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$$\frac{n!}{(n-1)!} p^{m-1} (1-p)^{n-m} = p \sum_{\ell=0}^{n-1} \frac{\ell+1}{n} \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell}$$
$$= p \frac{n-1}{n} \sum_{\ell=0}^{n-1} \left[\frac{\ell}{n-1} + \frac{1}{n-1} \right] \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell} = p^2 \frac{n-1}{n} +$$

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Minimum Wage Increase and Firm Profitability: Evidence from Poland

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Abstract:

In this paper, we investigate how the increase in minimum wages affect firm profitability. We focus on the firm-level panel data in Poland, where minimum wage growth remained stable and averaged around 4 percent between 2003 and 2007 but accelerated to 20 percent in 2008. Implementing a difference-in-difference approach in this quasi-experimental setting, we find that the minimum wage increase contributed positively to average wages and negatively to firm profitability. Intuitively, the increased labor costs due to a higher wage floor directly reduce profits in the absence of labor demand adjustments. We formally test and confirm validity of these empirical predictions in a simple theoretical model of a profit maximizing firm.

JEL: C21, J23, L25

Keywords: Minimum wage, firm profitability, difference-in-difference

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1. Introduction

Despite decades of research, the question about economic impact of minimum wages continues to be debated among policy makers and researchers. Even though the rich literature has rigorously documented a positive impact of minimum wages on earnings of low-wage workers, the existing studies provide ambiguous predictions about potential implications for firm operation including changes in employment, profitability, and productivity among other characteristics. Although these factors remain equally important, evidence on how firm profits are affected by the wage floor is particularly limited.* In this context, the analysis of the current literature is further constrained to the case of developed countries, and there is surprisingly the lack of empirical evidence on this effect in developing economies. This paper, therefore, seeks to fill this gap in the literature by exploring the impact of minimum wages on firm profits in a developing country setup, where the nature of labor market is very different relative to developed country settings explored before. Furthermore, to the authors' knowledge, this is a first attempt at showing the link between minimum wages and firm profitability in one of the Eastern European countries.

We perform the analysis using the firm-level panel data in Poland between 2006 and 2009. The Polish labor market environment during the considered period has several distinct attributes that make it a suitable laboratory for evaluating the wage floor policy. First, the minimum wage in Poland was introduced in 1999 and its growth remained relatively stable until 2008 with an average value of around 4 percent between 2003 and 2007. Second, the minimum wage experienced the most significant rise of around 20 percent in 2008. This dramatic increase in the wage floor coupled with stable growth in the preceding years provides a quasi-experimental setting for examining the economic impact of the minimum wage increase via the difference-in-difference strategy. In our focus on firm profits, the study builds on earlier literature ([Draca, Machin and Van Reenen, 2011](#)) and takes advantage of the panel data at the firm level.

The results indicate that the minimum wage increase in Poland in 2008 had a negative impact on firm profitability. Consistent with the previous studies, we also show that

*An extensive survey by [Lemos \(2008\)](#) documents over 300 papers on employment effects and none on profit effects in the earlier literature. [Draca, Machin and Van Reenen \(2011\)](#) is the first paper evaluating the impact of the minimum wage introduction on firm profitability in the United Kingdom.

average wages experienced a significant increase in response to the higher wage floor. We provide an intuitive explanation of our main predictions through the lens of a simple theoretical model and formally test whether the empirical results remain consistent with the theory. Furthermore, the results of this study are robust to different identification assumptions.

Employment effect. The standard economic theory suggests that minimum wages increase earnings of low-wage workers and depress employment (Brown, 1999; Borjas, 2004). The empirical literature generally supports a positive impact on the structure of wages, but provides mixed conclusions on employment effects. With respect to the latter evidence, a large strand of the literature documents a significant negative impact of the minimum wage on employment of teenagers (Neumark and Wascher, 1992; Baker, Benjamin and Stanger, 1999). Using the restaurant industry data, Aaronson and French (2007) further show that a 10 percent minimum wage increase leads to a 2.5 to 3.5 percent decline in employment. Neumark and Wascher (2007) provide a comprehensive summary of these earlier studies (around 90 research papers) published during the 1995-2007 period. They conclude that the introduction or increase of a minimum wage indeed reduces employment of low-skilled and young workers, especially young teenagers. Recently, Dube, Lester and Reich (2010) compare employment growth across U.S. counties with different levels of the minimum wage and show that employment trends may alternate substantially between regions. The overall employment has higher growth rate in those parts of the country where minimum wages are lower, and lower growth rate in those parts with higher minimum wages. Sabia, Burkhauser and Hansen (2012) study the increase in the New York state minimum wage and show that the policy raises wages of less-skilled younger workers and decreases employment of younger less educated individuals, with the largest effects for those aged between 16 and 24. Overall, these studies document a detrimental effect of minimum wages on employment.

On the other hand, a number of studies suggest an insignificant or even positive effect of wage floors on employment. One of the most influential studies is the paper by Card and Krueger (1994) investigating changes in employment in the fast-food industry in New Jersey in response to the 1992 increase in the state minimum wage. The authors present evidence that the policy has no effect or even a small positive impact on employment. However, their findings have been criticized over both choice of the research

design (Hamermesh, 1995) and the phone survey methodology (Welch, 1995). Stewart (2004) uses individual-level longitudinal data from matched Labour Force Surveys in the UK and does not find a significant adverse employment effect of the minimum wage for any demographic group. Giuliano (2013) uses the personnel data on adults and teenagers and demonstrates that a compulsory minimum wage increase in the US in 1996 has an insignificant effect. Recently, Hirsch, Kaufman and Zelenska (2015) documents the same findings based on a sample of 81 fast-food restaurants in Georgia and Alabama during the 2007-2009 period.

Yet another strand of the literature echoes these contradictory predictions in the context of Central and Eastern European countries. For instance, Fialova and Mysikova (2009) find that the minimum wage increases regional unemployment and reduces the probability of employment in the Czech Republic, while Eriksson and Pytlikova (2004) indicate moderate job losses in response to the minimum wage introduction during the period 1999-2002 in the Czech Republic and Slovakia. The impact of the minimum wage on the Polish labor market is of particular interest of this study. Melnyk (1996) concludes that the wage floor increases national unemployment. Moreover, the author emphasizes that some regions are more affected by the binding wage floor and suggests determining the minimum wage on a local level. Further, Jacukowicz (2007) finds no impact of the minimum wage on employment and Majchrowska and Zulkiewski (2012) document an adverse impact only on the youngest workers with the largest effect during the periods of a higher increase in the minimum salary.

Profitability Effect. The aforementioned papers discuss how changes in the minimum wage can potentially affect employment and the structure of wages. Since firms incur higher wage costs, their profits should be reduced. In order to avoid these losses, firms can adjust to new conditions by increasing their output prices. Lemos (2008) provides the survey of 30 studies on the relation between minimum wages and prices, and finds no big impact on the latter ones due to higher wage floors. Consistent with this evidence, Wadsworth (2010) reports very limited effects of the minimum wage introduction on prices for goods and services in Great Britain in the short term. There are, however, several exceptions including studies of fast-food sectoral prices (Aaronson, 2001) and restaurant prices (Aaronson and French, 2007; Aaronson, French and MacDonald, 2008).

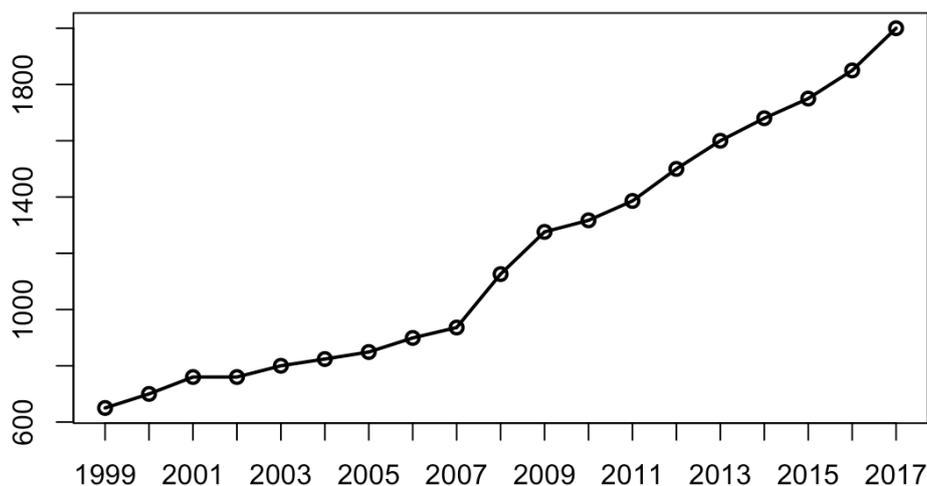
A scant evidence on price adjustments suggests that higher wage costs would lead to a reduction in firm profits. [Draca, Machin and Van Reenen \(2011\)](#) confirm this prediction based on the minimum wage introduction in UK in 1999. Recently, [Bell and Machin \(2016\)](#) study fluctuations in the firm value in response to the wage floor increase. Their results indicate a significant drop in the stock market value for low wage firms. This decrease in the firm value is associated with the decline in profitability. Surprisingly, the connection between minimum wages and profits remains briefly addressed by the existing studies. This paper, therefore, seeks to fill this gap in the literature by exploring the impact of minimum wages on firm profits in Poland. To the authors' knowledge, this is a first attempt at showing the link between the increase in the minimum wage and firm profitability in one of the Eastern European countries. The study is inspired by the [Draca, Machin and Van Reenen \(2011\)](#) and adjust their methodology to the Polish environment.

2. Minimum Wage in Poland

The minimum wage in Poland is established on the national level since 1999. According to the Act of October 10, 2002, the Tripartite Commission for Social and Economic Affairs sets the minimum wage annually and announces its new level in "Monitor Polski" before September 15. A new minimum wage is in place from January 1 of the following year. There are no regional or sectoral differences in the wage floor. The minimum wage is generally updated once a year, however, it is adjusted the second time if the price index is too high (105% or higher).

Figure 1 illustrates the historical wage dynamics in Poland from 1999 to 2017. The size of the wage up-ratings fluctuated considerably from 0% between 2001 and 2002, when the minimum wage stayed flat at 760 PLN, to 20.3% in 2008, when the wage floor was increased from 936 PLN in the previous year to 1,126 PLN. The first noticeable rise of around 8% happened between 2000 and 2001. In the subsequent period from 2002 to 2007, minimum wage growth was slower and relatively stable leading to an increase from 760 PLN to only 936 PLN over the whole five-year period. After 2007 there were two consecutive episodes when the national wage floor was significantly raised by 20.3% and 13.3% in 2008 and 2009, respectively. This rapid growth was followed by less than 5% up-ratings in 2010-2011 and it slightly accelerated in the period 2012-2018, though never

Figure 1: Dynamics of the Minimum Wage in Poland, 1999-2017



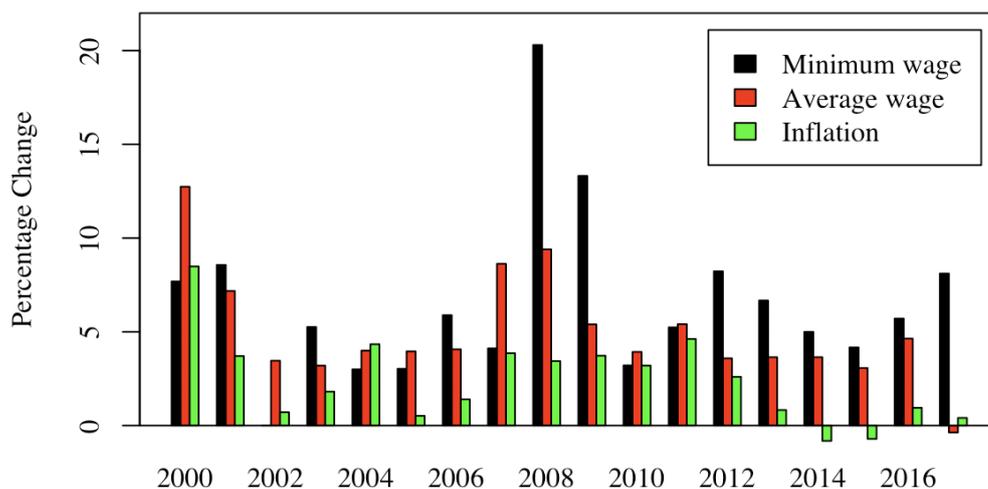
Data Source: www.stat.gov.pl

reaching growth rates observed in 2008 and 2009. Overall, the minimum wage increased more than three times from 650 PLN in 1999 to 2,000 PLN in 2017.

Figure 2 augments the description of the minimum wage in Poland by comparing its growth dynamics with national average wage and inflation for the considered time interval. It can be observed that the average wage grew in tandem with the minimum wage except for 2008-2009 and 2012-2013 periods when growth in the former was twice slower than in the latter. Also, the minimum wage grew by around 8% in 2017, while the average wage actually declined in the same year. In relative terms, the ratio of the minimum wage to the average wage increased from around 0.35 in 2007 to almost 0.49 in 2017. Figure 2 further shows that inflation tends to correspond well to increases in the minimum wage in the period before 2008, however, minimum wage growth begins to consistently surpass inflation starting from 2008 with especially pronounced domination in 2008-2009 and 2012-2017. This suggests that the minimum wage remained relatively stable in real terms before 2007 and between 2010 and 2011, while it grew strongly in 2008-2009 and after 2012.

In the Polish setting, the firms and workers know that each year the minimum wage will change but they never know by how much. This randomness in the size of wage increases creates the quasi-experimental setup where firms paying wages just below the minimum wage level can be compared to the firms paying just above the minimum wage level. Therefore, the difference-in-difference technique is a suitable methodology for

Figure 2: Minimum Wage Growth, Average Wage Growth and Inflation in Poland, 2000-2017 (y/y, %)



Data Source: www.stat.gov.pl

evaluating the economic impact of this policy. In particular, we focus on the abnormal minimum wage increase in 2008 and study its implications for firm profitability in Poland. This research question has not been addressed by the existing studies, thus, we aim to fill in this gap in the literature.

One potential criticism of our choice of the studied period is that the unprecedented increase in the national minimum wage happened during the period of the Financial Crisis. As a result, the actual impact of the event under our consideration will be muted by the adverse global shock on the economy of Poland. Although this argument could be generally a source of major concern, we would like to point out the fact that Poland was the only European union country, which was not affected by the recession. According to [Drozdowicz-Biec \(2011\)](#) this could be explained by several main factors. First, a significant amount of direct investments into the economy of Poland strengthened the productivity growth during the crisis period. Second, the presence of a relatively large domestic market and small dependence on exports to other countries made the worldwide slump less noticeable for Poland. Third, flexible exchange rate and currency depreciation supported the international export and prevented country from increasing own costs of production during the recession. The last but not least factor is the economic boost caused by EU transfers after the country entered EU in May, 2004. The volume of the inflows was not uniformly distributed over the 2004-2010 and was the largest in 2007-2008.

All those conditions helped Poland to face the financial recession.

3. Theoretical Framework

In order to gain a better understanding of the scope for minimum wages to influence profitability, we follow [Ashenfelter and Smith \(1979\)](#) and present a simple theoretical framework. This model illustrates how an introduction of the minimum wage affects the outcome of a profit maximizing firm. Consider a competitive firm which hires a fixed amount of workers L at the fixed wage rate W . Additionally, the firm uses another factor of production, capital K at the price r . The final output Q is sold at price p . Consequently, the firm solves a simple profit maximization problem:

$$\Pi(W, r, p) = pQ - rK - WL, \quad \text{where } Q = Q(K, L).$$

The first order conditions imply that the values of all marginal products are equalized to the corresponding prices of inputs:

$$\frac{\partial \Pi}{\partial K} = p \frac{\partial Q}{\partial K} - r = 0, \quad \frac{\partial \Pi}{\partial L} = p \frac{\partial Q}{\partial L} - W = 0$$

Using FOCs, we can find the optimal allocation of labor L and capital K . Substituting the optimal labor L and capital K into the objective function, we obtain the firm's profit $\Pi = \Pi(W, r, p)$ as a function of prices W , r , and p . Taking first and second order derivatives of the profit function with respect to W produces:

$$\frac{\partial \Pi}{\partial W} = p \left(\frac{\partial Q}{\partial L} \frac{\partial L}{\partial W} + \frac{\partial Q}{\partial K} \frac{\partial K}{\partial W} \right) - \left(L + W \frac{\partial L}{\partial W} \right) - r \frac{\partial K}{\partial W} = \quad (3.1)$$

$$= \left(\underset{\text{FOC}_0}{p \frac{\partial Q}{\partial L} - W} \right) \frac{\partial L}{\partial W} + \left(\underset{\text{FOC}_0}{p \frac{\partial Q}{\partial K} - r} \right) \frac{\partial K}{\partial W} - L = -L, \quad (3.2)$$

$$\frac{\partial^2 \Pi}{\partial W^2} = -\frac{\partial L}{\partial W}. \quad (3.3)$$

Assume the minimum wage W^* is introduced. The situation when the existing wage W is above the required threshold W^* is trivial since the minimum wage will have no impact on firm's inputs and profit. Therefore, we are interested in a non-trivial case when the firm initially offers the wage level W below a required wage rate W^* . What will happen with the firm's profitability in this situation? It will be reduced by $\Pi(W, r, p) - \Pi(W^*, r, p)$. Substituting the first and second order derivatives defined by

(3.1)-(3.3) into a second-order Taylor series for the profit function, we can approximate a reduction in firm's profitability as follows:

$$\Pi(W, r, p) - \Pi(W^*, r, p) = -L(W^* - W) - \frac{1}{2} \frac{\partial L}{\partial W} (W^* - W)^2$$

or equivalently

$$\Delta\Pi = -WL \left(\frac{\Delta W}{W} + \frac{\eta}{2} \left(\frac{\Delta W}{W} \right)^2 \right), \quad (3.4)$$

where $\Delta W = W^* - W > 0$ and $\eta = \frac{W}{L} \frac{\partial L}{\partial W} < 0$ is the elasticity of labor demand. Equation (3.4) has two components on the right-hand side. The first term, $-WL \cdot \frac{\Delta W}{W}$, captures a labor demand effect, namely, a reduction in firm's profitability due to higher costs of a labor input. The second term, $-WL \cdot \frac{\eta}{2} \left(\frac{\Delta W}{W} \right)^2$, reflect a change in firm's profitability due to labor adjustment in response to higher labor costs. The size of this adjustment depends on the elasticity of labor demand. There are two important cases that are worth mentioning.

First, assuming no change in labor demand ($\eta = 0$), equation (3.4) simplifies to

$$\Delta\Pi = -WL \left(\frac{\Delta W}{W} \right). \quad (3.5)$$

Thus, one would observe a decline in firm's profitability equal to the wage bill multiplied by the proportionate change in the wage. Moreover, this decline is expected to be larger for those firms with lower wages since they will be more affect by the wage policy. Second, a general case with a non-zero elasticity of labor demand ($\eta \neq 0$), produces an ambiguous result. In this situation, the sign of the impact depends on η through the second order effect. Equation (3.4) shows that the second term may overweight the proportionate change in the wage leading to increased profitability of the firm. Intuitively, the firm can substitute more costly labor of low-wage workers with capital and avoid paying higher wages.

Formally, we test the assumption of "no behavioral response", or in other words no impact on labor demand, using the regression models described in Section 4.1. Dividing both sides of equation (3.5) by sales revenues denoted by S , we can rewrite (3.5) in the following form:

$$\Delta(\Pi/S) = -\psi \left(\frac{\Delta W}{W} \right), \quad (3.6)$$

where $\psi = WL/S$. Equation (3.6) establishes that, under "no behaviour response" assumption, the change in profit margins is proportional (in absolute terms) to the increase

in wages with the coefficient of proportionality ψ , which is equal to the ratio of the wage bill to total revenues. Combining the empirical estimates of changes in profit margins and wages caused by the minimum wage as measured by (4.8)-(4.9), equation (3.6) can be equivalently expressed as follows:

$$\theta_2 = -\psi\gamma_2. \quad (3.7)$$

We formal test of the restriction (3.7) in the quantitative section of this paper.

4. Modelling Design

The empirical analysis proposed in this study is based on the difference-in-difference approach in the spirit of [Card and Krueger \(1994\)](#). Specifically, we closely follow the strategy proposed by [Draca, Machin and Van Reenen \(2011\)](#) to evaluate the impact of the minimum wage increase on firm profitability in Poland. In line with the existing studies, we initially specify *a treatment group* consisting of those firms that are most likely to be affected by the new minimum wage level. The definition of "most likely to be affected" means that the minimum wage increase will likely lead to an increase in the existing wages of the firms under our consideration. Further, we identify *a comparison group* consisting of those firms where the wages are not affected at all or are affected to a much less extent after the new minimum wage is imposed. In this setting, we can look at the response of profitability before and after the policy change in these treatment and control groups in order to evaluate the impact of the new wage floor on firm profitability.

4.1. Empirical Specification

The baseline specification defines a treatment indicator variable for each firm in our sample based on the firm's pre-policy average wage $w_{t-1} = \ln(W_{t-1})$ and the minimum wage threshold $w_t^* = \ln(W_t^*)$, where t is the period when the policy is implemented and $t - 1$ is the period proceeding the minimum wage implementation. The treatment indicator is defined as $P = 1$ if $w_{t-1} < w_t^*$ and $P = 0$ otherwise. The difference in responses of firm profitability across the treatment and control firms evaluates the impact of the minimum wage increase on their profitability. The implicit assumption here is that wages increase more for the firms in the treatment group before and after minimum wage increase compared to those in the control group.

We formally check validity of this assumption by estimating a simple difference-in-difference regression model:

$$w_{i,t} = \alpha_0 + \alpha_1 X_{it} + \alpha_2 REG_i + \alpha_3 IND_i + \gamma_1 MWP_t + \gamma_2 I(w_{i,t-1} < w_t^*) + \gamma_3 [I(w_{i,t-1} < w_t^*) MWP_t] + \varepsilon_{it}^w, \quad (4.8)$$

where $w_{i,t}$ is a log average wage in the firm i at time t ; X_{it} is a set of firm specific control variables; REG_i is a vector of 16 region dummies corresponding to 16 administrative subdivisions in Poland[†]; IND_i is a vector of the two-digit industry level dummies; $I(\cdot)$ is an indicator function; w_t^* is a minimum wage at time t ; MWP_t is a policy dummy variable; and ε_{it}^w is the error term. Dummy variable MWP_t is equal to 0 for pre-policy periods and to 1 for years when the policy was already in place. The impact of the minimum wage increase on wages is captured by the difference-in-difference coefficient γ_2 . Alternatively, one can calculate an unconditional difference-in-difference estimator by using a simple formula

$$[\bar{w}_{MWP=1}^{P=1} - \bar{w}_{MWP=0}^{P=1}] - [\bar{w}_{MWP=1}^{P=0} - \bar{w}_{MWP=0}^{P=0}],$$

where the bar above a variable denotes an average value. For instance, our notations imply that $\bar{w}_{MWP=0}^{T=1}$ is a mean log wage for firms in the treatment group in the pre-policy period. Using the above estimates allows one to evaluate how wages respond to policy introduction.

Once we establish the relation between firm wages and the minimum wage increase, we investigate the impact of the latter one on firm profitability, the main interest of this study. We model firm profitability in terms of profit margins defined as gross profit to sales ratio π/s . Notice that this ratio is a function of before tax gross margins and other deductions rather than net margins. The gross profit to sales ratio is the most common measure of firm profitability as it measures the adequacy of the profits and tells whether firms sales are sufficient to cover firms own costs. It is a measure of firms performance, which indicates how efficient are firms adjustment costs and output prices.

[†]Poland is currently divided into 16 provinces known as voivodeships (Polish: *województwa*, singular *województwo*), which include Greater Poland (wielkopolskie), Kuyavia-Pomerania (kujawsko-pomorskie), Lesser Poland (małopolskie), Łódź (łódzkie), Lower Silesia (dolnośląskie), Lublin (lubelskie), Lubusz (lubuskie), Masovia (mazowieckie), Opole (opolskie), Podlaskie (podlaskie), Pomerania (pomorskie), Silesia (śląskie), Subcarpathia (podkarpackie), Holy Cross Province (świętokrzyskie), Warmia-Masuria (warmińsko-mazurskie), and West Pomerania (zachodniopomorskie).

Formally, the regression model for the profitability impact of the minimum wage increase is:

$$\begin{aligned} \left(\frac{\pi}{s}\right)_{it} = & \beta_0 + \beta_1 Y_{it} + \beta_2 REG_i + \beta_3 IND_i + \theta_1 MWP_t + \\ & + \theta_2 I(w_{i,t-1} < w_t^*) + \theta_3 [I(w_{i,t-1} < w_t^*) MWP_t] + \varepsilon_{it}^{\pi s}, \end{aligned} \quad (4.9)$$

where Y_{it} denotes a set of control variables; $\varepsilon_{it}^{\pi s}$ is a random error; and other variables correspond to the previous notations. The coefficient θ_2 is a classical difference-in-difference estimator of our interest, which identifies the impact of the minimum wage increase on the dependent variable. A set of all explanatory variables Y_{it} includes a capital to sales ratio, a wage bill to gross profit ratio, a proportion of part-time employees, a proportion of female employees, a proportion of union members and the average age of employees. For comparison, we also find the unconditional difference-in-difference estimator defined as:

$$\left[\left(\frac{\pi}{s}\right)_{MWP=1}^{P=1} - \left(\frac{\pi}{s}\right)_{MWP=0}^{P=1} \right] - \left[\left(\frac{\pi}{s}\right)_{MWP=1}^{P=0} - \left(\frac{\pi}{s}\right)_{MWP=0}^{P=0} \right].$$

4.2. Robustness Checks

The empirical strategy described in the previous sections establishes that, under the setting of minimum wage increases in Poland, the difference-in-difference methodology provides a strongly founded framework for evaluating the impact of the minimum wage increase on firm profitability. However, it is still possible to further fine-tune the results by formally verifying validity of our assumptions and performing robustness checks of the estimates. In this study, we consider the following sensitivity tests:

1. Check the robustness of results to alternative thresholds between treatment and control groups. Unfortunately, we do not observe wages of individual workers inside the firms and, as a result, we use the average wages to define the treatment and control firms. We probe this limitation of the baseline model by re-estimating regression equations and comparing obtained estimates for a range of alternative wage thresholds.
2. Test the possibility of pre-policy trends in profitability between treatment and control groups by performing "placebo test" on the pre-policy data. A potential caveat

of the quasi-experimental data is that firm profitability is mainly driven by the initial low-wage status and is not a result of the policy. We check this possibility in detail by carrying an extensive examination of firm profitability in treatment and control groups in response to falsification tests in the pre-policy periods.

3. Further examine pre-sample trends by allowing for lags and leads of the treatment in the regression specifications. In this case, verifying the common trend assumption in the difference-in-difference approach requires testing the hypothesis that the coefficients on all lags and leads of the treatment are zero.

5. Data and Definition of Treatment

In this paper, we use two main sources for the data: Bureau Van Dijk "Amadeus" dataset and Polish Labor Force Survey (PLFS). Amadeus is a comprehensive firm-level database of private and publicly quoted non-financial firms. It covers 19 million companies in both Western and Eastern Europe including Poland. The information on Polish firms is collected by Polish National Court Register and delivered to Bureau Van Dijk. All listed companies in Poland are obliged to provide their annual and semi-annual reports to the National Court at the end of their financial year. Informal sector is excluded from the database. One of the most important feature of the Amadeus database is the fact that it contains information on firms not listed in the stock exchange market. Therefore, a large number of small and medium sized firms are present in the database and those firms are the most relevant for our analysis. Amadeus contains detailed financial and accounting information of firms, including balance sheet, profit and loss statements, together with other relevant characteristics such as a year of incorporation, an official address, a legal form, auditors, a number of employees, and industry codes. Amadeus reports annual accounting information of firms. Unfortunately, Amadeus does not report the individual earnings of the workers and their personal characteristics. We merged the Amadeus dataset with Polish Labor Force Survey (PLFS) to overcome this issue at least on industry-region level.[‡] PLFS reports the information about a proportion of female workers, part-time employees and workers with higher education. We include those variables in the regression model as controls. We report descriptive statistics of the firm- and industry-level data in Appendix.

[‡]We used NACE Rev.1 Classification of Economic Activities

In our analysis, we construct the panel of firms over four financial years with reporting date from January 1, 2006 to December 31, 2009. Including additional pre- or post-policy years significantly reduced a number of firms in the panel, thus we decide to focus on the firms over a four-year period. We use the profit to sales ratio as a proxy of firm profitability. We include a firm specific capital to sales ratio that enables us to control for capital intensity differences among firms. We define a treatment group as a set of firms with monthly average wages in 2007 below the national minimum wage level in 2008, which is equal to 1,126 PLN. The comparison group consists of those firms with monthly average wages above the treatment threshold but below 2,000 PLN.[§] We check the sensitivity of our results with respect to alternative treatment thresholds in the robustness section.

6. Main Results

6.1. Firm-Level Estimates: Wages and Profitability

Table 1 reports the unconditional difference-in-differences estimators for the minimum wage impact on average wages and profit margins. It is evident from the upper panel that wage growth among low-wage firms was faster across the pre- and post-policy periods as compared to wage growth among the high-wage firms: 20.6 log point in the treatment group relative to 13.7 log points in the control group. The unconditional difference-in-difference estimate of 6.8 percentage points is positive but not statistically significant, $p\text{-value} = 0.1411$. We will later show that statistical significance is strongly improved once other factors are controlled for.

The bottom panel of Table 1 provides the corresponding statistics for profit margins. It is visible that profit margins in the low-wage firms decreased more during the observed period compared to the high-wage firms. The decline in the former group was 7.02, while it was only 2.43 in the latter one. These results suggest the negative unconditional difference-in-difference estimator of -3.63 . This difference is statistically significant and consistent with our initial hypothesis that the increase in the minimum wage adversely

[§]According to the national law in Poland, the minimum wage level is expected to increase until it reaches a half of average wages. In our sample, the mean of firm wages is around 4,000 PLN. This motivates our choice of an upper cut-off since firms with average wages about it will likely not be affected by the future minimum wage increases.

Table 1

Changes in Average Wage and Firm Profitability Before and After the Increase of the National Minimum Wage in 2008

	Before MW increase (1)	After MW increase (2)	Difference (3)
<i>Average Wage, $\ln(W)$</i>			
low-wage firm, T=1	6.461	6.667	0.206
non low-wage firm, T=0	7.340	7.478	0.137
Difference-in-difference			0.068 (0.141)
<i>Profit Margin, $\frac{\Pi}{S}$</i>			
low-wage firm, T=1	0.073	0.002	-0.070
non low-wage firm, T=0	0.027	0.002	-0.024
Difference-in-difference			-0.046** (0.036)

Notes: The "Before MW increase" column corresponds to the estimates of the two financial years January 1, 2006 - December 31, 2007. $T = 1$ indicates the treatment group and $T = 0$ indicates the comparison group. The low-wage firm in the Before MW increase period is defined as firm with a monthly average wage equal to or below 1126 PLN, the comparison firm is defined as firms with monthly average wage between 1126 PLN and 2000 PLN in the Before MW increase financial years up to December 31, 2007. The standard errors are clustered at the firm level and sample size is 1730 (569 firms).

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

affects profitability of low-wage firms.

Table 2 presents the results from statistical difference-in-difference estimators for wage and profitability regressions that additionally control for different firm and industry specific factors. The preliminary results obtained by unconditional estimators for wages and profit margins are confirmed by these conditional counterparts. We find a positive

Table 2

**Changes in Average Wage and Firm Profitability Before and After
the Increase of the National Minimum Wage in 2008**

	Change in average wage, $\Delta \ln w$	Change in gross profit margin $\Delta \frac{\Pi}{S}$
Difference-in-Differences	0.085* (0.056)	-0.045** (0.033)
Test of no behavioral response	$p = 0.151$	

Notes: Coefficients estimated by ordinary least squares and standard errors in parentheses below are clustered by firm (there are 569 firms). The before policy (Increase) period covers 2 financial years January 1, 2006 - December 31, 2007 and the after policy period covers 2 financial years January 1, 2008 - December 31, 2009. The treatment group or low-wage firm is defined as a firm with average wage below 1126 PLN per month. The comparison group consists of firms with average wage between 1126 PLN and 2000 PLN. The set of control variables include industry dummies, regional dummies, proportion of workers graduated with higher degree, proportion of part-time workers and female employment rates. "Test of no behavioral response" correspondence to equation "*number*" in the model

- *** Significant at the 1 percent level.
- ** Significant at the 5 percent level.
- * Significant at the 10 percent level.

effect on the average wage (an 8.5 percent point) and a negative impact on firm profitability (an -4.5 percent point). The two difference-in-difference estimates are statistically significant at the 1 and 5 percent levels, respectively. While comparing these results to average profits of low-wage firms in the pre-policy period, there is a sizable drop in profit margins of around 61.6 percent (-0.045/0.073). We further test the no-behaviour response model and, based on the p-value from the F-test, we cannot reject the relation defined by equation (3.7).

6.2. Further Probing of the Baseline Results

The baseline results presented in Table 2 support the idea that the minimum wage increase has a positive impact on earnings of low-wage workers but negatively affects firm profitability. In our definition of treatment and control groups, we rely on the average wage of the firms in our data. Obviously, the same average wage in a particular firm might

be potentially consistent with different wage distributions among workers. This limitation of our analysis originates from the fact that we do not observe the individual earnings of workers. To better understand the scope of this limitation, this section performs a number of robustness checks.

First, we check sensitivity of our results to alternative definitions of treatment and control groups. For this purpose, we re-estimate the profitability model from Table 2 for a range of wage thresholds. We consider several values for the monthly wage threshold ranging from 800 PLN to 1,500 PLN. The results in Table 3 show that the difference-in-difference estimates obtained in different specifications confirm similar effect on firm profitability. As expected, the magnitude of this impact is higher for lower thresholds and is lower for higher ones.

Second, another source of concern is the possibility that the effect we observe is simply a connection between a reduction in firm profitability and their initial low-wage status. In this case, changes in profit margins have nothing to do with an increase in the minimum wage. We test this issue by estimating the profitability regression model assuming the MWI policy was in place two years earlier. Table 4 reports the results of this "placebo test" as if the minimum wage increase was introduced in January 2006 instead of January 2008. As it is evident in Table 4, we do not find a negative trend in firm profitability in the period preceding policy introduction. Similarly to [Draca, Machin and Van Reenen \(2011\)](#), we elaborate on this issue in more detail by re-estimating the baseline model and the specification with a imaginary policy for a rolling threshold. We change the values in a range from 800 PLN to 1,600 PLN with a step 25 PLN. Figure 3 plots the coefficients in the two specifications. In the true model, the difference-in-difference estimates are negative from around -3% to -5% and are statistically significant. In contrast, the difference-in-difference coefficients during the imaginary policy become positive and statistically insignificant.

Finally, we perform an additional formal test of common support, an underlying assumption of the difference-in-difference methodology. Similarly to [Autor et al. \(2007\)](#), we test this assumption by including lags and leads of the treatment into the baseline specification. The results presented in Table 5 suggest that the difference-in-difference technique is adopted well in the regression model since all the treatment coefficients on lags are statistically insignificant.

Table 3**Alternative Definitions of Treatment Group – Change in Gross Profit Margin Models**

	<i>AW</i> < 800	<i>AW</i> < 1000	<i>AW</i> < 1126	<i>AW</i> < 1350	<i>AW</i> < 1500
Diff-in Diff	−0.048 (0.109)	−0.052** (0.028)	−0.045** (0.033)	−0.028* (0.082)	−0.032** (0.027)
Policy On	−0.030*** (0.000)	−0.025*** (0.000)	−0.025*** (0.000)	−0.026*** (0.000)	−0.020** (0.010)
Treatment	0.036* (0.085)	0.037** (0.036)	0.036** (0.019)	0.028** (0.020)	0.023** (0.049)
Control Variables	yes	yes	yes	yes	yes
Industry Dummies	yes	yes	yes	yes	yes
Regional Dummies	yes	yes	yes	yes	yes
<i>No. of Observations in Treatment group</i>	309	460	555	797	989

Notes: Each column shows the results from a separate difference in differences regression where the treatment and comparison groups are defined according to different thresholds as indicated at the head of the relevant column.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

7. Conclusion

A large body of the literature discusses economic effects of minimum wages on employment. However, the literature is scant on the role of wage floors on firm profits. Exploiting a firm-level panel dataset in Poland, this study presents compelling empirical evidence of the existence of a negative impact of the minimum wage increase on firm profitability. The study employs an identification strategy of [Draca, Machin and](#)

Table 4**Wages and Profitability Before and After Placebo MWI, 2004-2007**

	Change in average wage $\Delta \ln W$	Change in gross profit margin $\Delta \frac{\Pi}{S}$
Difference-in-Differences	0.313*** (0.001)	0.028 (0.225)

Notes: Coefficients estimated by Pooled Least Squares Estimator and standard errors (p-values in parentheses) below are clustered by firm level (there are 188 firms). The before MWI period covers 2 financial years January 1, 2004 - December 31, 2005 and the after MWI policy period covers 2 financial years January 1, 2006 - December 31, 2007. The treatment group or low-wage firm is defined as a firm with average wage below 1126 PLN per month. The comparison group consists of firms with average wage between 1,126 PLN and 2,000 PLN. The set of control variables include industry dummies, regional dummies, proportion of workers graduated with higher degree, proportion of part-time workers and female employment rates and firms capital to sales ratio.

*** Significant at the 1 percent level.

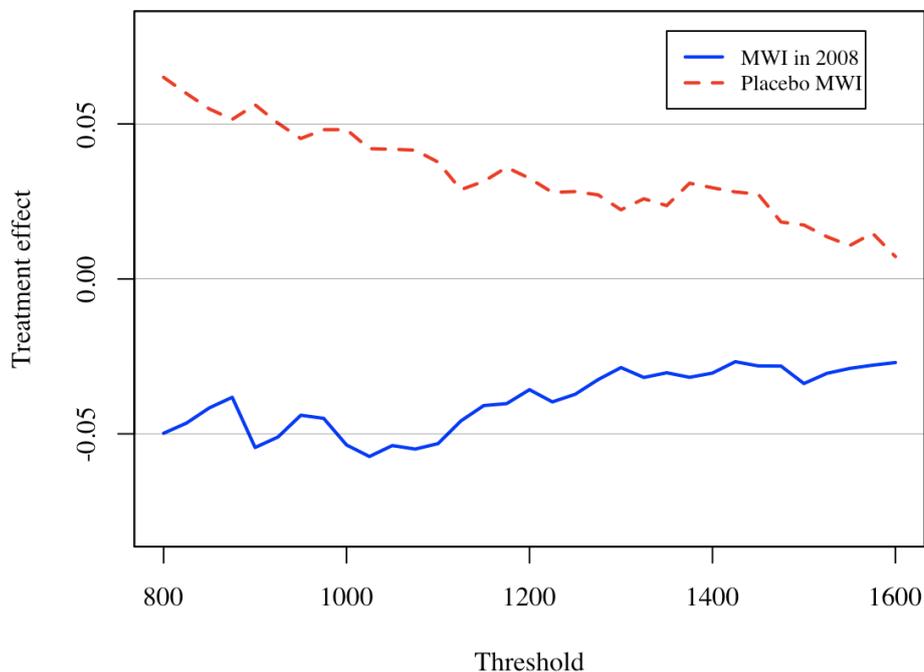
** Significant at the 5 percent level.

* Significant at the 10 percent level.

Van Reenen (2011) for evaluating the impact of the policy on firm characteristics via a difference-in-difference estimation methodology. The results indicate that the increase in minimum wages leads to a reduction in firm profits, while the higher wage floor introduced by national legislation is found to contribute positively to average wages. The results are consistent with the predictions of a theoretical model with a profit maximizing firm and are robust to alternative assumptions in the identification strategy. These findings established in the case of a developing country (Poland) generally support the scant evidence on the relationship between minimum wages and firm profits in developed countries (United Kingdom).

There are, of course, a number of shortcomings that the authors would like to take into account in the future research. First, it would have been useful to test our assumption, which is based on the evidence of similar studies in other countries, that the

Figure 3: Changes in the Treatment Effect Coefficients for the Difference-in-Difference Profitability Model



firms do not pass higher costs due to increased wage bills on to consumers. Testing this hypothesis would require obtaining and comparing the difference-in-difference estimated based on the firm-level data according to competitiveness of the industry of their operation. Second, having the data on prices would enable us to directly check whether prices responded to the increase of the minimum wage. Finally, the current analysis focuses on the short term responses of firms but it would be equally interesting to explore changes in our results if there is a possibility that firms could leave or enter labor market as a result of the policy change.

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Appendix

A. Data

Firm level data

The Bureau Van Dijk “Amadeus” dataset contains information about private and publicly owned non-financial firms in Poland. We used the data for six financial years from January 1st 2006 to December 31st 2009. We drop all the firms where at least one of the main variables was missing (profits, wages, sales, capital, industry and region). Additionally, we drop observations where profit to sales ratio was greater than one in absolute values.

Profits to Sales: Gross profits (before any tax reductions) divided by turnover (sales).

Average wages: Costs of employees divided by total number of employees.

Capital to Sales: Tangible assets over turnover (sales).

Table 6
Descriptive Statistics of Control and Treatment Group

	Treatment Group	Control Group	All
	T=1	T=0	All
Average wage	868.125	1,746.203	1,464.507
Profit/Sales	0.036	0.014	0.021
Capital/Sales	0.583	0.336	0.415
Proportion part-time Employees	0.071	0.059	0.063
Proportion female Employees	0.428	0.418	0.421
Proportion college graduated Employees	0.078	0.062	0.067
Number of observations	555	1,175	1,730

Industry level data

Polish Labor Force Survey (PLFS) is a large household based survey which is conducted to collect information about labor market status of the population. Since the date of the implementation of minimum wage coincides with beginning of calendar year, we

calculated the following statistics for each calendar year:

Part-Time Employees: Proportion of an active employed population classified as part-time, annual values. Defined at the highest NACE level classification and each NUTS2 region.

Female Employees: Proportion of active an female population. Defined at the highest NACE level classification at each NUTS2 region.

College Graduated Employees: Proportion of graduate qualified employed population. Defined at the highest NACE level classification and each NUTS2 region.

Regions: NUTS 2 classification of Poland. The classification includes regions: Dolnośląskie, Kujawsko-pomorskie, Lubelskie, Lubuskie, Łódzkie, Małopolskie, Mazowieckie, Opolskie, Podkarpackie, Podlaskie, Pomorskie, Śląskie, Świętokrzyskie, Warmińsko-mazurskie, Wielkopolskie, and Zachodniopomorskie.

Table 5
Validity of the Common Support Assumption

	Change in gross profit margin $\Delta \frac{\Pi}{S}$
Policy in 2006	0.008 (0.789)
Policy in 2007	0.040 (0.185)
Policy in 2009	-0.022 (0.435)
Control variables	yes
<i>No. of Observations</i>	555
<i>in Treatment group</i>	

Notes: Coefficients estimated by Pooled Least Squares Estimator and standard errors (p-value in parentheses) below are clustered by firm (there are 569 firms). The before policy (Increase) period covers 2 financial years January 1, 2006 - December 31, 2007 and the after policy period covers 2 financial years January 1, 2008 - December 31, 2009. The treatment group or low-wage firm is defined as a firm with average wage below 1126 PLN per month. The comparison group consists of firms with average wage between 1126 PLN and 2000 PLN. The set of control variables include industry dummies, regional dummies, proportion of workers graduated with higher degree, proportion of part-time workers and female employment rates.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table 7**Distribution of Firms according to NACE Rev.1 Classification of Economic Activities**

	Percentage of Firms
Agriculture, hunting and forestry	3.4
Mining and quarrying	0.2
Manufacturing	27.5
Electricity, gas and water supply	0.2
Construction	8.3
Wholesale and retail trade: repair of motor vehicles, motorcycles personal and household goods	30.5
Hotels and restaurants	2.5
Transport, storage and communications	6.5
Financial intermediation	1.1
Real estate, renting and business activities	15.5
Education	0.5
Health and social work	2.0
Other activities	1.8

Table 8**Distribution of Firms According to NUTS 2 Classification of Regions**

Voivodeship	Percentage of Firms
Łódzkie	7.1
Małopolskie	8.5
Mazowieckie	42.5
Opolskie	2.1
Podkarpackie	4.2
Podlaskie	4.2
Pomorskie	6.3
Śląskie	5.1
Świętokrzyskie	0.7
Warmińsko-mazurskie	2.0
Wielkopolskie	13.9
Zachodniopomorskie	3.5

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