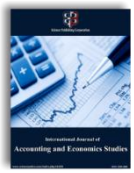
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Beyond The Numbers: Machine Learning Forecasting of Cash Flows in Emerging Markets

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Abstract

This study examines the ability of past operating cash flows and earnings to predict future cash flows in the context of the Palestinian economy. Prior research offers mixed evidence on which measure—cash flows or earnings—has greater predictive value. Using a panel of twelve industrial firms listed on the Palestine Exchange (PEX) from 2014 to 2021, this study moves beyond conventional linear models by applying a non-linear machine learning method, specifically the Boosted Tree model in JMP. The results show that while the Generalized Method of Moments (GMM) provided statistically insignificant outcomes, the Boosted Tree model exhibited strong predictive power. This indicates that both past earnings and cash flows can be effective predictors when used within a flexible, adaptive modeling framework. These findings highlight the importance of methodological innovation, especially in emerging markets like Palestine, where financial limitations, weak institutional structures, and political instability are prevalent. By introducing Boosted Tree modeling, this study contributes a valuable forecasting approach for data-constrained and complex environments. The results offer practical implications for investors, analysts, and corporate decision-makers aiming to improve cash flow forecasting in volatile and structurally fragile economies.

Keywords: *Cash flow prediction, Palestine Exchange, Generalized Method of Moments (GMM), JMP Boosted Tree, emerging markets.*

1. Introduction

Forecasting the future cash flows is a core part of the financial decision-making process, allowing business owners and investors to plan appropriately about cash flows, liquidity, and crisis contingency planning in terms of how solvent they are (Greenberg et al., 1986; Barth et al., 2001; Chotkunakitti, 2005). The Financial Accounting Standards Board (FASB, 1978) acknowledged the role of cash flow predictability by declaring that the fundamental objective of financial reporting is to produce information that could help in predicting future cash flows. A considerable amount of empirical literature has since been produced to examine the predictive ability of historical earnings and cash flows for future cash flows, and the associated relationship has become one of the most studied issues in accounting and financial research.

For over four decades, the relationships between past earnings, cash flows, and future cash flows have been examined in many empirical studies assessing their relative information (forecasting) power to predict the future financial performance of firms (Greenberg et al., 1986; McBeth, 1993; Finger, 1994; Dechow et al., 1998; Barth et al., 2001; Chotkunakitti, 2005; El-Sayed Ebaid, 2011; Zhou et al., 2021). However, the results in this area are inconclusive, as researchers have come to different conclusions about which prediction of future cash flows is superior. The literature provides four alternative views: (1) both earnings and cash flows together explain future cash flows, (2) earnings have more explanatory power, (3) cash flows is a better predictor, and (4) neither earnings nor cash flows explain future cash flows. Research on this topic has produced mixed results, highlighting the need for further empirical studies, particularly in distinctive financial environments such as the Palestine Exchange (PEX).

This debate remains unresolved, signaling the need for further empirical investigation of whether past earnings/cash flows could make a larger contribution in the prediction of future cash flows than its counterparts. This study offers a timely and empirically grounded contribution to the literature on financial forecasting in emerging markets. This research is anticipated to provide insights for users of financial statements, helping them out for their proper investment and managerial decisions through a better understanding of cash flow predictability.

This study aims to evaluate the relevance of historical operating cash flows and earnings in predicting future operating cash flows. This study aims to give a new understanding to financial reports users, such as financial analysts, investors, and other decision makers who use financial reports, which of the past earnings or past operating cash flows have greater relevance to the future, by making a comparison of past earnings and past operating cash flows. To the knowledge of the researcher, no previous studies have addressed this issue in Palestine. Thus, this study fills an important gap in the literature and has practical implications for financial analysts and practitioners in corporate finance in emerging markets with unique economic and institutional structures.

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2. Literature Review and Hypothesis Development

2.1 Cash Flow Forecasting: A Review of the Literature

Cash Flow forecasting is one of the most important processes in financial planning for any business to avoid financial distress and crisis (Barth et al., 2001). The Financial Accounting Standards Board echoes that sentiment, stating the fundamental purpose of financial reporting is to provide information that is useful for predicting future cash flows (FASB, 1978; paragraphs 37-44). Since this claim, cash flow forecasting has been addressed extensively in both the United Kingdom and the United States, with mixed results.

Many academic studies have highlighted the importance of both cash flow and earnings for predicting future cash flows. The findings remain inconclusive across studies, due to variations in economic context, firm characteristics, and modeling approaches. Based on this reasoning, some researchers have argued that historical cash flows are a better predictor of future operating cash flows than historical earnings (Lorek & Willinger, 1993; Finger, 1994; Bowen et al., 1986). On the other hand, other research indicates that past earnings are a better predictor of future cash flow (Greenberg et al., 1986; Kim & Kross, 2005; Dechow et al., 1998; Takhtae & Karimi, 2013).

2.2 The Role of Earnings and Cash Flows in Predicting Future Cash Flows

Greenberg et al. (1986) confirmed FASB's claim about the usefulness of earnings in predicting future cash flows, demonstrating that past earnings provide better predictive power for future cash flows than the past operating cash flows. Likewise, Kim and Kross (2005) used the same model as the one used by Dechow et al. (1998), and they found that earnings outperform operating cash flows in predicting future cash flows. Multiple studies have concluded that accounting earnings are more predictive than cash flow measures (Arnold et al, 1991; Quirin et al, 1999; Quirin et al, 2000).

Conversely, Bowen et al. (1986) have reported that earnings are a weak predictor of future cash flow compared to working capital, and combined with depreciation and amortization. Murdoch and Krause (1990) and Percy and Stokes (1992) also arrived at similar conclusions. Lorek and Willinger (1993) and Finger (1994) demonstrated that the operating cash flows as cash flow predictors outperform earnings. Further research by Lev and Sougiannis (2010), Farshadfar et al. (2008), and Habib (2010) highlighted the superiority of operating cash flows over earnings in forecasting future cash flows.

According to Al Attar and Hussein (2004), cash flows from operations, earnings, and their parts are analyzed in terms of predicting future cash flows, "as a component of cash flows," outperforming earnings as a predictor of future cash flows. In contrast, McBeth (1993) claimed that the superior predictive ability of cash flows and earnings is not against the future cash flows. These findings provide contrary evidence to the FASB's claim that earnings are the best predictor of cash flow. While some prior studies discuss the 'value relevance' of earnings and cash flows, this study adopts a forecasting approach focused on 'predictive power'—that is, the statistical ability of historical financial indicators to forecast future operating cash flows. The distinction is important: value relevance generally refers to explanatory power in market value terms, while predictive power emphasizes forward-looking forecasting performance.

2.3 Empirical Studies in the MENA Region

This is like recent studies in MENA (Middle East and North Africa) countries that found no results about cash flow prediction. For example, Al Debie (2011) determined that earnings are less predictive than operating cash flows when attempting to predict future cash flows for companies listed on the Amman Stock Exchange. Mooi (2007), Ahmadi and Ahmadi (2012), and Mulenga (2015) have also reported similar results in Malaysia, Iran and India, respectively.

Alternatively, FASB's view (Shubita, 2013; Takhtae, & Karimi, 2013; Moeinaddin et al., 2013) has been supported by several studies claiming earnings provide a better predictor of subsequent cash flows. More recently, Ahmed and Abu Harb (2025) conducted a study in the Palestinian banking sector examining the relationship between liquidity risk and financial performance over ten years. Despite utilizing a relatively small sample of seven banks, comparable in scale to the sample size used in this study, the authors effectively employed machine learning techniques to uncover patterns not captured by traditional econometric models. Their findings strongly advocate for the integration of artificial intelligence tools, including machine learning, into financial forecasting and risk mitigation processes. The methodological implications of their work further validate the use of non-linear and adaptive models, such as Boosted Trees, in structurally constrained and volatile markets like Palestine.

2.4 The Need for a New Study in Palestine

The exploration of the existing literature reveals that both past cash flows and past earnings hold predictive capacity over future cash flows in international markets, but the results are not definitive and differ by study context and sample characteristics. Although the topic is widely covered by literature in many parts of the world, the predictive ability of past cash flows and earnings has not been previously studied in Palestine. The gap raises the question of whether cash flows or earnings are better at predicting future cash flows in the Palestinian market. Therefore, this study seeks to fill this research gap and enrich the financial and accounting literature with new empirical evidence coming from the Palestine Exchange.

Depending on the objectives of this paper, which is providing evidence from Palestine about the predictive capability of past year earnings and past year operating cash flows in explaining future operating cash flows Hereinafter is the hypothesis that meets the objectives:

2.5 Main hypothesis:

H0: The past operating cash flows and past earnings have value relevance in predicting the future operating cash flows.

The preceding review of the literature reveals that the predictive ability of past earnings and cash flows varies significantly across different contexts and empirical models. While some studies emphasize the superior forecasting power of earnings, others find that cash flow provides more reliable estimates, particularly in emerging markets. However, very few studies have examined this issue within fragile economies like Palestine, where institutional instability may distort conventional financial relationships. In light of these inconsistencies, this study aims to empirically evaluate the predictive relevance of both earnings and operating cash flows in the Palestinian context using advanced modeling techniques.

To address these gaps and build on the findings from prior research, the following section outlines the methodological framework used in this study. It describes the data sources, sample selection, and analytical models, including both traditional econometric approaches and machine learning techniques, employed to assess the predictive power of historical financial metrics on future cash flows.

3. Methodology

3.1 Data Collection

This research uses panel data of financial data for 12 publicly traded Palestinian companies, all of them classified to the industrial sector on the Palestine Exchange (PEX). The research period has been set from 2014 until 2021, which totals seven years and a total of 72 firm-year observations. The data include the key variables–operating cash flows and earnings before interest and tax (EBIT)–that are scaled by the average total assets, allowing comparisons across firms and periods.

3.2 Sample Justification

Although the 12 reported industrial firms in the sample may seem small, one must realize the structural constraints on the market in Palestine. The unique geopolitical as well as economic context of the Palestinian economy dictates the limits on the number of publicly listed firms, especially in the industrial sector. Therefore, this selected sample provides a large enough segment of the sector to be a valid argument for forecasting the future cash flow decisions in a developing, politically constraining economy.

Publications in smaller and less mature markets have low sample sizes at best, reflecting a limited number of firms that can be sampled and researched. Despite this limitation, however, similar studies in similar contexts have shown that meaningful insights can be gained when the sample is representative of the pop of interest. In the Palestinian context, the selection of 12 industrial firms for this study reflects a significant share of the industrial sector listed on the Palestine Exchange (PEX), thus providing a robust representation of the target population. The sample is justified not only by sectoral coverage but also by its comparability to prior empirical research conducted in Palestine. For example, Faris (2011) investigated capital structure determinants using a sample of only 15 firms across multiple sectors, selected out of 28 listed firms at the time, based on data availability and reporting continuity. Similarly, Daraghma and Alsinawi (2010) conducted a statistical analysis on a sample of 28 corporations over a four-year period (2005–2008), which represents the full exchange during that time. More recently, Ahmed and Abu Harb (2025) examined the financial performance of banks in Palestine using a sample of just 7 institutions over 10 years, highlighting that small but consistent datasets are not only standard but also necessary due to structural limitations in the market. Their study further recommends the adoption of machine learning tools to enhance financial operations and mitigate risks—an endorsement that strengthens the methodological direction taken in this paper. These precedents confirm that smaller, context-specific samples can yield valuable insights and are methodologically sound within the Palestinian financial environment. Accordingly, the selected sample size is considered adequate to derive an empirical found examination.

3.3 Model Specification

As is consistent with previous literature, there is no undisputed theoretical model for predicting the future cash flow (Bowen et al., 1986). To achieve this, the researcher adopts the framework introduced by Dechow et al. (1998) to analyze how well past earnings and past operating cash flows predict future operating cash flows. A one lagged model is used to evaluate the relationship:

$$OCFit = \beta0 + \beta1\ OCFi\ (t\text{-}1) + \beta2\ Ei\ (t\text{-}1) + \varepsilon it$$

Where:

- OCFit represents the expected operating cash flows, scaled by the average total assets for firm i in period t.
- OCFi(t−1) denotes past operating cash flows, scaled by the average total assets for firm i in period t−1.
- Ei(t−1) signifies past accounting earnings, scaled by the average total assets for firm i in period t−1. The variable representing earnings in this study is defined as EBIT (Earnings Before Interest and Taxes), scaled by average total assets. For consistency, we refer to this measure as 'EBIT' throughout the empirical sections of the paper.
- ϵit is the error term.

3.4 Estimation Techniques and Justification for

The selection of estimation techniques is important to maintain the validity and reliability of the results that can be obtained. The researcher in this study initially chose the Generalized Method of Moments (GMM) as the estimation method, which is an accepted estimation method in the panel data context. GMM was chosen because it can overcome numerous problems, including endogeneity, heteroscedasticity, and autocorrelation, which can all occur in financial data.

The major benefit of GMM, in this researcher's experience, is the internal instruments based on lagged values of the variables that assist in eliminating bias from potential simultaneity as well as omitted variable biases due to rigid theoretical assumptions (Cuicui & Wooldridge, 2020). GMM has been extended to dynamic panel models used widely in the literature of accounting and finance to test the predictive ability of financial variables (Lorek & Willinger, 1996; Greenberg et al., 1986). Despite having some advantages, the researcher using GMM did have low predictive ability when calculating cash flows, with an adjusted R-squared value of 0.14 and insignificant coefficients for both previous earnings and previous cash flows.

Notwithstanding the methodological plausibility, the limitations of linearity and possible misspecification of the model significantly inhibit the validity of cash forecasting, especially in today's complicated economic environment in Palestine. As previously noted, the GMM model demonstrated limited predictive capacity, which prompted the shift to a more adaptive machine learning approach. To mitigate linearity and discover other predictors with potentially superior predictive power, the researcher extended the analysis using Boosted Tree modeling using JMP software.

Boosted Trees are an ensemble machine learning method that can reveal non-linear relationships and interactions amongst variables, which traditional econometric models fail to capture completely. JMP Boosted Trees do not rely on strict distributional assumptions and appear

to be appropriate for small samples and noisy data. This is ideal for researchers in emerging markets like Palestine, where samples are available but noisy, and do not meet the regression assumption of normality.

The Boosted Tree model produced significantly greater predictive ability using R-squared values of 0.685, meaning almost 69 percent of the variance in future operating cash flows might be explained by the model. Given that the Boosted Trees model was a better predictive model of operating cash flows than past operating cash flows and past earnings were both important predictors, where past earnings produced a slightly greater contribution to the prediction.

These findings provide further empirical evidence on machine learning methods to produce reliable financial forecasts for future cash forecasting and illustrate a practical and original application of machine learning techniques to the overall area of the Palestine Exchange. The decision to apply Boosted Tree analysis techniques showed the researcher wanted to accurately apply the best methodological process to achieve valid, reliable findings which represent the related theory.

This reflects a broader academic imperative, as the researcher seeks to apply and validate the techniques used of more advanced forecasting methods in a financial market which are less scrutiny. Thus, while the GMM model can reasonably support the validity of the methods applied, the Boosted Tree model allows for a place to produce valid, reliable prediction, while also enhancing the significance of the outcomes as a practical contribution to the study's goal. However, while the Boosted Tree model demonstrates strong predictive capability, it is important to recognize certain limitations. One concern is the risk of overfitting, especially when dealing with small datasets, as the model may capture noise rather than the true signal. Additionally, the computational complexity and the need for advanced technical knowledge in tuning model parameters (e.g., learning rate, number of trees, depth) may limit its practical adoption by non-experts. Another issue is interpretability; unlike linear models, Boosted Trees do not offer simple coefficient-based explanations, making them less transparent in financial reporting contexts. These considerations highlight the importance of using such models with caution, especially in regulatory or audit-sensitive environments. With this expansion in practice and application, the use of the new technique is a substantive contribution to the literature as it incorporates a more recently developed data-driven, evidence-based forecasting approach to determine the accuracy of financial indicators, especially in emerging markets where the traditional econometric models are less reliable.

Furthermore, it allows an opportunity for future empirical research to examine the contribution of machine learning techniques that can add to more traditional econometric approaches that can help researchers produce more accurate conclusions analysts and make more accurate financial decisions.

4. Analysis, Assumptions, and Results Analysis

4.1 Analysis Assumptions

To ensure the robustness and reliability of the study's initial econometric findings, a series of diagnostic tests were conducted under standard practices for panel data analysis. The tests included normality, autocorrelation, heteroscedasticity, multicollinearity, and stationarity tests. Notably, the data showed that it was not normal, with a Jarque-Bera test p-value of 0.000000. This lack of normality indicated that some classical linear modeling assumptions might be violated. Autocorrelation was determined using the Breusch-Godfrey Serial correlation LM Test, yielding an F-statistic of 1.747847 and p-value=0.1820. This indicated the absence of autocorrelation. The Breusch-Pagan-Godfrey test for heteroscedasticity was statistically significant with an F-statistic of 3.579496 ($p = 0.0332$), indicating a violation of the constant variance assumption. The study confirmed that multicollinearity among the predictors was not present, and all dependent and independent variables were stationary according to the Augmented Dickey-Fuller tests.

These findings provided solid support for the parameters of the Generalized Method of Moments (GMM), which compensated for certain complications that are inherent in financial data applications like endogeneity and dynamic relationships. It was the GMM's abilities to provide robust, consistent estimates in heteroskedasticity and possible simultaneity and its heuristic prevalence in financial econometrics work (Cuicui & Wooldridge, 2020) that led to its installation in this study.

However, for this study, the GMM was weak in terms of prediction power and performance, with both past earnings and past operating cash flows eliciting statistically insignificant coefficient results, leaving the model only capable of explaining minor variations in future cash flows. As previously noted, the GMM model demonstrated limited predictive capacity, which prompted the shift to a more adaptive machine learning approach. Despite these weaknesses, the researcher opted for a more flexible and data-motivated approach—Boosted Trees modeling in JMP software.

Boosted trees provide non-parametric modeling that combines a flexible framework and avoids otherwise problematic assumptions like normality, linearity, homoscedasticity, or even stationarity. Non-parametric models are not computationally restricted by or run towards statistical assumptions like classical regression modeling. Non-parametric modeling fits the form of non-linear interactions that may exist between financial variables.

Furthermore, traditional regression may not reflect the financial variables with representative accuracy and precision in emergent markets, where financial interaction shows considerable variability, with volatile macroeconomics and structured economic conditions presented as irregular patterns. Boosted tree modeling demonstrates promise in the financial domain because it make no formal tests or lessens diagnostic corrections for violations of classical models' assumptions, allowing the goal of robust prediction efficiency to be maximized without the extensive limitations of regression temporal order.

The move to Boosted trees aims to find the best fit or representation of data structure using the greatest level of research competencies available. This methodological choice illustrates a purposeful effort to seek relative best results, not the usual convention. Additionally, this advanced machine learning model offers a valuable contribution to the literature and presenting a strong contribution to the literature, introducing an empirical assessment of the predictability method for financial indicators, especially in settings without stability and robust data applications.

This form will be a new addition to the literature, with implications for the foundation in financial prediction-based research in emerging markets, where machine learning techniques may be similarly applied to financial prediction.

4.2 Results Analysis

The research initially examined the value relevance of past operating cash flows and past earnings in predicting future operating cash flows using the Generalized Method of Moments (GMM) due to the ability to control endogeneity and dynamic relationships. However, the GMM results revealed that neither of the independent variables of past operating cash flows (OCFt-1) nor past earnings (Et-1) were statistically significant predictors of future operating cash flows (OCFt) with p-values of 0.1041 and 0.2583, respectively, both of which are

well above the conventional statistical significance thresholds (1%, 5%, and 10%). Further, the adjusted R-squared for the GMM model was only 0.14, indicating that the model could only explain 14% of the variance of the dependent variable.

In summary, the findings from this study support those made by McBeth (1993) who argued that neither earnings nor operating cash flow serves as a useful predictor of future cash flows in certain economic conditions (e.g., Palestine). This argument contradicts that of the FASB, who purport that earnings are a better predictor of cash flows than operating cash flow. The operational consequences of the GMM results also contradict some empirical evidence that favoured cash flows (e.g., Lorek & Willinger, 1993; Finger, 1994; Bowen et al., 1986) or earnings (e.g., Greenberg et al., 1986; Kim & Kross, 2005; Dechow et al., 1998; Takhtae & Karimi, 2013) as superior cash flow predictors.

Statistical limitations of the GMM model were further demonstrated with the results of the Ramsey RESET test, which was very significant (F-statistic = 11.85255, p = 0.0010), evidencing an omitted variable bias. This indicated that past earnings and past cash flows alone were not likely to produce a reliable prediction model for future cash flows, particularly in an emerging and structurally constrained financial environment such as Palestine.

Hence, to account for these limitations and to try and find a more accurate and robust prediction method, the researcher attempted a machine learning-based approach using a Boosted Tree predictive approach through JMP. The Boosted Tree approach permits prediction modeling to develop and train without requiring a normal, homoscedastic, or linear predictor, while also being capable of supporting complex, non-linear relationships as part of the model.

To ensure the robustness of the findings and avoid overreliance on a single algorithm, this study evaluated multiple alternative machine learning models. As shown in Table 1, several non-linear predictive methods outperformed classical econometric models. Notably, Bootstrap Forest achieved an R^2 of 0.5641, while Support Vector Machines and Neural Boosted models yielded R^2 values of 0.4393 and 0.4138, respectively, substantially exceeding the R^2 of traditional methods such as Fit Least Squares (0.1652) and Stepwise Regression (0.115). Although Boosted Tree produced the best results (R^2 = 0.6223, RASE = 0.04195), the performance of other machine learning models further reinforces the methodological position that non-parametric, adaptive algorithms are more suitable for forecasting in data-constrained and volatile environments like Palestine. These findings highlight the consistent superiority of machine learning techniques in capturing complex and non-linear financial dynamics.

Table 1: Comparative Performance of Machine Learning and Traditional Models

Method	N	R^2 (R-Squared)	RASE (Root Average Square Error)
Boosted Tree	72	0.6223	0.04195
Bootstrap Forest	72	0.5641	0.04507
Support Vector Machines	72	0.4393	0.05112
Neural Boosted	48	0.4138	0.05328
Fit Least Squares	72	0.1652	0.06418
Generalized Regression Lasso	72	0.1631	0.06245
K Nearest Neighbors	72	0.1497	0.06295
Fit Stepwise	72	0.1150	0.06422

The results from the Boosted Tree markedly improved the prediction power of the model. The model produced an R-squared of 0.685, indicating that almost 69% of the variability in future operating cash flows is explained by the model, a considerable improvement over GMM. Furthermore, both past earnings and past cash flows did add value to the model, with past earnings (Et-1) estimating almost 57.3% of model power contribution and past cash flows (OCFt-1) about 42.7%.

Table 2: JMP Boosted Tree Results Summary

Metric	Value
Target Variable	OCFt
Number of Observations	72
R-Squared (R^2)	0.685
Root Average Square Error (RASE)	0.0383
Key Predictors	Et-1, OCFt-1
Contribution of Et-1	57.3%
Contribution of OCFt-1	42.7%

The model yielded significantly improved results, demonstrating its ability to capture complex financial patterns that traditional models failed to detect. These results suggest that the Boosted Tree model accommodates the complexities and irregularities of Palestinian financial data much better than the linear GMM model may accommodate. This is due to the non-linear interactions, threshold effects, adaptability, and lack of stringent assumptions compared to traditional econometric modeling. It also adds support because the R-squared value improves, and both predictors, the contributions of both predictors, were meaningful and should be taken into consideration.

Consequently, this study not only affirms the limitations of traditional prediction models for emerging markets but also makes a methodological advancement in establishing the validity of Boosted Tree modeling. Utilizing an entirely new technique is a new contribution to the literature because it provides a modern, data-driven way of forecasting future cash flows, especially in limited financial and politically constrained environments like Palestine. Furthermore, it demonstrates a practical approach for future researchers and financial practitioners searching for better forecasting tools in very uncertain market environments.

4.3 Detailed Model Interpretation and Practical Predictive Insight

To further validate the strength and reliability of the Boosted Tree model, the researcher presents an in-depth examination of the JMP software outputs to include variable contributions and the computed Root Mean Square Error (RMSE) that provides a richer level of understanding regarding predictive capability. The model employs a non-parametric approach—one that does not assume a specific data distribution—and utilizes multiple decision splits, which are branching points where the model segments the data based on predictor values.

Variable Contribution to Predictive Power The model's internal structure clarified the utility of the two predictors, Past Earnings (E t-1) contributed to 57.33% of the variance explained, occurring in 180 decision splits. Past Operating Cash Flow (OCF t-1) contributed to 42.67% variance explained, occurring in 102 splits.

Overall, these statistics reaffirmed our intuition that while both variables are important, earnings had a slight superiority in predictive power for the application at hand. It is especially interesting given the conventional view that cash flows produce more reliable estimates, which

emphasizes the hidden potential of non-linear methods. In addition to the R^2, which indicates that the model explains 68.5% of the variance, the RASE value of 0.0383 also provides a complementary metric reflecting the model's absolute prediction accuracy. RASE can be reported in the same units as the dependent variable, which corresponds to the typical size of error in the prediction. So, a relatively small RASE like 0.0383 should give thinkers confidence that they can estimate an accurate value for cash flows even in a very limited sample of only 72 observations.

The metric is especially helpful to ascertain practical financial forecasts because it provides a sense of how accurately the model's predicted cash flows are beyond the model's reported percentage of variance explained. Prediction Profiler and Nonlinear Effects. From the model, we present the prediction profiler feature that indicates how each predictor influences the predicted outcome. For E t-1, the black curve presents a positive and somewhat nonlinear effect on predicted cash flows, particularly between values 0.05 and 0.1. For OCF t-1, the response curve is flatter and generates a smaller incremental effect over its range.

From the profiler, the results can be visualized that those earnings not only have greater statistical importance, but also a more consistent effect on the model predictions. The ascertainable nonlinear dynamics in our data support our choice to utilize a flexible machine learning framework. This extended account completes the practical appeal of the Boosted Tree model. By offering RASE and contribution metrics, the findings provided more than a statistically sound model for stakeholders; this study provided an interpretable, useful, and accurate model that can assist in practical financial decision-making in volatile markets such as Palestine.

4.4 Interpretation of the First Boosted Tree and Its Scientific Contribution

To enhance the interpretability of the Boosted Tree model applied in this study, the researcher examines the structure of the first decision tree (Layer 1) used in the boosting process.

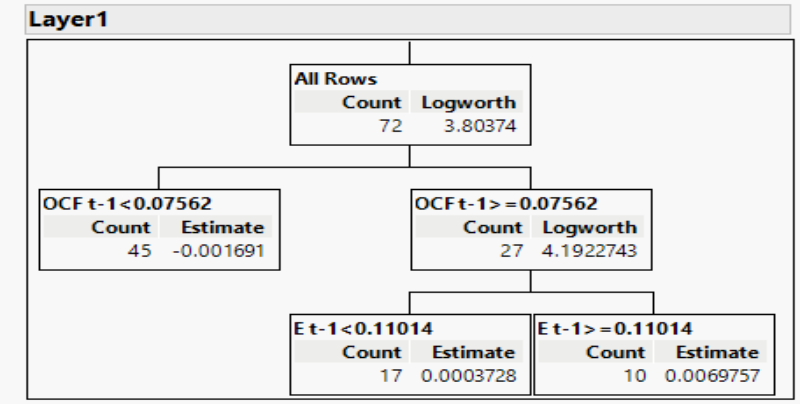


Fig. 1: Layer 1 Decision Tree of the Boosted Tree Model, Illustrating Non-Linear Interactions Between Past Operating Cash Flows (OCFt−1) and Past Earnings (Et−1) in Predicting Future Cash Flows

This tree provides initial insights into how past financial indicators, namely, past operating cash flows (OCF t-1) and earnings (E t-1), interact in a non-linear fashion to predict future operating cash flows (OCF t).

The root node includes all 72 firm-year observations. The first split occurs based on OCF t-1, with a threshold of 0.07562:

- OCF t-1 < 0.07562: 45 cases are predicted to have slightly negative current cash flows (estimate ≈ -0.001691).
- OCF t-1 ≥ 0.07562: 27 cases are further split based on earnings (E t-1).
- For the higher cash flow group (OCF t-1 ≥ 0.07562), the model then splits at E t-1 = 0.11014:
- E t-1 < 0.11014: 17 cases, predicted small positive cash flow (estimate ≈ 0.0003728).
- E t-1 ≥ 0.11014: 10 cases, predicted significantly higher cash flow (estimate ≈ 0.0069757).

These rules demonstrate that both indicators work jointly in a non-linear and hierarchical manner. High historical cash flow combined with high earnings substantially improves the prediction of future cash flow.

This tree interpretation provides an innovative layer of model transparency and interpretability, rarely achieved in financial forecasting within emerging markets. Unlike linear models, which assume constant marginal effects, the Boosted Tree approach captures complex interactions and conditional relationships between financial variables.

The ability to visualize prediction rules, such as "if past cash flow is high and earnings are high, expect strong future cash flows, "transforms the model from a statistical tool into a practical decision-making framework for investors and analysts. Furthermore, this layer of analysis highlights a major scientific contribution to the study:

- Introducing machine learning with traceable logic into financial prediction in politically and economically constrained environments. Demonstrating that data-driven models can achieve both accuracy and interpretability, overcoming the traditional trade-off in statistical modeling.
- The Boosted Tree model's ability to detect hidden patterns and adapt to the financial complexity of the Palestinian market marks a noteworthy methodological advancement. This research, through the integration of advanced machine learning techniques and interpretable model outputs, offers a new scientific benchmark for forecasting future cash flows in emerging markets where classical models fail to perform.
- This empirical evidence not only strengthens the validity of machine learning in financial research but also sets the groundwork for future studies seeking both predictive power and practical applicability in volatile and uncertain market conditions.

4.5 Discussion

The former purported assertion from the Financial Accounting Standards Board (FASB) that earnings have more predictive power than cash flows (in general) in the forecasting of future operating cash flows is challenged by the findings of this study. Past earnings and past operating cash flow both have very limited ability to predict future operating cash flows to a new benchmark in the case of Palestinian firms, when looking at conventional econometric modeling like GMM.

This finding illustrates the financial and economic environment in which these firms work, illustrating the contextual particulars of the challenges of uniformly applying Western financial paradigms to emerging and geographically unstable economies. Palestinian firms, for example, are faced with unique economic constraints that lead them to often rely exclusively on internal financing, with limited options for external funding sources.

Palestinians found several limitations regarding access to finance, including the absence of key financial instruments like a functional bond market and different methods of debt financing. As such, Palestinian firms have higher levels of cash flow uncertainty, and the historical periods of their financial statements may have less relevance for their forecasts.

Conventional guidance, like previous levels of earnings or previous cash levels, does not provide useful foresight, especially when a firm's presence is based on short-term or repairs are markedly short-term. logically, the financial burden of planning financial situations has an impact on the firm. In addition, the degree of political instability and economic uncertainty in the region undermines legitimate estimates of a firm's cash flow.

External shocks in the form of escaled trade restraints, regulatory changes, and recurring issues significantly influence the cash flow of finance plans. Coupled with these realities, it is even more challenging for firms to expect their financial history from their current economic situation to make their plans, whereas firms in stable economies have a more structured financial and legal environment to work within and can accurately predict the future based on prior commitments (Omet et al., 2015; Akingunola et al., 2017; Almanaseer, 2019).

Institutions like the World Bank (2020), the Palestinian Economic Policy Research Institute (2021), and the Palestinian Institute for Economic Research (2022) all pointed out that institutional deficiencies, legal ambiguities, and regulatory unpredictability only add to the confusion of financial behavior within the Palestinian private sector.

These constraints, together, create a financial context in which conventional models like GMM cannot capture the true environment. In fragile economies like Palestine, financial decision-making is inseparable from the broader institutional and political context. Political instability, lack of sovereign control over borders, weak legal enforcement, and regulatory fragmentation directly influence financial reporting, capital structure, and predictability of future cash flows (Faris, 2011; World Bank, 2020). Traditional models such as the Trade-Off Theory, which assume rational capital structure optimization, fail to account for exogenous shocks like operational shutdowns, infrastructure destruction, or abrupt regulatory changes (Awartani et al., 2016). These realities diminish the relevance of historical financial indicators in cash flow forecasting. Furthermore, access to external financing in Palestine is severely constrained, pushing firms to rely heavily on internally generated cash flows, which amplifies the importance and volatility of cash flow prediction. From an accounting perspective, this unpredictable financial environment challenges the preparation of reliable financial reports, highlighting the need for adaptive forecasting tools like Boosted Tree models. These tools can better navigate the non-linear, context-sensitive dynamics that traditional linear econometric models often overlook. Interdisciplinary approaches that integrate political economy, regulatory context, and accounting standards are essential to accurately assess financial behavior and forecast future outcomes in such volatile markets. Given this backdrop, the outcomes provided by the Boosted Tree model provided the author a new lens to view the results. Unlike GMM, the Boosted Tree model identified significant predictive capabilities for both earnings and cash flows, as well as explaining nearly 69% of the variability in future cash flows.

The results indicate that the machine learning approach is not only superior because it is able to capture complex, non-linear interactions also as well as being more immune to traditional statistical assumptions being violated. The implication of the superior performance of the Boosted Tree model, according to these authors, is that even though the underlying financial information may, under any linear models, seem weak from a figure-based linear framework, there may still be enough predictive information contained within the financial data to draw strength from using more adaptive tools.

Overall, the findings validate the need to criticize traditional financial models used in volatile, underdeveloped markets and suggest a greater commitment to more flexible, data-driven methodologies in forecasting financial behaviors. This study adds to the academic studies and provides insights into emergent market finance, yet the machine learning type models, such as Boosted Trees, provide a significant advancement.

5. Conclusion

The results of this study show that traditional econometric models, such as the Generalized Method of Moments (GMM), do not produce significant predictive power for either prior earnings or prior operating cash flows in estimating future cash flows of Palestinian firms. This finding is a context specific to the Palestinian business environment, which currently faces a range of economic, political, and institutional barriers that act to shape the Palestinian economic outcome and, as such, produce structural obstacles to the relationship between historical financial data and future performance.

The inclusion of a machine learning model - the Boosted Tree model from JMP - does, however, demonstrate a substantial advance in predictive ability when compared to the linear GMM test. The Boosted Tree produced a R-squared value of 0.69 as compared with the 0.14 produced by the GMM, and as such demonstrates that past earnings and past cash flows have predictive ability when examined in a non-linear adaptive way.

The Boosted Tree model demonstrated strong predictive ability even with known violations of normality, heteroscedasticity, and measured multiple associations in the data. In comparison, the GMM produced no statistical relevance to the task, even though, by conceiving predictive intent for a corporation, the GMM results would suggest mark-up arbitration in pricing operations.

These outcomes provide informative avenues for all stakeholders, researchers, and financial decision makers of emerging markets and suggest that machine learning and advanced techniques such as Boosted Trees can certainly uncover predictive relationships not captured by traditional measures of activity, especially in uncertain and variable access to capital market settings.

Additionally, the use of the new method enriches the literature, presents a new discipline appropriate to the probabilistic environment with regards to Palestinians or similar nations, and introduces contextual conditions for forward-looking financial outcomes. By modifying the methodological lens from strict linear constraints to adaptive machine learning models, this study presents a novel and powerful challenge to predictability, and thus, financial prediction concerning complex past financial behaviors occurring in uncertain economic environments.

6. Future Research

Future consideration should consider several extensions of the understanding of cash flows in Palestine, first and foremost, sectors that could disentangle service or finance sectors from the industrial sector, which may switch analysis as they may demonstrate different

financial structures and cash flow behaviors. Comparing these analyses would shed light on whether machine learning models, for example, the Boosted Tree, can share predictive strength as an industry standard.

Other useful lines of research include incorporating a broader range of macroeconomic measures, such as inflation, interest rates, and trade activity, that may have some additional dynamics for firms and cash flow decisions in a politically or economically variable direction. A simple qualitative component could also be added by conducting interviews with financial executives, and industry leaders could employ another contextual component to the artificial world of structured finance decision-makers.

Observational requests have also been made for longitudinal data over fifteen years or more, to observe future cash flow patterns, what type of predictive power the identified variables produce, and to consider the changes in forecasted managers' decisions with respect to changing economic conditions. A longer data frame of persistent reporting could create a composite picture of current financial behavior and provide an accurate perspective of the cash flow studies across time frames and distinct economies.

This manuscript has not been published previously and is not under consideration by another publisher or journal, and the study in this manuscript has been conducted according to the Ethical Guidelines.

Declaration:

I declare that I have no conflict of interest.

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