instytut badań strukturalnych

IBS WORKING PAPER 04/2020
JUNE 2020

# THE HETEROGENOUS REGIONAL EFFECTS OF MINIMUM WAGES IN POLAND

Maciej Albinowski
Piotr Lewandowski

ibs working paper 04/2020
june 2020

# THE HETEROGENOUS REGIONAL EFFECTS OF MINIMUM WAGES IN POLAND•

Maciej Albinowski♠
Piotr Lewandowski♦

## Abstract

Since 2008, Poland has been among the EU countries that have increased their minimum wage levels the most, following period in the mid-2000s during which the country's minimum wage was barely raised. We evaluate the impact of these minimum wage hikes on employment and wage growth in Poland between 2004 and 2018. We estimate panel data models utilising the considerable variation in wage levels, and in minimum wage bites, across 73 Polish NUTS 3 regions. We find that minimum wage hikes had a significant positive effect on wage growth and a significant negative effect on employment growth only in regions of Poland that were in the first tercile of the regional wage distribution in 2007. These effects were moderate in size, and appear to be more relevant for wages. Specifically, we show that if the ratio of minimum wage to average wage had remained constant after 2007, by 2018, the average wages in these regions would have been 3.4% lower, while employment would have been 1.2% higher. On the other hand, in the remaining two-thirds of Polish regions, we find no significant effects of minimum wage hikes on average wages or on employment. We also find indicative evidence that the effects on employment growth differ between groups of workers: i.e., that they are negative for men and for workers in industry, but they are positive for women and for workers in services.

Keywords: minimum wage, spatial heterogeneity, panel data.

JEL: J21, J23, J38

• This paper uses Statistics Poland data. Statistics Poland has no responsibility for the results and conclusions, which are those of the authors. The usual disclaimers apply. All errors are our own.

♠ Institute for Structural Research (IBS), Warsaw. E-mail: maciej.albinowski@ibs.org.pl.

♦ Institute for Structural Research (IBS), Warsaw, and IZA, Bonn. E-mail: piotr.lewandowski@ibs.org.pl. Corresponding author.

ISSN 2451-4373 | IBS ®

# 1. Introduction and motivation

Minimum wages are one of the most popular labour market policies in both the developed and the developing world. Of the 28 European Union member states in 2018, 22 had statutory national minimum wages. Among the 21 EU countries that had statutory national minimum wages in 2008, by 2018, Poland had recorded the fourth-largest increase in the real value of the minimum wage (58%), and the fourth-largest increase in the ratio of the minimum wage to the average wage (7.1 pp).[1] However, between 2002 and 2007, the minimum wage in Poland grew by only 9% in real terms, and declined in relation to the average wage, while wage inequality widened.[2] The government that took power in 2007 increased the minimum wage by 20%, and a series of hikes followed, reflecting a general shift in the attitude towards the minimum wage in Poland. However – and perhaps surprisingly – there has so far been no systematic evaluation of the employment or the wage effects of these minimum wage hikes in Poland. Our paper fills this gap.

In this paper, we evaluate the impact of minimum wage hikes on employment and wage growth in Poland between 2004 and 2018. To do so, we utilise the substantial variation in the minimum wage bite across the 73 NUTS 3 subregions in Poland. We treat the regional minimum wage bite as a continuous treatment variable (Ahlfeldt et al., 2018), and we follow Meer and West (2016) in estimating the effects of changes in the minimum wage on the dynamics of outcome variables. This approach is well-suited to the empirical and institutional setting in Poland. First, in line with Meer and West (2016), we assume that as Poland experienced steady increases in employment and wages throughout the period studied, minimum wage hikes may have affected the growth of these variables, rather than their levels. Second, our model is equivalent to a model with the pre-treatment trends in variable levels removed (Ahlfehldt et al., 2018, Monras, 2019), which helps us to isolate the effects of the acceleration of minimum wage hikes that began in 2008.

Our first contribution is to assess the spatially differentiated effects of minimum wage hikes in Poland. By studying labour markets at the subregional level, we are able to grasp much more nuanced differences in the minimum wage effects than previous studies, which analysed labour markets across 16 NUTS 2 regions in Poland (Majchrowska et al., 2016). This is crucial, because the variance of subregional wages within particular NUTS 2 regions in Poland has been substantial: in 2007, 75% of the variance of average wages at the NUTS 3 level could be attributed to the within-NUTS 2 variance, while only 25% could be attributed to the between-NUTS 2 variance. Moreover, the within-region variances of wages were significantly different across the NUTS 2 regions. By studying the NUTS 3 subregions, we are able to examine finely disaggregated differences in wages that translate into differences in the minimum wage bite.

Our second contribution is to provide empirical evidence on the spatial heterogeneity of minimum wage effects. As the effects of the minimum wage are likely to differ depending on the level of the wage (Cengiz et al., 2019, Dube, 2019, Manning, 2016), we allow for the minimum wage effects to differ in subregions that belong to the first tercile of the NUTS 3 wage distribution in 2007; i.e., before minimum wage hikes accelerated in Poland.

[1] Bulgaria, Latvia, and Romania were the only countries with larger increases in the real value of the national minimum wage; while Croatia, Latvia, and Slovenia were the only countries with larger increases in the minimum-to-average wage ratio. Germany first introduced a national minimum wage in 2015, and is not included in the comparison.

[2] The D9/D1 ratio of annual gross earnings increased from 3.89 in 2002 to 4.32 in 2006, and the D5/D1 ratio increased from 1.99 in 2002 to 2.05 in 2006. The periods used here reflect the data availability in our study.

We find that the effects of minimum wage hikes in Poland were significant only in the subregions that belonged to the bottom 33%, as measured by the average wages before the shift in the minimum wage policy in 2007. In 2007, the minimum wage bite in these subregions was already at a level of 48% or higher. In these subregions, the hikes led to significantly higher average wages and lower employment. We also find that employment adjusted to the minimum wage hikes in the same year, while wages took longer to adjust, as wages responded to the hikes in both the current and the previous year. In the remaining subregions, no significant effects of minimum wage hikes are found. Our findings are in line with the recent evidence for Germany, which shows that the minimum wage effects have been significant only in areas that had relatively low wages before the introduction of the minimum wage (vom Berge and Frings, 2019, Ahlfehldt et al., 2018).

Importantly, the economic significance of the positive wage effects appears to be larger than that of the negative employment effects. Using our regression results, we find that if the minimum-to-average wage ratio had not changed since 2007, in 2018, the average wage in the low-wage subregions of Poland would have been 3.4% lower, while employment would have been 1.2% higher. We also provide indicative evidence that the employment effects of minimum wage hikes differed between various groups of workers in Poland: i.e., that they have been negative among men and among workers in industry, but positive among women and among workers in services. These heterogeneities may indicate that substituting labour with capital has been easier in industry than in services. They may also suggest that higher minimum wages pushed up the labour supply of women, in line with the mechanisms described by Card and Krueger (1994). Unfortunately, due to a lack of data, we cannot assess the sector-specific or the gender-specific wage effects.

Our findings shed new light on the effects of minimum wage hikes in Poland, and in Central Eastern Europe economies (CEE) more generally. Majchrowska et al. (2016) argued that minimum wage hikes could limit youth employment growth in less-developed regions in the southeast of Poland. However, our findings show that the small negative employment effects are present in the least developed subregions spread around the country, and have been accompanied by noticeable positive wage effects. Trade-offs between employment and wages have been reported by Baranowska-Rataj and Magda (2015) and Kamińska and Lewandowski (2015). However, those studies were based on annual labour market flows that were constructed using individual Polish labour force survey data. When relying on these data, controlling for unobservable characteristics that may influence both employment status and wage is challenging, which makes it difficult to isolate the effects of minimum wage hikes. Significant, but quantitatively small effects of minimum wage hikes on job separations in Poland were found by Albinowski (2018), who was able to control for time-invariant individual characteristics by using employees' tax return data. Finally, surveys of managers in Central and Eastern European countries have shown that firms often increase wages in response to minimum wage hikes, and that reducing employment tends to be less relevant as an adjustment channel than increasing productivity, reducing non-labour costs, and raising product prices (Bodnár et al., 2018). Firms in CEE have also reported that they are more likely to hire fewer new employees than they are to terminate existing employment contracts (Bodnár et al., 2018). These results suggest that studies of worker-level job separations may fail to capture a major component of employment adjustment, while we are able to grasp it by analysing aggregate, subregional employment levels.

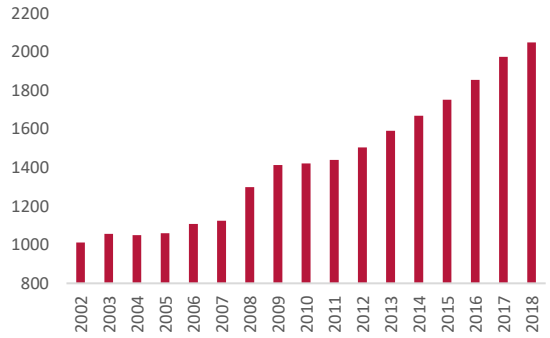
In the next section, we describe the setting and the evolution of minimum wage levels in Poland. In the third section, we outline our methodology and data. In the fourth section, we provide some descriptive evidence. In the fifth section, we present our econometric results. In the final section, we conclude and discuss the policy implications of our findings.

## 2. Minimum wage in Poland

In Poland, minimum wage regulations have been in force since 1956. Until 2002, the level of the minimum wage was set by the Minister responsible for Labour and Social Affairs. Between 2002 and 2015, the minimum wage was set annually by the Tripartite Commission for Social and Economic Affairs. Since 2015, the minimum wage has been set by the Social Dialogue Council[3] based on proposals submitted by the government. If the Commission/ Council cannot reach a consensus, the government decides independently. Additionally, since 2003, the minimum wage proposed in a given year cannot be lower than the minimum wage from the previous year, adjusted by the forecasted change of the Consumer Price Index (CPI). Moreover, since 2006, if the minimum wage in a given year is lower than 50% of the average wage in the economy, then in the following year, the minimum wage must be increased by at least two-thirds of the forecasted nominal GDP growth.

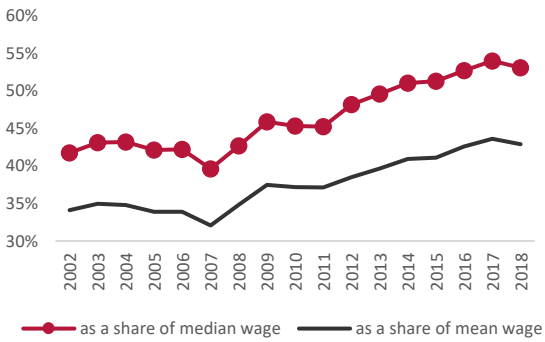
The coverage of the minimum wage in Poland is, in essence, uniform: i.e., all workers with an employment contract based on the labour code are covered. However, individuals who were self-employed or who were employed through a civil law contract (i.e., a contract of mandate or a contract for products) were not covered by minimum wage until 2016. These workers are not included in our sample.

Figure 1. Monthly minimum wage in Poland, 2002-2018 (in zloty, 2015 prices).




*Source: Own calculations based on the Statistics Poland data.*

Figure 2. Monthly minimum wage as a share of the mean and the median wage in Poland, 2002-2018.




*Source: Own elaboration based on the OECD Statistics data.*

After the law changed in 2002, the level of the minimum wage remained fairly stable until 2007, both in real terms (on average, it remained at 1079 zloty based on 2015 prices)[4] and in relation to the mean wage (on average, it was 34% of the mean wage, Figures 1 and 2). In relation to the median wage, the minimum wage even declined slightly (Figure 2). However, a series of increases have been implemented since 2007. Between 2007 and 2017, the minimum wage rose from 1124 zloty to 1972 zloty, which represented an increase in real terms of 76%. At the same time, the mean wage rose 30% in real terms, which means that the minimum-to-mean wage ratio increased from 33% in 2007 to 44% in 2017. Similarly, the minimum-to-median wage ratio increased from 40% in 2007 to 54% in 2017 (Figure 2). The largest increases in relative terms were implemented in 2008, when the minimum wage rose by 20%; and in 2009, when it increased by 13%.

[3] The Council replaced the Commission. Both have included selected members of the council of ministers, trade unions, and employers' organisations. The Council that replaced the Commission has a slightly broader mandate than the Commission had, but the process of setting the minimum wage remained intact.

[4] Unless stated otherwise, monetary values are given in real terms as per 2015 prices.

# 3. Methodology and data

## 3.1 Methodology

To assess the effects of minimum wage on outcome $y_{it}$ in subregion $i$ and time $t$, we take advantage of the substantial variation in the minimum wage bite across the NUTS 3 subregions in Poland. We evaluate the minimum wage bite as a continuous treatment variable (Ahlfehldt et al., 2018). We study two outcome variables: employment and wage growth.

Following Meer and West (2016), we estimate the effects of minimum wage changes on the dynamics of the outcome variables. This approach is particularly suitable for Poland, because of the persistent growth in total employment and wages in the country throughout the period covered by our analysis. Moreover, as the dynamics of the average wage in Poland have been driven by the medium-term convergence towards the EU average (World Bank Group, 2017), we analyse residuals from the regression of NUTS 3 wage growth on national wage growth.[5] This approach is similar to that of Monras (2019), who estimated the impact of the minimum wage on residuals from a Mincerian wage regression. Finally, as our model is equivalent to a model in which the pre-treatment trends in variable levels were removed (Ahlfehldt et al., 2018, Monras, 2019), it is suitable for the institutional setting in Poland, where the minimum wage was increased in each year covered by our sample, but the annual hikes were much larger after than before 2008.

Formally, we estimate the following model:

$$\Delta y_{it} = \alpha_i + \beta \cdot \Delta mw_{it} + \beta_{LW} \cdot \Delta mw_{it} \cdot LW_i + \varphi \cdot \Delta controls_{it} + \epsilon_{it} \qquad (1)$$

The treatment variable, minimum wage bite $mw_{it}$, is defined as the ratio of the national minimum wage in year $t$ to the average wage in year $t-1$ in subregion $i$. $LW_i$ is a dummy variable equal to one if subregion $i$ belongs to the lowest tercile of wage distribution in 2007; i.e., the year before the acceleration of minimum wage hikes. We allow the effects of the minimum wage hikes to differ between the low-wage subregions and the rest of the country for two main reasons. First, the subregional differences in wage levels in Poland have been rather large. In 2007, the coefficient of the variation of average wages across the NUTS 3 subregions amounted to 14.4%, and the ratio of the 90th to the 10th percentile was 1.4. Second, until the policy change went into effect in 2008, the Kaitz index in Poland was rather low (below 35%). Given that the effects of the minimum wage can be stronger in markets with a larger minimum wage bite (Ahlfeldt et al., 2018, Cengiz et al., 2019), it is possible that minimum wage hikes had a greater impact on subregions with lower average wages before the policy change was implemented. We elaborate on the characteristics of the low-wage subregions and the remaining subregions in Section 4.

The vector $controls_{it}$ includes key demand- and supply-side factors. The demand-side factors capture aggregate and cyclical fluctuations. They include lagged subregional GDP and labour demand shocks,

[5] We also test formally the relationship between national wage growth and increases in minimum wage bite. Time-series regressions on 14 observations indicate that national real wage growth is not related to neither contemporaneous nor lagged increases in minimum wage bite. In contrast, there is a significant correlation with GDP growth. Results are available upon request.

calculated in line with the (Bartik, 1991) shift-share method applied to four sectors.[6] The supply-side factors capture changes in the labour supply on local labour markets. They include changes in the domestic labour supply aged 20-64, and in the number of immigrant workers in relation to the population aged 20-64. We control for immigration explicitly, because since 2014, Poland has experienced large inflows of temporary workers, especially from Ukraine, who are not reflected in the population numbers (OECD, 2019). We also control for subregion fixed effects $\alpha_i$. In all regressions, standard errors are calculated with the use of the Driscoll and Kraay (1998) estimator that accounts for cross-sectional dependence.[7]

We also consider three modifications of model (1). First, we estimate a simple model that assumes a uniform effect of the minimum wage across all subregions. Second, we test whether the effects of the minimum wage materialise with a delay, and estimate model (1) with a lagged change in the minimum wage bite, $\Delta mw_{i,j,t-1}$, as an additional regressor. We use only one lag because our time series before the policy change went into effect in 2008 are relatively short. Third, following Meer and West (2016), we use the leading value of the minimum wage hike to validate our research design. If we find significant coefficients pertaining to future minimum wage hikes, the relationship between the dependent variable and minimum wage might be spurious, and could reflect unobserved trends. As in our case $mw_{i,j,t+1}$ contains wages from period $t$, we instead employ $mw_{i,j,t+2}$, and add it as an additional regressor in equation (1).

We also perform several robustness tests of our results. We use the Huber-White estimator instead of the Driscoll and Kraay (1998) estimator; we change the definition of low-wage subregions to the first quartile of the 2007 distribution of the average NUTS 3 wages; we weight the observations with the employment level in a given NUTS 3 subregion in 2007; and we use unemployment changes as a control variable. We also re-estimate our models on subsamples that are constructed by omitting NUTS 3 subregions that belong to particular NUTS 2 subregions.

Having estimated the models, we assess the economic significance of the minimum wage hikes. We calculate a counterfactual simulation of the evolution of the average wage and employment, while assuming that the ratio of the minimum wage to the average wage has remained constant since 2007; and we compare these simulations with the actual evolution of employment and wages.

## 3.2 Data

Our data cover the period 2003-2018. The Local Data Bank of Statistics Poland is our main data source. Our data on wages and employment are based on non-agricultural entities that employ at least 10 persons (micro-enterprises do not report the relevant information to Statistics Poland). Employment is measured by the number of employees (neither self-employed individuals nor workers with non-employment contracts, such as civil law contracts, are included in this statistic). The wage and GDP data are converted to real terms using the 2015 prices.

[6] Employment is available in the following four groups of NACE sections: 1) Mining, Manufacturing, Electricity Supply, Utilities, Construction; 2) Trade, Transportation and Storage, Accommodation and Food Service Activities, Information and Communication; 3) Financial and Insurance Activities, Real Estate Activities; and 4) Other Services. The sector structure used reflects data availability at the NUTS 3 level.

[7] In the case of the wage equation, tests for cross-sectional dependence reject the null hypothesis that error terms are independent across regions.

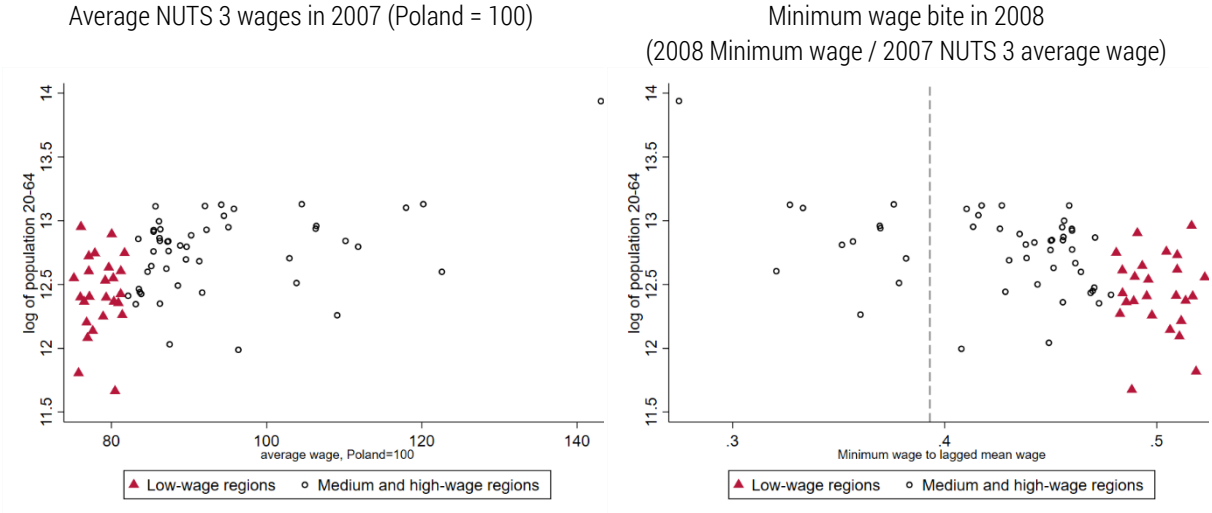
To measure immigration inflows, we use data on work permits for foreigners obtained from the Ministry of Family, Labour, and Social Policy, which is a common way to measure the spatial allocation of migrants in Poland (Górny and Śleszyński, 2019). These data are available from 2008 onwards, and we assume that in 2002-2008, the numbers of work permits were at the 2008 level. In doing so, we take advantage of the fact that the number of immigrants in Poland was very low until 2015, and has grown rapidly since then (White et al., 2018). The median proportion of temporary immigrant workers to the working-age population in a NUTS 3 subregion was 0.02% in 2008, but exceeded 1% by 2018.

# 4. Descriptive evidence

In this section, we provide descriptive evidence showing that the low-wage subregions and the rest of the country exhibited common trends in the minimum wage bite, employment, and wage trends before 2008, but that these trends diverged from 2008 onwards; i.e., after the minimum wage hikes accelerated. This suggests that our estimate of a continuous treatment variable can be interpreted in terms of the difference-in-difference estimator.

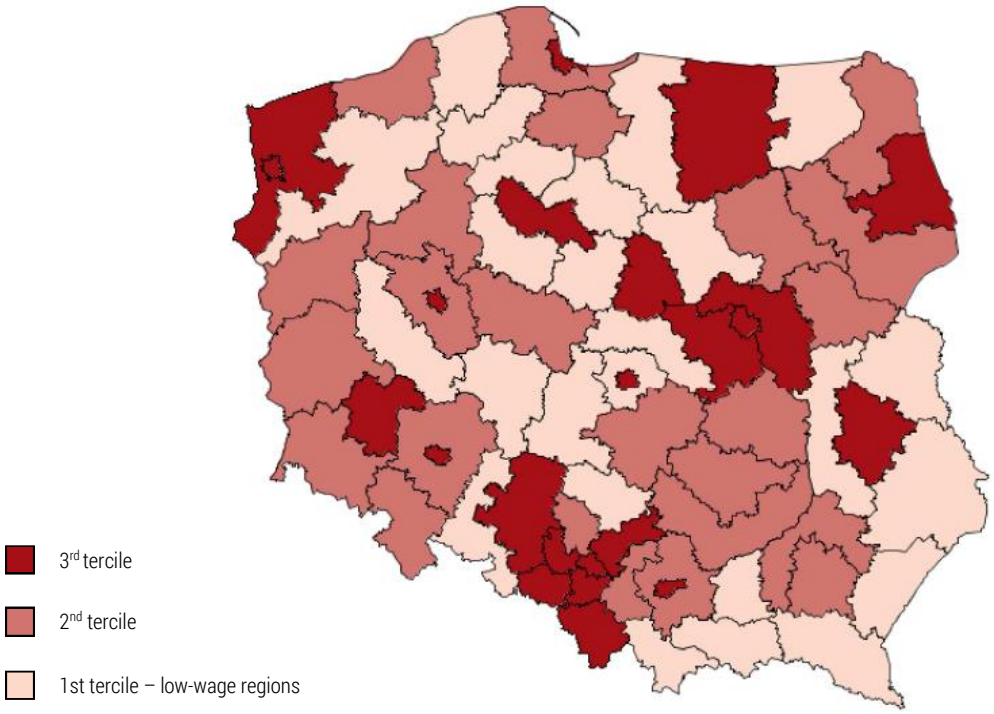
We define the low-wage subregions as those in the first tercile of the average NUTS 3 wage distribution in 2007. In the low-wage subregions, the average wages in 2007 were below 82% of the national average; and the 2008 minimum wage bite was above 48%, or 8.8 pp above the country-level bite (Figure 3). The low-wage subregions were spread across the country (Map 1), and together accounted for 21.2% of employment in 2007. The complete list of NUTS 3 subregions by terciles of the 2007 wage distribution is presented in Table A1 in the appendix.

**Figure 3. Allocation of Polish NUTS 3 subregions into groups based on the 2007 wage level.**




*Note: In the right panel, the vertical line denotes the country-average minimum wage bite.*
*Source: Own calculations based on Statistics Poland Local Data Bank data.*

Map 1. Terciles of the 2007 NUTS 3 average wage distribution in Poland.




*Source: Own elaboration based on the Geostatistics Portal, Statistics Poland.*

Before 2008, the subregional Kaitz indices (i.e., the relation of the minimum wage to the subregional mean wage) changed little in both the low-wage subregions and the medium- and high-wage subregions. In 2007, the Kaitz index in the low-wage subregions was, on average, 6.4 pp higher than it was in the rest of the country. Since 2008, the Kaitz indices have been increasing in both groups (Figure 4). The employment and wage dynamics were virtually identical in the two groups of subregions in 2002-2007, but have been diverging since 2008. In 2008-2018, average employment growth was 0.9% in the low-wage subregions, and was 1.3% in the rest of the country (Figure 5). At the same time, the subregions that initially (2007) had lower average wages experienced stronger growth starting in 2008, with the difference in cumulated wage growth over the 2008-2018 period amounting to 2.5 pp (Figure 6).

Overall, the descriptive evidence suggests that the observed convergence in wages and divergence in employment growth might have been related to the acceleration of minimum wage hikes since 2008. We test this conjecture formally in the next section.

Figure 4. Minimum wage bite by groups of NUTS 3 subregions in Poland, 2002-2018.

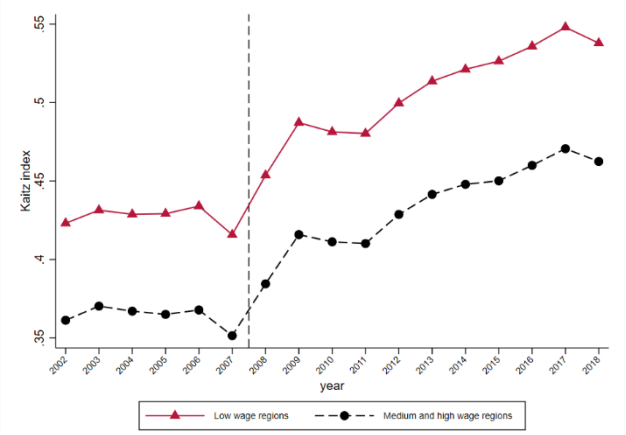



Figure 5. Average employment dynamics by groups of NUTS 3 subregions in Poland, 2003-2018 (2007=100).

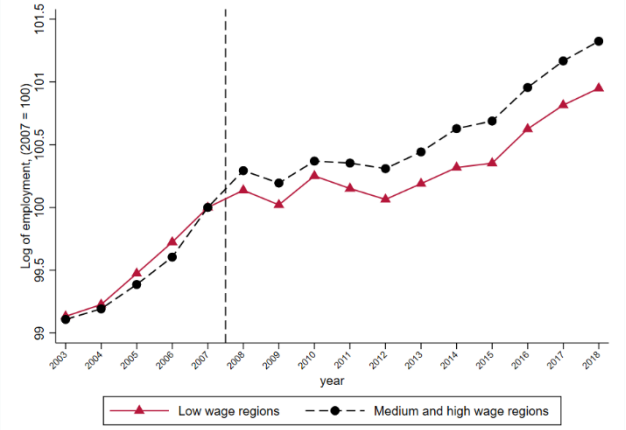



Figure 6. Average real wage dynamics by groups of NUTS 3 subregions in Poland, 2002-2018 (2007=100).


*Source: Own calculations based on Statistics Poland Local Data Bank data.*

# 5. Econometric results

## 5.1 Effects of minimum wage hikes on employment and wages

We find that the minimum wage hikes in Poland had no overall effects on employment (Table 1) or on wage growth (Table 2) in the pooled sample of 73 subregions in the 2004-2018 period. The estimated effect on employment is negative, but it is small and insignificant. The effect on relative wages is close to zero and is insignificant, which suggests that there was no wage compression across subregions in the overall sample.[8]

However, the effects on both employment and wage changes are much greater in the low-wage subregions. These effects can be seen by looking at the estimated interaction terms (column 2 of Tables 1 and 2) pertaining to the minimum wage hikes in the subregions that belonged to the lowest tercile of the wage distribution in 2007; i.e., before the minimum wage policy was changed. Moreover, we can see that the pooled employment effect of the minimum wage is no longer negative, which suggests that the small average effect (column 1 of Table 1) was driven by developments in the low-wage subregions. According to the semi-elasticities shown in column 2 of Tables 1 and 2, the increase in the minimum wage bite of 10 pp in the low-wage subregions was associated with a 1.9% decline in employment and a 0.6-pp increase in wage growth (though this effect is not statistically significant). The discussed size of the shock is comparable to the actual increase in the minimum wage bite in the low-wage subregions between 2007 and 2017, which amounted to 12.4 pp, on average.

Table 1. Effects of minimum wage hikes on subregional employment in Poland

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| ΔMW | -0.049<br>(0.032) | 0.041*<br>(0.021) | 0.044*<br>(0.024) | 0.04<br>(0.030) |
| ΔMW × (low wage subregion) | | -0.229***<br>(0.067) | -0.224***<br>(0.064) | -0.242***<br>(0.060) |
| ΔMW(t-1) | | | 0.017<br>(0.040) | 0.011<br>(0.045) |
| ΔMW(t-1) × (low wage subregion) | | | 0.069<br>(0.092) | 0.088<br>(0.082) |
| ΔMW(t+2) | | | | 0.016<br>(0.025) |
| ΔMW(t+2) × (low wage subregion) | | | | 0.012<br>(0.081) |
| Observations | 1095 | 1095 | 1095 | 1022 |
| Within R2 | 0.327 | 0.33 | 0.331 | 0.341 |

*Note: The dependent variable is employment growth in a NUTS 3 subregion. The MW is defined as the ratio of the national minimum wage to the previous year's average wage in a given subregion. All regressions use the NUTS 3 fixed effects and the following controls varying at the NUTS 3 level: growth of the active population aged 20-64; lagged growth of GDP; Bartik (1991) labour demand shocks; and growth in the ratio of the immigrant to the working-age population. Driscoll-Kraay standard errors in parentheses. * p < .1 ** p < .05 *** p < .01.*
*Source: Own estimations based on Statistics Poland Local Data Bank data.*

[8] Low-wage regions are characterised by slightly higher growth in the minimum wage bite due to the lower denominator.

Table 2. Effects of minimum wage hikes on subregional wages in Poland

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| ΔMW | 0.005<br>(0.041) | -0.032<br>(0.029) | -0.026<br>(0.028) | -0.013<br>(0.030) |
| ΔMW × (low wage subregion) | | 0.095<br>(0.060) | 0.107*<br>(0.058) | 0.090<br>(0.087) |
| ΔMW(t-1) | | | 0.043<br>(0.037) | 0.042<br>(0.029) |
| ΔMW(t-1) × (low wage subregion) | | | 0.151***<br>(0.046) | 0.145***<br>(0.048) |
| ΔMW(t+2) | | | | 0.062<br>(0.057) |
| ΔMW(t+2) × (low wage subregion) | | | | -0.091<br>(0.073) |
| Observations | 1095 | 1095 | 1095 | 1022 |
| Within R2 | 0.001 | 0.004 | 0.02 | 0.025 |

*Note: The dependent variable is the residual from the regression of subregional wage growth on national wage growth. The MW is defined as the ratio of the national minimum wage to the previous year's average wage in a given subregion. All regressions use NUTS 3 fixed effects and the following controls varying at the NUTS 3 level: growth of the active population aged 20-64; lagged growth of GDP; Bartik (1991) labour demand shocks; growth in the ratio of the immigrant to the working-age population; and lagged growth of unemployment. Driscoll-Kraay standard errors in parentheses. * p < .1 ** p < .05 *** p < .01.*

*Source: Own estimations based on Statistics Poland Local Data Bank data.*

Next, we expand the baseline specification with lagged minimum wage hikes in order to test whether the hikes affected labour markets with a delay. We find a significant and sizeable delayed effect on average wage growth in the low-wage subregions (column 3 in Table 2). This finding suggests that the wage effects materialised gradually, possibly because of spillover effects through the wage distribution. At the same time, the results show that the lagged effect on employment was not significant, which suggests that the adjustment of the employment level occurred almost immediately (column 3 in Table 1). Finally, accounting for the lagged minimum wage hikes confirms our conclusion that the minimum wage hikes had no effects in the pooled sample of all subregions.

A causal interpretation of our findings is supported by the results of the Meer and West (2016) falsification test. The leading values of the minimum wage hikes, both pooled and interacted with low-wage subregion fixed effects, are insignificant in both models (column 4 in Tables 1 and 2).[9] This result confirms our assumption that the estimated effects of minimum wage hikes were not driven by any unobserved trends.

[9] This specification implies that the sample size is reduced by excluding data from 2018 (used to calculate lead values).

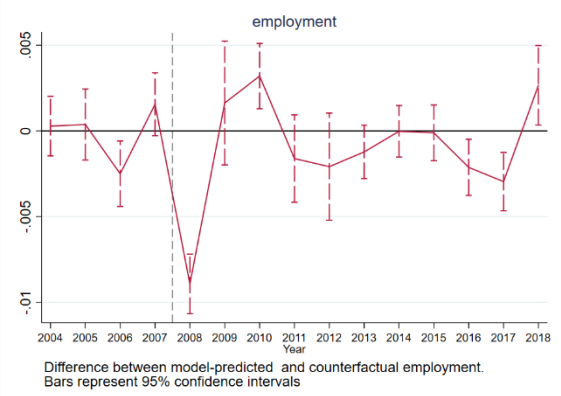
## 5.2 Economic significance of minimum wage increases

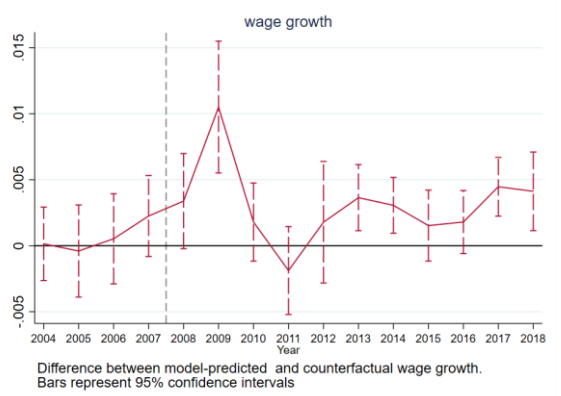
In order to assess the economic significance of minimum wage hikes, we assess the annual and the cumulated economic effects of minimum wage hikes on subregional labour markets using the models that account for lagged minimum wage hikes (column 3 of Tables 1 and 2). We evaluate the effects of successive minimum wage hikes on annual employment and wage growth (Figure 7), and calculate counterfactual simulations of employment and wage levels under the assumption that the ratio of the minimum to the average wage (Kaitz index) has remained constant since 2007 (Figure 8).

We find that the minimum wage hikes in 2008 and 2016-2017 had the most pronounced effects. In the low-wage subregions, about 1 pp of the average wage growth in 2008-2009, and about 0.4 pp in 2017-2018 can be attributed to minimum wage increases. In 2013-2014, the effects of the minimum wage hikes on wage growth were also positive and quite sizable (Figure 7). At the same time, the substantial minimum wage hike in 2008 reduced the level of employment growth in low-wage subregions by about 1 pp, and the hikes in 2016-2017 reduced it by about 0.2-0.3 pp. On the other hand, in 2010 and in 2018, the minimum wage hikes were so small that the minimum wage bite actually declined, and the effects on employment in low-wage subregions were positive. The coincidence of the positive effects on wages and employment in low-wage subregions in 2018 was due to the delayed effects of 2017 hike on wage growth. In contrast, there were no significant effects on employment or on relative wages in the medium- and high-wage subregions.

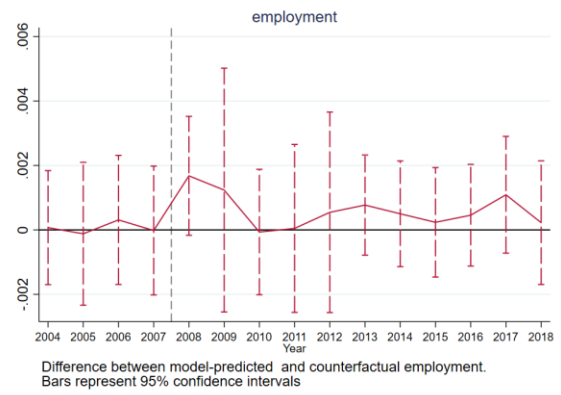
**Figure 7. The effects of minimum wage hikes on employment changes (left panel) and wage changes (right panel)**

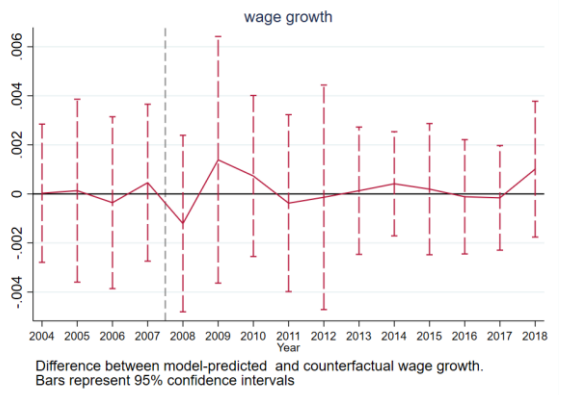
Low-wage subregions




Medium- and high-wage subregions



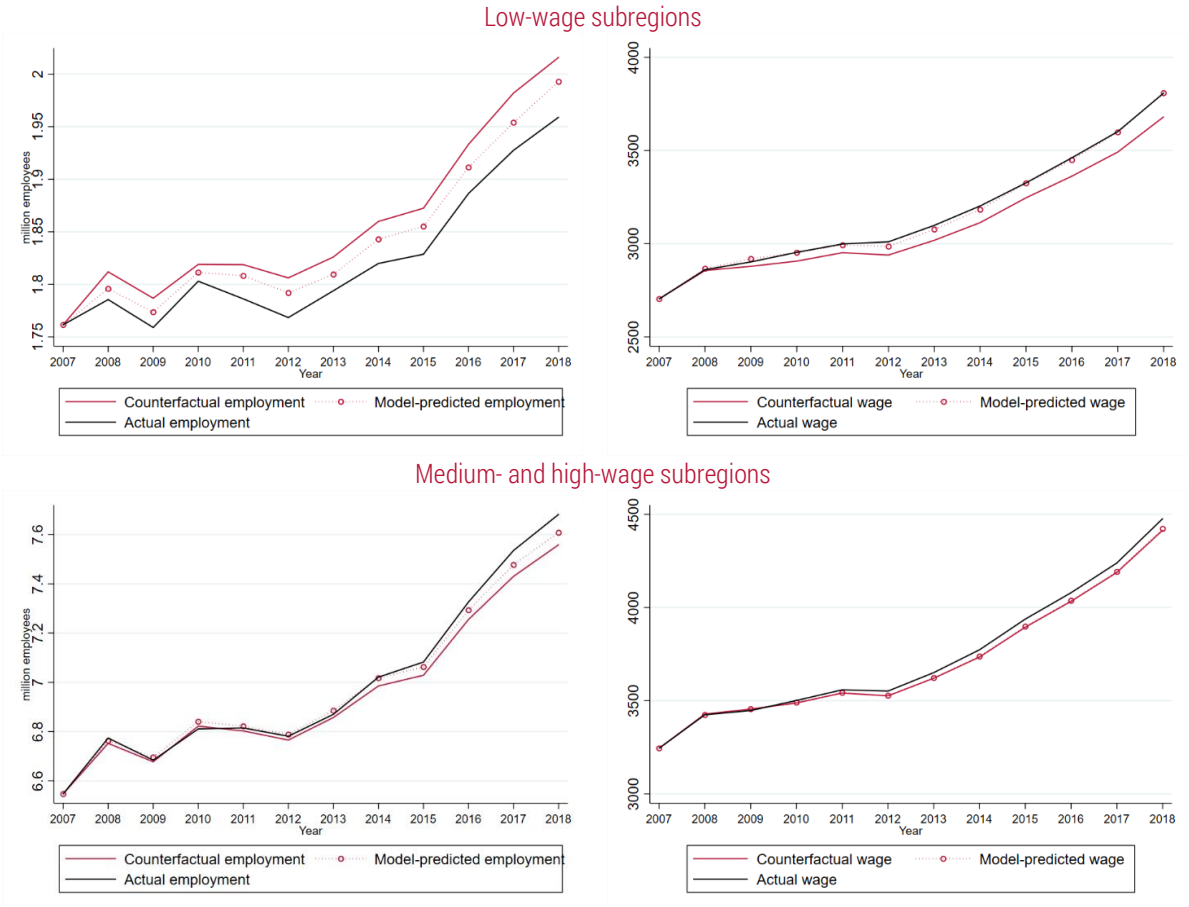




*Source: Own estimations based on models presented in column 3 of Tables 1 and 2, and on Statistics Poland Local Data Bank data.*

Our counterfactual simulations show that the acceleration of minimum hikes in Poland from 2008 onwards resulted in noticeably higher wages and somewhat lower employment in the low-wage subregions (Figure 8). If the minimum-to-average wage ratio had remained constant since 2007, in 2018, the average wage in the low-wage subregions would have been 3.4% lower (by 128 zloty per month, and 1536 zloty per year), while employment would have been 1.2% higher (23,000 additional jobs in the population of firms employing at least 10 workers). Note that while the cumulated employment effect was greater in 2017, and amounted to 1.5% of employment (28,000 jobs), a slight decrease in the minimum wage bite in the low-wage subregions reduced this effect in 2018.

On the other hand, in the in medium- and high-wage subregions, the minimum wage hikes had virtually no effect on average wages (there was a gain of two zlotys per month, and of 30 zlotys per year in 2018), and had a positive effect on employment (amounting to 41,800 additional jobs, equivalent to 0.5% of total employment). However, these point estimates for medium- and high-wage subregions should be interpreted as insignificant, because they are based on insignificant coefficients and annual effects that are not statistically different from zero (Figure 7).

**Figure 8. Counterfactual scenario of employment (left panel) and wages (right panel) in Poland under the assumption of no changes in the Kaitz index after 2007**




*Source: Own estimations based on models presented in column 3 of Tables 1 and 2, and on Statistics Poland Local Data Bank data.*

## 5.3 Heterogeneity of employment effects

In the following, we examine the heterogeneity of the employment effects of minimum wage hikes by exploring how these hikes affected workers in industry and in services, and men and women. Studying heterogenous effects on wages is impossible due to the lack of disaggregated wage data. Regression results are presented in Tables 3 and 4, and the cumulated employment effects are shown in Figures A1-A2 in the appendix.

We find suggestive evidence of differences between particular subgroups of workers. The employment effects among men and among workers in industry are found to be negative in general, and even more so in the low-wage subregions. At the same time, the employment effects among workers in services and among women are shown to be positive. The negative effects observed in industry may be related to the fact that the substitution of labour with capital and technology is easier in industry than in services (Alvarez-Cuadrado et al., 2017). The positive effects found among women suggest that minimum wage hikes may have incentivised women – and especially low-skilled women – to increase their labour supply and take up employment, in line with the supply effects described by Card and Krueger (1994).[10] However, the test of the leading minimum wage indicates that the results on women's employment may be driven by unobserved trends; i.e., factors other than the minimum wage. Thus, our findings on the gender-specific minimum wage effects in Poland should be interpreted as indicative and taken with caution.

Table 3. Employment effects of minimum wage hikes by economic sectors

| | Industry | | Services | |
|---|---|---|---|---|
| ΔMW | -0.134* | -0.198** | 0.227*** | 0.243*** |
| | (0.072) | (0.079) | (0.065) | (0.074) |
| ΔMW × (low wage subregion) | -0.268** | -0.364*** | -0.205*** | -0.169** |
| | (0.125) | (0.136) | (0.071) | (0.069) |
| ΔMW(t-1) | -0.056 | -0.056 | 0.081 | 0.081 |
| | (0.145) | (0.165) | (0.054) | (0.062) |
| ΔMW(t-1) × (low wage subregion) | -0.131 | -0.09 | 0.240*** | 0.247*** |
| | (0.323) | (0.298) | (0.069) | (0.070) |
| ΔMW(t+2) | | -0.099 | | 0.08 |
| | | (0.075) | | (0.075) |
| ΔMW(t+2) × (low wage subregion) | | -0.083 | | 0.082 |
| | | (0.131) | | (0.073) |
| Observations | 1095 | 1022 | 1095 | 1022 |
| Within R2 | 0.383 | 0.397 | 0.157 | 0.162 |

*Note: The dependent variable is employment growth in the industry sector / the services sector in a NUTS 3 subregion. All regressions are based on a specification reported in column 3 of Table 1. However, in columns 1 and 2, we replace the Bartik instrument with growth of industry employment in the rest of the country; and in columns 3 and 4, with analogous growth of services employment. * p < .1 ** p < .05 *** p < .01.*

*Source: Own estimations based on Statistics Poland Local Data Bank data.*

[10] In the studied period, reforms aimed at increasing the labour force participation of older workers, in particular of women aged 55+, were introduced in Poland (Lewandowski and Rutkowski, 2017). We account for the potential effects of these reforms by controlling for changes in the labour force participation of women.

Table 4. Employment effects of minimum wage hikes by gender

| | Women | | Men | |
|---|---|---|---|---|
| ΔMW | 0.155** | 0.166** | -0.052 | -0.079** |
| | (0.072) | (0.073) | (0.038) | (0.033) |
| ΔMW × (low wage subregion) | -0.184 | -0.083 | -0.278*** | -0.337*** |
| | (0.112) | (0.106) | (0.093) | (0.092) |
| ΔMW(t-1) | 0.265*** | 0.288*** | -0.174** | -0.216*** |
| | (0.091) | (0.082) | (0.074) | (0.072) |
| ΔMW(t-1) × (low wage subregion) | -0.075 | -0.033 | 0.108 | 0.132 |
| | (0.087) | (0.090) | (0.189) | (0.184) |
| ΔMW(t+2) | | 0.047 | | -0.03 |
| | | (0.061) | | (0.042) |
| ΔMW(t+2) × (low wage subregion) | | 0.261** | | -0.051 |
| | | (0.116) | | (0.106) |
| Observations | 1095 | 1022 | 1095 | 1022 |
| Within R2 | 0.192 | 0.206 | 0.319 | 0.331 |

*Note: The dependent variable is employment growth for women / men. All regressions are based on a specification reported in column 3 of Table 1. However, in columns 1 and 2, we replace growth of the active population aged 20-64 with growth of active women aged 20-64; and in columns 3 and 4, analogous growth for men is displayed. * p < .1 ** p < .05 *** p < .01.*
*Source: Own estimations based on Statistics Poland Local Data Bank data.*

## 5.4 Robustness analysis

In this subsection, we present a range of robustness checks of our baseline regression (column 3 of

Table 1 and 2). First, we use the commonly used Huber-White estimator (instead of the Driscoll and Kraay (1998) estimator) to calculate standard errors (column 1 of Tables 5 and 6). Second, we weight the observations by employment level in a given NUTS 3 subregion in 2007 (column 2). Third, we add lagged unemployment changes as a control variable (column 3). Finally, we define the low-wage subregions more strictly; namely, as the subregions that belong to the first quartile of the 2007 distribution of average NUTS 3 wages (column 4).

Our conclusions are robust to all these modifications. In all specifications, the estimated employment effects in low-wage subregions are of comparable sizes, and are significant at the 1% or the 5% level, while the estimated employment effects in the medium- and high-wage subregions are small and insignificant. In the case of wages, our findings also robust, as the coefficients of interest are close to those estimated in the baseline specification. The effects in low-wage subregions are significant at the 1% level (the lagged wage effect), except for the variant in which the low-wage subregions are defined on the basis on the first quartile of the 2007 average wage distribution. In the latter specification, the effect is somewhat smaller in size and is significant at the 10% level, while the overall effect is stronger than in the baseline specification (column 3 of Table 2) and in the other robustness checks (Table 6). This pattern suggests that the effects in the subregions that belong to the bottom tercile, but do not belong to the bottom quartile of the 2007 average wage distribution are significant. Thus, our baseline definition of the low-wage subregions as those in the first tercile seems to be better suited to capturing which subregions are particularly affected by minimum wage hikes in Poland.

Table 5. Robustness analysis of employment effects

| | (1) | (2) | (4) | (5) |
|---|---|---|---|---|
| | Huber-White SE | Employment weight, Huber-White SE | Added Δunemp (t-1) | Low-wage subregions: quartile |
| ΔMW | 0.044 | 0.018 | 0.050 | 0.024 |
| | (0.055) | (0.057) | (0.034) | (0.032) |
| MW × (low wage subregion) | -0.224** | -0.215** | -0.225*** | -0.231** |
| | (0.087) | (0.092) | (0.066) | (0.099) |
| ΔMW(t-1) | 0.017 | -0.07 | 0.02 | 0.028 |
| | (0.069) | (0.105) | (0.045) | (0.035) |
| ΔMW(t-1) × (low wage subregion) | 0.069 | 0.087 | 0.068 | 0.049 |
| | (0.106) | (0.114) | (0.095) | (0.090) |
| Observations | 1095 | 1095 | 1095 | 1095 |
| Within R2 | 0.331 | 0.338 | 0.331 | 0.331 |

*Note: The dependent variable is employment growth in a NUTS 3 subregion. All regressions are based on a specification reported in column 3 of Table 1. The first column reports the robust standard errors estimated by the Huber-White estimator. The second column uses the employment level of 2007 as a weight. The third column adds lagged unemployment growth to the baseline specification. The fourth column uses a more strict definition of low-wage subregions. * p < .1 ** p < .05 *** p < .01*

*Source: Own estimations based on Statistics Poland Local Data Bank data.*

Table 6. Robustness analysis of relative wage effects

| | (1) | (2) | (4) | (5) |
|---|---|---|---|---|
| | Huber-White SE | Employment weight, Huber-White SE | Added Δunemp (t-1) | Low-wage subregions: quartile |
| ΔMW | -0.026 | -0.032 | 0.006 | -0.010 |
| | (0.043) | (0.041) | (0.028) | (0.030) |
| MW × (low wage subregion) | 0.107* | 0.110** | 0.101 | 0.088 |
| | (0.059) | (0.054) | (0.063) | (0.072) |
| ΔMW(t-1) | 0.043 | -0.024 | 0.059* | 0.067* |
| | (0.038) | (0.056) | (0.035) | (0.035) |
| ΔMW(t-1) × (low wage subregion) | 0.151*** | 0.215*** | 0.147*** | 0.122* |
| | (0.056) | (0.066) | (0.050) | (0.069) |
| Observations | 1095 | 1095 | 1095 | 1095 |
| Within R2 | 0.02 | 0.013 | 0.028 | 0.017 |

*Note: The dependent variable is residual from the regression of subregional wage growth on national wage growth. All regressions are based on a specification reported in column 3 of Table 2. The first column reports robust standard errors estimated by the Huber-White estimator. The second column uses the employment level of 2007 as a weight. The third column adds lagged unemployment growth to the baseline specification. The fourth column uses a more strict definition of low-wage subregions. * p < .1 ** p < .05 *** p < .01.*

*Source: Own estimations based on Statistics Poland Local Data Bank data.*

Our final robustness check is to re-estimate the baseline regressions on 16 subsamples that are created by excluding NUTS 3 subregions that belong to particular voivodeships (16 NUTS 2 regions). The main findings are confirmed in all cases: i.e., that in the low-wage subregions, the employment effects are negative, while the lagged wage effects are positive and significant at a level of 5% or lower. The small positive employment effect in medium- and high-wage subregions becomes significant at the 5% level in two of 16 regressions; while in nine regressions, it is not significant at the 10% level. These results are available upon request.

# 6. Summary and conclusions

We have studied the employment and wage effects of minimum wage hikes in Poland, a country that has introduced some of the largest increases in the minimum wage level in the EU since the 2008 global economic crisis. To examine the effects of these minimum wage hikes, we utilised the large variation in the wage levels and in the minimum wage bite across 73 Polish NUTS 3 subregions. Controlling for a range of labour demand and labour supply factors, we found that the minimum wage hikes had a significant positive effect on wage growth and a significant negative effect on employment growth, but only in the subregions that belonged to the first tercile of the subregional wage distribution in 2007. These effects were found to be moderate in size, and to be more relevant for wages: if there had been no minimum wage hikes after 2007, by 2018, the average wage in these subregions would have been 3.4% lower, while employment would have been 1.2% higher. On the other hand, we found no significant effects on average wages or on employment in subregions that had medium or high wage levels in 2007. We also found indicative evidence that the effects on employment growth differ between groups of workers: i.e., that the effects were negative for men and for workers in industry, but were positive for women and for workers in services.

Our study has limitations. Due to a lack of data, we could not account for workers hired under civil law contracts; i.e., precarious contracts not covered by the labour code or by minimum wage laws (until October 2016). The number of such workers has been increasing between the early 2000s and the mid-2010s, and these workers were more likely to be paid less than the minimum wage (Goraus-Tańska and Lewandowski, 2019). However, if we had been able to account for these workers, it is likely that the estimated effects would have been smaller in absolute terms. This result would have reinforced our finding that the impact of these workers was insignificant in the medium- and high-wage subregions. In addition, due to a lack of data, we only able to analyse employment and wage growth in firms that employed at least 10 workers. We were also unable to account for spillovers between particular subregions or the role of cross-regional commuting, as data on input-output connections or commuting in Poland are not available at such a highly disaggregated spatial level.

Our findings have some important policy implications. First, although the minimum wage has increased substantially in Poland, the effects of this development have been benign. Our findings show that minimum wage hikes have compressed inter-regional wage inequality by accelerating wage growth in the least developed subregions, and that the associated employment losses have been very small. However, there are two caveats when projecting our findings into the future. First, as the minimum to average wage ratio has been increased over time, the current elasticities may be larger than the average elasticities that we have estimated. In 2018, in the medium- and high wage subregions the Kaitz index reached the level recorded in the low-wage subregions in 2008 (45%), and in the low wage subregions it reached 54%, surpassing the nationwide target set by legislation. This means that the trade-off between wage growth and employment losses may become less

beneficial over time if the minimum wage becomes "too high" (Dube, 2019, Manning, 2016). However, our analysis does not allow us to determine the optimal minimum wage level in Poland. Second, between 2003 and 2018, economic growth in Poland has been rapid, which has led to strong labour demand (Lewandowski and Magda, 2018, Piątkowski, 2018). An economic slowdown, and especially a recession triggered by the COVID-19 pandemic, may lead to reduced labour demand, which could, in turn, increase the risk of job losses related to minimum wage hikes. The authorities should take such uncertainties into account when setting the minimum wage level. Third, our results also show that in a country with large spatial differences in labour markets, such as Poland, it may be hard to achieve policy goals by applying a nationwide minimum wage level. However, setting a minimum wage at the level of NUTS 2 regions – which in Poland are administrative units (voivodeships) – would not solve this conundrum, and thus should not be pursued. Twelve of the 16 NUTS 2 regions in Poland include both a low-wage and a high-wage subregion. Therefore, we think that the setting of the nation-wide minimum wage should prioritise impacts on the less developed subregions. In the largest cities with the highest wages, it could be complemented by promoting the living-wage approach and encouraging collective bargaining to set higher levels of wages which account for differences in cost of living.

## References


Ahlfeldt, G.M., Roth, D., Seidel, T., 2018. The regional effects of Germany's national minimum wage. Economics Letters 172, 127–130.

Albinowski, M., 2018. Short-term and long-term employment effects of minimum wage: evidence from Poland ( No. 31), MF Working Papers. Ministry of Finance in Poland.

Alvarez - Cuadrado, F., Long, N.V., Poschke, M., 2017. Capital–labor substitution, structural change, and growth. Theoretical Economics 12, 1229–1266.

Baranowska-Rataj, A., Magda, I., 2015. The impact of the minimum wage on job separations and working hours among young people in Poland. Institute of Statistics and Demography, Warsaw School of Economics.

Bartik, T.J., 1991. Who Benefits from State and Local Economic Development Policies? W.E. Upjohn Institute for Employment Research, Kalamazoo, MI.

Bodnár, K., Fadejeva, L., Iordache, S., Malk, L., Paskaleva, D., Pesliakaitė, J., Jemec, N.T., Tóth, P., Wyszyński, R., 2018. How do firms adjust to rises in the minimum wage? Survey evidence from Central and Eastern Europe. IZA Journal of Labor Policy 7, 1–30.

Card, D., Krueger, A.B., 1994. Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. American Economic Review 84, 772–793.

Cengiz, D., Dube, A., Lindner, A., Zipperer, B., 2019. The Effect of Minimum Wages on Low-Wage Jobs. Q J Econ 134, 1405–1454.

Driscoll, J.C., Kraay, A.C., 1998. Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. The Review of Economics and Statistics 80, 549–560.

Dube, A., 2019. Impacts of minimum wages wages: review of the international evidence.

Goraus - Tańska, K., Lewandowski, P., 2019. Minimum wage violation in central and eastern Europe. International Labour Review 158, 297–336.

Górny, A., Śleszyński, P., 2019. Exploring the spatial concentration of foreign employment in Poland under the simplified procedure. Geographia Polonica 93, 331–345.

Kamińska, A., Lewandowski, P., 2015. The effects of minimum wage on a labour market with high temporary employment. IBS Working Papers.

Lewandowski, P., Magda, I., 2018. The labor market in Poland, 2000–2016. IZA World of Labor.

Lewandowski, P., Rutkowski, J. (Eds.), 2017. Population ageing, labour market and public finance in Poland. European Commission Representation in Poland, Warsaw.

Majchrowska, A., Broniatowska, P., Żółkiewski, Z., 2016. Minimum Wage in Poland and Youth Employment in Regional Labor Markets. Emerging Markets Finance and Trade 52, 2178–2194.

Manning, A., 2016. The Elusive Employment Effect of the Minimum Wage ( No. 1428), CEP Discussion Papers. Centre for Economic Performance, LSE.

Meer, J., West, J., 2016. Effects of the Minimum Wage on Employment Dynamics. J. Human Resources 51, 500–522.

Monras, J., 2019. Minimum Wages and Spatial Equilibrium: Theory and Evidence. Journal of Labor Economics 37, 853–904.

OECD, 2019. International Migration Outlook 2019. OECD, Paris.

Piątkowski, M., 2018. Europe's Growth Champion: Insights from the Economic Rise of Poland. Oxford University Press, Oxford, New York.

vom Berge, P., Frings, H., 2019. High-impact minimum wages and heterogeneous regions. Empirical Economics.

White, A., Grabowska, I., Kaczmarczyk, P., Slany, K., 2018. The Impact of Migration on Poland: EU Mobility and Social Change. UCL Press.

# Appendices

## Appendix A. Additional tables and figures

Table A1. List of NUTS 3 subregions by groups distinguished by their 2007 average wage levels

| Low-wage subregions (1st tercile of wage distribution) | | Medium-wage subregions (2nd tercile of wage distribution) | | High-wage subregions (3rd tercile of wage distribution) | |
|---|---|---|---|---|---|
| Subregion | Mean wage 2007 | Subregion | Mean wage 2007 | Subregion | Mean wage 2007 |
| Sieradzki | 2155 | Łomżyński | 2354 | Szczeciński | 2568 |
| Chojnicki | 2172 | Koszaliński | 2382 | Warszawski wschodni | 2570 |
| Grudziądzki | 2178 | Tarnobrzeski | 2392 | Olsztyński | 2587 |
| Kaliski | 2181 | Pilski | 2394 | Białostocki | 2617 |
| Inowrocławski | 2192 | Siedlecki | 2397 | Tyski | 2628 |
| Nowotarski | 2201 | Gorzowski | 2402 | Bydgosko-toruński | 2638 |
| Ełcki | 2205 | Bytomski | 2426 | Bielski | 2643 |
| Elbląski | 2209 | Gdański | 2440 | Łódź | 2698 |
| Krośnieński | 2210 | Wrocławski | 2448 | Lubelski | 2708 |
| Łódzki | 2212 | Zielonogórski | 2448 | Opolski | 2724 |
| Bialski | 2224 | Koniński | 2449 | Sosnowiecki | 2745 |
| Leszczyński | 2232 | Kielecki | 2455 | Żyrardowski | 2761 |
| Ciechanowski | 2262 | Wałbrzyski | 2468 | Gliwicki | 2950 |
| szczecinecko-Pyrzycki | 2270 | Radomski | 2470 | Szczecin | 2976 |
| Przemyski | 2274 | Piotrkowski | 2471 | Kraków | 2995 |
| Nowosądecki | 2283 | Ostrołęcki | 2471 | Rybnicki | 3047 |
| chełmsko-Zamojski | 2294 | Krakowski | 2473 | Wrocław | 3049 |
| Tarnowski | 2300 | Sandomiersko-jędrzejowski | 2495 | Płocki | 3126 |
| Skierniewicki | 2302 | Rzeszowski | 2500 | Poznań | 3157 |
| Świecki | 2306 | Jeleniogórski | 2502 | Warszawski zachodni | 3203 |
| Włocławski | 2319 | Oświęcimski | 2503 | Trójmiejski | 3380 |
| Nyski | 2327 | Suwalski | 2508 | Katowicki | 3444 |
| Puławski | 2328 | Starogardzki | 2538 | Legnicko-głogowski | 3513 |
| Słupski | 2333 | Poznański | 2546 | Warszawa | 4100 |
| Częstochowski | 2342 | | | | |
| Average | 2252 | Average | 2456 | Average | 2951 |

*Source: Own elaboration based on Statistics Poland Local Data Bank data.*

Table A2. Complete estimation results of baseline specifications for employment and wages

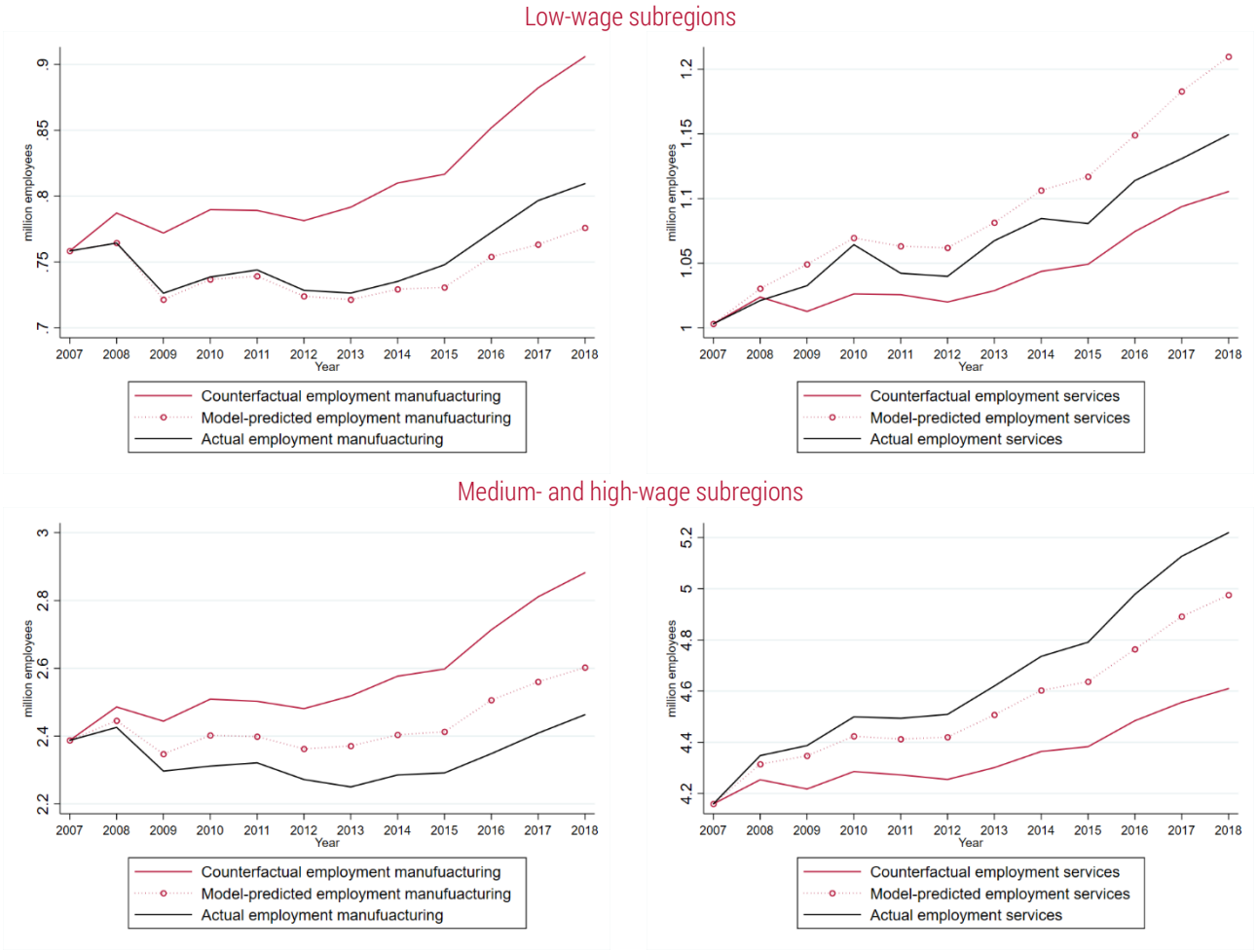
| | Employment | Wages |
|---|---|---|
| ΔMW | 0.044* | -0.026 |
| | (0.024) | (0.028) |
| ΔMW × (low wage subregion) | -0.224*** | 0.107* |
| | (0.064) | (0.058) |
| ΔMW(t-1) | 0.017 | 0.046 |
| | (0.040) | (0.038) |
| ΔMW(t-1) × (low wage subregion) | 0.069 | 0.150*** |
| | (0.092) | (0.046) |
| Bartik instrument | 0.988*** | 0.05 |
| | (0.037) | (0.060) |
| ΔLN(GDP) (t-1) | 0.023* | -0.007 |
| | (0.014) | (0.013) |
| ΔLN(Population active on labour market) (t-1) | 0.024 | 0.025 |
| | (0.028) | (0.028) |
| Δ(Inflow of immigrants / Population aged 20-64) | -0.238** | -0.019 |
| | (0.108) | (0.115) |
| Constant | -0.002** | -0.001 |
| | (0.001) | (0.002) |
| Observations | 1095 | 1095 |
| Within R2 | 0.331 | 0.021 |

*Note: The dependent variables are employment growth in a NUTS 3 subregion and the residual from the regression of subregional wage growth on national wage growth. The MW is defined as the ratio of the national minimum wage to the previous year's average wage in a given subregion. Both regressions use NUTS 3 fixed effects.*

*Driscoll-Kraay standard errors in parentheses. * p < .1 ** p < .05 *** p < .01.*

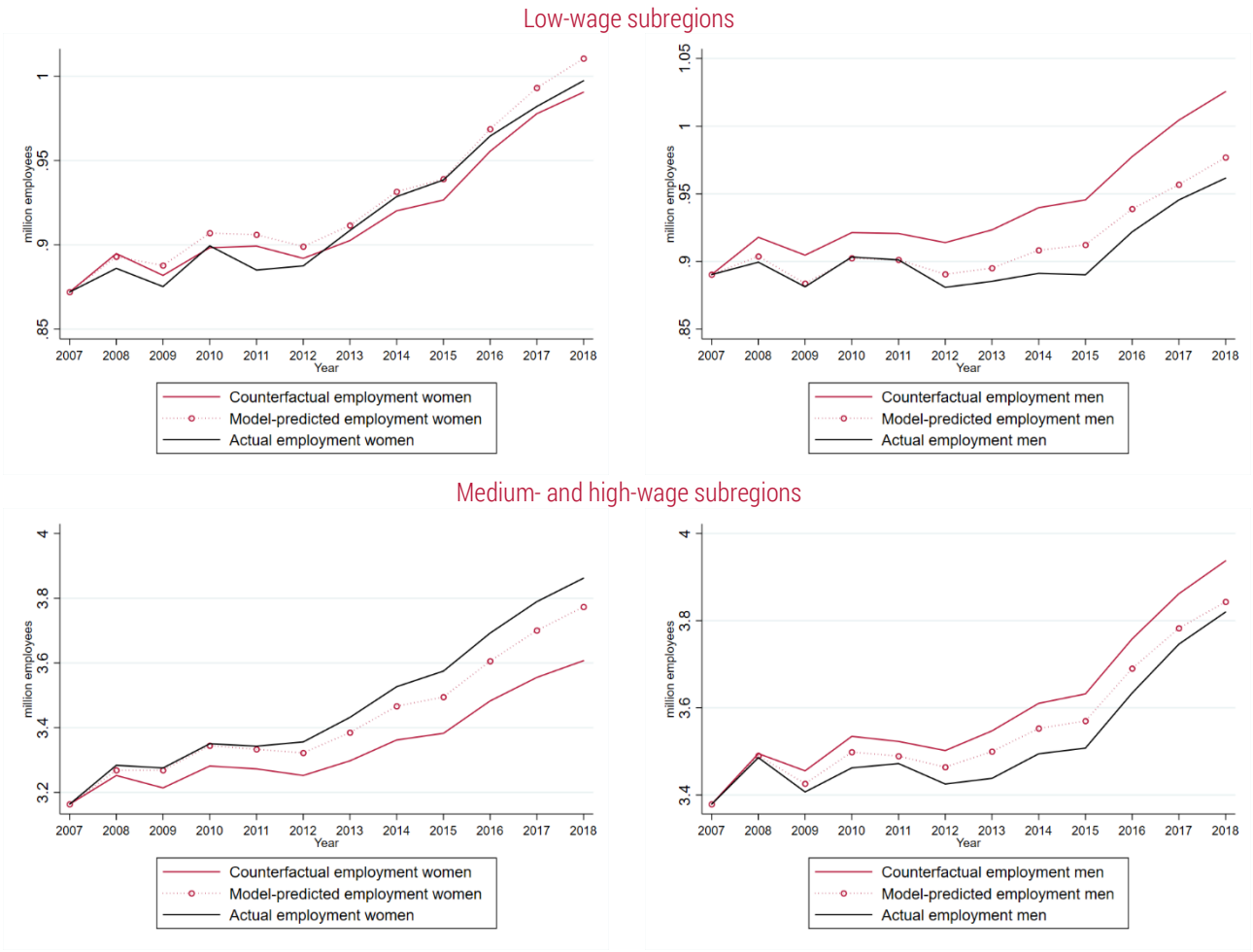
*Source: Own estimations based on Statistics Poland Local Data Bank data.*

Figure A1. Counterfactual scenario of employment in manufacturing (left panel) and in services (right panel) in Poland under the assumption of no changes in the Kaitz index after 2007




*Source: Own estimations based on models presented in Table 3, and on Statistics Poland Local Data Bank data.*

Figure A2. Counterfactual scenario of female employment (left panel) and male employment (right panel) in Poland under the assumption of no changes in the Kaitz index after 2007




*Source: Own estimations based on models presented in Table 4, and on Statistics Poland Local Data Bank data.*


www.ibs.org.pl