1 for observations in the treatment group (Kurzeme, Latgale, Vidzeme, and Zemgale) and equal to 0 for observations in the control group (Riga).
Time	Binary variable that is equal to 1 for observations in the year after the minimum wage change and equal to 0 for observations in the year before the change.
Interaction	The interaction term between <i>Treatment</i> and <i>Time</i> binary variables. Equal to 1 for observations in the treatment group in the year after the minimum wage change and equal to 0 for all other observations.
S1	Binary variable that is equal to 1 for observations that denote people working in the manufacturing sector and 0 for all other observations.
S2	Binary variable that is equal to 1 for observations that denote people working in the wholesale sector and 0 for all other observations.
S3	Binary variable that is equal to 1 for observations that denote people working in the retail sector and 0 for all other observations.
S4	Binary variable that is equal to 1 for observations that denote people working in the service sector and 0 for all other observations.
S5	Binary variable that is equal to 1 for observations that denote people working in the construction sector and 0 for all other observations.

Table 5. Variables included in the regressions.

Made by authors.

For each minimum wage increase, the regression was repeated three times: once with only the informal wages, once with only the formal wages, and once with the total wages. Because the effect on the informal wages is separated from the effect on the formal wages, it is possible to determine where the effect had been stronger.

However, besides the minimum wages, there are other external factors that might influence wage levels, such as GDP growth, education, inflation etc. In addition, our observations might be influenced by different unknown individual aspects. However, all the omitted outer variables are “collected” by the error term ε_{at} in equation (2). Macroeconomic factors are the same or at least very close for both the control and the treatment groups. Similarly, for individual aspects – we can assume that due to the large sample of employee data, personal biases are cancelled out. This serves as a big benefit for the difference-in-differences method.

3.2.2. Correspondence of data and the model. As explained previously, the data used for the statistical analysis contained only observations from Latvian companies; hence, both the treatment and control groups come from the same geographical region meaning that the treatment effect might affect both groups. However, another feasible option would have been to include Lithuanian and Estonian companies, since our dataset contains the necessary information to create both control and treatment groups consisting of either Lithuanian or Estonian companies. We could have tested the impact of minimum wage changes on envelope wages by considering either Lithuanian or Estonian observations as the control group and Latvian observations as the treatment group. This would also have required us to consider only those years when Latvian minimum wage had changed and, in addition, there were no minimum wage changes in either Lithuania or Estonia in order for them to serve as an applicable control group. However, there were certain arguments that made us reject this approach.

Firstly, and most essentially, the dataset that was available to us unfortunately did not represent the entire population of all Baltic state companies. The samples that were available to us deviated from population statistics enough to make intercountry comparisons biased. Most importantly, year-to-year average wage growth rates differed significantly in Latvia and Lithuania due to sample differences and this might have caused a huge bias in the DID estimator. Table 6 Table 6 depicts the weighted growth rates of the average wage of our dataset for all three countries. Due to the significant

differences in the growth rates for all years, we decide that this approach would be impractical and erroneous.

Average wage growth rate			
	<i>2010/2011</i>	<i>2013/2014</i>	<i>2014/2015</i>
Latvia	-23.3%	-3.2%	-7.8%
Estonia	4.2%	3.9%	2.8%
Lithuania	5.9%	-7.2%	10%

Table 6. Average wage growth rates in Baltic countries.

Made by the authors.

These growth rates do not precisely depict the actual growth of the average wage in Latvia over the years because the dataset does not contain population statistics. However, this is not a barrier in our analysis, because the DID estimator extracts the treatment effect as long as we consider the appropriate control and treatment groups.

Adding to the argumentation of omitting Estonian and Lithuanian observations, we were interested in years when either Lithuanian or Estonian minimum wage was kept constant, but had been changed in Latvia at the same time. There have been only two such years: 2011 and 2014. Because the introduction of the euro is a factor that also influences wages, as argued in section 3.1., it rendered 2014 unusable because the currency had been introduced in Latvia that year. The only suitable year for analysis would have been 2011, assuming there had been no major tax changes in either Lithuania or Estonia in that particular year.

Finally, although Latvia is a relatively similar country in comparison to Lithuania and Estonia, we believed that, in order to acquire the most precise results, one had to create both control and treatment groups that came from at least the same legal environment and were governed by the same regulatory bodies, but more in-depth explanations for this will follow in the next section.

3.3. Influence of Tax Changes on Net Wages

This section analyses the influence of other legal regulatory implications that may leave an effect on net wages. Besides other general macroeconomic factors (explained in 3.2.1), net wages are also influenced by the extent of taxation and non-taxable minimum thresholds. We distinguish the taxation factor separately because its effect on net wages is more clearly observable and it may have a different effect based on the level of the gross wage. A significant impact on net wages from changes in the taxation system is a possible pitfall – the DID estimator might be influenced too much in one or another way by a factor other than minimum wage change and that would prevent us from acquiring credible conclusions. Thus, the goal of this section is to determine how severe is the impact that changes in tax policy have left on net wage levels. Based on that, we make conclusions whether the specific years are suitable for our analysis.

Historical tax policy changes in Latvia

	<i>2010</i>	<i>2011</i>	<i>2013</i>	<i>2014</i>	<i>2015</i>
MSIC ¹ (employer)	24.09%	24.09%	24.09%	23.59%	23.59%
MSIC ² (employee)	9%	11%	11%	10.5%	10.5%
Income tax	26%	25%	24%	24%	23%
Non-taxable minimum	25 LVL	45 LVL	45 LVL	75 EUR	75 EUR
Tax relief for 2 dependents	126 LVL	140 LVL	160 LVL	330 EUR	330 EUR

Table 7. Historical tax policy changes in Latvia.

Created by the authors using data from Likumi (n.d.).

The analysis focused on three periods that were outlined previously in the section 3.1.1 – years 2011, 2014, and 2015 – which were then compared to their respective previous years. Table 7 summarises changes of historical mandatory social insurance contribution, income tax, non-taxable minimum, and tax relief for one's

¹ Mandatory social insurance contribution rate that is paid by the employer.

² Mandatory social insurance contribution rate that is paid by the employee.

dependents in Latvia for all years of our interest. These variables were further implemented to calculate the net wage for a minimum wage earner and an average wage earner in a period before and after the minimum wage change.

All calculations considered the following assumptions: (1) it was assumed that the person had submitted their tax certificate; (2) the minimum wage earner had no dependent people registered on their name; (3) the average wage earner had two dependent people registered on their name.

Table 8 shows the difference in net wage as a result of changes in taxes and the non-taxable minimum in 2011. The first case shows a person that earned a gross wage that was equal to the minimum monthly wage in 2011. As it is shown in the table, the difference in the net wage caused by these changes was less than 1 LVL (a change of 0.67%) and can therefore be considered negligible. The second case shows a person that earned the national gross monthly average wage as of January 2011 retrieved from Central Statistical Bureau of Latvia (n.d.-b). Although, compared to the case of the minimum wage earner, the difference was slightly larger in nominal terms, it constituted a net wage increase of slightly more than only 0.5%.

	<i>Minimum wage earner</i>		<i>Average wage earner</i>	
	<i>Gross wage, LVL</i>	<i>Net wage, LVL</i>	<i>Gross wage, LVL</i>	<i>Net wage, LVL</i>
2010	200	143.78	446.98	342.85
2011	200	144.75	446.98	344.61

Table 8. Influence of tax changes on net wages in 2011.

Created by the authors.

Changes in tax policy did not have a significant impact on net wages in 2011. Therefore, we considered this period valid and applicable to our analysis. These slight nominal deviations did not exceed 1%, thus we considered them too small to be accounted for.

	<i>Minimum wage earner</i>		<i>Average wage earner</i>	
	<i>Gross wage, EUR</i>	<i>Net wage, EUR</i>	<i>Gross wage, EUR</i>	<i>Net wage, EUR</i>
2013	320	231.81	744	573.25
2014	320	235.66	744	603.27

Table 9. Influence of tax changes on net wages in 2014.

Created by the authors.

A similar analysis for 2014 is shown in Table 9. The difference in the net wage caused by these changes was slightly larger (3.85 EUR), and constituted a 1.6% increase in net wage. The second case shows a person that earned the national gross monthly average wage as of January 2014, retrieved from Central Statistical Bureau of Latvia (n.d.-b). Due to a large increase in the amount of tax relief that a person received per each dependent person, the net wage increased by 30.02 EUR, which corresponded to an increase of 5.2%.

Mainly because of the changes in tax relief for those who have dependents, net wages were significantly influenced by changes in tax policy for 2014. Changes of 1.6% and 5.2%, respectively, were no longer negligible. This impact could essentially lead to an overstatement of the increase in net formal wage, as well as net total wage in our analysis.

	<i>Minimum wage earner</i>		<i>Average wage earner</i>	
	<i>Gross wage, EUR</i>	<i>Net wage, EUR</i>	<i>Gross wage, EUR</i>	<i>Net wage, EUR</i>
2014	360	262.87	778	626.40
2015	360	265.34	778	629.31

Table 10. Influence of tax changes on net wages in 2015.

Created by the authors.

Table 10 shows the same analysis for 2015. For the minimum wage earner, the difference in the net wage caused by these changes was 2.47 EUR or 0.94% in percentage terms. The second case shows a person that earned the gross monthly average wage as of January 2015, retrieved from Central Statistical Bureau of Latvia (n.d.-b). The difference here was 2.91 EUR (a change of 0.46%).

Similar to the case of 2011, we were safe to say that changes in tax policy had had a very slim impact on net wages in 2015 – both for the minimum wage and average wage earners the effect was below 1%, which we considered to be a negligible effect.

To summarise this section, we concluded that years 2011 and 2015 were both valid from the tax policy point of view. The changes in mandatory social insurance contribution, tax reliefs, non-taxable minimum, and income tax had not damaged the applicability of our data for those periods. However, as explained in section 3.1.1, data for year 2014 might have been too erroneous to produce reasonably reliable results and this is in compliance with the results depicted in this section as well. Due to the significant impact that tax policy changes had on net wage in 2014, we considered this set of observations to be inapplicable further in our analysis.

4. Analysis of Results

In compliance with the description under the methodology section on the underlying mechanics of our chosen model, the first step of the analysis was to perform the OLS regression (equation 2) to obtain the wage estimates that were further used to calculate the DID estimator. In total, nine regressions were performed. Three regressions for each one of the hike periods were necessary to determine the impact of the treatment effect on total, legal, and envelope wage levels respectively.

Appendix A contains the results of all nine regressions. Each regression is summarised in a separate table. The interpretations for all variables are as follows. As explained in section 3, denotations *S1*, *S2* etc. were used as dummy variables to denote sectors. The coefficients for those variables provide only an intuitional meaning – if the coefficient is negative, the wage in this particular sector has been below the sample average in both years before and after the treatment. The coefficient for the *Treatment* variable is interpreted in the following way – if the coefficient is positive, the average

wage in the treatment group was higher than the respective average wage of the sample; the opposite if this coefficient is negative. The coefficient of the variable *Year* shows the nominal change in the average wage of the respective sample after the treatment. The *Constant* is the value of the regression if all dummy variables in equation 2 take the value of zero and could be expressed as the respective average wage in the control group before the treatment effect. Essentially, this figure does not provide a meaningful interpretation in our context.

However, we were foremost interested in analysing the coefficient for the *Interaction* variable – the difference-in-differences estimator – and it was the main coefficient for making any conclusions about analysis. This coefficient shows the impact of the treatment on the respective sample. *Interaction* shows the difference in either total, legal, or envelope average wage samples before and after the treatment. A negative coefficient would mean a decrease in this value.

Summary of results

<i>Hike</i>	<i>Sample</i>	<i>Interaction</i>	<i>P > t </i>	<i>95% Confidence Interval</i>	
2011	Total	25.396	0.014** ³	5.228	45.565
	Legal	-98.329	0.000*** ⁴	-116.036	-80.622
	Envelope	123.726	0.000***	111.014	136.437
2015	Total	89.976	0.000***	62.212	117.740
	Legal	114.984	0.000***	81.520	148.449
	Envelope	-25.008	0.006***	-42.796	-7.221

Table 11. Summary of results.

Made by the authors using data from the regressions.

Table 11 contains a concise summary of results of the analysis. It contains the interaction coefficient for all samples in both periods when minimum wage hikes were

³ Two asterisks denote significance at a 5% level.

⁴ Three asterisks denote significance at a 1% level.

observed. All results are significant at 1% level at least, except for the total wage sample in 2011, which is significant at a 5% level.

The following paragraphs describe the results of the analysis in more depth for each period; however, a more analytical approach to analysing the results is applied in section 5. As explained above, we conducted a statistical analysis for the minimum wage hike of 2014 as well and the results can be seen in Table A.2, but the period is omitted from in-depth analysis due to its inapplicability and erroneous dataset. In order to avoid imprecise statements on the results, we considered the figures from the 95% confidence interval instead of the coefficient itself.

4.1. Minimum Wage Change of 2011

The results of the regressions regarding the 2011 minimum wage change are shown in Table A. 1. The minimum wage was increased from 256.12 EUR to 284.57 EUR, effective January 1, 2011 (Ministry of Welfare of Latvia, n.d.).

The DID estimators were significant for legal and envelope wages at the 1% level, but for the total wage – at the 5% level. The estimators showed that the minimum wage increase had caused an average net total wage increase between 5.2 to 45.6 EUR, an average net formal wage decrease between 116.0 and 80.6 EUR, and an average informal wage increase between 111.0 and 136.4 EUR. Those numbers are within the 95% confidence interval.

4.2. Minimum Wage Change of 2015

The results of the regressions regarding the 2015 minimum wage change are shown in Table A. 3. The minimum wage was increased from 320 EUR to 360 EUR, effective January 1, 2015 (Ministry of Welfare of Latvia, n.d.).

The DID estimators were significant for all three regressions at the 1% level. The estimators showed that the minimum wage had caused an average net total wage increase between 62.2 and 117.7 EUR, an average net formal wage increase between 81.5 and 148.4 EUR, and an average informal wage decrease between 42.8 and 7.2 EUR. Those numbers are within the 95% confidence interval.

5. *Discussion of Results*

In the following paragraphs, we discuss the results of our analysis in more depth by providing several alternative interpretations and explanations. We compare the acquired results with the conclusions drawn from the literature review. The statistical analysis allows us to make judgements on hypotheses and furthermore to answer the research question. This section also aims to show the importance of our study and the possible suggestions that arise from our work. As a part of the discussion, we also outline the main drawbacks of our research and limitations could have possibly jeopardised the plausibility and significance of our results.

5.1. **Implications of Results**

5.1.1. *Results of the first hike.* The minimum wage hike of 2011 caused an increase in average net total wage that was slightly larger than the increase in net wage for a minimum wage earner. This shows that one of the goals of the hike – to drive wage growth – was successful, if an increase in total wage, rather than formal wage, is an acceptable outcome. The results of the regression do not allow to draw statistically significant conclusions about whether the increase that was caused by the minimum wage hike exceeded the amount by which the net wage increased for minimum wage earners.

The average net formal wage was influenced negatively in 2011 as a result of the minimum wage increase, while the average net informal wage was influenced positively by the same change. The effect of the minimum wage change had been much stronger on the two components of the total wage than it had been on their sum (i.e., total wage). This suggests that in 2011, the change of the national minimum wage in Latvia caused a move of partially or entirely formally employed people deeper into the informal sector.

Although concerns about the extent of the shadow economy have not been cited as a reason for raising the minimum wage by politicians in Latvia, this outcome has to be taken into account due to the large extent of the shadow economy in the country. The average worker's income was slightly driven up by the increase in minimum wage, but their legal income, and with it, amount paid in taxes, would have been slightly higher.

To find reasons for such a result, we looked at the circumstances of the minimum wage increase in 2011 and the economy of Latvia in that year. The 2011 minimum wage hike happened two years after the last increase while the country was still recovering from a major recession that saw its GDP per capita (at 2010 prices) drop by 11.7 percent from Q4 2008 to Q4 2009 (Central Statistical Bureau of Latvia, n.d.-c).

During January 2009, when the minimum wage was raised to 256.12 EUR, the average gross wage was 670 EUR (Central Statistical Bureau of Latvia, n.d.-a); at that point, the minimum wage was set at 38% of the average wage. In the following months, wages decreased, and had not reached the level of early 2009 when the minimum wage was increased. In the first month of 2011, the minimum wage was raised to 284.57 EUR, and the average gross wage reached 636 EUR (Central Statistical Bureau of Latvia, n.d.-a), meaning that the minimum wage had reached 45% of the average wage. It is possible that the economy had not yet recovered enough for a minimum wage change to be entirely beneficial.

Another possible explanation is connected to the extent of shadow economy in Latvia at the time. According to research by the SSE Riga Centre for Sustainable Business, the size of the shadow economy in Latvia was 38.1% of GDP in 2010 and 30.2% of GDP in 2011 (SSE Riga, n.d.). It is expected that at some point, envelope wages are so pervasive that minimum wage hikes force employers to either increase the proportion of wage paid formally or not to register their employees, thus paying their wages entirely informally. With such a strong informal sector, it is possible that most employers actually had room to decrease the proportion paid formally or that many of those that had tried not to break the law, gave in because too many of their competitors were already doing that.

It is important to note that the results of our research do not contradict those of the SSE Riga Shadow Economy Index for the Baltic Countries: the treatment effect estimates only show the average impact of the minimum wage change on wages. These estimates do not match the average change in sample wages. While the SSE Riga Shadow Economy Index shows that the shadow economy decreased from 2010 to 2011, our estimates only show that the envelope wages were driven up by the minimum wage change. Other factors counteracted the upwards pressure on envelope wages, thus causing a net decrease. Furthermore, our research was only focused on envelope wages,

while the SSE Riga Shadow Economy Index also utilised unreported business income as a measure for determining the extent of shadow economy.

5.1.2. Results of the second hike. As for the second case, the minimum wage hike of 2015 appears to have produced the exact results that policy makers should be aiming to achieve. Our analysis signifies that the treatment effect not only worked in the desired direction, but also had a strong and significant impact. The minimum wage hike had a positive impact on average net total wage, meaning that the objective of driving up the wage levels had been successfully achieved.

In addition to an increase in the net total wage, the minimum wage hike, contrary to the hike of 2011, had also positively influenced the net legal wages. At the same time, results show that the net envelope wage had decreased, though the extent of this decrease differs within the confidence interval. The finding that the minimum wage increase had a positive impact on net legal wages in 2015 is important because it suggests that this decision will have had a positive impact on tax revenue, which is an important consideration for policy makers.

However, the most interesting finding is that the increase in the net formal wage had exceeded the growth of the average net total wage. This suggests that the minimum wage hike caused more employers to decrease envelope wages than it caused employers to increase them. In other words, the net effect of the minimum wage hike was a decrease in the percentage of average wage paid as envelope wages. The 2015 minimum wage change can therefore be used as an example of minimum wage being used as an instrument to combat the shadow economy.

The success behind the minimum wage hike of 2015 might have several possible explanations. The minimum wage increase from 320 EUR to 360 EUR in 2015 was a continuation to a similar hike a year ago, when the minimum wage was increased from 200 LVL (284.74 EUR) to 320 EUR. Firstly, companies that were already paying minimum formal wages to their employees and part of their wage informally were forced to either move their employees entirely into the shadow economy or pay a larger share of the total wage legally, thus decreasing the envelope wage. Evidently, the latter case seems to have been stronger, and suggests that employers were unwilling to move entirely to the informal sector.

In addition, this series of significant increases in the minimum wage came at a moment when the economy of Latvia had just fully recovered from the financial crisis by reaching the former levels of real GDP (Organization for Economic Co-operation and Development, n.d.). Economic growth had finally established a decent momentum. The population of Latvia was still on a downward trend, but unemployment rate was vastly decreasing. At the same time, labour productivity levels were on the rise (Organization for Economic Co-Operation and Development, n.d.). Those combined factors might lower employers' intentions for sticking with high levels of informal wages. Productivity growth would return more goods produced per unit of labour; thus, boosting profits per employee as well. Employers are naturally no longer required to seek remedy in desperate cost-saving methods that could have led them to the informal sector during the years of crisis.

Yet another reason for the drop in informality after the minimum wage hike might be a general trend of continuously decreasing shadow economy level in Latvia. According to SSE Riga (n.d.), shadow economy has been consistently decreasing since 2010. It had dropped as low as 21.3% in 2015 from the peak of 38.1% in 2010. Due to this trend, employers might feel less pressure from their peers to inflate wages with an informal fraction of salary to gain an edge over others. Moreover, companies that have maintained high levels of informality might be disregarded by new job-seeking workers who have become more future-orientated and more aware of the dire consequences for not contributing to their, for example, pension savings.

5.1.3. *The compliance of results with the literature review.* Our study did not aim to establish a framework for policy making, nor tried to make confident predictions for future implementations. The goal of this research was to determine the relation between historical minimum wage changes and the impact on net total, formal, and informal wages that might follow those implementations. The review of past studies allowed us to introduce provisional answers to this issue and we formulated them as three hypotheses – minimum wage changes in Latvia have had:

- (1) a positive impact on the informal wages;
- (2) no significant impact on the formal wages;
- (3) a positive impact on the total wages.

Essentially, the impact of a minimum wage hike on the informal wages is the most sensitive and, at the same time, most valuable answer we try to find. Considering that the five authors that we reviewed all made different conclusions in this matter, we slightly leaned towards the conclusions made by Khamis (2013) which stated that an increase in the minimum wage should also increase the envelope wage, thus adjusting our hypothesis similarly. However, in our case this hypothesis is both accepted and rejected depending on the year we consider. After the 2011 minimum wage hike, the informal wage had drastically increased, allowing us to accept the hypothesis. Whereas after the 2015 minimum wage hike, we see a slight decrease in the informal wage, making us reject the hypothesis for this year. Both conclusions are significant at a 1% level.

Forming the second hypothesis about the impact on formal wages was not as straight forward. The formal wage can be calculated by subtracting the informal wage from the total wage. Since we predicted that a minimum wage hike would have a positive impact on both the total and informal wages, the conclusion about the formal wage is hardly predictable. Hence, we predicted the impact to be either very little or unchanged. Eventually, the minimum wage hike produced a different impact on the formal wage in each period. In 2011, the formal wage was negatively influenced by the minimum wage hike contrary to the positive impact in 2015. Therefore, the second hypothesis can be rejected for both minimum wage hikes. Both conclusions are significant at a 1% level.

Besides the possible impacts of a minimum wage hike on formal and informal wages, we predicted the impact on net total wages to be positive. The hike is expected to increase the total average wage by lifting the left tail of the income distribution a little higher; despite the potential of a large fraction of workers turning informal, either way the total effect should be nominally positive. Thus, we introduced the third hypothesis. The analysis showed that, indeed, the impact of the minimum wage hikes has been significant and positive in both years; therefore, we accept the third hypothesis. The result for 2011 is significant at a 5% percent level, whereas the 2015 effect is significant at a 1% level.

Summary of hypotheses

	<i>Hypothesis 1</i>	<i>Hypothesis 2</i>	<i>Hypothesis 3</i>
Hike 1	Accepted	Rejected	Accepted
Hike 2	Rejected	Rejected	Accepted

Table 12. Summary of hypotheses.

Made by the authors.

A brief overview of our hypotheses can be seen in Table 12. The results of our analysis are generally on par with IMF (2016) and overlap with the main conclusions that we draw from the review of past literature. We argued that this issue is very country-specific by providing evidence from multiple countries around the world and showing that a minimum wage change has left a different impact in each one of them. We still stand by this argument; moreover, our results show that minimum wage policy is not only a country-specific issue, but is also significantly influenced by timing. In the case of Latvia, a minimum wage hike in 2011 vastly opposes the findings for the minimum wage hike of 2015. The impact of minimum wage policy is unpredictable and dependent on various factors that are far more complex than the oversimplified theoretical frameworks put forward by, for instance, Harris and Todaro (1970), Fiszbein (1992), or Harrison and Leamer (1997).

5.2. Novelty of Results

We argued in the beginning of the paper about the importance of tackling the problem of a high shadow economy: how the decision by employers to pay an informal salary eventually fosters unfair competition in the labour market and reduces the fiscal income, and how envelope wages directly affect the social insurance or capability of acquiring credits for employees. In short, a big informal sector comes with a threat to a country's growth and longevity. Labour economists have long recognised this issue and have tried to find ways of eliminating such risk by contributing with academic research. However, a country's success in battling its shadow economy is mainly determined by the quality of its policy making.

Policy instruments such as the minimum wage might be very handy in reducing at least one of informal sector's biggest components – the envelope wage. Multiple authors, including the ones that we refer to in section 2, have tried to establish models or find different relations that may serve as a guidance for policy makers. However, those conclusions are more often ambiguous and broadly inapplicable due to the issue being very country-specific, as explained in IMF (2016). To the best of our knowledge, there exist no explicit and recent academic studies on the relation between informal wage and minimum wage change in the Baltic countries. Thus, we contribute to the existing literature by studying an unorthodox case – an OECD country with a rather high level of shadow economy.

First and foremost, we emphasise the finding that the minimum wage hikes in 2011 and 2015 have had a drastically different impact on salaries in both the formal and informal sectors. The first minimum wage hike has had a generally negative effect – it caused an increase in wage informality. The second hike had the complete opposite effect – one that policy makers essentially should aim for. In our context, disregarding the other factors that come with minimum wages, we must say that successful minimum wage policy implications are distinguishable. However, this argument connects with the next finding.

Despite both hikes being only four years apart, the difference in results is enormous. Our results only emphasise the fact that successful minimum wage policy implications are highly dependent on their timing and the overall economic environment during which they are implemented. Although this issue is frequently analysed and revised by local economists (for example, we refer to some of those articles by Krasnopjorovs (2011, 2016), Purviņš (2010) in the introduction) who try to determine the most appropriate moments for implying minimum wage hikes, we still believe there is a gap in this research field. We suggest the topic of determining the “perfect” economic environment for minimum wage policy changes as a good subject for future research.

Finally, we supplement the minimum wage literature with a study on a country that lacked in-depth research in this field. To our knowledge most of the previous studies focus on either developed rich countries mostly from Western Europe and North America or on the developing countries. The research is very scarce on countries that

are in between those two categories. Hence, a research on Latvia – a developed country with a high level of shadow economy – provides a completely new insight.

5.3. Limitations

There are several limitations regarding this research. First of all, the data that were used was taken from a survey of firms, rather than people. This means the wage information did not capture the variance between different employees of the same company, both in amount and the proportion paid out informally. This also means individual control variables, such as education and gender, were not available.

Second, because the data were gathered from a survey, there is a chance that some of the data are imprecise. Despite the anonymous nature of the survey, some of the respondents might have deliberately or accidentally reported inaccurate information, in particular with regards to the extent of their informal activity.

Due to the dataset showing a sample of companies, rather than the entire population, there is some variance with regards to the variables. While data by the Central Statistical Bureau (n.d.-a) show that the wages have grown steadily since 2010, the wages in the dataset fluctuate due to sample variance. Due to this effect, in some cases the average wage decreased year-on-year, even if only matched companies were kept in the dataset.

Another limitation of this research paper is that the dataset covered a relatively short time span and therefore only two minimum wage changes could be analysed. If there were data covering a larger period, it would have been possible to provide explanations for why different minimum wage hikes have different effects with more certainty. It would also have been possible to analyse minimum wage changes at different points of the business cycle.

Finally, although the original company samples in the dataset were constructed so that they would be representative of the general population of companies, there is a possibility that in the process of removing observations that did not appear in both years and excluding anomalies, the sample had become slightly biased towards a particular company size.

6. Conclusions

The practice of paying envelope wages in Latvia is widespread relative to other European countries. Government institutions have been fighting this problem for many years, but, as of 2015, Latvia still has by far the largest informal sector relative to its gross domestic product among the Baltic states (SSE Riga, n.d.). The aim of our research was to find out what has been the effect of minimum wage changes on envelope wages in Latvia. Our research has shown that there have been different outcomes, but that a well-planned minimum wage hike can potentially be used as an instrument to combat envelope wages.

Unsurprisingly, an increase in minimum wage has caused an increase in the average total wage in both of the minimum wage hikes analysed. However, when we looked at formal and informal wages separately, we found out that in 2011 the minimum wage increase caused employers to pay larger proportions of wages informally. In 2015 there was an opposite effect, with employers increasing the proportion of wage paid legally as a result of the increase in minimum wage. This suggests that in the right conditions and with a correctly-judged increase, a minimum wage hike can decrease the prevalence of envelope wages, like it did in 2015.

These findings should be of interest to policy makers in Latvia, as well as other developed countries with similar shadow economy problems. When planning future minimum wage hikes, countries with large informal sector activity must look at minimum wage increases in the past and their impact on the envelope wages. Our research has shown that in some cases, a minimum wage hike can exacerbate existing problems with envelope wages.

Further research on this topic can be focused on analysing minimum wage changes in Latvia outside the period that was available at the time this paper was written. With a larger variety of economic conditions to work with, as well as approaches to the research, it would be possible to better identify the factors that determine the effectiveness of a minimum wage hike in reducing envelope wages. Due to the country-specific nature of minimum wage policy, it would also be beneficial to conduct similar research in other European countries with large informal sector activity.

7. References

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8. Appendices

Appendix A. Results of the Minimum Wage Changes

<u>TOTAL</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	-19.2225	21.74857	-0.88	0.377	-61.8543	23.40934
S2	-7.01779	22.13133	-0.32	0.751	-50.3999	36.36432
S3	-56.3854	22.16908	-2.54	0.011	-99.8415	-12.9293
S4	6.002157	21.77412	0.28	0.783	-36.6797	48.68405
S5	-10.6269	22.17664	-0.48	0.632	-54.0978	32.84403
Treatment	-59.1377	8.81482	-6.71	0.000	-76.4166	-41.8588
Time	-135.568	8.79847	-15.41	0.000	-152.815	-118.322
Interaction	25.39634	10.28886	2.47	0.014	5.228	45.56468
Constant	572.6356	21.89026	26.16	0.000	529.7261	615.5451

<u>LEGAL</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	5.148192	19.85284	0.26	0.795	-33.7676	44.06395
S2	6.645675	21.62423	0.31	0.759	-35.7424	49.03375
S3	-93.1096	20.88718	-4.46	0.000	-134.053	-52.1663
S4	10.29538	20.54551	0.50	0.616	-29.9782	50.56895
S5	-26.5977	21.00252	-1.27	0.205	-67.7671	14.57167
Treatment	84.16871	6.666912	12.62	0.000	71.10015	97.23727
Time	20.79659	6.994943	2.97	0.003	7.085019	34.50816
Interaction	-98.3293	9.033179	-10.89	0.000	-116.036	-80.6223
Constant	325.2695	20.32357	16.00	0.000	285.431	365.108

<u>ENVELOPE</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	-24.3707	15.24699	-1.60	0.110	-54.258	5.516672
S2	-13.6635	15.90473	-0.86	0.390	-44.8401	17.51317
S3	36.72427	15.2704	2.40	0.016	6.791058	66.65748
S4	-4.29323	14.94697	-0.29	0.774	-33.5925	25.00601
S5	15.97083	15.92418	1.00	0.316	-15.2439	47.1856
Treatment	-143.306	6.320435	-22.67	0.000	-155.696	-130.917
Time	-156.365	4.77379	-32.75	0.000	-165.723	-147.007
Interaction	123.7256	6.484791	19.08	0.000	111.014	136.4372
Constant	247.3661	14.89655	16.61	0.000	218.1657	276.5665

Table A. 1. Results of the 2011 minimum wage change.

Table made by authors using the results acquired from statistical tests.

<u>TOTAL</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	-79.973	5.560919	-14.38	0.000	-90.8739	-69.0722
S2	277.7911	14.98066	18.54	0.000	248.4252	307.157
S3	-23.3168	11.93627	-1.95	0.051	-46.7149	0.081354
S4	69.30127	2.242279	30.91	0.000	64.90584	73.69671
S5	80.168	12.11315	6.62	0.000	56.42315	103.9129
Treatment	-21.5419	7.282948	-2.96	0.003	-35.8184	-7.26552
Time	30.9415	10.63803	2.91	0.004	10.08827	51.79474
Interaction	-80.3943	11.13029	-7.22	0.000	-102.213	-58.5762
Constant	620.9948	7.312037	84.93	0.000	606.6613	635.3282

<u>LEGAL</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	-54.0933	19.57689	-2.76	0.006	-92.469	-15.7176
S2	284.6086	24.0001	11.86	0.000	237.5624	331.6549
S3	-5.88276	22.14629	-0.27	0.791	-49.2951	37.52958
S4	112.3592	18.7543	5.99	0.000	75.59598	149.1224
S5	-3.77669	26.87213	-0.14	0.888	-56.4529	48.89952
Treatment	34.18647	8.396283	4.07	0.000	17.72762	50.64532
Time	93.5611	11.50232	8.13	0.000	71.01363	116.1086
Interaction	-167.84	12.40521	-13.53	0.000	-192.158	-143.523
Constant	507.5927	20.3504	24.94	0.000	467.7008	547.4847

<u>ENVELOPE</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	-25.8798	18.81866	-1.38	0.169	-62.7691	11.0096
S2	-6.81759	19.13803	-0.36	0.722	-44.333	30.69782
S3	-17.434	18.99293	-0.92	0.359	-54.665	19.79696
S4	-43.0579	18.6208	-2.31	0.021	-79.5594	-6.55639
S5	83.94469	22.97943	3.65	0.000	38.89917	128.9902
Treatment	-55.7284	3.911491	-14.25	0.000	-63.3959	-48.0609
Time	-62.6196	3.780745	-16.56	0.000	-70.0308	-55.2084
Interaction	87.44595	5.222444	16.74	0.000	77.20864	97.68327
Constant	113.4021	18.87454	6.01	0.000	76.40318	150.4009

Table A. 2. Results of the 2014 minimum wage change.

Table made by authors using the results acquired from statistical tests.

<u>TOTAL</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	146.7157	10.16419	14.43	0.000	126.7889	166.6425
S2	110.5903	13.61508	8.12	0.000	83.89801	137.2826
S3	22.81726	9.6763	2.36	0.018	3.846941	41.78757
S4	151.5521	9.752215	15.54	0.000	132.433	170.6713
S5	138.0445	15.7661	8.76	0.000	107.1352	168.9539
Treatment	-81.7387	11.72806	-6.97	0.000	-104.732	-58.7459
Time	-78.2639	8.420858	-9.29	0.000	-94.7729	-61.7548
Interaction	89.97603	14.16152	6.35	0.000	62.21248	117.7396
Constant	577.3047	8.789654	65.68	0.000	560.0726	594.5367

<u>LEGAL</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	174.9743	13.60167	12.86	0.000	148.3083	201.6402
S2	0.319367	20.26891	0.02	0.987	-39.4177	40.05642
S3	-65.4097	14.17767	-4.61	0.000	-93.205	-37.6145
S4	181.9558	14.19211	12.82	0.000	154.1322	209.7793
S5	147.9591	17.00049	8.70	0.000	114.6298	181.2885
Treatment	-60.0987	13.54622	-4.44	0.000	-86.656	-33.5415
Time	-128.265	10.14686	-12.64	0.000	-148.158	-108.372
Interaction	114.9843	17.06934	6.74	0.000	81.52001	148.4487
Constant	509.1522	13.50031	37.71	0.000	482.685	535.6195

<u>ENVELOPE</u>	Coefficient	Std. error	t	P > t 	95% confidence interval	
S1	-28.2585	9.304553	-3.04	0.002	-46.5001	-10.017
S2	110.2709	12.1105	9.11	0.000	86.52836	134.0135
S3	88.22698	11.5672	7.63	0.000	65.54957	110.9044
S4	-30.4037	10.43333	-2.91	0.004	-50.8581	-9.94919
S5	-9.9146	12.17312	-0.81	0.415	-33.7799	13.95072
Treatment	-21.64	6.095548	-3.55	0.000	-33.5902	-9.68969
Time	50.00127	5.500858	9.09	0.000	39.21688	60.78567
Interaction	-25.0083	9.072896	-2.76	0.006	-42.7957	-7.22096
Constant	68.15248	10.45792	6.52	0.000	47.64981	88.65515

Table A. 3. Results of the 2015 minimum wage change.

Table made by authors using the results acquired from statistical tests.