# Labor Cost and Innovation: The Unintended Effects of Raising the Minimum Wage*

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## Abstract

This study explores the impact of minimum wage policies on firms' investment decisions during economic downturns in the United States. Specifically, this study analyzes the effect of the federal minimum wage hike between 2007 and 2009 using a difference-in-differences method. The findings indicate that firms in states affected by the hike increased R&D investment, reduced employment, and enhanced productivity compared to firms in unaffected states. In particular, labor-intensive industries, industries with more routine task-intensive labor forces, and industries facing heightened peer pressure exhibited substantial R&D investment. The study reveals some important unintended effects of minimum wage policies.



Keywords: Minimum Wage Policies, Economic Downturns, Labor Cost, R&D Investment

JEL Classification: G01, G31, J3

## 1. Introduction

The principal objective of minimum wage policies is to elevate workers' compensation, ensuring support for individuals at the lower end of the wage distribution. While existing literature has examined the impact of minimum wage hikes on various labor market metrics, such as workers' employment, skills, wage and income distributions (Card and Krueger, 1995; Neumark and Wascher, 2008; Dube et al., 2010, 2016; Neumark et al., 2014; Meer and West, 2016), a notable gap persists in understanding how these policies influence firms' financial decisions. Understanding the impact of minimum wage policies on firms' decisions and behaviors is vital. It not only helps explain current research findings on their effects on individual workers but is also essential for evaluating the broader consequences of these policies. Our research aims to bridge this gap by exploring how minimum wage policies specifically influence corporate investment strategies.

On the one hand, the elevation of the minimum wage establishes a higher baseline for wages, presenting challenges for firms to adapt wages and labor costs flexibly, particularly during economic downturns. This phenomenon results in a stickiness of labor costs, making the costs less correlated with output, and generating a labor leverage effect, as elucidated by Favilukis et a. (2020) and Schoefer (2021). The consequent increase in default risk becomes a pivotal factor compelling firms to strategically curtail hiring and scale back investments, especially in projects perceived as riskier. This strategic response aims to effectively navigate the complexities of heightened labor costs and default risks triggered by increases in the minimum wage, thereby ensuring a prudent and resilient financial approach during challenging economic periods.

On the other hand, elevating minimum wages may induce firms to strategically reorganize their business, accentuating investments in innovation and a shift toward automation and machinery. This conceptual framework aligns with the insights derived from John Hicks'

seminal work, *The Theory of Wages*, which postulates that alterations in relative factor prices prompt the development of specific inventions designed to economize the use of relatively expensive factors (Hicks, 1932, p.124). As minimum wages rise, labor becomes more expensive and less competitive than capital. Consequently, the escalation in minimum wages can stimulate firms to embrace productivity-enhancing equipment and technology, potentially displacing low-skilled jobs (Kleinknecht, 1998; Bassanini and Ernst, 2002; Aaronson and Phelan, 2019; Geng et al., 2022). This substitution effect can be particularly conspicuous during recessions when the opportunity cost of investment—that is, the foregone sales that could have been achieved—decreases, giving firms greater incentives to strategically prioritize advanced technologies and labor-saving methods. Such a strategic shift would help mitigate the impact of rising costs and allow firms to sustain competitiveness in economic downturns.

Building on the method of Clemens and Wither (2019), our study capitalizes on the differential binding nature of the increases in the federal minimum wage across states during the 2007–2009 period. The minimum wage of the United States (US) is contingent on both federal and state legislation, wherein workers are entitled to receive the higher of the two minimum wages. Notably, from July 23, 2007, to July 24, 2009, the federal minimum wage experienced an increment from $5.15 to $7.25 per hour. This resulted in 31 states with a minimum wage lower than the new federal rate being obligated to elevate their minimum wage (classified as bound states), while 19 states plus District of Columbia with a minimum wage surpassing the new federal rate remained unaffected (classified as unbound states). To investigate the effects of the 2007–2009 federal minimum wage hike on firms, we employ a difference-in-differences method, comparing firms situated in states where the minimum wage was binding and those located in states where it was not.

To substantiate the validity of the difference-in-differences identification strategy employed in this study, we first conduct a thorough comparison of firms situated in bound

states and those in unbound states. This comparative analysis illuminates a parallel evolution between these two groups leading up to the 2007–2009 federal minimum wage hikes. Given that the federal minimum wage increases occurred during the Great Recession, we also investigate the potential differential impact of the Great Recession on bound and unbound states. This investigation aims to confirm that any observed outcomes are not attributable to the potential disparate effects of the financial crisis on these distinct groups. The findings robustly indicate that both sets of states exhibited similar business cycle patterns over the sample period, with the financial crisis demonstrating no significantly disparate impact on one group compared to the other.

Subsequently, we undertake a comprehensive examination to discern the prevailing impact of minimum wage hikes on firms, distinguishing between the labor leverage effect and the substitution effect. This analysis examines the effects of federal minimum wage increases on firm investment. If minimum wage hikes affect firms through the labor leverage effect, we expect firms to decrease investments, particularly in risky projects, to control default risk. Conversely, if firms respond to minimum wage hikes by substituting capital for labor, a notable surge in investment is expected, particularly in R&D. Such strategic investment is poised to propel technological advancements and process automation, thereby enhancing overall operational efficiency and sustaining competitiveness. Our empirical findings indicate that bound firms exhibited a 28-percentage-point increase in the R&D investment ratio compared to unbound firms after minimum wage increases. Nevertheless, binding minimum wage hikes did not yield a significant impact on firms' capital expenditure, the allocation of financial resources toward augmentations to property, plant, and equipment. These results indicate the prevalence of the substitution effect over the labor leverage effect. They are in line with existing literature, which posits that firms engage in innovation to counteract the effects of cost competition and leverage innovation as a strategic means to attain a competitive edge. The

impetus provided by federal minimum wage hikes encourages firms to restructure their operations and invest in advanced labor-saving innovations that might not be considered otherwise. Furthermore, our results resonate with Manso et al. (2023), underscoring the meticulous cost assessment firms undertake in their R&D investment. During the financial crisis, the opportunity cost of firms' innovative pursuits diminished. Consequently, bound firms displayed a heightened inclination to prioritize long-term investments in response to the minimum wage increases.

We proceed by estimating the effects of binding minimum wage increases on firms' employment and productivity. After controlling for pertinent firm-level characteristics, state-level employment, income, and real estate characteristics, and employing fixed effects, our findings reveal that firms subject to the minimum wage increases experienced a more pronounced reduction in their workforce compared to their unbound counterparts. Specifically, the employment of bound firms decreased on average by 560 workers per year relative to unbound firms after the federal minimum wage hikes. Simultaneously, we observe a noteworthy enhancement in the productivity of employees in bound firms. On average, these firms registered a $24,818 greater increase in annual sales per employee compared to their unbound counterparts. These outcomes align with prior research, emphasizing that minimum wage increases can lead to employment declines and induce firms to adopt strategies substituting labor with technology, thereby augmenting productivity and efficiency.

Following this, we investigate the dynamics of firms' R&D investment surrounding the implementation of federal minimum wage increases. Our findings indicate a parallel evolution of R&D investment for both bound and unbound firms before the federal changes. However, the group of bound firms experienced a notable and consistent increase in R&D investment following the federal minimum wage hikes. This empirical evidence shows the validity of the difference-in-differences design employed in our study. Furthermore, we extend our analysis

and utilize a border and distance-matching sample to examine the impact of minimum wage hikes on firms' R&D investment. This approach aims to mitigate potential confounding factors and address concerns regarding the potential differential effects of the financial crisis on firms in bound and unbound states. The supplementary analysis results are consistent with our primary findings, reinforcing the robustness and reliability of the main results.

Finally, a battery of heterogeneity tests is conducted to gain further insights into the effect of minimum wage hikes on firms' investment decisions. Our analysis reveals that firms' responses to increased labor costs following federal minimum wage hikes are contingent on specific business characteristics. High labor intensity and a workforce susceptible to potential replacement by technology, machinery, and automation prompt firms to strategically invest in R&D. Additionally, the impact of federal minimum wage hikes varies across industries, dependent on their geographical distribution. Firms operating within less affected industries but personally affected by the increases exhibit increased incentives to invest in R&D. Such bound firms, under heightened peer pressure, strategically invest to substitute capital for labor, curtail labor costs, and ensure sustained competitiveness within their industry.

Our study contributes to the existing literature by uncovering the strategic investment decisions made by firms in response to minimum wage policies. While previous research in labor economics has extensively examined the effects of minimum wage hikes on fundamental labor market metrics, such as employment, income, and productivity (Card and Krueger, 1995; Neumark and Wascher, 2008; Dube et al., 2010, 2016; Neumark et al., 2014; Meer and West, 2016), the impact of minimum wage policies on firms' financial decisions remains largely unexplored, with a few exceptions investigating the effects of minimum wages on corporate investment. Leveraging variations in minimum-wage policies observed at county borders in China, Geng et al. (2021) discover a positive association between minimum wages and capital

investment, while Cho (2022) reveals a negative correlation between state-level minimum wages and capital expenditure among US public firms.

Also exploring the differential effects of federal minimum wage hikes on firms, Gustafson and Kotter (2023) provide evidence that heightened minimum wages prompt US public firms operating in minimum wage-sensitive sectors (e.g., retail, restaurant, and entertainment) to curtail capital expenditure. Diverging from Gustafson and Kotter (2023), we examine the investment behaviors of all public firms, with a specific emphasis on R&D, following the implementation of a federal minimum wage increase during an economic downturn. Existing research has established that minimum wage policies exhibit a spillover effect, influencing the income not only of workers whose wages fall below the minimum threshold but also of those whose wages exceed it (Grossman, 1983; Akerlof and Yellen, 1990; Lopresti and Mumford, 2016; Engbom and Moser, 2022). Consequently, minimum wage policies may exert a more general impact on firms, extending beyond those operating in minimum wage-sensitive industries alone, and our findings substantiate this broader influence. Our study shows a strategic response from firms, revealing a noteworthy inclination toward investment in R&D and the substitution of capital for labor—an unforeseen consequence arising from the implementation of minimum wage policies.

Importantly, our research contributes to the literature examining how economic recessions reshape innovation activities. We concentrate on assessing the consequences of the 2007–2009 federal minimum wage increases, a period coinciding with the financial crisis. Economic downturns have the potential to disrupt the innovation process directly, leading to substantial setbacks in economic activity (Gourio et al., 2016). Nevertheless, amid these challenges, the opportunity cost associated with firms' innovative activities diminishes, and financial recessions may provide a distinctive opportunity to reshape the innovation process, directing firms toward more efficient organizational structures (Schumpeter, 1942; Hershbein

and Kahn, 2018; Manso et al., 2023; Babina et al., 2023). Our study sheds light on how firms strategically make innovative investment decisions in response to the minimum wage hikes during the financial crisis. We show that during the crisis, when the opportunity cost of R&D investment diminishes, firms are more inclined to expedite production restructuring and adopt labor-saving technologies as labor costs escalate.

Finally, our study contributes to the expanding body of literature investigating the impact of labor market frictions on firm financial policies. Chen et al. (2011) emphasize the role of labor unions in elevating firms' equity costs through a reduction in operating flexibility. Serfling (2016) examines the effects of Wrongful Discharge Laws adopted by US state courts on capital structure decisions, revealing increased employment rigidity and reduced debt ratios following their adoption. Favilukis and Lin (2016) argue that sticky wages serve as a form of operating leverage, contributing to higher firm risk. This study extends the emerging literature by investigating labor market frictions induced by minimum wage policies. Specifically, it illustrates that minimum wage increases drive firms to strategically invest in R&D while concurrently reducing their workforce—a deliberate response aimed at mitigating the heightened and less flexible labor costs resulting from minimum wage hikes. These findings provide valuable insights into firms' adaptive strategies in response to minimum wage changes, elucidating the intricate dynamics of the labor market and their consequential impact on firms' financial decisions.

The remainder of the paper is structured as follows. Section 2 discusses the data and sample used in the analysis. Section 3 presents the summary statistics and pre-trend tests. Section 4 investigates the impact of the federal minimum wage increase on firms' investment. Section 5 concludes.

## 2. Sample Selection

### 2.1 Data Source

Data on state employment, gross domestic product (GDP), personal income, population information, and per capita personal income are sourced from the Bureau of Economic Analysis. The house price index information is obtained from the Federal Housing Finance Agency. Firms' financial information is extracted from the COMPUSTAT database. Detailed definitions of variables constructed using these databases are provided in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles.

## 2.2 Bound Firms versus Unbound Firms

The determination of the minimum wage in the US is a function of federal legislation, complemented by individual state minimum wage laws. In cases in which an employee is subject to both federal and state minimum wage laws, the employer must adhere to the higher of the two rates. Consequently, the impact of federal minimum wage increases varies across states, depending on their pre-existing minimum wage policies. States without a specific minimum wage or with a rate lower than the new federal standard are obliged to elevate their minimum wage, while states already exceeding the new federal rate remain unaffected by these increases. This study leverages the heterogeneous effects of federal minimum wage increases across states to investigate their subsequent influence on the financial policies of firms.

Our study examines the impact of the most recent federal minimum wage increase, which was introduced through the Fair Minimum Wage Act of 2007. This act, introduced by Representative George Miller on January 5, 2007, and signed into law by former President George W. Bush on May 25, 2007, raised the federal minimum wage by over 40% in three stages: $5.15 per hour to $5.85 per hour effective July 24, 2007; $6.55 per hour effective July 24, 2008; and $7.25 per hour effective July 24, 2009. For this study, "bound states" are defined as those with minimum wages lower than the new federal minimum wage when it took effect,

and subject to the federal minimum wage increase. Conversely, those unaffected by the increase in the federal minimum wage are referred to as "unbound states".[1]

Among the 50 states and the District of Columbia, 31 states were subject to the increases, while 19 states and the District of Columbia remained unaffected owing to pre-existing higher state-level minimum wages. Figure 1 illustrates the average minimum wage growth in both bound and unbound states. The solid line denotes the trajectory of average minimum wage growth in bound states, while the dashed line illustrates the growth in unbound states. In the period between 2004 and 2006, cumulative minimum wage increases for bound and unbound states averaged approximately 5% and 8.8%, respectively. However, the period 2007–2009 was characterized by federal minimum wage hikes, with a more rapid increase in minimum wages for bound states than unbound states. Specifically, the average cumulative minimum wage increases for bound states from 2007 to 2009 were nearly 10% higher than those observed for unbound states.[2] For the following analysis, headquarters location information from COMPUSTAT is merged with state-level minimum wage data. The resulting sample, excluding firms in the financial and utility industries, encompasses 1,908 firms located in states bound by the 2007–2009 federal minimum wage increase and 1,581 firms located in states unbound by the rise.

[Figure 1 about here]

## 3. Summary Statistics and Pre-trend Tests

### 3.1 Summary Statistics

Panel A of Table 1 presents the summary statistics of state characteristics in 2006, offering insights into various key indicators that encompass state employment, GDP, personal

[1] The monthly state minimum wage data are collected by David Neumark and are accessible on his website (http://www.economics.uci.edu/~dneumark/datasets.html).
[2] The average cumulative minimum wage increases of bound states from 2007 to 2009 is approximately 29.9%, and that of unbound states is around 20.9%.

income, population, and per capita personal income. The mean value of state employment, an encompassing metric that includes both full-time and part-time positions, stands at 3,448,404, reflecting the total number of jobs within a state. State GDP exhibits a mean value of $269,254 million. State personal income, quantifying the total income in millions received by or on behalf of state residents, has an average value of $222,992 million. We also include data on the state population, representing the total number of individuals residing in a state, and state per capita personal income, calculated as personal income divided by the resident population.

[Table 1 about here]

Panel B of Table 1 summarizes the financial characteristics of firms in bound and unbound states in 2006. These financial metrics include profitability, firm size, liability ratio, cash reserve, and Tobin's Q. Profitability, defined as operating income before depreciation over total assets, exhibits a mean ratio of 0.007 with a standard deviation of 0.36, indicating a diverse range of profitability among the sampled firms. Firm size, measured as the natural logarithm of total assets, provides insights into the scale of these entities. The liability ratio, representing the proportion of total liabilities to total assets, averages 0.209 and is 0.003 at the $25^{th}$ percentile and 0.317 at the $75^{th}$ percentile. The cash ratio, defined as the proportion of cash plus short-term investments to total assets, has an average value of 0.231 and is 0.036 at the $25^{th}$ percentile and 0.354 at the $75^{th}$ percentile. These statistics underscore the significant heterogeneity in the corporate financing and cash-holding policies observed among the sample firms, shedding light on the nuanced financial landscape within which these entities operate.

## 3.2 Pre-trend Tests

Our research employs a difference-in-differences method to compare firms situated in states bound and unbound by federal minimum wage increases and examine the impact of these minimum wage hikes on firms' characteristics and behaviors. The validity of this method hinges on the assumption that firms in both bound and unbound states evolve in a parallel

manner before the implementation of federal minimum wage hikes. Table 2 examines the pre-trends in both state and firm characteristics. Panel A of Table 2 compares the year-over-year growth in the variables of interest between bound and unbound states in the three years preceding the federal minimum wage increases. The results demonstrate that bound and unbound states exhibit similar trajectories before the 2007–2009 federal minimum wage hikes, validating the foundational assumption of parallel evolution. Panel B of Table 2 reveals that, despite initial differences in profitability, size, and cash reserve, firms in bound states and unbound states evolve in tandem before the implementation of federal minimum wage increases. This alignment lends credence to the effectiveness of the difference-in-differences approach in isolating the impact of minimum wage policy changes.

[Table 2 about here]

Finally, considering the concurrent occurrence of the 2007–2009 federal minimum wage increases and the Great Recession, it is crucial to scrutinize whether our research findings are shaped by the dynamics of the financial crisis rather than the inherent impact of the federal minimum wage increase. Following the method proposed by Chava et al. (2023), we leverage the State Leading Index from the Federal Reserve Bank of Philadelphia to examine the business cycles of bound and unbound states. This index signals directional changes in the business cycle and allows us to assess whether bound and unbound states followed similar business cycles before and after the 2007–2009 federal minimum wage hikes. Figure 2 illustrates the monthly changes in the State Leading Index for both groups, with the solid line representing bound states and the dashed line portraying unbound states. The indexes follow a comparable pattern, indicating similar business cycles for both groups. Supplementing this graphical representation, Table 3 presents the outcomes of t-tests, comparing the year-over-year changes in the State Leading Index between bound and unbound states.[3] The results indicate no

[3] The Annual State Leading Index is calculated as the average of the monthly State Leading Index for each year.

significant difference in the State Leading Index changes between the two groups, suggesting that both experienced akin business cycles before and after the onset of the Great Recession. This aligns with the findings of Chava et al. (2023), reinforcing the conclusion that states, irrespective of their binding status, exhibited analogous business cycles during and following the federal minimum wage increases enacted in recession years.

[Figure 2 about here]

[Table 3 about here]

# 4. Empirical Results

## 4.1 Empirical Strategy

To investigate the impact of binding minimum wage increases, our study employs a difference-in-differences analytical approach and estimates the following model:

$$Dependent_{i,s,t} = \beta_1 Bound\ Firm \times After + \beta_2 Financial\ Controls_{i,t-1} + \beta_3 State\ Controls_{s,t-1} + \alpha_i + \gamma_t + \varepsilon, \quad (1)$$

where $Dependent_{i,s,t}$ is the variable of interest for firm *i* located in state *s* in year *t;* the term *Bound Firm* × *After* is an interaction variable of *Bound Firm*, which equals 1 for firms located in states subject to the 2007–2009 federal minimum wage increases and 0 for firms in unbound states, and *After*, which equals 1 for the years 2007, 2008, and 2009, and 0 for the years 2004, 2005, and 2006; the vector $Financial\ Controls_{i,t-1}$ encompasses firm-level controls of firm *i* in year *t-1*, including profitability, firm size, financial leverage, cash reserve, and Tobin's Q; $State\ Controls_{s,t-1}$ is a vector of state-level controls for state *s* in year *t-1*, including the natural logarithm of state employment, GDP, personal income, population, and per capita personal income, serving as proxies for the macroeconomic environment. Even though the results in Table 3 indicate a comparable impact of the Great Recession on both bound and unbound states, we incorporate the state house price index as an independent variable to further control for any latent differentials in the effects of the recession. This index serves as a proxy

for the state-level severity of the housing crisis. Given the close association between the Great Recession and the housing bubble, the state house price index provides insights into the differential impact of the financial crisis. The fixed effects in the model include $\alpha_i$ for firm-specific effects and $\gamma_t$ for year fixed effects. The error term is denoted as $\varepsilon$. All control variables are lagged by 1 year, and standard errors are heteroskedastic-robust and clustered at the firm level. The primary focus of interest in the model is in the interaction term, examining the effect of binding minimum wage increases on firms.

## 4.2 Minimum Wage and Investment

We first study how minimum wage hikes affect firms' investment behaviors. The labor leverage effect posits that a federal minimum wage increase may elevate default risks for firms, compelling them to strategically curtail hiring and scale back investments, particularly in projects deemed riskier. By contrast, the substitution effect suggests that firms might opt for a capital-for-labor substitution strategy, investing in advanced labor-saving technologies to enhance productivity and offset augmented labor costs resulting from minimum wage increases. To discern the prevailing influence, we first estimate Equation (1) by using *R&D Investment* as the dependent variables. *R&D Investment* encapsulates costs related to the development of new products or services. The variable is scaled by the lagged property, plant, and equipment. Table 4 presents the results on how the binding minimum wage increases affect firms' *R&D Investment*. Columns (1) includes the interaction term of *Bound Firm* and *After* and the fixed effects while Columns (2) also incorporates the firm-level financial controls and state-level controls. As Column (1) shows, the coefficient of the interaction term between *Bound Firm* and *After* is significantly positive at the 1% level. After controlling for firm-level and state-level independent variables and fixed effects, the binding minimum wage hikes still have a significantly positive effect on firms' *R&D investment*. Quantitatively, firms subject to federal minimum wage hikes exhibited a remarkable 28-percentage-point surge in the *R&D investment*

ratio relative to their unbound counterparts after the implementation of the new federal minimum wage. This finding is both economically and statistically significant.

[Table 4 about here]

California and Massachusetts stand out as the two most innovative states in the US, boasting a concentration of cutting-edge industries (Mukherjee et al., 2017). To ensure the robustness and generalizability of our findings, we conduct an exclusionary analysis by omitting firms situated in these two states and re-estimating Equation (1). The outcomes of this refined analysis are both economically and statistically akin to our primary results. Moreover, the variance in state-level policies, including tax credits, depreciation allowances, and corporate taxes, may affect firms' R&D activities. To preclude any potential influence of these policies on our observed results, we re-estimate Equation (1) and include an additional variable, the R&D tax price—a metric devised by Wilson (2009) that quantifies the impact of state-level taxes and allowances on R&D. Notably, our analysis reveals that even after accounting for these nuanced state-level factors, the positive effect of binding minimum wage increases on *R&D investment* persists, underscoring the robustness and independence of this observed relation in the face of diverse state-level policies.[4]

We further explore the effect of minimum wage hikes on firms by examining their impact on capital expenditure. To do so, we estimate Equation (1) with *Capital Expenditure* as the dependent variable. *Capital Expenditure* represents financial allocations for augmentations to property, plant, and equipment, excluding amounts arising from acquisitions. The variable is scaled by the lagged property, plant, and equipment. The results are reported in Table 5. Column (1) of Table 5 shows a statistically positive relation between capital expenditure and minimum wage increases. However, after controlling for firm-level and state-level

[4] The results of the exclusionary analysis and the results obtained through regression, controlling for R&D tax price, are available upon request.

characteristics, this positive association dissipates, as evidenced in the results presented in Column (2), signifying that minimum wage increases exhibit no significant impact on firms' capital expenditure.

[Table 5 about here]

Overall, the results suggest that firms bound by minimum wages do not adopt a risk-averse stance in response to the heightened risks induced by minimum wage increases; instead, they display a significant surge in R&D expenditure. Notably, R&D investment is inherently riskier than capital expenditure on property, plant, and equipment, as established by prior research (e.g., Bhagat and Welch, 1995; Kothari et al., 2002; Coles et al., 2006). This shift toward increased R&D expenditure reflects important strategies firms adopt in response to rising labor cost. First, firms increase investment in R&D to restructure their business and strategically substitute capital for labor, thereby mitigating the adverse effects induced by the minimum wage increases. This aligns with existing literature, showing that firms strategically invest in innovation to navigate the challenges of cost competition and leverage innovation to gain a competitive advantage (Hombert and Matray, 2018). Second, the results resonate with the findings of Manso et al. (2023), emphasizing that firms carefully evaluate costs when embarking on R&D investment. During financial crises and periods of increased labor costs, the opportunity cost associated with innovative pursuits—that is, the foregone sales that could have been achieved—is diminished. Consequently, bound firms exhibit a heightened incentive to prioritize long-term investments, recognizing the inherently low anticipated short-term profits. The results highlight a strategic shift toward R&D investment as a means to navigate economic challenges and enhance long-term profitability. The findings reveal a complex interplay between minimum wage policies, risk management, and strategic investment decisions.

## 4.3 Minimum Wage, Employment, and Productivity

In this subsection, we further investigate how minimum wage hikes affect the employment of firms. The effect of minimum wage changes on employment has been a focal point of scholarly debate (Card and Krueger, 1995; Neumark and Wascher, 2008; Dube et al, 2010; Neumark et al, 2014; Meer and West, 2016). We estimate Equation (1) with *Employment*, defined as the ratio of the number of employees (in thousands) to total assets (in billions), to assess the impact of minimum wage changes on employment.

The results, detailed in Table 6, reveal a significantly negative relation between the interaction term and employment in Column (1). After controlling for firm financial and state characteristics in Columns (2), the negative significance of the interaction term endures. Specifically, the coefficient of the *Bound Firm* × *After* interaction, standing at -0.251, remains significantly negative at the 5% level. The magnitude of this finding becomes more palpable when considering that, on average, a firm in a bound state reduced its workforce by approximately 560 workers in response to the implementation of the new federal minimum wage policies.[5]

[Table 6 about here]

This outcome aligns with the findings revealed in the 2016 Global Business Outlook Survey conducted by Duke University and CFO magazine in 2016, emphasizing managers' inclination to decrease their workforce in reaction to rises in the minimum wage. These results are also consistent with the research of Autor and Dorn (2013), Autor et al. (2015), and Lordan and Neumark (2018). They suggest that the growing prevalence of technological advancements and decreasing technology costs have resulted in the substitution of workers in recent decades. Specifically, the rise in minimum wages significantly diminishes the proportion of jobs that are automatable. Moreover, during the financial crisis, the difficulty in transferring wage costs

[5] The average size of firms in the bound states is $2.231 billion. Therefore, the average number of jobs cut is 0.251*2.231*1000= 560.

to consumers is notably exacerbated, as economic uncertainties and constrained consumer spending pose additional challenges for firms. Our findings align with Harasztosi and Lindner (2019), who demonstrate that the negative effects of minimum wage increases on employment intensify when firms face difficulties in transferring wage costs to consumers.

Next, we examine the changes in productivity between firms bound by the federal minimum wage increases and those unbound. Utilizing the ratio of sales (in millions) relative to the number of employees (in thousands) as a proxy for productivity, the results presented in Column (2) of Table 7 show a significantly positive effect of binding minimum wage increases on worker productivity. On average, the annual sales per employee of bound firms increased by $24,818 more than that of unbound firms.

[Table 7 about here]

The findings from Tables 6 and 7 reveal a notable trend—firms, rather than solely absorbing heightened labor costs, proactively seek to elevate their operational efficiency and productivity levels in response to minimum wage hikes. These findings align with previous studies, such as Lordan and Neumark (2018) and Aaronson and Phelan (2019), emphasizing that the adoption of labor-technology substitution strategies is a contributing factor to employment declines after minimum wage hikes. These strategic responses can enhance firms' productivity and competitiveness in the market.

## 4.4 Dynamics in Investment

In this subsection, we explore the dynamics in *R&D investment* of firms before and after the implementation of the federal minimum wage increases in 2007. We estimate Equation (1), substituting the interaction term *Bound Firm* × *After* with interactions between *Bound Firm* and *Year* dummies spanning from 2004 to 2009. The base year is designated as 2006 and excluded when estimating the regression. Figure 3 presents the results, illustrating the differences in *R&D investment* between firms in states bound by the minimum wage

increases and those in unbound states over time. It shows that the *R&D investment* differentials between firms in bound and unbound states during 2004 and 2005 are similar to those in the baseline year, 2006. After the initiation of the federal minimum wage increases in 2007, there is a discernible and significant surge in *R&D investment* by firms in bound states over time.

[Figure 3 about here]

The detailed regression outcomes are presented in Table 8. After controlling for fixed effects, Column (1) of Table 8 shows that the coefficients of the interaction terms for 2004 and 2005 do not significantly differ from 0. However, the coefficients for 2007, 2008, and 2009 emerge as significantly positive, relative to the base year 2006. This analysis suggests that the disparities in *R&D investment* between firms in bound and unbound states remained relatively stable during 2004, 2005, and 2006, indicating a comparable trajectory for both groups of firms leading up to the federal changes. With the implementation of the 2007 federal minimum wage increase, firms in bound states exhibited a notable uptick in their *R&D investment*. After controlling for firm-level and state-level characteristics, Column (2) provides further insights, revealing a monotonic increase in *R&D investment* by firms in bound states after the introduction of the federal minimum wage increase in 2007. The results presented in Table 8 underscore the parallel evolution of *R&D investment* between bound and unbound firms before the federal minimum wage changes, providing additional evidence for the validity of the difference-in-differences specification our paper relies on. The findings also further confirm that firms in bound states intensify their investments in R&D activities as a strategic response to counteract the augmented labor costs.

[Table 8 about here]

## 4.5 Minimum Wage and Investment Analysis based on a Matching Sample

Our research studies the effect of federal minimum wage hikes during the financial crisis, juxtaposing firms in states bound by these increases with those in unbound states.

However, a concern may arise that the observed outcomes could be attributed to divergent business cycles or varying impacts of the crisis on the two groups of firms. Although our prior analysis indicates similar business cycles in both sets of states before and after the financial crisis, this subsection employs a distance matching method to further address these potential issues.

The distance matching method involves pairing a firm in a bound state with its closest counterpart in an unbound state within the same Standard Industrial Classification (SIC) two-digit industry. This strategic matching aims to mitigate concerns related to varying economic conditions and structures by focusing on nearby pairs of firms whose local economic conditions are expected to exhibit less pronounced variations. This method is essentially similar to that used in pervious research on minimum wage (Card and Krueger, 1994; Dube et al, 2010; Gustafson and Kotter, 2023) and enables us to further confirm that the observed increases in R&D investment are attributable to minimum wage changes.

The outcomes of our distance matching analyses, presented in Table 9, underscore the robustness of our findings. After controlling for firm-level and state-level characteristics, firms in bound states demonstrated a statistically and economically significant increase in *R&D investment* compared to their counterparts in unbound states within the same industry and proximity. This result, observed after accounting for local economic conditions, reinforces the conclusion that the federal minimum wage increases during the financial crisis had a significantly positive impact on *R&D investment* by firms in bound states.

[Table 9 about here]

## 4.6 Labor Force Characteristics and Investment

Increases in minimum wage carry significant consequences for labor expenses, impacting not only individuals with lower wages but also extending to those earning higher wages, as demonstrated by Lopresti and Mumford (2016). Engbom and Moser (2022) further

reveal that this influence can reach as far as the 80$^{th}$ percentile in the distribution of earnings. Considering that labor-intensive firms heavily depend on labor for their production procedures, the expenses related to labor form a substantial portion of their overall costs. Consequently, if the escalation of the federal minimum wage does prompt firms to substitute capital for labor and channel resources into R&D, this impact is likely to be more conspicuous within labor-intensive firms. In essence, the higher minimum wage may encourage these businesses to strategically reallocate resources, prioritizing technological investments and innovation to offset the effects of increased labor costs.

To test this hypothesis, firms are classified into labor-intensive and capital-intensive categories based on the median value of the property, plant, and equipment to the number of employees ratio in the year 2006. The analysis examines the consequences of the 2007–2009 federal minimum wage hikes on the *R&D investment* of these two categories of firms. The results are presented in Columns (1) and (2) of Table 10 for labor-intensive firms and Columns (3) and (4) for capital-intensive firms. The results in Columns (1) and (2) reveal a significantly positive effect of binding minimum wage increases on labor-intensive firms' *R&D investment*. By contrast, Columns (3) and (4) demonstrate that federal minimum wage hikes exhibited no significant impact on capital-intensive firms. This disparity suggests that businesses operating in labor-intensive industries are more inclined to strategically respond to increased labor costs by investing in technology and innovation. These findings underscore varied reactions to minimum wage increases among firms, shaped by their levels of labor and capital intensity.

[Table 10 about here]

When the federal minimum wage policy increases labor costs, the decision of firms to invest in R&D and reduce labor expenses is contingent not only on the overall significance of the workforce in their operations but also on the specific occupational characteristics of their labor force. If firms have a substantial workforce engaged in routine tasks, vulnerable to

replacement by technology and automation, we expect these firms to be more likely to substitute capital for labor and increase investments in R&D in response to minimum wage increases. In further exploration of this dynamic, we investigate how occupational routine task-intensity influences firms' decisions regarding R&D investment in the face of binding minimum wage increases. Following Bates et al. (2023), we calculate the weighted average occupational routine task-intensity (*RTI*) for each industry using Autor and Dorn's (2013) occupational routine task-intensity index data.[6] This index ascends with the increasing prominence of routine tasks in each occupation and descends with the importance of manual and abstract tasks. It serves as a gauge for the ease of automating specific occupations by evaluating their reliance on routine tasks. As federal minimum wage increases, firms characterized by a higher proportion of routine task workers may find greater incentives to invest in R&D. This strategic response involves leveraging automation to address the augmented labor costs, allowing for the efficient execution of repetitive and predictable tasks by machines and artificial intelligence. Consequently, firms adopting this approach may enhance operational efficiency and successfully adapt to the changing economic landscape prompted by the minimum wage increases.

To dissect this phenomenon, firms are categorized into two groups based on the median value of the weighted average occupational *RTI* for industries in the year 2006: those operating in industries with high *RTI* and those in industries with low *RTI*. The regression results, presented in Columns (1) and (2) of Table 11 for the high *RTI* group and Columns (3) and (4) for the low *RTI* group, reveal insightful patterns. Notably, the coefficients of the interaction terms between *Bound Firm* and *After* are found to be significantly positive exclusively for firms operating in industries characterized by high *RTI*. By contrast, these coefficients are not significantly different from 0 for firms in industries with low *RTI*. These results underscore

[6] The data are from David Dorn's website https://www.ddorn.net/data.htm.

that the escalation of federal minimum wages compels firms, particularly in high *RTI* industries, to proactively adopt new technologies.

[Table 11 about here]

## 4.7 Industry Pressure and Investment

In this subsection, we explore the impact of industry peers' influence on firms' investment decisions. Firms often make investment decisions in response to the strategic moves of their industry counterparts. When minimum wage increases impact only a segment of firms within an industry, those affected firms may have strong incentives to opt for increased investments in R&D to curtail labor costs and sustain competitiveness. However, if most firms within an industry face the impact, these firms might wield greater bargaining power, leading them to pass on the increased labor costs to customers. This, in turn, would diminish their incentives to substitute capital for labor. In other words, the broader dynamics at the industry level would significantly mold how firms navigate changes in minimum wages. To assess this, we utilize information on firms' total asset values to aggregate the total value of assets for each two-digit SIC industry. We then calculate the industry-level percentage of assets located in states where the minimum wage was binding for the year 2006. Categorizing firms into two groups based on the median value of this percentage, we distinguish between firms operating in industries more affected by federal minimum wage increases and those less affected by the changes. The former group exhibits a higher concentration of assets in states where the minimum wage is binding, while the latter has a lower concentration.

For firms in the latter group, if they are located in states where the minimum wage is binding, the binding minimum wages may matter more. This is because they may face higher industry pressure than firms in the former group when the binding minimum wages come into effect. In industries within the latter group, where most firms are generally not affected by the minimum wage changes, being in bound states places these firms in the minority of businesses

within their industry. This unique situation leads to greater incentives for firms in bound states within these industries to substitute capital for labor and implement cost control measures to remain competitive. Conversely, for firms in the former group, operating in industries where most firms are affected, the changes in minimum wages do not matter as much. In these industries, most firms are subject to minimum wage increases, giving the industry greater bargaining power. Firms in bound states within these industries may find it less imperative to substitute capital for labor, as the increased labor costs can be passed on to customers more easily.

To assess these dynamics, we employ Equation (1) to examine the effects of minimum wage increases on firms operating in industries more and less affected by these changes, respectively. The results, presented in Table 12, shed light on how firms in bound states, across different industries, respond to the challenges posed by minimum wage increases. Columns (1) and (2) present the regression outcomes for firms in industries less affected by federal minimum wage increases, while Columns (3) and (4) depict the results for firms in industries more affected by the changes. As expected, our findings show that firms bound by the minimum wage changes significantly increased *R&D investment* only when most of their industry peers were not similarly bound by these changes. This highlights that industry pressure also plays an important role when firms decide how to respond to minimum wage hikes.

[Table 12 about here]

## 5. Conclusions

Our study investigates the impact of the 2007–2009 changes in the federal minimum wage on firms' investment strategies. We adopt a difference-in-differences method to assess the impact, comparing firms in states bound by the exogenous policy change with those in unbound states. Our analysis reveals that firms located in bound states responded significantly differently to firms in unbound states. Specifically, these bound firms increased investments in

R&D, reduced employment, and demonstrated more substantial productivity improvements compared to unbound firms. Notably, labor-intensive industries, industries with more routine task-intensive labor forces, and industries facing heightened peer pressure exhibited substantial R&D investment. These results suggest that the rise in labor costs triggered by the minimum wage policy prompted firms to substitute capital for labor and accelerate the adoption of technological advancements. Consequently, this study sheds light on the unintended effects of minimum wage policies, highlighting the intricate interactions between labor costs, firm behavior, and technology adoption. Our study contributes valuable insights into the consequences of minimum wage policies for the business landscape.

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## Appendix A

*Capital Expenditure*: Capital Expenditure/the lagged property, plant, and equipment. Data source: COMPUSTAT

*Cash*: Cash and short-term investments/total assets. Data source: COMPUSTAT

*Employment*: Number of employees (in thousands)/total assets (in billions). Data source: COMPUSTAT

*Liability Ratio*: Total liabilities/total assets. Data source: COMPUSTAT

*Productivity*: Sales (in millions)/number of employees (in thousands). Data source: COMPUSTAT

*Profitability*: Operating income before depreciation/total assets. Data source: COMPUSTAT

*R&D Tax Price*: An indicator of the impact of state-level tax credits, depreciation allowances, and corporation taxes on R&D. The R&D tax-price data are used by Lucking et al. (2018) and are available on Nicholas Bloom's website (https://nbloom.people.stanford.edu/research).

*R&D Investment*: Research and development expense (R&D)/the lagged property, plant, and equipment. If the R&D value is missing in a given year, this study assumes the value of R&D of that year to be 0. Data source: COMPUSTAT

*Size*: Ln(Total assets) in millions. Data source: COMPUSTAT

*State Employment*: A count of jobs, both full-time and part-time, of a state. Data source: Bureau of Economic Analysis

*State GDP*: Gross domestic product (GDP) of a state in millions of current dollars (not adjusted for inflation). Data source: Bureau of Economic Analysis

*State House Price Index*: An indicator of single-family house price trends of a state. Data source: Federal Housing Finance Agency

*State Leading Index*: An index predicts the six-month growth rate of the state's coincident index. Data source: Federal Reserve Economic Data

*State Per Capita Personal Income*: The personal income of a state divided by the resident population of the area. Data source: Bureau of Economic Analysis

*State Personal Income*: Total income in millions received by or on behalf of the persons residing in a state for their provision of labor, land, and capital used in current production as well as other income, such as personal current transfer receipts. Data source: Bureau of Economic Analysis

*State Population*: The number of individuals (both civilian and military) who reside in a state. Data source: Bureau of Economic Analysis

*Tobin's Q*: (Total assets+market capitalization-common equity-deferred taxes and investment tax credit)/total assets. Data source: COMPUSTAT

Figure 1: Minimum Wage Growth

This figure shows the minimum wage growth of bound states and unbound states, respectively. The solid (dashed) line represents the wage growth of bound states (unbound states).

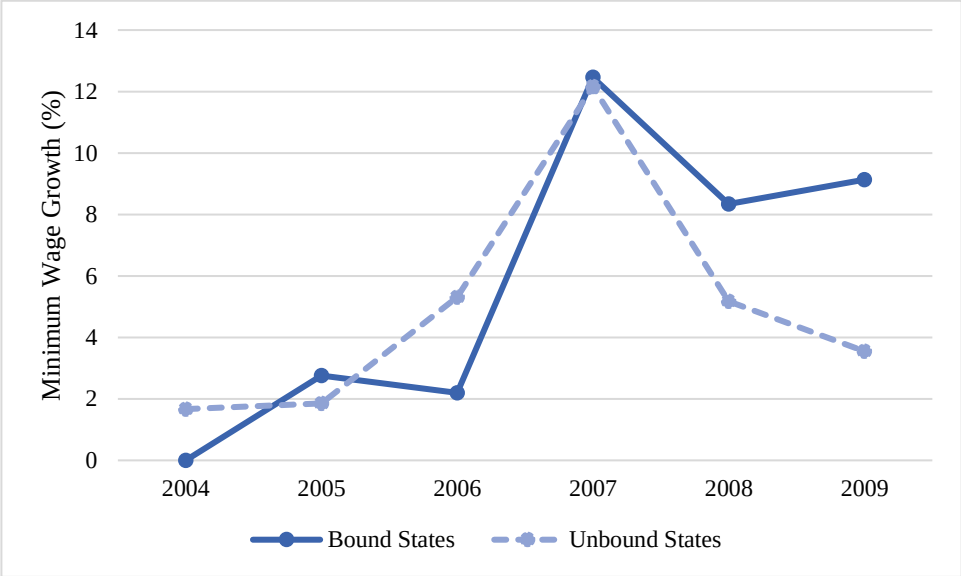

Figure 2: Monthly Change in State Leading Index

This figure shows the monthly changes in the State Leading Index of bound states and unbound states. The solid (dashed) line represents the changes in the index of bound states (unbound states).

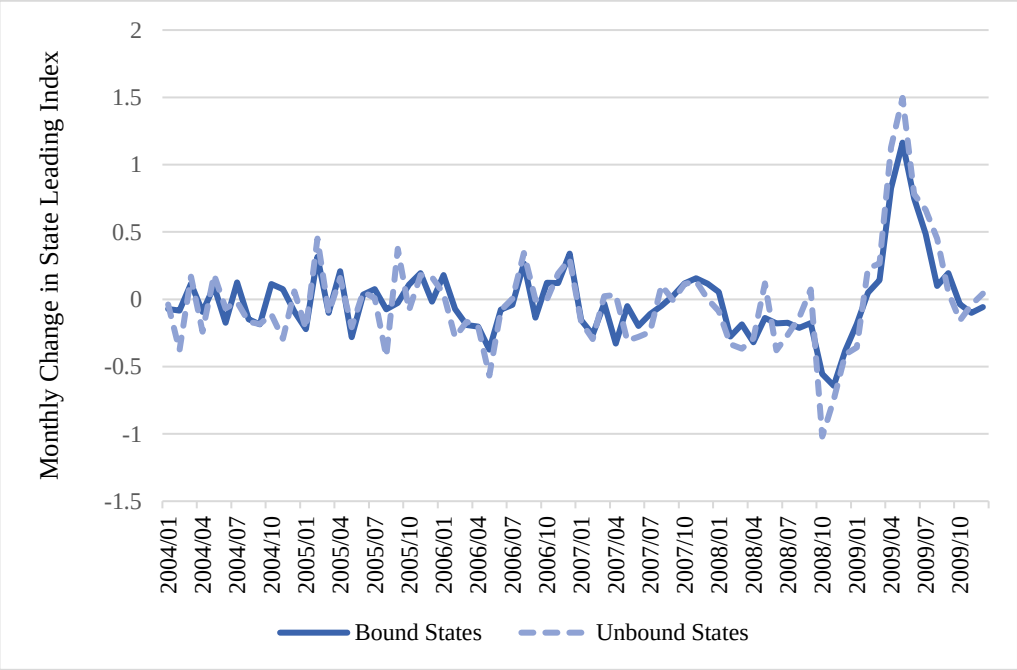

Figure 3: Trend in Firm R&D Investment Surrounding the Fair Minimum Wage Act of 2007

This figure plots the estimates of the differences in firms' R&D investment between bound states and unbound states surrounding the Fair Minimum Wage Act of 2007. The regression results are reported in Table 8. The diamond markers represent the estimates from the regression while the vertical lines represent the 90% confidence interval. The base year is 2006, 1 year before the Fair Minimum Wage Act of 2007 came into effect.

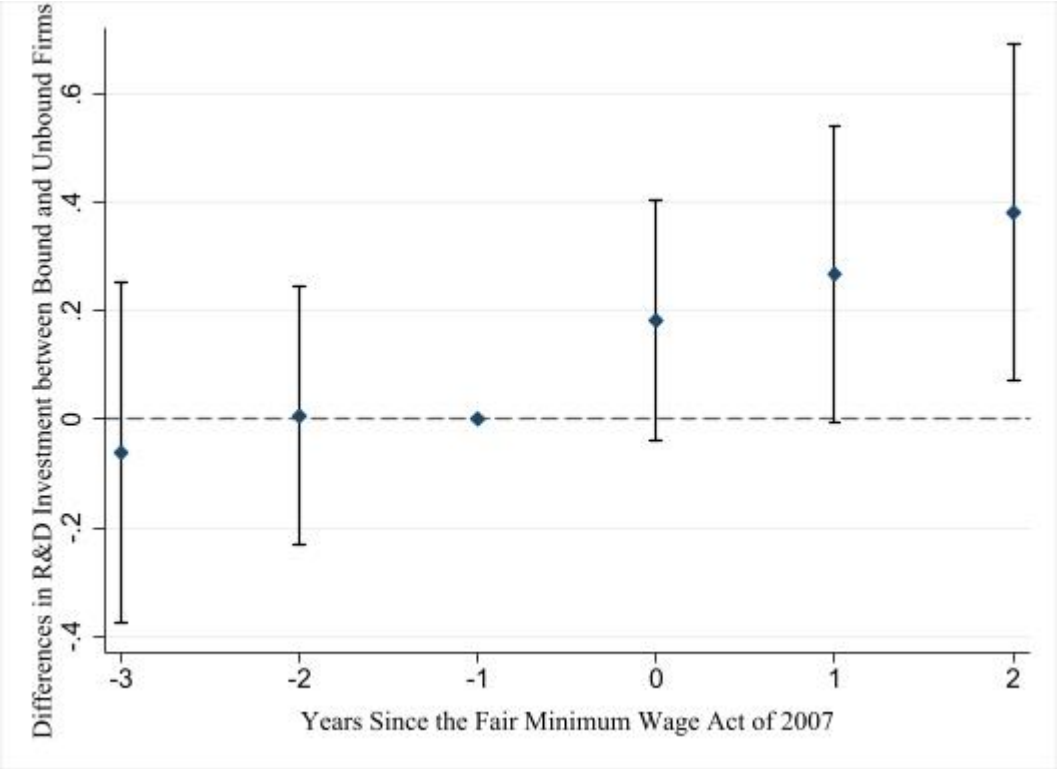

Table 1: Summary Statistics

Panels A and B describe the state characteristics and firm characteristics in 2006, respectively. State employment is the number of jobs of a state, both full-time and part-time. State GDP is the GDP of a state in millions of current dollars (not adjusted for inflation). State personal income is the total income in millions received by or on behalf of the persons residing in a state. State population is the number of individuals (both civilian and military) who reside in a state. State per capita personal income is the personal income of a state divided by the resident population of the state. Profitability is the ratio of operating income before depreciation to total assets. Size is the natural logarithm of total assets in millions. The liability ratio is the ratio of total liabilities to total assets. Cash is the ratio of cash plus short-term investments to total assets. Q is the ratio of total market value to total assets. P25 and P75 indicate the 25$^{th}$ and 75$^{th}$ percentile, respectively.

Panel A: State Characteristics

| | Mean | P25 | Median | P75 | Std. Dev. |
|---|---|---|---|---|---|
| State Employment | 3448404 | 899832 | 2374830 | 4110415 | 3740903 |
| State GDP | 269254 | 62365 | 155153 | 361266 | 330426 |
| State Personal Income | 222992 | 52179 | 134579 | 305337 | 268626 |
| State Population | 5850587 | 1468669 | 4219239 | 6410084 | 6578558 |
| State Per Capita Personal Income | 37213 | 33040 | 35125 | 40278 | 6093 |

Panel B: Firm Characteristics

| | Mean | P25 | Median | P75 | Std. Dev. |
|---|---|---|---|---|---|
| Profitability | 0.007 | 0.009 | 0.100 | 0.162 | 0.360 |
| Size | 5.596 | 4.119 | 5.659 | 7.091 | 2.186 |
| Liability Ratio | 0.209 | 0.003 | 0.143 | 0.317 | 0.237 |
| Cash | 0.231 | 0.036 | 0.134 | 0.354 | 0.247 |
| Q | 2.508 | 1.316 | 1.780 | 2.695 | 2.512 |

Table 2: Pre-trend Tests

Panel A compares the year-over-year growth in the variables of interest between bound and unbound states from 2004 to 2006. Panel B compares the year-over-year growth in the variables of interest for firms located in bound and unbound states during the same period. Bound states are defined as those whose minimum wages were affected by the federal minimum wage hikes from 2007 to 2009 while unbound states are defined as those whose minimum wages were unaffected by the hikes. All variables are as defined in Table 1. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: State Characteristics

| | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|
| | Diff | T-stat | Diff | T-stat | Diff | T-stat |
| △State Employment (%) | -0.006 | -0.020 | 0.147 | 0.369 | 0.512 | 1.541 |
| △State GDP (%) | 0.318 | 0.466 | 0.851 | 0.905 | 1.185 | 1.425 |
| △State Personal Income (%) | -0.231 | -0.428 | 0.879 | 1.298 | 0.426 | 0.682 |
| △State Population (%) | 0.230 | 1.010 | 0.295 | 1.193 | 0.132 | 0.335 |
| △State Per Capita Personal Income (%) | -0.465 | -1.060 | 0.579 | 1.102 | 0.296 | 0.506 |

Panel B: Firm Characteristics

| | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|
| | Diff | T-stat | Diff | T-stat | Diff | T-stat |
| △Profitability (%) | -4.079 | -0.705 | 8.411 | 1.540 | -6.289 | -1.064 |
| △Size (%) | -2.486** | -2.133 | -0.349 | -0.313 | -0.454 | -0.419 |
| △Liability Ratio (%) | -15.802 | -1.077 | -18.915 | -1.253 | 5.503 | 0.362 |
| △Cash (%) | 27.196*** | 3.191 | 13.109 | 1.624 | 3.972 | 0.567 |
| △Q (%) | 3.659*** | 2.602 | 1.015 | 0.766 | -0.250 | -0.185 |

Table 3: Business Cycle Tests

This table compares the year-over-year changes in business cycles between bound and unbound states from 2004 to 2009. Business cycles are proxied by the State Leading Index, an index that predicts the six-month growth rate of the state's coincident index. Bound states are defined as those whose minimum wages were affected by the federal minimum wage hikes from 2007 to 2009 while unbound states are defined as those whose minimum wages were unaffected by the hikes. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | Bound States | Unbound States | Diff | T-stat |
|---|---|---|---|---|
| 2004 | -0.027 | -0.091 | 0.064* | 1.660 |
| 2005 | 0.018 | 0.030 | -0.012 | -0.273 |
| 2006 | -0.006 | -0.035 | 0.030 | 0.689 |
| 2007 | -0.064 | -0.074 | 0.010 | 0.243 |
| 2008 | -0.266 | -0.320 | 0.055 | 1.149 |
| 2009 | 0.277 | 0.380 | -0.102 | -1.578 |

Table 4: Minimum Wage and R&D Investment

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on R&D investment of firms located in bound states. The dependent variable is *R&D Investment*, which is defined as the ratio of research and development expense (*R&D*) of year *t* to property, plant, and equipment of year *t-1*. Dummy variable *Bound Firm* equals 1 for firms located in bound states and 0 for films located in unbound states. Dummy variable *After* equals 0 for the years 2004, 2005, and 2006 and equals 1 for the years 2007, 2008, and 2009. *State House Price Index* is an indicator of single-family house price trends of a state from the Federal Housing Finance Agency. All other variables are as defined in Table 1. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) |
|---|---|---|
| Bound Firm *After | 0.335*** | 0.280** |
| | (0.107) | (0.114) |
| Lag Profitability | | -0.086 |
| | | (0.398) |
| Lag Size | | -0.353*** |
| | | (0.110) |
| Lag Liability Ratio | | -0.059 |
| | | (0.424) |
| Lag Cash | | 3.599*** |
| | | (0.576) |
| Lag Q | | 0.165*** |
| | | (0.044) |
| Lag Ln (State Employment) | | -6.401 |
| | | (4.886) |
| Lag Ln (State GDP) | | 1.817 |
| | | (1.811) |
| Lag Ln (State Personal Income) | | -3,241.818 |
| | | (2,539.481) |
| Lag Ln (State Population) | | 3,242.466 |
| | | (2,538.869) |
| Lag Ln (State Personal Per Capita Income) | | 3,242.128 |
| | | (2,539.993) |
| Lag State House Price Index | | 0.006*** |
| | | (0.002) |
| Year FE | YES | YES |
| Firm FE | YES | YES |
| Observations | 19,739 | 18,156 |
| R-squared | 0.814 | 0.822 |

Table 5: Minimum Wage and Capital Expenditure

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on capital expenditure of firms located in bound states. The dependent variable is *Capital Expenditure*, which is defined as the ratio of capital expenditure of year *t* to property, plant, and equipment of year *t-1*. All other variables are as defined in Table 1 and Table 4. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) |
|---|---|---|
| Bound Firm *After | 0.031** | 0.011 |
| | (0.013) | (0.014) |
| Lag Profitability | | 0.276*** |
| | | (0.040) |
| Lag Size | | -0.092*** |
| | | (0.014) |
| Lag Liability Ratio | | -0.145*** |
| | | (0.044) |
| Lag Cash | | 0.578*** |
| | | (0.057) |
| Lag Q | | 0.037*** |
| | | (0.005) |
| Lag Ln (State Employment) | | 0.025 |
| | | (0.564) |
| Lag Ln (State GDP) | | -0.072 |
| | | (0.220) |
| Lag Ln (State Personal Income) | | -343.441 |
| | | (389.626) |
| Lag Ln (State Population) | | 343.398 |
| | | (389.647) |
| Lag Ln (State Personal Per Capita Income) | | 343.506 |
| | | (389.651) |
| Lag State House Price Index | | 0.000 |
| | | (0.000) |
| Year FE | YES | YES |
| Firm FE | YES | YES |
| Observations | 19,695 | 18,117 |
| R-squared | 0.423 | 0.457 |

Table 6: Minimum Wage and Employment

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on the employment of firms located in bound states. The dependent variable is *Employment*, which is defined as the ratio of the number of employees (in thousands) to total assets (in billions). All other variables are as defined in Tables 1 and 4. The sample period starts in 2004 and ends in 2009. All control variables are lagged by 1 year. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) |
|---|---|---|
| Bound Firm *After | -0.291** | -0.251** |
| | (0.124) | (0.127) |
| Lag Profitability | | -0.076** |
| | | (0.037) |
| Lag Size | | -0.131*** |
| | | (0.014) |
| Lag Liability Ratio | | 0.125** |
| | | (0.050) |
| Lag Cash | | -0.120** |
| | | (0.052) |
| Lag Q | | -0.010* |
| | | (0.005) |
| Lag Ln (State Employment) | | 0.857 |
| | | (0.589) |
| Lag Ln (State GDP) | | 0.206 |
| | | (0.213) |
| Lag Ln (State Personal Income) | | -744.468** |
| | | (340.119) |
| Lag Ln (State Population) | | 743.428** |
| | | (340.138) |
| Lag Ln (State Personal Per Capita Income) | | 744.338** |
| | | (340.134) |
| Lag State House Price Index | | -0.000* |
| | | (0.000) |
| Year FE | YES | YES |
| Firm FE | YES | YES |
| Observations | 19,492 | 17,956 |
| R-squared | 0.924 | 0.928 |

Table 7: Minimum Wage and Productivity

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on the productivity of firms located in bound states. The dependent variable *Productivity*, which is defined as the ratio of sales (in millions) to the total number of employees (in thousands). All other variables are as defined in Tables 1 and 4. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) |
|---|---|---|
| Bound Firm *After | 19.876*** | 24.818*** |
| | (6.707) | (7.595) |
| Lag Profitability | | 42.303** |
| | | (18.986) |
| Lag Size | | 31.683*** |
| | | (8.945) |
| Lag Liability Ratio | | 2.459 |
| | | (19.597) |
| Lag Cash | | -76.093*** |
| | | (19.628) |
| Lag Q | | 4.453*** |
| | | (1.580) |
| Lag Ln (State Employment) | | -382.465 |
| | | (362.052) |
| Lag Ln (State GDP) | | 405.865*** |
| | | (137.667) |
| Lag Ln (State Personal Income) | | -180,654.176 |
| | | (170,361.821) |
| Lag Ln (State Population) | | 180,528.488 |
| | | (170,295.018) |
| Lag Ln (State Personal Per Capita Income) | | 180,567.063 |
| | | (170,303.869) |
| Lag State House Price Index | | -0.261** |
| | | (0.104) |
| Year FE | YES | YES |
| Firm FE | YES | YES |
| Observations | 19,400 | 17,893 |
| R-squared | 0.901 | 0.898 |

Table 8: Trend in Firm R&D Investment Surrounding the Fair Minimum Wage Act of 2007

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on the R&D investment of firms located in bound states. The dependent variable is *R&D Investment*. Dummy variables *2004, 2005, 2007, 2008,* and *2009* equal 1 for the years 2004, 2005, 2007, 2008, and 2009, respectively, and 0 for all other years. All other variables are as defined in Tables 1 and 4. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) |
|---|---|---|
| Bound Firm*2004 | 0.003 | -0.062 |
| | (0.141) | (0.161) |
| Bound Firm*2005 | 0.126 | 0.007 |
| | (0.111) | (0.121) |
| Bound Firm*2007 | 0.198* | 0.182 |
| | (0.107) | (0.113) |
| Bound Firm*2008 | 0.376*** | 0.268* |
| | (0.137) | (0.140) |
| Bound Firm*2009 | 0.598*** | 0.381** |
| | (0.152) | (0.158) |
| Lag Profitability | | -0.087 |
| | | (0.398) |
| Lag Size | | -0.355*** |
| | | (0.111) |
| Lag Liability Ratio | | -0.060 |
| | | (0.424) |
| Lag Cash | | 3.594*** |
| | | (0.576) |
| Lag Q | | 0.164*** |
| | | (0.044) |
| Lag Ln (State Employment) | | -6.551 |
| | | (4.892) |
| Lag Ln (State GDP) | | 2.077 |
| | | (1.805) |
| Lag Ln (State Personal Income) | | -3,197.969 |
| | | (2,506.532) |
| Lag Ln (State Population) | | 3,198.341 |
| | | (2,505.820) |
| Lag Ln (State Personal Per Capita Income) | | 3,197.937 |
| | | (2,507.010) |
| Lag State House Price Index | | 0.005** |
| | | (0.002) |
| Year FE | YES | YES |
| Firm FE | YES | YES |
| Observations | 19,739 | 18,156 |
| R-squared | 0.814 | 0.822 |

Table 9: Minimum Wage and R&D Investment Based on a Distance Matching Sample

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on the R&D expense of firms located in bound states. The sample used is based on a distance matching method. A firm in the bound state is matched to a firm in the unbound state with the shortest distance and in the same industry. The dependent variable is *R&D Investment*. All variables are as defined in Tables 1 and 4. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | (1) | (2) |
|---|---|---|
| Bound Firm *After | 0.101** | 0.143*** |
| | (0.045) | (0.052) |
| Lag Profitability | | -0.482* |
| | | (0.287) |
| Lag Size | | -0.108 |
| | | (0.068) |
| Lag Liability Ratio | | 0.110 |
| | | (0.225) |
| Lag Cash | | 1.650*** |
| | | (0.424) |
| Lag Q | | 0.077** |
| | | (0.035) |
| Lag Ln (State Employment) | | -3.000 |
| | | (2.677) |
| Lag Ln (State GDP) | | 0.423 |
| | | (0.915) |
| Lag Ln (State Personal Income) | | -1,833.589 |
| | | (1,178.266) |
| Lag Ln (State Population) | | 1,834.632 |
| | | (1,177.907) |
| Lag Ln (State Personal Per Capita Income) | | 1,833.827 |
| | | (1,178.187) |
| Lag State House Price Index | | 0.002 |
| | | (0.002) |
| Year FE | YES | YES |
| Firm FE | YES | YES |
| Observations | 21,043 | 19,086 |
| R-squared | 0.870 | 0.877 |

Table 10: Labor Intensity and R&D Investment

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on the R&D expense of firms located in bound states. The dependent variable is *R&D Investment*. Firms are classified into labor-intensive firms and capital-intensive firms by using the median value of the property, plant, and equipment to number of employees ratio in year 2006. All variables are as defined in Tables 1 and 4. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | Labor-Intensive Firms | | Capital-Intensive Firms | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Bound Firm *After | 0.600*** | 0.537*** | 0.081 | 0.075 |
| | (0.186) | (0.203) | (0.107) | (0.112) |
| Lag Profitability | | -0.115 | | 0.257 |
| | | (0.532) | | (0.574) |
| Lag Size | | -0.540*** | | -0.233** |
| | | (0.183) | | (0.112) |
| Lag Liability Ratio | | -0.209 | | -0.179 |
| | | (0.711) | | (0.326) |
| Lag Cash | | 5.260*** | | 1.517*** |
| | | (0.874) | | (0.538) |
| Lag Q | | 0.187*** | | 0.084** |
| | | (0.058) | | (0.041) |
| Lag Ln (State Employment) | | -11.426 | | -3.589 |
| | | (9.643) | | (2.955) |
| Lag Ln (State GDP) | | 1.533 | | 2.545* |
| | | (3.654) | | (1.523) |
| Lag Ln (State Personal Income) | | -3,847.540 | | -3,340.673 |
| | | (4,556.137) | | (2,382.429) |
| Lag Ln (State Population) | | 3,851.718 | | 3,338.981 |
| | | (4,555.915) | | (2,381.605) |
| Lag Ln (State Personal Per Capita Income) | | 3,852.764 | | 3,337.595 |
| | | (4,557.353) | | (2,383.103) |
| Lag State House Price Index | | 0.006* | | 0.002 |
| | | (0.004) | | (0.002) |
| Year FE | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES |
| Observations | 9,337 | 8,671 | 9,418 | 8,617 |
| R-squared | 0.828 | 0.837 | 0.688 | 0.696 |

Table 11: Routine Task-Intensity and R&D Investment

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on the R&D expense of firms located in bound states. The dependent variable is *R&D Investment*. Firms are classified into firms operating in industries of high routine task-intensity (*RTI*) and firms operating in industries of low *RTI* by using the median value of *RTI* index of industries in year 2006. All variables are as defined in Tables 1 and 4. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | High RTI | | Low RTI | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Bound Firm *After | 0.416*** | 0.357** | 0.105 | 0.065 |
| | (0.135) | (0.142) | (0.149) | (0.165) |
| Lag Profitability | | -0.187 | | -0.0179 |
| | | (0.557) | | (0.126) |
| Lag Size | | -0.512*** | | -0.149 |
| | | (0.154) | | (0.130) |
| Lag Liability Ratio | | -0.420 | | 0.871* |
| | | (0.557) | | (0.463) |
| Lag Cash | | 4.467*** | | 1.733** |
| | | (0.745) | | (0.817) |
| Lag Q | | 0.185*** | | 0.128 |
| | | (0.054) | | (0.082) |
| Lag Ln (State Employment) | | -6.076 | | -9.299* |
| | | (6.275) | | (5.011) |
| Lag Ln (State GDP) | | 2.719 | | 1.071 |
| | | (2.514) | | (2.008) |
| Lag Ln (State Personal Income) | | -4,122.845 | | -1,211.421 |
| | | (3,370.006) | | (2,764.022) |
| Lag Ln (State Population) | | 4,121.658 | | 1,217.642 |
| | | (3,369.331) | | (2,763.285) |
| Lag Ln (State Personal Per Capita Income) | | 4,122.819 | | 1,213.667 |
| | | (3,370.845) | | (2,764.324) |
| Lag State House Price Index | | 0.006** | | 0.002 |
| | | (0.003) | | (0.003) |
| Year FE | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES |
| Observations | 14,397 | 13,217 | 5,149 | 4,757 |
| R-squared | 0.816 | 0.826 | 0.756 | 0.758 |

Table 12: Industry Pressure and R&D Investment

This table adopts an OLS regression and analyzes the impact of 2007–2009 federal minimum wage hikes on the R&D expense of firms located in bound states. The dependent variable is *R&D Investment*. Firms are classified based on whether they belong to industries with fewer assets located in bound states or industries with more assets located in bound states, using the median value of the percentage of assets located in bound states for all industries in the year 2006. All variables are as defined in Tables 1 and 4. All control variables are lagged by 1 year. The sample period starts in 2004 and ends in 2009. Standard errors are heteroskedastic-robust, clustered at the firm level, and presented in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

| | Industries Less Affected | | Industries More Affected | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Bound Firm *After | 0.297*** | 0.276** | 0.340* | 0.197 |
| | (0.106) | (0.120) | (0.200) | (0.206) |
| Lag Profitability | | -0.498 | | 0.201 |
| | | (0.603) | | (0.555) |
| Lag Size | | -0.649*** | | -0.294* |
| | | (0.137) | | (0.156) |
| Lag Liability Ratio | | 0.645 | | -0.631 |
| | | (0.568) | | (0.586) |
| Lag Cash | | 2.065*** | | 5.076*** |
| | | (0.679) | | (0.860) |
| Lag Q | | 0.189*** | | 0.117** |
| | | (0.058) | | (0.057) |
| Lag Ln (State Employment) | | -4.754 | | -6.141 |
| | | (4.719) | | (8.185) |
| Lag Ln (State GDP) | | 0.958 | | 2.492 |
| | | (1.688) | | (2.993) |
| Lag Ln (State Personal Income) | | -1,609.460 | | -4,902.866 |
| | | (2,416.462) | | (4,348.828) |
| Lag Ln (State Population) | | 1,611.391 | | 4,900.570 |
| | | (2,415.998) | | (4,348.335) |
| Lag Ln (State Personal Per Capita Income) | | 1,613.166 | | 4,899.493 |
| | | (2,416.756) | | (4,349.880) |
| Lag State House Price Index | | 0.003 | | 0.008** |
| | | (0.002) | | (0.003) |
| Year FE | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES |
| Observations | 9,824 | 8,968 | 9,865 | 9,137 |
| R-squared | 0.757 | 0.769 | 0.829 | 0.838 |