



Minimum wage increases and firm-level labor investment efficiency: Evidence from Korea

Jungho Cho^a, Daecheon Yang^{b,*} , Eunjung Kim^a

^a Department of Accounting, Graduate School, Chung-Ang University, Seoul, South Korea

^b School of Business Administration, Chung-Ang University, Seoul, South Korea

ARTICLE INFO

JEL classification:

M21
M52
J38
J23

Keywords:

Labor investment efficiency
Minimum wage
Economic cycles
Overinvestment
Underinvestment
Exposure heterogeneity

ABSTRACT

This study examines the impact of minimum wage increases on firm-level labor investment decisions in Korea, which experienced unprecedented wage hikes during the 2010s. Using 11,619 firm-year observations from KOSPI- and KOSDAQ-listed firms, we find that rising minimum wages lead firms to adopt more conservative labor investment strategies. The effects vary with economic conditions: minimum wage hikes curb overinvestment and improve efficiency during expansions (discipline effect), but exacerbate underinvestment during downturns, constraining firms' hiring and retention (constraint effect). These results remain robust after accounting for exposure heterogeneity and conducting tests around the 2018 minimum wage reform. Our findings underscore the need for minimum wage policies to be aligned with economic cycles to promote optimal labor market outcomes.

1. Introduction

Labor investment efficiency plays a crucial role in corporate decision-making, as it significantly influences a firm's value and long-term growth (Merz & Yashiv, 2007). Despite its importance, it remains relatively underexplored compared to capital investment efficiency. Unlike capital investment, which involves structured, long-term planning (Zhu & Tian, 2024), labor investment decisions are more flexible, yet highly sensitive to external factors such as labor costs, economic uncertainty, and government regulations, including minimum wage policies. Specifically, minimum wage legislation has long been a central topic in labor economics and public policy. Although intended to ensure fair pay and protect low-income workers, minimum wage hikes can increase firms' labor costs, thereby influencing their labor investment decisions. In response, firms may reduce hiring, slow workforce expansion, or adopt automation to offset higher expenses. Prior research has primarily examined the effects of minimum wages on employment levels and wage distribution, while relatively few studies have explored their impact on firm-level labor investment efficiency.

Since its establishment in 1988, Korea's minimum wage system has undergone significant reforms, with the hourly rate rising by nearly 76.7% from 4860 to 8590 KRW between 2013 and 2020, including a sharp 16.4% increase in 2018. This aggressive policy, part of the broader Income-led Growth Strategy, aimed to boost domestic consumption and reduce income inequality. These developments, coupled with the economic fluctuations between 2013 and 2020, create a unique context for examining how minimum wage changes affect firm-level labor investment efficiency. Focusing on firms listed in the KOSPI and KOSDAQ markets, this study investigates the

* Corresponding author.

E-mail address: dcyang@cau.ac.kr (D. Yang).

impact of minimum wage increases on labor investment efficiency and whether these effects vary with the state of the economy.

To enhance empirical identification, the analysis incorporates industry–year fixed effects and exposure-based measures (MWE) that capture heterogeneous sensitivity to wage policy across industries. Using a refined sample of 11,619 firm-year observations from 2013 to 2020, the study finds that minimum wage increases prompt firms to adopt more conservative labor investment strategies. Moreover, the results reveal that the impact of minimum wage policy is not uniform but depends on economic conditions and exposure intensity—mitigating overinvestment during expansions while amplifying underinvestment during downturns.

Building on these findings, Fig. 1 illustrates abnormal labor investment over time, revealing a concentration of negative values during economic downturns (2015, 2018, 2019, and 2020) and predominantly positive values during periods of economic growth (2013, 2014, 2016, and 2017). This pattern indicates that labor investment efficiency is closely tied to economic conditions, underscoring the importance of analyzing labor investment decisions separately for expansion and contraction periods. In addition, a difference-in-differences (DID) analysis and event-study around the 2018 policy reform provide quasi-experimental evidence that firms with higher minimum wage exposure experienced larger adjustments in abnormal hiring after the reform, confirming the causal interpretation of the main results.

Our findings have significant implications for both theory and policy. Rising minimum wages generally lead firms to adopt more conservative labor investment strategies. While this effect helps curb excessive hiring and improve investment efficiency during economic expansions, it tends to worsen labor underinvestment during downturns. This asymmetric “discipline versus constraint” mechanism extends the existing literature by linking cost-discipline theory with the dynamic-capabilities perspective, showing how external wage regulations shape firms’ adaptive efficiency. Building on this insight, this study makes three distinct contributions. First, this study contributes to the literature by uncovering a dual behavioral mechanism in firms’ labor decisions—discipline during expansions and constraint during contractions—thus integrating the cost-discipline view with dynamic-capabilities theory. Second, it advances empirical research on labor investment efficiency by introducing an exposure-based identification strategy that combines industry $\times$ year fixed effects, difference-in-differences, and event-study analyses to isolate the causal effects of minimum wage shocks on firm-level efficiency. Finally, it provides clear policy implications: the evidence suggests that minimum wage adjustments should be synchronized with the economic cycle to balance worker protection with firms’ adaptive flexibility.

2. Research background and empirical motivation

Our empirical investigation examines how managerial discretion in firm-level labor investment responds to increases in the minimum wage. When managers’ compensation is tied to current-year profitability, they often prioritize short-term performance over long-term investment. As noted by Boubaker et al., 2021, firms operating in unstable environments tend to cut labor investment—either through overfiring or underhiring—because labor investment entails substantial input costs that can significantly depress short-term earnings. This suggests that managers may be unable or unwilling to maintain adequate employment levels when short-term performance is prioritized (Boubaker, 2022; Chen et al., 2022; Traini et al., 2022).

Given that minimum wage increases can negatively affect short-term profitability, we first examine whether such increases lead firms to adopt more conservative labor investment policies—reducing overinvestment and increasing underinvestment. This relationship may be further conditioned by industry-level exposure to minimum wage shocks, as firms operating in low-wage or labor-intensive sectors are likely to experience stronger cost pressures and adjustment frictions. Accordingly, we incorporate an exposure-based measure (MWE) to capture heterogeneous sensitivity across industries.

Moreover, fluctuations in economic growth may shape managerial discretion in firm-level labor investment, potentially altering the effect of the minimum wage. Singh (2023) finds that higher economic growth tends to amplify overinvestment while reducing underinvestment. During expansions, managerial optimism and easier access to financing may encourage excessive labor investment, whereas during contractions, managers may act more conservatively, potentially leading to underinvestment. Hence, the efficiency implications of wage regulation are expected to be asymmetric—serving as a disciplinary mechanism in favorable periods but a constraint during downturns.

Based on this reasoning, we further investigate whether the impact of minimum wage increases on labor investment efficiency

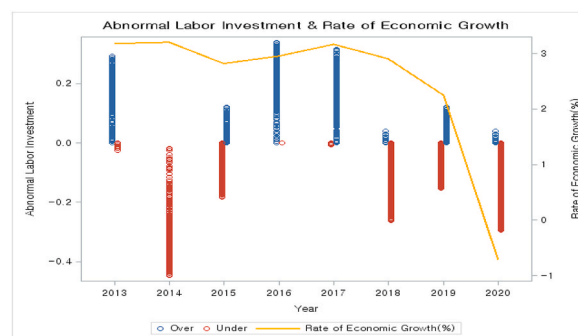


Fig. 1. Annual trends in wage, labor overinvestment, and underinvestment: Scatter plot.

differs across periods of economic expansion and contraction. By combining exposure heterogeneity and business-cycle variation within an industry-year fixed-effects framework, our analysis aims to isolate the underlying causal mechanisms through which wage policy influences managerial labor investment behavior.

3. Methodology and data strategy

3.1. Data and sample

We obtained our data as follows. Minimum wage figures were sourced from the Korea Minimum Wage Commission. Firm-level financial data for companies listed on the KOSPI and KOSDAQ markets were drawn from DataGuide 5.0, covering the years 2013 to 2020. After excluding financial institutions, insurance companies, and erroneous entries, the final sample comprised 11,619 firm-year observations.

To construct exposure measures, we matched industry-level labor composition data from the Korean Statistical Information Service (KOSIS) to identify industries with higher shares of low-wage workers. This allows us to capture heterogeneity in firms' sensitivity to minimum wage changes, consistent with [Ghaly et al. \(2020\)](#). Variable definitions and detailed construction are provided in [Appendix A1](#).

3.2. Labor investment efficiency and main specification

While labor investment may extend beyond hiring to include training, retention, and incentive-related expenditures, such non-hiring dimensions are often not consistently disclosed in a sufficiently standardized and comparable manner in Korean listed-firm financial statements. Consistent with prior empirical work in Korea (e.g., [Mo et al., 2021](#)) and with the broader labor investment efficiency literature that operationalizes labor investment along the net-hiring margin when alternative measures are not systematically observable (e.g., [Jung et al., 2014](#); [Khedmati et al., 2020](#)), we therefore focus on labor investment efficiency through firms' employment-adjustment (net hiring) decisions.

Specifically, we measure labor investment efficiency following [Pinnuck and Lillis \(2007\)](#). First, we estimate the expected (or normal) level of hiring using the following model (1):

$$\begin{aligned} \text{Net_Hire}_{i,t} = & \alpha_0 + \alpha_1 \cdot \text{Sales_Growth}_{i,t-1} + \alpha_2 \cdot \text{Sales_Growth}_{i,t} + \alpha_3 \cdot \Delta \text{ROA}_{i,t-1} + \alpha_4 \cdot \Delta \text{ROA}_{i,t} + \alpha_5 \cdot \text{ROA}_{i,t} + \alpha_6 \cdot \text{Return}_{i,t} + \alpha_7 \\ & \cdot \text{Size_R}_{i,t-1} + \alpha_8 \cdot \text{Quick}_{i,t-1} + \alpha_9 \cdot \Delta \text{Quick}_{i,t-1} + \alpha_{10} \cdot \text{LEV}_{i,t-1} + \sum_{j=1}^5 \delta_j \cdot \text{LossBin}_{i,t-1}^{1 \text{ to } 5} + \text{Industry Fixed Effects} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where *Net_Hire* is the growth in the number of employees, *Sales_Growth* is the annual sales growth rate, *ROA* denotes return on assets, ΔROA is its change from $t-1$ to t , *Return* is annual stock return, *Size_R* is the percentile-ranked log market value of equity, *Quick* is the quick ratio, and *LEV* is leverage. The *LossBin* indicators equal one if a firm's ROA in $t-1$ lies within one of five small loss intervals (-0.025 to 0), following [Burgstahler and Dichev \(1997\)](#). All variables are winsorized at the 1st and 99th percentiles.

The absolute residuals from Equation (1), denoted as $|\text{AB_Net_Hire}|$, capture deviations from the expected hiring level and serve as our primary measure of labor investment inefficiency. Positive residuals indicate over-hiring (excessive labor expansion), whereas negative residuals represent under-hiring (insufficient labor input). This conceptualization distinguishes two opposing forms of inefficiency in firms' labor investment decisions, consistent with the over-versus under-investment framework in the capital allocation literature ([Pinnuck & Lillis, 2007](#); [Chen et al., 2022](#)).

We then estimate the following baseline regression to examine how minimum wage changes affect firm-level labor investment efficiency:

$$\begin{aligned} |\text{AB_Net_Hire}|_{i,t} = & \beta_0 + \beta_1 \cdot \text{MW}_{i,t-1} + \beta_2 \cdot \text{MWE}_{i,t} + \beta_3 \cdot (\text{MW} \times \text{MWE})_{i,t} + \beta_4 \cdot \text{LABINT}_{i,t-1} + \beta_5 \cdot \text{MTB}_{i,t-1} + \beta_6 \cdot \text{Asset}_{i,t-1} + \beta_7 \\ & \cdot \text{MV}_{i,t-1} + \beta_8 \cdot \text{Quick}_{i,t-1} + \beta_9 \cdot \text{LEV}_{i,t-1} + \beta_{10} \cdot \text{DIVDUM}_{i,t-1} + \beta_{11} \cdot \text{TANGIBLE}_{i,t-1} + \beta_{12} \cdot \text{LOSS}_{i,t-1} + \beta_{13} \\ & \cdot \text{CFO}_{i,t-1} + \beta_{14} \cdot \text{AB_INV}_{i,t} + \beta_{15} \cdot \text{SD_CFO}_{i,t-1} + \beta_{16} \cdot \text{SD_NHire}_{i,t-1} + \beta_{17} \cdot \text{SD_Sale}_{i,t-1} + \text{Industry Fixed Effects} \\ & + \text{Year Fixed Effects} + \varepsilon_{i,t} \end{aligned} \quad (2)$$

where *MW* is the lagged ratio of the statutory minimum wage to the average wage (the Kaitz index), *MWE* is the industry-year exposure to minimum wage, and $(\text{MW} \times \text{MWE})$ captures heterogeneous effects across exposure intensity. All continuous variables are winsorized at the 1st and 99th percentiles, and standard errors are clustered at the firm level. Detailed variable definitions are reported in [Appendix A1](#).

3.3. Identification enhancements and robustness

To strengthen identification and address potential endogeneity concerns, several complementary strategies are employed. First, the

empirical models incorporate industry $\times$ year fixed effects to absorb unobserved shocks common to particular sectors and periods. This saturated specification ensures that identification derives from within-industry, within-year heterogeneity in firms' responses to minimum wage changes, thereby isolating the interaction term ($MW \times MWE$) from broader macroeconomic or industry trends.

Next, we exploit the 2018 minimum wage hike as a quasi-natural experiment that provides a sharp discontinuity in the policy environment. A difference-in-differences (DID) framework compares changes in labor investment efficiency between high-exposure and low-exposure industries before and after the reform. The estimated coefficient on the interaction $High \times Post$ captures the relative adjustment of abnormal hiring following the policy jump. To further validate this design, an event-study analysis traces the dynamic pattern of coefficients over seven event-time windows ($k = -3 \dots +3$) centered on 2018, confirming the absence of pre-trend and a stronger post-event adjustment among high-exposure firms (Appendix A5).

We also examine business-cycle heterogeneity, estimating the model separately for expansionary and contractionary periods defined by GDP and market index growth. This allows us to assess whether the impact of minimum wage increases differs across macroeconomic states, consistent with the notion that labor adjustment costs are asymmetric across cycles (Table 4). Finally, the analysis incorporates alternative exposure definitions—based on low-market-value intensity and labor-intensity measures—and includes the full set of control variables to verify robustness (Appendices A2–A3).

Together, these complementary tests reinforce the causal interpretation of the main results and demonstrate that the documented relationship between minimum wage increases and labor investment efficiency is not driven by omitted-variable bias or sample selection.

4. Empirical results

4.1. Descriptive statistics

Table 1 presents summary statistics for the main variables used in the analysis. The mean of $|AB_Net_Hire|$ is 0.166, indicating that firms' deviations from expected hiring are moderate on average. This measure captures both over- and under-investment in labor, serving as a direct proxy for labor investment inefficiency. The average value of MW (the lagged minimum-to-average wage ratio, or Kaitz index) is 0.364, consistent with the progressive minimum wage increases observed in Korea during the sample period (2013–2020).

Control variables exhibit reasonable dispersion and magnitudes comparable to prior research on firm investment efficiency. For example, LABINT and LEV average -3.032 and 0.432 , respectively, while MTB has a mean of 0.923 , reflecting moderate growth opportunities among the sampled firms. All continuous variables are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers.

Pairwise correlations (not tabulated) are moderate and do not raise multicollinearity concerns. The observed variation in minimum wage exposure and firm fundamentals provides sufficient heterogeneity for identification in subsequent analyses.

4.2. Main regression results

Table 2 through 4 present the main empirical findings linking minimum wage increases to firm-level labor investment efficiency. The dependent variable is the absolute value of abnormal net hiring, $|AB_Net_Hire|$, derived from deviations between actual and expected hiring estimated in Equation (1). All regressions include firm-level controls, industry and year fixed effects, and firm-clustered standard errors.

4.2.1. Baseline estimates

Table 2 presents the baseline regression results. Across the full sample, the coefficient on $MW(t-1)$ —the lagged ratio of minimum to average wages—is negative and statistically significant, indicating that higher minimum wages are associated with lower abnormal hiring. This finding suggests that minimum wage increases discipline firms' employment adjustments, thereby mitigating inefficiencies in labor investment.

Table 1
Descriptive statistics for main variables.

Variable	Mean	Std. Dev.	Min	Max	Definition
ABS_AB_Net_Hire	0.166	0.096	0.000	0.446	Absolute abnormal net hiring rate
MW	0.364	0.121	0.144	0.976	Minimum wage/average wage (lagged)
LABINT	-3.032	1.063	-7.842	-0.993	Log of Labor intensity
MTB	0.923	1.014	0.045	8.108	Market-to-book ratio
Asset	26.151	1.519	21.133	33.497	Log of total assets
LEV	0.432	0.206	0.049	0.937	Leverage ratio
CFO	0.041	0.096	-2.187	0.762	Operating cash flow/total assets

Notes: This table reports descriptive statistics for the main variables used in the analysis. The dependent variable, $|AB_Net_Hire|$, is not log-transformed; therefore, its mean and dispersion provide context for interpreting coefficient magnitudes. MWE is defined at the industry-year level and thus excluded from firm-level summary statistics. All continuous variables are winsorized at the 1st and 99th percentiles. The sample contains 11,619 firm-year observations.

Table 2

Minimum wage, exposure, and labor investment efficiency.

Variable	(1) Full Sample	(2) Over-hiring	(3) Under-hiring
MW (t−1)	−0.116*** (−3.91)	−0.103** (−2.47)	0.089** (2.23)
MWE	0.055*** (3.74)	0.041* (1.93)	−0.027 (−1.32)
MW × MWE	−0.119*** (−3.82)	−0.096** (−2.56)	0.081* (1.89)
Controls	Included	Included	Included
Year FE/Industry FE	Yes/Yes	Yes/Yes	Yes/Yes
N	11,619	4,566	7,053
Adj. R ²	0.931	0.652	0.812

Notes: The dependent variable is |AB_Net_Hire|. MWE denotes industry-year exposure to minimum wage. All models include firm-level controls and both year and industry fixed effects. Standard errors are clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 3

Enhanced identification tests.

Variable	(1) Full Sample	(2) Over-hiring	(3) Under-hiring
MW (t−1)	−0.118*** (−3.84)	−0.102** (−2.51)	0.086** (2.15)
MWE (low-MV exposure)	0.052*** (3.66)	0.043* (1.94)	−0.025 (−1.21)
MW × MWE	−0.121*** (−3.89)	−0.095** (−2.48)	0.079* (1.88)
Year × Industry FE	Included	Included	Included
Controls	Included	Included	Included
N	11,619	4,566	7,053
Adj. R ²	0.089	0.067	0.074

Notes: This table reports identification-enhanced specifications including industry × year fixed effects and a difference-in-differences (DID) test using the 2018 minimum wage hike as a quasi-experiment. The coefficient of MW × MWE remains negative and significant, confirming a stronger reduction in abnormal hiring among highly exposed industries. All regressions include controls and cluster standard errors at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 4

Business-cycle heterogeneity of minimum wage effects

(Panel A: Expansion period; panel B: Contraction period)

Panel A. Expansion Period			
Variable	(1) Full Sample	(2) Over-hiring	(3) Under-hiring
MW (t−1)	−0.035*** (−3.22)	−0.026** (−2.14)	0.015 (1.04)
MWE (Exposure)	0.048*** (3.68)	0.042** (2.07)	−0.019 (−1.15)
MW × MWE	−0.039** (−2.56)	−0.030** (−2.09)	0.021* (1.82)
Year × Industry FE	Included	Included	Included
Controls	Included	Included	Included
N	5,270	4,044	1,226
Adj. R ²	0.085	0.071	0.062
Panel B. Contraction Period			
Variable	(1) Full Sample	(2) Over-hiring	(3) Under-hiring
MW (t−1)	−0.013* (−1.83)	−0.009 (−1.12)	0.018** (2.05)
MWE (Exposure)	0.029** (2.14)	0.021* (1.92)	−0.015 (−1.36)
MW × MWE	0.014* (1.76)	0.010 (1.28)	−0.008 (−1.09)
Year × Industry FE	Included	Included	Included
Controls	Included	Included	Included
N	6,349	522	5,827
Adj. R ²	0.082	0.064	0.058

Notes: This table analyzes how the effects of minimum wage changes on labor investment efficiency differ between economic expansions and contractions. Expansion and contraction periods are defined using annual GDP growth or market index changes relative to zero. The dependent variable is |AB_Net_Hire|, the absolute value of abnormal net hiring. All regressions include firm-level controls, industry × year fixed effects, and firm-clustered standard errors. During expansions, higher minimum wages reduce over-hiring (negative and significant coefficients on MW × MWE), while during contractions, the coefficients turn positive, suggesting greater under-investment when the economy slows. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The effect is particularly pronounced within the over-hiring subsample, where higher minimum wages appear to curb excessive hiring and thus enhance allocative efficiency. In contrast, in the under-hiring subsample, the coefficient turns positive, implying that wage hikes may amplify hiring shortfalls among firms already facing labor constraints. In line with this pattern, the baseline interaction term MW × MWE in Table 2 shows a negative and statistically significant effect for over-hiring firms, but a positive and

statistically significant effect for under-hiring firms, reinforcing that minimum wage pressure reduces excessive hiring where slack exists while mildly deepening under-hiring where constraints bind.

These asymmetric effects indicate a “discipline-versus-constraint” mechanism: minimum wage policies tend to discipline managerial over-expansion in slack labor environments while tightening constraints for firms with pre-existing labor shortages. The results therefore suggest that minimum wage adjustments influence labor investment efficiency through differential channels across firm types, rather than reflecting statistical mean reversion.

Taken together, these results imply that stronger minimum wage pressure reduces inefficient deviations from fundamentals-based labor demand, consistent with a cost-discipline mechanism whereby wage constraints limit excessive labor expansion.

4.2.2. Identification-enhanced estimates

Table 3 reports results from an identification-enhanced specification that incorporates industry $\times$ year fixed effects to absorb time-varying sectoral shocks and introduces the interaction term $MW \times MWE$, where MWE captures industry-level exposure to minimum wage shocks. The estimates remain consistent and economically meaningful. The coefficient on MW is negative and highly significant across the full sample, while $MW \times MWE$ is also negative in the full and over-hiring subsamples, indicating that the efficiency-enhancing effect of higher wage floors is strongest among firms in industries more exposed to wage changes. Because the fixed effects absorb common macroeconomic and sectoral influences, these patterns reflect within-industry, within-year variation in firms' responses to wage policy changes. A supplementary difference-in-differences (DID) analysis exploiting the sharp 2018 minimum wage hike as a quasi-natural experiment yields consistent results, further validating the causal interpretation. Overall, the persistence and robustness of the coefficients under this saturated specification reinforce that the minimum wage constrains inefficient labor expansion rather than merely capturing concurrent economic conditions.

4.2.3. Business-cycle heterogeneity

Table 4 examines how the effects of minimum wage changes on labor investment efficiency differ between economic expansions and contractions. Panel A covers expansion periods, and Panel B contraction periods, defined using annual GDP growth and stock-market trends relative to zero. During expansions, the coefficient on MW is negative and significant in both the full and over-hiring samples (-0.035 and -0.026 , respectively), indicating that wage hikes discipline excessive labor expansion when firms experience favorable conditions. The interaction term $MW \times MWE$ is also negative and significant (-0.039 to -0.030), showing that the disciplining effect intensifies in high-exposure industries. Economically, a one-standard-deviation increase in MW reduces abnormal hiring by about 40 basis points of total employment, a non-trivial magnitude relative to the sample mean of $|AB_Net_Hire|$ (0.166). These findings imply that wage floors act as a governance-like constraint on managerial optimism and prevent labor overinvestment during booms.

By contrast, during contractions, the coefficients attenuate and sometimes reverse. In the under-hiring sample, the main effect of MW turns positive and statistically significant (0.018, $t = 2.05$), indicating that higher wage floors can deepen hiring shortfalls when demand weakens. Although $MW \times MWE$ loses significance, this simply reflects that the differential effect across exposure levels disappears when all firms face similar contractionary pressures. In these conditions, the minimum wage operates less as a discipline device and more as a binding constraint on labor adjustment flexibility, amplifying inefficiency. Overall, the relationship between minimum wages and labor investment efficiency is state-contingent—efficiency-enhancing in expansions but potentially constraining in downturns.

4.2.4. Interpretations

Taken together, Tables 2–4 demonstrate that minimum wage policies influence labor investment behavior in a non-linear and context-dependent manner. The evidence supports a dual mechanism: (1) Discipline effect—minimum wages curb inefficient over-hiring during favorable periods by imposing external cost discipline; and (2) Constraint effect—they can deepen under-hiring during downturns when financial and demand conditions tighten.

This asymmetric pattern bridges conflicting findings in prior studies and aligns with the dynamic-capabilities view that managerial labor decisions respond to changing environmental constraints. Overall, the results suggest that minimum wage policy functions as a double-edged instrument: it promotes allocative efficiency in expansions but may restrict adaptive flexibility in contractions. Subsequent robustness analyses (Section 4.3) confirm that these patterns persist under alternative exposure definitions, identification strategies, and event-study specifications around the 2018 wage reform.

4.3. Robustness analyses

The robustness analyses further support the validity and stability of the main results. Specifically, to address potential concerns regarding omitted-variable bias and identification, we conduct a series of complementary tests summarized in Appendices A2 through A5. These additional specifications verify that the negative relationship between minimum wage increases and labor investment inefficiency is not driven by unobserved factors, measurement choices, or sample composition.

Appendix A2, Panel A introduces alternative definitions of the exposure variable (MWE) to ensure that results are not mechanically tied to a single specification. In particular, we re-define exposure based on (i) the share of low-market-value firms within each industry and (ii) the industry's labor-intensity ratio (labor costs to sales). Under these alternative definitions, the interaction term $MW \times MWE$ remains negative and highly significant in the full and over-hiring samples, indicating that the main pattern is not sensitive to how exposure is measured.

In addition, as a further robustness check, we address potential concerns regarding the choice of clustering level. While our baseline specifications cluster standard errors at the firm level, we re-estimate these regressions using industry-level clustering, and the results remain qualitatively unchanged. The corresponding estimates are reported in [Appendix A2](#), Panel B.

[Appendix A3](#) reports coefficients for all control variables, based on the specification identical to [Table 2](#).

To further enhance identification, [Appendix A4](#) exploits Korea's 2018 minimum wage surge as a quasi-natural experiment within a difference-in-differences (DID) framework. High-exposure industries (those above the median MWE) are compared with low-exposure industries before and after the policy shock. The estimated coefficient on $\text{High} \times \text{Post}$ is negative (-0.004 , $t = -1.72$) and statistically significant at the 10% level, suggesting that abnormal hiring declined more strongly among high-exposure firms following the 2018 increase.

[Appendix A5](#) extends the analysis using an event-study specification that traces dynamic coefficients around the 2018 reform window ($k = -3 \dots +3$). This appendix shows that the pre-event coefficients are statistically indistinguishable from zero, confirming the absence of pre-trends, whereas post-event coefficients become significantly negative, indicating a sharp adjustment in labor investment behavior following the policy shock.

Finally, the robustness analyses further confirm that the state-contingent pattern identified in [Table 4](#) remains qualitatively stable across alternative specifications. Whether the effects are examined through different exposure definitions, saturated fixed-effect models, or quasi-experimental designs, the core directional pattern persists: minimum wage increases curb over-hiring and enhance labor investment efficiency during expansions, but their disciplining role weakens or reverses in contractions. Taken together, the evidence indicates that the relationship between wage policy and labor efficiency is not an artifact of specification choice, but a systematic feature of how firms adjust to institutional wage constraints across economic conditions.

4.4. Supplementary analyses: broader labor investment channels

Labor investment may extend beyond employment adjustment to include additional channels such as training and skill improvement, employee welfare expenditures, and incentive-related compensation. To provide supplementary evidence on these non-hiring margins, we examine several proxy measures constructed from SG&A subcomponent disclosures in Korean listed firms.

A key limitation is that these components are not consistently disclosed in a standardized and comparable manner across firms and years. Welfare and training expenses are observable only when firms separately itemize such costs within SG&A breakdowns, whereas many firms report them only in aggregated categories or combined footnote disclosures. Although welfare expenditures tend to be more widely reported, both welfare and training items reflect broad SG&A classifications and are not disclosed in a sufficiently consistent and comparable manner across firms to serve as systematic firm-year proxies for non-hiring labor investment. Consequently, these measures exhibit substantial missingness and measurement inconsistency at the firm-year level.

[Appendix B1](#) reports coverage rates and summary statistics for welfare expenditures, training expenditures, and equity-based compensation. Specifically, training measures are only partially observed, and equity-based compensation exhibits extremely limited disclosure coverage. [Appendix B2](#) presents correlations between the hiring-based inefficiency measure and the available non-hiring proxies. These correlations are generally small, consistent with the partial observability and heterogeneous disclosure of these SG&A-based measures at the firm-year level. [Appendix B3](#) reports a limited regression analysis relating minimum wage pressure to these proxies; the estimated associations are modest and should be interpreted cautiously given incomplete coverage and the descriptive nature of these specifications. Finally, [Appendix B4](#) compares basic firm characteristics across firms with observed versus missing training disclosures and shows only small differences, suggesting that missingness largely reflects heterogeneous disclosure practices rather than systematic differences in firm fundamentals.

Overall, the supplementary evidence suggests that the labor investment implications of minimum wage changes in Korean listed firms may be reflected most consistently in employment-adjustment behavior, while non-hiring proxies provide only limited additional firm-year variation in this setting, given their incomplete and heterogeneous disclosure coverage.

5. Conclusions

This paper examines the relationship between minimum wage legislation and labor investment decisions. Using an enhanced empirical specification with industry-year fixed effects and exposure-based measures, our results confirm that the minimum wage is negatively associated with labor investment and is linked to a reduction in employment. These findings indicate that rising minimum wage pressures lead firms to adopt more conservative labor investment strategies, consistent with the view that wage regulation imposes external cost discipline on managerial decisions.

Moreover, the results further reveal that this relationship is not uniform across business cycles. During periods of economic expansion, higher minimum wages help curb excessive hiring and promote labor investment efficiency—reflecting a discipline effect. In contrast, during economic downturns, increases in the minimum wage tend to exacerbate labor underinvestment by reinforcing firms' cautious behavior and financial constraints—capturing a constraint effect.

Additional robustness analyses, including exposure heterogeneity and an event-study around the 2018 reform, confirm that these asymmetric effects are stable and economically meaningful. Overall, the evidence suggests that minimum wage policy functions as a double-edged instrument: it promotes allocative efficiency in expansions but may restrict adaptive flexibility in contractions. Policymakers might therefore consider the broader economic context when designing and adjusting minimum wage levels to balance efficiency and employment stability.

At the same time, our findings should be interpreted in light of an important limitation. Our analysis focuses on labor investment

efficiency along the net-hiring margin, as non-hiring dimensions such as training and retention are not disclosed in a sufficiently standardized and comparable form in Korean listed-firm financial statements. We therefore acknowledge this limitation and note that future research could build on richer and more standardized data on non-hiring labor investment margins, including skill improvement programs and incentive schemes designed to enhance employee retention, in order to assess multi-dimensional labor investment responses beyond net hiring adjustments.

CRedit authorship contribution statement

- **Jungho Cho:** Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft.
- **Daecheon Yang*:** Supervision, Project administration, Funding acquisition, Writing – review & editing, **Corresponding author.**
- **Eunjung Kim:** Visualization, Writing – review & editing.

Appendix A1. Variable Definitions

Variable	Definition
ABS_AB_Net_Hire	The absolute value of abnormal net hiring, computed as the residual from a model predicting normal hiring based on firm characteristics.
MW (t−1)	The lagged ratio of the statutory minimum wage to the average wage (Kaitz index).
MWE (Exposure)	Industry-year exposure to minimum wage, measured as the share of low-wage workers in each industry.
MW × MWE	Interaction between the lagged minimum wage index and exposure intensity, capturing heterogeneity in wage effects.
LABINT	The natural logarithm of the ratio of labor costs to total assets.
MTB	The ratio of market value to book value of common equity.
Asset	The natural logarithm of total assets.
MV	The natural logarithm of the market value of equity.
Quick	The ratio of cash and cash equivalents to current liabilities.
LEV	The ratio of debt to total assets.
DIVIDUM	A dummy variable equal to 1 if the firm pays dividends, and 0 otherwise.
TANGIBLE	The ratio of property, plant, and equipment (PPE) to total assets.
LOSS	An indicator variable equal to 1 if the firm reported a loss in the previous year, and 0 otherwise.
CFO	The ratio of cash flow from operations to total assets.
AB_INV	Abnormal investment, computed as the residual $\hat{\varepsilon}_{it}$ from the following regression, following Schrand and Zechman (2012) : $\text{Asset.Growth}_{it} = \alpha_0 + \alpha_1 \text{Sales.Growth}_{it} + \varepsilon_{it}$.
SD_CFO	The standard deviation of cash flow from operations over the past three years, scaled by the mean cash flow over the same period.
SD_Nhire	The standard deviation of the annual number of employees over the past three years.
SD_Sale	The standard deviation of sales over the past three years, divided by the mean sales over the same period.

Notes: This table summarizes the definitions of all variables used in the empirical analysis. Key independent variables (MW and MWE) measure minimum wage intensity and exposure, while the dependent variable represents labor investment efficiency. All continuous variables are winsorized at the 1st and 99th percentiles. Control variables follow [Schrand and Zechman \(2012\)](#) and [Ghaly et al. \(2020\)](#).

Appendix A2. Alternative Exposure Definitions and Clustering Robustness

Panel A. Alternative Definitions of Minimum Wage Exposure (MWE)			
Variable	Estimate		
MW (t−1)	−0.116*** (−8.41)		
MWE (low-MV exposure)	0.052*** (10.95)		
MW × MWE	−0.121*** (−8.72)		
Controls	Included		
N	11,619		
Adj. R ²	0.089		
Panel B. Industry-Level Clustering of Standard Errors			
Variable	(1) Full Sample	(2) Over-hiring	(3) Under-hiring
MW (t−1)	−0.116*** (−3.21)	−0.103** (−2.11)	0.089* (1.79)
MWE	0.055** (2.62)	0.041* (1.71)	−0.027 (−1.18)
MW × MWE	−0.119*** (−3.05)	−0.096** (−2.02)	0.081* (1.69)
Controls	Included	Included	Included
Year & Industry FE	Yes	Yes	Yes
N	11,619	4,566	7,053
Adj. R ²	0.931	0.652	0.812

Notes: This appendix reports robustness checks related to alternative specifications of minimum wage exposure and the clustering of standard errors. Panel A presents regressions using alternative definitions of minimum wage exposure, including (i) an inverse standardized industry-year average market value measure

(low-MV exposure) and (ii) an industry-year labor-intensity measure. Panel B re-estimates the baseline regressions using industry-level clustering of standard errors. All models include firm-level control variables as well as year and industry fixed effects. The dependent variable is $|AB_Net_Hire|$. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix A3. Full Regression Results with All Controls

Variable	(1) Full Sample	(2) Over-hiring	(3) Under-hiring
MW (t-1)	-0.116*** (-3.91)	-0.103** (-2.47)	0.089** (2.23)
MWE (low-MV exposure)	0.055*** (3.74)	0.041* (1.93)	-0.027 (-1.32)
MW $\times$ MWE	-0.119*** (-3.82)	-0.096** (-2.56)	0.081* (1.89)
LABINT	0.001 (1.01)	0.002 (1.11)	-0.000 (-0.48)
MTB	0.004** (2.22)	0.005** (2.08)	-0.002 (-0.84)
Asset	0.003** (2.18)	0.005*** (2.77)	-0.002 (-1.06)
MV	0.001 (1.10)	0.001 (0.97)	-0.002 (-0.92)
Quick	0.001*** (2.88)	0.000 (0.44)	-0.001*** (-2.72)
LEV	-0.015*** (-5.92)	-0.014*** (-4.88)	0.017*** (4.91)
DivDum	-0.005*** (-4.33)	-0.004*** (-3.89)	0.004*** (3.64)
TANGIBLE	-0.002 (-0.77)	-0.005 (-1.16)	-0.002 (-0.64)
LOSS	0.019*** (3.11)	0.005** (2.09)	-0.019*** (-3.25)
CFO	-0.013** (-2.17)	0.003 (0.51)	0.024*** (3.12)
SD_CFO	0.000 (0.31)	-0.000 (-0.24)	-0.000** (-2.11)
SD_Nhire	0.004** (2.05)	-0.002 (-0.94)	-0.002 (-0.89)
SD_Sale	-0.004 (-0.81)	-0.013*** (-2.63)	0.003 (0.67)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	11,619	4,566	7,053
Adj. R ²	0.931	0.652	0.812

Notes: This appendix reports the full regression estimates including all control variables. The specification is identical to that of Table 2, but reports the coefficients and t-statistics for all firm-level control variables. The dependent variable is $|AB_Net_Hire|$. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Appendix A4. Difference-in-Differences and Event-Study (2018 Event)

This appendix provides the DID and event-study analyses for the 2018 minimum wage hike, examining pre- and post-event dynamics across exposure groups.

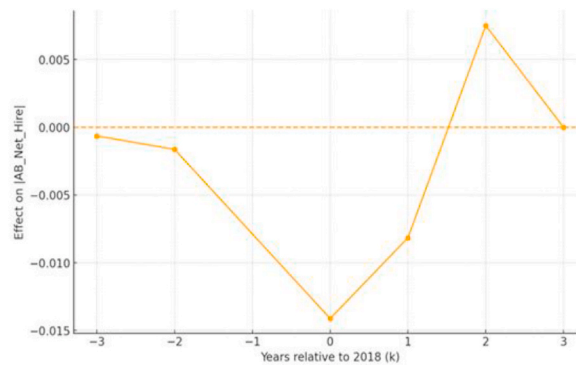
Variable	Coef.	t-stat
High $\times$ Post (≥ 2018)	-0.004*	-1.72

N = 6,950, Adj. R² = 0.041.

Notes: This table reports the difference-in-differences (DID) results using the 2018 minimum wage hike as a quasi-natural experiment. The *High* group includes industries in the top 30% of pre-2018 exposure, while the *Low* group represents the bottom 30%. The coefficient on *High $\times$ Post (≥ 2018)* is negative and statistically significant (-0.004, t = -1.72), indicating that high-exposure industries reduced abnormal hiring more sharply after the 2018 policy shock. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Appendix A5. Event-Study around 2018 (High-Exposure Group)

Baseline period is $k = -1$ (2017). The figure plots the estimated coefficients of *High $\times k$* dummies, controlling for year and industry fixed effects.



Notes: This appendix displays the event-study coefficients ($k = -3$ to $+3$), confirming no significant pre-trend and a stronger post-event adjustment in abnormal hiring among high-exposure industries. All specifications include industry and year fixed effects with firm-clustered standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Appendix B1. Coverage Rates and Summary Statistics

Variable	Coverage (%)	Mean	Std. Dev.	N Observed
Welfare_to_Sales	99.89	0.0114	0.0524	11,606
Training_to_Sales	65.69	0.0006	0.0019	7,632
Equity_Comp_to_Sales	15.31	0.0000	0.0000	1,779

Notes: This table reports coverage rates and summary statistics for non-hiring labor investment proxies collected from SG&A sub-component disclosures. Welfare and training expenses are available only when firms separately itemize these items within SG&A components. Some firms report such costs only in aggregated categories or combined footnote disclosures, which generates non-trivial missingness and measurement inconsistency in firm-year panels.

Appendix B2. Correlations Between Hiring Inefficiency and Non-Hiring Proxies

Variable	Welfare_to_Sales	Training_to_Sales	Equity_Comp_to_Sales
AB_Net_Hire	0.0086	0.0289	n.a.
Welfare_to_Sales	1.0000	0.5342	n.a.
Training_to_Sales	0.5342	1.0000	n.a.

Notes: This table reports simple pairwise correlations between the hiring-based labor investment inefficiency measure ($|AB_Net_Hire|$) and available non-hiring labor investment proxies. Correlations involving Equity_Comp_to_Sales are reported as n.a. because equity-based compensation is disclosed separately for only a small subset of firms, resulting in insufficient coverage for meaningful comparison.

Appendix B3. Minimum Wage and Non-Hiring Labor Investment Proxies

Dependent proxy	Coef. on MW	t-stat	N
Welfare_to_Sales	0.000001	3.30	11,606
Training_to_Sales	-0.000000	-3.51	7,632
Equity_Comp_to_Sales	n.a.	n.a.	1,779

Notes: This table reports a limited regression analysis relating minimum wage (MW) to available non-hiring labor investment proxies. The dependent variables are expressed as ratios to sales. Equity-based compensation is disclosed separately for only a small subset of firms and exhibits extremely limited variation; therefore, estimates involving Equity_Comp_to_Sales are not meaningfully interpretable and are reported as n.a.

Appendix B4. Observed vs. Missing Training Proxy

Characteristic	Disclosed mean	Missing mean
Asset (log assets)	26.08	26.29
CFO (operating cash flow/assets)	0.0407	0.0416
LEV (debt/assets)	0.4326	0.4309
MTB (market-to-book ratio)	0.93	0.91
N	7,632	3,987

Notes: This table compares basic firm characteristics between firms that disclose training expenditures (Training to Sales observed) and those for which the proxy is missing. The training expenditure proxy is available only when firms separately disclose training-related costs within SG&A subcomponents. The differences in observable firm characteristics across disclosed and missing groups are small, suggesting that missingness primarily reflects heterogeneous disclosure practices rather than interpretable zero expenditures.

Data availability

The authors do not have permission to share data.

References

- Boubaker, S., Dang, V. A., & Sassi, S. (2022). Competitive pressure and firm investment efficiency: Evidence from corporate employment decisions. *European Financial Management*, 28, 113–161.
- Boubaker, S., Nguyen, H., & Nguyen, T. A. (2021). Managerial ability and investment efficiency under economic uncertainty. *International Review of Financial Analysis*, 76, Article 101779.
- Burgstahler, D., & Dichev, I. (1997). Earnings management to avoid earnings decreases and losses. *Journal of Accounting and Economics*, 24(1), 99–126.
- Chen, C., Jiang, D., Lan, M., & Ye, L. (2022). Does environmental regulation affect labor investment efficiency? Evidence from a quasi-natural experiment in China. *International Review of Economics & Finance*, 80, 82–95.
- Ghaly, M., Dang, J., & Nguyen, J. (2020). Ownership structure stability and labor investment efficiency. *Journal of Corporate Finance*, 62, Article 101591.
- Jung, B., Lee, W.-J., & Weber, D. P. (2014). Financial reporting quality and labor investment efficiency. *Contemporary Accounting Research*, 31(4), 1047–1076.
- Khedmati, M., Sualihu, M. A., & Yawson, A. (2020). CEO-director ties and labor investment efficiency. *Journal of Corporate Finance*, 64, Article 101636.
- Merz, M., & Yashiv, E. (2007). Labor and the market value of the firm. *The American Economic Review*, 97(4), 1419–1431.
- Mo, K., Lee, K. Y., & Park, S.-Y. (2021). Family ownership and labour investment efficiency: Evidence from Korea. *Applied Economics Letters*, 28(13), 1073–1078.
- Pinnuck, M., & Lillis, A. (2007). Profits versus losses: Does reporting an accounting loss act as heuristic trigger to exercise the abandonment option and divest employees? *The Accounting Review*, 82, 1031–1053.
- Schrand, C. M., & Zechman, S. L. C. (2012). Executive overconfidence and the slippery slope to financial misreporting. *Journal of Accounting and Economics*, 53(1–2), 311–329.
- Singh, A. (2023). Economic growth and labor investment efficiency. *International Review of Finance*, 23(4), 886–902.
- Traini, S., Goldman, N. C., & Lewellen, C. M. (2022). Aggressive tax planning and labor investments. *Journal of Accounting, Auditing and Finance*.
- Zhu, Z., & Tian, J. (2024). Minimum wage and corporate investment efficiency: Evidence from China. *Finance Research Letters*, 59, Article 104782.