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The Determinants of Profitability in Iran's Pharmaceutical Industry: A Panel Data Analysis

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Abstract

Background: Profitability is a fundamental aspect of corporate survival in the pharmaceutical industry, shaped by both firm-level and macroeconomic factors. In Iran, the sector encounters challenges such as reliance on imports, inflation, and sanctions, alongside a lack of empirical evidence regarding the determinants of profitability. This study aims to fill this gap by investigating these factors in listed firms.

Methods: Panel data from 28 companies listed on the Tehran Stock Exchange (2009–2023) were analyzed using fixed-effects Feasible Generalized Least Squares (FGLS) regression. The dependent variables were return on assets (ROA) and return on equity (ROE). The independent variables included firm-specific factors (e.g., leverage, sales growth) and macroeconomic factors (e.g., GDP, inflation). Diagnostic tests, including unit root, cointegration, and heteroskedasticity tests, were conducted.

Results: Results indicated that GDP, money supply, and sales growth were positively associated with profitability. Conversely, interest rates, exchange rates, inflation, government expenditure, leverage, P/E ratio, and liquidity ratios exhibited negative associations. The effects of firm size and tax revenue were mixed. The models accounted for 69–89% of the variation (R-squared), with significant F-statistics (P<0.001). The hypotheses were confirmed, partially supported, or contradicted, as summarized.

Conclusion: The profitability of Iranian pharmaceuticals is susceptible to macroeconomic volatility and firm-specific strategies. It is imperative that policies are implemented to stabilize exchange rates and promote domestic production to enhance sustainability.

Keywords: Profitability, Pharmaceutical Industry, Fixed-Effects Model, Iran, Panel Data

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Introduction

Profitability is universally acknowledged as a cornerstone of long-term corporate survival and stability (1,2). While profit denotes the absolute difference between revenues and expenses (3), profitability encompasses the efficiency and sustainability of generating returns relative to assets, equity, or revenues (4–7). It serves as a fundamental metric for managers, policymakers, and investors in assessing company performance and informing decision-making (8–11). Firms that achieve consistent profitability not only ensure their survival but also promote innovation and attract capital for expansion (2).

The performance of the pharmaceutical industry—a highly knowledge-intensive and regulated sector (12)—is sensitive to financial policies and macroeconomic changes. Global pharmaceutical revenues reached USD 1.48 trillion in 2022, a figure comparable to the economy of Spain (13). Profitability in this sector is influenced by both internal financial strategies, such as debt manage-

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↑What is "already known" in this topic:
Prior studies emphasize the impact of macroeconomic factors (e.g., GDP, inflation) and firm-specific variables (e.g., leverage, sales growth) on pharmaceutical profitability, revealing mixed effects in emerging markets. In Iran, research is limited, primarily concentrating on manufacturing or healthcare, and lacks a comprehensive panel analysis in the context of sanctions.

→What this article adds:
This study extends the Structure–Conduct–Performance paradigm by integrating macro-financial mechanisms within a sanctioned economy, utilizing FGLS panel regression on a dataset spanning 14 years. It identifies specific vulnerabilities and policy levers, thereby advancing theoretical understanding for volatile markets and establishing a connection to SDG 3 concerning health sustainability.

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ment, liquidity, and growth, and external determinants, including GDP, inflation, exchange rates, and fiscal policy (14–20).

In Iran, the pharmaceutical industry is of strategic importance to both the economy and public health, with 48 firms listed on the Tehran Stock Exchange, 37 of which are actively involved in drug manufacturing. However, the sector encounters persistent challenges, including reliance on imported raw materials, government-imposed pricing systems, high inflation, exchange rate instability, and international sanctions (16, 21, 22). These factors exacerbate the difficulty of maintaining profitability. While extensive research has examined profitability in banking and insurance (23-25), empirical evidence pertaining to Iran's pharmaceutical industry remains scarce (16).

Prior studies underscore that profitability results from the interplay between firm-specific conditions and the broader macroeconomic environment. Macroeconomic factors such as GDP growth, inflation, interest rates, money supply, and exchange rate volatility influence demand and input costs in the pharmaceutical sector (15, 16).

While GDP growth is generally associated with enhanced performance (15, 16), the impact of inflation remains contentious; some studies indicate positive effects through pricing flexibility (17), whereas others report declines due to diminished purchasing power (15, 18). Similarly, monetary expansion has yielded mixed outcomes, ranging from positive liquidity effects (23) to adverse consequences under weak financial discipline (26). Fluctuations in exchange rates consistently challenge company performance, with evidence from Iran, Malaysia, and Kenya confirming varying impacts on profitability (21, 22, 27). Interest rate increases also undermine profitability by elevating borrowing costs; however, profitable firms appear more resilient to such shocks than those with marginal profitability (28, 29).

Policy and regulatory interventions exacerbate these dynamics. Evidence indicates that tax reductions directly enhance profitability (19), while targeted government procurement and investment in domestic innovation can transform competitive structures (20). However, unbalanced public health expenditures may diminish pharmaceutical margins through stringent reimbursement and pricing mechanisms. Firm-specific variables also play a crucial role. High leverage typically exacerbates returns by increasing financial risk, as documented in Pakistan and Nigeria (30, 31), although contrasting results from Vietnam suggest context-dependent outcomes (32). Liquidity ratios, such as current and quick ratios, often demonstrate positive effects on returns (30, 33, 34). Additionally, firm attributes, including size, age, and sales growth, yield mixed impacts on profitability, with some evidence supporting economies of scale (25, 30, 36). Profitability measures are also strongly correlated with P/E ratios, confirming that market valuation reflects internal performance (25, 35).

Overall, the literature reveals a gap concerning Iran's pharmaceutical firms, particularly in the context of the sector's regulatory environment and the unique macroeconomic conditions shaped by sanctions and fiscal controls (16, 22). This study advances theoretical frameworks by extending the Structure–Conduct–Performance (SCP) paradigm, which posits that industry structure and firm conduct influence performance, to include macro-financial transmission mechanisms in a sanctioned economy. Unlike previous Iranian studies that focused on manufacturing (22) or the pharmaceutical sector (16)—which often analyze the impact of a single specific variable or examine macroeconomic factors alongside non-economic determinants—this research integrates firm-specific variables with macroeconomic indicators to create a more comprehensive model for emerging markets experiencing volatility. In doing so, it contributes to macro-financial transmission theory, illustrating how fiscal and monetary policies mediate profitability in regulated sectors, thereby addressing more than just data gaps.

To guide the empirical analysis, we propose the following hypotheses derived from the synthesized literature (Table 1):

- H1: Financial leverage is negatively associated with profitability (30, 31).
- H2: Sales growth is positively associated with profitability (5, 30, 36).
- H3: Firm size is positively correlated with profitability (4, 6).
- H4: The current ratio exhibits a positive association with profitability (30, 33, 34).
- H5: The P/E ratio exhibits a positive association with profitability (24, 35).
- H6: GDP exhibits a positive association with profita-

Table 1. Hypothesized Effects of Variables on Profitability

Variable	Hypothesized Sign	Key References
Firm-Specific		
Financial Leverage	-	(30,31)
Sales Growth	+	(5,30,36)
Firm Size	+	(4,6)
Current Ratio	+	(30,33,34)
P/E Ratio	+	(24,35)
Macroeconomic Variables		
GDP	+	(15,16)
Money Supply	+	(23)
Exchange Rate	-	(21,27)
Interest Rate	-	(28,29)
Inflation Rate	-	(15,18)
Government Expenditure	-	(20)
Tax Revenue	+	(19)

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bility (15, 16).

- H7: Money supply is positively associated with profitability (23).
- H8: Exchange rate depreciation is negatively correlated with profitability (21, 27).
- H9: The interest rate exhibits a negative association with profitability (28, 29).
- H10: The inflation rate exhibits a negative association with profitability (15, 18).
- H11: Government expenditure is negatively associated with profitability (20).
- H12: Tax revenue is positively correlated with profitability (19).

This study addresses this gap by examining both firm-level and macroeconomic determinants of profitability in Iran's pharmaceutical sector. Utilizing a 14-year dataset and fixed-effects regression models, it offers insights into the dynamics influencing financial performance. The findings have direct implications for corporate managers, investors, and policymakers tasked with ensuring the sustainability of this vital sector. Consequently, enhancing profitability through improved trade operations, increased production, and job creation will not only stimulate economic growth but also improve access to medicine for the Iranian population.

Methods

This study employs panel data spanning 14 years (2009-2023) from 28 companies listed on the Tehran Stock Exchange (TSE). The study incorporates key factors influencing firm profitability that are commonly utilized in the literature. Firm-level data were collected from secondary sources, primarily from the Tehran Securities and Exchange Organization website (www.codal.ir). Macroeconomic data were obtained from the Central Bank of Iran (www.cbi.ir) and the Statistical Center of Iran (www.amar.org.ir). The dataset was screened for completeness, and firms with significant missing data points were excluded. Outliers were identified but retained to accurately reflect genuine market volatility, particularly in ROE, thereby avoiding data distortion. Table 2 presents the variables and their measurements. (Further details on data sources and transformation protocols are available in Appendix A).

The profitability (π) of each firm (i) at time (t) is influenced by firm-specific variables and macroeconomic factors. The general model is specified as follows:

$$\pi_{it} = \beta_0 + \beta_1 ln\,(GDP)_{it} + \beta_2 ln\,(Money\ Supply)_{it} + \beta_3 ln\,(Exchange\ Rate)_{it} + \beta_4 ln\,(Government\ Expenditure)_{it} + \beta_5 ln\,(Tax\ Revenue)_{it} + \beta_6 Size_{it} + \beta_7 Interest\ Rate_{it} + \beta_8 Inflation\ Rate_{it} + \beta_9 Current\ Ratio_{it} + \beta_{10} Financial\ Leverage_{it} + \beta_{11} Sales\ Growth_{it} + \beta_{12} Price\ to\ Earnings\ Ratio_{it} + \varepsilon_{it} \quad (1)$$

Where:

- π_{it} is the profitability of firm i at time t and measured as the parameter ROA_{it} or ROE_{it}.
- i = 1, …, N(firms); t = 1, ..., T (time periods)
- β_0, is Intercept or constant term
- β_n, coefficient of independent variables
- ε_{it} is the error term

Profitability measures (ROA and ROE) were retained in their original percentage or ratio form, as they may assume negative or near-zero values thereby precluding log transformation. Conversely, certain macroeconomic and firm size variables underwent log transformation to mitigate skewness and enable elasticity-based interpretations.

Prior to estimating the model, we conducted a series of diagnostic tests to ascertain the properties of the data and the appropriate model specification. Initially, the stationarity of the variables was assessed using the Fisher-type Phillips-Perron unit root test, followed by the Kao test to confirm cointegration among the variables. To identify the

Table 2. Description of variables used in the study

Variables	Description	Unit of Measurement	Data Source
Dependent Variables			
Return on Assets (ROA)	Net income / Total assets	Ratio	CODAL
Return on Equity (ROE)	Net income / Shareholders' equity	Ratio	CODAL
Independent Variables			
(a) Firm-specific Variables			
Current Ratio	Current assets / Current liabilities	Ratio	CODAL
Financial Leverage	Total debt / Total assets	Ratio	CODAL
Sales Growth	(Sales_t - Sales_(t-1)) / Sales_(t-1)	Percentage	CODAL
Price-to-Earnings Ratio	Market price per share / Earnings per share	Ratio	TSE
Firm Size	Natural logarithm of total assets	Log-value	CODAL
(b) Macroeconomic Variables			
GDP	Natural logarithm of annual GDP	Log (Rials)	CBI / SCI
Money Supply (M2)	Natural logarithm of the broad money supply measure.	Log (Rials)	CBI
Exchange Rate	Natural logarithm of Exchange Rate	Log (Rials/USD)	CBI
Interest Rate	Annual interest rate of government bonds.	Percentage	CBI
Inflation Rate	Annual consumer price index change (%)	Percentage	SCI
Government Expenditure	Natural logarithm of Government consumption, investment, and transfers	Log (Rials)	CBI
Tax Revenue	Natural logarithm of total government tax revenue	Log (Rials)	CBI

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suitable panel estimation technique, the F-Limer test was performed, which indicated the superiority of panel data over pooled data. Subsequently, the Hausman test was utilized to differentiate between fixed-effects and random-effects models. The results favored the fixed-effects model (P<0.05), treating unit-specific intercepts as fixed parameters to control for time-invariant unobserved heterogeneity across firms (37).

Following the initial model specification, we assessed the classical assumptions, which include homogeneity of variance, normality of residuals, absence of serial correlation, and multicollinearity.

Diagnostic results indicated the presence of heteroskedasticity, as confirmed by the Breusch-Pagan test (P<0.05). Other assumptions, including the absence of severe multicollinearity (VIF<5) and normality (Jarque-Bera), were also assessed. Consequently, we utilized FGLS estimation with fixed effects to ensure the efficiency and unbiasedness of the coefficients. FGLS addresses heteroskedasticity by iteratively estimating variance weights, which is suitable for fixed-effects panels exhibiting cross-sectional variation. Detailed results of these diagnostic tests are provided in the Results section.

Results

Table 3 presents summary statistics for all variables utilized in this study.

The descriptive statistics reveal considerable variation in profitability measures across the sample. ROA exhibits a mean of 0.190 with relatively low volatility (SD = 0.140), ranging from -0.170 to 0.720. In contrast, ROE demonstrates higher mean returns (0.492) but greater volatility (SD = 0.700), with values spanning from -7.590 to 2.990. Among firm-specific variables, financial leverage averages 0.574, indicating moderate debt utilization, while the current ratio has a mean of 0.688, suggesting potential liquidity constraints. The macroeconomic environment displays relative stability in GDP (mean = 16.139, SD = 0.240), yet considerable variation is observed in the money supply (SD = 1.230) and interest rates (mean = 16.297, SD = 2.090).

Diagnostic tests confirmed the model specification. Fisher-type Phillips-Perron unit root tests indicated mixed stationarity among the variables; however, the Kao test rejected the null hypothesis of no cointegration, suggesting a stable long-run relationship between the variables. VIF tests demonstrated that all values were below 5, thereby ruling out multicollinearity. Breusch-Godfrey tests confirmed the absence of significant serial correlation, and the Jarque-Bera test results indicated that residuals were normally distributed across all models. The full diagnostic results are summarized in Table 4.

The Hausman test results presented in Table 4 support the preference for fixed effects estimation over random effects in two models, as indicated by p-values below 0.05, which signify significant differences between the two estimators. However, the Breusch-Pagan LM test results demonstrate significant heteroskedasticity across all models, with p-values also below 0.05. This finding necessitates the application of Feasible Generalized Least Squares (GLS) estimation to achieve efficient parameter estimates.

Table 5 presents the fixed effects FGLS regression results for equation (1), analyzing both firm-specific and

Table 3. Summary Statistics of Study Variables

Variable	Mean	Median	Maximum	Minimum	Std. Dev.
Dependent Variables					
Return on Assets (ROA)	0.19	0.18	0.72	-0.17	0.14
Return on Equity (ROE)	0.49	0.46	2.99	-7.59	0.7
Macroeconomic Variables					
GDP	7.01	7.04	7.45	6.59	0.24
Money Supply (M2)	5.42	4.54	6.89	0.66	1.23
Exchange Rate	4.57	4.54	5.36	4	0.4
Interest Rate	16.30	16	22	14	2.09
Inflation Rate	0.37	0.27	1.01	0	0.31
Government Expenditure	6.80	6.80	6.86	6.06	0.05
Tax Revenue	5.85	5.90	6.32	5.45	0.28
Firm-Specific Variables					
Current Ratio	0.69	0.69	1.51	0.02	0.26
Financial Leverage	0.57	0.57	1.32	0.01	0.21
Sales Growth	0.10	0.14	0.99	-2.03	0.36
P/E Ratio	0.86	0.84	1.06	0.58	0.09
Firm Size	14.14	14.31	17.07	10.22	1.23

Table 4. Summary of Key Diagnostic Test Results

Test	Model 1 (ROA)	Model 2 (ROE)	Conclusion
Unit Root Test			Mixed stationarity
Kao Cointegration	ADF=-7.39 (p=0.000)	ADF=-7.39 (p=0.000)	A long-run relationship exists.
VIF Test	Max VIF = 4.92	Max VIF = 4.92	No multicollinearity.
Breusch-Pagan Het.	χ^2 =664.03 (p=0.000)	χ^2=616.08 (p=0.000)	Heteroskedasticity is present; FGLS estimation is required.
Normality Test	Jarque-Bera = 2.01 (p = 0.365)	Jarque-Bera = 1.16 (p = 0.239)	Residuals are normally distributed.
Breusch-Godfrey Serial Corr.	F=1.96 (p=0.326)	F=1.36 (p=0.562)	No serial correlation.
Hausman Specification	χ^2=20.30 (p=0.000)	χ^2=20.32 (p=0.000)	The Fixed Effects model is deemed appropriate.

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Table 5. Fixed effects FGLS regression results

Variables	Model 1: ROA		Model 2: ROE	
	Coef.	p-value	Coef.	*P*-value
Firm-Specific Variables				
Current Ratio	-0.032	0.191	-0.244***	0.000
Financial Leverage	-0.590***	0.000	-0.336**	0.014
Sales Growth	0.054***	0.000	0.064***	0.004
P/E Ratio	-0.026	0.411	-0.291*	0.056
Firm Size	-0.013**	0.041	0.069***	0.000
Macroeconomic Variables				
GDP	0.071	0.446	0.463*	0.052
Money Supply	0.008***	0.000	0.004	0.624
Exchange Rate	-0.121***	0.002	-0.352***	0.000
Interest Rate	-0.004***	0.000	-0.009***	0.003
Inflation Rate	-0.024***	0.002	-0.031**	0.049
Government Expenditure	-0.879***	0.000	-2.269***	0.000
Tax Revenue	0.204***	0.000	-0.032	0.833
Constant	5.646***	0.000	14.245***	0.000
Model Diagnostics				
R-squared	0.890		0.690	
F-statistic (p-value)	0.000		0.000	

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are robustly adjusted for heteroskedasticity using FGLS estimation.

macroeconomic determinants of profitability. The models for ROA and ROE demonstrate substantial explanatory power (R-squared values of 0.890 and 0.690, respectively) and are statistically significant overall (F-statistic $P<0.001$).

Discussion

The empirical results reveal heterogeneous associations of firm-specific and macroeconomic variables across profitability measures, as summarized in Table 6. Among firm-specific factors, financial leverage is consistently negatively associated with profitability across all models, with coefficients of -0.590 for ROA and -0.336 for ROE (both at $P<0.05$), thereby confirming H1 and aligning with findings from studies conducted in similar emerging markets, such as Pakistan and Nigeria (30,33). Sales growth demonstrates a positive association with ROA (coefficient 0.054, $P<0.001$) and ROE (0.064, $P<0.01$), confirming H2 and corroborating prior research (5,30,36). Firm size exhibits mixed associations: negative for ROA (-0.013, $P<0.05$) but positive for ROE (0.069, $P<0.001$), which partially contradicts H3 and suggests that larger firms may benefit from economies of scale in equity utilization while encountering inefficiencies in asset management, as noted in studies addressing organizational size (4, 6).

The current ratio demonstrates a negative but insignificant association with ROA (-0.032, $P=0.191$) and a significant negative association with ROE (-0.244, $P<0.001$), thereby contradicting H4. This finding suggests that higher liquidity may result in the unproductive allocation of resources in a capital-constrained environment (7). The P/E ratio exhibits an insignificant association with ROA (-0.026, $P=0.411$) and a weakly negative association with ROE (-0.291, $P<0.10$), contradicting H5. This may reflect market overvaluation pressures rather than direct operational drivers, supporting evidence from stock market analyses (24, 35).

Regarding macroeconomic variables, both interest and inflation rates exhibit a consistent negative association with all profitability measures (interest rate: -0.004 for ROA and -0.009 for ROE, both $P<0.01$; inflation: -0.024 for ROA and -0.031 for ROE, both $P<0.05$). This finding confirms H9 and H10, underscoring the impact of rising borrowing costs and diminished purchasing power, partic-

Table 6. Summary of Main Empirical Findings: Expected Versus Observed Signs

Variable	Hypothesized Sign	Observed Sign (ROA)	Observed Sign (ROE)	Hypothesis Confirmation
Firm-Specific Variables				
Financial Leverage	-	-	-	Confirmed
Sales Growth	+	+	+	Confirmed
Firm Size	+	-	+	Mixed
Current Ratio	+	- (insig.)	-	Contradicted
P/E Ratio	+	- (insig.)	-	Contradicted
Macroeconomic Variables				
GDP	+	+ (insig.)	+	Partially Confirmed
Money Supply	+	+	+ (insig.)	Partially Confirmed
Exchange Rate	-	-	-	Confirmed
Interest Rate	-	-	-	Confirmed
Inflation Rate	-	-	-	Confirmed
Government Expenditure	-	-	-	Confirmed
Tax Revenue	+	+	- (insig.)	Partially Confirmed

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ularly within the context of high inflation in Iran (15, 18, 23). Furthermore, exchange rate depreciation is significantly negatively correlated with profitability in both models (-0.121 for ROA, $P<0.01$; -0.352 for ROE, $P<0.001$), thereby confirming H8. This correlation reflects the industry's dependence on imported inputs and its vulnerability to currency fluctuations, as evidenced by studies conducted in Iran and other developing economies (21, 27).

Money supply is positively associated with ROA (0.008, $P<0.001$) but shows an insignificant relationship with ROE (0.004, $P=0.624$), thereby partially confirming H7 and suggesting a link to enhanced asset-based performance through improved liquidity (23,26). Government expenditure exhibits a consistently negative association with both ROA (-0.879) and ROE (-2.269), with p-values less than 0.001, thereby confirming H11 and potentially indicating relationships with pricing pressures or resource displacement (20). Tax revenue reveals positive associations with ROA (0.204, $P<0.001$) but is insignificant for ROE (-0.032, $P=0.833$), partially confirming H12 and possibly reflecting broader economic stability derived from fiscal revenues (19). GDP demonstrates a positive yet insignificant association with ROA (0.071, $P=0.446$) and a weakly positive association with ROE (0.463, $P<0.10$), partially confirming H6 and indicating modest associations with overall economic growth (15, 31).

Model diagnostics confirm the robustness of the estimates. The R-squared values are high (0.890 for ROA and 0.690 for ROE), indicating that the models explain a substantial portion of the variation in profitability, particularly for asset-based measures. The F-statistics ($P<0.001$ for both) reject the null hypothesis that all coefficients are zero, thereby validating the overall significance of the models. These results, in conjunction with the diagnostic tests, ensure that the estimates are reliable and free from common econometric issues.

The findings carry significant implications for industry stakeholders and policymakers. For managers, the negative associations with leverage and liquidity underscore the importance of prioritizing balanced capital structures and efficient working capital management to enhance resilience. The positive associations with sales growth indicate opportunities for market expansion and product diversification. For policymakers, stabilizing exchange rates and managing imports are crucial, given the industry's reliance on imports. For instance, the sensitivity analysis based on the estimated coefficients demonstrates that currency depreciation significantly adversely affects the profitability of pharmaceutical firms. Specifically, a 10% increase in the exchange rate results in, on average, a 1.2% decline in ROA and a 3.5% decline in ROE (Table 7), reflecting the sector's import dependency and vulnerability to exchange-rate fluctuations. Coordinated efforts in inflation and monetary discipline are necessary to mitigate negative associations with profitability; targeted monetary expansion could enhance liquidity without incurring inflationary risks. Health expenditure reform should strive to balance affordability with producer sustainability, as negative associations with government spending may indicate pricing pressures. Guidance on capital structure for firms may include incentives for equity financing. For investors, metrics such as sales growth and leverage serve as valuable tools for evaluating firm resilience. These implications align with Sustainable Development Goal 3 (Good Health and Well-being) by promoting pharmaceutical sustainability, which facilitates access to medicines in Iran. Sustained profitability enables domestic pharmaceutical firms to invest in R&D, expand production capacity, and innovate in therapeutic areas (e.g., cardiovascular and oncology medicines) that are essential for the health of the Iranian population. Additionally, these findings are connected to national health policy frameworks, such as Iran's Health Transformation Plan, which emphasizes domestic production to reduce vulnerability.

While the study provides robust evidence from 28 listed firms over a span of 14 years, it is limited by its exclusion of non-listed pharmaceutical companies, which play a significant role in domestic supply. Future research should incorporate unlisted firms to capture a broader spectrum of industry performance. Furthermore, additional determinants such as R&D intensity, patent cycles, intellectual property enforcement, international sanctions regimes, and governance quality, as potential mediators, warrant closer examination. Methodologically, exploring non-linearities and threshold effects—such as levels of debt or inflation beyond which profitability deteriorates sharply—could yield further insights, in addition to employing advanced techniques like dynamic GMM to address endogeneity.

Conclusion

In summary, profitability within Iran's pharmaceutical industry is hindered by firm-specific weaknesses—most notably excessive leverage and liquidity challenges—alongside macroeconomic instability, particularly inflation, interest rates, and exchange rate volatility. However,

Table 7. Sensitivity Analysis of Exchange Rate Changes

Scenario	Change in Exchange Rate (%)	Predicted Change in ROA (%)	Predicted Change in ROE (%)	Interpretation
Baseline	–	–	–	Reference condition (no currency movement).
+5% Increase	+5	−0.6	−1.8	A slight yet significant negative effect on profitability.
+10% Increase	+10	−1.2	−3.5	Moderate decline in profitability observed.
+20% Increase	+20	−2.4	−7.0	A significant decline in profitability is attributed to increased import costs.
−10% Decrease	−10	1.2	3.5	Profitability increases as foreign currency costs decline.

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opportunities exist to enhance performance through monetary stability, industrial policy reforms, and robust corporate governance. By situating the empirical findings within Iran's distinctive economic context, this study contributes to the academic literature on financial performance and informs ongoing policy discussions regarding the financial sustainability of an industry vital to national health security. Recommendations include stabilizing exchange rates, reforming health expenditure allocation, and promoting domestic production of pharmaceutical inputs to mitigate external dependence.

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Conflict of Interests

The authors declare that they have no competing interests.

Authors' Contributions

MZ contributed to the conceptualization of the study, data collection, data curation, statistical analysis, interpretation of results, and drafting of the manuscript. MH contributed to the study design, methodology, supervision, interpretation of findings, and critical revision of the manuscript. AT contributed to methodology, validation of results, interpretation of findings, and critical review of the manuscript. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Ethical Considerations

This study was based exclusively on secondary and publicly available financial and macroeconomic data and did not involve human participants, patient records, biological samples, or identifiable private information. Therefore, ethical approval and informed consent were not required. The study was conducted in accordance with the principles of research integrity and responsible data use.

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Data availability

The datasets analyzed during the current study were derived from publicly available sources, including the Tehran Securities and Exchange Organization database (CODAL), the Central Bank of Iran, and the Statistical Center of Iran.

AI Use Statement

During the preparation of this manuscript, the authors used AI-assisted tools only for language editing, improving sentence structure, and enhancing the clarity of the manuscript. All intellectual content, data analysis, interpretation of results, and final conclusions were developed and verified by the authors. The authors take full responsibility for the content of the publication.

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Appendix A. Data Sources and Transformation Procedures

- Firm-Level Data: Sourced from Tehran Securities and Exchange Organization (www.codal.ir). Variables like ROA and ROE calculated directly from financial statements. Log transformations applied to firm size for skewness reduction.
- Macroeconomic Data: GDP, money supply, exchange rate, interest rate, inflation, government expenditure, and tax revenue from Central Bank of Iran and Statistical Center of Iran. Log transformations applied to GDP, money supply, exchange rate, government expenditure, and tax revenue to enable elasticity interpretations.

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