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Effects of minimum wage changes on the wage distribution in low-wage and high-wage sectors

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Abstract

Aim: The research aims to compare the effects of a change in the national minimum wage on the wage distribution in the low and high-paid economic sectors. We assess how wages in different economic sectors react to the minimum wage policy established at the national level.

Methodology: We use individual wages and employment characteristics data from the Structure of Earnings Survey in Poland. The methodology applied in this study uses reweighting decomposition based on the non-parametric approach of DiNardo et al. (1996).

Results: The results showed that minimum wage growth impacts economic sectors differently. In low-wage sections, minimum wage legislation forced wage growth in the left tail of the wage distribution. Up to the third decile, wage growth was equal to minimum wage growth. Moreover, the results indicated the significantly varying lengths of the spill-over effects across the analysed NACE sections. We found strong spill-over effects in low-wage sections on the entire wage distribution. In the high-wage sector, we did not observe the spill-over effects of a minimum wage increase.

Implications and recommendations: Our results are important from both the theoretical and practical points of view as they explain why the literature reports conflicting evidence regarding the impact of minimum wage changes on wage distribution and the presence of the spill-over effects. Our results indicate that the most important reason is that national minimum wage increases affect wages in

different parts of the economy to different extents, and thus are beneficial for the policymakers. They show that from the point of view of the policy of compressing wage inequalities, the effects of raising the minimum wage turned out to be not so obvious.

Originality/value: According to our knowledge, this is the first study on the impact of minimum wage on wage distribution at the NACE economic section level.

Keywords: Minimum wage, low-wage sector, wage distribution, spill-over effects

1. Introduction

In most of the new EU member states, the wage inequalities in the recent years have decreased, while in many developed European countries the overall wage inequalities increased (see Pereira, & Galego, 2019). Several public policies may affect the distribution of wages and hence wage inequalities for individuals. Local and national taxes, minimum wage legislation, social insurance policies, transfer programmes, trade union density and coverage, the level of coordination and centralisation of wage bargaining, and employment protection legislation are some examples. Most of the wage-oriented policies aim to redistribute income towards a more socially satisfactory distribution, that is, to decrease wage inequalities.

Minimum wage increases can affect the wage distribution by boosting the wages of low paid workers relative to those high paid (Redmond et al., 2021). Moreover, since employees account for both their wage levels and their relative standing in the wage distribution, minimum wage changes may increase not only the wages of low-wage workers, but also impact the level of wages in higher deciles. Such spill-over effects are observable up to 125% of the minimum wage (Butcher et al., 2012).

The drivers behind diverging patterns of wage inequality are not evident. Economic theory suggests that workers are paid accordingly to their marginal product (McCausland et al., 2020). Differences in wages across industries may result either from the structure of the industry or from the human capital characteristics of the employed labour force – among structural factors the level of international competition is the most important. Since the distribution of workers across industries is not uniform, the differences in labour productivity between economic sectors translate to differences in wages. The increases in the national minimum wage may therefore affect the wage distribution of workers in the high and low-wage sectors differently.

The aim of this study was to compare the effects of a change in the national minimum wage on the wage distribution in the low and high-paid economic sectors, and in particular to assess how wages in different economic sectors react to the minimum wage policy established at national level. Five economically important NACE sections were chosen, two of them with a high share of low-wage workers: *Accommodation and food service activities* (section I) and *Administrative and support service activities* (section N). Then, we compared the distributional effect of the minimum wage to three other sections: *Manufacturing* (section C) and two high-paid sections *Information and communication* (section J) and *Financial and insurance activities* (section K). The analysis at sectoral level allowed to observe the existing heterogeneous reactions in different sectors, which are not visible at the level of the economy.

This study contributes to the existing literature by providing new evidence on the effects of minimum wage increases on wage distribution. We demonstrate that the conflicting evidence on the effects of minimum wage changes on the wage distribution may occur because the effects differ across the low and high-paid economic sectors. It was also shown that the impact of the minimum wage policies on wage distribution and the size of spill-over effect depends on the industry and on the point of the distribution where the employee is placed. To the best of our knowledge this is the only study of the impact of minimum wage on wage distribution at sectoral level.

As a case study we chose Poland, one of the Central and Eastern European Union countries. Analysing the effects of minimum wage changes in Poland was interesting for several reasons. First, the minimum

wage policy, conducted at national level, is simple and has a long history; moreover, all the regions, occupations, and sectors have the same minimum wage. Second, according to Eurostat data, Poland's share of minimum wage workers is one of the highest among the European economies. Third, there has been a sustained increase in the national minimum wage in Poland in recent years. Fourth, Poland is one of the largest EU economies, with workers present in all NACE economic sections and the minimum wage coverage is extensive.

Several important changes in the minimum wage have been observed since Poland joined the European Union in 2004. The average yearly minimum wage increase was 4% in real terms over the period of 2006-2014. Additionally, the government boosted the minimum wage by 26% in 2008-2009. Importantly, the growth of minimum wage was above the growth of average wages; as a consequence, the Kaitz index increased by 9 pp. (Pereira, & Galego 2019). These changes significantly reduced wage inequality in Poland – the greatest change being a reduction of a distance between median and the bottom of the wage distribution.

We used individual data on wages and employment characteristics from the Structure of Earnings Survey (SES) in Poland which is part of the large European-wide survey coordinated by the Eurostat. The analysed period was 2014-2018, characterised by relatively stable economic activity. In the analysed period, the minimum wage increased by 25% in nominal and by almost 23% in real terms. The methodology applied in this study used reweighting decomposition based on the non-parametric approach of DiNardo et al. (1996) for the wage equation.

The results show that minimum wage growth impacts economic sectors differently. In both low-wage NACE sections analysed, minimum wage legislation forced wage growth in the left tail of the wage distribution; up to the third decile, and wage growth was equal to minimum wage growth. Without national minimum wage growth, the wage growth among these groups of workers would not occur or would be significantly lower. The evolution of wages differs in the right tail of the wage distribution of the low-wage sectors because of the base effect. In the NACE section with the lowest wages, the wage increases which occurred in the study period were higher than minimum wage growth. Additionally, we found that the spill-over effects differed significantly between the low and high-paid economic sectors. In the former, we observed strong spill-over effects for the entire wage distribution, whereas in the latter, we found no spill-over effects from the minimum wage increase.

The remainder of this article is structured as follows. Part 2 reviews the relevant literature. Part 3 describes the data, minimum wage policy in Poland, and the macroeconomic background in 2014--2018. Parts 4 and 5 present the methodology and empirical results, respectively. Part 6 concludes.

2. Literature review

Many studies have investigated the impact of minimum wage changes on employment. Neumark and Shirley (2021) and Wolfson and Belman (2019) presented the most recent summaries of evidence from the US. For other countries, Campolieti (2020) provided a meta-analysis for Canada, and Dube (2019) summarised the international evidence. Despite many years since the Card and Krueger (1994) findings on the positive relationship between minimum wage and employment and the Neumark and Wascher (2000) counterarguments, neither the direction nor strength of this relationship has been unequivocally determined. The most recent studies indicate a small and negative impact of minimum wage growth on employment, particularly among the young and less educated. Neumark and Shirley (2021) highlighted the fact that disagreement on the impact of minimum wage changes on employment not only exists across individual studies, but also in the meta-analyses summarising the body of the literature.

Another problem examined by prior studies is the impact of minimum wage increases on the wages. One aspect was the impact on wage inequality, as increases in minimum wages would affect the left tail of the wage distribution to a higher extent by boosting the wages of low paid workers relative to

high paid ones. The literature shows the effect depends on the direction of minimum wage changes. Teulings (2003) confirmed that the reduction in minimum wage in the US during the 1980s led to the rise in wage dispersion in the lower half of the wage distribution. Moreover, his findings indicated that the effect of changing minimum wages on relative wages is concentrated just above the minimum wage binding point.

Recent studies confirm that increases of minimum wage reduce the wage inequalities and compress the wage distribution in both developed and developing countries. Redmond et al. (2021) analysed the impact of minimum wage increases in Ireland, finding that wage inequality, measured by the ratio of wages in the 90th and 10th percentiles and the 75th and 25th percentiles, decreased by approximately 8% and 4%, respectively. For workers under 25 years of age, the effects were greater, with a 24% reduction in the ratio of wages in the 90th and 10th percentiles. Dolton et al. (2012) find that an increased 'bite' of the national minimum wage is associated with falls in lower tail wage inequality in the UK. This study confirmed the earlier findings of Dickens and Manning (2004a and 2004b). Similarly, a reduction in wage inequality in the US has been confirmed due to minimum wage increases (Autor et al., 2016; Bauducco, & Janiak, 2018).

Similar effects are reported for developing countries. Lin and Yun (2020) found that increasing the minimum wage exerted beneficial effects on the earnings distribution in China by reducing the earnings gap between the median and the bottom decile. Sotomayor (2021) confirmed the inequality decline in Brazil underlying that potential unemployment costs were overwhelmed by benefits in the form of higher wages among working individuals. Another aspect of the influence of minimum wage increases on wages concerned the spill-over effects, however, neither the presence nor the length have been unanimously determined. Gopalan et al. (2021) using administrative data for the US found modest spill-overs extending up to $2.50 above the minimum wage. Spill-overs accrue to both incumbent workers and new hires, but only within firms that employ a significant fraction of low-wage workers. Other researchers (e.g. Bauducco, & Janiak (2018), Autor et al. (2016), and Neumark et al. (2004)) also confirmed the positive spill-over effects on higher wages in the case of the US.

Conversely, the literature for the UK reported little to no evidence of minimum wage spill-overs in the UK (see e.g. Stewart, 2012, Dickens and Manning, 2004a, 2004b). Stewart (2012) explained that this might be due to the fact that that the UK minimum wage has always been below the 10th percentile of the wage distribution. By contrast, Butcher et al. (2012), showed evidence of wage spill-overs up to 40% above the national minimum wage which corresponds to the 25th percentile of wage distribution. They also indicated that these spill-overs are larger in low-wage segments (women as opposed to men, the young as opposed to the old, and low-wage regions as opposed to high-wage regions).

Garcia-Louzao and Tarasonis (2023) analysed the effects of a historically large increase in the minimum wage in Lithuania. Their results indicated that the minimum wage hike significantly increased the earnings of low-wage workers and had spill-over effects that extended up to the median of the pre-treatment earnings distribution. Both the direct and indirect effects were strongest just after the minimum wage increase. and weakened slightly a year later. Moreover, the positive wage effects were particularly salient among groups who exhibit lower average incomes, i.e. women, young workers, and non-tradable industries.

The spill-over effects were also found in Turkey (see Sefil-Tansever, & Yılmaz, 2023). Interestingly, these were more pronounced during macroeconomic instability from 2016 to 2022, compared with the relatively stable period of 2004-2015. Moreover, the outcomes differed depending on individual attributes like gender, age, education, and other relevant factors. The differences in the spill-over effects due to workers characteristics were also found by Laporšek et al. (2019). This article analysed the effects of a large increase in Slovenia's minimum wage in March 2010. The results showed that the minimum wage increase produced sizeable spill-over effects, which were higher among young or older workers, especially for wage levels near the new minimum wage.

Another important point was raised by Gregory and Zierahn (2022). They studied the impact of a minimum wage introduction on wages and employment in a quasi-experimental setting where the minimum wage was set extraordinarily high during an economic downturn. They found positive spill-over effects for wages of medium-skilled workers paid just above the minimum wage level. More importantly, their study revealed negative wage effects for high-skilled workers further up the wage distribution scale, followed by reduced returns to skills and industry skill supply.

3. Data

To identify how the minimum wage affects wage distribution across NACE sections, we need comprehensive and reliable data on wages. Thus, we use individual data on wages and employment characteristics from the SES in Poland. The SES is a large representative enterprise sample survey that provides detailed information on the relationships between the level of remuneration and individual worker characteristics (gender, age, occupation, work experience, highest educational level attained, and type of job contract). The SES, conducted biennially, covers around 12-15% of all enterprises that employ more than nine workers in Poland.

The advantages of this database include its high reliability and size. Wages are reported by the accounting departments of the enterprises. Additionally, each sample is very large: over 730,000 observations in 2014 and over 860,000 in 2018. The database represents only entities employing more than nine workers, though the employment structure in Poland has a very high share of self-employed individuals operating without job contracts (own-account workers). The authors estimate that the SES database covers nearly 90% of all contract workers in Poland.[1] Another advantage is that, unlike in other countries, the SES is conducted biennially rather than every four years.

From the SES database, we obtained information about monthly salaries and individual worker characteristics. In Poland, almost all employees are paid monthly rather than weekly. The minimum wage level was established at the monthly and hourly basis; using either set of data did not bias our results as all data were recalculated into full-time equivalents, and based on information about the education level of individuals, age, work experience, gender, occupational group, type of contract, and firm size. We included both full-time and part-time workers, but recalculated the wages of part-time workers as full-time equivalents. Moreover, the sample was limited to private sector workers because only a small fraction of minimum-wage workers are employed in the public sector (below 2%). For this study, we used data from 2014 and 2018[2] – a period long enough to cover significant increases in the minimum wage, while being short enough to ensure that the structure of the sample, workers' characteristics, and macroeconomic conditions did not change much.

We investigated how the effects of minimum wage increases differ across low-paid and high-paid economic sectors. To select the economic sections most and least exposed to minimum wage changes, we analysed several economic indicators including share of total employment, gross value added, the share of employed in firms with foreign owners, and the share of minimum wage workers. The share of total employment is an indicator of the importance of a particular section in the economy. We focused on sectors employing at least 2.5% of total contract workers in the private sector, whilst the gross value added was related to profitability and hence wages. Additionally, according to the recent study by Strawiński and Broniatowska (2021), wages in firms with foreign owners were on average 5% higher than in those with domestic owners in the private sector. Following Eurostat methodology, we calculated the share of minimum wage workers as the proportion of employees earning less than 105%

[1] According to the Central Statistical Office of Poland, only 34% of workers in micro firms in 2016 were contract employees. https://stat.gov.pl/obszary-tematyczne/podmioty-gospodarcze-wyniki-finansowe/przedsiebiorstwa-niefinansowe/dzialalnosc-gospodarcza-przedsiebiorstw-o-liczbie-pracujacych-do-9-osob-w-2016-roku,1,11.html (in Polish). [Accessed: 19.12.2022]

[2] The 2020 data were affected by the COVID lockdowns.

of the minimum wage in a given section in a given year.[3] Moreover, to calculate the half-decile groups, and ensure the reliability of the results, only those sections with a large number of workers were selected.

Finally, we end up with two NACE sections with a high share of minimum wage workers and the lowest gross value added per worker: *Accommodation and food service activities "Horeca"* (section I) and *Administrative and support service activities "Support services"* (section N). In 2014, 38% and 44% of workers in those sections received 105% of the minimum wage or less, respectively. Then, we selected two high-wage sections: *Information and communication "ICT"* (section J), and *Financial and insurance activities "Finance"* (section K) to compare the distributional effects of minimum wage changes. Both sections have a very low share of minimum wage workers, 6% and 5% in 2014, respectively, and at the same time a relatively high gross value added per worker and share of employment by multinational firms (see also Strawiński, & Broniatowska, 2021). The analyses for these sections can show how the wage distribution would change in an economy with scarce minimum wage workers. Moreover, the authors examined *Manufacturing* (section C), which covers approximately 40% of employment in the private sector in Poland; therefore, it can be treated as representative for the entire economy. In 2014, 12% of workers in this section received 105% of the minimum wage or less. Table 1 summarises the information about the minimum wage workers and sample sizes in the sections analysed.

Table 1. Macroeconomic characteristics of selected NACE sections in Poland in 2018

NACE sector	Share of total employment (%)	Share of employment in firms with foreign owners (%)	Gross value added *per worker* (thousand EUR)	Gross average wage (EUR)	Share of MW workers (%)*
C: Manufacturing	37.6	37.1	32.1	1034	10.2
F: Construction	6.4	12.1	35.8	899	24.3
G: Trade	20.8	31.9	33.1	946	15.0
H: Transport	5.9	27.3	31.3	942	19.2
I: Horeca	2.5	13.6	19.6	703	31.7
J: ICT	3.7	58.0	45.7	1891	2.7
K: Finance	3.8	53.1	31.2	1768	3.3
M: Professional	3.9	41.8	111.2	1373	8.5
N: Support Services	5.7	13.2	15.6	807	30.0
P: Education	2.6	0.5	33.1	946	7.9
Total	92.9	30.6	27.9	1076	13.7

* Following Eurostat methodology, the authors calculated the share of minimum wage workers as the proportion of employees earning less than 105 % of the minimum wage in a given section in a given year.

Note: Trade – Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles; Transport – Transportation and storage; Horeca – Accommodation and food service activities; ICT – Information and communication; Finance – Financial and insurance activities; Professional – Professional, scientific and technical activities; Support Services – Administrative and support service activities.

Source: Central Statistical Office of Poland and Structure of Earnings Survey in Poland, 2018 edition; own calculations.

As far as the minimum wage is concerned, Poland is one of 22 countries out of the 27 EU Member States which have a national minimum wage. The minimum wage in Poland is set up annually through negotiations within the Social Dialogue Council, which consists of representatives from the government, employers' organisations, and trade unions. If the Council is unable to reach a consensus, then the Council of Ministers sets the minimum wage level for the following calendar year. The minimum wage in Poland is set up at the monthly basis. Additionally, in 2017 an hourly minimum wage rate was

[3] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Minimum_wage_statistics#Proportion_of_minimum_wage_earners [Accessed: 19.12.2022]

introduced. There is one minimum wage rate for all regions, occupations, and sectors. The minimum yearly growth rate of the national minimum wage in Poland is regulated by law. Its annual increase is guaranteed to be at least equal to the projected rise in the price levels for the next year plus two-thirds of the forecasted GDP growth rate.

In 2014, the monthly minimum wage was 1680 PLN. In the period 2014-2018, it increased to 2100 PLN[4], or by 25%. At the same time, the average wage grew by 21.2% from 3783.46 PLN to 4585.03 PLN. In that time Poland had a low inflation rate, which did not exceed 1% per year on average. In real terms, the minimum wage in Poland increased, therefore, by almost 23% (see Table 2). The sample period of 2014-2018 also saw stable economic growth (GDP grew by 4.4% yearly on average; GVA by 5.7%) and had good labour market conditions, with a stable average growth rate of employment at almost 1% per year. The unemployment rate fell from 9 to 4%. Good macroeconomic situation prevented workers from transitioning to the agriculture sector for labour hoarding purposes, as is common in times of economic slowdown.

Table 2. Minimum wage and macroeconomic conditions in Poland in 2014-2018

	Nominal minimum wage (PLN)	HICP (2015=100)	Real minimum wage (PLN, 2015 prices)	Nominal minimum wage growth (%)	Real minimum wage growth (%)	Real GDP growth (%)
2014	1680	100.7	1668	5.0	4.9	3.4
2015	1750	100	1750	4.2	4.9	4.2
2016	1850	99.8	1854	5.7	5.9	3.1
2017	2000	101.4	1972	8.1	6.4	4.8
2018	2100	102.6	2047	5.0	3.8	5.4

Source: Central Statistical Office of Poland and Eurostat, own calculations.

The coverage of minimum wage workers in Poland is extensive, i.e. the minimum wage legislation covers all workers in the private sector. Several groups of public sector workers (teachers, medical workers, public defence, and others) however have separate wage policies, therefore, the further analyses included only private sector workers.

4. Methodology

In this study, we focused on the impact of minimum wage changes on the wage distribution. Prior studies commonly estimate the effect of changes in policy by conducting difference-in-differences (DID) analysis (Card, & Krueger, 1994). In this study, we were not able to use this approach because the used data were from cross-sectional study and not a balanced panel, thus we cannot ascertain that we observed exactly the same individuals at both points in time, before and after policy change.

Following the seminal work of Mincer (1974), we assume that wage (*w*) is a function of individual characteristics (*X*) and wage policy (*P*). Hence the wage for the group of workers is

$$F(w) = F(X, P). \tag{1}$$

We estimate the effect of the change between two periods, denoted as *t*=0 and *t*=1, which represent the period before and after the policy change, respectively. We can write the outcome of the change in the policy as follows:

$$\Delta = F(X_{t=1}, P_{t=1}) - F(X_{t=0}, P_{t=0}). \tag{2}$$

If we assume that individual characteristics are stable over time, namely $X_{t=1} = X_{t=0}$, then we can attribute the change in the outcome fully to the change in policy. However, in this study it was not

[4] The minimum wage in Poland was equal to approximately 400 EUR in 2014 and to approximately 500 EUR in 2018 (Eurostat data).

possible to directly estimate equation (2) for several reasons. First, there is a serious identification problem; the change in the wage distribution between two periods (2014 and 2018) might have occurred due to a change in the wage-setting scheme or due to a change in workers' characteristics, and a period of four years makes the latter effect non-negligible. The composition of the labour force might change significantly due to a substantial increase in the average education level, such as young workers with secondary and tertiary education replacing elderly workers with primary education.

To correct the wage distribution to account for the abovementioned effects we adapt the method of DiNardo et al. (1996) method, which allowed us to reweight the actual characteristics of workers using estimated propensity scores to construct the counterfactual distribution of workers characteristics (see Majchrowska, & Strawiński, 2018). Consequently, we can treat the wage distribution for the reweighted sample as if the workers' characteristics did not change. The counterfactual wage distribution describes the wages in t=1 (2018) if employees possess characteristics as ones in t=0 (2014). We used weights w_i to transform the actual distributions $F(X_{t=0})$ to the counterfactual one $F(\hat{X}_{t=0})$, and estimated the change in the wage distribution as

$$\Delta = F(X_{t=1}, P_{t=1}) - F(\hat{X}_{t=0}, P_{t=0}). \quad (3)$$

The empirical strategy was divided into two steps. In the first step, we applied the DiNardo et al. (1996) reweighting approach described above, and generated the propensity scores from the logit model estimated from the pooled sample, as this distribution better handles long and heavy tails. The dependent variable is the year dummy, and the independent variables include age, working experience and its square, education dummies, firm size dummies, type of contract dummies, and some of the interactions. The policy variable is the minimum wage change, whilst the outcome variable is the average monthly salary. The estimated propensity scores were used as weights in the reweighting procedure to assess how much of the change in the salary[5] distribution between 2014 and 2018 can be attributed to differences in the distributions of worker and employer characteristics. Then, the counterfactual distribution was used which assumes that workers characteristics did not change from those in 2014 to eliminate the impact of the changes in workers' characteristics. We compared the differences in wages between the two periods, given the same workers characteristics hence any differences between the distributions were supposed to be due to factors external to the model identified with minimum wage increases. This assumption was justified since it showed that the macroeconomic conditions in this period were stable, and the impact of trade unions and wage bargaining in the private sector in Poland was marginal. In fact, the minimum wage is the only labour market institution which externally impacts wage growth in the private sector in Poland.

In the second step, we applied the reweighting decomposition to a Mincer-type extended wage equation. This methodological approach provided consistent estimates over time and allowed to separate the effect of the policy change from that of the change in workers characteristics. While both the standard decomposition and the DiNardo et al. (1996) methods are related to the construction of a counterfactual distribution, the former being fully parametric and the latter non-parametric, as it involves the weighted kernel density estimation. The methods also provide different outcomes. The former approach describes a change in mean wages, while the latter indicates a change in the entire wage distribution. We followed Majchrowska and Strawiński (2018), taking advantage of both methods by simply combining them.

The proposed method is similar to those found in the literature, however this approach is more efficient and less computationally burdensome. A recent popular approach is a combination of the recentred influence function regressions with unconditional quantile regressions (Firpo et al., 2009), however it was designed to estimate the effect of covariates on the quantiles of the dependent variable, and especially to decompose an effect into the contribution of each covariate. As we are interested in the policy impact represented by a single dummy covariate on the entire distribution of the dependent variable, we use simpler approach.

[5] In Poland most employees are paid a monthly (not weekly) salary.

5. Empirical results

We start our empirical analysis with looking at the actual wage distribution in each of the NACE sections chosen, as depicted in Figure 1. We analyse nominal changes in wages since in 2014-2018 the inflation rate in Poland was negligible (in 2014-2018 the CPI increased by 1.9%). We can see significant differences in the shape of the distribution, with a much greater concentration of workers in the left tail for the low-wage NACE sections of *Accommodation and food service activities* (section I) and *Administrative and support service activities* (section N). Looking at the changes in the wage distributions over time, we observe that in all sections, the wage distribution moved to the right.

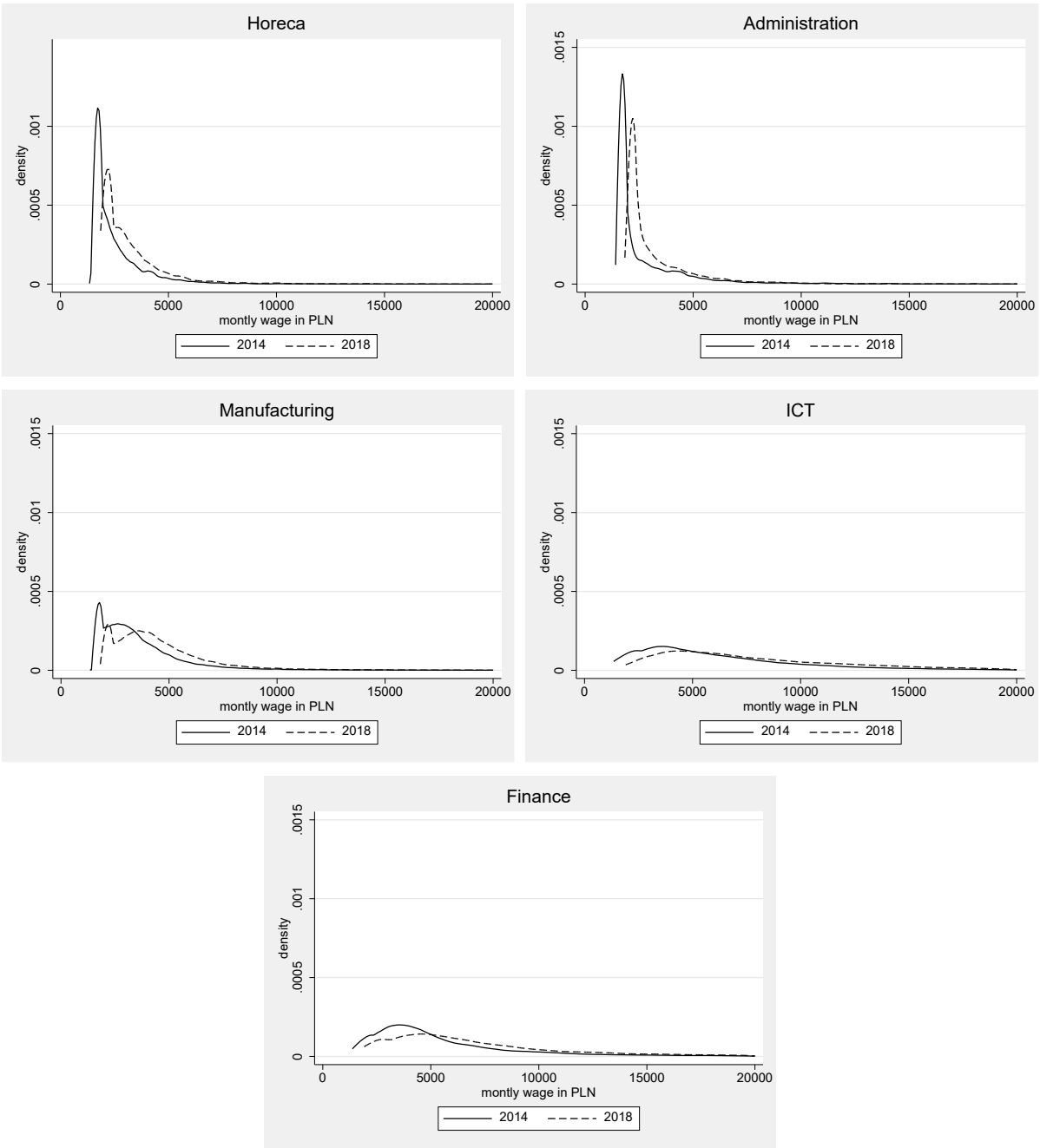

Fig. 1. Actual wage distributions in analysed NACE sections in 2014 and 2018

Source: Structure of Earnings Survey in Poland, 2014 and 2018 editions, own calculations.

In the low-wage sections, the wage distribution was concentrated around the minimum wage, whereas in the high-wage sections, the wage distribution was spread more evenly. In the low-wage sections, 25–30% of workers earned no more than the minimum wage, and 80% no more than twice the minimum wage (see Table 3). In high-wage sections, less than 5% of workers earned no more than minimum wage, and 20–25% of workers earn no more than twice the minimum wage.

Table 3. Actual wage distribution by half-deciles in analysed NACE sections in 2014 and 2018 (PLN)

Percentiles	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018
	Horeca		Administration		Manufacturing		ICT		Finance	
5	**1680**	**2100**	**1680**	**2100**	**1680**	**2100**	1730	2656	1793	2306
10	**1680**	**2100**	**1680**	**2100**	1699	2200	2219	3263	2200	2720
15	**1680**	**2100**	**1680**	**2100**	1875	2500	2690	3724	2548	3203
20	**1680**	**2100**	**1680**	**2100**	2057	2781	3062	4194	2819	3600
25	**1680**	**2100**	**1680**	2138	2233	3012	3400	4549	3083	4000
30	**1680**	2197	**1680**	2206	2408	3234	3700	5000	3342	4350
35	1720	2300	1682	2246	2578	3450	4075	5500	3585	4708
40	1800	2473	1717	2283	2754	3637	4480	6000	3841	5066
45	1892	2589	1782	2355	2920	3847	4900	6473	4118	5490
50	2000	2741	1840	2463	3098	4048	5327	7031	4402	5948
55	2095	2879	1944	2600	3282	4258	5818	7650	4726	6417
60	2214	3024	2078	2788	3487	4500	6356	8408	5093	6972
65	2378	3207	2307	3000	3710	4764	6986	9121	5533	7575
70	2540	3458	2658	3289	3992	5062	7617	10050	6125	8321
75	2773	3675	3048	3656	4300	5429	8437	11179	6808	9209
80	3039	4007	3559	4167	4692	5882	9497	12431	7770	10483
85	3403	4437	4204	4713	5209	6486	10851	14000	9179	12311
90	4000	5129	5000	5630	6059	7431	12852	16218	11289	14965
95	5035	6551	6884	7400	7867	9495	16772	20398	16039	19700

Note: Bolded half-deciles with wage not higher than minimum wage and grey marks the half-deciles with wage not higher than twice minimum wage binding in a given year. Minimum wage in 2014 equalled 1680 PLN, in 2018 equalled 2100 PLN.

Source: Structure of Earnings Survey in Poland, 2014 and 2018 editions, own calculations.

We look more deeply into the changes in the actual wage distribution in the chosen sections between 2014 and 2018 to determine whether the changes were lump-sum, proportional or whether the effect was non-linear. For each NACE section, we regressed the values of the half-deciles in 2018 on their values in 2014 and their squares:

$$HD_{t=1,i} = \alpha_0 + \alpha_1 HD_{t=0,i} + \alpha_2 HD^2_{t=0,i} + \varepsilon_i, \quad (4)$$

where HD indicates the value of the *i*-th half-decile of wage distribution in each NACE section at time *t*=1 (2018) and *t*=0 (2014).

Table 4. The estimates of equation (4) separately for analysed NACE sections

	Horeca	Administration	Manufacturing	ICT	Finance
HD_2014	1.572***	1.156***	1.328***	1.368***	1.607***
	(0.141)	(0.075)	(0.040)	(0.027)	(0.021)
$(HD\_2014)^2$	-0.111*	-0.048*	-0.043***	-0.023***	-0.051***
	(0.056)	(0.024)	(0.011)	(0.004)	(0.003)
Constant	-323.497	315.998**	72.457	112.038	-730.467***
	(193.252)	(116.346)	(79.606)	(96.094)	(69.715)
Adj. R^2	0.994	0.996	0.999	0.999	0.999
Number of observations	19	19	19	19	19

Note: HD – half-decile of the wage distribution; estimated parameters (standard errors).

Source: own estimates.

The results are presented in Table 4. In the low-wage sector, the parameter estimated by the squared half-decile was significant at the 10% significance level only, indicating that in these sections the changes in wages across half-deciles seemed to be linear, and in the analysed period wages grew by almost the same percentage in each half-decile. In the high-wage sector, the parameters squared half-deciles were significant at the 1% level and negative. This indicates that the wage growth effects were in those sections non-linear; wage growth was higher in the lower half-deciles than in the higher ones.

We would like to assess the extent to which changes in the wage distribution in the analysed NACE sections were the result of changes in workers' characteristics, and to what extent to other factors, which we identify in this study with minimum wage changes. This was done by calculating the counterfactual wage distribution in 2018, which assumes that all workers' characteristics were the same as in 2014. Then, we performed the reweighting decomposition of the estimated difference between the actual and counterfactual wage distribution in 2018. In Table 5, the difference between the means of the actual and counterfactual wage distribution varies between 20% and 24%, with the highest differences found in the *Horeca* section. The lowest difference occured in the high-wage *Finance* section. In all sectors, the effects of changes in workers' characteristics were statistically not significant, which shows that the counterfactual wage distribution was properly constructed.

Table 5. The estimated differences between actual and counterfactual mean wages for analysed sections in 2018

	Horeca	Administration	Manufacturing	ICT	Finance
CF_wages_2018	7.775*** (0.021)	7.793*** (0.029)	8.125*** (0.009)	8.656*** (0.041)	8.536*** (0.026)
AC_wages_2018	8.012*** (0.020)	8.003*** (0.018)	8.338*** (0.007)	8.885*** (0.029)	8.740*** (0.042)
Difference	-0.237*** (0.029)	-0.211*** (0.034)	-0.213*** (0.011)	-0.229*** (0.050)	-0.204*** (0.050)
Explained part	-0.001 (0.023)	0.001 (0.026)	0.003 (0.008)	0.003 (0.031)	-0.006 (0.024)
Unexplained part	-0.236*** (0.017)	-0.211*** (0.021)	-0.215*** (0.008)	-0.233*** (0.038)	-0.198*** (0.042)
Number of observations in CF_2018	8,497	20,209	171,999	17,204	22,265
Number of observations in A_2018	9,955	26,505	201,955	20,554	24,658

Note: CF_wages – counterfactual wages; AC_wages – actual wages; estimated parameters (standard errors).
Source: Structure of Earnings Survey in Poland, 2014 and 2018 editions, own estimates based on individual data.

To check for spill-over effects of minimum wage growth across the wage distribution in particular NACE sections, the reweighting decomposition was performed again, but adding the indicator variables for each half-decile group in the left tail of the wage distribution for each section. In the low-wage sections, all the workers in the first five half-deciles received exactly the minimum wage, therefore, we added the indicators for the sixth and consecutive half-deciles. In the remaining NACE sections, we analysed the spill-over effects in the first six half-deciles. We report the results in Tables 6-10.

Table 6. Estimated difference between actual and counterfactual wage distribution in section Horeca with additional dummies for low-wage half-deciles

	Eq_0	Eq_1	Eq_2	Eq_3	Eq_4	Eq_5	Eq_6	Eq_7
CF_2018	7.775***	7.775***	7.775***	7.775***	7.775***	7.775***	7.775***	7.775***
AC_2018	8.012***	8.012***	8.012***	8.012***	8.012***	8.012***	8.012***	8.012***
difference	-0.237***	-0.237***	-0.237***	-0.237***	-0.237***	-0.237***	-0.237***	-0.237***
explained	-0.001	-0.062**	-0.067***	-0.077***	-0.078***	-0.086***	-0.089***	-0.095***
unexplained	-0.236***	-0.174***	-0.170***	-0.160***	-0.159***	-0.150***	-0.147***	-0.142***

Explained								
HD_6		-0.062***	-0.068***	-0.075***	-0.079***	-0.085***	-0.089***	-0.094***
HD_7			0.001	0.001	0.002	0.002	0.002	0.002
HD_8				-0.003	-0.003	-0.004	-0.004	-0.004
HD_9					0.003**	0.003**	0.004**	0.004**
HD_10						-0.002	-0.002	-0.003
HD_11							0.001	0.002
HD_12								-0.000
Unexplained								
HD_6		-0.011***	-0.015***	-0.021***	-0.024***	-0.034***	-0.041***	-0.052***
HD_7			-0.006***	-0.007***	-0.008***	-0.010***	-0.012***	-0.014***
HD_8				-0.009***	-0.010***	-0.012***	-0.014***	-0.016***
HD_9					-0.006***	-0.008***	-0.009***	-0.011***
HD_10						-0.011***	-0.013***	-0.016***
HD_11							-0.009***	-0.011***
HD_12								-0.013***
constant	-0.203***	-0.037	-0.023	0.007	0.016	0.080	0.099*	0.127**
Number of observations	18,452	18,452	18,452	18,452	18,452	18,452	18,452	18,452

Note: CF_wages – counterfactual wages; AC_wages – actual wages; HD_6 (and further) – additional dummy for the 6th half-decile.

Source: own estimates.

Table 7. Estimated difference between actual and counterfactual wage distribution in section Administration with additional dummies for low-wage half-deciles

	Eq_0	*Eq_1*	*Eq_2*	*Eq_3*	*Eq_4*	*Eq_5*	*Eq_6*	*Eq_7*
CF_2018	7.793***	7.793***	7.793***	7.793***	7.793***	7.793***	7.793***	7.793***
AC_2018	8.003***	8.003***	8.003***	8.003***	8.003***	8.003***	8.003***	8.003***
difference	-0.211***	-0.211***	-0.211***	-0.211***	-0.211***	-0.211***	-0.211***	-0.211***
explained	0.001	-0.076***	-0.072**	-0.080***	-0.088***	-0.095***	-0.102***	-0.110***
unexplained	-0.211***	-0.134***	-0.138***	-0.130***	-0.123***	-0.116***	-0.109***	-0.100***
Explained								
HD_6		-0.078***	-0.080***	-0.086***	-0.094***	-0.103***	-0.112***	-0.121***
HD_7			0.006***	0.007***	0.008***	0.010***	0.011***	0.013***
HD_8				-0.002	-0.003	-0.003	-0.003	-0.004
HD_9					-0.000	-0.001	-0.001	-0.001
HD_10						0.000	0.000	0.000
HD_11							0.001	0.001
HD_12								-0.000
Unexplained								
HD_6		-0.016***	-0.017***	-0.023***	-0.031***	-0.041***	-0.055***	-0.075***
HD_7			-0.004***	-0.005***	-0.006***	-0.007***	-0.009***	-0.011***
HD_8				-0.010***	-0.011***	-0.014***	-0.017***	-0.021***
HD_9					-0.012***	-0.014***	-0.018***	-0.022***
HD_10						-0.013***	-0.016***	-0.020***
HD_11							-0.015***	-0.020***
HD_12								-0.020***
constant	-0.196	-0.133	-0.135	-0.123	-0.114	-0.094	-0.074	-0.010
Number of observations	46,714	46,714	46,714	46,714	46,714	46,714	46,714	46,714

Note: CF_wages – counterfactual wages; AC_wages – actual wages; HD_6 (and further) – additional dummy for the 6-th half-decile.

Source: own estimates.

Table 8. Estimated difference between actual and counterfactual wage distribution in section Manufacturing with additional dummies for low-wage half-deciles

	Eq_0	*Eq_1*	*Eq_2*	*Eq_3*	*Eq_4*	*Eq_5*	*Eq_6*
CF_2018	8.125***	8.125***	8.125***	8.125***	8.125***	8.125***	8.125***
AC_2018	8.338***	8.338***	8.338***	8.338***	8.338***	8.338***	8.338***
difference	-0.213***	-0.213***	-0.213***	-0.213***	-0.213***	-0.213***	-0.213***
explained	0.003	0.004	0.010	0.014*	0.016*	0.019**	0.021**
unexplained	-0.215***	-0.216***	-0.223***	-0.227***	-0.229***	-0.231***	-0.234***
Explained							
HD_1		0.001	0.001	0.001	0.001	0.001	0.001
HD_2			0.007***	0.008***	0.008***	0.009***	0.010***
HD_3				0.003*	0.003*	0.003*	0.004*
HD_4					0.001	0.001	0.001
HD_5						0.001	0.001
HD_6							0.001
Unexplained							
HD_1		0.001	0.003***	0.004***	0.004***	0.003***	0.003***
HD_2			0.001***	0.001***	0.001***	0.000***	0.000***
HD_3				-0.000	-0.000	-0.000	-0.001
HD_4					-0.001***	-0.001***	-0.002***
HD_5						-0.001***	-0.002***
HD_6							-0.002***
Constant	-0.231***	-0.203***	-0.239***	-0.226***	-0.213***	-0.215***	-0.211***
Number of observations	373,954	373,954	373,954	373,954	373,954	373,954	373,954

Note: CF_wages – counterfactual wages; AC_wages – actual wages; HD_1 (and further) – additional dummy for the 1-th half-decile.

Source: own estimates.

Table 9. Estimated difference between actual and counterfactual wage distribution in section ICT with additional dummies for low-wage half-deciles

	Eq_0	Eq_1	Eq_2	Eq_3	Eq_4	Eq_5	Eq_6
CF_2018	8.656***	8.656***	8.656***	8.656***	8.656***	8.656***	8.656***
AC_2018	8.885***	8.885***	8.885***	8.885***	8.885***	8.885***	8.885***
difference	-0.229***	-0.229***	-0.229***	-0.229***	-0.229***	-0.229***	-0.229***
explained	0.003	0.015	0.024	0.031	0.036	0.038	0.042
unexplained	-0.233***	-0.244***	-0.253***	-0.260***	-0.265***	-0.267***	-0.271***
Explained							
HD_1		0.012	0.013	0.015	0.016	0.017	0.018
HD_2			0.007	0.008	0.009	0.010	0.010
HD_3				0.005	0.006	0.006	0.007
HD_4					0.003	0.003	0.004
HD_5						-0.000	-0.001
HD_6							0.002
Unexplained							
HD_1		-0.000	-0.001	-0.000	-0.000	-0.000	-0.000
HD_2			-0.005*	-0.005**	-0.006***	-0.006***	-0.006***
HD_3				-0.000	-0.001	-0.001	-0.001
HD_4					-0.001	-0.002	-0.001
HD_5						0.000	0.000
HD_6							-0.001
constant	-0.454**	-0.397**	-0.404***	-0.415***	-0.397***	-0.430***	-0.425***
Number of observations	37,758	37,758	37,758	37,758	37,758	37,758	37,758

Note: CF_wages – counterfactual wages; AC_wages – actual wages; HD_1 (and further) – additional dummy for the 1-th half-decile.

Source: own estimates.

Table 10. Estimated difference between actual and counterfactual wage distribution in section Finance with additional dummies for low-wage half-deciles

	Eq_0	*Eq_1*	*Eq_2*	*Eq_3*	*Eq_4*	*Eq_5*	*Eq_6*
CF_2018	8.536***	8.536***	8.536***	8.536***	8.536***	8.536***	8.536***
AC_2018	8.740***	8.740***	8.740***	8.740***	8.740***	8.740***	8.740***
difference	-0.204***	-0.204***	-0.204***	-0.204***	-0.204***	-0.204***	-0.204***
explained	-0.006	0.023	0.012	0.017	0.023	0.030	0.033
unexplained	-0.198***	-0.227***	-0.216***	-0.221***	-0.227***	-0.234***	-0.237***
Explained							
HD_1		0.030	0.031	0.033	0.035	0.037	0.038
HD_2			-0.012**	-0.013**	-0.015**	-0.016**	-0.017**
HD_3				0.004	0.004	0.005	0.005
HD_4					0.004	0.004	0.005
HD_5						0.005*	0.006*
HD_6							0.000
Unexplained							
HD_1		0.011**	0.007*	0.006*	0.005	0.004	0.004
HD_2			-0.001	-0.001	-0.000	0.000	0.000
HD_3				0.000	0.001	0.001	0.001
HD_4					0.001	0.001	0.002
HD_5						-0.000	-0.000
HD_6							-0.000
Constant	-0.274	-0.253**	-0.204*	-0.203**	-0.195**	-0.207**	-0.199***
Number of observations	46,923	46,923	46,923	46,923	46,923	46,923	46,923

Note: CF_wages – counterfactual wages; AC_wages – actual wages; HD_1 (and further) – additional dummy for the 1-th half-decile.

Source: own estimates.

The results indicate significantly the varying length of the spill-over effects across the analysed NACE sections. In the low-wage sector, we found significant effects of the minimum wage increases throughout the wage distribution. The parameters estimated for the added variables in the unexplained part of the decomposition were significant for all half-deciles (see Tables 6 and 7) and the effects are diminishing. This was due to the fact that in this sector low wages were observed even in the right tail of the distribution, whilst wages in the 8th decile were still lower than twice the amount of the minimum wage.

The situation was different in the high-wage sections. The parameters estimated by the added variables in the unexplained part of the decomposition were insignificant or significant but quantitatively very small; they were statistically significant, though their significance was a side effect of the large sample size. Hence, in the high-wage sector, we did not observe spill-over effects of a minimum wage increase. In the *Finance* section, we found a small distributional effect related to the number of minimum wage workers in the second half-decile.

Similarly, in the *Manufacturing* section there was also a distributional effect related to the number of minimum wage workers, however the effect was weak. In this section there were not observed any significant spill-over effects.

Finally, we analysed how changes in minimum wage affected wage inequalities in different sectors in the top and the bottom half of the wage distribution. In most of the analysed NACE sections, the comparison of the 95th to 5th percentile indicated wage compression (Table 11); the exception was *Accommodation and food service activities*. It should be stressed that wages in that NACE section were the lowest in the economy, and the ratio of 95th to 5th percentile was just above 3, so wage inequality in that sector was very low.

Additionally, it could be noted that the effects of a reduction in wage inequality were diversified in the different parts of the wage distribution. In the bottom half we observe the divergence of wages in almost all the analysed NACE sections, with the exception of ICT, while in the top half of the wage distribution the convergence of wages is observed.

Table 11. Wage inequality measures across analysed sections between 2014 and 2018

	Horeca		Administration		Manufacturing		ICT		Finance	
	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018
95/5	3.00	3.12	4.10	3.52	4.68	4.52	9.69	7.68	8.94	8.54
90/10	2.38	2.44	2.98	2.68	3.57	3.38	5.79	4.97	5.13	5.50
75/25	1.65	1.75	1.81	1.71	1.93	1.80	2.48	2.46	2.21	2.30
50/10	1.19	1.31	1.10	1.17	1.82	1.84	2.40	2.15	2.00	2.19
90/50	2.00	1.87	2.72	2.29	1.96	1.84	2.41	2.31	2.56	2.52

Source: own calculations.

Minimum wage changes affect companies wage setting schemes depending on the degree of international competition and international openness of the economic sector. Among companies that operate locally (*Horeca*, *Administration*, and part of *Financial services*), labour cost expressed as percent of gross value added was not rising, due to the fact that they were able to increase prices (see also Majchrowska, 2022). However, globally the growth of GVA per worker was slower than that of the minimum wage (see Table 12).

Table 12. Change of labour cost and gross value added 2014 and 2018

NACE section	Labour costs as % of GVA (2014)	Labour costs as % of GVA (2018)	% change in GVA per worker
Manufacturing	43.6	48.0	11.3
Horeca	43.7	41.1	23.8
ICT	38.6	45.9	1.7
Finance	40.0	38.5	22.3
Administration	56.2	52.5	31.6

Source: CSO, own calculations.

Companies that face international competition, or are intermediaries in value chains, were not able to rise prices, so wage share in value added in those sectors increased (see Nikulin et al., 2022).

The performed analyses allowed to explain the differences in the reaction of wages to the minimum wage changes across low-wage and high-wage NACE sections. The growth of wages of workers in the first 20-30 percentiles was equal to minimum wage growth in that period, while the wages of workers in the middle of distribution increased. At the same time the wages of the top earners rose at a slower pace than the minimum wage.

6. Conclusions

In this study, we analysed the differences in the impact of minimum wage increases on the wage distribution between the low and high-wage sectors, using individual data on wages and worker characteristics from the SES in Poland for 2014-2018. In this period, stable macroeconomic conditions were observed and the minimum wage increased by 25% in nominal and 23% in real terms. We checked for diverse effects on the wage distributions in low-wage and high-wage sectors. According to our best knowledge, this is the first study on the impact of minimum wage on wage distribution at NACE economic section level. We applied reweighting decomposition to determine the extent to which

changes in the wage distribution were due to changes in workers' characteristics, and to what extent to changes in minimum wage.

The research results explain why the literature reports mixed outcomes when examining the impact of minimum wage changes on the wage distribution. The results indicate that the most important reason is that minimum wage increases affected wages in different parts of the economy to different extents, while the earlier studies provided conflicting evidence regarding the presence of spill-over effects. We demonstrated that the effects of minimum wage increases affected the wage distribution in the low and high-wage sectors differently. In the low-wage sector, we find spill-over effects throughout the distribution, whereas in the high-wage sector, we can see no spill-over effects of a minimum wage increase. Finding this dichotomy was one of the main contributions of this study.

Recent studies pointed out that minimum wage increases compress the wage distribution in a given country, however the results of this study showed that increasing the minimum wage impacts differently wage inequalities across sectors. In most of the analysed sectors, minimum wage increases reduced wage inequalities. These findings were in line with the results of previous research (e.g. Autor et al., 2016). Without the obligatory increases in wages among low-wage workers, the differences between low and high-wage workers would be higher. In this sense, our results are similar to those of Redmond et al. (2021), however, we found that in NACE sections with very low wages, low productivity and low wage dispersion, the obligatory increase in minimum wages led to a slight increase in wage differences. Importantly, the effects were diversified in the different parts of the wage distribution. In the bottom half we observe a divergence of wages in almost all the analysed NACE sections, while in the top half – a convergence of wages. This may stem from the fact that the study covers a period of economic expansion, when employers were able to increase wages for all workers, not limited to obligatory increases for minimum wage workers.

The results are beneficial for policymakers. The effects of minimum wage policy differ by sector, and depend on sector productivity, level of competition and openness. From the point of view of the policy of compressing wage inequalities, the effects of raising the minimum wage turned out to be not so obvious, was also emphasised by the ILO (2020).

This study has some limitations. Not all contract workers were covered by the data, and the data did not include non-contract workers and B2B contracts. We did not have information on workers in micro firms, however this should not be a big issue since the results are significant and robust. The inclusion of these workers, in our opinion, would strengthen the results obtained in the study.

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