MACROECONOMIC DRIVERS OF PROFITABILITY IN BANGLADESH'S CEMENT SECTOR: A PANEL ANALYSIS OF COMPANIES LISTED ON THE DHAKA STOCK EXCHANGE

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Abstract

This study assesses the relative impact of macroeconomic variables and firm-level mechanisms on the profitability of listed cement companies in Bangladesh from 2015 to 2024. A total of 70 firm-year observations across a balanced panel are used to analyze ROA and ROE through panel-regression models selected using diagnostic procedures. The findings show that the determinants explain ROA more effectively than ROE. Broad money growth has a positive and significant effect on ROA which suggests that liquidity expansion may support profitability through credit availability, construction activity, and investment demand. In contrast, leverage and cost intensity negatively affect ROA, indicating that debt burden and rising operating costs constrain profitability in this capital-intensive sector. However, GDP growth, unemployment, exchange rate movement, FDI, and monetary-condition indicators do not show strong direct effects. Overall, the findings highlight the importance of monetary conditions, debt management, cost efficiency, and firm-level resilience for cement-sector profitability.

Keywords : *Firm level mechanism, Return on Assets, Return on Equity, Money Supply, Exchange Rate, FDI, Leverage, Cost Intensity, Asset Turnover*

JEL Classification : *L61, G32, E51, C23, L25, O53*

1. INTRODUCTION

Bangladesh has experienced an impressive economic development during the last ten years, with an average annual GDP growth rate of more than 6% between 2015 and 2024 (World Bank, 2025). A crucial element behind this growth has been the development of infrastructure, which has amplified the demand for building supplies, particularly cement. With thousands of trained and unskilled people employed nationally and generated export revenue of $14.39 million in the first nine months of FY 2023-24, the cement industry is an essential part of Bangladesh's industrial sector (Musa & Akther, 2024). The contribution of this industry to the sustainable development and economic resilience is growing as urbanization has picked up speed, albeit the government-led mega projects have slowed down recently following the recent political shift.

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Notwithstanding the expansion of the industry, cement producers work in a setting influenced by macroeconomic instability. Because of its close relationship to building activity, which usually varies with larger economic cycles, the cement business is sensitive to macroeconomic conditions. Production costs, pricing tactics, and ultimately company profitability are impacted by changes in inflation, monetary policy changes that impact the broad money supply, and changes in foreign direct investment inflows (Omankhanlen, 2011). While under tighter labor market conditions, wage-setting dynamics and operational efficiencies may change, a currency depreciation relative to the US dollar makes imported capital equipment and raw materials more expensive. Such external conditions provide both opportunities and challenges for listed cement companies in managing cyclical building demand changes against continued government fiscal and monetary policy changes.

Consequently, it is not surprising that the capital-intensive nature of the cement industry, closely interlinked with the key strategic area of national development, indeed establishes a link between macroeconomic conditions and firm performance. Therefore, understanding such linkages is justified from a conceptual perspective and is justified by the potential applications for several important stakeholders. For instance, investors want to understand how external economic changes affect firm profits. Also, corporate managers would be optimistic about strategic insights for nominal and real operational decisions and investment implications under macroeconomic uncertainty. In addition, such evidence is crucial for policymakers when assessing how fiscal and monetary policies are transmitted in such key industrial sectors.

The primary objectives of this research are:

- To evaluate the relationships between the selected macroeconomic indicators and profitability metrics of cement sector corporations.
- To determine whether firm-level characteristics, including leverage, cost intensity, and asset turnover, influence the relationship between macroeconomic conditions and profitability.

As a whole, this study investigates how vital macroeconomic variables and firm-level mechanisms influence the profitability of listed cement companies in Bangladesh. As the cement industry is closely related to infrastructure, housing, and other types of construction activities combined with government spending on infrastructure, the profitability of the cement companies is channeled through demand, cost, financing, and capacity-utilization variables for changes in monetary policy, FDI, exchange rates, and overall economic activity. While several past works researched the profitability of cement firms in Bangladesh, only scant evidence exists regarding how such macroeconomic variables are transmitted through firm-level factors, including firm size, asset turnover, leverage, and cost intensity, whether they have significant effects on ROA and ROE. Using listed cement firms in Bangladesh, this paper made an effort to fill the gap and provides practical implications for managers, investors, creditors, and policy planners in view of the goal of financial development.

This study is subject to several limitations. The use of yearly statistics may obscure short-term reactions to policy changes and intra-year volatility. Although the study incorporates particular firm-level variables, namely leverage, cost intensity measures, asset turnover, and firm size, still, broad governance-related variables, such as board composition, ownership structure, and quality of management, are not considered. The monetary-policy channel was retained through the PCA-based Inflation–Real Interest Monetary Conditions Index (IR-MCI). However, this index is a constructed measure that cannot substantively represent the monetary transmission channel wholly. Finally, the study is limited to seven listed cement companies in Bangladesh. Hence, the results are not relevant to unlisted companies or industries or even a different economy.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Cement companies profit considerably from macroeconomic variables, which affect input costs and demand-side dynamics. An in-depth review of existing literature establishes that the influence of macroeconomic variables on cement company profits varies across geographies and economic environments. These findings are attested by empirical studies conducted in developing countries within the South Asian region, such as Bangladesh. The studies in this region reported that the cement industry is significantly affected by the country's economic conditions, exchange rate dynamics, and infrastructural investment.

A firm's financial health hinges on one critical factor: profitability. It is the main measure of how well a company can generate returns and reflects the core efficiency of its operational model. One can talk about a firm's growth potential or how innovative they are, but when it comes down to if a firm is increasing its profits or generating profit from its operations and assets, the responses are fairly academic. In terms of estimation, most people consider a firm's ROA (Return on Assets), ROE (Return on Equity), and perhaps most importantly, its ROI (Return on Investment) as the three key measures of profitability (Van Horne & Wachowicz, 2005; Hanif et al., 2024).

Multiple countries' research consistently identifies macroeconomic influences on the profitability of the cement industry. Ibrahim and Sidam (2021) found that in Nigeria, inflation, exchange rates, and interest rates showed a negative impact on the profitability of cement firms, while GDP growth correlation was positive. Giang (2023) enriched this narrative with a study in Vietnam that also looked at financial indicators like, financial leverage, solvency ratio, and cost-to-revenue ratio which also showed negative impacts on cement firm profitability. More recently, Ibrahimov et al. (2025) studied the cement industry in Turkey and found that interest rates, unemployment, and a composite Macroeconomic Stress Index shows significant association with profitability. The composite index on accessibility and the costs of loans and construction materials, and construction labor strongly predicts the profitability of the cement industry in Turkey.

Similar findings were made by Puci et al. (2023) in Albania, who found that interest rates and GDP growth were good indicators of profitability whereas inflation and

exchange rates had a detrimental impact on business performance. Such findings align with broader empirical evidence suggesting that economic stability induces higher profitability levels through its favorable effect on investment confidence and reducing operational expenses. Indeed, Liu (2006) empirically argued that profitability responds not only to changes in macroeconomic variables but also to variations to productivity, input quantities, and relative prices among different firms in the Taiwanese cement industry. These results support the widely held view in the literature that businesses operating under favorable and stable macroeconomic conditions are expected to have relatively higher profitability levels.

The findings of these various South Asian studies reinforce the belief that macroeconomic variables substantially impact the profitability of cement manufacturing firms. Bhayani (2010) explored the role of liquidity, age of the firm, operational profit margin, interest rates, and inflation in determining profit in the Indian cement industry. Using regression analysis, the author inferred that while higher interest and inflation rates negatively impacted firm profitability measures, liquidity and operational efficiency were positively related to them in both cases. In explaining this, the author argued that moderate inflation could be translated in pricing the firm's products to compensate for cost increases, although it makes them relatively more expensive. The author also suggested that the two best dependent variables of profitability in his model were ROA and ROE, which would also be acceptable in the South Asian context.

Karim and Kamruzzaman (2022) empirically investigated financial structure impacts on firm profitability using pooled OLS regression, fixed effect, and random effect methods in Bangladesh and found that long-run debt ratios negatively impact profitability. In contrast, short-term debt ratios have a rather strong positive relationship with profitability, measured by ROE and ROA. These two indicators give a broader idea of the shareholder return (ROE) and operational efficiency (ROA), thus indicating the firm's overall success. Although firm age negatively correlates with profitability, firm size, asset turnover, and growth positively correlate with profitability. It can be implied that proliferation opportunities would lean toward young firms rather than older ones.

Similar evidence was obtained by Rezina et al. (2020), who analyzed what determines the profitability of the cement industry in Bangladesh and underlined that management decisions on leverage, asset structure, and operating efficiency have a substantial impact on profitability outcomes. The explanatory variables in their model included interest rate, GDP growth rate, and Return on Assets (ROA) as a measure of profitability. Although macroeconomic variables were better able to explain inter-firm differences, the authors have also taken into consideration firm-specific determinants.

Another important macroeconomic variable widely explored in the literature has to do with exchange rate volatility, as many Asian countries import coal and clinker as basic raw materials. According to Mohd and Siddiqui (2020), cement firms

suffer from currency devaluation since it raises the cost of inputs. He discovered that companies with significant exposure to foreign exchange, such as a number of cement manufacturers in Bangladesh, had unstable profit margins.

In a time-series investigation of Pakistan's cement industry, Saeed (2012) verified that interest rate volatility had a detrimental effect on profitability. Higher borrowing costs serve as a restraining factor on investments in fixed assets and thus denies companies the ability to expand their businesses. Earnings per share (EPS) being an indicator of wealth creation from the shareholders' perspective, pertains more to companies whose shares are traded on stock exchanges. This study further considers EPS as a profitability variable. Tse and Raftery (2001) regard money supply as an important macroeconomic variable influencing construction activity. They found that broad money supply has a significant causal relationship with construction flows, suggesting that monetary expansion may increase cement demand through higher liquidity, credit availability, and construction-sector activity.

Foreign Direct Investment (FDI) is another factor that catalyzes more competitive, productive, and innovative cement industries. In this sense, a study by Mohd and Siddiqui (2020) argued that FDI inflows into South Asia led to proliferation in the profitability of capital-intensive sectors. Moreover, the study notes that the maintenance of macroeconomic stability neutralized the potential benefits of higher FDI to productivity.

More recently, firm-specific, macroeconomic, and capital structure determinants of profitability in the industrial context in South Asia were analyzed by Ullah et al. (2020). Their findings validated the inclusion of core profitability metrics like ROA and ROE, while confirming the significant impact of interest, exchange rate, and inflation shocks.

From the above evidence, it appears that the that profitability in the cement industry can be explained by determinants at both macro and micro levels. However, not all macro variables influence profitability similarly at the firm level: the influence is realized at the firm level through leverage, cost intensity, asset turnover, and size of the firm. This is of particular importance in cement manufacturing as the industry has high capital requirements in the aspect of plant, machinery, and raw materials, as well as energy inputs and distribution networks.

Another important transmission channel will be leverage. Most cement firms have a huge need to borrow funds for capacity expansion and fixed asset creation. Therefore, once interest rates rise, an increase in interest payments shrinks net income, especially under high leverage. This was supported in Giang (2023), who confirmed a negative relationship between debt and profitability. Rezina et al. (2020) empirically showed that leverage adversely influences the profitability of cement firms in Bangladesh. By a similar logic, variations in the costs of inputs such as fuels, electricity, clinker, limestone, transport, and imported goods create associated cost changes that, when rising, deplete profits. Such inputs are all affected by inflation or

foreign exchange depreciation; hence, profit margins will deteriorate in cases where the firm cannot raise prices correspondingly. Similar evidence emerges from recent studies by Ibrahim (2021), Puci et al. (2023), Giang (2023), and Hanif et al. (2024), all of which find that inflation, exchange rates, and interest rates unfavorably affect cement company performance.

Asset turnover, capacity utilization, and firm size are other dimensions through which profitability differentials can be explain for cement companies. GDP growth, higher investments in infrastructure, and increases in the money supply and FDI all stimulate large-scale construction activities that demand cement and induce the firm to utilize its installed capacity in a more optimum manner. In this vein, Liu (2006) posited that cement firms' profitability is related not only to macroeconomic variables but also to changes in firm-specific differences, including input use, productivity, and relative prices. For instance, larger firms enjoy economies of scale, greater efficiency in distribution, access to cheaper financing, and better negotiation power with their suppliers. For this reason, macroeconomic variables should be analyzed together with firm-level factors through which external changes in the economic environment affect profitability.

The selection of variables in this study is backed by strong theoretical support. According to Bain (1951), the Structure-Conduct-Performance paradigm provides the theoretical basis for the inclusion of macroeconomic variables within profitability studies because these external market and economic conditions directly impact industry performance. Resource-based view of the firm, which was formalized into an empirical framework by Barney (1991), identifies that resources and capabilities at the firm level, such as firm size, cost efficiency, and asset utilization, would explain the difference in firms' profitability performance. Based on the pecking order theory, leverage also impacts profitability because a firm's financing structure reflects its profitability: highly profitable firms rely on internal funds, while less profitable firms have to resort to incurring a debt burden and borrowing costs (Myers & Majluf, 1984). Hence, the choice of variables can be traced to both the existing literature and theoretical models that connect firm performance to macroeconomic factors, firm resources, and financial structure to explain profitability.

Panel data is very much salient in profitability studies as it accommodates firm heterogeneity across cross-section and over time. Typical approaches involve pooled OLS, fixed-effects, and random-effects models as the major models of comparison to tackle unobserved heterogeneity, differentiation, and economic meaning at the firm level (Baltagi, 2021; Giang, 2023; Wooldridge, 2010). Recent empirical works on firm profitability, capital structure, firm performance, and leverage, using dependent variables such as ROA and ROE, usually pursue this approach while also integrating determinants such as leverage and firm size (Singh & Bagga, 2019; Ahmed & Bhuyan, 2020; Karim & Kamruzzaman, 2022). Identification of the final model among random effects and fixed effects models within a panel framework is usually based on the Hausman test (Hausman, 1978). Thus, previous methodological and

empirical studies support the use of panel-model selection procedures in profitability research.

This study attempt to fill a gap in the current literature by empirically examining the influence of macroeconomic variables on ROA and ROE while considering firm-level transmission channels in Bangladesh's listed cement sector. Unlike prior studies, which have treated firm-specific and macroeconomic determinants of profitability separately, this study links macroeconomic conditions to leverage, cost intensity, asset turnover variables, and firm size to explain the variation in profitability across firms better.

3. DATA METHODOLOGY

3.1 Data Sources

The dataset for this study constitutes annual observations that span over ten years: from 2015 to 2024. That makes a balanced panel dataset of 70 firm-year observations for all seven cement companies currently listed on the Dhaka Stock Exchange (DSE). As only secondary data was used, originally published and thus available in the public domain, there were no privacy issues at the level of the individual. All firm-level financial data, such as ROE, ROA, leverage, cost intensity, asset turnover, and firm size have been collected directly from the companies' annual reports. Macroeconomic data, including GDP growth, inflation, broad money (M2) growth, FDI, unemployment rate, and lending interest rate have been collected from the World Bank's World Development Indicators data source (World Bank, 2025). The CUEX (Centralized Uniform Currency) platform, a centralized system for reporting official foreign exchange rates, provided the foreign currency data needed to calculate the mid-year rate between the IMF SDR and the Bangladeshi taka. The sampling frame ensures full coverage of the industry, enhancing external validity.

3.2 Explained Variables

This study employs two distinct company profitability metrics as dependent variables which are presented in Table 1, Return on Equity (ROE), which measures the return produced for equity investors, is calculated by dividing net income by average shareholders' equity. Return on Assets (ROA), which is computed by dividing net income by average total assets, shows how well a company uses its asset base to produce profits. From the perspective of firm-specific determinants of corporate performance, many of these variables have been used either exclusively or bundled in explaining performance from various operating and financial perspectives. Because several indicators depict different aspects of a relationship, no single profitability metric can adequately capture the industry's profit-generating capacity. Each company's annual ROE and ROA values were computed from audited financial statements and cross-checked for every firm.

Table 1: Summary of Variables

Variable	Type	Calculation/Definition
ROA (Return on Assets)	Dependent	Net income/Average total assets
ROE (Return on Equity)	Dependent	Net income/Average shareholder's equity
GDP Growth Rate	Independent	Lagged GDP growth (prior year %)
Foreign direct investment	Independent	FDI, net (Natural Log, current US$)
Unemployment Rate	Independent	Unemployment, total (% of total labor force)
Broad Money Growth	Independent	Broad money growth (annual %, current BDT)
Exchange Rate	Independent	(BDT/XDR, % change)
Inflation Rate	Index construction variable	Consumer prices (annual %)
Real Interest Rate	Index construction variable	Nominal lending interest rate minus inflation rate (%)
IR-MCI	Independent / monetary-condition variable	First principal component of inflation and real interest rate
Leverage	Firm-level mechanism variable	Total debt / Total assets
Cost Intensity	Firm-level mechanism variable	Cost of goods sold / Revenue
Asset Turnover	Firm-level mechanism variable	Revenue / Average total assets
Firm Size	Control variable	Natural logarithm of total assets
IR-MCI × Leverage	Interaction term	Monetary conditions × leverage
Exchange Rate × Cost Intensity	Interaction term	Exchange-rate movement × cost intensity
GDP Growth × Asset Turnover	Interaction term	GDP growth × asset turnover

3.3 Explanatory Variables

Table 1 also lists the explanatory variables used in this study. The macroeconomic variables include GDP growth rate, Foreign Direct Investment, Unemployment Rate, Broad Money (M2) growth, Exchange Rate movement, and Monetary Conditions. Initially, the real lending interest rate and inflation rate showed close theoretical conformance as channels of monetary policy. But due to extremely high multicollinearity of the two variables, an Inflation–Real Interest Monetary Conditions Index (IR-MCI) was constructed using principal component analysis

based on inflation and real interest rates as proxies, where real interest rate is defined as the nominal lending interest rate minus inflation. The index was oriented so that a high score on the IR-MCI index corresponds to an inflationary monetary condition. Firm-level variables were also included for mechanism testing. Leverage captures the financial leverage channel, cost intensity captures the cost-exposure channel, and asset turnover captures the operating-efficiency channel. Firm size is included as a control variable to account for scale-related differences in profitability.

The choice of independent variables has been justified based on theoretical relevance and identified precedence in the literature. All the variables representing macroeconomic conditions were collected for annual frequencies and converted to or used in year-over-year percentage changes or log-transformed series when necessary to ensure stationary series.

3.4 Analytical Process

The data were subjected to initial analysis, including descriptive statistics, followed by a Pearson correlation matrix and panel regression analysis. The baseline models were followed by firm-level mechanism tests using interaction terms. The data were validated thoroughly prior to regression estimation through multicollinearity, heteroskedasticity, and serial-correlation diagnostics. To allow replicability and alignment with conventional econometric practice, all regression analyses, diagnostic tests, and all transformations on the data were performed using IBM SPSS Statistics Version 27.

3.5 Model Specification

Two separate models of multiple linear regressions were run for ROE and ROA. Based on the Hausman test results, the random-effects was selected as the preferred specification for both profitability measures. The random-effects model allows the analysis to account for unobserved firm-specific heterogeneity while retaining both within-firm and between-firm variation in the panel dataset. The baseline random-effects models are:

$$ROE_{i,t} = \beta_0 + \beta_1 GDP_t + \beta_2 FDI_t + \beta_3 UNEM_t + \beta_4 M2_t + \beta_5 EX_t + \beta_6 IRMCI_t + \beta_7 SIZE_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

$$ROA_{i,t} = \beta_0 + \beta_1 GDP_t + \beta_2 FDI_t + \beta_3 UNEM_t + \beta 4 M2_t + \beta_5 EX_t + \beta_6 IRMCI_t + \beta_7 SIZE_{i,t} + \mu_i + \varepsilon_{i,t} \quad (2)$$

where,

$ROE_{i,t}$ = Return on Equity of the firm i at time t,

$ROA_{i,t}$ = Return on Assets of the firm i at time t,

GDP_t = GDP Growth Rate at time t,

FDI_t = Foreign Direct Investment at time t,

$UNEM_t$ = Unemployment Rate at time t,

$M2_t$ = Broad Money Growth i at time t,

EX_t = Exchange Rate Movement at time t,

$IRMCI_t$ = Inflation–Real Interest Monetary Conditions Index at time t,

$SIZE_{i,t}$ = firm size of firm i at time t,

μ_i = firm-specific random effect,

$\varepsilon_{i,t}$ = Error term,

$\beta_0, \beta_1, ... \beta_7$ Regression coefficient

3.6 Firm-Level Mechanism Testing

To address the possibility that macroeconomic conditions affect profitability through internal firm-level channels, the study incorporates firm-level mechanism testing. Three mechanisms are examined: financial leverage, cost exposure, and operating efficiency. The financial leverage mechanism was tested through the interaction between IR-MCI and leverage. The cost-exposure mechanism was tested by interacting exchange-rate movement with cost intensity. The operating-efficiency mechanism is tested through the interaction between GDP growth and asset turnover.

The mechanism tests are estimated using interaction-based random-effects models. The first mechanism model examines whether firms with relatively high indebtedness are more responsive to macroeconomic variable-driven changes in profitability:

$$Profitability_{i,t} = \beta_0 + \beta_1 GDP_t + \beta_2 FDI_t + \beta_3 UNEM_t + \beta_4 M2_t + \beta_5 EX_t + \beta_6 IRMCI_t + \beta_7 LEV_{i,t} + \beta_8 (IRMCI_t \times LEV_{i,t}) + \beta_9 SIZE_{i,t} + \mu_i + \varepsilon_{i,t} \quad (3)$$

The second mechanism model examines whether exchange-rate movement affects profitability more strongly among firms with higher cost intensity:

$$Profitability_{i,t} = \beta_0 + \beta_1 GDP_t + \beta_2 FDI_t + \beta_3 UNEM_t + \beta_4 M2_t + \beta_5 EX_t + \beta_6 IRMCI_t + \beta_7 COST_{i,t} + \beta_8 (EX_t \times COST_{i,t}) + \beta_9 SIZE_{i,t} + \mu_i + \varepsilon_{i,t} \quad (4)$$

The third mechanism model examines whether GDP growth translates more effectively into profitability for firms with stronger asset utilization:

$$Profitability_{i,t} = \beta_0 + \beta_1 GDP_t + \beta_2 FDI_t + \beta_3 UNEM_t + \beta_4 M2_t + \beta_5 EX_t + \beta_6 IRMCI_t + \beta_7 ATO_{i,t} + \beta_8 (GDP_t \times ATO_{i,t}) + \beta_9 SIZE_{i,t} + \mu_i + \varepsilon_{i,t} \quad (5)$$

where $Profitability_{i,t}$ represents either ROA or ROE, $LEV_{i,t}$ represents leverage, $COST_{i,t}$ represents cost intensity, and $ATO_{i,t}$ represents asset turnover. The interaction terms were constructed from the mean-centered variables to reduce nonessential multicollinearity. In such a case, a significant coefficient on the interaction term provides some evidence that the relevant firm-level characteristic conditions the relationship between macroeconomic variables and profitability.

3.7 Diagnostic Tests and Inference

Variance Inflation Factor (VIF) analysis was used to assess multicollinearity before regression estimation. Due to a high degree of multicollinearity between the nominal lending interest rate and the inflation rate, the monetary-policy channel was retained through the PCA-based IR-MCI instead of including them as separate regressors.

The Hausman test was used to choose between fixed-effects and random-effects estimators, which favored the random-effects models for ROA and ROE. Heteroskedasticity was examined using the Breusch–Pagan test, serial correlation was assessed using the Wooldridge test, and cross-sectional dependence was tested using the Pesaran CD test. The ROA model showed no heteroskedasticity, serial correlation, or cross-sectional dependence at the 5% level, whereas the ROE model showed evidence of all three. Therefore, the final random-effects models were estimated using robust standard errors, which were applied consistently across the reported specifications.

4. EMPIRICAL RESULTS

4.1 Descriptive Statistics

The Table 2 provides a summary of the key descriptive statistics of the variables under study, including the profitability measures, macroeconomic variables, and firm-level mechanism variables. The summary statistics presented in the form of observations, mean, standard deviation, minimum and maximum values, serve as the baseline for further statistical analysis and interpretation.

Table 2: Descriptive Statistics

	Observation	Mean	Std. dev.	Min	Max
ROA	70	3.31	5.50	-8.86	18.21
ROE	70	-1.07	58.15	-423.68	123.73
GDP	70	6.29	1.36	3.45	7.88
Exchange	70	2.70	5.62	-9.45	12.90
M2 growth	70	12.11	3.20	7.01	16.70
FDI	70	21.31	0.24	20.94	21.74
Unemployment	70	4.61	0.40	4.19	5.40
IR-MCI	70	0.00	1.30	-1.15	2.38
Firm Size	70	23.20	0.66	21.49	24.32
Leverage	70	0.65	0.20	0.27	1.10
Cost Intensity	70	0.86	0.19	0.64	1.87
Asset Turnover	70	0.73	0.36	0.02	1.86

The mean ROA is 3.31, indicating that cement shares recorded a modest level of profit generated from assets over the sample period. On the other hand, the mean ROE was -1.07, implying poor profitability computed from equity holders. The standard deviation is 58.15, with a minimum value of -423.68, suggesting extremely wide dispersion in profitability from equity, with one company getting spectacular losses from the equity measure.

The macroeconomic variables also show meaningful variation across the sample period, with growth of GDP, for example, having an average of 6.29, while the

average growth of M2 is 12.11. Exchange rate is 2.70 on average, with a standard deviation 5.62, indicating a high variability within the study period. Since the IR-MCI was constructed through PCA-based index, the series mean value is zero. A higher index value will indicate more monitory pressure from an inflationary standpoint.

Among the firm-level variables, leverage averaged 0.65, indicating that debt represented a substantial portion of firm financing. Average cost intensity stood at 0.86, indicating that production costs absorbed a large share of revenue in the cement sector. Asset turnover averaged 0.73, and size stood at 23.20 in logarithmic form.

4.2 Correlation Matrix

The correlation matrix from Table 3 provides a complete examination of the linear relationships among profitability, macroeconomic variables, and firm-level characteristics. The strength and direction of the relationships between the independent variables and the dependent variables (ROE and ROA) are revealed by the correlation coefficients and their corresponding significance levels.

The correlation matrix shows a significant positive association between ROA and ROE, with $r = 0.432$ and $p = 0.000$. Other important ROA determinants are positively correlated with M2 growth, firm size, and asset turnover. In this case, the correlation coefficient between ROA and M2 is 0.256, with 0.033 significance. Similarly, ROA is also significantly correlated with firm size ($r = 0.369$; $p = 0.002$) and asset turnover ($r = 0.274$; $p = 0.022$).

Furthermore, at the firm level, the most significant determinants of profitability are leverage and cost intensity. ROA exhibits significant negative correlation with leverage and cost intensity: -0.807 and -0.595, respectively. Likewise, sizeable negative correlations manifest for ROE with leverage and cost intensity: -0.347 and -0.483. These indicate that very low profitability occurs where significant debt and high levels of cost burden exist.

IR-MCI is significantly correlated with several macroeconomic variables, including GDP, FDI, M2, and exchange-rate movement. Hence, this suggests that the macroeconomic variables were moving together in the given sample period; more so, given that IR-MCI proved highly correlated with M2 and exchange-rate movements, thus justifying the need for an analysis of the VIF and subsequent use of the IR-MCI based on principal component analysis (PCA), which reduces multicollinearity.

Table 3: Pearson's Correlation Matrix

	ROA	ROE	GDP	FDI	Unemployment	M2 growth	Exchange	IR-MCI	Firm Size	Leverage	Cost Intensity	Asset Turnover
ROA	1											
ROE	0.432**	1										
GDP	0.098	-0.033	1									
FDI	0.230	0.073	0.574**	1								
Unemployment	-0.038	0.055	-0.614**	-0.495**	1							
M2 growth	0.256*	0.153	0.399**	0.723**	-0.184	1						
Exchange	-0.176	-0.187	-0.125	-0.665**	0.045	-0.689**	1					
IR-MCI	-0.192	-0.153	-0.429**	-0.752**	0.144	-0.905**	0.761**	1				
Firm Size	0.369**	0.204	-0.175	-0.383**	0.190	-0.411**	0.339**	0.369**	1			
Leverage	-0.807**	-0.346**	-0.101	-0.220	0.028	-0.274*	0.208	0.232	-0.442**	1		
Cost Intensity	-0.595**	-0.483**	-0.131	-0.258*	0.030	-0.326**	0.278*	0.329**	-0.238*	0.517**	1	
Asset Turnover	0.274*	0.268*	0.137	0.109	-0.077	0.074	-0.045	-0.068	0.053	-0.252*	-0.265*	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

4.3 Test for Multicollinearity

The test for multicollinearity was conducted using the Variance Inflation Factor (VIF) analysis to assess the degree of correlation among the independent variables. The VIF measures the extent to which multicollinearity inflates a regression coefficient's variance. Generally, VIF values beyond 5 to 10 are considered indicative of multicollinearity problems because they imply a strong association between one or more predictor variables, inducing unstable estimates in model coefficients.

Initially, the VIF test was conducted for all independent variables, including GDP, Inflation Rate, FDI, Exchange Rate, Broad Money (M2), Unemployment Rate, and Real Interest Rate. The results shown in Table 4 revealed that real interest rate and inflation rate have an abnormally high VIF values of 24.11 and 13.41 respectively, suggesting significant multicollinearity. The remaining variables have VIF values ranging from 4.60 to 5.90.

To mitigate potential multicollinearity problems and preserve the monetary-policy channel, the interest rate was dropped and replaced by an Inflation–Real Interest Monetary Conditions Index (IR-MCI). That combines inflation and real interest rate into a single monetary-condition variable. This brought down the VIF for all other explanatory variables to between 2.13 and 5.69. These modified VIF values, which are displayed in Table 4, show a considerable reduction in multicollinearity and indicate that the independent variables are sufficiently independent of one another.

Table 4: VIF Values Pre- and Post-adjustment

	Pre-Adjustment VIF	**Post-Adjustment VIF**
GDP	4.89	2.44
M2	5.83	5.69
FDI	4.71	4.33
Exchange	4.60	3.30
Unemployment	5.90	2.13
RIR	24.11	
Inflation	13.41	
IR-MCI		8.35

4.4 Test for Heteroskedasticity

This study utilized Breusch–Pagan test for checking heteroskedasticity, which identifies whether the variance of the error terms is non-constant across observations, in the dataset. If the p-value of chi-squared test is less than 0.05, then it means heteroskedasticity exists. The test for the regression model using ROE ($p < 0.001$) rejected the null of homoskedasticity, indicating the presence of heteroskedasticity, but the model for ROA ($p = 0.0679$) did not contain heteroskedasticity. As a result, robust standard errors were used for the ROE model. For consistency, robust standard errors were also used across the final random-effects specifications.

4.5 Test for Serial Correlation

To assess the presence of serial correlation in the regression residuals, which determines whether the error terms are correlated with their own past values over time, this study employed the Wooldridge test for panel data. A p-value of less than 0.05 confirms the presence of serial correlation. In this case, model based on ROA did not show evidence of serial correlation, with a p-value of 0.1337. In contrast, the ROE model exhibited serial correlation (p = 0.0002). These results indicate that the ROE specification required correction for serial correlation. Therefore, final inference was based on random-effects models with robust standard errors.

4.6 Cross-Sectional Dependence

The Pesaran CD test was used to examine residual dependence across firms, which detects whether the error terms are correlated across different companies within the same time period. The ROA model shows no evidence of cross-sectional dependence, with a p-value of 0.1233. Whereas the ROE model rejected the null hypothesis of no cross-sectional dependence (p = 0.0000). This is plausible because listed cement firms face common macroeconomic and industry-wide shocks. Therefore, the ROE results are interpreted cautiously using robust standard errors.

4.7 Model Selection

The Hausman specification test was used to determine whether the fixed-effects or random-effects estimator was more appropriate for the panel regression models. Under the Hausman test, the null hypothesis states the random-effects estimator is consistent and efficient. For ROA (p = 0.976) and ROE (p = 0.989), the null hypothesis could not be rejected, indicating that the data would be fit for the random-effects model. Accordingly, the random-effects estimator was selected for the baseline and firm-level mechanism models. This specification acknowledges unobserved heterogeneity across firms and would allow estimators to identify both within-firm and between-firm variation within the panel data structure.

4.8 Results of Random Effects Regression

The Hausman specification test allowed the application of a random effect for both ROA and ROE. Random-effect estimates with robust standard errors are thus reported to estimate the final baseline models (1) and (2).

Table 5: Model Summary

	Wald Chi-square	Model Sig.	Within-R^2	Wooldrige Test P-value	Breusch–Pagan test P-value	Pesaran CD Test P-value	Hausman Test P-value
ROE	8.23	0.3129	0.0426	0.0000	0.0000	0.0000	0.989
ROA	19.48	0.0068	0.2042	0.1337	0.0679	0.1233	0.976

4.8.1 Return on Equity

According to the model summary in Table 5, the baseline random-effect ROE model gives a Wald chi-square p-value of 0.3129, and this is not significant at the 5% level. The within R-squared is 0.0426, indicating limited explanatory power for year-to-year changes in ROE within firms.

Results are reported in Table 6 for individual coefficients, showing that in the baseline ROE model, M2 growth has a positive and statistically significant coefficient of 4.093, with a p-value of 0.044. This implies that as the growth in broad money increases, so does ROE. The firm size coefficient in this case is 28.167; it is positive and statistically significant with a probability value of 0.052. Other independent variables in the baseline model for ROE were insignificant, including GDP, FDI, unemployment, exchange, and IR-MCI. Their coefficients are -2.899, -18.742, -5.070, -2.068, and 0.129, respectively.

Table 6: Baseline and Firm-level Coefficients of ROE Model

	Baseline Coefficient	Robust SE	P-value	Leverage channel Coefficient	Cost channel Coefficient	Turnover channel Coefficient
gdp	-2.899	2.537	0.253	-3.925	-4.635	-3.591
fdi	-18.742	33.385	0.575	-21.338	43.303	-22.407
unemployment	-5.070	7.201	0.481	-7.699	-2.712	-6.317
m2	4.093**	2.031	0.044	2.890*	7.448	4.217**
exchange	-2.068	2.206	0.348	-1.890	-3.221	-1.979
ir_mci	0.129	3.435	0.97	1.944	20.903	-0.081
firm_size	28.167*	14.524	0.052	18.007*	21.222**	28.035**
leverage				-59.419*		
cost intensity					137.561	
asset turnover						41.229*
int_irmci_lev				-44.902**		
int_ex_cost					-40.612**	
int_gdp_ato						13.942
constant	-257.689	400.661	0.52	107.211	-1563.106	-199.138

** Coefficient is significant at the 0.05 level

* Coefficient is significant at the 0.1 level

4.8.2 Return on Assets

As is evident from the Model Summary in Table 5, the baseline random effects model for ROA is significant, and its Wald chi-square p-value is 0.0068. The dependent variable explained about 20.42% of its within-variation as reflected by the within R-squared. Thus, the variation explained by the model supports a moderate level of asset return explanation across time within the sampled firms.

The coefficients reported in Table 7 reveal that two of the predictors of ROA exert a statistically significant effect. M2 growth has a positive and statistically significant coefficient of 0.987 at 1% significance, with a p-value of 0.009, which means the growth of broad money affects ROA positively when controlling for the effect of other variables. Foreign direct investment is positive at 10%, with a coefficient of 6.979 and a p-value of 0.080. The firm size is also positive at 10%, with a coefficient of 3.477 and a p-value of 076. GDP, unemployment, exchange rate movement, and IR-MCI have no significant impact on the baseline ROA results. Their coefficients are -0.060, 0.991, -0.042, and 1.775, respectively, which indicates that all these variables are zero individually at the 10% significance level in terms of their effects on ROA.

Table 7: Baseline and Firm-level Coefficients of ROA Model

	Baseline Coefficient	Robust SE	P-value	Leverage channel Coefficient	Cost channel Coefficient	Turnover channel Coefficient
gdp	-0.060	0.465	0.897	-0.166	-0.047	-0.213
fdi	6.979*	3.985	0.08	4.879	5.918	6.794*
unemployment	0.991	1.678	0.555	0.385	0.922	0.752
m2	0.987**	0.376	0.009	0.474	0.787**	1.005**
exchange	-0.042	0.074	0.574	0.012	0.002	-0.042
ir_mci	1.775	1.134	0.117	1.388	1.700	1.689
firm_size	3.477*	1.959	0.076	1.379	2.656	4.026*
leverage				-19.785**		
cost intensity					-11.994**	
asset turnover						3.037
int_irmci_lev				-3.907		
int_ex_cost					0.384	
int_gdp_ato						-0.193
constant	-242.122*	129.668	0.062	-126.082	-187.675	-251.278*

** Coefficient is significant at the 0.05 level

* Coefficient is significant at the 0.1 level

4.9 Firm-Level Mechanism Testing

Firm-level mechanism testing was conducted using interaction terms. Three channels were examined: financial leverage, cost exposure, and operating efficiency. The models were estimated using random-effects regression with robust standard errors. The coefficient values are presented in Tables 6 and 7 for ROE and ROA respectively.

4.9.1 Financial Leverage Mechanism

The financial leverage mechanism was tested using the interaction between IR-MCI and leverage. In the ROA model, the coefficient for leverage is negative and

statistically significant at 19.785 with a p-value of 0.000; that means a larger financial leverage position reduces asset profitability. However, the interaction term IR-MCI × Leverage is not significant in the ROA model.

The interaction term IR-MCI × Leverage is negative for the ROE model, equal to -44.902, and significant at a p-value of 0.001. This supports the financial leverage mechanism for equity profitability. The result suggests that a firm with a large financial leverage position would have its ROE fall more sharply under the inflationary monetary conditions. Leverage itself is also significant at 10% with a coefficient of -59.419 and a p-value of 0.091.

4.9.2 Cost-Exposure Mechanism

The cost-exposure mechanism was tested through the interaction term Exchange × Cost Intensity. In the ROA model, the coefficient for Cost Intensity is negative and significant 11.994 at a p-value of 0.036. Thus, firms with heavy cost burdens show low ROAs. Nevertheless, the interaction term Exchange × Cost Intensity fails to be significant in the ROA model.

As for the ROE model, the coefficient for the interaction term Exchange × Cost Intensity is shown to be negative and significant at -40.612 with an estimated p-value of 0.038, indicating that there is a cost exposure mechanism for equity profits. The relationship suggests that increased exchange rate pressure leads to a decrease in the rate of return on equity for firms with higher cost intensity. There is a statistically significant positive parameter for firm size, 21.222 with a $p = 0.024$.

4.9.3 Operating-Efficiency Mechanism

The operating-efficiency mechanism was tested using the interaction between GDP growth and asset turnover. In the ROA model, the coefficient estimate for asset turnover is positive but insignificant ($\beta = 3.037$). The coefficient for the interaction GDP × Asset Turnover is also another insignificant estimate ($\beta = -0.193$). The above does not support the operating efficiency mechanism in the ROA case.

In the ROE model, asset turnover is positive and statistically significant at the 10%, with a coefficient of 41.229 and a p-value equal to 0.081. However, the estimated GDP × Asset Turnover parameter is insignificant ($\beta = 13.942$), which suggests that during the sample period, there was no transmission of GDP growth into profitability through asset turnover. In the ROE asset-turnover case, the M2 coefficients maintain their positive and significant signs ($\beta = 4.218$; $p = 0.013$). Firm size was also significant and positively associated with ROE ($\beta = 28.035$; $p = 0.001$).

5. DISCUSSION

5.1 Differential Effects on ROE and ROA

The results for the Random Effects Regression indicate that the selected macroeconomic and firm-level variables explain ROA more effectively than ROE. The ROA model is statistically significant (Wald $\chi^2 = 19.48$; $p = 0.0068$), which is

consistent with Rezina et al. (2020), who also found ROA model to be significant for Bangladeshi cement companies. Similar findings were reported by Ibrahim (2021) in the Nigerian context, where he observed that macroeconomic variables jointly affected ROA in cement firms. This suggests that asset-based profitability is meaningfully influenced by the explanatory variables used in this study.

However, the overall explanatory power of ROE is weak (Wald $\chi^2 = 8.23$; $p = 0.3129$), which is not in line with the findings from Karim and Kamruzzaman (2022) and Hanif et al., (2024), who found statistically significant evidence in support of the ROE model in the cement sector. This weak ROE result suggests that, at least in the present sample, shareholder return on equity is more sensitive to firm-level financing, equity structure, retained earnings, and dividend-related aspects which are not wholly captured in the model.

5.2 Theoretical Interpretation of the Findings

The findings can be interpreted through the Structure-Conduct-Performance paradigm and the Resource-Based View. According to the Structure-Conduct-Performance framework, the driving forces of firm conduct and performance are the structure of the industry and the macroeconomic environment (Bain, 1951). Within the cement industry, this is indicated by the level of demand for cement products, costs of materials and fuels, financing conditions, and investment in capacity expansion. That also explains why construction demand, cost pressures, and development lending structures are considered significant channels through which monetary growth, inflation, exchange rates, and FDI affects profitability as demand and supply drivers.

As per the Resource-Based View, latent differences between firms in macroeconomic conditions stem from the degree to which they use firm-specific resources, such as internal resources, cost control, sales, distribution networks, and financial management, to insulate themselves from unconventional shocks (Barney, 1991). Based on this line of reasoning, the insignificant coefficient does not imply that the variable is entirely irrelevant; in contrast, its relative importance has already been accounted for through decisions on pricing strategy and procurement, leveraged financial sourcing, and capacity utilization. This aligns with Liu (2006), who postulated that profitability for cement depend on macroeconomic variables and productivity-at-firm, inputs-at-firm, and relative price-at-firm.

5.3 Monetary Conditions and Profitability

In the baseline model, broad money growth is positive and statistically significant on ROA ($\beta = 0.987$; $p = 0.009$), which is also confirmed under the cost-channel model ($\beta = 0.787$; $p = 0.019$) and turnover-channel model ($\beta = 1.005$; $p = 0.013$). Thus, implying that monetary expansion may support cement companies' profitability through liquidity, credit availability, construction activity, and investment demand. Since cement demand is highly elastic to infrastructure development, real estate, and construction activities, expansionary monetary conditions may boost sales volume and asset utilization.

Such findings are consistent with the demand-side view of greater liquidity and investment spending as sources of profitability for firms. This is linked to the findings of Tse and Raftery (2001) who saw that money supply influences construction flows and subsequently argued that monetary expansion will likely support cement profitability through increased construction activity, credit demand, and investment expenditure. This, however, should not be interpreted as unconditional. The profitability effect can weaken if the monetary expansion is associated with excessive inflation, exchange-rate pressure, or higher input costs. In the ROE model, M2 also shows a positive association in some specifications (baseline: $\beta = 4.093$; $p = 0.044$; turnover channel: $\beta = 4.218$; $p = 0.013$), but this should be treated as supplementary due to the weaker overall ROE model.

5.4 Inflation, Exchange Rate, GDP, FDI, and Unemployment

Several macroeconomic variables are statistically insignificant in the ROA model, including GDP growth, unemployment, exchange rate movement, and IR-MCI. Given the nature of the cement industry, in which profitability depends more on long-term infrastructure projects and cost conditions, as well as firm's efficiency, rather than short-term macroeconomic movements.

The insignificant exchange-rate result may also mean that these firms partly absorb or pass on the cost impacts of imported commodities through pricing, procurement, and inventory management strategies. While Hanif et al. (2024) reported negative exchange-rate effects on Pakistan's cement sector, the evidence found here may suggest that such an effect for Bangladesh is, ceteris paribus, a function of cost-intensiveness and firm-specific exposure rather than a direct average effect.

FDI is positive and marginally significant in the baseline and turnover specification for ROA (baseline: $\beta = 6.979$; $p = 0.080$; turnover channel: $\beta = 6.794$; $p = 0.096$), indicating possible link with construction sector demand, infrastructure activity, and industrial expansion. However, this evidence remains only suggestive. Similarly, the non-significant results for unemployment are also reasonable because cement manufacturing is highly capital intensive. Thus, profitability will depend less on the short-term labor market fluctuations than on energy and raw materials costs, plant utilization, and debt service payments.

5.5 Firm-Level Mechanism

The firm-level mechanism provides the clearest explanation of the results. Financial leverage was found to be strongly negative and significant at 1% for ROA in the leverage channel model ($\beta = -19.785$; $p = 0.000$). That means, as also demonstrated by Rezina et al. (2020) and Karim and Kamruzzaman (2022), that the capital structure is among the most critical determinants of the ROA and profitability of cement enterprises in Bangladesh. Even though there is not much scope for comparing coefficients across models and variables due to different approaches to models and variables, the direction of the effects is similar. Higher exposure to debt reduces profitability.

This finding also supports the pecking-order theory, according to which more profitable companies are less likely to seek external debt, while those that borrow have higher financing costs and increased financial risk (Myers & Majluf, 1984). Since cement production requires substantial investment in plants, heavy machines, bulk storage and distribution systems, heavy debt exposure would have tightened ROA by absorbing a significant portion of operating income.

Cost intensity is also negatively significant in the cost channel model ($\beta = -11.994$; $p = 0.036$), meaning that operating and production costs have a negative impact on asset-based profitability. This aligns with the Resource-Based View, which argues that firms with stronger cost control and operational efficiency are better able to enjoy a higher level of profitability (Barney, 1991). These findings are, therefore, also consistent with Giang (2023) and Hanif et al. (2024), who argue that cement industry performance is adversely affected by cost-related and macroeconomic pressures.

Firm size is positive and marginally significant in some ROA specifications (baseline: $\beta = 3.477$; $p = 0.076$; turnover channel: $\beta = 4.026$; $p = 0.061$). It is also significant in some ROE specifications (cost channel: $\beta = 21.222$; $p = 0.024$; turnover channel: $\beta = 28.035$; $p = 0.001$), although the ROE results should be interpreted cautiously. Thus, it can be conjectured that large firms have been able to capture more advantage from their economies of scale, more favorable market relationships, and easier access to external financing. However, asset turnover is positive but mostly insignificant, implying that capacity utilization may affect profitability, but it is far from being a major driver of profitability in the present channel modeling.

5.6 Overall Implications

Overall, the findings suggest that macroeconomic conditions affect cement firm profitability mainly through firm-level financial and operational mechanisms, in which ROA is positively impacted by money supply growth and negatively affected by leverage and cost intensity. Other macroeconomic variables, including GDP growth, exchange rate movement, unemployment, and IR-MCI are individually not significant in the main ROA model. Their impact might most likely be captured through the mechanisms of debt burden, cost structure, pricing power, and capacity utilization.

These results reinforce the importance of leverage and financial structure, as Rezina et al. (2020) and Karim and Kamruzzaman (2022) have stated. Conversely, the findings diverge from those of Hanif et al. (2024), who found rather direct effects of GDP, inflation, and exchange rate on the profitability of the cement sector in Pakistan. These results indicate that macroeconomic effects at this level may operate differently across countries, time samples, and firm levels. Compared with a listed cement company in Bangladesh, profitability in terms of ROA is a better measurement compared to the ROE. The latter is too sensitive to factors affected by unobserved drivers at the financing and equity levels.

6. CONCLUSION

This study enriches the literature on how macroeconomic conditions and firm-level mechanisms shape the profitability of Bangladesh's cement sector by examining the ROA and ROE of seven DSE-listed firms from 2015 to 2024. Using panel-regression analysis, the study finds that the selected variables explain ROA more effectively than ROE. Broad money growth positively affects ROA, while leverage and cost intensity negatively affect it, indicating that liquidity conditions, debt burden, and operating costs are central to cement-firm profitability. GDP growth, unemployment, exchange rate movement, and IR-MCI do not show significant direct effects, suggesting that macroeconomic influences may operate through firm-level channels such as cost structure, pricing power, debt exposure, and capacity utilization. Therefore, the findings provide useful insights for managers, investors, and policymakers in designing strategies related to debt control, cost efficiency, monetary conditions, and cement-sector development.

This study can be complemented using broader firm-specific financial and governance variables, such as debt maturity, ownership structure, board composition, pricing power, and management efficiency. Second, employing a higher frequency dataset along with structural-break tests would help identify short-run policy shocks and regime shifts more cleanly. Third, extending the sample to related construction-material industries and other South Asian economies would show whether the findings are sector-specific or regionally consistent. Fourth, the future research direction could be measuring social welfare effects of cement-sector profitability, for instance, through increased housing prices and thus costs of infrastructure and quality of employment in the construction sector. Fifth, further research could explore why ROA is more responsive to macro conditions than ROE, as this may reveal whether external conditions affect operational performance before influencing the returns to shareholders. Sixth, supplementing the quantitative analysis with qualitative evidence on the level of pricing power and passthrough behavior and hedging practice would better inform the insignificant effects of inflation, exchange rates, and FDI and provide a more comprehensive account of the transmission of macroeconomic conditions to the profitability of the cement sector. Ultimately, mapping these specialized macroeconomic transmission channels onto broader asset-pricing frameworks will allow future research to calibrate macro-driven investment valuation models and refine corporate credit risk parameters.

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