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Examining the Threshold Effects of Corporate Governance in the Relationship between Investment Cash Flow Dynamics, Financial and Business Cycles of Listed Companies, and Earnings Quality

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ABSTRACT

The present study aims to examine the threshold effects of corporate governance in the relationship between investment cash flow dynamics, financial and business cycles of listed companies, and earnings quality. From the perspective of its objective, the study is applied in nature, and in terms of methodology, it follows a descriptive–analytical approach. The analysis is conducted using panel data from listed companies over the period 2011 to 2024. After applying screening criteria, a total of 106 companies were selected as the final sample and subjected to empirical analysis. Earnings quality is measured using discretionary accruals, while investment cash flow dynamics and financial and business cycles are assessed using standard indicators widely employed in the financial literature. In addition, a composite corporate governance index is constructed based on nine components, including board size and independence, gender diversity, board tenure, the existence of specialized committees, executive compensation, and institutional ownership. These components are reduced to a single index using the Principal Component Analysis (PCA) method. Prior to model estimation, the stationarity of variables is examined using the Levin–Lin–Chu unit root test, the results of which indicate that all variables are stationary at levels. Furthermore, the Kao panel cointegration test confirms the existence of a long-run equilibrium relationship among the study variables. To investigate nonlinear and threshold relationships, the Panel Smooth Transition Regression (PSTR) model is employed. The results of linearity diagnostic tests reveal that the relationships among the variables are nonlinear in nature, and that a logistic transition function with a single threshold is sufficient to capture this behavior. The findings from the PSTR model estimation indicate that investment cash flow dynamics and financial cycles have a positive and statistically significant effect on earnings quality, whereas firms' business cycles exert a negative and significant impact on earnings quality. Moreover, corporate governance, as the transition variable, plays a reinforcing role in this relationship, such that once the corporate governance index exceeds the estimated threshold level, the magnitude of the explanatory variables' effects on earnings quality increases significantly. These results suggest that improving corporate governance structures through enhanced transparency, reduced agency problems, and strengthened monitoring mechanisms can facilitate more efficient management of investment cash flows and better alignment of financial and business cycles, ultimately leading to improved earnings quality. By extending the literature on nonlinear relationships in corporate finance, the findings of this study provide valuable implications for managers, investors, and policymakers in promoting more efficient decision-making and enhancing the sustainability of corporate performance.

Keywords: Corporate governance; earnings quality; investment cash flow dynamics; financial cycles; business cycles

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Introduction

In recent decades, the analysis of nonlinear dynamics and threshold effects has become a central theme in financial economics and corporate finance, particularly in explaining how structural and institutional factors condition the impact of financial variables on firm-level and macroeconomic outcomes. Traditional linear models often fail to capture regime-dependent behaviors, abrupt shifts, and asymmetric responses that characterize real-world financial systems. As a result, scholars increasingly emphasize threshold-based frameworks to identify critical points beyond which the magnitude, direction, or significance of economic relationships change. This growing body of literature highlights that financial and economic processes are rarely continuous and proportional, but instead exhibit discontinuities driven by institutional quality, policy regimes, and structural characteristics (1, 2).

Within this context, capital flow dynamics, financial cycles, and business cycles have attracted substantial scholarly attention due to their pivotal role in shaping firms' investment behavior, risk exposure, and performance outcomes. Capital flows and investment cash dynamics are fundamental channels through which firms allocate resources, respond to uncertainty, and adjust to macro-financial conditions. Empirical evidence from emerging and developed economies suggests that fluctuations in capital flows and financial cycles significantly influence corporate stability, profitability, and vulnerability to systemic risk (3, 4). However, these effects are rarely uniform across firms or over time, implying that mediating and moderating factors—such as governance structures and institutional arrangements—are critical in determining the ultimate outcomes.

Corporate governance has emerged as one of the most influential institutional mechanisms shaping how firms respond to financial and business cycle fluctuations. By defining the rules, incentives, and monitoring processes that govern managerial decision-making, corporate governance directly affects investment efficiency, financial transparency, and the credibility of reported earnings. Strong governance mechanisms mitigate agency problems, reduce information asymmetry, and align managerial actions with shareholder interests, thereby enhancing earnings quality and financial resilience. Conversely, weak governance structures can amplify the adverse effects of financial volatility, encourage opportunistic behavior, and deteriorate the quality of accounting information (5, 6).

Earnings quality, as a critical indicator of the reliability and informativeness of financial reporting, plays a central role in capital markets. High-quality earnings enhance investors' ability to assess firm performance, forecast future cash flows, and allocate capital efficiently. Prior research demonstrates that earnings quality is closely linked to working capital management, investment decisions, and financial constraints. Efficient working capital management not only supports operational continuity but also stabilizes cash flows, reduces financing costs, and improves profitability, particularly in environments characterized by financial frictions and uncertainty (7, 8). These findings suggest that the interaction between investment cash flow dynamics and earnings quality is complex and potentially nonlinear, especially when influenced by governance and macro-financial conditions.

The literature on financial and business cycles further underscores the importance of synchronization and regime dependence. Financial cycles—encompassing credit expansion, asset price movements, and liquidity conditions—often interact with business cycles related to production, sales, and inventory adjustments. Misalignment between these cycles can generate liquidity shortages, investment inefficiencies, and heightened earnings volatility, whereas synchronized cycles tend to support smoother operations and more stable financial performance (9, 10). Recent empirical studies emphasize that synchronization itself may be subject to threshold effects, where the benefits of alignment become significant only after certain institutional or financial conditions are met.

Threshold effects have been widely documented across diverse areas of economics and finance, reinforcing the relevance of nonlinear modeling approaches. For instance, research on public debt and economic growth reveals that debt can stimulate growth up to a critical threshold, beyond which its effect becomes negative, with institutional and resource-related factors shaping this turning point (11, 12). Similar threshold dynamics have been identified in financial inclusion, fintech development, and systemic risk regulation, where the effectiveness of policies or innovations depends on surpassing specific structural or institutional levels (2, 5, 13). These studies collectively suggest that governance quality may operate as a key threshold variable that conditions the impact of financial dynamics on firm outcomes.

In the domain of corporate finance, nonlinear relationships between growth, profitability, and investment behavior have been increasingly recognized. Evidence from firm-level studies indicates that profitability and growth interact in a nonlinear manner, with different regimes prevailing under varying financial conditions and governance environments (14). Moreover, excess cash holdings, capital regulation, and macroprudential policies have been shown to exert regime-dependent effects on investment efficiency and risk-taking, highlighting the importance of institutional context in shaping corporate responses (8, 15, 16).

Despite these advances, there remains a notable gap in the literature concerning the integrated analysis of investment cash flow dynamics, financial and business cycles, earnings quality, and corporate governance within a unified nonlinear framework. While prior studies have examined these factors in isolation or through linear specifications, limited attention has been paid to how corporate governance may act as a threshold variable that alters the strength and direction of the relationships between capital flow dynamics and earnings quality. This gap is particularly salient in emerging markets, where institutional quality varies widely across firms and over time, and where financial and business cycles tend to be more volatile (3, 9).

Furthermore, recent research on global and regional financial cycles emphasizes the transmission of external shocks to domestic financial systems and firms, underscoring the need for firm-level governance mechanisms capable of absorbing and managing such shocks (4, 15). In this regard, governance structures may not only influence internal decision-making but also determine how firms adapt to macro-financial pressures, thereby affecting the quality and sustainability of reported earnings. Threshold-based approaches, such as panel smooth transition regression models, provide a powerful methodological framework to capture these regime-dependent effects and to identify critical governance levels at which corporate behavior fundamentally changes (1, 17).

The relevance of this research agenda is further reinforced by policy and regulatory considerations. As regulators increasingly rely on macroprudential tools and governance reforms to enhance financial stability and transparency, understanding the nonlinear interactions between governance, investment dynamics, and earnings quality becomes essential for effective policy design (15, 16). Insights into threshold effects can inform targeted interventions, helping policymakers and market participants identify minimum governance standards required to ensure that investment activity translates into high-quality earnings and sustainable performance.

In sum, the existing literature points to three key insights: first, financial and business cycle dynamics exert significant but nonlinear effects on firm outcomes; second, earnings quality is a crucial channel through which these dynamics influence market efficiency and investor confidence; and third, corporate governance plays a central moderating role that may operate through threshold mechanisms. However, empirical evidence that simultaneously integrates these dimensions within a nonlinear panel framework remains limited, particularly in the context of listed firms in emerging capital markets (5, 9, 14).

Against this background, this study aims to examine the threshold effects of corporate governance in the relationship between investment cash flow dynamics, financial and business cycles, and earnings quality in listed companies.

Methods and Materials

The present study is applied in terms of its objective and descriptive–analytical in nature. The study period covers the years **2011 to 2024**, and the analysis is conducted on selected listed companies. After applying the screening criteria, 106 firms were selected as the final sample and were examined and analyzed. Following prior studies by Siladjaja et al. (2024), Jarou et al. (2024), Salisu et al. (2022), Leupersberger et al. (2022), and Amat (2021), this article investigates the threshold effects of corporate governance in the relationship between investment cash flow dynamics, financial and business cycles of listed companies, and earnings quality. The regression model of the study is specified as follows:

$$DA_t = \alpha_0 + \beta_1 ACC_t + \beta_2 PCB_t + \beta_3 FC_t + \beta_4 YG_t + \beta_5 SIZE_t + \beta_6 LEV_t + \beta_7 ROA_t + \beta_8 GR_t + \beta_9 CG_t$$
$$+(\theta_1 ACC_t + \theta_2 PCB_t + \theta_3 FC_t + \theta_4 YG_t + \theta_5 SIZE_t + \theta_6 LEV_t + \theta_7 ROA_t + \theta_8 GR_t + \theta_9 CG_t)\, F(S_t, \gamma, c) + u_t$$

where the transition function $F$is defined as:

$$(2) F(\gamma, s_t, c) = (1 + \exp\{-\gamma(s_t - c)\})^{-1}, \gamma > 0$$

To examine the properties of the PSTR model with a logistic transition function based on the model proposed by van Dijk (1999), it is assumed that the dependent variable (DA) is solely a function of its own lagged values. Under this assumption and considering a two-regime transition function, the following relationship is obtained:

$$(3) DA_t = (\theta_0 + \theta_1 DA_{t-1} + \cdots + \theta_p DA_{t-p}) + (\phi_0 + \phi_1 DA_{t-1} + \cdots + \phi_p DA_{t-p}) G(DA_t, \gamma, c) + u_t$$

$$G(DA_t, \gamma, c) = \frac{1}{1 + \exp\{-\gamma(FC_t - c)\}}$$

The results of this specification constitute a two-regime PSTR model, in which the location parameter $c$represents the point of transition between the two extreme regimes, namely $G(FC_t, \gamma, c) = 0$and $G(FC_t, \gamma, c) = 1$, where $G(FC_t, \gamma, c) = 0.5$. The parameter γindicates the speed of transition between regimes, with higher values of γreflecting faster regime changes.

Dependent Variable

Earnings Quality (DA)

In this study, discretionary accruals are used as a proxy for earnings quality. To compute discretionary accruals, which serve as an indicator for measuring earnings quality, the Modified Jones Model (1995), as developed by Dechow et al., is employed. To obtain discretionary accruals, total accruals and non-discretionary accruals must first be calculated, with discretionary accruals ultimately derived as the difference between these two components. In this approach, total accruals are calculated using the following equation:

$$TA_t = NI_t - CFO_t$$

where TA_tdenotes total accruals of the firm in year t, NI_trepresents net income in year t, and CFO_tindicates operating cash flows in year t.

Measurement of Discretionary Accruals

Prior to calculating discretionary accruals, non-discretionary accruals are estimated using the following equation:

$$NDA_t = \alpha_1\left(\frac{1}{A_{t-1}}\right) + \alpha_2\left(\frac{\Delta REV - \Delta REC}{A_{t-1}}\right) + \alpha_3\left(\frac{PPE}{A_{t-1}}\right)$$

where NDA_t denotes non-discretionary accruals of the firm in year t, A_{t-1} is total assets at the beginning of year t, ΔREV represents the change in net revenues between years $t-1$ and t, ΔREC indicates the change in net trade receivables between years $t-1$ and t, and PPE refers to property, plant, and equipment in year t. The parameters α_1, α_2, and α_3 are firm-specific estimated coefficients obtained from the following regression model:

$$= \alpha_1(1/A_{it-1}) + \alpha_2(\Delta REV_{it}/A_{it-1}) + \alpha_3(PPE_{it}/A_{it-1}) + \varepsilon_{it}$$

It should be noted that in this model, total assets at the beginning of each period are used to standardize and scale the parameters in order to reduce volatility. When non-discretionary accruals (NDA) are subtracted from total accruals (TA), discretionary accruals (DA) are obtained. Accordingly, discretionary accruals are calculated as the residual of the following regression model based on the Modified Jones Model:

$$DA_t = TA_t - NDA_t$$

Explanatory Variables

ACC: Accrual working capital.

Financial cycles: For this index, variables such as bank credit facilities granted to listed companies (FC) and stock price returns (PCB) are used.

Business cycles: The output gap of each firm (YG) is employed as a proxy, defined as potential output minus actual output. The output gap is calculated using the Hodrick–Prescott filter and serves as an indicator of firms' business cycles.

Corporate Governance Index (CG): The corporate governance index reflects the extent to which firms comply with corporate governance standards. The corporate governance variable is constructed based on the components presented in the following table (Almutairi & Quttainah, 2019).

Abbreviation – English Name – Variable Name – Data Source – Measurement Method:

BoS – Board Size – Board size – Board of Directors' Report and Financial Statements – Total number of board members.

BoInd – Board Independence – Board independence – Board of Directors' Report and Financial Statements – Ratio of independent board members to total board members.

GD – Gender Diversity – Gender diversity – Board of Directors' Report and Financial Statements – Ratio of female board members to total board members.

BoTen – Board Tenure – Board tenure – Board of Directors' Report and Financial Statements – Number of years of board membership.

AC – Audit Committee – Audit committee – Board of Directors' Report and Financial Statements – Number of audit committee members.

RC – Risk Committee – Risk committee – Board of Directors' Report and Financial Statements – Number of risk management experts.

APC – Appointments Committee – Appointments committee – Board of Directors' Report and Financial Statements – Number of appointments committee members.

CFS – Compensation for Services – Executive compensation – Board of Directors' Report and Financial Statements – Annual bonuses paid to managers, extracted from selling, general, and administrative expenses.

IIN – Institutional Investors – Institutional ownership – Board of Directors' Report and Financial Statements – The ratio of shares held by banks and insurance companies, holdings, investment companies, pension funds, investment banks, investment funds, governmental organizations, and state-owned companies to total outstanding shares.

Finally, the corporate governance index is computed using the Principal Component Analysis (PCA) method.

Control Variables

Firm size (SIZE): Measured as the natural logarithm of total firm assets.

Financial leverage (LEV): Measured as the ratio of total liabilities to total assets.

Return on assets (ROA): Calculated as net income divided by total assets.

Annual sales growth (GR): Measured as sales in the current year minus sales in the previous year, divided by sales in the previous year.

Findings and Results

In this article, the following variables are used to construct the composite Corporate Governance Index.

Abbreviation	Variable (Corporate Governance Dimension)
BoS	Board size
BoInd	Board independence
GD	Gender diversity
BoTen	Board tenure
AC	Audit committee
RC	Risk committee
APC	Appointments committee
CFS	Compensation for services (executive compensation)
IIN	Institutional ownership (institutional investors)

To determine the general direction of the data points, an ellipse is drawn to reveal the correlations among variables.

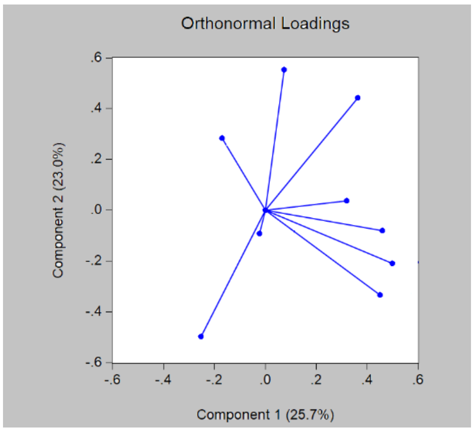

Figure 1. Projection of Data onto Principal Components

The primary direction of the dispersion of points is not aligned with X_1, X_2, or any other single variable; rather, it lies between them and is largely aligned with the major axis (principal diagonal) of the ellipse. This axis is referred to as PC_1, which represents the first principal component of variability in X_1, X_2, and the other variables. The second component (PC_2) lies along the minor axis of the ellipse, is exactly orthogonal to PC_1, and explains the remaining variation in X_1, X_2, and the other variables. Accordingly, PC_1, PC_2, and the remaining components define a new set of axes for explaining X_1, X_2, and the other variables. Therefore, it can be stated that X_1, X_2, …, $X_9$are linear combinations of PC_1, PC_2, …, PC_9, as follows:

$$X_i = a_{i1}PC_1 + a_{i2}PC_2 + a_{i3}PC_3 + a_{i4}PC_4 + a_{i5}PC_5 + a_{i6}PC_6 + a_{i7}PC_7 + a_{i8}PC_8 + a_{i9}PC_9$$

Moreover, the values of the principal components can be obtained using the following equations:

$$PC_1 = W_1X_1 + W_2X_2 + W_3X_3 + W_4X_4 + W_5X_5 + W_6X_6 + W_7X_7 + W_8X_8 + W_9X_9$$

$$PC_2 = W_{10}X_{10} + W_{11}X_{11} + W_{12}X_{12} + W_{13}X_{13} + W_{14}X_{14} + W_{15}X_{15} + W_{16}X_{16} + W_{17}X_{17} + W_{18}X_{18}$$

…

$$PC_9 = W_{73}X_{73} + W_{74}X_{74} + W_{75}X_{75} + W_{76}X_{76} + W_{77}X_{77} + W_{78}X_{78} + W_{79}X_{79} + W_{80}X_{80} + W_{81}X_{81}$$

where $W_i$denotes the regression coefficient (loading/weight) of the principal components on the variables.

Principal components can be computed using the original dataset; if the original data are not available, they may be calculated using the covariance matrix or the correlation matrix. Typically, when variables have different measurement units or substantially different variances, the correlation matrix is used. When the correlation matrix is applied, the analysis is effectively conducted on standardized variables with a mean of zero and a standard deviation of one.

The first extracted principal component captures the maximum amount of dispersion (variance) in the full dataset. This implies that the first component is correlated with at least some of the variables. The second extracted component has two key properties: first, it captures the maximum variance not explained by the first component, meaning it is correlated with variables that do not have a high correlation with the first component; second, it is uncorrelated with the first component (i.e., the correlation between the two components is zero). The remaining extracted components in this method also satisfy these two properties.

The number of extracted components in each model equals the number of variables analyzed; however, a subset of components can be selected. Usually, the first two or three components account for a substantial proportion of the variance in the dataset; therefore, selecting the first two or three components is often sufficient for subsequent analysis. In some cases, however, additional criteria should be considered to determine the required number of components. These criteria include:

The first criterion (Scree test) involves plotting eigenvalues against the corresponding principal components, yielding a scree plot that displays changes in the relative importance of eigenvalues across components. Figure 2 illustrates a hypothetical scree plot. As shown, the eigenvalue of the first component (variance explained by the first component) is approximately 2.3, the eigenvalue of the second component is approximately 2.1, and ultimately the eigenvalue of the ninth component is less than 0.4. In other words, the decline in importance is initially steep and then levels off. The “elbow” (breakpoint) indicates the maximum number of principal components that should be retained; selecting one fewer component than the elbow may also be appropriate. Based on Figure 2, the first component up to the first three components may be selected.

The second criterion (Eigenvalue rule) retains components whose eigenvalues are greater than one and discards the remaining components.

The third criterion (Variance explained) retains components that explain a larger percentage of dispersion; typically, the first component accounts for the greatest share of variance.

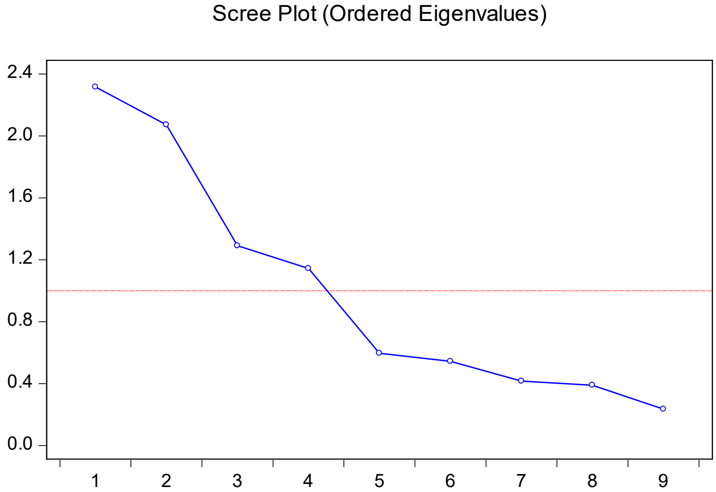

Figure 2. Eigenvalues of the Principal Components

To extract the corporate governance index, nine variables are used: board size, board independence, gender diversity, board tenure, audit committee, risk committee, appointments committee, compensation for services, and institutional ownership (institutional investors).

Table 1. Correlation Matrix of Corporate Governance Criteria

	BoS	BoInd	GD	BoTen	AC	RC	APC	CFS	IIN
BoS	1.000000								
BoInd	0.165995	1.000000							
GD	-0.103783	-0.358379	1.000000						
BoTen	-0.128613	-0.008877	0.187941	1.000000					
AC	0.032978	0.100707	0.131337	-0.228512	1.000000				
RC	0.609053	0.161638	-0.323739	-0.170545	-0.061763	1.000000			
APC	0.525666	0.109060	0.025898	-0.031410	0.009685	0.414297	1.000000		
CFS	0.131295	0.223358	0.124128	0.476611	0.000612	0.114349	0.313530	1.000000	
IIN	-0.122007	-0.310014	-0.085014	-0.443305	0.055429	0.146620	-0.060383	-0.518628	1.000000

Table 1 indicates that there is a relatively high correlation among the above criteria. Therefore, by reducing the dimensionality of variables using Principal Component Analysis, the corporate governance index is extracted.

Table 2 indicates that the eigenvalue of the first component is larger than the others, and approximately 25% of the dispersion in the dataset is explained by this component; therefore, this component represents the best choice for constructing the index.

Table 2. PCA Results for Estimating the Composite Corporate Governance Index Eigenvalues (Sum = 9, Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	2.316320	0.244827	0.2574	2.316320	0.2574
2	2.071493	0.781555	0.2302	4.387813	0.4875
3	1.289938	0.146412	0.1433	5.677751	0.6309
4	1.143526	0.547791	0.1271	6.821277	0.7579
5	0.595735	0.052060	0.0662	7.417012	0.8241
6	0.543675	0.127906	0.0604	7.960688	0.8845
7	0.415769	0.027118	0.0462	8.376457	0.9307

8	0.388651	0.153759	0.0432	8.765108	0.9739
9	0.234892	---	0.0261	9.000000	1.0000

Eigenvectors (Loadings)

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9
BoS	0.498997	-0.209736	0.225361	-0.013214	-0.400467	-0.400655	-0.003541	0.177866	0.550911
BoInd	0.321701	0.036918	-0.570283	0.345787	-0.134822	0.300890	0.564911	0.144004	0.042207
GD	-0.169882	0.283044	0.647471	0.162744	-0.275140	0.050451	0.580694	-0.126092	-0.118197
BoTen	0.075269	0.552262	0.002317	-0.266789	0.329713	-0.259983	0.140067	0.649376	-0.023430
AC	-0.021142	-0.093035	0.152450	0.848350	0.316871	-0.270020	-0.170742	0.194220	-0.088122
RC	0.452132	-0.334017	0.055934	-0.201237	0.294130	-0.355547	0.301367	-0.227171	-0.533882
APC	0.461104	-0.081160	0.379751	-0.013977	0.021906	0.649800	-0.268456	0.307592	-0.216769
CFS	0.363735	0.441806	0.072586	0.069640	0.444137	0.110177	-0.047849	-0.546552	0.389847
IIN	-0.251386	-0.497532	0.170049	-0.131740	0.502373	0.212369	0.360148	0.165463	0.434087

The relationship between the observed variables and the principal components can be expressed using **factor loadings**, and an estimate of the principal components using **factor scores** can be written as follows:

$$PC_1 = 0.49\,BoS + 0.32\,BoInd - 0.16\,GD + 0.07\,BoTen - 0.02\,AC + 0.45\,RC + 0.46\,APC + 0.36\,CFS - 0.25\,IIN$$

Accordingly, the linear combination of the first principal component (PC_1) for the Corporate Governance Index is given by the equation above.

Finally, the weight of each sub-index in the composite Corporate Governance Index is presented in the following table.

Table 3. Relative Importance of Variables in the Composite Corporate Governance Index

Variable	Relative Importance (%)
Board size	25.74
Board independence	23.02
Gender diversity	14.33
Board tenure	12.71
Audit committee	6.62
Risk committee	6.04
Appointments committee	4.62
Compensation for services (executive compensation)	4.32
Institutional ownership (institutional investors)	2.61
Total	100.00

Table 3 reports the relative importance of the components of the overall Corporate Governance Index, disaggregated by the selected variables under the rotational component regression approach. Based on the obtained weights, board size has the largest contribution to the composite Corporate Governance Index. Ultimately, using the *make Principal Component Analysis* command, the composite index of corporate governance is extracted and applied in the final empirical model of the study. The analysis begins with examining the stationarity of the variables included in the regression framework. Based on the Levin–Lin–Chu unit root test, if the p-value of the test statistic is smaller than the specified significance level (0.05 in this study), the independent, dependent, and control variables are stationary over the study period.

Table 4. Results of Stationarity (Unit Root) Test

Situation	Probability	Statistic	Method	Variable
I(0)	0.0000	-19.8098	Levin, Lin & Chu t	ACC
I(0)	0.0032	-2.73053	Levin, Lin & Chu t	CG
I(0)	0.0000	-9.92624	Levin, Lin & Chu t	DA
I(0)	0.0000	-12.6245	Levin, Lin & Chu t	FC

I(0)	0.0000	-14.9221	Levin, Lin & Chu t	GR
I(0)	0.0000	-10.9814	Levin, Lin & Chu t	LEV
I(0)	0.0000	-6.38006	Levin, Lin & Chu t	PCB
I(0)	0.0000	-9.01075	Levin, Lin & Chu t	ROA
I(0)	0.0000	-13.8853	Levin, Lin & Chu t	SIZE
I(0)	0.0000	-20.8959	Levin, Lin & Chu t	YG

The null hypothesis in the Levin–Lin–Chu test is that the variables are non-stationary, and the hypotheses can be stated as follows:

H0: The variable under study is non-stationary.

H1: The variable under study is stationary.

As shown in Table 4, the p-values for the independent variables are all smaller than 0.05, indicating that the variables are stationary. This implies that the mean and variance of the variables remain constant over time, and the covariance of the variables across different years is stable.

In the present study, to ensure the existence of a long-run equilibrium relationship, the Kao panel cointegration test is employed.

Table 5. Results of the Kao Panel Cointegration Test

Var.	t-Statistic	Prob.
ADF	-6.654050	0.0000

As reported in Table 5, the panel cointegration test confirms the existence of a relationship among the variables in the estimated regression, thereby validating a long-run equilibrium association.

In the cointegration test, the hypotheses are defined as follows:

H0: No cointegration.

H1: Cointegration among variables.

Given that the p-value is lower than 0.05, the null hypothesis of no cointegration is rejected. Therefore, the variables are cointegrated in the long run, and a long-run relationship exists among them.

To assess whether the relationship among model variables is linear or nonlinear, it must be examined whether m(the number of regime parameters) equals one. It should be noted that in the following tests, the null hypothesis assumes that the model is linear, whereas the alternative hypothesis corresponds to a logistic PSTR model ($m = 1$) or an exponential PSTR model ($m = 2$). The diagnostic test results presented in Table 6 indicate that the null hypothesis of linearity is rejected; therefore, a nonlinear relationship exists among investment cash flow dynamics, financial and business cycles of listed companies, and earnings quality. Consequently, the PSTR method is required to estimate the model parameters.

Table 6. Results of the Linearity Hypothesis Test (BBC Test)

Null Hypothesis	F-Statistic	Significance Level (p-value)
Wald test	5.236	0.000
Fisher test	4.598	0.000
LRT test	4.789	0.000

As also evident from the results in Table 6, the hypothesis of linearity in the relationship among variables is rejected; thus, the likelihood of a linear association among the variables is ruled out. It should also be noted that the proposed PSTR model, conditional on the selected transition variable, is adopted as the optimal framework for estimation. To this end, following González et al. (2005) and Colletaz and Hurlin (2006), the null hypothesis of a

PSTR specification with a single transition function is tested against the alternative hypothesis of a PSTR specification with at least two transition functions. The results are presented in Table 7. The findings indicate that the null hypothesis—suggesting that one transition function is sufficient—is not rejected under both the one-threshold and two-threshold cases. Therefore, a single transition function is able to characterize the nonlinear behavior linking investment cash flow dynamics, financial and business cycles of listed companies, and earnings quality.

Table 7. Test for the Presence of Remaining Nonlinearity

Two-threshold case (M=2)			One-threshold case (M=1)		
LR	LMf	LMw	LR	LMf	LMw
1.425 (0.489)	1.239 (0.532)	1.258 (0.521)	1.236 (0.542)	1.116 (0.612)	1.012 (0.687)

H0: $r = 1$, H1: $r = 2$

After confirming the existence of nonlinearity among the variables and the adequacy of a single transition function to describe the nonlinear behavior, the optimal case between a transition function with one or two thresholds must be selected. Accordingly, the PSTR model corresponding to each of these cases is estimated, and among them—based on the sum of squared residuals, the Schwarz criterion (BIC), and the Akaike information criterion (AIC)—the PSTR model with one threshold is identified as the optimal specification. Hence, a PSTR model with a single transition function and one threshold is selected to examine the nonlinear behavior among the study variables.

Using a PSTR model in which corporate governance serves as the transition variable, the earnings quality function of listed firms is modeled. The estimation results for the nonlinear part of the model (second regime) indicate that accrual working capital, as a proxy for investment cash-flow dynamics, has a positive and statistically significant effect on earnings quality at the 95% confidence level. The financial-cycle variables, including PCB and FC, also have positive and statistically significant effects on firms' earnings quality. The firm business cycle, proxied in the model by the output gap, exerts a negative and statistically significant effect on earnings quality for the sampled firms at the 95% confidence level. Consistent with the model estimates, corporate governance has a positive and statistically significant effect on earnings quality at the 5% significance level. Corporate governance, as a set of rules, processes, and relationships used to direct and control corporations, plays a critical role in strengthening these interactions. Sound governance structures increase transparency and managerial accountability and reduce agency problems, which ultimately enhance earnings quality and facilitate investment flows. Key governance mechanisms include an independent board of directors, specialized committees, performance-based compensation policies, and accurate and timely disclosure of information.

Moreover, the synchronization of financial and business cycles is considered a key factor in improving firms' operational and financial efficiency. Financial cycles encompass financing activities, debt management, and liquidity management, whereas business cycles involve production, sales, and inventory management processes. Coordination between these two cycles allows financial resources to be allocated more efficiently and operational processes to proceed without disruption and at the lowest possible cost. A lack of synchronization can lead to liquidity constraints, mismatches in raw-material procurement, lower productivity, and deterioration in earnings quality. Therefore, optimal cycle management—particularly under macroeconomic instability—is of substantial importance. Financial and managerial policies aimed at enhancing the alignment between financial and business cycles play a significant role in improving investment efficiency and strengthening earnings quality.

Empirical evidence suggests that dynamic interactions between investment flows and earnings quality are shaped by governance structures and the degree of cycle synchronization. Firms with strong governance and highly coordinated financial and business cycles have been able to manage their investment flows more efficiently and report higher earnings quality, thereby increasing shareholder confidence and attracting further investment. In addition, threshold analyses indicate that the level of cycle synchronization can act as a turning point in determining the effect of investment flows on earnings quality: at low levels of coordination, the impact of investment on earnings quality is limited or even negative, whereas as synchronization increases, this effect becomes positive and stronger. Governance structures can also shift these thresholds and contribute to overall performance improvements.

From a policy perspective, strengthening corporate governance and improving the alignment of financial and business cycles is of high importance. Governments and supervisory bodies can facilitate these improvements through appropriate regulation, managerial training, support for financial transparency, and the development of technological infrastructure. Practical experiences across financial markets indicate that firms paying particular attention to these factors are more resilient to market volatility and adverse economic conditions and achieve superior financial performance. The adoption of modern information and financial technologies, robust reporting systems, and flexible organizational structures are among the effective strategies in this regard. Ultimately, examining the dynamic interactions between investment flows and earnings quality within the context of corporate governance and cycle synchronization provides a comprehensive perspective for managers, investors, and policymakers to make more strategic decisions and support the sustainable growth of firms and the national economy.

Table 8. PSTR Model Estimation Results (Dependent Variable: Earnings Quality)

Linear Part of the Model				
Variable	Coefficient	Std. Error	t-Statistic	p-value
CONSTANT	0.521556	0.300193	1.737401	0.0823
ACC	0.047188	0.007428	6.352493	0.0000
PCB	0.038076	0.004899	7.771932	0.0000
FC	0.134509	0.049589	2.129247	0.0345
YG	-0.289564	0.208206	-1.390754	0.1664
ROA	0.139694	0.048299	2.892296	0.0038
SIZE	0.237879	0.061631	3.859691	0.0001
LEV	-0.035862	0.014372	-2.495362	0.0129
GR	0.134509	0.025286	5.319560	0.0000
CG	0.071610	0.029185	2.453674	0.0147
Nonlinear Part of the Model				
CONSTANT	0.235516	0.085117	2.762255	0.0053
ACC	0.014838	0.006607	2.245690	0.0378
PCB	0.120704	0.060604	1.991677	0.0487
FC	0.168514	0.052726	3.196026	0.0015
YG	-0.023450	0.011084	-2.115589	0.0347
ROA	0.177326	0.070478	2.516070	0.0126
SIZE	0.092670	0.046017	2.013833	0.0444
LEV	-0.035862	0.014372	-2.495362	0.0129
GR	0.102195	0.043170	2.367280	0.0267
CG	0.433451	0.159418	2.718959	0.0218
Threshold (c)	-0.211146	0.023650	-8.927949	0.0000
Slope parameter (γ)	3.620499	0.723642	5.003163	0.0000

Adjusted $R^2 = 0.88$

Comparing coefficients across the two regimes depends on the transition variable and its realized values: the value of the transition variable determines the transition function and, consequently, the prevailing regime. In the above estimation, the transition variable is corporate governance, and the estimated threshold value for this variable is -0.21. Depending on the distance of earnings quality from this threshold value, the model follows two different extreme regimes. Comparing the coefficients across the two regimes shows that once corporate governance surpasses the threshold (-0.21)—i.e., the transition from the linear to the nonlinear regime—the responsiveness of earnings quality to changes in corporate governance increases markedly. Thus, as corporate governance improves, earnings quality increases more strongly and improves.

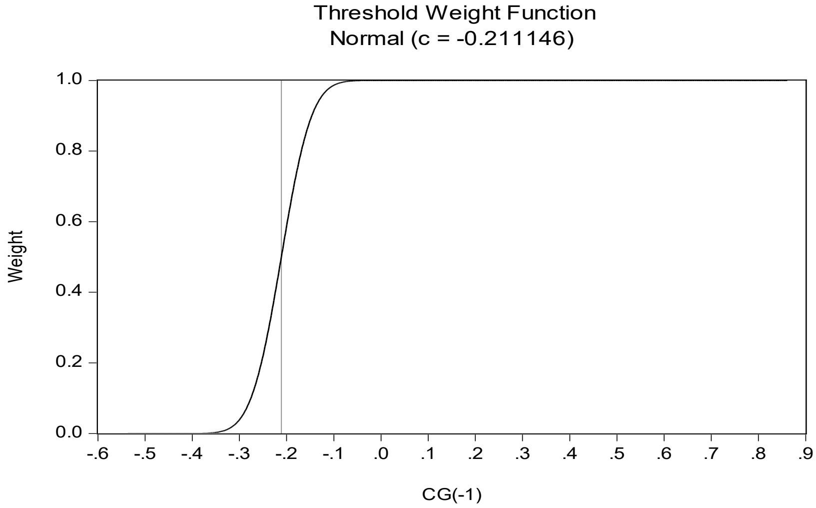

Figure 3. Relationship between the Transition Function and the Corporate Governance Transition Variable

In the present study, the Durbin–Watson test is used to examine autocorrelation.

Table 9. Autocorrelation Test Results

F-statistic	Prob.	Durbin–Watson
1.458	0.480	2.398

As shown in Table 9, the Durbin–Watson autocorrelation test indicates that there is no correlation among the disturbance terms; therefore, the third classical assumption regarding the absence of autocorrelation in the error terms is not violated. Hence, the estimators possess the required properties (minimum variance and efficiency).

Another classical assumption is homoskedasticity; in this study, the Breusch–Pagan–Godfrey test is used.

Table 10. Heteroskedasticity Test Results

F-statistic	Prob.	Breusch–Pagan–Godfrey
0.698	0.812	1.139

As shown in Table 10, the test results indicate no evidence of heteroskedasticity.

Another suitable criterion for evaluating the quality of the estimated model is examining coefficient changes across the two regimes. If the estimated model is appropriate, the coefficients are expected to remain stable and unchanged when the regime shifts.

Table 11. Results of the Smooth Transition Parameter Stability Test

Null Hypothesis	F-statistic	Prob.
$b_1 = b_2 = b_3 = b_4 = 0$	1.236	0.653
$b_1 = b_2 = b_3 = 0$	1.326	0.574
$b_1 = b_2 = 0$	1.348	0.512
$b_1 = 0$	1.487	0.456

As shown in Table 11, the coefficient stability test across the two regimes indicates that the coefficients do not change as a result of regime switching.

Discussion and Conclusion

The findings of the present study provide robust empirical evidence that the relationship between investment cash flow dynamics, financial and business cycles, and earnings quality is fundamentally nonlinear and regime-dependent, with corporate governance acting as a critical threshold variable. Using the Panel Smooth Transition Regression (PSTR) framework, the results demonstrate that once corporate governance surpasses an estimated threshold level, the magnitude and significance of the effects of key financial variables on earnings quality increase markedly. This finding is consistent with the growing body of threshold-based literature emphasizing that institutional quality and structural conditions determine whether financial dynamics translate into favorable corporate outcomes (1, 2).

One of the central results of this study is the positive and statistically significant effect of investment cash flow dynamics, proxied by accrual working capital, on earnings quality, particularly in the high-governance regime. This result suggests that firms with stronger governance structures are better able to channel investment-related cash flows into productive activities, thereby reducing opportunistic earnings management and enhancing the informational content of reported earnings. This finding aligns with firm-level evidence showing that effective working capital management improves profitability and financial transparency by stabilizing operational cash flows and reducing short-term financing pressures (7). Moreover, when governance mechanisms such as board independence and monitoring committees are effective, managers face stronger constraints against manipulating accruals, which strengthens the positive investment–earnings quality nexus (5, 6).

The results further indicate that financial cycles, captured through bank credit expansion and stock price returns, exert a positive and significant impact on earnings quality, particularly beyond the governance threshold. This finding suggests that favorable financial conditions—such as increased credit availability and positive market valuations—can enhance earnings quality when firms operate under sound governance. This outcome is consistent with evidence that financial cycle synchronization improves firms' access to external finance, lowers capital costs, and incentivizes transparent reporting to sustain investor confidence (4, 9). In contrast, under weak governance regimes, financial expansion may instead encourage excessive risk-taking and earnings manipulation, which explains why the positive effects become more pronounced only after the governance threshold is crossed.

In contrast to financial cycles, the business cycle, proxied by the firm-level output gap, shows a negative and significant effect on earnings quality. This result implies that cyclical fluctuations in production and sales introduce operational volatility that may deteriorate earnings quality, especially during downturns or periods of excess capacity. This finding is consistent with studies documenting nonlinear and asymmetric effects of growth and profitability across business cycle phases, where downturns intensify managerial incentives to smooth earnings or engage in accrual manipulation (14). However, the PSTR results indicate that strong corporate governance mitigates this adverse effect, reducing the sensitivity of earnings quality to cyclical shocks. This supports the view that governance structures function as stabilizing mechanisms that buffer firms against macroeconomic volatility (15, 16).

A key contribution of this study lies in identifying corporate governance as a reinforcing transition variable rather than merely a direct determinant of earnings quality. The estimated threshold implies that governance quality must reach a minimum effective level before investment cash flows and financial cycles positively and significantly affect earnings quality. This finding resonates with threshold-based evidence in other domains, such as public debt, fintech development, and financial inclusion, where institutional quality determines whether economic variables generate beneficial or adverse outcomes (5, 11, 12). In this sense, corporate governance operates as an enabling condition that unlocks the positive potential of financial dynamics.

The sharp increase in the coefficient of corporate governance in the nonlinear regime highlights its multiplier role in shaping financial reporting outcomes. When governance quality improves beyond the threshold, mechanisms such as independent boards, specialized committees, and performance-based compensation appear to significantly strengthen managerial discipline and reduce agency costs. This result is consistent with evidence that strong governance frameworks enhance transparency, constrain regulatory arbitrage, and reduce systemic risk at both firm and financial-system levels (13, 15). It also aligns with findings that governance quality conditions the effectiveness of macroprudential and regulatory policies, suggesting a close interaction between firm-level governance and broader financial stability (16).

The threshold nature of the results also has important implications for understanding capital flow dynamics in emerging markets. Prior studies show that capital flows and financial cycles in emerging economies are highly volatile and sensitive to global conditions, often transmitting external shocks to domestic firms (3, 4). The present findings suggest that firms with stronger governance structures are better positioned to absorb these shocks and maintain earnings quality, whereas firms below the governance threshold remain vulnerable to volatility-induced distortions in financial reporting. This helps explain heterogeneity in firm performance within the same macroeconomic environment.

Overall, the findings confirm that linear models are insufficient to capture the complexity of the relationships among investment cash flows, cycles, and earnings quality. Instead, regime-switching behavior dominates, with corporate governance determining the regime in which firms operate. This result extends prior threshold regression studies conducted at the macro level to the firm level, demonstrating that similar nonlinear mechanisms operate within corporate financial systems (1, 2). By integrating investment dynamics, cyclical factors, and governance into a unified nonlinear framework, the study advances the literature on earnings quality and corporate finance.

Despite its contributions, this study is subject to several limitations. First, the analysis relies on a composite corporate governance index constructed through principal component analysis, which, although comprehensive, may obscure the heterogeneous effects of individual governance mechanisms. Second, the study focuses on listed firms within a single emerging market context, which may limit the generalizability of the findings to other institutional or regulatory environments. Third, earnings quality is proxied by discretionary accruals, which, while widely used, may not fully capture all dimensions of reporting quality. Finally, the PSTR framework, although powerful, assumes smooth transitions between regimes and may not fully capture abrupt structural breaks or crisis-driven shifts.

Future research could extend this study in several directions. Scholars may examine the role of specific governance components—such as board independence or institutional ownership—as separate threshold variables rather than relying on a composite index. Comparative cross-country studies could also assess whether governance thresholds differ across legal systems and levels of market development. Additionally, future work could incorporate alternative measures of earnings quality, such as real earnings management or forecast accuracy, to validate and extend the findings. Finally, integrating global financial variables or crisis indicators into the nonlinear framework could provide deeper insights into how external shocks interact with firm-level governance and investment dynamics.

From a practical perspective, the results underscore the importance of strengthening corporate governance frameworks to ensure that investment activity translates into high-quality earnings. Firms should prioritize improving board effectiveness, enhancing transparency, and aligning managerial incentives with long-term performance. Regulators and policymakers can support these efforts by enforcing governance standards, promoting disclosure quality, and encouraging institutional investor participation. Investors may also benefit from incorporating governance thresholds into their evaluation models, recognizing that financial performance and earnings quality are highly sensitive to governance regimes rather than linear financial indicators alone.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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