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Economic and Financial Determinants of Pharmaceutical Stock Returns: Evidence from Panel Data Analysis

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Abstract

Background: Fundamental analysis has gained significant attention among capital markets researchers and investors in recent years. In the fundamental analysis method, it is assumed that stock returns are not solely determined by the stock market; major effects originate from the overall economy, industry situation, and company conditions. This research aimed to investigate the relationship between financial fundamentals, stock returns, and investment risk.

Methods: The study was a retrospective analytical study. The financial data of 20 pharmaceutical firms listed on the Tehran Stock Exchange from April 2011 to March 2021 were assessed by panel data analysis in Eviews to evaluate the relation between fundamentals and risk and return.

Results: The results demonstrated that 23 and 35 percent of changes in stock return in the same year and the following year can be explained by seven significant variables, including cash ratio, asset turnover, inventory turnover period, debt-equity ratio, quick ratio, total inflation, and healthcare inflation. In this analysis, we also assessed the impact of fundamental variables on investment risk. The results showed that six significant variables, including gross profit margin, debt-asset ratio, quick ratio, interest coverage rate, total inflation, and healthcare inflation, can explain 35 percent and 30 percent of investment risk for the same year and the following year, respectively.

Conclusion: The fundamentals and macroeconomic factors can partially predict the risk and return of pharmaceutical companies.

Keywords: Fundamental analysis, Firm's Performance, Markowitz model, Panel data analysis, Pharmaceutical industry, Stock return

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Introduction

Capital markets communicate their expectations about the future performance of companies through stock prices. The value of stocks is strongly influenced by the financial position and financial ratios of these companies. Changes in stock value significantly impact managerial decision-making. For example, companies with low financial returns and equity value are inclined to make more adjustments to their current product portfolio and supply chain compared to high-performing companies. In contrast, companies whose stocks outperform the industry tend to make fewer changes to their current product portfolio and supply chain.

In recent years, financial ratios have garnered the attention of stock investors. They employ financial ratios and macroeconomic variables to forecast stock returns and assess potential risks. Consequently, the analysis of fac-

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↑What is "already known" in this topic:
Industries need to attract capital to innovate and progress. Pharmaceutical industries, which have a significant impact on health and public access to medicine, are no exception to this rule.

→What this article adds:
By examining the financial ratios of pharmaceutical companies and macroeconomic variables, an econometric model was presented to explain the profitability and risk of pharmaceutical companies' stocks, which can explain about 35% of the changes.

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tors influencing changes in stock returns and investment risks is a crucial consideration for managers and investors in financial markets (1).

Hence, we elucidated the key success factors in the financial market through an analysis of the fundamentals of pharmaceutical companies in the Tehran Stock Exchange. This included examining financial reports and assessing financial risks. Fundamental analysis relies on past and present information and data to forecast financial outcomes.

Prior research has consistently demonstrated the significant impact of financial fundamentals on stock performance. For instance, Kebriaee-zadeh et al. (2013), utilized a panel data model with 22 pharmaceutical firms from the Tehran Stock Exchange, revealing that 80% of stock return variations could be explained by nine fundamental variables, including the current ratio, debt-equity ratio, and net profit margin (2). Similarly, studies on other stock exchanges, such as the Bombay Stock Exchange (BSE) by Natarajan et al. (2020) have shown a significant positive correlation between financial performance and stock returns (3). Pawankumar Sharma et al. (2019) examining pharmaceutical companies on the India National Stock Exchange, found that asset turnover ratios positively affected stock returns, while current and inventory turnover ratios had negative effects (4). Further supporting these findings, Muhammad et al. (2018) demonstrated that fundamental data can forecast stock returns on the Karachi Stock Exchange (KSE) using panel data analysis (5). Kodithuwakku et al. (2016) and Menike M. et al. (2014) both found positive correlations between stock prices with earnings per share (EPS), dividends per share (DPS), and book value per share (BVPS) on the Colombo Stock Exchange (CSE) (6, 7).

However, not all studies have yielded uniform results. Haque et al. (2013), analyzing the Dhaka Stock Exchange (DSE), found that market share prices were overvalued compared to net asset value and were insensitive to fundamental criteria, suggesting the influence of unauthorized information (8). This discrepancy underscores the context-specific nature of financial market dynamics and the need for further investigation within the Tehran Stock Exchange's pharmaceutical sector.

Building upon these findings, this study aims to delineate the optimal financial structure for the Iranian pharmaceutical industry, specifically investigating the impact of financial ratios on stock value and investment risks. By examining the fundamental factors influencing stock returns, this research seeks to provide valuable insights for both managers and investors operating within this critical market segment. This research will address the need to determine the specific effects of financial ratios within the Tehran Stock Exchange, contributing to the existing body of knowledge by providing a focused analysis on the Iranian pharmaceutical sector.

Methods

Sample

This is a retrospective analytical study that analyses all the pharmaceutical companies listed on the Tehran stock exchange because of their financial transparency. Stock return was defined as the overall profit gained by stockholders from their investments, while risk was calculated using the Markowitz method (9, 10). In this method, the variance of fluctuations less than the average return is calculated as a risk indicator. The data was distributed across various firms and years, necessitating the use of panel data regression. Panel data regression is a statistical analysis designed for examining multidimensional data, specifically combining cross-sectional and longitudinal data (11).

The analysis was carried out using data from 20 pharmaceutical companies listed on the Tehran Stock Exchange (TSE) between 2011 and 2021. These years were chosen due to the availability of data, during which time the Health Transformation Plan was implemented to increase public access to health services. Company data were retrieved from official balance sheets and other financial statements accredited by authorities. Due to the impact of general inflation on stock return expectations and healthcare sector inflation on pharmaceutical industry return expectations, these two variables were entered into the model. Macroeconomic data were obtained from the website of the Central Bank and the Statistical Center of Iran. The Eviews 12.0 software was employed for data analysis. Heteroscedasticity and autocorrelation were checked by the Breuch-Pagan test and the Durbin-Watson test.

Measurements

Unit Root Test

A unit root test assesses whether a time series variable exhibits a unit root or not. The null hypothesis posits the presence of a unit root, while the alternative hypothesis suggests the absence of a unit root in the time series. In this study, the Lin, Levin, Chu test was employed to identify the unit root. This test is well-suited for examining unit roots in medium-sized panels, typically involving 10-250 cross-sectional units and 25-250 observations for each cross-section (12, 13).

Model Selection

The panel data regression model is applied to analyze the matrix of data and find the relationship between dependent and independent variables in a study. There are three types of models for data analysis: Common Effects Model (Pooled Regression), Fixed Effects Model, and Random Effects Model(14). The panel data model can be formulated as follows, where i refers to observations between firms and t refers to observations over time:

$$Y_{it}=\alpha+\beta X_{it}+\epsilon_{it}$$

These models have different assumptions about intercepts and slopes. In the common effects model, the intercept remains constant across the time series and cross-sections. In the fixed effects model, the intercept is group-specific. In the random effects model, the intercept is assumed to be non-specific and behaves randomly. In this study, the Hausman test was applied to evaluate the most

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appropriate type of panel data model (15). The statistical hypotheses of the Hausman test are:

H0: Random effects model is suitable (If *P*-value>0.05)

H1: Fixed effects model is suitable (If *P*-value≤0.05)

The Hausman test was applied to determine whether the fixed effects model or the random effects model should be used. The results of the Hausman test supported the finding that the random effects model is more appropriate for our analysis.

Results

Regression

In this study, the panel data regression model (Estimated Generalized Least-Squares (EGLS) estimators) was applied to analyze the time series of cross-sectional observations and determine the relationship between independent and dependent variables.

According to the Unit Root test results (Table 1), with p-values less than 0.05, we rejected the null hypothesis, indicating the presence of a unit root. Stationary variables were retained, and non-stationary variables were excluded from the regression based on the Lin, Levin, Chu test to prevent spurious regression. Since the dependent variables in our study were stationary, there was no concern about co-integration.

The Hausman test results are presented in Tables 2 and 3, indicating that the two-way random effects model is suitable. The regression results are presented in Tables 4 and 5.

In total, we identified 10 significant variables and their relationship with returns and risk, both within the same year and with a one-year lag. Tables 4 and 5 present the relationship between returns and fundamentals, while Tables 6 and 7 illustrate the relationship between risk and fundamentals as follows:

Annual inflation had a significant effect on stock returns in the same year and the following year. The coefficients were 5.76 and 9.36, respectively, which represent the significant role of total inflation in the Iranian economy in increasing pharmaceutical companies' stock returns. These ratios indicated that a one percent increase in total inflation every year led to a 5.76 percent increase in returns for the same year and a 9.36 percent increase in returns for the following year, assuming all other conditions remain constant. Additionally, the relationship between the inflation rate and risk revealed that a 1 percent increase in the inflation rate was associated with a 1.1 percent reduction in risk for the same year and a 1.65 percent reduction in risk for the following year. The significant positive effect of the inflation rate on stock returns and the reduction of risk indicated a high inflationary expectation within society. In other words, individuals are willing to purchase stocks at a price higher than the prevailing inflation because they anticipate higher inflation rates in the future.

The results indicated that the cash ratio had a significant negative impact on the stock return of the same year and the following year, with coefficients of -4.06 and -4.43, respectively. As previously mentioned, the cash ratio represents the most conservative liquidity ratio. A high ratio suggests that the company has significant unused cash resources.

The quick ratio exhibited a positive impact on stock returns for the same year and the following year, with coefficients of 2.53 and 1.87, respectively. Additionally, the

Table 1. Unit root test result.

Variable	Levin, Lin & Chu	Null Hypothesis
	P value	
Investment risk	<0.001	Rejected
Stock return	<0.001	Rejected
Asset turnover	<0.001	Rejected
Cash turnover	<0.001	Rejected
Currency rate	1.00 ٠	Passed
Current ratio	<0.001	Rejected
Cycle collection	<0.001	Rejected
Dept-asset ratio	<0.001	Rejected
Dept-equity ratio	<0.001	Rejected
Gross profit margin	<0.001	Rejected
Healthcare inflation	<0.001	Rejected
Total inflation	<0.001	Rejected
Interest coverage ratio	0.001	Rejected
Inventory turnover	0.002	Rejected
Net profit margin	0.477	Passed
Operating profit margin	0.042	Rejected
Quick ratio	0.038	Rejected
ROA[1]	0.204	Passed
ROE[2]	0.047	Rejected

[1] Return on asset
[2] Return on equity

Table 2. Hausman test-stock return

Correlated Random Effects - Hausman Test	Chi-Sq. Statistic	Chi-Sq. d.f.	*P* value
Cross-section random	0.00	17	1.000

Table 3. Hausman test- risk

Correlated Random Effects - Hausman Test	Chi-Sq. Statistic	Chi-Sq. d.f.	*P* value
Cross-section random	0.00	17	1.000

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Table 4. Relationship between fundamentals and same-year stock return

Variable	Coefficient	Std. Error	t-Statistic	*P* value
C	-3.84	0.83	-4.60	<0.001
Asset turnover	1.36	0.80	1.70	0.041
Cash turnover	-4.06	1.10	-3.69	<0.001
Current ratio	-0.97	1.20	-0.82	0.412
Dept-asset ratio	-1.03	1.37	-0.75	0.453
Dept-equity ratio	0.27	0.17	1.66	0.099
Interest coverage ratio	-0.03	0.03	-1.09	0.276
Inventory turnover	0.00	0.00	2.02	0.045
Operating profit margin	-1.01	1.18	-0.85	0.394
Quick ratio	2.54	1.38	1.84	0.048
Healthcare inflation	0.05	0.02	2.51	0.013
Total inflation	5.77	1.32	4.36	<0.001
Effects Specification				
			S.D.	Rho
Cross-section random			0.00	0.00
Idiosyncratic random			1.66	1.00
Weighted Statistics				
Root MSE	1.63	R-squared		0.27
Mean dependent var	1.01	Adjusted R-squared		0.23
S.D. dependent var	1.91	S.E. of regression		1.68
Sum squared resid	529.75	F-statistic		6.39
Durbin-Watson stat	2.35	Prob(F-statistic)		0.00

Table 5. Relationship between fundamentals and the following year's stock return

Variable	Coefficient	Std. Error	t-Statistic	*P* value
C	-4.79	0.71	-6.76	<0.001
Cash_Ratio (-1)	-4.43	1.01	-4.39	<0.001
Dept_Equity_Ratio (-1)	0.39	0.11	3.43	<0.001
Inventory_Turnover (-1)	0.01	0.00	2.81	0.006
Quick_Ratio (-1)	1.87	0.33	5.64	<0.001
Healthinflation (-1)	0.03	0.02	1.95	0.052
Inflation (-1)	9.37	1.36	6.90	<0.001
Effects Specification				
			S.D.	Rho
Cross-section random			0.00	0.00
Idiosyncratic random			1.57	1.00
Weighted Statistics				
Root MSE	1.58	R-squared		0.37
Mean dependent var	1.07	Adjusted R-squared		0.35
S.D. dependent var	1.99	S.E. of regression		1.61
Sum squared resid	447.91	F-statistic		17.24
Durbin-Watson stat	1.37	Prob(F-statistic)		0.00

relationship between the quick ratio and investment risk for both the same year and the following year was significant, with a coefficient of -0.203 and -0.208, respectively.

The primary distinction between the quick ratio and the cash ratio lies in the inclusion of receivables in the calculation of the quick ratio. The presence of a significant amount of receivables may suggest high business activity, positively impacting stock returns. However, due to the risk of default, its effect on the company's stock risk is not substantial.

The gross profit margin exhibited the most substantial impact on risk, with coefficients of -1.61 and -1.84 for the same year and the following year, respectively. This indicated that a one-unit increase in gross profit significantly reduced the investment risk by nearly two times.

The total asset turnover ratio for each year had a positive and significant effect on stock return for the same year, with a coefficient of 1.35

The debt-assets ratio had a weak impact on the investment risk for the current year and the following year, with coefficients of 0.8 and 0.85, respectively. The debt-equity ratio had a statistically significant impact on the risk of the following year, with a coefficient of 0.38. The interest coverage ratio also had a negligible effect on risk, with coefficients of 0.01 and 0.02. The minimal impact of this ratio is likely due to the presence of persistent inflation, as the bank interest rate (which the government sets) is lower than the general inflation rate. In this scenario, assets purchased with loans typically experience higher price growth than the bank interest rate. Therefore, taking loans does not pose a significant risk for a company. In such conditions, banks often have stricter rules for loan allocation. However, pharmaceutical companies, given their role in societal health and government support, almost always benefit from these loans.

Discussion

This article examines the impact of fundamental and macroeconomic variables on stock returns and stock risk in the Tehran Stock Exchange from 2011 to 2021. The selection of pharmaceutical companies was driven by the existence of numerous prior studies on these firms, allowing for the assessment of the robustness and replicability of the results over time.

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Table 6. Relationship between fundamentals and same-year risk

Variable	Coefficient	Std. Error	t-Statistic	*P* value
C	1.63	0.21	7.89	<0.001
Cash_Ratio	0.47	0.29	1.64	0.103
Dept_Asset_Ratio	0.80	0.32	2.53	0.012
Gross_Profit_Margin	-1.62	0.58	-2.80	0.005
Interest_Coverage_Ratio	0.02	0.01	2.48	0.014
Operating_Profit_Margin	0.70	0.53	1.32	0.187
Quick_Ratio	-0.20	0.10	-2.14	0.034
Healthinflation	-0.02	0.00	-4.56	<0.001
Inflation	-1.00	0.35	-2.89	0.004
Effects Specification				
			S.D.	Rho
Cross-section random			0.14	0.09
Idiosyncratic random			0.44	0.91
Weighted Statistics				
Root MSE	0.44	R-squared		0.32
Mean dependent var	0.44	Adjusted R-squared		0.29
S.D. dependent var	0.54	S.E. of regression		0.45
Sum squared resid	39.03	F-statistic		11.20
Durbin-Watson stat	2.08	Prob(F-statistic)		0.00

Table 7. Relationship between fundamentals and the following year risk

Variable	Coefficient	Std. Error	t-Statistic	*P* value
C	1.71	0.20	8.42	<0.001
Cash_Ratio (-1)	0.47	0.29	1.65	0.100
Dept_Asset_Ratio (-1)	0.86	0.30	2.82	0.005
Gross_Profit_Margin (-1)	-1.85	0.55	-3.35	0.010
Interest_Coverage_Ratio (-1)	0.02	0.01	2.88	0.005
Operating_Profit_Margin (-1)	0.73	0.51	1.44	0.152
Quick_Ratio (-1)	-0.21	0.10	-1.99	0.048
Healthinflation (-1)	-0.02	0.00	-4.16	<0.001
Inflation (-1)	-1.56	0.37	-4.21	<0.001
Effects Specification				
			S.D.	Rho
Cross-section random			0.119148	0.07
Idiosyncratic random			0.426402	0.93
Weighted Statistics				
Root MSE	0.43	R-squared		0.39
Mean dependent var	0.48	Adjusted R-squared		0.36
S.D. dependent var	0.55	S.E. of regression		0.44
Sum squared resid	33.42	F-statistic		13.38
Durbin-Watson stat	2.01	Prob(F-statistic)		0.00

The increase in the general inflation rate, compared to the healthcare-specific inflation rate, had a much more significant effect on the stock returns of pharmaceutical companies, suggesting that the rise in stock prices was primarily due to the increased value of fixed assets rather than the everyday operations of the pharmaceutical companies. To prevent the devaluation of their cash holdings, people tend to invest in stocks, real estate, gold, and foreign currencies, especially since the general inflation rate during this period surpassed the interest rates of banks. Under these circumstances, buying shares emerged as one of the best options for small investments. The increased demand for converting cash assets into shares further explains why the general inflation rate had a greater impact than the healthcare inflation rate. Health sector policymakers should also pay more attention to the imbalance between healthcare inflation and general inflation, as it can threaten the financial sustainability of pharmaceutical companies. This finding aligns with the results of Mehrara and Karimzadeh (16).

The cash ratio had a negative impact on the stock returns of pharmaceutical companies, primarily due to high inflation and interest rates. Holding large amounts of cash reduces the efficiency of capital use and even diminishes its value. Contrariwise, the quick ratio illustrated a positive impact on stock returns, maybe the result of its inclusion of receivables, which can signal high business activity.

The most considerable negative effect on investment risk belonged to the gross profit margin. This suggests that a higher gross profit margin substantially reduces a company's investment risk, proposing that firms with strong profitability are prepared to absorb operational and economic shocks. This financial resilience provides greater stability and predictability for investors.

The collection period increased consistently from 2014 to 2017, with the average period extending from 101 days in 2011 to 150 days in 2017. One contributing factor was the implementation of the Health Transformation Plan, which placed significant financial burdens on public and private hospitals, resulting in large accumulated debts that diverted funds from the pharmaceutical cycle to other healthcare sectors. This phenomenon manifested as an increase in credit sales and prolonged settlement periods.

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The issue was resolved when legislation was passed to separate the budget line for pharmaceuticals and medical supplies from other health budget items, reducing the collection period in the pharmaceutical industry to around 100 days.

One of the limitations of the study was the small number of samples. Only 20 pharmaceutical companies are listed on the Tehran Stock Exchange; therefore, only data from these companies were used, given the reliability of the data.

Conclusion

In this study, five significant fundamental variables accounted for approximately 23% of the changes in stock return for the same year. Furthermore, there was a stronger relationship between the variables and the stock return for the following year. This association could explain 35% of return changes with five significant variables. The analysis also delved into the impact of fundamental variables and macroeconomic variables on investment risk. In this research, we identified six significant variables that influenced the risk in the same year. These variables predicted approximately 30% of the changes (Table 5). Additionally, we examined the relationship between the variables of each year and the risk of the following year. The six significant variables accounted for 35% of the risk changes in the following year.

There are some discrepancies between our results and previous studies. Compared to a study conducted in the last decade, the effective ratios in our model, as well as the magnitude and significance of the coefficients, have changed. In recent years, the business environment, including rules on currency allocation and inflation rates resulting from sanctions, has undergone significant changes. Macroeconomic variables not only directly affect the return and risk of the company but also alter the intensity and significance of the financial ratios in the model. This necessitates a more in-depth investigation of the interplay between these factors over a longer time horizon.

Authors' Contributions

S Zartab, MM Mojahedian, and A Ahmadi Teymourlouy conceptualized the study; S Zartab, H Takamoli extracted the data; S Zartab, MM Mojahedian analyzed the data; S Zartab, H Takamoli contributed to preparing the original draft; A Nabizadeh reviewed and edited the writing; S Zartab, MM Mojahedian supervised all processes.

Ethical Considerations

Not applicable.

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Conflict of Interests

The authors declare that they have no competing interests.

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