IJAAF; Vol. 9, No. 4, Autumn 2025, Serial 33

Ferdowsi University of Mashhad

Iranian Journal of
Accounting, Auditing & Finance

Quarterly

RESEARCH ARTICLE

The Effects of Cost Efficiency and Investment Efficiency on Value Chain Performance and Cash Flow Growth

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How to cite this article:
Badpa, B. and Jamshidi, M. A. (2025). Effects of Cost Efficiency and Investment Efficiency on Value Chain Performance and Cash Flow Growth. Iranian Journal of Accounting, Auditing and Finance, 9(4), 27-44. doi: 10.22067/ijaaf.2025.46482.1513
https://ijaaf.um.ac.ir/article_46482.html

ARTICLE INFO

Article History
Received: 2024-11-29
Accepted: 2025-03-20
Published online: 2025-10-05

Abstract

Value creation is one of the primary strategic objectives of firms, as it plays a crucial role in ensuring their sustainability and success within competitive markets, often leading to increased cash flow growth. Achieving value creation requires the efficient and effective utilization of organizational resources. In this regard, cost control, prudent financial resource management, and investment in value-generating projects are key drivers of success in enhancing value chain performance and improving cash flow. The present study aims to examine the effects of cost efficiency and investment efficiency on value chain performance and cash flow growth among companies. The statistical population comprises all firms listed on the Tehran Stock Exchange (TSE) during the period 2017–2022, of which 115 firms were selected through purposive sampling. Data were analyzed using multivariate regression techniques. The findings indicate that both cost efficiency and investment efficiency have significant positive effects on value chain performance. Moreover, the results show that higher levels of cost and investment efficiency contribute to increased cash flows. In other words, controlling and managing costs effectively, as well as avoiding over- or under-investment, enhances firms' overall performance across the value chain and leads to greater cash flow growth. From a practical perspective, policymakers can promote value creation by developing supportive regulations, offering financial incentives, and encouraging firms to adopt cost efficiency as a strategic mindset. Analysts can also rank companies based on their cost and investment efficiency, assisting managers in making better-informed decisions. Likewise, investors can evaluate firms' efficiency levels alongside other performance indicators when constructing their investment portfolios according to their desired investment horizons. Finally, this study contributes to the existing literature by expanding the understanding of value creation, performance evaluation, and optimal resource allocation in capital markets.

Keywords:
Cost Efficiency, Investment Efficiency, Value Chain Performance, Cash Flow Growth, Stochastic Frontier Function

https://doi.org/10.22067/ijaaf.2025.46482.1513

NUMBER OF REFERENCES
42

NUMBER OF FIGURES
-

NUMBER OF TABLES
7

Homepage: https://ijaaf.um.ac.ir
E-Issn: 2717-4131
P-Issn: 2588-6142

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1. Introduction

Value creation is among the most important strategic objectives of companies, as it often leads to increased cash flows. Investment plays a vital role in ensuring sustainable development in competitive markets and, consequently, in fostering corporate value creation. Because investment decisions have long-term implications, they must be made prudently to help firms secure a strong market position while ensuring their long-term survival. In other words, business enterprises must strive to enhance their investment efficiency (He et al., 2019). On the other hand, improving cost efficiency can be achieved by enhancing the quality of products and services, as well as minimizing waste throughout the production process. To achieve favorable financial outcomes, firms must optimize the allocation and utilization of their financial resources. According to Beladi et al. (2021), companies that successfully optimize their costs typically perform better across the value chain and achieve higher customer satisfaction by improving product and service quality. This, in turn, not only increases the company's market share but also strengthens its financial position.

Companies today face numerous financial and economic challenges. Under such circumstances, optimizing costs and investing efficiently in profitable projects have become increasingly important. Identifying and analyzing the effects of these two factors enables managers to make better decisions and allocate resources more effectively. As the variety and quality of products and services evolve at an accelerated pace, stakeholders' expectations of companies have also risen. In this complex and competitive environment, firms must enhance their performance across all stages of the value chain to ensure sustainable revenue generation and stakeholder satisfaction (Ju et al., 2006). Accordingly, it is essential to identify and evaluate the factors that influence improvements in value chain performance. The concept of the value chain encompasses all activities that contribute to creating value for a company's products or services. A strong value chain translates into a competitive advantage. Firms that maintain high competitiveness across various stages of the value chain are better positioned to create greater added value. In its most common application, value chain analysis serves as a strategic management and cost accounting tool used to identify and strengthen a firm's competitive advantage.

Investing in new and innovative projects, which often enhance investment efficiency, can lead to increased cash flow. Firms that allocate resources effectively to research and development (R&D) activities generally perform better across various stages of the value chain and experience lower cash flow volatility, thereby reducing financial risk (Xu et al., 2019). Such an investment orientation fosters the creation of new products, increases future revenues, and ultimately improves overall corporate performance. Furthermore, the optimal management of cash flows is essential. Strong cash flows not only enable firms to meet their debt obligations on time but also provide the flexibility to utilize financial resources during economic downturns and to seize new investment opportunities (Arianpoor & Mehrfard, 2023). Therefore, the direct relationship between cost efficiency, optimal investment, and cash flow management must be recognized for organizations to remain successful in today's competitive environment. A detailed examination of the effects of cost and investment efficiency on value chain performance and cash flow growth is essential for this purpose. This study aims to identify best practices in financial and human resource management and to propose strategies for enhancing efficiency and reducing costs. Considering the rapid pace of economic change and the necessity for firms to adapt to evolving market conditions, this issue holds considerable significance. Furthermore, based on the mechanistic hypothesis, improvements in performance indicators and increases in stock prices may stem from changes in accounting methods and earnings management practices. Therefore, examining the relationship between operational efficiency and cash flow performance can provide more substantial support for the research findings. One of the key innovations of this study lies in its examination of the role of cost efficiency and investment efficiency

in enhancing value chain performance among companies listed on the Tehran Stock Exchange. Additionally, it evaluates how these efficiencies contribute to improving corporate cash flows. The remainder of this paper is structured as follows: the next section presents the theoretical foundations and prior research, followed by a description of the research methodology. The final sections report the findings, conclusions, and practical as well as research recommendations.

2. Literature review and hypothesis development

Efficiency is a concept that evaluates the cost of resources utilized in the process of achieving specific objectives. In other words, efficiency is determined by comparing the outputs achieved with the inputs consumed. To measure efficiency, various factors, including human resource costs, equipment utilization costs, financing expenses, return on investment, and other relevant expenditures, are considered (Meeusen & Van Den Broeck, 1977). From an economic perspective, efficiency refers to producing the maximum possible output from a given set of inputs. It is also defined as the ratio of actual output to the standard or expected output—essentially, the proportion of work accomplished relative to the work that should have been completed (Ray, 2002). Therefore, efficiency serves as a key performance indicator that reflects how effectively a firm manages its available resources and evaluates the operational performance of a system in different dimensions. Overall, efficiency demonstrates the extent to which an organization utilizes its resources to achieve optimal production at a given point in time (Seth et al., 2021).

There are two methods for measuring efficiency: Data Envelopment Analysis (DEA) and the Stochastic Frontier Approach (SFA). In DEA, a linear programming method is employed in which model residuals are not decomposed into random shocks and inefficiency components; thus, all deviations from the efficient frontier are interpreted as inefficiency. In contrast, the stochastic frontier approach attributes the deviation between actual and potential (frontier) output to both random errors and inefficiency. Accordingly, when a firm's performance falls below the production frontier, part of the gap is attributed to technical inefficiency, while the remainder is due to random factors. Conversely, if a firm performs above the estimated production frontier, this deviation is entirely explained by random shocks (Sharif-Azadeh and Basirat, 2013).

2.1. Cost efficiency, value chain performance, and cash flows

The value chain serves as a managerial tool for coordinating and directing a company's activities across all departments. By analyzing the interactions and behaviors of these departments, firms can assess their performance in terms of both competitive and functional advantages, such as cost reduction and improved output quality. Applying the value chain concept fosters an integrated perspective of organizational activities and resources, thereby enabling firms to assess how effectively their resources contribute to achieving competitive advantage. Since the structure of the value chain varies depending on the nature of a company's operations, each department contributes differently to the firm's overall value creation and competitive strength (Ghaffari-Darab et al., 2015). Among the various models developed to evaluate departmental or operational activities, Porter's Value Chain Model is one of the most widely used. According to Porter (1985), a firm's activities are categorized into primary and support activities, and together, these activities form the company's value chain. The value generated through these interrelated processes collectively determines the overall value of the firm.

From the perspective of management accounting, the value chain serves as an analytical framework that enables firms to identify the key steps involved in delivering a product or service to

customers. This framework is typically divided into three broad stages: upstream activities, production or operational activities, and downstream activities. Upstream activities encompass research, design, product development, and interactions with suppliers of raw materials and other essential components. Operational activities include the manufacturing and production of goods or the provision of services, while downstream activities involve product delivery, customer service, and post-sale interactions. Accordingly, some scholars associate upstream activities with supply chain management and downstream activities with customer relationship management (Badpa & Mohamadvali, 2023). The central premise of value chain analysis is that each stage of a company's operations should be carefully examined to determine its contribution to profitability and competitive advantage. Cost efficiency, defined as the optimization of resources and reduction of expenses through effective cost management, plays a pivotal role in this process. Efficient cost management enhances value chain performance and increases cash flows, underscoring the importance of prudent financial resource management in establishing a competitive advantage (Blocher et al., 2009). Moreover, effective cost management is directly linked to value chain performance and, consequently, to corporate cash flows. Improved cash flow not only strengthens financial stability but also catalyzes further investment, thereby fostering corporate growth and long-term development (Alu, 2023).

Viverita et al. (2024) investigated the impact of cost efficiency on liquidity generation in Islamic and conventional banks across the ASEAN-4 countries. Using data from 117 banks (103 conventional and 14 Islamic) and applying a dynamic panel regression model, they found that banks with higher cost efficiency possess a greater ability to generate liquidity. However, increased market competition tends to weaken this ability. However, the negative impact of competition diminishes as banks become more cost-efficient, indicating that efficient banks are better positioned to maintain liquidity generation in competitive markets. The study also revealed that Islamic banks outperform conventional banks in liquidity creation. Similarly, Kinyugo (2014) examined the effect of cost efficiency on the financial performance of firms listed on the Nairobi Stock Exchange. Analyzing data from 47 companies, the study concluded that cost efficiency has a positive influence on firms' return on assets (ROA), confirming that efficient cost management contributes to improved financial performance. Kordestani and Mortazavi (2011) examined the moderating role of cost efficiency in the relationship between the operating expense ratio and firms' future performance. Their findings indicated that the selling, general, and administrative expenses ratio (SG&A ratio) has a significantly positive effect on future operating income only when SG&A efficiency exists and when there is sufficient potential to reduce the cost of goods sold. Under these conditions, SG&A expenditures represent strategic investments in enhancing manufacturing efficiency. Similarly, Lin (2005) analyzed the cost efficiency of Taiwanese commercial banks during periods of merger activity. The results revealed that mergers between heterogeneous banks improve cost efficiency, whereas mergers between homogeneous banks do not significantly affect cost control performance. The study further demonstrated that smaller banks in Taiwan outperform larger ones in terms of cost efficiency. Accordingly, it can be inferred that achieving optimal cost efficiency enables firms to streamline processes, reduce waste, and enhance value chain performance and customer satisfaction. These improvements contribute to higher cash flows, as reduced costs and increased revenues enhance profitability, liquidity, and overall financial stability. Based on this reasoning, the research hypotheses are formulated as follows:

H1: Cost efficiency has a significant positive effect on the company's value chain performance.
H2: Cost efficiency has a significant positive effect on the company's cash flow growth.

2.2. Investment efficiency, value chain performance, and cash flows

The business and economic environments in which companies operate have undergone profound changes worldwide. In developing countries, finding appropriate solutions to optimize the use of resources and wealth is essential for addressing economic challenges. One of the most effective approaches in this regard is the expansion and development of investment activities (Muñoz, 2013). Corporate investment in various sectors has long been regarded as a key driver of growth and a safeguard against stagnation and financial distress. However, due to resource constraints, firms must pursue investment development in tandem with improving investment efficiency (Hubbard, 1998). Investment efficiency refers to a firm's ability to invest solely in projects with a positive net present value (NPV), thereby avoiding unproductive or value-destroying investments (Biddle et al., 2009). Achieving optimal investment efficiency requires preventing the over-allocation of resources to over-optimized areas and redirecting them toward activities with greater investment potential (Madan, 2007). A company's investment efficiency policy typically dictates that all projects with a positive net present value (NPV) should be accepted, as they are expected to generate future cash inflows. Historical evidence from many developed and industrialized countries demonstrates that investment enhances production capacity and quality, which in turn leads to improved firm performance (Surya et al., 2021). Optimal investment contributes to superior performance in the value creation process, and the resulting increase in firm value enhances cash flow generation (Richardson, 2006). However, market imperfections—such as information asymmetry and agency costs—can lead to investment inefficiency, thereby negatively affecting value chain performance (Ascioglu et al., 2008). Overall, empirical evidence supports that greater investment efficiency promotes sustainable growth in firms' cash flows by ensuring that resources are allocated to projects with the highest potential for long-term value creation.

Badpa and Mohamadvali (2023) investigated the impact of entrepreneurial orientation on value chain efficiency among firms listed on the Tehran Stock Exchange. They measured innovation through investments in machinery, equipment, and software, and found that innovation, risk-taking, and business continuity—key dimensions of entrepreneurial orientation—have positive and significant effects on value chain efficiency. Similarly, Salehi et al. (2022), using data from 177 firms listed on the Tehran Stock Exchange from 2014 to 2021, demonstrated that investment efficiency has a positive influence on firm value. Moreover, institutional ownership and board independence were found to moderate this relationship. In another study, Abbas et al. (2018) examined the relationship between investment efficiency and the cost of equity using a sample of 235 firms listed on the Pakistan Stock Exchange (PSX) for the period 2005–2015. Their results indicated that investment efficiency has a significant negative effect on the cost of equity. Specifically, over-investment was positively associated with the cost of equity, whereas under-investment had no significant impact, suggesting that over-investment poses a more serious concern for investors. Additionally, Foroughnejad et al. (2016) demonstrated that investment efficiency has a positive effect on the performance of companies listed on the Tehran Stock Exchange. These findings are consistent with those of Nkundabanyanga et al. (2017) and López-Salazar et al. (2012), who emphasized that effective financial resource management and investment in high–value-added projects are key success factors in enhancing value chain performance and cash flow growth. They further argued that research in this domain can provide practical guidance for managers to achieve sustainable growth through cost optimization and strategic investment decisions. Based on these empirical insights, the research hypotheses are formulated as follows:

H3: Investment efficiency has a significant positive effect on the company's value chain performance.

H4: Investment efficiency has a significant positive effect on the company's cash flow growth.

3. Research methodology

3.1. Research design

This study is applied in nature and descriptive in terms of data collection and implementation method. The research data were obtained from Tadbirpardaz and Rahavard-Novin databases, while additional information was extracted directly from firms' financial statements and accompanying notes available on the Codal website. Data processing and variable calculations were conducted using Microsoft Excel, and EViews software was employed for reporting descriptive statistics, estimating the research models, and testing the hypotheses. The statistical population comprises all firms listed on the Tehran Stock Exchange (TSE). The research period spans from 2017 to 2022. Given the large population size and heterogeneity among firms, specific criteria were applied to select the final sample. Accordingly, 115 firms listed on the TSE that met the selection requirements were included in the study (Table 1).

Table 1. Sample selection with the purposive sampling method

Listed companies on the Tehran Stock Exchange (TSE) at the end of 2022		*603*
Companies delisted from the TSE during the 2017–2022 period	*167*	
Financial institutions (e.g., insurance, banks, investment firms) are excluded	*61*	
Companies newly listed on the TSE during the 2017–2022 period	*88*	
Companies with a fiscal year differing from the standard reporting period	*56*	
Companies with incomplete financial reports during the 2017–2022 period	*116*	
Total companies excluded from the statistical population		*(488)*
Total samples (number of firms)		***115***
Total samples for six years = 6 × 115		***690***

3.2. Research models

Based on the theoretical framework and the research variables discussed in the preceding sections, the following regression models were developed to test the research hypotheses in accordance with their order:

[

$$VCP_{i,t} = \beta_0 + \beta_1 CostEff_{i,t} + \beta_2 \text{ControlVariable}_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$CFO_{i,t} = \beta_0 + \beta_1 CostEff_{i,t} + \beta_2 \text{ControlVariable}_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$VCP_{i,t} = \beta_0 + \beta_1 InvestmentEff_{i,t} + \beta_2 \text{ControlVariable}_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$CFO_{i,t} = \beta_0 + \beta_1 InvestmentEff_{i,t} + \beta_2 \text{ControlVariable}_{i,t} + \varepsilon_{i,t} \quad (4)$$

VCP: Value Chain Performance (Dependent Variable).
CFO: Operating Cash Flow Growth (Dependent Variable).
Cost_{Eff}: Cost Efficiency (Independent Variable).
$\text{Investment}_{\text{Eff}}$: Investment Efficiency (Independent Variable).
ControlVariable: Control Variables.

3.3. Research variables

Cost efficiency (CostEff) and investment efficiency (InvestmentEff) are considered as the independent variables of this study, while value chain performance (VCP) and cash flow growth (CFO) serve as the dependent variables. The methods used to measure these variables, along with the control variables included in the research models, are described as follows:

3.3.1. Independent variables

Investment efficiency (Investmen$_{Eff}$): One of the independent variables in this study is investment efficiency. Investment efficiency is achieved when a firm allocates its resources to projects with a positive net present value (NPV). To quantify this variable, the model developed by Biddle et al. (2009) was employed, as specified in the following equation:

$$Invesment_{i,t} = \beta_0 + \beta_1 SalesGrowth_{i,t} + \varepsilon_{i,t} \quad (5)$$

- $\text{Investment}_{i,t}$: Represents firm i's investment in year t, measured as the net increase in tangible and intangible assets divided by total assets at the beginning of the period.
- $\text{SalesGrowth}_{i,t}$: Denotes firm i's sales growth in year t, calculated as the change in sales revenue divided by the sales at the beginning of the period.
- $\varepsilon_{i,t}$: Refers to the residual term of the regression model, which captures the degree of overinvestment or underinvestment in the current period. The absolute value of the residuals is multiplied by (–1) to obtain the measure of investment efficiency, where higher values indicate greater efficiency.

Cost efficiency (Cost$_{Eff}$): To measure cost efficiency, the stochastic cost frontier function was estimated using STATA software. The general form of the stochastic frontier model is expressed as follows:

$$Output_{it} = C_{it} + \beta \times Input_{it} + \varepsilon_{it} \quad (6)$$

$$\varepsilon_{it} = V_{it} - U_{it}$$

$$U_{it} \geq 0$$

- In this model, i denotes the firm and t represents the financial period. The residuals of the stochastic frontier model are decomposed into two components: the inefficiency term and the random error term. Cost efficiency is then calculated as (1 – inefficiency) (Sun et al., 2020; Sharif-Azadeh & Basirat, 2013; Sun & Cui, 2012). To estimate this variable and incorporate it into the final research models, the cost of goods sold (COGS) and selling, general, and administrative expenses (SG&A) were entered as input variables, while sales revenue was considered as the output variable (Kordestani & Mortazavi, 2011; Viverita et al., 2024). The functional form of the cost efficiency model is presented as follows:

$$Ln(Sales_{it}) = \alpha_0 + \alpha_1 \times Ln(COGS_{it}) + \alpha_2 \times Ln(SGA_{it}) + \varepsilon_{it} - \eta_{it} \quad (7)$$

3.3.2. Dependent variables

Value chain performance (VCP): The performance of a firm's value chain was measured using a stochastic frontier function estimated in STATA software (Equation 2). To achieve accurate and reliable estimates of value chain performance efficiency, appropriate input and output variables were incorporated into the model. Specifically, trade receivables, working capital, retained earnings, cost of goods sold (COGS), and selling, general, and administrative expenses (SG&A) were used as input variables. At the same time, cash flows were designated as the output variable. In this framework, trade receivables serve as an indicator of customer relationships and the firm's credit policy; retained earnings and working capital represent internal financial support; cost of goods sold reflects production efficiency and the quality and quantity of relationships with suppliers; and selling, administrative, and general expenses indicate marketing and customer service efforts. Collectively,

these input variables capture the diverse components and stages of the intra-firm value chain, providing a comprehensive measure of its overall performance efficiency (Gruca and Rego, 2005; Luo and Homburg, 2008; Sun and Cui, 2012; Dutta et al., 1999; Sun et al., 2020; Narasimhan et al., 2006; Fang et al., 2008). The applied research model for extracting data regarding the performance of the company's value chain is as follows:

$$Ln(CF_{it}) = \alpha_0 + \alpha_1 \times Ln(COGS_{it}) + \alpha_2 \times Ln(RE_{it}) + \alpha_3 \times Ln(WCAP_{it}) + \alpha_4 \times Ln(SGA_{it}) + \alpha_5 \times Ln(REC_{it}) + \varepsilon_{it} - \eta_{it} \quad (8)$$

CF_{it}: Current cash flows
$COGS_{it}$: Cost of goods sold
RE_{it}: Retained earnings
$WCAP_{it}$: Working capital
SGA_{it}: Firm's selling, administrative, and general expenses
REC_{it}: Trade receivables

Cash flow growth (CFO): The difference between the current year's operating cash flows and those of the previous year is calculated and then divided by the cash flows of the last year (Sun and Cui, 2012).

3.3.3. Control variables

Company size: Equals the natural logarithm of the assets at the end of the period (Harymawan et al., 2019).

Growth opportunity: Equals the ratio of the market value to the book value of the company's equity (Frank and Goyal, 2009).

Asset structure: Equals the ratio of net fixed assets to total assets of the company (Frank and Goyal, 2009).

Return on assets: Equals the ratio of net profit to total assets of the company (He et al., 2019).

4. Findings

Before presenting the descriptive statistics of the study's final variables, data on value chain performance, cost efficiency, and investment efficiency were first extracted. Specifically, investment efficiency was calculated using Equation (1) in EViews software. The cost efficiency variable was derived using the stochastic cost frontier function estimated in STATA software based on Equation (3). Similarly, data on value chain performance were obtained using the stochastic frontier function in STATA software, as outlined in Equation (4).

4.1. Descriptive statistics

Table 2 presents the descriptive statistics for the study variables. As shown in the table, the average level of cost efficiency is approximately 0.4. Since efficiency is measured as a ratio ranging between 0 and 1, this result indicates that the cost efficiency of the sample firms is below the optimal level. This suggests that the manufacturing firms listed on the Tehran Stock Exchange could improve their cost efficiency by adopting advanced machinery, innovative production methods, and modern management practices. In addition, investment efficiency, derived from the residuals of the investment opportunity model, exhibits a relatively large standard deviation. This dispersion implies noticeable variation in the investment behavior and efficiency levels across the sampled firms.

Table 2. Descriptive statistics

Research variables		Mean	Median	SD	Minimum	Maximum
Cost efficiency		0.402	0.411	0.103	0.391	0.523
Investment efficiency		-0.218	-0.101	0.522	-0.489	-0.156
Input and output variables of the value chain stochastic frontier function*	Trade receivables	0.587	0.327	0.435	0.113	0.754
	Working capital	0.652	0.412	0.651	0.003	0.851
	Retained earnings	0.478	0.217	0.232	0.004	0.634
	Cost of goods sold	0.617	0.656	0.145	0.087	0.883
	Selling, general, and administrative expenses	0.292	0.102	0.109	0.093	0.814
	Cash flows	0.014	-0.460	0.205	0.171	1.641
Value chain performance		0.761	0.572	0.109	0.001	0.953
Operating cash flow growth		0.615	0.598	1.036	0.156	0.856
Control variables	Return on assets	0.492	0.502	0.109	0.206	0.814
	Company size*	8.431	7.523	0.201	2.121	13.109
	Growth opportunity	2.145	2.316	1.037	1.061	5.613
	Asset Structure	0.268	0.271	0.091	0.259	0.603

*The natural logarithm of these variables has been calculated.

The value chain performance (VCP) variable, obtained through the efficiency function, has an average value of approximately 0.76, which is above the midpoint level of 0.50. This indicates that, despite the suboptimal cost efficiency observed among the sample firms, other components of the value chain exhibit satisfactory performance. The remaining descriptive statistics for all variables are presented in Table 2.

4.2. Inferential statistics

To analyze the relationships between the independent and dependent variables, it is essential to conduct regression assumption tests to ensure the reliability of the results. The classical regression assumptions represent a set of conditions that must be satisfied for the estimated regression models to yield valid results. These assumptions include the normality of the dependent variable, homoscedasticity (equal variance) of the residuals, absence of multicollinearity among explanatory variables, and independence (lack of autocorrelation) of the model errors. Violation of any of these assumptions can result in biased estimations and unreliable statistical results.

4.2.1. Testing research hypotheses

The models can be estimated after verifying that the assumptions of linear regression are satisfied. The purpose of model estimation is to employ the coefficient results to test the research hypotheses. Each hypothesis is subsequently tested statistically and independently. Since the research data combine both time-series and cross-sectional elements, it is necessary to determine the appropriate estimation method—either pooled or panel data—based on the data structure before fitting the regression models. At this stage, the type of estimation model is identified using the F-Limer test. If the results of this test reject the pooled data method, the Hausman test is then applied to decide whether the model should be estimated using fixed effects or random effects. The results of the F-Limer and Hausman diagnostic tests for all research models are presented in Table 3.

4.2.1.1. Results of testing the first hypothesis

Based on the first hypothesis, the effect of cost efficiency on the company's value chain

performance was examined (Equation 1). According to the results of the regression assumption and diagnostic tests (F-Limer and Hausman), this model was estimated using the fixed-effects method. Furthermore, to address the issue of heteroskedasticity, a weighted regression approach—specifically, generalized least squares (GLS) rather than ordinary least squares (OLS)—was employed. The results of the model estimation are presented in Table 4.

Table 3. Diagnostic tests for model estimation

Model	Test	Statistic	Prob	Result
Equation 5	*F-Limer*	3.718	0.000	Fixed effects model
	Hausman	53.576	0.000	
Equation 6	*F-Limer*	6.157	0.000	Fixed effects model
	Hausman	78.103	0.000	
Equation 7	*F-Limer*	4.154	0.000	Fixed effects model
	Hausman	62.239	0.000	
Equation 8	*F-Limer*	8.281	0.000	Fixed effects model
	Hausman	91.258	0.000	

Table 4. The effect of cost efficiency on value chain performance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.168	0.194	21.513	0.000
Cost efficiency	0.214	0.044	4.911	0.000
Company size	1.156	0.117	9.918	0.000
Growth opportunity	2.065	5.419	0.381	0.805
Asset Structure	-0.719	0.101	-7.088	0.000
Return on assets	1.249	0.122	10.221	0.000
F-statistic	209.229			
Prob (F-statistic)	0.000			
Adjusted R-squared	0.591			
Durbin-Watson stat	2.109			

The model estimation results presented in Table 4 indicate that the probability value of the F-statistic is less than 5%, confirming the overall significance of the linear regression model. The Durbin–Watson statistic falls between 1.5 and 2.5, suggesting no significant autocorrelation among the model's error terms. The adjusted coefficient of determination (R^2) reveals that approximately 59% of the variation in the value chain performance variable is explained by the model's independent and control variables. Furthermore, the probability value of the t-statistic for the cost efficiency variable is below the 5% significance level, and its t-value (4.91) lies outside the critical interval (–1.96 to 1.96). Therefore, the first research hypothesis is confirmed at the 95% confidence level. The positive sign of the beta coefficient for cost efficiency indicates a statistically significant and positive relationship between cost efficiency and value chain performance. In other words, higher cost efficiency leads to improved performance in the value chain. An examination of the control variables reveals that firm size and return on assets have a positive and statistically significant effect on value chain performance. In contrast, growth opportunity has no statistically significant impact.

4.2.1.2. Results of testing the second hypothesis

Based on the second hypothesis, the effect of cost efficiency on the company's cash flow growth was examined (Equation 2). According to the results of the regression assumption and diagnostic tests (F-Limer and Hausman), this model was estimated using the fixed-effects method. Furthermore, to address the issue of heteroskedasticity, a weighted regression approach—specifically, generalized least squares (GLS) rather than ordinary least squares (OLS)—was employed. The results of the model estimation are presented in Table 5.

Table 5. The effect of cost efficiency on the company's cash flow growth

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.911	0.175	16.584	0.000
Cost efficiency	0.205	0.040	5.049	0.003
Company size	0.411	0.052	7.885	0.000
Growth opportunity	-0.074	0.019	-3.775	0.006
Asset Structure	1.611	0.140	11.453	0.000
Return on assets	2.165	10.362	0.209	0.882
F-statistic	193.719			
Prob (F-statistic)	0.000			
Adjusted R-squared	0.509			
Durbin-Watson stat	2.083			

The model estimation results presented in Table 5 indicate that the probability value of the F-statistic is less than 5%, confirming the overall significance of the linear regression model. The Durbin–Watson statistic lies between 1.5 and 2.5, suggesting no significant autocorrelation among the model's residuals. The adjusted coefficient of determination (R^2) shows that approximately 51% of the variation in the company's cash flow growth is explained by the model's independent and control variables. Furthermore, the probability value of the t-statistic for the cost efficiency variable is below the 5% significance level, and its t-value (5.049) lies outside the critical interval (–1.96 to 1.96). Therefore, the second research hypothesis is confirmed at the 95% confidence level. The positive sign of the beta coefficient for cost efficiency indicates a statistically significant and positive relationship between cost efficiency and the company's cash flow growth. In other words, higher cost efficiency leads to improved cash flow growth. An analysis of the control variables and their significance levels reveals that firm size and asset structure have a positive impact on cash flow growth, whereas growth opportunity has a negative effect. Return on assets, however, exhibits no statistically significant impact on cash flow growth.

4.2.1.3. Results of testing the third hypothesis

Based on the third hypothesis, the effect of investment efficiency on the company's value chain performance was examined (Equation 3). According to the results of the regression assumption and diagnostic tests (F-Limer and Hausman), this model was estimated using the fixed-effects method. Furthermore, to address the issue of heteroskedasticity, a weighted regression approach—specifically, generalized least squares (GLS) rather than ordinary least squares (OLS)—was employed. The results of the model estimation are presented in Table 6.

Table 6. The effect of investment efficiency on value chain performance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.265	0.202	16.152	0.000
Investment efficiency	0.082	0.031	2.646	0.019
Company size	1.195	0.112	10.619	0.000
Growth opportunity	0.719	1.712	0.420	0.720
Asset Structure	-0.611	0.068	-8.940	0.000
Return on assets	0.719	0.074	9.699	0.000
F-statistic	109.991			
Prob (F-statistic)	0.000			
Adjusted R-squared	0.472			
Durbin-Watson stat	1.878			

The model estimation results presented in Table 6 indicate that the probability value of the F-

statistic is less than 5%, confirming the overall significance of the linear regression model. The Durbin–Watson statistic lies between 1.5 and 2.5, suggesting no significant autocorrelation among the model's residuals. The adjusted coefficient of determination (R^2) shows that approximately 47% of the variation in value chain performance is explained by the model's independent and control variables. Furthermore, the probability value of the t-statistic for the investment efficiency variable is below the 5% significance level, and its t-value (2.647) lies outside the critical interval (–1.96 to 1.96). Therefore, the third research hypothesis is confirmed at the 95% confidence level. The positive sign of the beta coefficient for investment efficiency indicates a statistically significant and positive relationship between investment efficiency and value chain performance. In other words, greater investment efficiency leads to improved performance in the company's value chain. An examination of the control variables reveals that firm size and return on assets have a positive influence on value chain performance, whereas asset structure has a negative effect. Growth opportunity, however, does not exhibit a statistically significant relationship with value chain performance.

4.2.1.4. Results of testing the fourth hypothesis

Based on the fourth hypothesis, the effect of investment efficiency on the company's cash flow growth was examined (Equation 4). According to the results of the regression assumption and diagnostic tests (F-Limer and Hausman), this model was estimated using the fixed-effects method. Furthermore, to address the issue of heteroskedasticity, a weighted regression approach—specifically, generalized least squares (GLS) rather than ordinary least squares (OLS)—was employed. The results of the model estimation are presented in Table 7.

Table 7. The effect of investment efficiency on cash flow growth

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.847	0.209	18.419	0.000
Investment efficiency	0.098	0.032	3.048	0.002
Company size	0.482	0.055	8.719	0.000
Growth opportunity	-0.166	0.035	-4.720	0.000
Asset Structure	1.320	0.113	11.624	0.000
Return on assets	2.419	12.514	0.193	0.873
F-statistic	216.619			
Prob (F-statistic)	0.000			
Adjusted R-squared	0.514			
Durbin-Watson stat	1.885			

The model estimation results presented in Table 7 indicate that the probability value of the F-statistic is less than 5%, confirming the overall significance of the linear regression model. The Durbin–Watson statistic lies between 1.5 and 2.5, suggesting no significant autocorrelation among the model's residuals. The adjusted coefficient of determination (R^2) shows that approximately 51% of the variation in the company's cash flow growth is explained by the model's independent and control variables. Furthermore, the probability value of the t-statistic for the investment efficiency variable is below the 5% significance level, and its t-value (3.048) lies outside the critical interval (–1.96 to 1.96). Therefore, the fourth research hypothesis is confirmed at the 95% confidence level. The positive sign of the beta coefficient for investment efficiency indicates a statistically significant and positive relationship between investment efficiency and the company's cash flow growth. In other words, higher investment efficiency leads to improved cash flow growth. An examination of the control variables reveals that firm size and asset structure have a positive influence on cash flow growth, whereas growth opportunity has a negative effect. Return on assets, however, does not show a statistically significant impact on cash flow growth.

5. Discussion and conclusion

The capital market plays a crucial role in the economic development of every country by mobilizing capital for corporations. Successful companies in the capital market continually create value, which directly and indirectly affects various segments of society, including shareholders, customers, suppliers, and employees. Given the critical importance of capital markets, evaluating the performance of manufacturing companies and assessing the efficiency of their operations are essential (Zhang & Zhang, 2012). The primary objective of management accounting is to assist managers in making better decisions, thereby enhancing corporate success and value creation. Management accountants employ modern management approaches—such as customer orientation—to create value, with customer satisfaction achieved through the optimal performance of the company's value chain (Blocher et al., 2009). However, firms whose top management fails to pursue new business opportunities or adopt innovative management practices risk losing their market share, and the inability to create value may ultimately lead to bankruptcy (Gupta et al., 2018). Therefore, companies can enhance value creation and achieve sustainable cash flows by improving efficiency through cost management and making optimal investment decisions. Accordingly, enhancing investment efficiency and cost management are regarded as strategic imperatives for business success (Xu et al., 2019). In this context, the present study examines the effects of cost efficiency and investment efficiency on value chain performance and cash flow growth among 115 companies listed on the Tehran Stock Exchange over the five years from 2017 to 2022. Cost efficiency and value chain performance were measured using accounting data and the stochastic frontier approach, which represents one of the methodological innovations of this study. Moreover, analyzing the effects of cost and investment efficiency on both value chain performance and cash flow growth constitutes a key theoretical and empirical contribution of the present research.

The research findings, at a 95% confidence level, indicate that cost efficiency has a significant and positive effect on value chain performance. In other words, better control and management of the cost of goods sold and operating expenses enhance a company's performance across various stages of its value chain. This result is consistent with Kinyugo (2014), who demonstrated that cost efficiency has a positive effect on firms' return on assets in Nairobi. It also aligns with the findings of Kordestani and Mortazavi (2011), who showed that, in the presence of efficiency, operating expenses can play a crucial role in achieving operating profit, and the optimal cost and expense control can increase future profitability. Similarly, Blocher et al. (2009) and Alu (2023) argued that effective expense management improves company performance across value chain stages and has a positive impact on shareholder wealth. Porter (1985) also emphasized that optimal control of production costs can create a competitive advantage for firms. Accordingly, it is recommended that policymakers, government officials, and managers develop strategies to optimize production costs. Providing financial incentives and support to companies that actively improve their cost efficiency can further motivate them. Such efforts not only enhance profitability but can also improve product and service quality. To achieve this, mechanisms for improving cost efficiency should include training programs for managers and employees in cost control techniques, as well as the adoption of new technologies to optimize production processes and eliminate unnecessary costs. Moreover, clarifying the relationship between cost efficiency and value chain performance can help promote this strategic mindset within organizations.

The findings also revealed that cost efficiency has a significant and positive effect on cash flow

growth. In other words, better control and management of the cost of goods sold and operating expenses enhance the company's cash flows. This result is consistent with the findings of Viverita et al. (2024), who demonstrated that improving the efficiency of bank expenditures leads to greater liquidity. It also aligns with the results of Dechow et al. (1998), who examined the relationship between corporate financial performance and future cash flows using profitability as an indicator of firm performance. Their results showed that higher profitability improves the predictability of future cash flows. Based on these findings, it is recommended that analysts rank companies according to their level of cost efficiency, as improvements in cost efficiency reduce unnecessary expenditures and cash outflows while increasing profit margins. This, in turn, can lead to higher dividend payments to shareholders. Moreover, investors, creditors, and shareholders are advised to consider a firm's expense management performance in relation to its profitability and capital structure when constructing their investment portfolios.

Additionally, the findings suggest that investment efficiency has a significant and positive impact on value chain performance. In other words, optimal investment decisions enhance the company's overall performance across the stages of its value chain. Investment inefficiency reflects either overinvestment or underinvestment—where overinvestment reduces liquidity and returns despite favorable growth opportunities, and underinvestment limits the firm's ability to capitalize on such opportunities, thereby lowering operational efficiency. These results are consistent with the findings of Badpa and Mohamadvali (2023), who demonstrated that entrepreneurial orientation—reflecting innovation and risk-taking—enhances value chain performance. Similarly, Salehi et al. (2022) found that investment efficiency has a significant impact on firm value. Furthermore, the results of Foroughnejad et al. (2016), Nkundabanyanga et al. (2017), and López Salazar et al. (2012) confirm that the optimal utilization of financial resources, including investment efficiency, has a positive impact on corporate performance. Abbas et al. (2018) also reported a positive relationship between overinvestment (inefficiency) and the cost of equity, supporting the conclusions of the present study. Based on the findings related to the third hypothesis, it is recommended that managers and analysts avoid relying solely on direct measures of investment efficiency or inefficiency ratios. Instead, they should align their evaluations with value chain performance, since investment efficiency improves when firms are capable of creating value in competitive markets. Likewise, investors and shareholders are encouraged to base their investment decisions on value chain performance—an outcome closely linked to investment efficiency—to achieve sustainable long-term returns.

Finally, the findings indicate that investment efficiency has a significant and positive effect on the company's cash flow growth. In other words, optimal investment decisions enhance corporate cash flows. Richardson (2006) argued that efficient investment increases a firm's value, which in turn improves its cash flows. The results of this hypothesis test are consistent with the findings of Foroughnejad et al. (2016), Abbas et al. (2018), Nkundabanyanga et al. (2017), and López Salazar et al. (2012), all of whom reported that investment efficiency enhances firms' financial performance. This hypothesis aligns with the long-standing view in accounting that improvements in cash flows are often realized through enhancements in financial performance indicators. Investment efficiency is recognized as a key measure of corporate performance and constitutes a component of operational

efficiency. Some accounting theories suggest that improvements in performance indicators and increases in firm value (e.g., stock price) may stem from changes in accounting methods or earnings management. However, the generation of cash flows through operational efficiency reflects genuine, value-creating activities within the firm—an outcome supported by most conventional accounting theories. Therefore, it is recommended that analysts, managers, and investors avoid relying solely on conventional performance indicators when evaluating firms. Instead, they should assess companies based on their ability to generate sustainable cash flows relative to their investment activities and the efficiency of their resource management.

Practical recommendations were provided based on the results of each hypothesis test. This research contributes to the existing literature on corporate value creation, performance evaluation, and optimal resource allocation in the capital market. Moreover, the findings can help investors select an optimal stock portfolio, thereby supporting improved market efficiency and economic growth. For future research, managerial and psychological characteristics can be incorporated to examine how individual traits—such as overconfidence, myopia, optimism, and pessimism—affect investment efficiency, cost efficiency, and overall firm performance.

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