

# Is the Innovation Factor Priced? ——An Empirical Study on the A-Share Pharmaceutical Industry Based on CAPM, Fama-French, and Five-Factor Models

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## Abstract

As an innovation-driven industry, the pharmaceutical industry's value creation model poses challenges to traditional asset pricing theories. This study aims to systematically test the explanatory power of the Capital Asset Pricing Model (CAPM), the Fama-French three-factor model, and a five-factor model including patent factor (PAT) and R&D factor (RDI) in the A-share pharmaceutical industry, and to explore whether innovation activities constitute an independent systematic risk factor.

This study selects data from A-share pharmaceutical listed companies from January 2010 to December 2024, based on the CSMAR database, and constructs the pharmaceutical industry's excess return as the dependent variable. Drawing on the Fama-French portfolio sorting method, patent factor and R&D factor characterizing corporate innovation capability are constructed. Using time-series regression methods, empirical tests are conducted on the CAPM, three-factor, and five-factor models, and their performance is evaluated by comparing the goodness-of-fit ( $R^2$ ), factor significance, and pricing error (Alpha) of each model.

The empirical results show that: (1) The Fama-French three-factor model has the strongest explanatory power, with an adjusted  $R^2$  of 0.5719, and it effectively eliminates the significant Alpha (0.1259) in the CAPM model, substantially reducing the pricing error; (2) The pharmaceutical industry exhibits significant growth characteristics, with a significantly negative coefficient for the value factor (HML); (3) The impact of the size factor (SMB) is not significant; (4) The newly constructed patent factor and R&D factor are both insignificant ( $P$ -value  $> 0.7$ ) in the five-factor model, failing to provide incremental explanatory power, and the  $R^2$  of the five-factor model (0.5019) does not show significant improvement.

This study confirms the applicability of the Fama-French three-factor model in the A-share pharmaceutical industry but finds no evidence of a significant risk premium for innovation factors. This suggests that the current A-share market may underprice the innovative activities of pharmaceutical companies, or that the realization of innovation value is long-term and complex. The research results provide theoretical basis and practical insights for investors, enterprises, and regulatory agencies.

**Keywords:** Asset Pricing Model; Pharmaceutical Industry; Innovation Factor; Patent; R&D Investment; Fama-French Three-Factor Model

## 1. Introduction

### 1.1 Research Background and Significance

The pharmaceutical industry is a vital industry related to the national economy and people's livelihood, characterized by high investment, high risk, long cycle, and high return. As a technology-intensive and innovation-driven industry, the value creation of pharmaceutical companies increasingly relies on continuous R&D investment and innovation capability. Their patent reserves and R&D pipeline value have become core assets and key competitiveness. However, this value-driven model centered on innovation poses challenges to traditional asset pricing theories. The classic Capital Asset Pricing Model (CAPM) only considers market systematic risk and is difficult to fully capture the unique risk-return

characteristics of the pharmaceutical industry. Although the three-factor model proposed by Fama and French (1993) introduces size and value factors, enhancing the explanatory power for cross-sectional stock returns, its factor composition is still mainly based on traditional financial indicators, which may not effectively price the specific risks induced by innovation activities.

In this context, a core question arises: Are traditional asset pricing models sufficient to explain the returns in China's A-share pharmaceutical industry? Do the core elements driving industry development—innovation and R&D—constitute independent systematic risk factors and are they priced by the market? Exploring this issue has important theoretical and practical significance for deepening the application of asset pricing theory in specific industries and identifying the capital market value of innovation activities.

Theoretically, this study attempts to incorporate patent data characterizing corporate innovation capability and R&D investment intensity into the asset pricing framework, constructing an enhanced factor model applicable to innovation-driven industries. This is not only an important supplement to existing multi-factor pricing models but also provides empirical evidence from emerging markets on how the capital market identifies and prices "innovation" as an intangible asset.

Practically, the conclusions of this study provide clear implications for different market participants. For investors, a more accurate pricing model can improve investment decision efficiency and help identify companies with genuine innovation potential; for pharmaceutical companies, clarifying the market pricing mechanism of innovation activities helps them optimize R&D resource allocation and market value management; for regulators, the research conclusions can provide policy references for improving market mechanisms and guiding capital to effectively support pharmaceutical innovation.

## 1.2 Literature Review

Domestic and foreign scholars have conducted extensive research on asset pricing models and their application in specific industries, especially in the innovation-driven pharmaceutical field. Existing studies have explored the drivers of asset expected returns from multiple perspectives. Through a review of the existing literature, it can be found that research in this field mainly revolves around three aspects: the application and improvement of traditional pricing models, the role of specific influencing factors, and the correlation with the macro environment.

In terms of the application and improvement of traditional pricing models, Lin Keli and Chen Yuan<sup>[1]</sup> studied the impact of the split-share structure reform on pharmaceutical listed companies in China using a multi-factor CAPM model, finding that returns showed a pattern of first rising and then falling during the reform period, and the consideration payment rate had the most significant impact on returns. Ao Shiwen and Gao Ya<sup>[2]</sup> introduced the end-of-period price-to-book ratio, a financial factor, into the residual income model. Empirical results showed that the improved model had good explanatory power for the stock prices of pharmaceutical listed companies in China in 2010, indicating that the model has application value both for corporate valuation and for investors to estimate expected returns.

In terms of research on specific influencing factors, Cao Yang<sup>[3]</sup> focused on the linkage mechanism between R&D investment and stock liquidity and expected returns of pharmaceutical companies, finding that R&D investment significantly affects stock liquidity, thereby indirectly affecting expected returns. However, the study also pointed out that due to the immature disclosure mechanism of R&D expenses in Chinese listed companies, where most companies are not required to mandatorily disclose, the sample could only cover a few companies voluntarily disclosing R&D expenditures, limiting the generalizability of the conclusions. Gu Xiaolin<sup>[4]</sup> started from three factors: turnover rate, per capita consumption growth rate, and population aging, using a sample of 30 pharmaceutical listed companies in 2014. The study found that these three factors all positively affect the price-earnings ratio, but also limited by the sample size, the conclusions have certain limitations.

In terms of macro factors, Liang Kai<sup>[5]</sup> analyzed the stock returns of Chinese pharmaceutical listed companies based on data from 2009-2015 using statistical models. The results showed that while macro factors influence asset returns, not all variables have significant explanatory power. Among them, macroeconomic indicators such as GDP and CPI showed strong significance, indicating that pharmaceutical industry asset returns are closely related to the overall economic environment.

In summary, existing studies provide useful references for understanding the formation mechanism of asset returns in the pharmaceutical industry, but there are still obvious limitations: on one hand, most studies have limited sample sizes or sample selection bias, affecting the robustness and generalizability of conclusions; on the other hand, despite involving

various factors, systematic asset pricing research on innovation factors (such as patents, R&D intensity) is still relatively lacking, especially integrated analysis based on multi-factor models. Therefore, based on the existing literature, this study will construct an expanded asset pricing model including innovation factors, use more comprehensive and timely sample data, and further test its explanatory power in the pharmaceutical industry to compensate for the shortcomings of existing research.

## 2. Research Design

### 2.1 Data Selection

The data used for analysis in this paper are all from the CSMAR database, with a time span from January 2020 to December 2024. According to the Shenwan Hongyuan industry classification, all stock data of the pharmaceutical industry in the A-share market were downloaded, including individual stock monthly returns, monthly individual stock circulating market value, book-to-market ratio, number of patents, monthly risk-free rate, CSI 300 Index, R&D investment as a percentage of operating revenue, and three-factor model data.

### 2.2 Data Preprocessing and Core Indicator Construction

In terms of data preprocessing, first, all companies are A-share listed enterprises. After excluding ST stocks, a total of 487 listed companies' A-share trading data were obtained. Second, the number of patents selected is the number of authorized patents, and missing values are treated as 0.

In terms of variable construction, first is the dependent variable. At the end of each month, based on the sample companies, the industry portfolio return for the next month is calculated. The portfolio return is calculated using the market value weighting method to more accurately reflect the actual returns of market investors. Finally, the monthly pharmaceutical industry portfolio return is subtracted by the contemporaneous risk-free rate to obtain the dependent variable—the monthly excess return of the pharmaceutical industry. Second, in terms of innovation indicators, this paper draws on the Fama and French (1993) portfolio double sorting method to construct the patent factor (PAT). Specifically, at the end of June each year, the cumulative number of invention patents of listed companies by the end of the previous year (after natural logarithm transformation to alleviate right-skewed distribution) is used as the sorting variable. All A-shares are divided into low, medium, and high groups according to the 30% and 70% percentiles, while simultaneously divided into large and small groups according to the median market value. Through cross-grouping, 2×3 six investment portfolios are formed, and the market value-weighted monthly returns of these portfolios over the next 12 months are calculated. The monthly return of the patent factor (PAT) is calculated by constructing a long-short portfolio, specifically adopting a strategy of longing the high patent portfolio and shorting the low patent portfolio, and taking the average across the market value dimension to eliminate the impact of the size effect.

$$PAT_t = (S/H_t + B/H_t) / 2 - (S/L_t + B/L_t) / 2$$

Where:

PAT<sub>t</sub>: Patent factor return in period t

S/H<sub>t</sub>: Return of small market value high patent portfolio in period t

B/H<sub>t</sub>: Return of large market value high patent portfolio in period t

S/L<sub>t</sub>: Return of small market value low patent portfolio in period t

B/L<sub>t</sub>: Return of large market value low patent portfolio in period t

This construction method ensures that the factor return purely captures the patent-related risk premium while effectively controlling for the size effect, ultimately obtaining a time series of monthly returns for the patent factor orthogonal to the size factor.

The R&D factor (RDI) is constructed similarly.

### 2.3 Model Specification

To test the explanatory power of different asset pricing models in the A-share pharmaceutical market and explore the incremental contribution of innovation factors, this paper uses the following three models for time-series regression analysis.

**(1) Capital Asset Pricing Model (CAPM)**

First, the traditional Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965) is used as the benchmark model, with the regression equation as follows:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_{mkt}(R_{m,t} - R_{f,t}) + \varepsilon_{p,t}$$

Where,

$R_{p,t}$  is the return of the pharmaceutical industry investment portfolio in period  $t$ ;

$R_{f,t}$  is the risk-free rate in period  $t$ ;

$R_{m,t}$  is the return of the market portfolio in period  $t$ ;

$\alpha_p$  is the intercept term, i.e., the pricing error of the regression. If the model is perfectly specified, its theoretical value should be zero;

$\beta_{mkt}$  is the systematic risk coefficient (Beta) of the investment portfolio;

$\varepsilon_{p,t}$  is the random error term.

**(2) Fama-French Three-Factor Model (FF3)**

Based on CAPM, the size factor (SMB) and value factor (HML) are introduced to construct the Fama-French three-factor model (Fama and French, 1993), with the equation as follows:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_{mkt}(R_{m,t} - R_{f,t}) + \beta_{smb}SMB_t + \beta_{hml}HML_t + \varepsilon_{p,t}$$

Where,

$SMB_t$  and  $HML_t$  represent the returns of the size factor and value factor in period  $t$ , respectively;

$\beta_{smb}$  and  $\beta_{hml}$  measure the exposure of portfolio returns to size risk and value risk, respectively;

Other variable definitions are the same as in equation (1).

**(3) Five-Factor Model with Innovation Factors (FF3+PAT+RDI)**

To further capture the innovation characteristics of the pharmaceutical industry, we add the patent factor (PAT) and R&D factor (RDI) constructed in this paper to the three-factor model, forming a five-factor model:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_{mkt}(R_{m,t} - R_{f,t}) + \beta_{smb}SMB_t + \beta_{hml}HML_t + \beta_{pat}PAT_t + \beta_{rdi}RDI_t + \varepsilon_{p,t}$$

Where,

$PAT_t$  and  $RDI_t$  represent the returns of the patent factor and R&D factor in period  $t$ , respectively;

$\beta_{pat}$  and  $\beta_{rdi}$  measure the sensitivity of portfolio returns to innovation risk;

Other variable definitions are the same as in equations (1) and (2).

By comparing the goodness-of-fit (Adjusted  $R^2$ ) of this model with the above two models, the incremental information of innovation factors in asset pricing can be evaluated.

### 3. Empirical Results Analysis

This study uses the Capital Asset Pricing Model (CAPM), the Fama-French three-factor model, and the five-factor model including patent and R&D factors to conduct time-series regression analysis on the excess returns of the A-share pharmaceutical industry. This section will report the regression results of each model in detail and conduct comparative analysis.

#### 3.1 CAPM Model Regression Results

First, the traditional Capital Asset Pricing Model (CAPM) is used for regression analysis on the pharmaceutical industry's excess returns. The results are shown in Table 1:

Table 1. CAPM Model Regression Results

Variable	Coefficient	t-statistic	P-value
Alpha	0.1259	7.299	0.000
Beta (Market Factor)	0.9112	7.217	0.000
R <sup>2</sup> : 0.4732			

From Table 3.1, the regression results of the CAPM model show that the market factor Beta coefficient is 0.9112 and significant at the 1% level, indicating that pharmaceutical industry stock returns are highly positively correlated with market returns, but slightly lower than the market average (Beta=1), showing certain defensive characteristics. The Alpha value is 0.1259, significantly positive at the 1% level, indicating that the CAPM model cannot fully explain the excess returns of the pharmaceutical industry, and there is a significant positive pricing error. The model goodness-of-fit R<sup>2</sup> is 0.4732, indicating that the market factor can explain 47.32% of the variation in pharmaceutical industry returns.

### 3.2 Fama-French Three-Factor Model Regression Results

To further improve the model's explanatory power, the size factor (SMB) and value factor (HML) are introduced to construct the Fama-French three-factor model. The regression results are shown in Table 2:

Table 2. Fama-French Three-Factor Model Regression Results

Variable	Coefficient	t-statistic	P-value
Alpha	0.0104	1.593	0.1168
Beta_MKT (Market Factor)	0.8702	5.835	0.0000
Beta_SMB (Size Factor)	0.1406	1.009	0.3172
Beta_HML (Value Factor)	-0.7729	-3.801	0.0004
R <sup>2</sup> : 0.5719			

From Table 3.2, the regression results of the Fama-French three-factor model show that the market factor Beta coefficient is 0.8702, still significant at the 1% level, but lower compared to the CAPM model. The size factor (SMB) coefficient is 0.1406, statistically insignificant (P=0.3172), indicating that pharmaceutical industry returns are not significantly exposed to the size effect. The value factor (HML) coefficient is -0.7729, significantly negative at the 1% level, indicating that pharmaceutical industry stock performance is closer to growth stock characteristics, negatively correlated with value stocks.

Compared with the CAPM model, the Alpha value of the three-factor model decreases to 0.0104 and is no longer significant (P=0.1168), indicating that the Fama-French three-factor model can better explain the excess returns of the pharmaceutical industry, with a substantial reduction in pricing error. The model adjusted R<sup>2</sup> increases to 0.5719, indicating that the three-factor model has stronger explanatory power than the CAPM model, explaining 57.19% of the variation in pharmaceutical industry returns.

### 3.3 Five-Factor Model Regression Results

To further capture the innovation characteristics of the pharmaceutical industry, the patent factor (PAT) and R&D factor (RDI) are added to the Fama-French three-factor model to construct a five-factor model. The regression results are shown in Table 3:

Table 3. Five-Factor Model Regression Results

Variable	Coefficient	t-statistic	P-value
Alpha	0.0157	0.481	0.6338
Beta_MKT (Market Factor)	0.8269	3.974	0.0003
Beta_SMB (Size Factor)	0.2036	1.221	0.2301
Beta_HML (Value Factor)	-0.4999	-2.087	0.0440
Beta_PAT (Patent Factor)	-0.0295	-0.302	0.7645
Beta_RDI (R&D Factor)	0.0511	0.376	0.7088

R<sup>2</sup>: 0.5019

From Table 3.3, the regression results of the five-factor model show that the market factor Beta coefficient is 0.8269, still significant at the 1% level. The size factor (SMB) coefficient is 0.2036, still statistically insignificant (P=0.2301). The value factor (HML) coefficient is -0.4999, significantly negative at the 5% level, but its absolute value is lower compared to the three-factor model.

The newly added patent factor (PAT) coefficient is -0.0295, and the R&D factor (RDI) coefficient is 0.0511, both statistically insignificant (P-values 0.7645 and 0.7088, respectively), indicating that during the sample period, the innovation factors did not provide significant incremental explanatory power. The Alpha value is 0.0157, statistically insignificant (P=0.6338), indicating no significant pricing error in the five-factor model.

It is worth noting that the R<sup>2</sup> of the five-factor model is 0.5019, which does not increase but slightly decreases compared to the Fama-French three-factor model, indicating that after adding innovation factors, the overall explanatory power of the model remains almost unchanged.

#### 4. Correlation Analysis Between Innovation Factors and Pharmaceutical Industry Returns

To further explore the performance of the patent factor (PAT) and R&D factor (RDI) in the asset pricing model, this paper analyzes the correlation between innovation factors and pharmaceutical industry excess returns, as well as the internal correlation between innovation factors. This analysis helps understand the effectiveness of innovation factors in capturing industry risk premiums and provides supplementary evidence for explaining their insignificance in the multi-factor model.

##### 4.1 Correlation Analysis Results

Based on monthly data from January 2021 to June 2024 (sample size N=42), the correlation analysis results between innovation factors and pharmaceutical industry returns are shown in Table 4:

Table 4. Correlation Analysis of Innovation Factors and Pharmaceutical Industry Returns

Analysis Item	Correlation Coefficient	Explanation
PAT Factor and Pharmaceutical Industry Excess Return	0.0199	Contemporaneous Correlation
RDI Factor and Pharmaceutical Industry Excess Return	0.2883	Contemporaneous Correlation
Correlation between PAT and RDI Factor Returns	0.2915	Inter-factor Correlation
Correlation between PAT and RDI Cumulative Returns	0.0467	Inter-factor Correlation

Sample Period: 2021-01 to 2024-06

Sample Size: 42 (monthly data points)

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## 4.2 Results Interpretation and Discussion

From Table 4.1, the following important findings can be drawn:

### 4.2.1. Significant Differences in Correlation Between Innovation Factors and Industry Returns

PAT factor is almost uncorrelated with pharmaceutical industry returns ( $r=0.0199$ ): This very low correlation coefficient indicates that the innovation factor based on patent count almost cannot explain the variation in pharmaceutical industry excess returns. This is highly consistent with the insignificant PAT factor in the five-factor model, indicating that patent stock as a proxy for innovation has obvious limitations in capturing industry risk premiums.

RDI factor is moderately positively correlated with pharmaceutical industry returns ( $r=0.2883$ ): The R&D factor shows relatively stronger explanatory power, indicating a certain positive association between R&D investment intensity and pharmaceutical industry returns. This finding is consistent with theoretical expectations, that R&D activities as the core driver of value creation in the pharmaceutical industry should positively impact industry returns.

### 4.2.2. Correlation Characteristics Between Innovation Factors

Factor returns are moderately correlated ( $r=0.2915$ ): The correlation between PAT and RDI factor returns indicates that they capture similar innovation risk characteristics to some extent, but the moderate degree of correlation suggests they still represent different dimensions of innovation activities.

Cumulative returns are almost uncorrelated ( $r=0.0467$ ): It is worth noting that the cumulative returns of PAT and RDI are almost uncorrelated, indicating fundamental differences in long-term cumulative effects between the two factors. The long-term performance of the patent factor is almost unrelated to the R&D factor, possibly reflecting a disconnect between the patent value realization path and the economic benefits of R&D investment.

### 4.2.3 Economic Implications and Insights

The above correlation analysis results provide important insights for understanding the performance of innovation factors in asset pricing:

First, the effectiveness of the patent factor is questioned. The almost zero correlation between the PAT factor and industry returns, combined with its insignificance in the five-factor model, jointly indicate that innovation measurement based on patent count may not be an effective pricing factor in the A-share pharmaceutical industry. This may be due to:

Huge differences in patent quality, mere quantity cannot reflect the economic value of innovation

Long time lags in patent commercialization, limited short-term market reaction

Insufficient pricing efficiency of patent information in the A-share market

Second, the R&D factor shows relatively better potential. The moderate correlation (0.2883) between the RDI factor and industry returns indicates that R&D investment information is reflected in the market to some extent. Although it did not reach statistical significance in the five-factor model, its relatively strong correlation provides direction for improving the construction method of the R&D factor in the future.

Finally, the multidimensionality of innovation factors is confirmed. The moderate correlation in short-term returns and almost no correlation in long-term cumulative returns between PAT and RDI factors reveal the complexity of innovation activities. As different aspects of innovation, the market pricing mechanisms of patents and R&D may have fundamental differences, supporting the research design of examining them as independent factors.

### 4.2.4 Connection with Main Regression Results

The results of this correlation analysis form a chain of mutually corroborating evidence with the regression analysis in Section 4.1:

The PAT factor performs poorly in both correlation analysis and regression analysis, further confirming its limitations as a pricing factor.

The RDI factor shows some explanatory power in correlation analysis but is insignificant in regression, possibly indicating that its information has been absorbed by traditional factors (such as the value factor).

The moderate correlation between innovation factors excludes serious multicollinearity problems, confirming that their insignificance in regression stems from essential underpricing rather than technical issues.

## 5. Conclusions and Discussion

Based on monthly data from January 2020 to September 2024, this study conducts a systematic empirical analysis of asset pricing in the A-share pharmaceutical industry using the CAPM, Fama-French three-factor model, and a five-factor model including patent and R&D factors. This chapter will summarize the previous empirical results, deeply discuss their economic implications, and point out the limitations of the study and future research directions.

### 5.1 Research Conclusions

Through comparative analysis of three asset pricing models, this study draws the following main conclusions:

First, the Fama-French three-factor model has the best explanatory power for the A-share pharmaceutical industry. Empirical results show that the adjusted  $R^2$  of the three-factor model reaches 0.5719, significantly higher than the 0.4732 of the CAPM model, and the Alpha value decreases from 0.1259 (significant) in CAPM to 0.0104 (insignificant), indicating that the three-factor model can more fully explain the excess returns of the pharmaceutical industry, with a substantial reduction in pricing error. This finding is consistent with the classic research of Fama and French (1993), supporting the superiority of multi-factor models in explaining asset returns.

Second, the pharmaceutical industry exhibits significant growth characteristics. In both the three-factor and five-factor models, the value factor (HML) coefficient is negative and statistically significant (-0.7729 and -0.4999, respectively), indicating that pharmaceutical industry stock performance is negatively correlated with value stocks, more characteristic of growth stocks. This finding aligns with the actual situation of the pharmaceutical industry, which typically has high R&D investment and high growth potential, with investors focusing more on future growth rather than current book value.

Third, the impact of the size factor is limited in the pharmaceutical industry. In both multi-factor models, the size factor (SMB) coefficient is insignificant (P-values 0.3172 and 0.2301, respectively), indicating that pharmaceutical industry returns are not significantly exposed to the size effect. This may stem from the particularity of the pharmaceutical industry—whether large pharmaceutical companies or small biotech companies, their value mainly depends on R&D pipeline and innovation capability, rather than size.

Fourth, innovation factors do not provide significant incremental explanatory power. The patent factor (PAT) and R&D factor (RDI) constructed in this study are both insignificant in the five-factor model (P-values 0.7645 and 0.7088, respectively), and after adding these two factors, the model  $R^2$  remains almost unchanged. This result indicates that during the sample period, innovation factors did not capture significant risk premiums, which may be related to the following factors: (1) The risk of innovation activities has been fully priced by the market and reflected through other factors; (2) The realization of innovation value is long-term and uncertain, difficult to reflect in stock prices in the short term; (3) The effectiveness of patents and R&D investment as proxies for innovation is limited.

### 5.2 Discussion of Results

The results of this study have important implications for understanding the pricing mechanism of the A-share pharmaceutical industry:

First, the effectiveness of the Fama-French three-factor model is verified in the A-share pharmaceutical industry. This finding provides a practical pricing tool for investors, indicating that when evaluating investment opportunities in the pharmaceutical industry, in addition to market risk, the impact of the value factor should be fully considered. The growth characteristics of the pharmaceutical industry investors that when seeking investment opportunities in this industry, they should pay more attention to the growth potential of enterprises rather than traditional value indicators.

Second, the insignificant result of innovation factors deserves in-depth consideration. Theoretically, innovation activities should generate risk premiums because R&D investment is highly uncertain, successful innovation can bring huge returns, while failure may lead to investment losses. The failure of this study to find significant innovation premiums may reflect the pricing efficiency of the A-share market for innovation value, or methodological challenges in innovation

measurement. Patent count and R&D investment intensity may not fully capture the quality and economic value of innovation. Future research may need more refined innovation measurement indicators.

Additionally, the particularity of the sample period may have affected the research results. During the 2020-2024 period, the pharmaceutical industry was significantly affected by the COVID-19 pandemic, and the performance of pandemic-related companies may have masked the role of innovation factors. At the same time, changes in the policy environment of the pharmaceutical industry (such as centralized procurement policies) may also have systematic impacts on industry valuation, and these factors were not fully controlled in the model.

### 5.3 Research Limitations and Prospects

This study has the following limitations:

**Measurement of innovation proxies:** Patent count and R&D investment intensity may not fully capture the economic value of corporate innovation activities. Future research could consider using more refined measurement methods such as patent citations, innovation quality indicators, etc.;

**Industry heterogeneity:** There is significant heterogeneity within the pharmaceutical industry (e.g., sub-sectors such as pharmaceuticals, biotechnology, medical devices). This study did not distinguish these sub-sectors for analysis. Future research could conduct more granular studies;

**Sample period:** The research period includes the special period of the COVID-19 pandemic, which may have systematic impacts on the results.

### 5.4 Future Research Directions

Based on the findings and limitations of this study, future research can deeply explore from the following directions:

**Improve innovation measurement indicators:** Develop more comprehensive and precise innovation measurement methods, such as considering patent quality, commercialization degree of innovation achievements, etc.;

**Extend sample period:** Use longer time series data to improve statistical power and test the long-term performance of innovation factors;

**Sub-industry research:** Distinguish different sub-fields of the pharmaceutical industry to explore the pricing role of innovation factors in different markets;

**Consider policy factors:** Incorporate pharmaceutical industry policy variables (such as centralized procurement policies, innovative drug approval speed, etc.) into the analysis framework;

**International comparative research:** Compare the performance of innovation factors in the A-share market and overseas mature markets to explore the impact of market development stage on innovation pricing.

### 5.5 Practical Implications

The results of this study have important implications for investment practice and industry policy:

For investors, the Fama-French three-factor model provides a practical framework for evaluating investments in the pharmaceutical industry. It is recommended to fully consider the impact of the value factor in investment decisions. At the same time, the insignificant result of innovation factors investors should not overly rely on simple patent or R&D indicators as investment basis, but should deeply analyze the quality and commercialization potential of innovation.

For policy makers, the results of this study indicate that the A-share market may not fully price pharmaceutical innovation, providing a basis for improving capital market mechanisms and enhancing innovation pricing efficiency. Policy makers can consider improving information disclosure, developing professional analyst teams, etc., to enhance the market's ability to identify and price innovation value.

For pharmaceutical companies, the research findings remind management that market recognition of their innovation activities takes time. They should focus on the quality and sustainability of innovation, rather than simply pursuing patent count or R&D investment scale.

In summary, this study systematically evaluates the applicability of different asset pricing models in the A-share pharmaceutical industry, confirms the effectiveness of the Fama-French three-factor model, and also reveals the complexity of innovation factor pricing, providing a useful basis for subsequent theoretical and empirical research.

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