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Developing a Model of Factors Predicting Future Cash Flows Using an Interpretive Structural Modeling Approach

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Abstract

This study aimed to develop a model of factors predicting future cash flows using an Interpretive Structural Modeling (ISM) approach. The information required for Interpretive Structural Modeling was collected from 17 experts, including financial managers and accounting managers of companies listed on the Tehran Stock Exchange, all of whom had more than 10 years of professional experience and held master's or doctoral degrees in finance or accounting. In addition, for the quantitative phase, 142 companies were selected from among firms listed on the Tehran Stock Exchange using the systematic elimination sampling technique and were examined over the period from 2014 to 2024. To evaluate the predictive capability of the model, data-mining procedures were implemented using Weka software. The proposed Interpretive Structural Modeling (ISM) model provides a hierarchical framework for analyzing and understanding the complex relationships among factors affecting the prediction of future cash flows. The model categorizes the factors into different levels and represents the direction of their effects through directional arrows. At the top of the structure is the dependent variable, “future cash flow prediction,” which represents the ultimate objective of the analysis. Factors at lower levels include “economic factors” (such as exchange rates and interest rates), “industry environment factors” (such as competition and price fluctuations), and “corporate financial factors” (such as liabilities, earnings quality, capital structure, and working capital management). These factors are positioned at intermediate levels and influence one another as well as factors located at higher levels. Finally, “accounting and managerial factors” (such as corporate governance, internal control systems, and accounting conservatism) are positioned at a higher level than industry environment and corporate financial factors and directly affect the ability to predict future cash flows.

Keywords: *future cash flow prediction, future cash flows, interpretive structural modeling.*

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1. Introduction

Cash flow forecasting occupies a central position in financial management, managerial accounting, valuation, investment appraisal, liquidity planning, and corporate decision-making because the ability of a firm to generate sufficient cash in future periods directly affects its solvency, financing flexibility, investment capacity, dividend policy, and long-term continuity. Although accounting profit remains one of the most widely used indicators of corporate performance, cash flows provide a different and often more direct representation of a firm’s capacity to meet obligations, finance operations, distribute returns to shareholders, and respond to unexpected economic shocks. For managers, creditors, investors, analysts, and other stakeholders, the estimation of future cash flows therefore represents not merely an accounting exercise but a strategic decision-support mechanism. Accurate cash flow forecasts can reduce uncertainty in capital budgeting, improve working capital planning, strengthen financing decisions, support credit assessment, and facilitate the evaluation of investment opportunities. Recent research has increasingly emphasized that cash flow forecasting should be viewed as a multidimensional process in which historical accounting information, managerial choices, market conditions, firm characteristics, and macroeconomic variables jointly

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determine forecasting quality [1, 2]. This perspective is particularly important in volatile economic environments, where the relationships between reported accounting information and subsequent cash realization may be affected by inflation, financing constraints, market uncertainty, changes in corporate policy, and shifts in the competitive environment.

The relevance of cash flow forecasting is closely related to the broader question of whether earnings or realized cash flows provide a stronger basis for predicting subsequent liquidity. In accounting theory, accrual-based earnings are designed to measure economic performance by recognizing revenues and expenses in the periods in which they are generated rather than solely when cash is received or paid. Accordingly, earnings potentially incorporate information about future cash consequences that is not yet reflected in current-period cash flows. At the same time, accruals may also introduce estimation error, managerial discretion, measurement uncertainty, and timing differences that weaken their predictive usefulness. Cash flows, by contrast, reflect realized transactions and are less directly affected by accrual estimates, but they may be more volatile and may fail to capture information about obligations and benefits that have not yet resulted in cash movements. This tension has produced an extensive literature comparing the forecasting power of earnings, operating cash flows, and accrual components. Evidence suggests that the relative predictive ability of earnings and cash flows depends on firm characteristics, the persistence and quality of accounting numbers, the forecasting horizon, and the economic context in which the firm operates [3, 4]. Consequently, future cash flow prediction cannot be reduced to a single accounting measure; rather, it requires an integrated understanding of the determinants that influence how current financial information translates into future liquidity.

Empirical studies in the Iranian capital market have similarly examined the predictive content of earnings, operating cash flows, and accruals. Research has shown that both earnings and cash flow information can contribute to forecasting future cash flows, although their relative explanatory power may differ across specifications and periods [5]. More recent evidence has explicitly evaluated the usefulness of operating cash flows, earnings, and accruals in predicting future cash flows and has reinforced the importance of combining accounting-based predictors rather than relying exclusively on one indicator [6]. These findings are particularly relevant because corporate cash flow generation is the final outcome of multiple interrelated processes, including revenue realization, operating cost management, working capital decisions, debt servicing, investment policies, and the timing of receipts and payments. Therefore, even when current earnings or operating cash flow exhibit significant predictive power, their forecasting performance may be conditioned by other variables such as profitability, liquidity, leverage, reporting quality, and the stability of the economic environment.

Liquidity-related characteristics constitute one important category of determinants in this context. Firms require adequate liquid resources to meet short-term obligations, maintain operational continuity, and respond to financing or investment opportunities. The relationship between profitability and liquidity is particularly important because highly profitable firms do not necessarily possess sufficient immediately available cash, while firms with strong liquidity may still experience weak profitability if excessive resources remain idle. Earlier evidence from Iranian companies has demonstrated that profitability and liquidity are closely connected to corporate financial policies, including dividend distribution decisions [7]. From the perspective of future cash flow forecasting, profitability may indicate the firm's underlying capacity to generate resources, whereas liquidity captures its ability to convert assets into cash and satisfy short-term obligations. Current liabilities and working capital management are also directly relevant because changes in receivables, inventories, trade payables, and other short-term accounts determine the timing with which accounting performance is converted into operating cash flows. Thus, the financial structure of the firm may shape both the level and predictability of future cash inflows and outflows.

Cash holdings provide another important connection between firm-level financial conditions and future cash generation. Corporate cash reserves are influenced by transaction needs, precautionary motives, investment opportunities, financing constraints, and the costs associated with external capital. Evidence from companies listed on the Tehran Stock Exchange indicates that firm-specific characteristics materially affect the level of cash holdings [8]. Cash holdings also have implications for subsequent corporate performance because excessively low cash balances can expose firms to liquidity risk and costly external financing, whereas excessively high holdings may represent inefficient resource allocation or agency problems. Research on Iranian listed firms has shown that deviations of cash holdings above or below their optimal level are associated with future corporate performance [9]. These

findings suggest that cash flow forecasting should account not only for current operating performance but also for the financial policies that govern liquidity accumulation, working capital, and financing flexibility. A firm's expected future cash position is therefore partly a function of current resource allocation decisions and the extent to which managers maintain an appropriate balance between liquidity and investment.

Capital structure is similarly intertwined with cash flow generation because financing decisions create future contractual obligations and influence the allocation of operating cash flows among creditors, shareholders, and investment projects. Higher leverage may reduce financial flexibility, increase interest and principal repayment requirements, and make future cash flows more sensitive to adverse economic conditions. Conversely, access to external financing may allow firms to undertake profitable investments that contribute to later cash generation. The choice between debt, equity, internal funds, and other financing sources can therefore affect both the magnitude and timing of future cash flows. Evidence from corporate financing research indicates that the source of financing is an important dimension of strategic financial transactions and may be associated with different economic incentives and consequences [10]. Relatedly, cash-based financial analysis has increasingly been incorporated into models of financial distress because deterioration in adjusted cash flow indicators can reveal weaknesses in a firm's ability to meet commitments before such problems become fully visible in conventional profitability measures [11]. These considerations reinforce the need to include capital structure, liabilities, and financing-related variables within a broader framework for predicting future cash flows.

The quality of accounting information constitutes another major determinant of cash flow forecasting accuracy. Financial reporting quality affects the extent to which reported earnings, accruals, assets, liabilities, and operating results faithfully reflect the underlying economic activities of the firm. Where financial reporting is transparent and measurement error is limited, historical accounting data provide a more reliable foundation for estimating future cash consequences. By contrast, aggressive accounting choices, earnings management, and discretionary accrual manipulation may distort the relationship between reported performance and subsequent cash realization. Research on corporate acquisitions has shown that managerial incentives can lead to accrual manipulation and earnings-management behavior before major transactions [12, 13]. More recent evidence also indicates that acquiring firms may engage in earnings management in cash-financed mergers, highlighting the continuing relevance of managerial discretion in interpreting reported accounting outcomes [14]. Such evidence is important for cash flow forecasting because the usefulness of earnings as a predictor depends on whether current reported performance reflects sustainable operations or transitory accounting adjustments.

Corporate governance and internal control mechanisms can mitigate some of these concerns by constraining opportunistic managerial behavior, improving oversight, enhancing financial reporting integrity, and increasing the reliability of accounting information used in forecasting. Effective governance structures may influence future cash flows indirectly by improving investment discipline and managerial accountability, and directly by limiting distortions in reported financial performance. The association between governance and accounting discretion is especially relevant in environments where ownership concentration, board characteristics, and managerial incentives affect reporting decisions. Board structure can also interact with managerial decision horizons and corporate cash flow outcomes. Evidence indicates that board size may influence the relationship between managerial myopia and operating cash flow as well as stock price outcomes [15]. This finding suggests that governance variables are not merely institutional background factors but can alter the behavioral mechanisms through which managerial decisions affect the firm's operating and financial consequences. Accordingly, corporate governance, internal control systems, financial reporting quality, accounting conservatism, and operating performance should be considered jointly when analyzing the determinants of future cash flow prediction.

Accounting conservatism is particularly relevant because it affects the timing of recognition of gains and losses and therefore influences the structure and persistence of reported earnings. Conservative accounting practices generally require a greater degree of verification for the recognition of favorable economic outcomes than for unfavorable outcomes, thereby producing asymmetric recognition patterns. While conservatism may reduce the risk of overstating net assets and earnings, it can also influence the correspondence between accounting performance and future cash realizations. From a forecasting standpoint, the implications of conservatism are therefore not unidirectional. More conservative recognition may increase the credibility of reported performance by limiting

aggressive reporting, but it may also shift the timing of accounting recognition relative to cash realization. This reinforces the broader principle that cash flow prediction depends not only on the amount of reported earnings but also on the accounting policies, governance arrangements, and reporting practices through which those earnings are generated and disclosed [4, 12].

The presentation and interpretation of cash flow information also affect forecasting outcomes. Even when the underlying economic information is unchanged, the manner in which cash flow data are reported can influence users' judgments and predictions. Experimental evidence has shown that the presentation method of cash flow information affects investors' forecasts of future cash flows, demonstrating that forecasting is influenced not only by the economic substance of accounting numbers but also by their reporting format and cognitive accessibility [16]. This finding has implications for both researchers and practitioners because models designed to explain future cash flows should recognize that information quality and information presentation are closely connected to decision usefulness. A theoretically complete forecasting framework must therefore consider both the economic determinants of future cash generation and the accounting mechanisms through which information about those determinants is communicated to stakeholders.

At the managerial level, cash flow forecasting is also embedded in organizational planning and capital budgeting processes. Forecasts are not automatically generated from historical numbers; they are constructed through managerial judgments, assumptions, scenario analysis, information integration, and coordination across organizational functions. Field-based research has demonstrated that management accountants purposefully shape cash flow forecasts in capital budgeting and product development decisions, suggesting that forecasting is an active organizational practice rather than a purely mechanical extrapolation exercise [2]. Managers may adjust forecasts according to investment objectives, perceived risks, market expectations, strategic priorities, and organizational incentives. This managerial dimension is especially important when economic conditions are uncertain, because forecasting increasingly depends on the interpretation of incomplete or changing information. Accordingly, a comprehensive model of future cash flow prediction should incorporate accounting and managerial determinants alongside financial and environmental factors.

Beyond firm-level variables, industry conditions can materially affect the stability and predictability of cash flows. Product market competition influences pricing power, sales growth, cost structures, investment requirements, and the ability of firms to pass rising costs on to customers. Firms operating in highly competitive industries may experience greater volatility in margins and cash conversion, while firms with stronger market positions may generate more stable operating cash flows. Changes in inventory prices are also relevant, particularly in industries where input costs or commodity prices fluctuate substantially. Such changes influence procurement expenditures, inventory valuation, gross margins, working capital needs, and the timing of operating cash flows. Capital market environmental uncertainty can further affect access to financing, investor expectations, cost of capital, and corporate investment behavior. These industry-related conditions interact with firm-specific financial variables, meaning that the same capital structure or working capital policy may produce different cash flow consequences across industries and market environments.

Macroeconomic factors constitute an even broader layer of influence. Inflation, exchange-rate movements, interest rates, and economic uncertainty can affect virtually every component of corporate cash generation. Inflation changes input costs, selling prices, nominal working capital requirements, borrowing costs, and the purchasing power of cash balances. Exchange-rate volatility influences firms with foreign-currency revenues, imported inputs, foreign debt, or international operations. Interest-rate changes affect the cost of debt financing, investment decisions, discount rates, and liquidity management. Economic uncertainty can cause firms to postpone investment, increase precautionary cash holdings, alter financing strategies, and reduce exposure to risky projects. Foundational evidence indicates that macroeconomic uncertainty has a significant effect on corporate cash-holding behavior, particularly among non-financial firms [17]. Because cash holdings are partly a response to expected future financing needs and economic risks, macroeconomic conditions can affect future cash flows both directly and indirectly through corporate financial policies.

The Iranian economic environment provides an especially relevant setting for analyzing these relationships because firms may face substantial volatility in inflation, exchange rates, financing costs, capital market conditions, and business uncertainty. In such an environment, forecasting future cash flows solely from historical earnings

or operating cash flow may overlook structural conditions that affect how accounting information is transformed into actual liquidity. Firm profitability, asset liquidity, capital structure, earnings quality, working capital management, current liabilities, governance mechanisms, internal controls, reporting quality, and operating performance may all interact with macroeconomic and industry-level conditions. Consequently, the determinants of future cash flow prediction are likely to form a hierarchical and interdependent system rather than a set of isolated predictors. Identifying this system is important because some variables may function as foundational driving factors, while others may operate as intermediate mechanisms or highly dependent outcomes.

Recent technological developments have further expanded the methodological possibilities for forecasting future cash flows. Artificial intelligence, machine learning, and data-mining techniques can identify nonlinear relationships, interactions, and patterns that may not be adequately captured by traditional linear forecasting models. These methods can integrate large numbers of firm-level and environmental variables and potentially improve predictive accuracy where financial relationships are complex or unstable [18]. Contemporary cash flow forecasting research increasingly combines theoretical financial reasoning with empirical and computational approaches, emphasizing that the value of a model depends not only on statistical predictive performance but also on whether it appropriately reflects the economic mechanisms underlying cash generation [1]. Nevertheless, sophisticated predictive techniques do not eliminate the need for conceptual structuring. When numerous variables are included without a clear understanding of their direction of influence or hierarchical relationships, highly accurate algorithms may still provide limited managerial interpretability.

This limitation highlights the usefulness of Interpretive Structural Modeling (ISM) for the present research problem. ISM is particularly suitable when a phenomenon involves multiple interacting factors whose relationships must be systematically organized into a hierarchical structure. Rather than treating predictors as independent variables with equal conceptual status, ISM allows researchers to determine which factors possess greater driving power, which are more dependent on other variables, and which occupy intermediate linkage positions. This is especially valuable for future cash flow prediction because economic conditions may influence industry variables, which in turn shape corporate financial characteristics and accounting or managerial outcomes before ultimately affecting the predictability of future cash flows. Such a hierarchical interpretation can provide managers, investors, analysts, and policymakers with a clearer understanding of where interventions or monitoring efforts should be concentrated.

Moreover, combining ISM with MICMAC analysis allows the identified factors to be classified according to their driving power and dependence power, thereby distinguishing independent, linkage, dependent, and autonomous components. Such classification can reveal whether macroeconomic variables function as foundational drivers, whether industry and corporate financial conditions transmit these effects, and whether accounting and managerial factors operate closer to the ultimate outcome of future cash flow prediction. This form of structural reasoning is especially useful when prior research has largely examined individual determinants separately, such as cash holdings, profitability, liquidity, earnings quality, governance, or macroeconomic uncertainty [7-9, 17]. By integrating these determinants, the present approach addresses the fragmentation of prior evidence and provides a more comprehensive framework for understanding how diverse predictors jointly contribute to future cash flow forecasting.

The importance of such integration is further reinforced by the fact that future cash flow prediction has implications beyond routine liquidity planning. Expected cash flows are fundamental to valuation, investment appraisal, financial distress prediction, merger and acquisition decisions, financing choices, and assessments of corporate sustainability. The reliability of cash flow forecasts may therefore affect decisions involving substantial capital commitments and long-term strategic consequences [10, 11]. At the same time, the potential influence of earnings management and managerial discretion means that forecasting frameworks must remain sensitive to the quality of the accounting information from which expectations are developed [13, 14]. A structurally integrated model can therefore improve not only predictive understanding but also the interpretation of financial information by identifying the channels through which economic, industry, financial, accounting, and managerial conditions contribute to future cash flow outcomes.

Despite the substantial literature on the predictive roles of earnings, operating cash flows, accruals, liquidity, corporate cash holdings, governance, and macroeconomic uncertainty, a notable gap remains in relation to the structural ordering of these determinants within a unified model. Prior studies have

generally emphasized whether particular variables significantly predict future cash flows or related financial outcomes, whereas comparatively less attention has been paid to the hierarchical relationships among the determinants themselves. Furthermore, research on cash flow forecasting has increasingly moved toward computational and data-driven approaches [18], while managerial research has highlighted the purposeful construction of forecasts within organizational decision processes [2]. Integrating these perspectives requires a framework that is simultaneously conceptually interpretable, empirically grounded, and capable of representing multiple levels of influence. In the Iranian capital market, where firm-level financial conditions are embedded in a comparatively volatile macroeconomic and institutional environment, such an integrated structural approach is particularly warranted.

Accordingly, the aim of the present study was to develop a hierarchical model of the factors predicting future cash flows using Interpretive Structural Modeling (ISM), with particular emphasis on the interrelationships among economic factors, industry environment factors, corporate financial factors, and accounting and managerial factors in the context of companies listed on the Tehran Stock Exchange.

2. Methodology

In terms of the implementation process and type of data, the present study adopted a mixed-methods research design. With respect to the practical outcome of the research, it is applied in nature; with respect to its implementation objective, it is exploratory and descriptive, incorporating a survey-based descriptive approach. From the perspective of research logic and type of reasoning, the study follows an inductive approach, while in terms of temporal dimension, it is cross-sectional. Based on its objective, the present research may also be regarded as fundamental because it seeks to develop a model of factors predicting future cash flows using an Interpretive Structural Modeling approach. The qualitative component of the study is presented through two descriptive and analytical approaches. The descriptive section describes the characteristics of the statistical sample, including qualitative participants and quantitative informants or knowledgeable respondents, in terms of various variables and components, whereas the analytical section examines assumptions and relationships among the variables. Given that both library-based methods and field methods, including interviews, were employed for data collection, the present study can be classified, in terms of data collection method, as a cross-sectional survey study.

To design the model based on the qualitative approach, a group of experts consisting of financial managers and accounting managers of listed companies who had more than 10 years of professional experience and held master's or doctoral degrees in finance or accounting were subjected to in-depth interviews. Participant selection and interviewing continued until theoretical saturation was achieved, after which the process was terminated. Purposive sampling using the snowball technique was employed. Accordingly, the first expert was selected based on preliminary investigations. After completion of the first interview, the participant was asked to introduce other experts who could provide informed perspectives on future cash flow prediction and contribute to the richness of the research model. This process continued until the data were considered sufficient to answer the research questions. Theoretical saturation was achieved during the 16th interview; however, to ensure data adequacy, interviews continued until the 17th participant.

3. Findings and Results

At this stage, the Content Validity Ratio (CVR) was used to determine the content validity of each component. For this purpose, a questionnaire was provided to the experts, who were asked to evaluate each component according to a three-point scale consisting of “essential,” “useful but not essential,” and “not essential.” Given that the expert panel consisted of 17 individuals, the content validity of a component was considered acceptable if its CVR value exceeded 0.49. The results obtained from the application of the Content Validity Ratio (CVR) are presented in Table 1.

Table 1. CVR Values for Each Factor

No.	Components	CVR	Main Components	CVR	Result
1	Inflation rate	1	Economic factors	1	Confirmed
2	Exchange rate	1			Confirmed
3	Bank interest rate	1			Confirmed
4	Economic uncertainty	1			Confirmed
5	Product market competition	1	Industry environment factors	1	Confirmed

6	Changes in inventory prices	1			Confirmed
7	Capital market environmental uncertainty	1			Confirmed
8	Corporate profitability	1	Corporate financial factors	1	Confirmed
9	Capital structure	1			Confirmed
10	Asset liquidity	1			Confirmed
11	Earnings quality	1			Confirmed
12	Working capital management	1			Confirmed
13	Current liabilities	1			Confirmed
14	Operating performance	1	Accounting and managerial factors	1	Confirmed
15	Internal control system	1			Confirmed
16	Corporate governance	1			Confirmed
17	Accounting conservatism	1			Confirmed
18	Financial reporting quality	1			Confirmed
19	Future cash flow prediction	1	Future cash flow prediction	1	Confirmed

As shown in Table 1, all 19 components extracted from the interviews were confirmed by the entire panel of experts. These components were subsequently classified into five main components.

Step 1: Identification of Components Related to the Research Problem

As explained in the previous section, the 19 components were classified into five main components. Fuzzy Delphi analysis was employed to confirm all of these components. All 19 components, grouped under five main components, were confirmed by the experts. Accordingly, these five main components were used to develop the "model of factors predicting future cash flows using an Interpretive Structural Modeling approach."

Table 2. Components Identified for Model Development

No.	Components
1	Economic factors
2	Industry environment factors
3	Corporate financial factors
4	Accounting and managerial factors
5	Future cash flow prediction

Step 2: Formation of the Structural Self-Interaction Matrix

After identifying the factors, the ISM questionnaire was developed, and the experts examined the factors pairwise and determined the relationships among them using the following symbols:

V: Factor *i* influences factor *j*.
A: Factor *j* influences factor *i*.
X: Factors *i* and *j* mutually influence each other.
O: No relationship exists between factors *i* and *j*.

The results obtained from the questionnaires concerning the components under investigation are presented in the following table.

Table 3. Results Obtained from the Questionnaires

No.	Components	1	2	3	4	5
1	Economic factors		V	V	V	V
2	Industry environment factors			X	V	V
3	Corporate financial factors				V	V
4	Accounting and managerial factors					V
5	Future cash flow prediction					

Step 3: Formation of the Initial Reachability Matrix

The initial reachability matrix is obtained by converting the Structural Self-Interaction Matrix into a binary matrix consisting of zeros and ones. To replace the four symbols presented in Tables 2 and 3 with zeros and ones and construct the initial reachability matrix, the following rules were applied:

If the entry (*i, j*) in the Structural Self-Interaction Matrix is **V**, the entry (*i, j*) in the initial reachability matrix is assigned a value of 1, while the entry (*j, i*) is assigned a value of 0.

If the entry (*i, j*) in the Structural Self-Interaction Matrix is **A**, the entry (*i, j*) in the initial reachability matrix is assigned a value of 0, while the entry (*j, i*) is assigned a value of 1.

If the entry (*i, j*) in the Structural Self-Interaction Matrix is **X**, both entries (*i, j*) and (*j, i*) in the initial reachability matrix are assigned a value of 1.

If the entry (*i, j*) in the Structural Self-Interaction Matrix is **O**, both entries (*i, j*) and (*j, i*) in the initial reachability matrix are assigned a value of 0.

Table 3 presents the initial reachability matrix.

Table 4. Initial Reachability Matrix

No.	Components	1	2	3	4	5
1	Economic factors	1	1	1	1	1
2	Industry environment factors	0	1	1	1	1
3	Corporate financial factors	0	1	1	1	1
4	Accounting and managerial factors	0	0	0	1	1
5	Future cash flow prediction	0	0	0	0	1

Step 4: Formation of the Final Reachability Matrix

After obtaining the initial reachability matrix, the transitive relationships among the components were examined. A transitive relationship exists when component *i* leads to component *j* and component *j* leads to component *k*; in such a situation, component *i* should also lead to component *k*. If this condition is not reflected in the initial reachability matrix, the matrix must be modified and the omitted relationships added. This procedure is commonly referred to as incorporating transitivity into the initial reachability matrix. At this stage, all transitive relationships among the components were examined; however, no additional transitive relationships were identified. Therefore, the final reachability matrix was identical to the initial reachability matrix. The driving power and dependence power of each component are also presented in this matrix. The driving power of a component is calculated as the total number of components influenced by that component, including the component itself. The dependence power of a component is calculated as the total number of components by which it is influenced, including the component itself.

Table 5. Final Reachability Matrix

No.	Components	1	2	3	4	5	Driving Power
1	Economic factors	1	1	1	1	1	5
2	Industry environment factors	0	1	1	1	1	4
3	Corporate financial factors	0	1	1	1	1	4
4	Accounting and managerial factors	0	0	0	1	1	2
5	Future cash flow prediction	0	0	0	0	1	1
Dependence Power		1	3	3	4	5	–

Step 5: Determination of Relationships and Level Partitioning of the Factors

At this stage, the reachability matrix was used to determine the reachability and antecedent sets, after which the intersection of these sets was calculated for each component.

The reachability set of a component includes the component itself and all components that it influences, which can be identified by the entries coded as “1” in the corresponding row.

The antecedent set of a component includes the component itself and all components that influence it, which can be identified by the entries coded as “1” in the corresponding column.

After determining the reachability and antecedent sets, their intersection was calculated for each component. Components for which the reachability set and the intersection set are identical are positioned at the highest level of the Interpretive Structural Modeling hierarchy. To identify the components constituting the next level of the system, the components assigned to the highest level are removed from the mathematical calculations in the corresponding table, and the same procedure is repeated to determine the next level. This process continues until the

components constituting all levels of the system are identified. Table 5 presents the first iteration of the level-partitioning process.

Table 6. Level Partitioning (Iteration 1)

No.	Components	Reachability Set	Antecedent Set	Intersection Set	Level
1	Economic factors	5, 4, 3, 2, 1	1	1	
2	Industry environment factors	5, 4, 3, 2	3, 2, 1	3, 2	
3	Corporate financial factors	5, 4, 3, 2	3, 2, 1	3, 2	
4	Accounting and managerial factors	5, 4	4, 3, 2, 1	4	
5	Future cash flow prediction	5	5, 4, 3, 2, 1	5	1

As shown in Table 5, the reachability set and intersection set of Component 5 are identical. Therefore, this component is assigned to Level 1 and is removed from the above table for the continuation of the level-partitioning process.

Table 7. Level Partitioning (Iteration 2)

No.	Components	Reachability Set	Antecedent Set	Intersection Set	Level
1	Economic factors	4, 3, 2, 1	1	1	
2	Industry environment factors	4, 3, 2	3, 2, 1	3, 2	
3	Corporate financial factors	4, 3, 2	3, 2, 1	3, 2	
4	Accounting and managerial factors	4	4, 3, 2, 1	4	2

As shown in Table 6, the reachability set and intersection set of Component 4 are identical. Therefore, this component is assigned to Level 2 and is removed from the above table for the continuation of the level-partitioning process.

Table 8. Level Partitioning (Iteration 3)

No.	Components	Reachability Set	Antecedent Set	Intersection Set	Level
1	Economic factors	3, 2, 1	1	1	
2	Industry environment factors	3, 2	3, 2, 1	3, 2	3
3	Corporate financial factors	3, 2	3, 2, 1	3, 2	3

As shown in Table 7, the reachability sets and intersection sets of Components 2 and 3 are identical. Therefore, these components are assigned to Level 3 and are removed from the above table for the continuation of the level-partitioning process.

Table 9. Level Partitioning (Iteration 4)

No.	Components	Reachability Set	Antecedent Set	Intersection Set	Level
1	Economic factors	1	1	1	4

As shown in Table 7, the reachability set and intersection set of Component 1 are identical. Therefore, this component is assigned to Level 4, the final level, and the level-partitioning process is completed.

Step 6: Development of the Final Model

At this stage, an initial model is constructed based on the levels of the components and the final reachability matrix. The final model is subsequently obtained by eliminating transitive links from the initial model. Accordingly, the final ISM model, developed from the components associated with identifying factors affecting future cash flow prediction and providing an appropriate model for the Iranian economic environment, is presented in Figure 1.

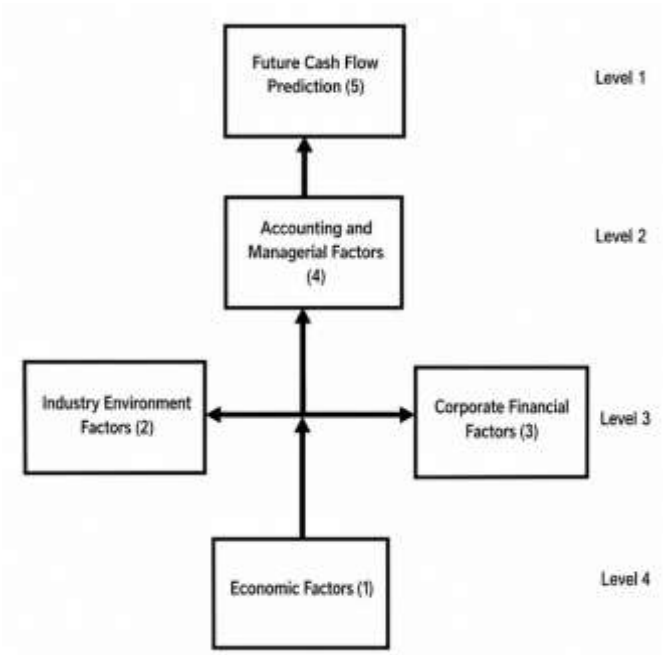


Figure 1. Initial ISM Model

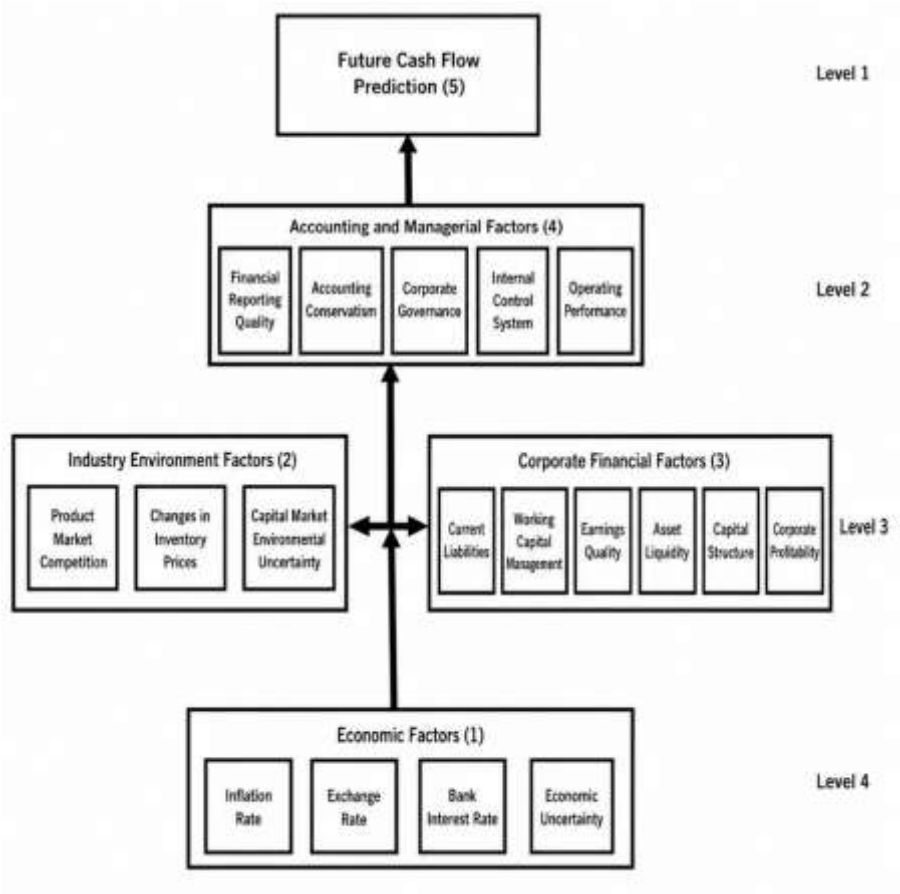


Figure 2. Final ISM Model

As shown in Figure 1, the five components constituting the model are distributed across four levels. Component 5, which is positioned at Level 1 of the ISM graph, is the most affected and most dependent component in the model. Component 4 is located at Level 2; it influences the component at Level 1 and is itself influenced by components located at lower levels. Components 2 and 3 are positioned at Level 3; they influence components at higher levels and are influenced by the component at the lower level. At the final level, Level 4, Component 1 is positioned as the most influential component with the greatest driving power in the model. This component influences all other components in the model.

Step 7: Analysis of Driving Power and Dependence Power (MICMAC Analysis)

At this stage, the components are classified into four groups. The first group consists of **autonomous components (Quadrant 1)**, which have weak driving power and weak dependence. These components are relatively disconnected from the other components and have only limited relationships with them. The second group consists of **dependent components (Quadrant 2)**, which have weak driving power but high dependence. The third group includes **linkage components (Quadrant 3)**. These components have both high driving power and high dependence. Consequently, any action affecting these components may lead to changes in other components. The fourth group consists of **independent components (Quadrant 4)**. These components have high driving power and low dependence. Components with high driving power are commonly referred to as key components. Such components are necessarily located in either the independent or linkage categories. The driving power and dependence power of the components are calculated by summing the entries coded as "1" in each row and column, respectively. On this basis, the driving power–dependence diagram is constructed.

Using the data obtained in Step 4, the components under investigation can be categorized into the following four groups according to the driving power of each component over other components and its degree of dependence on other components:

1. **Autonomous:** Components with minimal dependence and minimal driving power over other components.
2. **Dependent:** Components with a high degree of dependence on other components.
3. **Linkage:** Components that have reciprocal relationships with other components.
4. **Independent (Driving):** Components that exert substantial influence over other components.

To determine the coordinates of each component in the MICMAC matrix, the driving power and dependence power of that component must be used. These values are derived from the final reachability matrix. Table 8 presents the driving power and dependence power of each component.

Table 10. Driving Power and Dependence Power of the Components

No.	Components	Driving Power	Dependence Power
1	Economic factors	5	1
2	Industry environment factors	4	3
3	Corporate financial factors	4	3
4	Accounting and managerial factors	2	4
5	Future cash flow prediction	1	5

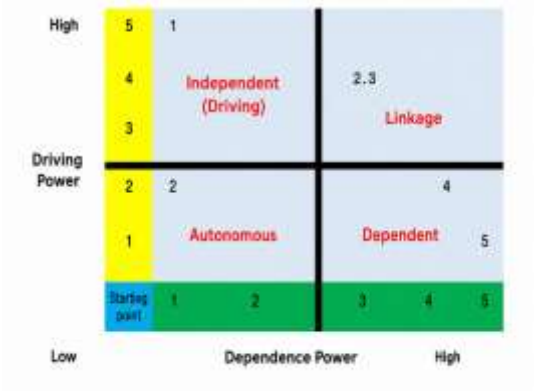


Figure 3. MICMAC Matrix

Using the coordinates of the components presented in Table 8, the MICMAC matrix was constructed, as illustrated in Figure 3.

As shown in the MICMAC matrix, Components 4 and 5 are located in the dependent quadrant, indicating that they have relatively low driving power but a high degree of dependence on other components. Component 1 is located in the independent or driving quadrant. This component has high driving power combined with minimal dependence. Components 2 and 3 are positioned in the linkage quadrant. These components exhibit relatively high levels of both driving power and dependence. They therefore play a key role in the model because they influence the components that are most susceptible to the effects of other factors. At this point, the Interpretive Structural Modeling process for "developing a model of factors predicting future cash flows using an Interpretive Structural Modeling approach" is completed.

4. Discussion and Conclusion

The present study sought to develop a structural model of the factors predicting future cash flows and to clarify the hierarchical relationships among those factors through Interpretive Structural Modeling (ISM) and MICMAC analysis. The findings first identified 19 components that were unanimously validated by the expert panel and subsequently organized into five overarching dimensions: economic factors, industry environment factors, corporate financial factors, accounting and managerial factors, and future cash flow prediction. The ISM results further demonstrated that these five dimensions were not positioned at an equivalent level of influence. Rather, they formed a four-level hierarchical structure in which economic factors occupied the deepest and most influential level, industry environment factors and corporate financial factors formed the third level, accounting and managerial factors were located at the second level, and future cash flow prediction constituted the first and most dependent level. The MICMAC analysis reinforced this hierarchy by classifying economic factors as independent or driving factors, industry environment and corporate financial factors as linkage factors, and accounting and managerial factors together with future cash flow prediction as dependent factors. Taken together, these findings indicate that forecasting future cash flows should be conceptualized as a multilevel process in which macroeconomic conditions initiate a chain of effects that is transmitted through the competitive and financial environment of the firm, subsequently reflected in accounting and managerial characteristics, and ultimately manifested in the ability to predict future cash flows.

The placement of economic factors at Level 4 and their classification as the most powerful independent drivers constitute one of the most important findings of the study. The economic dimension comprised inflation, exchange rates, bank interest rates, and economic uncertainty, all of which were found to exert substantial influence on the remaining dimensions while demonstrating minimal dependence on them. This result is theoretically plausible because macroeconomic conditions shape the overall financial environment within which firms operate and therefore affect revenue expectations, costs, borrowing conditions, working capital requirements, investment decisions, and liquidity management. The finding is consistent with evidence showing that macroeconomic uncertainty materially influences firms' cash-holding behavior and encourages companies to alter liquidity reserves in response to changes in perceived external risk [17]. It also accords with research on Iranian listed firms demonstrating that corporate cash holdings are determined by multiple financial and environmental characteristics [8]. From a forecasting perspective, instability in inflation, exchange rates, or financing costs may weaken the persistence of historical cash flow relationships and increase uncertainty regarding future receipts and payments. Therefore, the strong driving role assigned to economic factors in the present ISM structure suggests that future cash flow prediction cannot be separated from the macroeconomic context in which corporate operations occur.

The influence of economic conditions may be especially important in environments characterized by pronounced volatility. Inflation can change inventory replacement costs, operating expenditures, pricing decisions, nominal revenues, and the amount of working capital needed to sustain production. Exchange-rate changes may affect firms through imported inputs, export revenues, foreign-currency liabilities, and the valuation of international transactions. Interest rates directly influence debt-servicing costs and access to external financing, while generalized economic uncertainty can alter both managerial expectations and investor behavior. Such effects are consistent with the broader literature showing that firms adjust cash holdings, financing arrangements, and resource allocation policies in response to external uncertainty [17]. The findings of the present study therefore extend prior evidence by suggesting

that these variables should not merely be regarded as isolated predictors; instead, they represent foundational conditions capable of transmitting effects upward through industry, financial, accounting, and managerial mechanisms.

The positioning of industry environment factors and corporate financial factors at Level 3 also represents a central finding. Both dimensions exhibited relatively high driving power and relatively high dependence, leading to their classification as linkage factors in the MICMAC matrix. The industry environment dimension consisted of product market competition, changes in inventory prices, and capital market environmental uncertainty, whereas the corporate financial dimension included profitability, capital structure, asset liquidity, earnings quality, working capital management, and current liabilities. Their linkage status implies that these dimensions simultaneously receive substantial influence from economic conditions and transmit that influence to higher-order accounting and managerial factors and, ultimately, future cash flow prediction. This reciprocal position is conceptually important because industry and financial characteristics represent the interface through which broad economic pressures are translated into firm-specific cash-generating consequences.

The importance of the corporate financial dimension is strongly supported by previous studies. Profitability and liquidity have long been considered closely connected dimensions of corporate financial health, with evidence indicating that their relationship can influence distribution and financing decisions [7]. Similarly, the level of corporate cash holdings and deviations from an optimal cash balance have been associated with subsequent firm performance [9]. These findings align with the present result that firm financial characteristics occupy a key linkage position in the model. A profitable firm with adequate liquidity, balanced working capital, manageable current liabilities, and an appropriate capital structure is more likely to generate predictable cash flows than a firm with weak profitability, constrained liquidity, or excessive short-term obligations. However, these firm-specific attributes themselves remain vulnerable to changes in macroeconomic conditions, thereby explaining why they were not classified as purely independent drivers.

The role of capital structure within the corporate financial dimension also supports the structural relationships identified in the model. Financing choices determine future interest payments, principal repayments, and the degree of financial flexibility available to the firm. Research examining financing sources in major corporate transactions has shown that the choice of financing mechanism has meaningful consequences for subsequent firm behavior and financial outcomes [10]. Similarly, contemporary models of financial distress increasingly emphasize cash flow information because the deterioration of cash-generating capacity often signals financial weakness before conventional performance measures fully reflect it [11]. Accordingly, capital structure and current liabilities are not peripheral variables in future cash flow forecasting; rather, they directly determine mandatory future cash outflows and influence the resources available for operating and investment activities.

Working capital management and asset liquidity provide another explanation for the strong linkage role of corporate financial factors. Current-period sales and profitability do not automatically translate into cash unless receivables are collected, inventories are converted efficiently, and short-term liabilities are managed effectively. The transformation of accounting performance into cash is therefore mediated by working capital policies. The findings are compatible with previous evidence demonstrating the importance of liquidity for corporate financial outcomes [7] and the determinants of cash-holding behavior among Tehran Stock Exchange firms [8]. In this sense, the present model shows why forecasting future cash flows requires attention not only to earnings but also to the mechanisms through which earnings are converted into realized cash resources.

The study additionally revealed that accounting and managerial factors occupied Level 2 and were classified within the dependent region of the MICMAC matrix. This dimension included operating performance, internal control systems, corporate governance, accounting conservatism, and financial reporting quality. Its position indicates that accounting and managerial factors are substantially influenced by underlying economic, industry, and corporate financial conditions but, at the same time, directly influence the prediction of future cash flows. This finding is consistent with the proposition that accounting information functions as an intermediate representation of underlying economic activities. The quality and usefulness of that representation depend on governance arrangements, internal controls, management incentives, accounting policies, and reporting practices.

Previous research concerning earnings management and corporate governance provides substantial support for this result. Studies have demonstrated that managerial incentives may encourage earnings manipulation surrounding important corporate transactions [13, 14]. Other evidence

shows that corporate governance can play a significant role in constraining accrual manipulation, thereby affecting the credibility of reported financial information [12]. The finding that accounting and managerial factors directly precede future cash flow prediction is therefore meaningful: when governance structures are effective, internal controls are robust, and reporting quality is high, the accounting information used to estimate future cash flows is more likely to reflect the underlying economics of the firm. Conversely, weak governance and discretionary reporting behavior can reduce the correspondence between current financial information and subsequent cash realization.

The inclusion of corporate governance within this dimension is also supported by evidence regarding board structure and managerial decision horizons. Ahmadvand found that board size can influence the relationship between managerial myopia and operating cash flow as well as stock price outcomes [15]. This evidence suggests that governance mechanisms may alter the manner in which managerial behavior is translated into operational and financial consequences. In the context of the present study, corporate governance may therefore improve future cash flow prediction both directly, through enhanced oversight and strategic discipline, and indirectly, through improved reporting quality and more effective operational decision-making.

The predictive importance of earnings and cash flow information identified in previous research further supports the location of accounting and managerial factors immediately below the final dependent variable. Hajiannezhad et al. showed that both earnings and cash flow information possess predictive ability for future cash flows [5], while Jafarloo and Eskandari similarly emphasized the usefulness of operating cash flows, earnings, and accruals in forecasting subsequent cash flows [6]. International evidence has likewise examined the comparative predictive power of earnings and cash flows and concluded that their relative usefulness depends on the characteristics of the underlying accounting information [3]. Research on the properties of earnings and cash flows has also shown that their informational characteristics influence the extent to which they can be used for forecasting [4]. These studies are consistent with the present hierarchical model because they demonstrate that future cash flow prediction is closely connected to the quality, persistence, and composition of accounting performance measures.

The finding that future cash flow prediction occupied Level 1 and had the highest dependence power but the lowest driving power was also expected. In the ISM hierarchy, this variable represents the ultimate outcome generated through the interaction of the other dimensions. Its classification as dependent indicates that forecasting capability is determined by information arising from economic conditions, industry characteristics, firm financial structure, and accounting and managerial processes rather than functioning as an independent causal force within the system. This result supports the growing recognition that cash flow forecasting is a multidimensional activity. Contemporary studies emphasize that forecasting quality depends on combining historical financial information with contextual and managerial inputs rather than simply extrapolating past cash flows [1]. Field evidence further demonstrates that management accountants actively construct cash flow forecasts by integrating assumptions, managerial judgments, and decision-relevant information in capital budgeting contexts [2].

The finding also corresponds with experimental evidence showing that even the presentation method of cash flow information can influence investors' expectations of future cash flows [16]. This suggests that cash flow forecasting is influenced not only by the economic content of available information but also by how that information is processed and interpreted. Thus, the dependent position of future cash flow prediction in the model reflects the cumulative nature of the forecasting process: forecasts are the product of macroeconomic conditions, organizational realities, accounting measurements, managerial judgments, and the way financial information is communicated to decision makers.

The MICMAC analysis provides further insight into the systemic structure of the findings. Economic factors were situated in the independent or driving quadrant, demonstrating high driving power and low dependence. Corporate financial factors and industry environment factors were positioned in the linkage quadrant, indicating that changes in these dimensions may generate effects elsewhere in the system while also being sensitive to changes in their antecedents. Accounting and managerial factors and future cash flow prediction were placed in the dependent quadrant, suggesting that they primarily represent the consequences of conditions generated at deeper levels of the model. Importantly, no major component was classified as autonomous, indicating that the dimensions identified in the study are structurally connected rather than isolated. This is an important finding because it implies that interventions directed toward a single predictor without considering its

relationships with other factors may produce incomplete interpretations of forecasting behavior.

The linkage classification of industry and corporate financial factors also indicates potential instability within these dimensions. Linkage variables are characterized by feedback-like relationships because they possess both substantial dependence and substantial driving power. Consequently, changes in product market competition, inventory prices, financial leverage, working capital management, earnings quality, or liquidity may simultaneously result from broader economic changes and generate downstream consequences for managerial and accounting outcomes. This interpretation is compatible with studies showing that cash holdings and future performance are related [9] and that financing structures can have consequential effects on corporate decisions [10]. It also highlights why these variables merit particular attention in forecasting models: they may function as transmission mechanisms through which external shocks become internal financial consequences.

The findings additionally provide support for integrating structural models with contemporary data-driven forecasting techniques. Advances in artificial intelligence and machine learning have created new possibilities for analyzing multidimensional financial information and detecting nonlinear associations among predictors [18]. However, the predictive accuracy of algorithmic approaches does not necessarily reveal the conceptual direction or hierarchy of relationships among variables. The present ISM model helps address this limitation by identifying which groups of variables should be regarded as fundamental drivers, which serve as linkage mechanisms, and which constitute dependent outcomes. Consequently, the hierarchical structure identified here may provide a theoretically interpretable foundation for the selection and organization of variables in subsequent machine-learning or data-mining models.

Overall, the results indicate that future cash flow prediction is best understood as the endpoint of a hierarchical and interconnected system rather than as a function of historical cash flow or earnings alone. Previous research has established the usefulness of earnings, operating cash flows, and accruals for forecasting [3, 5, 6]; the present findings extend this literature by situating such accounting information within a broader framework that also incorporates macroeconomic, industry, financial, governance, and managerial determinants. The model therefore offers a more comprehensive explanation of how external and internal forces jointly shape the predictability of corporate cash flows, particularly in the context of firms operating in a volatile economic environment.

The findings of this study should be interpreted in light of several limitations. First, the qualitative component relied on the judgments of 17 financial and accounting experts, and although theoretical saturation was achieved, expert evaluations may still reflect professional experience, subjective interpretations, and context-specific perceptions. Second, the empirical context was restricted to companies listed on the Tehran Stock Exchange, meaning that the structure of relationships identified here may not be directly generalizable to privately held firms, financial institutions, small and medium-sized enterprises, or firms operating in economies with different regulatory and macroeconomic characteristics. Third, the ISM methodology determines the hierarchical direction of relationships based primarily on expert judgments rather than estimating causal effect sizes. Therefore, the resulting structure should not be interpreted as definitive evidence of causality. Finally, economic conditions may change substantially across periods, and relationships among inflation, exchange rates, interest rates, corporate financial characteristics, and future cash flows may vary during economic crises, periods of relative stability, or major regulatory changes.

Future studies could validate the proposed hierarchical model using larger samples and quantitative techniques such as structural equation modeling, panel-data analysis, dynamic panel models, or Bayesian network analysis. Researchers could also compare the relative predictive performance of alternative statistical and machine-learning algorithms using the factors identified in the present model and investigate whether incorporating the hierarchical structure improves out-of-sample cash flow forecasting accuracy. Comparative research across industries would be useful for determining whether the influence of competition, inventory price fluctuations, working capital requirements, and financing structures differs systematically between manufacturing, service, technology, and capital-intensive sectors. Cross-country studies could further examine whether the hierarchical position of macroeconomic factors changes in more stable economic environments. Future research may also separate positive and negative macroeconomic shocks, investigate nonlinear relationships, and assess whether corporate governance or financial reporting quality moderates the transmission of economic and financial shocks to future cash flows.

Managers and financial decision makers should treat future cash flow forecasting as an integrated process rather than relying exclusively on historical earnings or cash flow trends. Forecasting systems should systematically incorporate macroeconomic indicators, especially inflation, exchange-rate movements, interest rates, and economic uncertainty, because these factors represent the strongest underlying drivers in the proposed model. Firms should also closely monitor industry competition, changes in inventory costs, capital market uncertainty, liquidity, working capital, current liabilities, profitability, and capital structure because these factors function as important transmission mechanisms between the external environment and future cash generation. At the organizational level, strengthening corporate governance, internal control systems, accounting conservatism where appropriate, financial reporting quality, and operating performance can improve the reliability of the information used in forecasting. Financial managers may additionally benefit from integrating scenario analysis and data-mining tools into forecasting systems so that alternative macroeconomic and financial conditions can be evaluated before investment, financing, liquidity, and budgeting decisions are finalized.

Authors' Contributions

Authors equally contributed to this article.

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Declaration of Interest

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Ethical Considerations

All procedures performed in this study were under the ethical standards.

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