The Differential Effect of the Introduction of the Minimum Wage in Germany on Profitability and Employment at Private Equity Portfolio Companies

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ABSTRACT

This research studies the impact of the introduction of the minimum wage in Germany in 2015 on the profitability and employment levels of private equity portfolio companies, comparing these effects to those observed in other recently acquired firms. The Orbis M&A database was utilised to obtain a sample of 10,238 majority acquisitions between 2006 and 2024 in Germany. To conduct the analysis Propensity Score Matching was performed to create a control group of non-private equity deals for the following Difference-in-Difference analysis. The Difference-in-Difference analysis finds that the introduction of the minimum wage was associated with an overall increase in employment in the years following the introduction, however, this was significantly smaller for private equity-backed companies. The results also showed a significant increase in profitability after the introduction of the minimum wage, however, there was no significant difference in the effect between private equity portfolio companies and the control group. This provides insights into the private equity operating model and the impact policy interventions can have on companies owned by private equity.

Keywords: Private Equity, Minimum Wage, Profitability, Employment

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1 Introduction

In Germany, private equity-backed companies employ approximately 1.5 million workers or roughly 3.3% of the entire German workforce (McKinsey, 2015) underlining its importance for job and value creation in the German Economy. However, despite their significance, their role is not without controversy. The German Social Democrat Franz Müntefering, who later became vice-chancellor, commented on private equity in the following way: "Some of these investors do not waste a thought on people whose jobs they destroy. They remain anonymous, faceless, descend like swarms of locusts on companies, devour them, and move on. It is this kind of capitalism we are fighting." (*The Year of the Locust – DW*, 2005). This criticism of the perceived business model of private equity of paying low wages, laying off employees, and stripping down companies gives rise to the research described in the following paper. Namely, whether private equity portfolio companies' profitability and level of employment were affected differently by the introduction of the minimum wage in Germany in 2015, compared to non-private equity-backed companies.

Extensive research has been conducted on the effects private equity takeovers have on profitability and the level of employment at their portfolio companies. Whilst there is a consensus that private equity takeovers improve the profitability of their targets after the acquisition, findings vary with regard to the effect these takeovers have on employment. For instance, a UK study found that in the year after a buyout and for the subsequent years employment for buyout firms decreases more than for the comparison group (Cressy et al., 2007), whilst a study in Spain found employment growth after the acquisition to be larger for buyout firms than others (Alemany Gil & Martí Pellón, 2007). Similarly, the research on minimum wages concurs, that they have a negative effect on firm profitability through increasing labour costs, whilst the effect on employment varies between different studies. A study from Seattle concluded that increases in minimum wages in 2015 and 2016 led to decreases both in the number of employees, as well as the number of hours worked (Jardim et al., 2022), whilst a different study found that in highly concentrated labour markets minimum wages can actually lead to an increase in employment (Azar et al., 2023).

Whereas, there has been extensive research both into the effects private equity takeovers and introductions of minimum wages have on employment and profitability, there is no research that studies the effect of minimum wages in the specific setting of private equity portfolio companies. Analysing the introduction of the minimum wage is a suitable setting, since it represents a very significant change in the labour market, which occurs very suddenly. In light of research and public perception of how private equity funds operate, with regard to wages and other cost-cutting measures, this provides an ideal setting to analyse the effect this policy has. Looking at some key indicators such as profitability and employment at these private equity-owned companies, will provide insights into the effects of the policy,

as well as the general operating model of these funds. Investigating the effects such policies have on private equity-backed companies is crucial for policymakers to consider in the future, due to the growing importance of private equity around the world. On the other hand, private equity companies can better assess the risks they face from regulatory change and can potentially adjust to have a more resilient business model based on the research presented in this paper. Therefore this research will study:

"Did the introduction of the minimum wage in Germany in 2015 affect profitability and employment at private equity portfolio companies differently in comparison to those of other recently acquired non-private equity firms?"

In order to study these effects a sample of 10,238 majority acquisitions that occurred between 2006 and 2024 in Germany were studied, with the financial and administrative data of the target companies involved in these deals having been obtained from the Orbis database. For the purpose of this analysis, the Return on Assets (ROA) were used as a profitability measure and the number of employees will be the relevant measure to assess the employment level. The method of analysis will be a Difference-in-Difference model, where the treatment group will be target companies that were acquired by private equity, whilst the control group will consist of a selection of target companies that were acquired by entities other than private equity funds. The selection of the control group will occur through a propensity score matching procedure, where variables relevant to the buyout decision and the respective outcome, such as size, growth, and industry of the company, will be used to obtain a control group with similar characteristics to the treatment group.

Applying the methodology described above this research found that after the introduction of the minimum wage employment increased less for companies owned by private equity compared to the control group. In contrast to this the results did not show any significant difference in the profitability between private equity-owned companies and their counterparts in the control group, both on average over the entire time period under investigation, as well as after the introduction of the minimum wage.

Given the lack of research on this topic, the findings of this paper were an interesting addition both to the research on private equity companies and minimum wages, however, it also made it difficult to form expectations on the results. Based on the standalone research on the operations of private equity-backed companies and the effects of minimum wages this research expected to find that the portfolio companies would experience a more severe decrease in employment after the introduction of the minimum wage since they are typically less reluctant to lay off workers than their comparison group. Subsequently, the expectation based on the literature is that the decrease in profitability would be smaller for the portfolio companies since they would be less exposed to labour cost increases through their willingness to fire people to restrict potential cost increases.

This research will begin by separately reviewing the effects private equity ownership and minimum wages have on profitability, in order to derive an expectation on the conjoint effect. Subsequently, the process of data retrieval as well as an overview of the dataset and basic modifications will be provided. In the following chapter further data modifications as well as a description of the research methodology will be discussed. The results section will present the results of the regression and provide an accurate interpretation, whilst the discussion will explain the implications of the results and compare the findings to existing research. Lastly, the conclusion will summarise the entire research and discuss the potential limitations of the discussed findings.

2 Theoretical Framework

2.1 The Private Equity Industry

Ample research has been conducted on the private equity industry. Broadly defined private equity refers to investments in unlisted companies or the privatisation of public companies, whilst this can be both in the form of early-stage venture capital investments, or later-stage buyouts (Wood & Wright, 2009). However, for this research, we will focus on the latter method of buyouts, without differentiating between the various types of buyouts. These buyouts are often executed as leveraged buyouts, which means specialised investment firms use small proportions of equity and a relatively high amount of leverage to acquire majority stakes in companies and become active investors (Kaplan & Stromberg, 2009). The European private equity market has evolved significantly in the past decades, whilst in the 1980s there was very little private equity activity in Western Europe, in the following decades activity increased considerably leading to a market size of 142 billion Euros in 2006 (Wright et al., 2009). Subsequently, the private equity industry has continued to grow, with 789 funds raising 550 billion Euros for private equity investments in 2019 (Caselli & Negri, 2021), however, the industry has also attracted significant controversy for their business practices, such as US Senator Elizabeth Warren who was quoted saying: "Private equity firms were already gutting companies and killing jobs before COVID-19, now they're drooling over companies to exploit during this crisis. Private equity firms get rich off of stripping assets from companies, loading them up with a bunch of debt, and then leaving workers, consumers, and whole communities in the dust,"(Warren, 2021).

2.1.1 Effects of Private Equity Takeovers on Firm Profitability

Through their active roles as investors private equity firms can significantly change the way companies are run, however despite, the exhaustive research on the private equity industry, findings on the effects of private equity takeovers on their portfolio companies differ considerably. Despite this, there does appear to be a certain degree of consensus that buyouts have a positive effect on firm profitability. A study of French private equity buyouts finds various positive effects related to private equity takeovers, showing that in the three years after a leveraged buyout, targets increase profitability, grow faster than their peers, issue more debt, and increase capital expenditures (Boucly et al., 2011). The study primarily associated these effects with the private equity funds providing companies with capital in a credit-constrained environment. This positive effect of private equity buyouts on firm performance and profitability is also confirmed in the historical view, for instance, a US study in the 1980s found that various profitability and cash flow performance metrics improved in the two years after the buyout compared to the year before the buyout (Malone, 1989). Another, more recent study from the UK found that buyout firms were 3% - 5% more profitable, than non-buyout firms during the recession following the 2008 financial crisis (Wilson et al., 2012), which could signify that portfolio companies are more adaptable, reactive, and resilient in times of a strongly changing economic environment. Another

explanation for how private equity funds improve profitability is by offshoring and automating the work performed by low-productivity workers, which poses the question what effect private equity takeovers might have on employment (Olsson & Tåg, 2017).

2.1.2 Effects of Private Equity Takeovers on Employment

Similarly to the research on the effects private equity takeovers have on firm performance, there is little consensus on the effects private equity takeovers have on employment at their portfolio companies. Two papers, that apply different kinds of matching procedures to create the control group for the buyout targets find that private equity takeovers have a significant negative effect on employment. The first study (Cressy et al., 2007), which uses a set of non-acquired and non-private equity-owned companies as a control group, shows lower employment in the year after acquisition and higher decreases in employment for up to four years after the acquisition by private equity in the UK, whilst a second study also using non-acquired firms as a control, in the US finds 7% higher cumulative decreases in employment in the two years following a buyout (Davis et al., 2014). In contrast to the two previously discussed papers, two additional studies apply a very similar methodology to European countries, that find the opposite effect on employment. The first study analyses the effect of private equity takeovers in France, finding that in the four years after the buyout, employment growth is 13% higher than in the considered control group (Boucly et al., 2011). Whilst another study conducted in Spain finds growth in the three years after buyout to be 6.2% compared to 2.2% of the control sample (Alemany Gil & Martí Pellón, 2007). Ultimately, there are however also research papers applying similar matching procedures for control group creation to the previous papers, that simply do not find any significant effect of buyouts on the employment at target companies. One such example compared UK LBOs to non-private equity transactions and found no significant difference between the effect on employment between the two groups (Amess et al., 2008). The difference in the findings of these papers may be explained by the different method of constructing a control group. Whilst Davis and Cressy use non-acquired and non-private equity-owned companies as controls Amess uses companies recently acquired by non-private equity entities as a control group. Due to companies often undergoing radical change after being acquired, the findings based on a non-acquired control group might differ significantly from the research discussed in this paper and other research designs using recently acquired companies as a control group. Since the methodology described in Amess' research is more similar to the method applied in this paper these results are more likely to be comparable.

2.2 The German Minimum Wage

In January 2015 Germany introduced one of its largest labour market reforms of recent decades, a nationwide minimum wage of €8.5 per hour, which rose to €8.84 per hour through 2017 and 2018. This reform had a very significant effect on the labour market, since previous to the reform approximately 10% - 14% of the eligible workforce earned an hourly wage lower than the minimum wage level (Caliendo et al., 2019). The minimum wage was introduced in for almost all forms of employment, with very few exceptions, which made it not feasible to legally circumvent the minimum wage at a significant scale, meaning almost all companies were directly affected by the introduction at the beginning of 2015, albeit there may have been non-compliance from some companies. However, some industry-specific minimum wages already in existence were subject to a transitionary period due to the Posting of Workers Act (*Arbeitnehmerentsendegesetz*), which is why the general minimum wage only applied to all industries equally from 2017 onward, although these exceptions only made up a small proportion of the working population. The introduction of the minimum wage was heavily debated for a considerable time, with scientific research highlighting both potential positive as well as negative effects. On the one hand, advocates highlighted the positive effects on fairness, wealth distribution, and reducing the dependence on social transfers, whilst the opposition highlighted potential negative effects on employment. Later research should show clear evidence that the introduction of the minimum wage achieved the aforementioned positive effects to a certain extent (BMAS, 2014).

2.2.1 The Effects of Minimum Wages on Firm Profitability

One expected effect of the introduction of the minimum wage was that firms that were affected by the minimum wage would become less profitable, which was particularly relevant for companies in industries employing many low-wage workers. A research paper that studied the introduction of the minimum wage in the UK in 1999, concluded precisely that companies with a very low average wage experienced a significant decline in their profitability compared to a control group of companies with higher average wages. This was explained by the lower average wages making them more likely to be strongly affected by the minimum wage policy, whilst companies with higher average wages were less likely to be affected strongly by the introduction of the minimum wage (Draca et al., 2011). A further study analysing the effect of the introduction of the minimum wage on the profitability of companies in Germany also finds a negative effect related to the increase in labour costs, caused by the minimum wage, however, this is only weakly significant (Bossler et al., 2020). Additionally, a study from Poland, which did not study the introduction of a minimum wage, but the increase of its level, similarly found this process to have a negative impact on firm profitability through the increase in labour costs (Babiak et al., 2019). Through the review of the mentioned and further literature, it becomes apparent that there appears to be consensus in the research community, that implementing or increasing minimum wages has a negative effect on firm profitability.

2.2.2 The Effects of Minimum Wages on Employment

The previous chapter highlights that minimum wages increase labour costs for companies and reduce their profitability, which is likely to elicit a response from firms in order to stay profitable. One potential course of action could be laying off workers or reducing the amount of hours their employees work. There is ample research studying the effect, the introduction of minimum wages might have on employment decisions. A study analysing the effects of increases in minimum wages in Seattle in 2015 and 2016, found that decreases both in the number of employees and the number of hours worked could be attributed to the increase in minimum wages (Jardim et al., 2022). In contrast to this, there is however also research that suggests minimum wages do not have a negative effect on employment, for instance, a study from the US, which accounted for special heterogeneity in their analysis concluded that minimum wages do not have an effect on employment. However, they later concluded that due to flaws in their research approach, there do appear to be trade-offs between minimum wages and disemployment (Neumark et al., 2014). In contrast, when taking into account labour market concentration there are settings in which minimum wages can have surprising effects, namely that more concentrated labour markets tend to exhibit more positive employment effects from minimum wages, which explains some close to zero or even positive employment effects caused by minimum wages (Azar et al., 2023).

2.3 Minimum Wages and Private Equity

From the previous chapters it is apparent that there has been ample research into the effects both private equity and minimum wages have on companies' profitability and their employees. However, detailed research of existing studies has shown that there has not been any research on the conjuncture of the two, namely whether private equity portfolio companies are affected differently by such labour market reforms. This is particularly of interest, due to the nature of the private equity business model. Their focus on efficiency and cutting unnecessary expenses makes private equity portfolio companies prone to be affected more severely by a labour market reform such as the introduction of a minimum wage. Additionally, the majority of research on private equity was conducted in the UK and US, with only few studies focusing on Germany. In order to provide some insights as to whether private equity portfolio companies are affected differently than others by the introduction of minimum wages, this study will look at differential effects on profitability and employment, as well some additional measures at these companies in light of the introduction of the minimum wage in Germany. Based on the existing research differences in the effects of the minimum wage would be expected. Therefore, the two following hypotheses will be investigated throughout this research.

H1: The introduction of the minimum wage in Germany had a more negative effect on the level of employment at private equity portfolio companies than it did on companies recently acquired by non-private equity entities.

H2: The introduction of the minimum wage in Germany had a less negative effect on the profitability of private equity portfolio companies than it did on companies recently acquired by non-private equity entities.

3 Data

For the purpose, of this study a sample of 10,238 majority acquisitions occurring between 1 January 2006 and 1 January 2024 was obtained on 18.06.2024 from the Orbis M&A database, with majority acquisitions being defined as transactions, where the acquired stake is greater or equal to 50%. For approximately 10% (1,029) of these transactions, the acquirer was a private equity fund, whilst the remaining 90% (9,209) of transactions were carried out by non-private equity entities, such as major corporations or pension funds. For each of the 10,238 target companies' various financial variables were collected from the Orbis financial database, for the years 2004 to 2024, leading to a total of 214,998 observations. After removing observations, where the date of completion of the deal was not available, the deal was completed in or after 2015, the acquired stake was below 50%, and revenues or assets were negative in a given year a final sample of 104,444 observations was obtained. Of this final sample, approximately 11% (547 companies) were private equity transactions, with the remaining 89% (4426 companies) being without private equity involvement, meaning the original shares did not significantly change.

The variables from this panel dataset used for this analysis includes annual financial data, data on the number of employees and industry classifications, as well as the year in which the transaction was completed, and the total value of the deal. The industry classification is based on the two-digit NACE Rev. 2 code for European industry classification, with the *industry* variable listing the corresponding industry name and additionally a dummy variable for each of the industries was created. Furthermore, the *PrivateEquity* variable is a dummy with the value one, if the target was taken over by private equity and zero otherwise. The key variables for the analysis include revenues, total assets, long-term debt, net income, number of employees, and the deal value. Subsequently, growth rates for revenues, total assets, and the number of employees for each year were calculated as the difference between the natural logarithm of the value each year and the previous year, calculated as follows:

$$\log\_diff\_var_{i,t} = \log\_var_{i,t} - \log\_var_{(i,t-1)}$$

Moreover, the return on assets (ROA) was calculated as a measure of profitability, using the following calculation:

$$ROA_{i,t} = Net\ Income_{i,t}/Total\ Assets_{i,t}$$

Lastly, another ratio indicating the leverage of the companies namely the ratio between the long-term debt, which is defined as debt with maturity greater than one year, and total assets is included for each year. The leverage ratio gives insight into how the company finances its operations and how much

performance pressure there is, as higher levels are associated with higher interest payments, which need to be serviced. This variable is particularly of interest, since private equity funds are known for performing leveraged buyouts, which significantly increase debt levels at their target companies. The ratio used in the subsequent analysis is calculated as follows:

$$LTDebt/Assets_{i,t} = \frac{Long\ Term\ Debt_{i,t}}{Total\ Assets_{i,t}}$$

Additionally, there are dummies indicating for each year of the respective company, whether it is before, after, or in the year of completion of the deal. These dummies were then multiplied with all the variables being considered, to indicate only the values before deal completion as *Pre_var* the values in the year of completion as *Deal_var* and the values after completion as *Post_var*. Lastly, a dummy variable for all years after the occurrence of the deal, but before the introduction of the minimum wage denoted as *PostD_PreMW* as well as a dummy indicating all years after the introduction of the minimum wage in 2015 denoted as *Post_MW* were created.

Table 1: Descriptive Statistics (raw data)

Variable	Obs	Mean	Std. Dev.	Min	Max
PrivateEquity	104444	.107	.309	0	1
Employees	22499	442	5,604	0	243,226
ROA	10587	-.075	5.93	-598	22.5
Deal Value	21205	236	780	2	11,400
Total Assets	24950	155	1,439	.001	63,537
Long Term Debt	24642	19.1	216	-3,221	9,871
Revenue	14649	192	1,612	0	46,104
Net Income	10588	7.00	211	-4,088	17,030

Note: Descriptive Statistics. Variables Deal Value, Total Assets, Long Term Debt, Revenue and Net Income are expressed in million Euros. ROA is expressed as a decimal (0.05 would correspond to an ROA of 5%).

From the Table 1 of descriptive statistics, it becomes apparent that the variables, which are not dummies have very skewed distributions with extreme outliers. This can be seen by the standard deviations being multitudes larger than the respective means. Therefore, some modifications will need to be applied to the variables in order to make them more suitable for analysis, which are further detailed in the methodology section.

4 Method

4.1 Variable Transformations

To perform the analysis to test the previously elaborated hypotheses it is first necessary to transform the data to make it more suitable for statistical analysis. Firstly, the natural logarithm will be taken of the variables *Revenue*, *TotalAssets* and *NumberofEmployees*, since they all have very skewed distributions and only non-negative values. The newly created transformed variables will be denoted as *log_var*.

However, despite these transformations, the distributions of the variables are not ideal, additionally for other variables that entail negative values the logarithmic transformation is not applicable. Therefore, subsequently to the first transformation the variables will additionally be winsorised. Winsorising is a process, where one defines a certain percentile at either end, or both ends of the distribution as a cut-off point and then replaces all values more extreme than the cut-off point with the value of the respective cut-off percentile. Through this process one can attain a less skewed distribution without completely removing extreme outliers from the sample, however reducing the effect they have in the analysis. To appropriately modify the different variables used for this analysis different cut-off points were chosen depending on the variables' distributions, leading to the following percentile cut-off levels: *log_Revenue, log_TotalAssets, log_LTDebt, log_diff_TotalAssets* and *log_diff_Revenue* were winsorised at the first and 99th percentile, *log_Employees* only at the 99th percentile, LTDebt*/Assets* at the first and 95th percentile and *log_diff_Employees* and *ROA* at the third and 97th percentile. Since all variables apart from the dummy variables are winsorised there will be no separate denotation in the subsequent tables.

4.2 The Difference-in-Difference Method

The Difference-in-Difference (DiD) method is applied in many fields to evaluate the effect of interventions, where a randomised control trial is not feasible. This is done by comparing a treatment and control group in periods before the intervention and after. In order for, this comparison to yield insights into the treatment effect it is important for the parallel trends assumption to hold. This assumption states that before the intervention the outcome variable for both groups may have been at different absolute levels but follow the same trajectory thereby keeping the difference between them roughly constant. If this assumption holds it is reasonable to assume that this difference would persist in the future in case the intervention would not happen, so the difference changing after the intervention can be strong evidence that this change can be attributed to the effect of the intervention. In order to ensure the parallel trends assumption ideally holds the Propensity Score Matching procedure described subsequetnly was performed. After estimating the propensity scores each treated observation was matched with its five nearest neighbours in terms of propensity score, provided that their score did not deviate more than 0.1 in either direction from the score of the respective unit in the treatment group.

Applying this PSM specification the balancing property is satisfied, leaving 671 treatment observations and 4464 control observations.

Table 2: Balancing Table

	Means			
Variable	Treated	Control	%bias	V(C)
Pre-Deal Matching Variables				
Log-diff Employees	.002	.002	-.200	.930
log_Employees	1.24	1.13	4.60	1.11
Log-diff Total Assets	.003	-.003	5.40	1.09
Log-diff Revenue	.011	.012	-.700	1.12
Manufacturing	.486	.490	-.900	.
ROA	-.003	-.002	-1.20	.870
Outcome Variables				
Log Employees	5.49	6.44	-65.2***	.700*
ROA	-.007	-.009	1.20	1.12
Log Total Assets	11.1	12.5	-88.0***	.700*
Log Long-term Debt	8.80	10.1	-48.7***	.950
LTDebt/Assets	.209	.139	30.9***	2.19*

Note: *** p<.01, ** p<.05, * p<.1, the V(C) column shows whether there are significant differences in variance, which is defined as the variance ratio being outside [0.86; 1.16].

Table 2 shows a well-balanced sample with only some significant biases and differences in variances for some of the outcome variables, including *ROA*, *Log Total Assets*, *Log Long-term Debt* and *LTDebt/Assets,* and none of the matching variables, which is why all subsequent analysis will be applied to the matched sample. A graphical analysis of each outcome variable (see appendix A) shows that the parallel trends assumptions are not optimally fulfilled for *ROA*, *Log LTDebt* and *LTDebt/Assets*, whilst the assumption is met for the remaining outcome variables.

For the purpose of this DiD the intervention under investigation will be the introduction of the minimum wage in Germany on 01.01.2015, with the treatment group being companies acquired by private equity and the control group being companies acquired by other entities both before 2015. Since all companies in Germany were subject to the minimum wage in Germany, the DiD employed in this research will not provide the effect of the introduction of the minimum wage on private equity portfolio companies, but the differential effect between the treatment and control group, indicating, whether a specific group was affected more severely than the other. Important regressors for the DiD include *PrivateEquity*, which takes on the value of one if the company was acquired by private equity and zero otherwise, *Post_MW* a dummy indicating all years after the introduction of the minimum wage in 2015, *PostD_PreMW*, which indicates for each year for each company, whether it is after the date of acquisition and before the introduction of the minimum wage. The most important variable is *PE_PostMW*, which is a dummy which takes on the value one, for all private equity-backed companies after the introduction of the minimum wage, since the corresponding coefficient will indicate the differential effect that this research aims to estimate. In order to control for potential remaining differences between the sample all the matching variables used in the propensity score matching method as well as dummy variables for each deal year will be included as control variables in the DiD regression, leading to the following regression equation:

$$Outcome\ Variable_{i,t}$$
$$= \alpha + \beta_1 Private\ Equity + \beta_2 Post\_MW + \beta_3 PE\_PostMW + \beta_3 PostD\_PreMW$$
$$+ \beta_4 Manufacturing + \beta_x Controls + \epsilon_{i,t}$$

Besides the two key outcome variables *ROA* and *Log Employees* the regression will also be applied to *Log Total Assets*, *Log Long Term Debt* and *LTDebt/Assets* as outcome variables. Furthermore, each specification will also be run as a high dimensionality fixed effects regression, by including company level fixed effects, to further control for time invariant differences and reduce potential biases caused by omitted variables. This allows each company to have a different intercept in the regression analysis and thereby allows a more accurate estimation of the true coefficient.

4.3   The Propensity Score Matching Method

The method of propensity score matching (PSM) is applied to create a control group that is similar to the treatment group with respect to certain pre-treatment characteristics. Firstly, a propensity score, signifying the probability of receiving treatment, is estimated using a logistic regression. The treatment in this case is whether the target is acquired by private equity or not, whilst the regressors are pre-treatment variables, which are relevant to whether the companies receive treatment or not and whether they help predict the outcome under investigation in subsequent regressions. The probability for each target company to be acquired by private equity is then used to match companies that received treatment with companies that did not, despite having very similar pre-treatment characteristics. Through this procedure, a control group is created, where the only significant difference between the control and treatment group is that one was acquired by private equity and the other was not. For the particular purpose of this analysis the following variables were used for matching *Log-diff Employees*, *Log Employees*, *Log-diff Total Assets*, *Log-diff Revenue*, *ROA* and the industry dummy *Manufacturing.* The variables used for matching all serve at least one or both purposes of predicting being acquired by private equity or the key outcomes employment and profitability. Research into the target selection process has shown that key factors for private equity funds include profitability (Acharya et al., 2009), as well as size and growth prospects (Osborne et al., 2012). With the chosen matching variables it was possible to attain a well balanced matched sample, which can be seen by there being no significant biases in means or variances of the matching variables displayed in table 3. The three logarithmic difference variables were included to take into account the growth rates of the companies along various measures of size like the assets, employees or revenues, whilst also serving as a proxy for absolute size, since growth rates tend to be lower, the larger the company is. The *Log Employees* was included to also have an absolute measure of the level of employment at the firm before it was acquired, as this is an important predictor of the employment after acquisition. Including the growth rates also helps to predict the acquisition by private equity, since companies with high growth are particularly attractive to private equity companies. Furthermore, the pre-deal ROA was used for matching, since it is important both for predicting the profitability after acquisition and being acquired by private equity, since profitability is an important selection criterion for private equity funds when choosing their targets. Lastly, the dummy for the manufacturing industry was included, since it was the industry most represented in the sample and is also very prone to private equity transactions.

Table 3: Descriptive Statistics matched sample (Pre-Deal matching variables)

Variable	Obs	Mean	Std. Dev.	Min	Max
PrivateEquity	5135	.131	.337	0	1
ROA	5135	0	.069	-.514	.342
log Employees	5135	1.10	2.23	0	8.32
log-diff Employees	5135	.005	.074	-.544	.405
log-diff Total Assets	5135	.008	.128	-1.24	1.69
log-diff Revenue	5135	.010	.165	-1.95	1.73
Manufacturing	5135	.388	.487	0	1

Note: Descriptive Statistics, logarithms were taken of variables expressed in thousand Euros.

Table 4: Descriptive Statistics matched sample (outcome variables)

Variable	Obs	Mean	Std. Dev.	Min	Max
log Employees	5135	5.08	1.50	0	8.32
ROA	5135	.008	.151	-.514	.342
log TotalAssets	5135	10.6	1.70	3.39	14.9
log LongTermDebt	3200	8.25	2.80	-3.33	13.2
LTDebt/Assets	4956	.149	.220	0	.962

Note: Descriptive Statistics, logarithms were taken of variables expressed in thousand Euros.

5 Results & Discussion

5.1 Results

For each of the different dependent variables *ROA, Log Employees, Log Total Assets*, *Log Long Term Debt* and *LTDebt/Asset* two regressions were performed, with the first always being the basic regression specification described above, whilst the second will be including company level fixed effects. As a result of this the coefficients of the different regressions also have different interpretations, meaning the coefficients of the regular regression should be interpreted as the average effect of the respective variable, whilst the coefficients of the fixed effects regression will always show the effect net of firm-specific effects, so ought to be interpreted as changes from the individual means.

5.1.1 Results: Firm Size and Profitability

Table 5: Linear regressions of firm size and profitability

	Log Employees		ROA		Log Total Assets	
	(1)	(2)	(3)	(4)	(5)	(6)
PrivateEquity	.517***	(omitted)	-.006	(omitted)	.472***	(omitted)
	(.079)		(.007)		(.084)	
post_MW	1.412***	-.033	.030***	.013	1.419***	.204***
	(.110)	(.048)	(.010)	(.012)	(.114)	(.036)
PE_post_MW	-.205*	-.008	-.011	-.021	.321**	.118
	(.116)	(.093)	(.011)	(.017)	(.127)	(.081)
PostD_PreMW	1.156***	.028	.004	0.002	.917***	.063*
	(.119)	(.044)	(.011)	(.011)	(.125)	(.033)
Manufacturing	.335***	(omitted)	.004	(omitted)	-.137***	(omitted)
	(.038)		(.004)		(.044)	
Constant	3.717***	5.127***	-.018	-.000	9.361***	10.483***
	(.120)	(.041)	(.011)	(.010)	(.127)	(.028)
Number of obs	5135	4837	5135	4837	5135	4837
R-squared	.121	.945	.217	.590	.084	.955
Company Fixed Effects	No	Yes	No	Yes	No	Yes
Prob > F	.000	.004	.000	.000	.000	.000

Note: Standard errors in parentheses. *** p<.01, ** p<.05, * p<.1. Coefficients of the control variables mentioned above are not reported. Columns (1), (3) and (5) contain results of the basic regressions, whilst columns (2), (4) and (6), show the results of the same results, but including company level fixed-effects. R-Squared indicates the percentage of the variance in the outcome variable explained by the model. The Prob>F column indicates the likelihood of none of the independent variables having a significant effect on the dependent variable.

Column (1) and (5) in Table 5 shows the coefficients from the basic DiD regressions, measuring the size of the company in terms of employees and total assets, which appear to be similar. Both *PrivateEquity* and *Post_MW* have positive coefficients, which are significant at the 1% level. This shows that on average companies that were acquired by private equity on average had approximately 68% more employees and 53% more assets. Furthermore, on average companies in the years after the introduction of the minimum wage had 310% more employees and 313% more assets compared to the average of all the periods before the introduction. For the most informative coefficient for this research, *PE_PostMW,* the effects are significant at the 10% level for employment and 5% for assets however, the sign of the effects are opposite. Whilst the sign is positive for assets, signifying that, total assets increased by approximately 38% more for private equity-backed companies than the control group after the introduction of the minimum wage, the sign is negative for employment, which shows that the increase in employment was approximately 19% smaller for private equity-backed companies after the labour market intervention. The significant negative coefficient for *PE_PostMW* in the employee regression supports the expectation expressed *Hypothesis* 1, which states that the introduction of the minimum wage had on a more negative employment at private equity portfolio companies, compared to the control group. Although the results did not show an overall decrease in employment after the introduction of the minimum wage, it did show that the employment growth was lesser for the portfolio companies. The *PostD_PreMW* coefficient is once again positive and significant at the 1% level, indicating that all companies in the sample on average experienced growth in employees by approximately 218% and total assets of 150% after being acquired and leading up to the introduction of the minimum wage. Lastly, the manufacturing variable is also significant at the 1% level for both regressions, however, it indicates that on average companies in the manufacturing industry tend to have approximately 40% more employees and 13% fewer assets compared to companies in other industries. The constants do not offer any interpretive value in this case, so they will not be discussed further. When comparing the coefficients of the basic regressions (1) and (5), with the regressions including fixed effects, (2) and (6), it can be observed that all coefficients apart from the constants become insignificant for employment and some also become insignificant with total assets as the outcome variable, which could hint at there being time invariant characteristics of the companies that were not included in the regression that explain some of the variation in employment and assets. This means that some of the effect attributed to the respective variables may actually be caused by the time invariant characteristics of the firm, which is why the magnitude and potentially also the significance may have a certain degree of inaccuracy. This is also supported by the R-squared being relatively low, explaining only 12.1% and 8.4% of variation in the outcome, in the basic regressions compared to 94.5% and 95.5% in the regressions including fixed effects. However, we do see that the coefficients in the asset regression for *Post_MW* and *PostD_PreMW* remain significant and positive even after the inclusion of fixed effects. This highlights that on average there appears to have been significant growth in assets both after companies were acquired, as well as after the introduction of the minimum wage. This impression is reinforced when looking at the average

annual growth rates before 2015 and after. The average annual asset growth rates increased after the introduction of the minimum wage, with the average growth rate being 7.8% per year in the time period before 2015 and 8.7% in the time priod after 2015.

Subsequently looking at profitability the table shows that the basic regression for ROA (3) only has one significant coefficient, namely *Post_MW* at the 1% level, indicating that on average profitability in the sample was approximately 3% higher after the introduction of the minimum wage in 2015 compared to before. The inclusion of fixed effects in this regression (4) shows that all coefficients become insignificant, leading to similar concerns that were discussed for the basic regressions previously discussed. Since the coefficient for *PrivateEquity* and *PE_PostMW* are insignificant in both regressions it likely that there are no significant differences between PE-backed companies and the control group on average, and this was also not changed by the introduction of the minimum wage. As a result of this it is not possible to reject the null hypothesis of no effect, as there is not sufficient evidence to suggest that profitability at the portfolio companies was affected differently by the introduction of the minimum wage, compared to the control group. This does not support the expectations presented in *Hypothesis 2* and may hint at private equity funds not being as capable at increasing profitability as originally expected. The R-squared in the basic regression at 21.7% is comparatively higher than the other basic regressions, however, the inclusion of fixed effects increases the explanatory power less than in the other cases, only achieving an R-squared of 59%.

5.1.2   Results: Firm Leverage

Table 6: Linear regressions firm leverage

	Log Long-term Debt		LT Debt/Total Assets	
	(7)	(8)	(9)	(10)
PrivateEquity	.455***	(omitted)	.034**	(omitted)
	(.160)		(.013)	
post_MW	1.209***	.110	-.048***	-.018
	(.191)	(.258)	(.014)	(.016)
PE_post_MW	.651**	.160	.065***	-.018
	(.268)	(.355)	(.020)	(.028)
PostD_PreMW	.835***	.188	-.007	.001
	(.220)	(.219)	(.016)	(.015)
Manufacturing	-.304***	(omitted)	-.010	(omitted)
	(.097)		(.006)	
Constant	7.466***	8.170***	.180***	.152***
	(.230)	(.205)	(.017)	(.013)
Number of obs	3200	2914	4956	4658
R-squared	.043	.737	.042	.680
Company Fixed Effects	No	Yes	No	Yes
Prob > F	.000	.038	.000	.012

Note: Standard errors in parentheses. *** p<.01, ** p<.05, * p<.1. Coefficients of the control variables mentioned above are not reported. Columns (7) and (9) contain results of the basic regressions, whilst columns (8) and (10), show the results of the same results, but including company level fixed-effects. R-Squared indicates the percentage of the variance in the outcome variable explained by the model. The Prob>F column indicates the likelihood of none of the independent variables having a significant effect on the dependent variable.

For the purpose of analysing firm leverage two measures were investigated, the absolute level of long-term debt, as well as a normalised measure, namely the ratio between long-term debt and total assets. Both basic regressions (7) and (9) in Table 6 show a significant positive effect for being acquired by private equity, meaning that on average private equity-backed companies have approximately 58% higher levels of long-term debt, as well as a 3.2 percentage point higher ratio of long-term debt to total assets. For *Post_MW* both coefficients are significant at the 1% level, however for long-term debt the effect is positive, whilst it is negative for the debt-to-asset ratio, indicating the average amount of long-term debt in companies approximately was approximately 235% higher in the years after the introduction of the minimum wage in 2015, whilst being a 4.8 percentage point lower proportion of total assets. Subsequently, the coefficients for *PE_postMW* are significant at the 5% and 1% level respectively and positive for both regressions. This highlights that PE-backed companies increased their absolute level of long-term debt by approximately 92% more than the average company after the introduction of the minimum wage in 2015 and in contrast to the average company they also increased their long-term

debt as a proportion of total assets by 6.5 percentage points. The *PostD_PreMW* coefficient is only significant for the absolute level of long-term debt, showing that on average after being acquired, in the timeframe leading up to the introduction of the minimum wage companies in the sample on average experienced an increase in the absolute level of long-term debt by 130%, however their level of assets also grew, meaning the ratio between the two did not change significantly. Similarly, for *Manufacturing* only the absolute level of long-term debt is significantly lower, namely on average 26% lower compared to companies in other industries, however because the absolute level of assets is also lower for companies in the manufacturing industry in this sample, there is no significant difference in the ratio between long-term debt and total assets. Once again there is no value in interpreting the constant for the absolute level whilst for the ratio it can be said that the average non-private equity-backed company that was from an industry other than manufacturing had a ratio between long-term debt and total assets of 18% before being acquired and before the introduction of the minimum wage. After including company fixed effects all coefficients apart from the constants become insignificant showing that there were likely relevant time invariant characteristics of the companies omitted in the basic regressions, which once again raises concerns about the accuracy of the coefficients of the basic regression. Furthermore, accounting for company-specific effects the previously described ratio shown as the constant of regression (10) becomes slightly lower at 15.2%. The suspicion of not being able to account for certain variables is supported by the low R-squared in the basic regressions (7) and (9) only explaining 4.3% and 4.2% of the variance respectively. The explanatory power is significantly improved to 73.7% and 68% respectively by including fixed effects.

5.2   Discussion

In order to understand the implications of the previously presented results it is important to see them in the context of the most recent research findings presented in the theoretical framework. The discussion will mainly focus on the significant results found in the basic regressions, however in the cases, where these coefficients became insignificant in the fixed effects regressions it is possible that some of the effects attributed to the respective variable may actually be caused by underlying time invariant characteristics of the firms. Firstly, reviewing the results, based on the expectations formed in the theoretical framework it may seem surprising, that the results showed an increase in employment in the years after the introduction of the minimum wage in 2015 compared to the previous periods. However, this is likely due to the general growth trajectory of the companies over time and should not be seen as the isolated effect of the introduction of the minimum wage. The weakly significant and negative coefficient for *PE_PostMW* is however in line with expectations based on existing research, since private equity companies are known for acting more rigorously to reduce costs especially, when these are not justified by productivity (Olsson & Tåg, 2017). For these reasons, it seems plausible that the

private equity portfolio companies would see lower growth in employment after the introduction of the minimum wage, compared to their non-private equity counterparts.

With regard to the second key measure of interest, profitability, measured by ROA, it can be seen that in the periods after 2015 companies appear to have on average 3% higher ROA than in the periods before 2015. A possible explanation, which is also supported by research (Dix-Carneiro et al., 2023), for could be that the increased labour costs forced companies to turn more toward capital investments, which is supported by the significant growth in assets post-2015, such investments typically increase productivity and can be a potential explanation for part of the increase in profitability. However, interestingly there does not appear to be a significant difference in profitability between private equity-backed and non-private equity-owned companies, despite the portfolio companies seeing reduced increases in employment. This could support a common claim that private equity firms focus more on cutting costs, which is supported by the results, and are less likely to invest into the growth of the company. The lower increases in productivity at portfolio companies might offset the relatively lower labour costs as a potential explanation, for why there is no significant difference in profitability.

Besides the two key hypotheses of this research some further interesting findings could be made. Firstly, even after including fixed effects, there was significant growth in assets after the introduction of the minimum wage, which could support the previously discussed idea, that the introduction of the minimum wage forced companies to invest more into productive assets than before. Additionally, the regressions also showed a positive post-acquisition effect on assets, which could support the notion discussed by Boucly et al. (2011), that capital-constrained companies can unlock further growth potential through being acquired even when the acquisition is not performed by private equity. Lastly, the findings regarding leverage are in line with expectations derived from the common practice of leveraged buyouts, since private equity-owned companies had on average higher leverage than the control group and further increased this difference after the introduction of the minimum wage. It is particularly interesting to observe that the leverage ratio on average decreased after the introduction of the minimum wage, whilst it increased for private equity-backed companies, which highlights differences in how investments are financed when firms are owned by private equity.

6 Conclusion

6.1 Conclusion

The purpose of this study was to analyse whether the introduction of the minimum wage in Germany in 2015 affected the profitability and employment at private equity-backed companies differently compared to non-private equity-owned companies. Additionally, other financial outcomes such as firm size and leverage were analysed in this setting to provide insights into the way private equity funds structure operations and financing decisions in their portfolio companies. This is particularly important due to private equity companies' growing importance as an employer and major contributors to GDP in Germany and the world.

In order to analyse these outcomes a propensity score matching method was applied, using matching variables that help predicting the studied outcomes and the likelihood of being acquired by private equity, to create a suitable control group for the subsequent Difference-in-Difference analysis. The DiD included controls for various financial measures that were included in the matching procedure as well as the deal years to control for differences over time. The results offer a comparison between the estimated effects when applying the basic regression specifications as well as the same regressions including fixed effects, which serve to underpin the robustness of the estimates.

The results confirmed some of the research expectations, whilst providing slightly surprising results for others. As expected, it was possible to find results supporting *Hypothesis 1* meaning that being owned by private equity after the introduction of the minimum wage had a negative impact on employment compared to the non-private equity control group, however, surprisingly there was no evidence to support *Hypothesis 2*, as there did not appear to be a significant difference between the two groups with regard to profitability. Lastly, the analysis of firm leverage was in line with existing research, which highlights the importance of leverage as a means of financing for the private equity business model.

6.2 Limitations

Due to the private nature of many private equity deals data availability is an issue for all research in this field, as often financial data is no longer publicly available, when targets are privatised or when targets are consolidated as part of buy-and-build strategies. As a result of these difficulties with data availability, it can be difficult to obtain sufficient samples to create robust statistical models, where all necessary assumptions are met. Despite, various PSM specifications and DiD models it was not always possible to optimally fulfill the parallel trends assumption, which is necessary for the DiD analysis. As a result of this, it is possible that some of the reported coefficients are biased and do not accurately reflect the true effect of the introduction of the minimum wage, however, plausibility and robustness checks provide confidence that the results can be seen as indications of the true effects. Nevertheless, further

research applying different statistical methods could shed additional light on these issues. A further issue all minimum wage and other policy studies encounter is the issue of non-compliance. Research suggests that after the introduction of the minimum wage in Germany there were significant amounts of non-compliance, which obscure the true effect the policy may have had if it had been enforced more rigorously.

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APPENDIX A: Parallel Trends Graphs

Parallel Trends Check — Mean log employees vs Time Period (Treatment Group / Control Group)

Parallel Trends Check — Mean ROA vs Time Period (Treatment Group / Control Group)

Parallel Trends Check — Mean log Total Assets vs Time Period (Treatment Group / Control Group)

Parallel Trends Check — Mean log Long-Term Debt vs Time Period (Treatment Group / Control Group)

Parallel Trends Check — Mean LTDebt/Total Assets vs Time Period (Treatment Group / Control Group)