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The effect of money supply on investment efficiency

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ABSTRACT

In the modern economy, investment is the primary driver of economic development and value creation within firms. Improving investment efficiency by optimizing the selection of financial resources can lead to economic growth. From a conceptual standpoint, finding, funding, and carrying out projects with a positive net present value is known as investment efficiency. Monetary policies, as key tools of central banks, influence economic stability and the direction of financial flows. These policies, through variables such as interest rates, liquidity, and the money supply, affect investor behavior and corporate decisions. Based on this, the present study investigates the relationship between money supply and investment efficiency. The statistical sample for this study comprises 134 Tehran Stock Exchange-listed companies over 11 years, from March 21, 2013, to March 19, 2024. Data are estimated applying panel data to the generalized method of moments (GMM). The findings suggest that the money supply possesses a statistically significant and positive effect on investment efficiency. Furthermore, the findings suggest a negative and statistically significant impact of the money supply on insufficient investment, as well as a positive and statistically significant effect on excessive investment. These results suggest that an expansive monetary policy reduces the level of inadequate investment while increasing the level of overinvestment. This study emphasizes the impact of the money supply on various economic sectors. It makes sense for investors to diversify their investment portfolios and mitigate risks arising from sudden fluctuations in monetary policies.

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1. Introduction

One of the primary challenges in creating value for the company is the issue of investment, which plays a crucial role in economic development and infrastructure (Brealey, 2014). Investment activities are of paramount importance for economic development and creating value for companies. Inefficient investment at the firm level not only diminishes a company's value and hinders its growth but also negatively impacts the efficiency of resource allocation at the macroeconomic level. Consequently, inefficient investment can disrupt the sustainability and development of the macroeconomy. Therefore, identifying the reasons for low investment efficiency in companies and the factors influencing sufficient investment and improved investment efficiency in listed companies is of significant theoretical importance (Bian & Li, 2009). Corporate investment decisions determine the amount of resources a company allocates for its future development and growth. These decisions are influenced by various factors, including economic outlook, investment opportunities, and financing conditions (Fu & Liu, 2015). When undertaking various projects, companies must determine the optimal level of investment in accordance with their resource constraints. This process is carried out using project evaluation tools, particularly through the calculation of Net Present Value (NPV). According to this method, investment in a project is justifiable and efficient only when its NPV is positive. Conversely, accepting projects with a negative NPV can lead to overinvestment and, consequently, a decline in overall investment efficiency (Verdi, 2006). Conceptually, investment efficiency refers to the process of identifying, funding, and carrying out projects that have a positive net present value (Lara et al., 2016). Investment inefficiency is linked explicitly to agency theory and economic information theory, addressing issues like agency costs and information asymmetry. These theories explain how conflicts of interest between stakeholders and inequality in access to information can lead to inappropriate and insufficient investment decisions within organizations. In essence, the costs arising from

this agency and information limitations can negatively impact the effectiveness of investments (Yang & Jiang, 2008). While the government strives for sustainable growth and full employment through economic policy regulation, wrong policies can undermine macroeconomic goals and weaken the foundations of the national economy (Han & Zhang, 2016). Monetary policy, by utilizing its financial instruments and intermediate targets, can directly and immediately influence financial markets, including the stock market. These effects can lead to either stability or instability in financial markets, which in turn will have positive or negative consequences for the real economy (Bernanke & Kuttner, 2005). The prices of financial assets, including stocks, are recognized as one of the primary mechanisms for transmitting the effects of monetary policies (Mishkin, 2007). Money supplies primarily influence macroeconomic development and the performance of companies through two main channels: balance sheets and credit. Changes in money supply affect companies' balance sheet status, which in turn impacts their access to financing and investment. Additionally, money supplies alter companies' access to credit and its terms, influencing their cost of financing and investment decisions. On the other hand, companies' reactions and behavioral choices in response to money supplies also affect the effectiveness of the monetary transmission mechanism (Rocheteau et al., 2018; Silva, 2019). Money supplies affect investment through changes in investment behavior and efficiency (Jiang & Rao, 2011). Based on the contents stated, it can be understood that today, money supply is considered one of the main tools of economic policymaking in countries and has a significant impact on the economy and corporate performance, especially for listed companies. Therefore, this research investigates the connection between money supply and investment efficiency. The structure of the article is as follows: A thorough review of the current theoretical literature and research background is provided in Section 2. The data and research methodology are described in Section 3. The results are analyzed in Section 4. The research findings are discussed in Section 5. Lastly, the significance of the primary findings is emphasized in the conclusion of Section 6.

2. Theoretical Literature and Research Background

2.1. Theoretical Literature

Investment is a vital component for creating value within firms and addressing macroeconomic challenges faced by nations. This process involves transforming financial capital into productive assets, requiring meticulous assessment and management of shareholders' equity (Brealey, 2014; Fazzari et al., 2000). When developing investment strategies, organizations must consider resource limitations; neglecting projects with a positive net present value (NPV) can result in inefficiencies and suboptimal capital allocation. The concept of investment efficiency pertains to the optimal deployment of resources toward high-yield projects and is influenced by growth priorities and financial stability. Conversely, information asymmetry can impede optimal decision-making regarding investments (Verdi, 2006; Jin & Yu, 2018). There are two primary approaches to evaluating investment efficiency: (1) the effective utilization of financial resources to fund projects with positive expected returns, which may be constrained by financial limitations, and (2) efficient use of resources is not guaranteed, even if funding has been secured (Hubbard, 1998; Bertrand & Mullainathan, 2003). Governments employ regulatory policies to foster sustainable growth and achieve full employment; however, poorly designed policies can jeopardize economic stability. Additionally, money supply exerts a direct influence on financial markets, potentially promoting stability or inciting volatility, which subsequently affects real economic activity (Han & Zhang, 2016; Bernanke & Kuttner, 2005). Monetary policy significantly influences the money supply and market interest rates by affecting investment activities and liquidity flows. As a key aspect of financial management, investment decision-making is shaped by both internal factors and external economic conditions, including monetary policy dynamics. A thorough understanding of these influences enables organizations to optimize resource allocation and make more informed, strategic investment choices (My Tran et al., 2019; Fu & Liu, 2015). The

role of monetary policy and money supply in supporting sustainable economic growth is well established, with different policy types exerting varied impacts on investment efficiency (Kim & Kung, 2017; Duchin et al., 2010; Moyen & Platikanov, 2013). Contractionary monetary policies, characterized by rising interest rates, typically increase borrowing costs, reducing firms' willingness to invest and potentially slowing economic growth and industrial development. Conversely, expansionary policies, which lower interest rates and boost liquidity, decrease funding costs and encourage investment in new projects (Yang et al., 2021).

One of the principal factors contributing to financial crises, especially within the stock market, is the prevalence of low interest rates and the relaxation of lending standards that arise from expansionary monetary policies. Such conditions compel market participants to undertake more perilous ventures, thereby engendering instability (Mishkin, 2007). Expansionary monetary policies, which encompass the reduction of interest rates and the infusion of liquidity into the economy, are formulated to promote economic expansion. These strategies diminish the costs associated with borrowing and enhance the accessibility of financial resources for enterprises, consequently resulting in a heightened inclination to invest in innovative ventures (Yang et al., 2021). By buying bonds, the central bank raises liquidity under expansionary monetary policies, which lowers interest rates and expands bank lending to companies. This promotes economic expansion and the funding of new initiatives (Olweny & Chiluwe, 2012). The cost of capital influences the investment decisions made by businesses. Interest rate increases make borrowing costlier, which discourages businesses from making investments. As a result, projects with lower returns become less appealing, which eventually lowers total investment and discourages overinvestment (Wan & Lee, 2023). Contractionary monetary policies restrict liquidity and make it more challenging for companies, especially small and medium-sized ones, to access financial resources. This situation leads to higher financing costs and fewer investment opportunities,

which could negatively impact these businesses' overall growth and economic activity (Hirth & Viswanatha, 2011).

2.2. Research Background

Numerous studies have been conducted to investigate how monetary policies and the money supply influence investment and investment efficiency. For example, Huang et al. (2012) investigated how firm-specific characteristics influence the sensitivity of investment behavior to monetary policy adjustments. Their findings suggest that the impact of monetary policies on firm investment is heterogeneous and is moderated by factors such as liquidity, inventory levels, and the asset-to-debt ratio. Specifically, larger and more liquid firms exhibit lower sensitivity to monetary policy changes and tend to respond more strongly to price-driven policies. Pikarjo& Amirkhani (2012) examined how Iran's private sector investment is affected by monetary policy. They used the Autoregressive Distributed Lag (ARDL) econometric approach and time-series data from 1978 to 2010. The researchers evaluated the impact of three variables—Gross Domestic Product (GDP), liquidity, and the real interest rate—on private sector investment. The findings indicate that liquidity and the real interest rate had a positive and significant effect, while GDP had a negative and significant effect, on private sector investment. Fu & Liu (2015) looked at how monetary policy affected various aspects of firm investment and discovered that when monetary policy was expansionary as opposed to contractionary, the rate of investment adjustment was significantly higher. Their findings suggest that while contractionary monetary policies have less of an impact, expansionary monetary policies successfully encourage faster investment adaptation within businesses. Han & Zhang (2016) looked into how monetary policies affected Chinese companies' financial constraints and investment efficiency. According to their findings, firms invest in short-term

rather than long-term projects as a result of expansionary monetary policies, which also distort market interest rate signals. Shabani Koshalshahi et al (2016) investigated the impact of monetary policies on private sector investment in the sub-sectors of Iranian agriculture from 1978 to 2011. The findings of this study indicate that investment elasticity concerning interest rates and inflation rates was negative, while it was positive and significant concerning the exchange rate and price index. Similarly, the impact of monetary policy on firm investment and the mitigating effects of cash holdings in Chinese firms were studied by Yang et al. (2017). They found that contractionary monetary policy lowers firm investment and that liquidity reduction is especially crucial for firms with limited resources, non-state-owned businesses, and those operating in less developed financial markets.

My Tran et al. (2019) examined the relationships between macroeconomic determinants (typically monetary policies) and microeconomic factors (mainly cash flow and other control variables) of corporate investment for 250 non-financial firms in Vietnam. They discovered that between 2006 and 2016, expansionary monetary policy increased corporate investment activity in addition to encouraging borrowing. Durante et al. (2022) investigated the connection between firm diversification, investment, and monetary policy from 1999 to 2016, finding that monetary policy transmission is heterogeneous and operates through two main channels. Tirabadi & Tirabadi (2023) investigated monetary policy's effect on firm performance in Iran during the period from 2016 to 2020. This research, focusing on financial sanctions, utilized data from 120 companies listed on the Tehran Stock Exchange. The findings of this study indicate a significant positive relationship between monetary policies and firm performance, with financial sanctions moderating this relationship. Tang & Yang (2024) showed how monetary policy uncertainty reduces financial risk for businesses and incentivizes them to make lower-risk investments by

examining the relationship between monetary policy uncertainty and financial risk and the mediating role of corporate investment. Because of this circumstance, businesses steer clear of high-risk projects, reducing their overall financial risk. Zheng et al (2025) investigate the impact of monetary policy on corporate investment efficiency from the perspective of debt maturity structure, using data from large non-financial listed companies in China from 2007 to 2022. The findings indicate that expansionary monetary policy can have two opposing effects on corporate investment efficiency by extending firms' debt maturity structure: a reduction in underinvestment and an increase in overinvestment.

3. Data and Methodology

3.1. Data

Data from businesses on the Tehran Stock Exchange, and economic data from March 21, 2013, to March 19, 2024, were used in this study. For selecting the statistical sample, a systematic elimination method with six criteria is used:

1. The statistical sample will not include businesses whose fiscal year does not conclude on March 20.
2. The statistical sample will not include companies that have changed their fiscal period or activity during the study period (March 21, 2013, to March 19, 2024).
3. Companies will not be included in the statistical sample if they lack the financial and non-financial data required to accomplish the research.
4. Because of the unique nature of their operations, banks, insurance companies, holding companies, financial companies, and investment companies will not be included in the statistical sample.
5. Companies should not have experienced trading halts of more than six months.

Table 1. The sample of the study

Description	**Number of Companies**
Total number of companies listed on the Tehran Stock Exchange	793
Less: financial intermediation firms, banks, insurance companies, holding companies, and leasing companies.	(335)
Less: Companies that either modified their financial year-end or whose fiscal year did not conclude on March 20.	(159)
Less: Companies for which information was not available at the time of the study or that were recently listed on the stock exchange.	(133)
Less: industries where, after implementing the aforementioned restrictions, the number of businesses dropped below five.	(32)
Number of Companies Excluded Overall	(659)
Number of companies studied in the research	134

Source: Research findings

The library method is used in this study to gather theoretical data. The Securities and Exchange Organization's website [1]and Rahavard Novin software will be the sources of the accounting and market data used in this study. Furthermore, economic information was gathered from the Central Bank of the Islamic Republic of Iran's website[2]. Initial data processing will be done using Excel software[3], and statistical analyses and model testing will be done using EViews software[4].

3.2. Methodology

In this study, data are estimated using the generalized method of moments (GMM). Prior to estimation, the stationarity of all variables was assessed using the Levin, Lin, and Chu (LLC) panel unit root test. The Generalized Method of Moments (GMM) is a suitable solution for dynamic panel data

1. codal.ir
2. cbi.ir
3. Excel 2016
4. Eviews 13

models, as it effectively addresses the endogeneity of variables. Using GMM for dynamic panels offers several advantages, including accounting for individual heterogeneity, leveraging more information, and eliminating biases found in cross-sectional regressions. These benefits lead to more accurate and efficient estimates with less multicollinearity. A key condition for this approach is that the number of cross-sectional units (N) must be greater than the time period (T) (N > T). This condition is met in the article, as the number of companies exceeds the number of years. Since investment efficiency is dependent on its past values, the model should include lags of the investment efficiency variable to capture the dynamic nature of the data. GMM can provide consistent estimates by managing unobserved heterogeneity and serial correlation through the selection of appropriate instruments and the use of a weighting matrix. A key feature of this method is that it does not require prior knowledge of the distribution of the error terms; the primary assumption is that the error terms are uncorrelated with the instrumental variables.

The Generalized Method of Moments (GMM) offers significant advantages over other estimation methods:

1. Solving the Endogeneity Problem: In dynamic estimation, any regression variables that are uncorrelated with the error term (including lagged and differenced variables) can be used as instrumental variables. This reduces multicollinearity and improves consistency (Greene, 2008).
2. Eliminating Time-Invariant Variables: This method allows for the removal of time-invariant variables that could bias the estimation of investment efficiency. This is achieved through differencing, which leads to more precise and unbiased estimates (Baltagi, 2008). Based on theoretical foundations and previous research, the money supply and monetary policies play a key and influential role in the investment process and investment efficiency within firms, particularly through their impact on financing costs and interest rates. However, comprehensive studies in this area have not yet been conducted in Iran.

Therefore, further research is necessary, as its findings could serve as valuable guidance for investors and managers in making better decisions and utilizing financial resources more effectively. The following models will be used to test the models as explained in the research of Yang et al. (2021).

$$Investment_{i,t} = \beta_0 + \beta_1 MS_{i,t-1} + \beta_2 SIZE_{i,t} + \beta_3 ROA_{i,t} + \beta_4 AGE_{i,t} + \beta_5 GROW_{i,t} + \beta_6 LEV_{i,t} + \beta_7 CASHFLOW_{i,t} + \beta_7 TANG_{i,t} + \varepsilon \quad (1)$$

$$UNDERI_{i,t} = \beta_0 + \beta_1 MS_{i,t-1} + \beta_2 SIZE_{i,t} + \beta_3 ROA_{i,t} + \beta_4 AGE_{i,t} + \beta_5 GROW_{i,t} + \beta_6 LEV_{i,t} + \beta_7 CASHFLOW_{i,t} + \beta_7 TANG_{i,t} + \varepsilon \quad (2)$$

$$OVERI_{i,t} = \beta_0 + \beta_1 MS_{i,t-1} + \beta_2 SIZE_{i,t} + \beta_3 ROA_{i,t} + \beta_4 AGE_{i,t} + \beta_5 GROW_{i,t} + \beta_6 LEV_{i,t} + \beta_7 CASHFLOW_{i,t} + \beta_7 TANG_{i,t} + \varepsilon \quad (3)$$

Similar to the study by Yang et al (2021), the dependent variables in this research are: Investment efficiency, which is measured using the residual from the Richardson (2006) model.

$$Inv_{i,t} = \beta_0 + \beta_1 Inv_{i,t-1} + \beta_2 Cash_{i,t-1} + \beta_3 Age_{i,t-1} + \beta_4 \mathrm{Re}turn_{i,t-1} + \beta_5 Grow_{i,t-1} + \beta_6 Lev_{i,t-1} + \beta_7 Size_{i,t-1} + \sum Ind + \sum Year + \varepsilon \quad (4)$$

Where:

T, i: stands for the company and the year, respectively. Inv: investment level, which is calculated by subtracting the cash received from the sale of fixed assets, intangible assets, and other long-term assets from the cash paid for their acquisition. To obtain a homogeneous measure, this sum is then divided by the average assets. Cash: The company's cash assets, which show its liquidity and investment capacity, are determined by dividing monetary assets (cash, bank balances, and short-term investments) by average assets in year t. Age: The logarithm of the company's years of listing on the Tehran Stock Exchange is used to calculate the company's age. This logarithm is

equal to the natural logarithm of the difference between the years from the year of the initial public offering and the end of year t. Return: The yearly return on individual stocks after reinvesting dividends. Grow: investment opportunities, which equals the company's operating income growth rate. Lev, or financial leverage, is the ratio of total assets to total debt. Size: The size of the company is determined by taking the natural logarithm of the book value of all of its assets. Year: The variable of time effects. Ind: industry effects variable. ϵ: model residual. Overinvestment[1] is indicated by projects with negative net present value that have positive residuals or positive deviations from expected investment. Negative deviations from expected investment, or the absolute value of negative residuals, denote underinvestment.[2] Furthermore the failure to take advantage of investment opportunities with positive net present value. Investment efficiency[3] is represented by the regression equation's residuals. The Richardson model is an accepted standard framework in the investment efficiency literature, with numerous studies in various countries using this model or its adaptations. For example, studies have been conducted in emerging markets (Zheng et al, 2025; Yang et al, 2021; Verdi, 2006; Biddle et al., 2009). Similarly, in the current study, the model's coefficients have been fully estimated using data from the Tehran Stock Exchange and interpreted in accordance with Iran's institutional context (Table2). From an econometric perspective, while the mean of the residuals is close to zero, their cross-sectional and temporal variations provide meaningful information about firms' investment inefficiency. This inefficiency stems from agency problems, information asymmetry, and financial constraints. The use of residuals from the Richardson model as a proxy for investment efficiency is not only well-established in the international literature but also adaptable to Iran's institutional and economic context through a re-estimation of the model

1. Overinvestment (OVER I)
2. Underinvestment (UNDER I)
3. Investment efficiency (INVESTMENT)

using domestic data. The study's independent variable is the money supply. Since there are no actual interest rate announcements in Iran and the Central Bank sets bank interest rates through directives, the interest rate cannot be regarded as a valuable criterion for money supply formulation. As such, the liquidity volume to GDP ratio will be employed in this research as a money supply indicator. The liquidity-to-GDP ratio is a macroeconomic indicator that reflects the total volume of money in circulation and the availability of financial resources throughout an economy. An increase in this ratio means that the volume of money in the economy has risen, allowing companies to indirectly access more financial resources, even though interest rates are administered. This increased availability of financial resources influences companies' investment decisions, which is why this ratio, as a macro-level determinant, can affect the efficiency of corporate investment at the micro level. Therefore, in the context of the Iranian economy, this ratio can better reflect the impact of macroeconomic monetary policies on corporate financial behavior at the micro level compared to alternative indicators. The term "liquidity" refers to the total amount of money and quasi-money (Mishkin, 2007). According to Mankiw (2021), the gross domestic product is the total value of finished goods and services produced in a nation over a given period, usually one year.

The control variables used in this research are as follows:

Company Size[1]: The natural logarithm of the total assets of the company is used to calculate the company's size (Yang et al., 2021). Company Age[2]: The company's age is determined by taking the natural logarithm of the difference between the number of years from the year of the initial public offering to the end of the year (t), and This logarithm equals the number of years that the company has been listed on the Tehran Stock Exchange. (Yang et al., 2021). Operating Income Growth Rate[3]: The ratio of the operating

1. SIZE
2. AGE
3. Operating income growth rate (GROW)

income difference between the current year and the prior year to the operating income from the prior year is known as the operating income growth rate (Yang et al., 2021). Financial Leverage[1]: The ratio of the company's total debt to its total assets is used to calculate financial leverage (Yang et al., 2021). Operating Cash Flow Ratio[2]: The ratio of net cash inflow (outflow) from operating activities to total company assets is known as the operating cash flow ratio (Yang et al., 2021). Ratio of fixed assets to total assets[3] : This is calculated using the property, plant, and equipment to total company assets ratio (Biddle et al., 2009). Return on Assets[4]: This is derived from the ratio of pre-tax earnings to total assets of the company (He et al., 2019).

4. Analysis of results

4.1. Results of the investment efficiency estimation in Table2

Table 2: Results of the investment efficiency estimation (model using the Richardson 2006 model)

Variable Name	Model Coefficients	Standard Error	p-value	t-Statistic
INV(-1)	0.307	0.025	12.174	0.000
CASH(-1)	0.093	0.018	5.044	0.000
AGE(-1)	-0.011	0.005	-2.124	0.034
RETURN(-1)	0.000	0.000	1.287	0.198
GROW(-1)	0.001	0.001	0.628	0.530
LEV(-1)	-0.022	0.010	-2.259	0.024
SIZE(-1)	0.003	0.002	1.851	0.064
IND1	-0.062	0.012	-5.247	0.000
IND2	-0.055	0.012	-4.752	0.000
IND3	-0.050	0.014	-3.563	0.000

1. Financial leverage (LEV)
2. Cash flow ratio (CASH FLOW)
3. Ratio of fixed assets to total assets (TANG)
4. Return on assets (ROA)

Variable Name	Model Coefficients	Standard Error	p-value	t-Statistic
IND4	-0.075	0.015	-5.039	0.000
IND5	-0.063	0.013	-4.738	0.000
IND6	-0.053	0.012	-4.260	0.000
IND7	-0.050	0.015	-3.351	0.001
IND8	-0.052	0.013	-4.121	0.000
IND9	-0.046	0.013	-3.628	0.000
IND10	-0.004	0.013	-0.319	0.750
IND11	-0.045	0.012	-3.727	0.000
YEAR01	-0.023	0.011	-2.140	0.033
YEAR02	-0.018	0.011	-1.664	0.096
YEAR03	-0.035	0.010	-3.305	0.001
YEAR04	-0.027	0.010	-2.614	0.009
YEAR05	-0.023	0.010	-2.238	0.025
YEAR06	-0.010	0.010	-0.971	0.332
YEAR07	-0.036	0.010	-3.652	0.000
YEAR08	-0.005	0.011	-0.403	0.687
YEAR09	-0.004	0.009	-0.445	0.656
YEAR10	-0.019	0.009	-2.011	0.045
C	0.093	0.033	2.801	0.005
R-squared			0.239	
Adjusted R-squared			0.224	
F-statistic			16.194	
Prob(F-statistic)			0.000	
Durbin-Watson stat			2.078	

Source: Research findings

The use of residuals from the Richardson (2006) model as a measure of investment inefficiency is based on the logic that the model estimates the "optimal" and "predictable" portion of investment based on fundamental factors such as growth opportunities, cash flow, and others. Consequently, any deviation from this predicted amount (i.e., the residual) indicates inefficiency.

* The F-statistic and P-value (F-statistic = 16.194, Prob(F-statistic) = 0.000) confirm that the model is generally capable of meaningfully predicting the level of investment, which in turn enhances the credibility of the residuals, as they represent the deviation from a statistically valid prediction.

* Durbin-Watson statistic (Durbin-Watson stat = 2.078): with a value close to 2, indicates the absence of autocorrelation in the residuals. Simply put, the model's errors are randomly distributed and do not predict one another. This characteristic makes the residuals a reliable measure for assessing investment inefficiency.

The results show that the coefficients of key variables such as INV (-1), CASH (-1), AGE(-1), and LEV(-1) are statistically significant (p-values < 0.05). This implies that these variables are meaningfully related to investment, and the model is constructed based on sound fundamental factors. This further strengthens the validity of the residuals as a deviation from a fundamental benchmark.

Based on these results, the model is considered statistically valid, and its residuals serve as a reliable indicator for investment inefficiency (over-investment and under-investment).

4.2. Descriptive statistics

Descriptive statistics of variables are presented in Table 3

Table 3: Descriptive statistics

variables	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
INVESTMENT	0.001	-0.007	0.552	-0.665	0.074	0.596	20.496
MS	0.527	0.483	0.848	0.323	0.157	0.798	2.409
AGE	2.952	2.996	4.007	0.693	0.435	-0.887	5.853
CASHFLOW	0.114	0.090	1.027	-0.399	0.140	0.849	5.400
GROW	0.406	0.329	10.944	-0.768	0.588	5.169	72.930
LEV	0.526	0.522	1.805	0.017	0.22	0.339	3.855

variables	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
ROA	0.183	0.15	0.765	-0.404	0.175	0.513	3.319
SIZE	15.319	15.063	21.899	11.157	1.723	0.649	3.613
TANG	0.260	0.219	1.102	0..000	0.194	0.919	3.405

Source: Research findings

Note: INVESTMENT means investment efficiency; MS means money supply; AGE means company age; CASHFLOW means operating cash flow ratio; GROW means operating income growth rate; LEV means financial leverage; ROA means the return on assets; SIZE means company size; and TANG means the ratio of fixed assets to total assets.

The equilibrium point and features of the data distribution are represented by the mean and median, which are significant indicators of central tendency. According to Table3, the study's mean and median investment levels, which are 0.001 and -0.007, respectively, reflect company diversity. The money supply variable's mean is 0.527, its median is 0.483, its kurtosis is 2.409, and its positive skewness is 0.798. A notable departure from a normal distribution toward expansionary monetary policies is evident in this sample. The data is close to the mean when the standard deviation is 0.004. With a mean of 2.952 and a median of 2.996, the companies' ages indicate that they are young, and their acceptable diversity is indicated by a standard deviation of 0.435. With a mean of 0.114 and a median of 0.090, the operating cash flow ratio could help explain changes in the economy. The variable grow was winsorized at the 1% level. This is a standard statistical method used to manage outliers and reduce their influence on regression results. Reasonable uniformity in financial resources is linked to financial leverage, which has a mean of 0.526 and a median of 0.522. Furthermore, efficiency in profitability is demonstrated by the mean return on assets of 0.183 and its median of 0.150. Lastly, the diversity and structure of assets are demonstrated by the fixed assets to total assets ratio, which has a mean of 0.260, and the average company size of 15.319 with a standard deviation of 1.723.

4.3. Stationary tests

Table 4: stationary tests

variables	Statistic	Prob
INVESTMENT	-13.499	0.000
Underinvestment	-8.592	0.000
Overinvestment.	-5.634	0.000
MS	-4.562	0.000
AGE	-80.968	0.000
CASHFLOW	-15.966	0.000
GROW	-11.635	0.000
LEV	-15.477	0.000
ROA	-13.617	0.000
SIZE	-3.603	0.000
TANG	-15.904	0.000

Source: Research findings

The results of the stationarity tests indicate that all variables in the model are free of a unit root and are therefore statistically stationary. This conclusion is supported by the fact that the test statistics for all variables were found to be significant, with p-values below 0.01. This finding implies that the data series are stable, lacking any trended or non-constant behavior over time. Consequently, they are suitable for use in dynamic econometric models without the need for differencing to achieve stationarity. This ensures that the analysis avoids spurious regressions and maintains the validity of the model's conclusions.

4.4. Result of models

4.4.1. First model

H_1: Money supply has a significant effect on investment efficiency

Table 5: Results of data analysis to test Model 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INVESTMENT(-1)	-0.172	0.021	-8.313	0.000
MS	0.164	0.080	2.057	0.042
SIZE	0.019	0.007	2.830	0.005
ROA	0.102	0.027	3.787	0.000
AGE	-0.045	0.024	-1.843	0.068
GROW	-0.001	0.003	-0.375	0.709
LEV	0.129	0.018	7.147	0.000
CASHFLOW	0.123	0.021	5.760	0.000
TANG	0.100	0.022	4.441	0.000
Statistical Tests				
Test		**Test Statistic**	**p-value (Probability)**	
Sargan test		50.453	0.267	
AR(1)		-5.152	0.000	
AR(2)		-0.391	0.696	

Source: Research findings

The results presented in Table 5 show that the Generalized Method of Moments (GMM) estimation shows that the money supply (Ms) has a positive and significant effect on investment efficiency. The Sargan test statistic is 50.453 with a p-value of 0.267. This result means we cannot reject the null hypothesis that the instruments used are valid. In essence, the instruments selected for the model are appropriate and not correlated with the error term, which confirms the validity of the estimation results.* Serial Correlation Tests (AR (1) & AR (2)):* AR (1): The p-value is 0.000 (less than 0.05), indicating first-order serial correlation in the error terms. This is an expected and desirable outcome for GMM estimations in panel data models.* AR (2): The p-value is 0.696 (greater than 0.05), indicating the absence of second-order serial correlation. This finding is crucial for ensuring the reliability of the GMM estimates, as the presence of second-order correlation would invalidate the model's results. Overall, the model's

results are statistically reliable, and the economic analyses derived from them are considered valid. The estimation results show that prior period investment efficiency has a negative and statistically significant effect on current investment efficiency, with a coefficient of -0.172 ($p < 0.001$). This finding suggests that a firm's high investment efficiency in one period is followed by a reduction in efficiency in the subsequent period. Firm size shows a positive and significant relationship with investment efficiency (coefficient: 0.019, p=0.005). Return on assets is positively and significantly associated with investment efficiency (Coefficient: 0.102, p=0.000). Firm age has a negative coefficient (-0.045) and is marginally significant at the 10% level (p=0.068). Financial leverage demonstrates a positive and significant effect (coefficient: 0.129, p=0.000). Operating cash flow also shows a positive and significant relationship with investment efficiency (coefficient: 0.123, p=0.000). Finally, tangible assets are positively and significantly related to investment efficiency (coefficient: 0.100, p=0.000).

4.4.2. Second model

$H_{1\text{-}1}$: Money supply has a significant effect on underinvestment.

Table 6: Results of data analysis to test Model 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNDERI(-1)	0.216	0.067	3.224	0.002
MS	-0.035	0.010	-3.510	0.001
SIZE	-0.010	0.004	-2.400	0.018
ROA	0.140	0.034	4.074	0.000
AGE	0.035	0.024	1.458	0.148
GROW	-0.010	0.003	-3.719	0.000
LEV	0.016	0.026	0.601	0.549
CASHFLOW	-0.109	0.014	-7.771	0.000
TANG	0.029	0.031	0.924	0.358
Statistical Tests				
Test		**Test Statistic**	**p-value (Probability)**	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Sargan test		40.126	0.420	
AR(1)		-2.252	0.024	
AR(2)		1.021	0.307	

Source: Research findings

Based on the results provided, the model's statistical validity is confirmed. The Sargan test (p-value = 0.420) indicates that the instruments are not correlated with the error term, validating their exogeneity. The AR (2) test (p-value = 0.307) confirms the absence of second-order serial correlation, which is crucial for the reliability of GMM estimates. Furthermore, the variable MS exhibits a negative and statistically significant effect on the dependent variable (coefficient = -0.035, p-value = 0.001), suggesting that an increase in money supply negatively impacts underinvestment. The estimation results, as presented in Table 6, indicate a positive and statistically significant relationship between prior period underinvestment and current period underinvestment. The coefficient for the lagged underinvestment variable (UNDERI(-1)) was found to be 0.216, with a significance level of p = 0.002. This finding suggests a tendency for firms to persist in their underinvestment behavior over time. Firm size (SIZE) exhibits a negative and significant relationship with underinvestment (coefficient: -0.010, p=0.018). Return on assets (ROA) has a positive and highly significant coefficient (Coefficient: 0.140, p=0.000). Revenue growth (GROW) demonstrates a negative and statistically significant effect on underinvestment (Coefficient: -0.010, p=0.000). Operating cash flow (CASHFLOW) has a negative and highly significant coefficient (Coefficient: -0.109, p=0.000).

4.4.3. Third model

$H_{1\text{-}2}$: Money supply has a significant effect on overinvestment.

Table 7: Results of data analysis to test Model 3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OVERI(-1)	-0.137	0.027	-4.985	0.000
MS	0.042	0.021	2.044	0.045
SIZE	0.019	0.008	2.363	0.021
ROA	0.002	0.071	0.024	0.981
AGE	-0.085	0.057	-1.487	0.142
GROW	0.011	0.007	1.559	0.124
LEV	0.033	0.039	0.839	0.405
CASHFLOW	0.121	0.026	4.583	0.000
TANG	-0.064	0.036	-1.814	0.074
Statistical Tests				
Test		**Test Statistic**	**p-value (Probability)**	
Sargan test		39.408	0.241	
AR(1)		-2.748	0.006	
AR(2)		-1.519	0.129	

Source: Research findings

Based on the model's findings, the positive and significant coefficient of the money supply (0.042 at the 5% significance level) indicates that an increase in liquidity can lead to a rise in overinvestment. The Sargan test (p=0.241) confirms the validity of the instruments. The results of the AR (1) and AR (2) tests suggest the model is valid in terms of autocorrelation, as the presence of first-order autocorrelation is considered natural, while second-order autocorrelation is rejected. The estimation results show that prior period overinvestment (OVERI(-1)) has a negative and statistically significant effect on current overinvestment, with a coefficient of -0.137 ($p < 0.001$). This finding suggests that a firm's tendency to overinvest in one period is followed by a reduction in overinvestment in the subsequent period, indicating a lack of persistence in overinvestment behavior. Firm size (SIZE) presents a positive and significant coefficient (Coefficient: 0.019, p=0.021). Operating cash flow (CASHFLOW) demonstrates a positive and statistically significant coefficient (Coefficient: 0.121, p=0.000). Finally,

tangible assets (TANG) exhibit a negative coefficient (coefficient: -0.064), which is statistically significant at the 10% level (p=0.074).

5. Discussion

5.1. First model

The analysis results indicate that prior period investment efficiency has a negative and statistically significant effect on current investment efficiency. This finding suggests that a firm's high investment efficiency in one period is followed by a decline in efficiency in the subsequent period. This phenomenon can be interpreted as reversion to the mean, where firms, after capitalizing on their most profitable opportunities, face a reduction in attractive prospects for future investments. This is likely due to either resource constraints or diminishing marginal returns on subsequent investments. Furthermore, the findings show that money supply (MS) has a positive and statistically significant coefficient. This result suggests that increased liquidity in the economy enhances corporate investment efficiency. Increasing the money supply by lowering the cost of capital and facilitating access to financial resources improves the financing environment for firms. Consequently, companies are better equipped to pursue projects with a positive net present value (NPV > 0) and avoid underinvestment problems. From a theoretical perspective, this evidence is consistent with both the credit channel and the balance sheet channel of monetary policy transmission. Higher liquidity strengthens corporate balance sheets and expands their capacity to attract external financing. Thus, the expansion of the money supply contributes to a more efficient allocation of resources and improves overall investment efficiency. These results are aligned with prior studies, including Zheng et al. (2025), Yang et al (2021), Fu & Liu (2015), My Tran et al (2019), Pikarjo & Amirkhani (2012), Shabani Koshalshahi et al (2016), and Yang et al (2017). Furthermore, the current results contradict the long-term evidence presented by Han & Zhang (2016).

5.2. Second model

The coefficient on prior-period underinvestment is positive and statistically significant, indicating a strong persistence in underinvestment behavior. This finding suggests that firms experiencing underinvestment in one period are likely to continue this pattern in subsequent periods. This persistence may be attributed to a number of factors, including structural frictions within financial markets, limited access to external financing, or managerial conservatism that prevents firms from adjusting quickly toward their optimal investment levels. Furthermore, the coefficient on money supply (MS) is negative and statistically significant. This result demonstrates that increasing the money supply plays a crucial role in mitigating underinvestment. The increased liquidity in the economy reduces the cost of capital and enhances firms' access to financial resources. This allows them to finance projects with a positive net present value (NPV) that may have otherwise been unexploited due to funding constraints. Moreover, a higher money supply strengthens corporate balance sheets and increases the collateral value of assets, thereby facilitating external financing. Overall, these findings suggest that increasing the money supply, through mechanisms such as reduced financing costs and improved credit access, contributes to a more efficient allocation of resources and reduces the persistence of underinvestment. These results are consistent with previous studies, including Zheng et al (2025), Yang et al (2017), and Yang et al (2021).

5.3. Third model

The research findings clearly indicate that the phenomenon of overinvestment shows a natural tendency to adjust downward over time. The statistically significant and negative coefficient for the lagged overinvestment variable (OVERI (-1)) suggests the presence of an inherent correction mechanism. This means that if a company has a history of excessive investment, the intensity of this misallocation of capital is likely to diminish in subsequent periods. This finding is consistent with the theory of

dynamic capital adjustment in corporate finance literature. Our model's results confirm a positive and significant relationship between money supply and overinvestment. This implies that an increase in liquidity within the economy encourages firms to undertake projects that do not meet their required rate of return—meaning the projects' returns are lower than the firm's cost of capital. This behavior is likely a consequence of easier access to financing and lower borrowing costs, which can reduce a firm's internal hurdle rate for project approval. This finding is consistent with overinvestment theory, which posits that under conditions of abundant liquidity, managers may be driven by non-value-maximizing motives, such as firm growth incentives, to pursue even low-yield or suboptimal projects. This leads to inefficient capital allocation at the firm level and ultimately generates long-term financial risk. These results align with the research of Zheng et al. (2025).

Integrated Interpretation of Findings:

The findings related to the third hypothesis reveal that an increase in the money supply exacerbates corporate overinvestment. At first glance, this result may appear to conflict with the main hypothesis, which emphasizes the role of the money supply in improving investment efficiency. However, a more detailed analysis reveals that these results are not contradictory but are, in fact, complementary, illustrating the multifaceted effects of monetary policy on corporate investment behavior. According to the main hypothesis, an increase in the money supply, by reducing financing costs and easing credit constraints, enables firms to undertake projects with a positive net present value, thereby enhancing investment efficiency. Nevertheless, the results of the third hypothesis indicate that in conditions of excessive access to financial resources, the likelihood of distortions in investment decisions increases. In other words, when abundant liquidity is available to firms, managers may, due to agency incentives or a desire for excessive scale expansion, divert financial resources toward low-return or even loss-making

projects. This leads to overinvestment, which is considered a form of inefficiency in resource allocation. The positive relationship between the money supply and overinvestment does not contradict the main hypothesis. Instead, it reflects the dual nature of expansionary monetary policy. On the one hand, the money supply reduces underinvestment and promotes efficiency (as per the second hypothesis). On the other hand, by increasing access to financial resources, it can also create the conditions for overinvestment (as per the third hypothesis). Consequently, the results of the three hypotheses should be interpreted within an integrated framework. The main hypothesis highlights the potential of the money supply to improve investment efficiency, while the subsidiary hypotheses explain the conditions under which this potential could also lead to inefficiency. These findings collectively indicate that the money supply has a dual nature: it leads to improved efficiency when optimal resource allocation and regulatory mechanisms are in place, but in the absence of necessary controls, it may exacerbate inefficiency resulting from overinvestment.

5.4. Limitations of the Study

Limited Sample Scope: This study is confined to firms listed on the Tehran Stock Exchange. Consequently, the findings may not be generalizable to private companies, firms in unlisted industries, or those in other countries. Impact of Non-Monetary Macroeconomic Factors: The variables used in the model, such as money supply, may be influenced by non-monetary economic policies, structural changes in the market, or macroeconomic shocks that were not accounted for in the model. Use of Annual Data: The reliance on annual data may not fully capture the short-term effects or seasonal fluctuations of monetary and fiscal policies and could overlook temporary changes in corporate investment decisions. Limitations of Estimation Tools: Although the Generalized Method of Moments (GMM) is suitable for dynamic panel data, potential limitations, including its sensitivity to the choice of instruments and the need for large samples for accurate

estimation, could impact the precision of the results. Coverage of Control Variables: Certain influential factors on corporate investment, such as internal firm policies, management changes, or human capital, were not incorporated into the model. It is possible that some of the observed effects are attributable to these omitted variables.

6. Conclusion and suggestions

This study examines the impact of money supply on investment efficiency using a sample of 134 companies listed on the Tehran Stock Exchange between March 21, 2013, and March 19, 2024, employing the GMM estimation method. The results indicate that an increase in money supply (MS) positively affects overinvestment, encouraging firms to invest in low-return or suboptimal projects, which could lead to inefficient capital allocation and long-term financial risk. However, the study also shows that increased liquidity significantly reduces underinvestment, enabling companies to undertake projects with positive net present value that were previously abandoned due to financial constraints. As a result, although increasing the money supply may stimulate overinvestment in certain cases, its overall effect is an increase in total investment efficiency across firms by alleviating underinvestment and improving access to financial resources. To enhance the efficiency of corporate investment and mitigate the risk of over-investment, it is recommended that the central bank and other policymaking bodies direct liquidity towards productive projects and industries that offer genuine returns. This would ensure that financial resources are not spent on low-return investments. Establishing rigorous evaluation frameworks before granting loans or financial facilities could guarantee that companies only undertake projects with a positive net present value. The development of alternative financial instruments, such as the issuance of investment bonds and crowdfunding, along with strengthening the capital market, can increase firms' access to capital without inducing over-investment. Furthermore, bolstering corporate transparency and reporting, along with active

supervision by financial institutions, can prevent the inefficient allocation of resources and facilitate optimal investment decisions. Ultimately, harmonizing expansionary monetary policies with financial risk control and guiding liquidity toward the real sectors of the economy can enhance investment efficiency, reduce under-investment, and improve resource allocation within firms. Limitations of the study include its focus on Tehran Stock Exchange-listed companies, the potential influence of non-monetary macroeconomic factors, and the use of annual data that may not capture short-term liquidity fluctuations. Overall, properly managed expansionary monetary policy can enhance corporate investment efficiency, despite the risk of overinvestment, if accompanied by adequate monitoring and guidance.

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All authors had contribution in preparing this paper.

Conflicts of interest

The authors declare no conflict of interest

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