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## Article

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# Do analysts underreact to pension underfunding? Evidence from forecast bias and funding ratios of DB plans in Korea

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## Abstract

This study aims to empirically investigate the relationship between the funding status of defined benefit (DB) pension plans and the forecast bias of financial analysts. While prior research has documented the impact of pension underfunding on firm performance, investment efficiency and firm value, relatively little attention has been paid to how this information is reflected in analysts' forecasts. This paper seeks to fill that gap by examining whether financial analysts systematically underreact to the risks associated with underfunded pension obligations. The study focuses on the pension funding ratio (PFR), defined as the difference between plan assets and projected benefit obligations (PBO), scaled by market capitalization. A lower PFR indicates greater underfunding. Using a comprehensive sample of listed firms in Korea from 2011 to 2022, during which consolidated financial statements under K-IFRS became mandatory, the analysis evaluates the sensitivity of analysts' forecasts to underfunding risks across performance categories. Forecast bias is measured across multiple dimensions, including sales, earnings, cash flow and capital expenditures. The central hypothesis is that analysts issue more optimistic performance forecasts for firms with lower PFRs due to the complexity of pension accounting and the limited transparency of related disclosures. Empirical evidence supports this hypothesis, showing that analysts systematically underreact to underfunding risks when forming forecasts. By highlighting the informational role of pension funding status in analyst forecasts, this study contributes to the literature on financial disclosure, information asymmetry and market efficiency. It also offers policy implications for improving pension-related transparency and guiding more informed forecasting practices in capital markets.

**Keywords** Information asymmetry, Financial analysts, Forecast bias, Defined benefit pension plan, Funding ratio

**Paper type** Research article

## 1. Introduction

In accordance with the Act on the Guarantee of Employees' Retirement Benefits, Korea introduced the retirement pension system in 2005. As of the end of 2024, the total accumulated retirement pension assets reached KRW 431.7 trillion, marking a 12.9% increase from the previous year (Ministry of Employment and Labor and Financial Supervisory Service, 2024). Among these, defined benefit (DB) plans accounted for 49.8%, defined contribution (DC) plans for 27.4%, and individual retirement pensions (IRPs) for 22.9%. Despite the steady growth of DC and IRP accounts, DB-type plans continue to represent the largest share of the market. Employers that offer DB pension plans are legally required to pre-fund the retirement benefits through external funding vehicles to protect employee entitlements.

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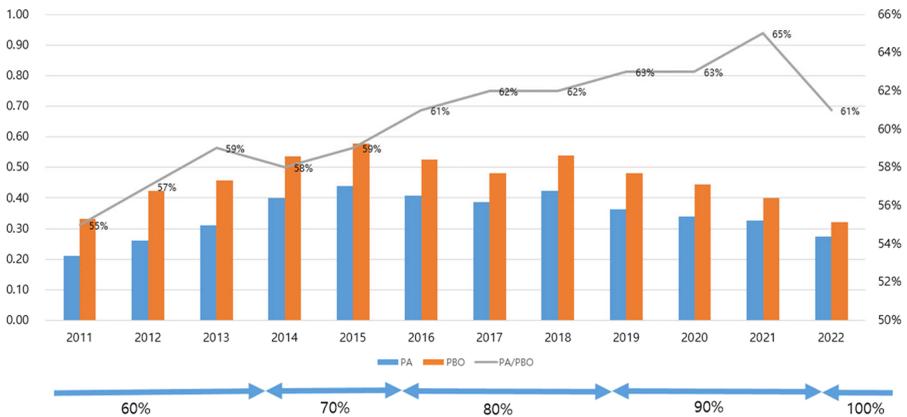
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Since the adoption of the International Financial Reporting Standards (IFRS) in 2011, Korean listed firms have been required to report net defined benefit liabilities by deducting plan assets from pension obligations. As of the end of 2022, the net DB obligation for listed firms amounted to approximately KRW 95 trillion [1]. This figure implies that firms would need to contribute this amount in cash to fully fund their retirement pension liabilities. To provide a visual overview of the pension funding landscape in Korea, Figure 1 presents the aggregate trends in pension assets (PA), projected benefit obligations (PBO), and the funding ratio (PA/PBO) from 2011 to 2022. Statutory minimum funding levels under the Retirement Benefit Security Act are also shown for reference.

One of the key reasons for the severe level of underfunding is the low rate of return on DB pension assets. As of 2024, 93.2% of DB pension assets were invested in principal-guaranteed products such as time deposits, and the 10-year annualized return was only 2.31% (Ministry of Employment and Labor and Financial Supervisory Service, 2024). Another structural reason is the weak enforcement of funding requirements. Under the Act, employers are required to submit a funding recovery plan if, as of the actuarial valuation date, the amount of pension assets falls below 100% of the legally mandated minimum funding level. However, there are no strong penalties for noncompliance, and the timing and amount of contributions to address the funding shortfall are left to the discretion of the firm [2]. This lack of enforcement makes it difficult for market participants to properly assess the impact of pension underfunding on a firm's future value [3]. These institutional features—combined with the relatively weak enforcement mechanisms and limited analyst attention to footnote-level disclosures—make Korea an ideal setting to examine how underfunded DB pensions affect analyst behavior and whether such risks are systematically underweighted in forecasts.

Korea presents a unique institutional setting for studying the relationship between pension funding and analyst forecast behavior. Although DB funding shortfalls are common, disclosure practices and enforcement mechanisms in Korea differ significantly from those in other countries. Firms enjoy broad discretion over contribution decisions, and enforcement of funding recovery plans has historically been weak. In addition, analysts in Korea tend to rely heavily on headline figures from financial statements and less on detailed footnote disclosures. Pension-related information, including actuarial assumptions and funding details, is typically buried in footnotes and requires specialized interpretation. These characteristics increase the likelihood that pension underfunding risks are underweighted in analyst forecasts, making Korea a compelling setting to examine the role of underfunded pensions in shaping forecast bias.



**Figure 1.** Trends in plan assets and projected benefit obligations (2011–2022). Note: PA denotes pension assets, and PBO refers to projected benefit obligations. The figures shown below the arrows indicate the legally mandated minimum funding level. For example, from 2011 to 2013, the regulation required that pension assets account for at least 60% of the projected benefit obligations. Source: The authors

Previous studies have pointed out that the funding status of defined benefit (DB) pension plans can affect firms' operating performance, investment behavior, and firm value through various channels. First, underfunded pension plans negatively influence employee incentives and productivity (Lazear, 1979, 1983; Hutchens, 1986). Second, they tend to increase credit risk and cost of capital, while reducing corporate investment and leading to inefficiencies in capital allocation (Rauh, 2006; Campbell *et al.*, 2012; Wang *et al.*, 2014; Chaudhry *et al.*, 2017; Woo and Kim, 2021). Firms with more severe underfunding are likely to require greater cash outflows to meet future obligations, thereby constraining new investment and capital expenditures. These distortions increase uncertainty around future performance and cash flows.

However, the complexity of pension accounting (Shivdasani and Stefanescu, 2010; Comprix and Muller, 2011) and the high degree of managerial discretion in determining pension contributions and valuation assumptions (Asthana, 1999; Bergstresser *et al.*, 2006) make it difficult for market participants to assess the risks associated with pension underfunding. Franzoni and Marin (2006) find that firms with severely underfunded pensions often experience negative abnormal returns due to the market's failure to incorporate pension-related risks, resulting in overvaluation. Chen *et al.* (2014) argue that analysts tend to underreact to the economic consequences of pension underfunding, leading to optimistic expectations about firms' future cash flows and stock performance.

Motivated by this background, this study empirically analyzes the relationship between DB pension funding ratios and analysts' forecast bias. While prior literature has primarily focused on forecast accuracy, this study emphasizes forecast bias to capture the directional tendency of analysts' expectations. Identifying whether analysts systematically produce optimistic forecasts for underfunded firms allows us to assess whether they appropriately consider pension-related risks.

Our results show that the pension funding ratio is negatively associated with analysts' forecast bias. That is, analysts tend to make more optimistic forecasts when the firm's pension funding ratio is low, suggesting that underfunding is not sufficiently incorporated into earnings expectations. This implies that pension funding status has incremental informational value that is not reflected in analyst forecasts.

This study contributes to the literature by empirically identifying how DB pension funding ratios affect the quality of market information and analyst behavior. In particular, we investigate whether pension underfunding offers additional information beyond what is already captured in analysts' forecasts. Chen *et al.* (2014) document similar analyst underreaction and optimism in the U.S. market; our study confirms that such patterns are also evident in the Korean market.

Furthermore, this study extends previous research, which has primarily focused on earnings forecasts, by analyzing whether pension underfunding influences forecast bias in sales, investment, and cash flow as well. Prior research has shown that pension underfunding affects not only profitability but also cash generation and investment behavior. Incorporating this broader scope allows us to assess which types of performance indicators analysts are more sensitive to. In this regard, our approach is distinguished from prior studies by exploring the pension underfunding effect across a wider set of forecast variables.

The findings of this study underscore the importance of pension funding information in the forecasting process and highlight its incremental value for financial analysts and market participants. Our results serve to raise awareness of pension-related risks and suggest that the pension funding ratio can help explain the extent of optimism in analyst forecasts, thereby contributing to a more comprehensive understanding of information asymmetry in financial markets.

## 2. Research hypotheses development

Prior studies on defined benefit (DB) pension plans have examined how the funding status of such plans affects corporate investment, performance, and firm value. Rauh (2006) argues that cash outflows to fund pension obligations constrain investment activity, leading to reduced

capital expenditures. [Campbell et al. \(2012\)](#) further find that for financially distressed firms, increases in external financing costs resulting from pension contributions are a direct cause of this investment decline. [Chaudhry et al. \(2017\)](#) report that firms with lower DB funding ratios tend to invest more, especially exhibiting signs of overinvestment in research and development.

In addition, underfunded pension plans are known to negatively affect employee incentives and productivity ([Lazear, 1979, 1983](#); [Hutchens, 1986](#)). [Wang et al. \(2014\)](#) demonstrate that pension underfunding leads to credit rating downgrades and increases in the cost of capital, ultimately reducing corporate profitability. These studies collectively suggest that underfunded DB pension plans can adversely affect a firm's operating performance.

Despite the significance of DB pension funding, market participants often find it difficult to assess the associated risks. [Franzoni and Marin \(2006\)](#) find that firms with severely underfunded pension plans tend to be overvalued by the market, as investors fail to anticipate the negative effects of pension liabilities on future profitability. They also emphasize that earnings shocks are more likely for these firms when actual earnings fall short of expectations. Similarly, [Park and Lee \(2024\)](#) find that even firms meeting the statutory minimum funding ratio, but falling short of full funding, are overvalued by the market. They interpret this as evidence that investors overlook underfunding risks, and thus, market prices fail to reflect them adequately. These results suggest that not only in the U.S. but also in the Korean market, firms with low DB pension funding ratios are overvalued due to insufficient market recognition of the risks associated with pension underfunding.

One major reason for this is the complex nature of pension accounting and disclosure. Key assumptions used to calculate the present value of pension liabilities and the fair value of pension assets—such as expected salary growth, discount rates, and expected return on plan assets—are disclosed in footnotes of annual reports. Interpreting the value relevance of pension-related figures requires a high degree of financial expertise. Prior studies on the U.S. market ([Shivdasani and Stefanescu, 2010](#); [Comprix and Muller, 2011](#); [Chen et al., 2014](#)) show that information disclosed in footnotes may differ significantly from headline figures reported in the financial statements. This discrepancy is partly due to smoothing mechanisms permitted by the Financial Accounting Standards Board (FASB), which allow firms to defer the immediate recognition of pension costs in their income statements. See [Shivdasani and Stefanescu \(2010\)](#) and [Chen et al. \(2014\)](#) for details.

Thus, if investors and analysts focus primarily on the headline figures in financial statements and overlook footnote disclosures, they may fail to fully grasp the implications of pension underfunding. Furthermore, several studies suggest that managers may act opportunistically in setting pension-related assumptions ([Asthana, 1999](#); [Bergstresser et al., 2006](#); [Shivdasani and Stefanescu, 2010](#)). [Bergstresser et al. \(2006\)](#) find that managers often assume higher expected returns on plan assets to inflate earnings before mergers or stock option exercises. Similarly, [Comprix and Muller \(2006\)](#) show that firms strategically raise assumed investment returns to boost reported pension income.

Such complexity in pension accounting and the managerial discretion involved can impair analysts' ability to interpret pension-related risks. Financial analysts play a vital role in mitigating information asymmetry by providing forward-looking forecasts and value-relevant insights ([Das et al., 1998](#); [Healy and Palepu, 2002](#); [Yu, 2008](#)). However, prior research finds that when information uncertainty increases, the accuracy of analysts' forecasts declines and earnings optimism becomes more likely ([Das et al., 1998](#); [Lim, 2001](#); [Jeong and Lim, 2005](#); [Ko et al., 2011](#)). Uncertain or complex pension information may therefore prevent analysts from fully incorporating the risks of underfunding into their earnings or stock price forecasts.

Taken together, the literature suggests that DB pension underfunding significantly affects firm growth, investment activity, and valuation. Yet, due to the complexity of pension accounting and the broad discretion allowed to management, market participants may find it difficult to fully recognize and assess these effects.

Accordingly, this study hypothesizes that financial analysts, when forecasting firm performance, do not fully reflect the risks associated with underfunded DB pension plans, and instead issue overly optimistic forecasts.

[Research Hypothesis] Financial analysts are more likely to make optimistic forecasts for firms with lower funding ratios in their defined benefit pension plans.

### 3. Research design

#### 3.1 Sample selection

To examine the informational effect of the funding ratio of defined benefit (DB) pension plans on analysts' forecast bias, we construct a sample of Korean listed firms over the period 2011–2022. The sample includes only those firms that satisfy the following conditions (see Table 1 for details of the sample selection process):

- (1) The firm is listed on either the KOSPI or KOSDAQ markets during the sample period;
- (2) The firm does not belong to the financial industry;
- (3) The firm operates a defined benefit (DB) pension plan;
- (4) Financial analyst forecast data are available for the firm during April to June of year  $t$ ;
- (5) The firm is not under capital impairment;
- (6) All financial and control variables necessary for regression analysis are available from the FnGuide database.

This study analyzes firms listed on the KOSPI and KOSDAQ markets from 2011 to 2022. The sample period begins in 2011 to ensure consistency in accounting standards. Since the adoption of the Korea International Financial Reporting Standards (K-IFRS) in 2011, consolidated financial statements have become the primary reporting format. Accordingly, this study uses only analysts' forecast data based on consolidated financial statements beginning in 2011 [4]. To ensure consistency in the timing of financial statement disclosures, the sample is further limited to firms with a December fiscal year-end.

Because analysts' forecasts may incorporate various events and types of information, we restrict the forecast data to those released within three months following the disclosure of the previous year's financial statements—specifically, from April to June of year  $t+1$ —to isolate the effect of pension funding information from year  $t$  (Chen *et al.*, 2014).

Financial analyst forecasts, pension-related data, and other financial and stock market information are obtained from the Dataguide database. To improve the comparability of the sample and account for industry-specific factors, firms in the financial sector are excluded. Firms

**Table 1.** Construction of the sample

Firms listed on KOSPI and KOSDAQ between 2011 and 2022		22,983
Excluding financial industry firms	(855)	
Excluding firms with non-December fiscal year-end	(476)	
Excluding firms without DB pension plans	(5,004)	
Excluding firms without analyst forecast data (April–June)	(11,729)	
Excluding firms under capital impairment	(61)	
Excluding firms with missing control variables in Dataguide	(1,875)	
Final sample		2,983

**Note(s):** The sample is constructed based on firm-year observations. Forecast data is collected between April and June of year  $t+1$  to reflect expectations based on financial statement disclosures of year  $t$

**Source(s):** The authors

with capital impairment are also excluded due to the potential unreliability of their financial statements. The final sample, after applying all filters, consists of 2,983 firm-year observations.

3.2 Variable measurement

3.2.1 DB Pension Funding Ratio (PFR). Firms that operate defined benefit (DB) pension plans are legally required to set aside a portion of the projected benefit obligation (PBO) to ensure future pension payments. In this study, we use the pension liability reported in financial statements as a proxy for the PBO. Under the Korean International Financial Reporting Standards (K-IFRS), pension liabilities are measured using the projected unit credit method and reported under the account name “defined benefit obligation.”

According to K-IFRS, the defined benefit obligation is calculated through the following steps:

- (1) Determine actuarial assumptions such as employee turnover rate, expected years of service, salary growth rate, mortality rate, and discount rate.
- (2) Using these assumptions, apply actuarial valuation techniques to estimate the future benefits payable to employees.
- (3) Allocate the estimated obligation over the expected working lives of employees.
- (4) Discount the allocated obligation to present value using the discount rate from the end of the fiscal year to the expected retirement date.

Firms operating defined benefit (DB) pension plans are legally required to contribute to an institution that is independent of the firm in order to secure employees’ pension entitlements. Under K-IFRS, the assets pre-funded by firms to support future pension payments are referred to as “plan assets.” Drawing on previous studies (Franzoni and Marin, 2006; Chen et al., 2014), we define the pension funding ratio (PFR) using two key components: the projected benefit obligation (PBO), which represents pension liabilities, and plan assets (PA), which represent the accumulated pension assets.

A lower PFR indicates a larger pension funding shortfall and a lower level of asset coverage relative to the firm’s total pension obligations. Unlike prior domestic studies (e.g. Noh, 2017), which focus on the ratio of PBO to plan assets, this study emphasizes the absolute funding gap expressed in monetary terms. This approach reflects a practical consideration: financial analysts typically issue forecasts for firm performance metrics such as revenue or net income in monetary units.

Following the methodology of Franzoni and Marin (2006) and Chen et al. (2014), we define the pension funding ratio as the difference between plan assets and pension obligations, scaled by market capitalization, [5] and [6]:

$$PFR_{i,t} = \frac{PA_{i,t} - PBO_{i,t}}{\text{Market Cap}_{i,t-1}} \tag{1}$$

Where:

PA<sub>i,t</sub>: Plan assets at the end of year *t* for firm *i*

PBO<sub>i,t</sub>: Projected benefit obligations at the end of year *t* for firm *i*

Market Cap<sub>i,t-1</sub>: Market capitalization at the end of year *t*–1 for firm *i*

3.2.2 Forecast bias of financial analysts. Forecasts issued by financial analysts play a key role in reducing information asymmetry between firms and investors (Das et al., 1998). Investors rely heavily on analysts’ earnings forecasts when making investment decisions, believing that analysts possess superior information and analytical capabilities (Ahn et al.,

2006). Managers, in turn, are incentivized to meet or exceed analysts' earnings forecasts, and this often leads to earnings management behavior (Degeorge *et al.*, 1999; Matsumoto, 2002). Analysts' forecasts influence stock prices and contribute to the efficient allocation of capital in financial markets (Graham *et al.*, 2005).

Whereas many prior studies focus on the accuracy of analysts' forecasts, this study emphasizes forecast bias, which refers to the systematic deviation of analysts' expectations from actual outcomes. We adopt this approach because the objective of this study is to analyze how analysts respond to underfunded DB pensions, and whether they reflect this risk appropriately in their forecasts. Forecast bias allows us to detect whether analysts are consistently optimistic or pessimistic in their forecasts based on the level of pension underfunding, whereas forecast accuracy alone cannot capture such directional tendencies.

We define forecast bias as follows:

$$\text{ForecastBias}_{i,t} = \frac{\text{Forecast}_{i,t} - \text{Actual}_{i,t}}{\text{TotalAssets}_{i,t-1}} \quad (2)$$

Forecasts are obtained between April and June of the year to reflect analysts' expectations formed after the disclosure of financial statements for the year but before mid-year earnings announcements. If an individual analyst issues multiple forecasts for the same firm during this window, we use the most recent forecast. If there are forecasts from multiple analysts, we use the average value.

We examine the following four types of forecast bias: Sales revenue (Bias\_Sales<sub>*i,t*</sub>), Net income (Bias\_NI<sub>*i,t*</sub>), Operating cash flow (Bias\_CF<sub>*i,t*</sub>), Capital expenditures (Bias\_Capex<sub>*i,t*</sub>). Following Chen *et al.* (2014), the use of April–June forecasts ensures that the effect of DB pension disclosures from year is isolated. This period excludes the effects of major earnings surprises or intra-year disclosures that could otherwise contaminate analysts' forecasts.

**3.2.3 Empirical model.** To test whether the funding ratio of DB pension plans influences analysts' forecast bias, we estimate the following regression model:

$$\text{Bias}_{i,t} = \beta_0 + \beta_1 \text{PFR}_{i,t} + \sum \text{Control Variables}_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where,

Bias<sub>*i,t*</sub>: Forecast bias for firm *i* in year *t*, separately measured for sales (Bias\_Sales), net income (Bias\_NI), operating cash flow (Bias\_CF), and capital expenditures (Bias\_CAPEX)

PFR<sub>*i,t*</sub>: Pension funding ratio as previously defined for firm *i* in year *t*

Control Variable :

SIZE<sub>*i,t*</sub>: Natural logarithm of total assets

LEV<sub>*i,t*</sub>: Total liabilities divided by total assets (leverage ratio)

ROA<sub>*i,t*</sub>: Net income divided by average total assets (return on assets)

MTB<sub>*i,t*</sub>: Market-to-book ratio

BETA<sub>*i*</sub>: Systematic risk measured using the market model

VOL<sub>*i,t*</sub>: Standard deviation of weekly stock returns (volatility)

Foreign<sub>*i,t*</sub>: Natural logarithm of the proportion of foreign ownership

Blockholder<sub>*i,t*</sub>: Ownership percentage of the largest shareholder

DA<sub>*i,t*</sub>: Discretionary accruals estimated using Kothari *et al.* (2005), [7]

Market<sub>*i,t*</sub>: Dummy variable equal to 1 if the firm is listed on KOSPI, 0 if listed on KOSDAQ

Big4<sub>*i,t*</sub>: Dummy variable equal to 1 if the auditor is a Big 4 firm, 0 otherwise

If financial analysts fully incorporate pension funding information into their forecasts, then the pension funding ratio (PFR) is not expected to have statistically significant explanatory power for forecast bias. Conversely, if analysts fail to sufficiently reflect pension information in their forecasts, the PFR should exhibit a statistically significant association with forecast bias. In such cases, the negative consequences of underfunded pensions would be observed only in actual performance, while analysts' forecasts would remain overly optimistic, resulting in systematic forecast bias. This would suggest that analysts do not adequately incorporate the implications of pension funding into their performance forecasting process.

This study includes several control variables based on prior literature that examines analysts' forecast behavior: firm size (SIZE), leverage (LEV), market-to-book ratio (MTB), return on assets (ROA), systematic risk (BETA), stock return volatility (VOL), foreign ownership (FOREIGN), blockholder ownership (Blockholder), discretionary accruals (DA), market type (Market), and Big4 auditor status (Big4). These variables are selected following previous studies including Behn *et al.* (2008), Tan *et al.* (2011), Cotter *et al.* (2012), Bae *et al.* (2012), Jeong *et al.* (2014), Nam (2015), and Park *et al.* (2016). In addition, the model includes fixed effects for industry ( $\Sigma$ IND) and year ( $\Sigma$ YD) to control for sector-specific and macroeconomic factors.

Larger firms are likely to disclose more information to the capital market, thereby reducing the level of information asymmetry (Behn *et al.*, 2008; Cotter *et al.*, 2012). Firms with higher leverage may have greater incentives to manage earnings to satisfy debt covenants, which could influence analysts' forecasts (Nam, 2015). The market-to-book ratio (MTB) reflects a firm's growth opportunities, and prior studies have found that higher MTB is associated with more accurate forecasts (Tan *et al.*, 2011; Park *et al.*, 2016).

BETA and VOL represent risk, and firms with greater systematic risk or stock return volatility are generally expected to exhibit higher information uncertainty (Tan *et al.*, 2011; Sonu *et al.*, 2010; Jeong *et al.*, 2012). A higher level of foreign ownership may lead to improved monitoring and lower information asymmetry (Ahn *et al.*, 2006; Park *et al.*, 2016; Jeong *et al.*, 2014). Based on literature suggesting a significant relationship between ownership structure and the quality of accounting information, blockholder ownership is also included as a control. However, since the effect of controlling shareholders on the informativeness of earnings may vary depending on whether their interests align with those of minority shareholders, we do not predict the direction of this relationship (Jeong *et al.*, 2002; Park, 2010).

Prior studies have shown that the quality of reported earnings influences the accuracy of analysts' forecasts (Bradshaw *et al.*, 2001; Cho and Cho, 2009). Accordingly, this study controls for earnings quality using discretionary accruals, measured following the method of Kothari *et al.* (2005). The Market variable controls for differences in the quality of earnings between firms listed on the KOSPI and KOSDAQ markets (Bae *et al.*, 2012). Big4 is a dummy variable indicating whether the firm is audited by a Big 4 accounting firm, which is expected to provide higher audit quality. Behn *et al.* (2008) find that firms audited by Big 4 auditors tend to have more accurate earnings forecasts.

## 4. Empirical results

### 4.1 Descriptive statistics

Table 2 presents descriptive statistics for the key variables used in this study, including the pension funding ratio (PFR) and various measures of analyst forecast bias, over the sample period from 2011 to 2022. Examining the average values of forecast bias across different performance indicators reveals that the bias tends to move closer to zero as the forecast target

**Table 2.** Descriptive statistics

Var.	N	Mean	Sd	p1	p25	p50	p75	p99
Bias_Sales	2,983	-0.989	0.516	-2.876	-1.236	-0.901	-0.635	-0.138
Bias_NI	2,885	-0.044	0.074	-0.291	-0.076	-0.038	-0.009	0.213
Bias_CF	2,529	-0.082	0.078	-0.367	-0.117	-0.073	-0.041	0.15
Bias_CAPEX	2072	-0.057	0.057	-0.297	-0.075	-0.039	-0.02	0.011
PFR	2,983	-0.035	0.068	-0.396	-0.032	-0.011	-0.003	0
SIZE	2,983	20.797	1.785	17.709	19.459	20.511	21.883	25.904
LEV	2,983	0.452	0.191	0.074	0.296	0.467	0.604	0.828
ROA	2,983	0.039	0.074	-0.2	0.009	0.037	0.072	0.242
MTB	2,983	0.905	0.989	0.064	0.299	0.601	1.138	5.175
Beta	2,983	0.955	0.49	-0.243	0.627	0.941	1.278	2.192
VOL	2,983	0.397	0.14	0.174	0.297	0.372	0.468	0.851
Foreign	2,983	2.127	1.161	-0.774	1.366	2.31	3.005	4.028
Blockholder	2,983	40.704	14.663	12.75	30.04	39.4	50.98	76.23
DA	2,983	-0.006	0.068	-0.216	-0.037	-0.003	0.027	0.202
Big4	2,983	0.696	0.46	0	0	1	1	1
Market	2,983	0.428	0.495	0	0	0	1	1

**Note(s):** PFR is defined as the difference between plan assets and pension obligations, divided by market capitalization, where a higher value indicates a better-funded DB pension plan. SIZE denotes firm size and is measured as the natural logarithm of total assets. LEV is the leverage ratio, calculated as total liabilities over total assets. ROA represents return on assets, measured as net income divided by average total assets. MTB is the market-to-book ratio, computed as the market capitalization at the fiscal year-end divided by average total assets. BETA refers to the firm's systematic risk, estimated using the market model. VOL is stock return volatility, measured by the standard deviation of weekly returns over the past year. FOREIGN is the natural logarithm of the percentage of shares held by foreign investors. Blockholder indicates the ownership percentage of the largest shareholder. DA represents discretionary accruals, estimated following the modified Jones model proposed by *Kothari et al. (2005)*. Big4 is a dummy variable equal to 1 if the firm is audited by one of the Big 4 accounting firms, and 0 otherwise. Market is a dummy variable equal to 1 for KOSPI-listed firms and 0 for KOSDAQ-listed firms

**Source(s):** The authors

shifts from sales to net income. Notably, the magnitude of bias is larger for cash flow forecasts than for net income forecasts. Moreover, the fact that the 75th percentile values of forecast bias are negative suggests that, in general, analysts tend to issue forecasts that are lower than the actual performance for firms operating DB pension plans. It is worth noting that these forecast data were issued within three months following the previous year's earnings announcement. Because this period precedes the release of first-half performance information, analysts may have taken a more conservative stance in forming their expectations.

The average value of the pension funding ratio (PFR) is  $-0.035$ , which indicates that, on average, DB pension plans are underfunded by KRW 35 per KRW 10,000 of market capitalization. The median PFR is  $-0.011$ , and the 25th percentile is  $-0.032$ , which is relatively close to the mean. This indicates a right-skewed distribution in which most observations are concentrated on the lower end. In addition, the 99th percentile of PFR is 0.000, implying that the vast majority of listed firms in Korea hold insufficient plan assets relative to their pension liabilities.

Table 3 reports the Pearson correlation coefficients among the main variables. Among the measures of analyst forecast bias, there are significantly positive correlations observed from sales to capital expenditures (CapEx). This indicates that analysts tend to exhibit forecast bias in the same direction across various financial indicators for a given firm. In practice, financial forecasting often begins with revenue projections and then extends to earnings, funding needs, and other performance estimates. These projections form the basis for evaluating a firm's operational and financial status. Therefore, it is expected that analyst forecast biases for different performance metrics would be positively correlated.

**Table 3.** Pearson correlation

Var.	Bias_Sales	Bias_NI	Bias_CF	Bias_CAPEX	PFR	SIZE	LEV	ROA	MTB	Beta	VOL	Foreign	Block holder	DA	Big4
Bias_Sales	1														
Bias_NI	0.2186*	1													
Bias_CF	0.2609*	0.9263*	1												
Bias_CAPEX	0.1049*	0.1893*	0.3339*	1											
PFR	-0.0327	-0.1652*	-0.1689*	-0.1127*	1										
SIZE	0.0168	0.0405*	0.0425*	0.0173	-0.1658*	1									
LEV	-0.2267*	0.3532*	0.3060*	0.0386	-0.3917*	0.3484*	1								
ROA	-0.2044*	-0.9665*	-0.8879*	-0.1355*	0.1477*	-0.0091	-0.3474*	1							
MTB	0.0162	-0.2358*	-0.2313*	-0.2063*	0.2532*	-0.3660*	-0.3761*	0.1933*	1						
Beta	0.0745*	0.1534*	0.1484*	0.0214	-0.0635*	0.0385*	0.1012*	-0.1637*	0.0266	1					
VOL	0.029	0.1123*	0.0688*	-0.0182	-0.0579*	-0.2888*	0.0548*	-0.1505*	0.2538*	0.4822*	1				
Foreign	-0.0551*	-0.2510*	-0.2400*	-0.0323	0.0722*	0.5146*	-0.0933*	0.2524*	0.0306	-0.1173*	-0.2884*	1			
Blockholder	-0.0857*	-0.003	0.0109	0.0810*	-0.0959*	0.0393*	-0.0181	0.0228	-0.1586*	-0.1435*	-0.0916*	-0.2188*	1		
DA	0.0739*	0.1780*	0.2067*	0.0476*	-0.0560*	0.0346	0.1102*	-0.1516*	-0.1068*	0.0399*	0.031	-0.1108*	-0.0098	1	
Big4	-0.0638*	0.0274	0.032	0.0585*	-0.0387*	0.4542*	0.1583*	-0.0107	-0.1720*	-0.0726*	-0.2156*	0.2942*	0.1322*	-0.0002	1
Market	0.0701*	-0.0844*	-0.1146*	-0.0842*	0.1815*	-0.6497*	-0.2577*	0.0575*	0.3261*	0.0146	0.2677*	-0.3338*	-0.1843*	-0.0386*	-0.4144*

**Note(s):** This table shows the Pearson correlation coefficients between variables. \* indicates statistical significance at the 5% or less significance level

**Source(s):** The authors

Of particular interest in this study is the relationship between the pension funding ratio (PFR) and analyst forecast bias. The analysis reveals a statistically significant negative correlation between these two variables. This implies that firms with higher pension funding ratios tend to exhibit actual performance that exceeds analyst forecasts, while firms with lower pension funding ratios tend to underperform relative to forecasts. In other words, the lower the pension funding ratio—that is, the more severely underfunded the pension plan—the more likely analysts are to overestimate firm performance. This suggests that analysts may not be fully accounting for the adverse impact of pension underfunding on corporate performance and investment activities. As a result, the pension funding ratio appears to carry incremental informational value that is not adequately reflected in analysts' forecasts.

Table 4 classifies firms into five portfolios based on the pension funding ratio (PFR) and compares the accuracy of analysts' forecasts across these groups. From the most underfunded firms (PF0) to the fully funded firms (PF4), the distribution shows that the majority of firms fall into the underfunded categories. The analysis reveals that among underfunded firms, the higher the funding ratio, the larger the gap between actual performance and analyst forecasts, meaning that firms with relatively higher funding ratios within this group tend to underperform relative to expectations.

In contrast, the fully funded group (PF4) exhibits the highest level of forecast bias, suggesting the possibility of a non-linear relationship between the pension funding ratio and forecast accuracy. While this result is noteworthy, it should be interpreted with caution, as only five to seven firms with analyst forecast data fall into the fully funded group.

To examine whether the results in Table 4 are driven by firm characteristics, Table 5 presents descriptive statistics of firm-specific variables across pension funding ratio (PFR) portfolios. Among underfunded firms, a higher PFR is associated with lower leverage (LEV) and blockholder ownership, while profitability (ROA), growth opportunities (MTB), systematic risk (Beta), foreign ownership, and the likelihood of being listed on the KOSPI increase. Firm size follows a U-shaped pattern, indicating that both severely underfunded and fully funded firms tend to be larger in scale.

In the fully funded group, the linear relationships observed in the underfunded group do not persist—a pattern consistent with Franzoni and Marin (2006), who report similar findings in the U.S. market. Compared to underfunded and severely underfunded firms, the fully funded group tends to exhibit lower firm size, ROA, MTB, Beta, and foreign ownership, but slightly higher leverage. Notably, blockholder ownership is relatively high in both PF0 (severely underfunded) and PF4 (fully funded) portfolios. The proportion of firms audited by Big 4 accounting firms is lowest in the fully funded group, which is also a noteworthy finding. Lastly, the mean value of discretionary accruals, which is estimated as a residual from the regression model, remains close to zero across all portfolios due to the construction of the variable.

**Table 4.** DB analyst forecast bias by pension funding ratio portfolios

Var.	UF PF0		PF1		PF2		PF3		OF PF4	
	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
PFR	3,912	-0.15	3,912	-0.03	3,912	-0.01	3,912	-0.002	91	0.001
Bias_Sales	630	-0.94	765	-0.99	982	-0.94	1,258	-0.98	7	-0.55
Bias_NI	604	-0.02	744	-0.03	951	-0.04	1,220	-0.06	7	0.01
Bias_CF	518	-0.06	640	-0.07	825	-0.08	1,123	-0.1	6	0
Bias_CAPEX	426	-0.04	494	-0.06	694	-0.06	957	-0.06	5	-0.03

**Note(s):** UF refers to the underfunded group, where plan assets are less than projected benefit obligations. OF refers to the overfunded (fully funded) group, where plan assets exceed projected benefit obligations. Pension funding ratio increases from PF0 to PF4. For variable definitions, refer to Table 2

**Source(s):** The authors

**Table 5.** Firm characteristics by pension funding ratio portfolios

Var.	UF PF0		PF1		PF2		PF3		OF PF4	
	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
PFR	3,912	-0.15	3,912	-0.03	3,912	-0.01	3,912	-0.002	91	0.001
SIZE	3,912	19.59	3,912	19.22	3,912	19.31	3,912	19.49	91	18.78
LEV	3,912	0.57	3,912	0.46	3,912	0.41	3,912	0.35	91	0.36
ROA	3,910	0	3,911	0.01	3,912	0.01	3,912	0.02	91	0
MTB	3,911	0.45	3,912	0.76	3,912	1.06	3,912	1.4	91	1.04
Beta	3,908	0.88	3,909	0.9	3,908	0.92	3,909	0.96	91	0.92
VOL	3,908	0.46	3,909	0.46	3,908	0.45	3,909	0.46	91	0.47
Foreign	3,721	0.67	3,755	0.72	3,793	1.02	3,810	1.29	89	0.54
Blockholder	3,910	41.95	3,910	39.96	3,911	39.26	3,912	38.89	91	40.37
DA	3,383	0	3,350	0	3,313	0	3,349	0	79	0.01
Big4	3,912	0.5	3,912	0.45	3,912	0.48	3,912	0.48	91	0.18
Market	3,912	0.44	3,912	0.6	3,912	0.61	3,912	0.63	91	0.66

**Note(s):** UF refers to the underfunded group, where plan assets are less than projected benefit obligations. OF refers to the overfunded (fully funded) group, where plan assets exceed projected benefit obligations. Pension funding ratio increases from PF0 to PF4. For variable definitions, refer to [Table 2](#)

**Source(s):** The authors

#### 4.2 Regression results and robustness test

This study investigates whether financial analysts adequately incorporate the implications of underfunded defined benefit (DB) pension plans into their earnings and performance forecasts. While most prior research has focused on forecast accuracy, we focus on forecast bias to examine the directional tendency of analysts' expectations in response to pension underfunding.

Pension underfunding has been shown to affect corporate outcomes through several channels. [Lazear \(1979\)](#) and [Hutchens \(1986\)](#) suggest that underfunding diminishes employee incentives and productivity. [Carroll and Niehaus \(1998\)](#) and [Choi and Noh \(2017\)](#) report that pension-related credit risk raises firms' interest expenses. [Franzoni and Marin \(2006\)](#) and [Rauh \(2006\)](#) argue that underfunding distorts investment behavior, particularly in financially constrained firms. Accordingly, [Chen et al. \(2014\)](#) predicts that firms with lower funding ratios will experience weaker future profitability.

If analysts fail to fully incorporate the risks of pension underfunding, these effects will be reflected in realized performance but not in forecasts—resulting in systematic optimism. Following [Chen et al. \(2014\)](#), we test this underreaction hypothesis by examining the relationship between the pension funding ratio (PFR) and analyst forecast bias.

[Table 6](#) presents the results of OLS regressions. Across all forecast measures—sales, net income, cash flow, and capital expenditures—we find a significant negative association between PFR and forecast bias at the 1% or 5% level. This suggests that analysts issue more optimistic forecasts when firms are more underfunded, and fail to fully adjust for the associated performance risks.

[Chen et al. \(2014\)](#) identify three main channels through which pension underfunding affects performance: (1) reduced labor incentives and productivity ([Lazear, 1979](#); [Hutchens, 1986](#)); (2) investment distortions from increased funding contributions, especially in financially constrained firms ([Myers, 1977](#); [Rauh, 2006](#)); and (3) higher capital costs driven by credit downgrades and the seniority of pension liabilities ([Carroll and Niehaus, 1998](#); [Choi and Noh, 2017](#); [Campbell et al., 2012](#); [Hong and Noh, 2021](#)). These mechanisms imply that underfunding may harm not only earnings, but also revenue, cash flows, and investment levels.

Consistent with this, the PFR coefficient is statistically significant across all forecast types, with larger magnitudes in sales (-0.700), cash flow (-0.028), and capital expenditures

Table 6. OLS regression results

Var.	Bias_Sales (1)	Bias_NI (2)	Bias_CF (3)	Bias_ CAPEX (4)
PFR	-0.700*** (0.000)	-0.009** (0.044)	-0.028*** (0.003)	-0.075*** (0.000)
SIZE	0.095*** (0.000)	0.000 (0.774)	-0.001 (0.177)	-0.006*** (0.000)
LEV	-1.257*** (0.000)	0.002 (0.610)	-0.021*** (0.000)	-0.046*** (0.000)
ROA	-2.152*** (0.000)	-0.949*** (0.000)	-0.941*** (0.000)	-0.118*** (0.000)
MTB	-0.018 (0.130)	-0.003*** (0.004)	-0.003*** (0.002)	-0.012*** (0.000)
BETA	-0.008 (0.696)	0.001 (0.182)	0.004** (0.039)	0.005* (0.088)
VOL	-0.062 (0.501)	-0.024*** (0.001)	-0.032*** (0.001)	-0.018 (0.186)
Foreign	-0.061*** (0.000)	-0.001* (0.065)	-0.001 (0.150)	0.004** (0.023)
Blockholder	-0.004*** (0.000)	0.000 (0.583)	-0.000 (0.145)	-0.000 (0.635)
DA	0.225 (0.122)	0.026*** (0.004)	0.069*** (0.000)	0.011 (0.576)
BIG4	-0.064*** (0.002)	0.000 (0.792)	-0.001 (0.723)	0.005 (0.179)
Market	0.116*** (0.000)	-0.002* (0.077)	-0.001 (0.438)	-0.012*** (0.004)
Industry FE	Included	Included	Included	Included
Year FE	Included	Included	Included	Included
N	2,983	2,885	2,529	2072
R <sup>2</sup>	0.378	0.940	0.837	0.266

**Note(s):** This regression uses robust standard errors. Values in parentheses indicate *p*-values. \*, \*\*, and \*\*\* denote statistical significance at the 10, 5, and 1% levels, respectively

**Source(s):** The authors

(-0.075), compared to net income (-0.009). This suggests that analysts' underreaction is more pronounced for forward-looking or investment-related indicators.

Among control variables, forecast bias tends to decline with greater leverage, profitability, growth (MTB), volatility, foreign ownership, and blockholder ownership. In contrast, higher discretionary accruals are associated with more optimistic forecast bias, reflecting lower earnings quality.

To address endogeneity, we apply Propensity Score Matching (PSM). As shown in Table 5, high-PFR firms tend to differ in size, leverage, ROA, MTB, Beta, foreign ownership, and market listing. Chaudhry *et al.* (2017) suggest that some firms strategically underfund pensions to preserve investment capital, while Noh (2017) finds a positive correlation between funding ratios and cash holdings—highlighting the need for further control.

To address potential endogeneity issues, we construct a logit model in which the dependent variable equals 1 if a firm's PFR is above the industry-year median. This approach accounts for changes in Korea's minimum funding standards and sectoral differences such as unionization. Explanatory variables include firm size, leverage, ROA, MTB, foreign and blockholder ownership, Big4 status, market dummy (KOSPI vs. KOSDAQ), and industry/year fixed effects.

Table 7 shows the covariate balance before and after matching. Prior to matching, high-PFR firms tend to be larger, more profitable, and less leveraged. After matching, these

**Table 7.** Comparison of sample characteristics before and after propensity score matching (PSM)

Variable	Unmatched Matched	Mean Treated	Control	% bias	% reduct Bias	t-test t	p > t
SIZE	U	19.488	19.336	9.70		6.04	0.00
	M	19.488	19.361	8.10	16.30	4.74	0.00
LEV	U	0.388	0.494	-54.30		-33.84	0.00
	M	0.388	0.383	2.30	95.80	1.37	0.17
ROA	U	0.017	0.003	13.00		8.12	0.00
	M	0.017	0.008	8.50	35.00	4.84	0.00
MTB	U	1.132	0.795	30.30		19.00	0.00
	M	1.132	1.196	-5.80	81.00	-2.82	0.01
Foreign	U	1.141	0.655	29.70		18.51	0.00
	M	1.141	1.038	6.30	78.70	3.89	0.00
Blockholder	U	39.954	40.399	-2.70		-1.65	0.10
	M	39.954	40.346	-2.30	12.10	-1.42	0.16
Big4	U	0.495	0.465	6.20		3.84	0.00
	M	0.495	0.483	2.50	59.90	1.51	0.13
Market	U	0.587	0.551	7.20		4.50	0.00
	M	0.587	0.607	-4.00	44.50	-2.47	0.01

**Note(s):** Due to space limitations, results for industry and year fixed effects are omitted. For variable definitions, refer to [Table 2](#)

**Source(s):** The authors

differences are substantially reduced. [Table 8](#) presents OLS regression results using the matched sample. The negative and statistically significant relationship between PFR and forecast bias remains, supporting the conclusion that analyst underreaction to pension underfunding persists even after controlling for observable firm characteristics [8].

## 5. Conclusion

This study empirically examines the effect of the funding ratio of defined benefit (DB) pension plans on the forecast bias of financial analysts. The results show that analysts tend to make more optimistic forecasts for firms with lower funding ratios—that is, with more severely underfunded DB obligations. This tendency remains consistent even after controlling for potential endogeneity using Propensity Score Matching (PSM), suggesting that analysts may not fully account for the risks and implications of pension underfunding.

Given the large and growing pension liabilities in Korea—estimated at KRW 95 trillion for listed firms as of 2022—our findings highlight the need for more transparent and standardized disclosures of pension funding status. Analysts' underreaction to pension underfunding exacerbates information asymmetry in the capital market and may lead to mispricing or distorted investment decisions. Enhancing the visibility and clarity of pension disclosures, particularly those buried in footnotes, would help analysts and investors better assess corporate financial health.

Furthermore, this study opens several avenues for future research. Given the differences in institutional frameworks, regulatory enforcement, and analyst behavior across countries, applying this framework to other markets—particularly those with stronger funding rules or alternative pension systems—could validate or contrast our findings. Future research could also explore cross-country comparisons or examine whether institutional investors and credit rating agencies respond differently to pension underfunding relative to financial analysts.

In addition, it would be valuable to investigate whether the observed analyst bias stems from behavioral misjudgment or from information asymmetry—particularly if underfunded firms tend to provide limited pension-related disclosures. If the bias serves as a proxy for

**Table 8.** OLS regression results after propensity score matching (PSM)

Var.	Bias_Sales (1)	Bias_NI (2)	Bias_CF (3)	Bias_ CAPEX (4)
PFR	-1.053*** (0.000)	-0.011* (0.059)	-0.020* (0.061)	-0.085*** (0.000)
SIZE	0.080*** (0.000)	-0.000 (0.875)	-0.001* (0.062)	-0.008*** (0.000)
LEV	-1.387*** (0.000)	0.004 (0.146)	-0.017*** (0.001)	-0.048*** (0.000)
ROA	-2.294*** (0.000)	-0.924*** (0.000)	-0.913*** (0.000)	-0.145*** (0.000)
MTB	-0.023** (0.027)	-0.003*** (0.001)	-0.003*** (0.001)	-0.011*** (0.000)
BETA	0.047** (0.022)	0.005*** (0.000)	0.007*** (0.000)	0.012*** (0.000)
VOL	-0.349*** (0.000)	-0.048*** (0.000)	-0.058*** (0.000)	-0.049*** (0.000)
Foreign	-0.053*** (0.000)	-0.002*** (0.000)	-0.003*** (0.000)	0.003* (0.078)
Blockholder	-0.004*** (0.000)	-0.000 (0.937)	-0.000** (0.034)	-0.000 (0.232)
DA	0.348** (0.018)	0.010 (0.303)	0.055*** (0.001)	0.027 (0.191)
BIG4	-0.032 (0.119)	0.001 (0.268)	0.000 (0.984)	0.005 (0.159)
Market	0.131*** (0.000)	-0.001 (0.588)	-0.002 (0.229)	-0.013*** (0.001)
Industry FE	Included	Included	Included	Included
Year FE	Included	Included	Included	Included
N	3,233	3,132	2,807	2,345
R <sup>2</sup>	0.420	0.934	0.837	0.311

**Note(s):** This regression uses robust standard errors. Values in parentheses indicate *p*-values. \*, \*\*, and \*\*\* denote statistical significance at the 10, 5, and 1% levels, respectively

**Source(s):** The authors

asymmetric information, subsequent studies could examine whether it has downstream effects on firm-level outcomes such as capital allocation, investment efficiency, or cost of capital. These perspectives would extend the practical implications of our findings.

Overall, our findings contribute to the literature on financial disclosure, information asymmetry, and analyst behavior by demonstrating how pension underfunding can distort earnings forecasts and signal potential risks that are not always visible through conventional financial metrics.

### Notes

1. As of 2022, the total underfunded pension liability was calculated by subtracting the sum of externally funded assets from the total defined benefit obligations of firms listed on the KOSPI and KOSDAQ markets (Source: Dataguide).
2. In contrast to Korea, the U.S. imposes a variety of legal penalties for underfunded pension plans under the Employee Retirement Income Security Act, including late contribution penalties, higher PBGC premiums, and legal actions (<https://www.irs.gov/retirement-plans/terminations-underfunded-single-employer-defined-benefit-plans>).
3. According to the 2022 amendment to the Act, a fine of up to KRW 10 million may be imposed for failing to submit funding plans. After a Grace period, the regulation has been fully enforced since 2024.

4. According to Dataguide, the number of analyst forecasts based on consolidated financial statements (K-IFRS(C)) between 2011 and 2022, limited to those issued between April and June, was 35,198, compared to 9,473 forecasts based on separate financial statements (K-IFRS(S)). Prior to the adoption of K-IFRS, from 2005 to 2010, there were 22,592 forecasts based on separate financial statements (K-GAAP(S)), while only 598 forecasts were based on consolidated statements (K-GAAP(C)). This study relies on the 35,198 analyst forecasts based on K-IFRS(C) for empirical analysis.
5. While prior domestic studies (e.g. Noh, 2017) have defined the pension funding ratio as the ratio of plan assets to pension obligations (PA/PBO), this study defines it as (plan assets – pension obligations) divided by market capitalization. This approach is better aligned with the fact that analyst forecasts are expressed in monetary terms. Furthermore, during data extraction from Dataguide, some recent-year records were found to contain values for net pension liabilities (i.e. PBO – PA) rather than gross obligations, necessitating adjustments. For firms without disclosed plan asset values, the value of PA was treated as zero. Therefore, to maintain consistency and reduce data-related bias, we adopt the definition based on the monetary difference between assets and obligations.
6. We gratefully acknowledge the anonymous reviewer for pointing out the potential implications of handling missing data. In response, we conducted an additional analysis excluding firms with undisclosed plan asset values, and found that the main results remain directionally consistent and statistically robust, suggesting that our findings are not sensitive to how missing PA values are treated.
7. Discretionary accruals are estimated using the modified Jones model with ROA adjustment (Kothari et al., 2005). The residuals from the following industry-year regression, excluding the firm in question, are used.
8. As a robustness check, we conducted both a two-stage least squares (2SLS) analysis using industry-average PFR and average employee tenure as instruments, and a difference analysis using year-over-year changes in both PFR and forecast bias. Across both methods, only Bias\_CAPEX remained statistically significant, consistent with our baseline results. While we do not claim full causal identification, the persistence of results for capital expenditure forecasts suggests a robust relationship in this dimension.

## References

- Ahn, Y., Yoo, Y., Cho, Y., Shin, H. and Jang, J. (2006), “The impact of financial analysts’ characteristics on earnings forecast accuracy”, *Korean Accounting Review*, Vol. 31 No. 4, pp. 1-24.
- Asthana, S. (1999), “Determinants of funding strategies and actuarial choices for defined-benefit pension plans”, *Contemporary Accounting Research*, Vol. 16 No. 1, pp. 39-74.
- Bae, S., Jung, S. and Oh, K. (2012), “K-IFRS disclosure quality and financial analysts’ earnings forecast dispersion”, *Korean Journal of Management*, Vol. 41 No. 4, pp. 643-674.
- Behn, B.K., Choi, J.H. and Kang, T. (2008), “Audit quality and properties of analysts’ earnings forecasts”, *The Accounting Review*, Vol. 83 No. 2, pp. 327-349, doi: [10.2308/accr.2008.83.2.327](https://doi.org/10.2308/accr.2008.83.2.327).
- Bergstresser, D., Desai, M. and Rauh, J. (2006), “Earnings manipulation, pension assumptions, and managerial investment decisions”, *The Quarterly Journal of Economics*, Vol. 121 No. 1, pp. 157-195.
- Bradshaw, M., Richardson, S. and Sloan, R. (2001), “Do analysts and auditors use information in accruals?”, *Journal of Accounting Research*, Vol. 39 No. 1, pp. 45-74, doi: [10.1111/1475-679x.00003](https://doi.org/10.1111/1475-679x.00003).
- Campbell, J.L., Dhaliwal, D.S. and Schwartz, W.C. (2012), “Financing constraints and the cost of capital: evidence from the funding of corporate pension plans”, *Review of Financial Studies*, Vol. 25 No. 3, pp. 868-912, doi: [10.1093/rfs/hhr119](https://doi.org/10.1093/rfs/hhr119).
- Carroll, T. and Niehaus, G. (1998), “Pension plan funding and corporate debt ratings”, *Journal of Risk and Insurance*, Vol. 65 No. 3, pp. 427-443, doi: [10.2307/253658](https://doi.org/10.2307/253658).
- Chaudhry, N., Au Yong, H. and Veld, C. (2017), “How does the funding status of defined benefit pension plans affect investment decisions of firms in the United States?”, *Journal of Business Finance and Accounting*, Vol. 44 Nos 1-2, pp. 196-235, doi: [10.1111/jbfa.12219](https://doi.org/10.1111/jbfa.12219).

- Chen, X., Yao, T., Yu, T. and Zhang, T. (2014), "Learning and incentive: a study on analyst response to pension underfunding", *Journal of Banking and Finance*, Vol. 45, pp. 26-42, doi: [10.1016/j.jbankfin.2014.04.001](https://doi.org/10.1016/j.jbankfin.2014.04.001).
- Cho, J.S. and Cho, M.H. (2009), "The impact of accrual variability on information asymmetry, earnings forecast, and cost of capital", *Accounting Journal*, Vol. 19 No. 3, pp. 175-199.
- Choi, J.S. and Noh, J.H. (2017), "The impact of pension funding levels relative to defined benefit pension liabilities on corporate bond credit ratings", *Korean Journal of Securities*, Vol. 46 No. 2, pp. 305-342, doi: [10.26845/kjfs.2017.03.46.2.305](https://doi.org/10.26845/kjfs.2017.03.46.2.305).
- Comprix, J. and Muller, K.A., III (2006), "Asymmetric treatment of reported pension expense and income amounts in CEO cash compensation calculations", *Journal of Accounting and Economics*, Vol. 42 No. 3, pp. 385-416.
- Comprix, J. and Muller, K.A. III (2011), "Pension plan accounting estimates and the freezing of defined benefit pension plans", *Journal of Accounting and Economics*, Vol. 51 Nos. 1-2, pp. 115-133.
- Cotter, J., Tarca, A. and Wee, M. (2012), "IFRS adoption and analysts' earnings forecasts: Australian evidence", *Accounting and Finance*, Vol. 52 No. 2, pp. 395-419, doi: [10.1111/j.1467-629x.2010.00392.x](https://doi.org/10.1111/j.1467-629x.2010.00392.x).
- Das, S., Levine, C.B. and Sivaramakrishnan, K. (1998), "Earnings predictability and bias in analysts' earnings forecasts", *The Accounting Review*, Vol. 73 No. 2, pp. 277-294.
- Degeorge, F., Patel, J. and Zeckhauser, R. (1999), "Earnings management to exceed thresholds", *The Journal of Business*, Vol. 72 No. 1, pp. 1-33, doi: [10.1086/209601](https://doi.org/10.1086/209601).
- Franzoni, F. and Marin, J.M. (2006), "Pension plan funding and stock market efficiency", *The Journal of Finance*, Vol. 61 No. 2, pp. 921-956.
- Graham, J., Harvey, C. and Rajgopal, S. (2005), "The economic implications of corporate financial reporting", *Journal of Accounting and Economics*, Vol. 40 Nos. 1-3, pp. 3-73.
- Healy, P.M. and Palepu, K. (2002), "Governance and intermediation problems in capital markets: evidence from the fall of Enron", *Harvard NOM Working Paper No. 02-27*.
- Hong, H.J. and Noh, J.H. (2021), "The impact of defined benefit pension funding on cost of capital", *Korean Accounting Information Review*, Vol. 39 No. 3, pp. 1-31, doi: [10.29189/kaiaair.39.3.01](https://doi.org/10.29189/kaiaair.39.3.01).
- Hutchens, R.M. (1986), "Delayed payment contracts and a firm's labor force profile", *Journal of Labor Economics*, Vol. 4 No. S3, pp. S153-S170.
- Jeong, S.W. and Lim, T.K. (2005), "The persistence of accounting earnings and the accuracy of financial analysts' forecasts", *Korean Accounting Review*, Vol. 30 No. 2, pp. 209-235.
- Jeong, S.W., Bae, S.H. and Lim, T.K. (2012), "The characteristics of financial analysts' earnings forecasts for firms exposed to foreign exchange risk", *Korean Accounting Review*, Vol. 37 No. 4, pp. 1-35.
- Jeong, K.Y., Kwon, S.Y. and Baek, W.S. (2002), "Corporate ownership structure and the information effect of earnings", *Korean Journal of Management*, Vol. 31 No. 6, pp. 1707-1727.
- Jeong, H.W., Lee, H.J. and Lee, K.I. (2014), "The impact of audit hours on financial analysts' earnings forecast bias", *Korean Journal of Management*, Vol. 43 No. 4, pp. 1079-1111.
- Ko, Y.S., Yoo, H.Y. and Lee, M.G. (2011), "The effect of related-party transactions on analysts' forecasts", *Korean Journal of Management*, Vol. 40 No. 5, pp. 1139-1161.
- Kothari, S.P., Leone, A.J. and Wasley, C.E. (2005), "Performance matched discretionary accrual measures", *Journal of Accounting and Economics*, Vol. 39 No. 1, pp. 163-197, doi: [10.1016/j.jacceco.2004.11.002](https://doi.org/10.1016/j.jacceco.2004.11.002).
- Lazear, E.P. (1979), "Why is there mandatory retirement?", *Journal of Political Economy*, Vol. 87 No. 6, pp. 1261-1284, doi: [10.1086/260835](https://doi.org/10.1086/260835).
- Lazear, E.P. (1983), "Pensions as severance pay", in Bodie, Z. and Shoven, J. (Eds), *Financial Aspects of the United States Pension System*, University of Chicago Press, pp. 57-90.
- Lim, T. (2001), "Rationality and analysts' forecast bias", *The Journal of Finance*, Vol. 56 No. 1, pp. 369-385, doi: [10.1111/0022-1082.00329](https://doi.org/10.1111/0022-1082.00329).

- Matsumoto, D. (2002), "Management's incentives to avoid negative earnings surprises", *The Accounting Review*, Vol. 77, pp. 483-514.
- Ministry of Employment and Labor and Financial Supervisory Service (2024), "Korea Retirement Pension Investment White Paper 2024".
- Myers, S.C. (1977), "Determinants of corporate borrowing", *Journal of Financial Economics*, Vol. 5 No. 2, pp. 147-175, doi: [10.1016/0304-405x\(77\)90015-0](https://doi.org/10.1016/0304-405x(77)90015-0).
- Nam, H.J. (2015), "The adoption of IFRS in Korea and financial analysts' earnings forecast characteristics", *Korean Journal of Management*, Vol. 4 No. 3, pp. 933-956.
- Noh, J.H. (2017), "The Korean stock market's evaluation of pension underfunding risk", *Korean Journal of Securities*, Vol. 46 No. 5, pp. 1157-1196, doi: [10.26845/kjfs.2017.12.46.5.1157](https://doi.org/10.26845/kjfs.2017.12.46.5.1157).
- Park, B.J. (2010), "The impact of corporate governance on analysts' earnings forecast errors and accuracy", *Journal of Financial Management*, Vol. 27 No. 1, pp. 31-62.
- Park, J.I., Ji, S.M. and Shin, J.E. (2016), "The impact of tax reporting aggressiveness on financial analysts' earnings forecast errors", *Korean Journal of Management*, Vol. 45 No. 6, pp. 1763-1804.
- Park, J.W. and Lee, W. (2024), "The risk of underfunded defined benefit pension and the stock returns", *Asian Review of Financial Research*, Vol. 37 No. 1, pp. 125-174.
- Rauh, J. (2006), "Investment and financing constraints: evidence from the funding of corporate pension plans", *Journal of Finance*, Vol. 61 No. 1, pp. 33-71, doi: [10.1111/j.1540-6261.2006.00829.x](https://doi.org/10.1111/j.1540-6261.2006.00829.x).
- Shivdasani, A. and Stefanescu, I. (2010), "How do pensions affect corporate capital structure decisions?", *Review of Financial Studies*, Vol. 23 No. 3, pp. 1287-1323, doi: [10.1093/rfs/hhp094](https://doi.org/10.1093/rfs/hhp094).
- Sonu, H.J., Choi, J.H. and Lee, B.H. (2010), "Ownership disparity and financial analysts' earnings forecast errors", *Korean Accounting Review*, Vol. 35 No. 2, pp. 1-34.
- Tan, H., Wang, S. and Welker, M. (2011), "Analyst following and forecast accuracy after mandated IFRS adoptions", *Journal of Accounting Research*, Vol. 49 No. 5, pp. 1307-1357, doi: [10.1111/j.1475-679x.2011.00422.x](https://doi.org/10.1111/j.1475-679x.2011.00422.x).
- Wang, L., Béland, D. and Zhang, S. (2014), "Pension fairness in China", *China Economic Review*, Vol. 28, pp. 25-36.
- Woo, J. and Kim, Y. (2021), "The market impact of futures trading by the National Pension Service of Korea", *Journal of Derivatives and Quantitative Studies*, Vol. 29 No. 1, pp. 45-78.
- Yu, F.F. (2008), "Analyst coverage and earnings management", *Journal of Financial Economics*, Vol. 88 No. 2, pp. 245-271, doi: [10.1016/j.jfineco.2007.05.008](https://doi.org/10.1016/j.jfineco.2007.05.008).

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