

The Comparison Research on the Application of Fama-French Asset Pricing Model in Energy Industry and High-Tech Industry

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Abstract: The development of different asset pricing models can support investors to evaluate the potential returns of listed stocks better. While the capital asset pricing model (CAPM) assumed stock returns only determined by systemic risk, Fama-French made improvements by adding other relative factors to the model. It is essential to consider the different effects of models in various industries, which help to evaluate investment selection. In this article, energy and high-tech industries were selected to be studied, and three-factor and five-factor models were adopted to run regressions, respectively. Then, the different explanatory abilities of each model between the two industries were compared. The results showed that the five factors for the high-tech industry were all significant. In contrast, the profitability factor and the investment style factor were not significant in the energy industry, and were regarded as redundant factors. Therefore, the high-tech industry has high requirements on the profitability and sustainable development ability of enterprises, and the rate of return also fluctuates with these factors accordingly, while the energy industry has little sensitivity to them. Coefficient direction differences suggest both industries are sensitive to the market factor and high-tech industry have higher growth opportunity. Energy and high-tech industry have their specific characteristic that should be adjusted suitable development strategy. As for investment selection, it's more appropriate to use the three-factor model to evaluate the energy industry and five-factor model for high-tech.

1. Introduction

It is vital for every investor to consider the potential return of portfolios on the stock market. In order to predict the performance of different investment portfolios, many valuation methods have been proposed over the years. The original model was proposed by William f. Sharpe in 1964 and is known as the capital asset pricing model (CAPM) [1]. According to Sharpe, the only reason for the increase in excess returns is the rise of investment risk. CAPM aims to quantify systematic risks and reveal the relationship between risks and expected returns. Further development was the Fama-French three-factor model proposed by Eugene F. Fama and Kenneth R. French, which introduced two additional factors of size and the book-to-market ratio [2]. They argue that the new model is more accurate than the CAPM for predicting expected excess returns on portfolios. The three-factor model established by Fama and French has good explanatory power for the return rate of the stock portfolio in the analysis section and has been widely applied in many economic fields in a certain period. However, with the development of the social economy, the applicability of this model has been challenged, and its explanatory power has been declining. In recent years, Fama and French five-factor model was created, in which two factors, including profitability and investment pattern factors, were added, which is more comprehensively covering the factors that may affect the stock return rate [3].

The explanatory abilities vary significantly in different models. The main object of domestic and foreign researches is the effectiveness of stock markets in different countries. For example, Liu tested the applicability of the Fama-French five-factor model in the stock analysis of Chinese listed companies [4]. They conclude that the five-factor model is more applicable to the Chinese market

because the CMA (invest conservatively minus aggressively) factor is no longer redundant in the five-factor model after controlling the influence of other factors. Gustavsson, Gustafsson and Taneja tested the performance of different models in the Indian market [5, 6]. By comparing CAPM and the three-factor model, found the three-factor model has better fitness in the Indian stock market. Gaunt found a similar result in the Australia market [7].

However, there are relatively few studies on the effectiveness of models in industries, and the research conclusions are still controversial. Manatsanan Srimarksuk tested the effectiveness of the Fama-French three-factor model in the stock exchange of Thailand in the energy sector [8]. Yang, Zhu and Mizrach tested the application of the five-factor model in the services sector and proved its efficiency [9]. Besides, as the five-factor model was introduced in recent years, the comparisons that include it were not sufficient.

The energy industry is a pillar of economic development, and the high-tech industry is an emerging industry and developing rapidly. Stocks of these two industries account for a large proportion of the stock market. Therefore, it is very imperative to study the performance of Fama-French models in these two industries, so as to better evaluate the stock.

Based on the above analysis, in order to evaluate the different performance of the high-tech and energy industry stocks in the US stock market, and test the effectiveness of asset pricing models in various industries, the three-factor model and the five-factor model were selected to study the return rate of portfolios. It helps to enrich the applicability of different models in the stock market and provide investors with advice.

2. Theory

2.1 The capital asset pricing model

The CAPM model was introduced by William sharp and John in 1964. It is a single factor model upgraded from Portfolio Theory. Portfolio Theory was developed by Markowitz and assumes that people are risk-averse [10].

The model can be shown as:

$$E(R_i) - R_f = \beta_M (E(R_M) - R_f) \quad (1)$$

$E(R_i)$ is the expected return of the investment portfolio, R_f is the risk-free rate, $E(R_M)$ is the market expected return, and the beta coefficient β_M implies the system risk.

The CAPM model believes that the investment risk comes from two aspects: one is the systematic risk which cannot be reduced by diversification; another is an unsystematic risk, that is, the risk of a particular single stock which can be reduced by diversification. Only systematic risk affects the expected return.

The left side of the equation, $E(R_i) - R_f$, implies portfolio expected excess return; the right side of the equation, $E(R_M) - R_f$, implies the market expected excess yields. That market risk premium is the difference of return on the market portfolio (which include all risky asset in the world) and the risk-free rate. Therefore, the capital asset pricing model means that the return of one particular portfolio depends on the sensitivity of that portfolio to the systematic risks in the market. β_M computes the effect of MKT on the return of this portfolio and implies the systemic risk of this portfolio. β_M of portfolios is different. β_M of the market portfolio is equal to 1. When the particular chosen portfolio is less sensitive to the macroeconomic variables change than the market, i.e., less risky than the market portfolio, β_M is less than 1; otherwise, when the portfolio is more sensitive, β_M is greater than 1.

2.2 Fama-french three-factor model theory

Many researchers consider adding factors to make improvement of the capital asset pricing model, and empirical evidence shows some factors that have explanatory power. Based on the original CAPM model, Fama and French added the firm size factor and book-to-market ratio factor, which have explanatory power to stock returns, and then set up a three-factor model.

The basic form of the model is:

$$E(R_i) - R_f = \beta_M (E(R_M) - R_f) + \beta_{SMB}SMB + \beta_{HML}HML \quad (2)$$

$E(R_i)$ is the actual rate of return of the portfolio, R_f is the risk-free rate of return, $E(R_M)$ is the rate of return of the market risk portfolio. SMB, which is a symbol for the small-minus-big, is the rate of return of the size factor. HML, which is a symbol for high-minus-low is the return rate of the book-to-market ratio factor. β_M represents the coefficient of risk in the stock portfolio market. β_{SMB} and β_{HML} respectively refer to the coefficient of size factor and book-to-market ratio factor.

SMB is the size factor and it is the return on small-firm stocks minus the return on large-firm stocks. It normally is positive, which shows small firms actually give higher risk-adjust returns than the large firms because small firms are considered riskier thus, investors require a higher return to them. Specifically, the average stock return of a firm with a small market size is higher than the average stock return of the firm with a large market size. Because stocks of firms with small market sizes are riskier, so the corresponding return should be higher. For instance, when someone purchasing shares in a small company, it is likely for him to become a big shareholder and have control power of the company at that time. If this big shareholder sells the stock, others will follow to sell, make share prices have plunged, which means the transaction cost will be too high and stock is riskier. On the opposite, when investors holding shares in a big company, selling it doesn't have much impact, and the transaction cost is lower. At one particular time, SMB is the same for every portfolio, but β_{SMB} is different for different portfolios. When β_{SMB} is less than 0, this factor SMB has a negative effect on stock return. That implies size factor make this portfolio is less risky than average, which indicates this portfolio belongs to a big firm or industry with high market value. Otherwise, β_{SMB} is greater than 0 means this portfolio belongs to a small firm.

HML is the book-to-market factor, and it is the return on high book-to-market-ratio stocks minus the return on low book-to-market-ratio stocks. It normally is positive, which means high book-to-market-ratio stocks give higher risk-adjust returns than the low book-to-market-ratio stocks. Because high book-to-market-ratio stocks are considered riskier and thus, investors require a higher return to them. Specifically, the book-to-market ratio (BM) represents the growth opportunity of a particular company or an industry. Stocks with a high BM will have a higher expected return than those with a low BM, because high BM indicates riskier. The reason is that companies with high BM are that companies with poor fundamental performance. Their financial situation is relatively fragile and their risks are relatively high. So the high returns are compensation for high risks. In addition, high BM is often referred to as value stocks, and low BM is often referred to as growth stocks, growth stocks often have good fundamental performance thus will be overvalued; on the contrary, value stocks are often maintained unchangeable and lack of growth momentum thus be adverse and undervalued, which means it can be used by lower price to buy stock in value stocks, and require higher expected returns in the future. It embodies the cigarette end theory of investing: buy cheap shares of companies that are temporarily underperforming but are not irreversibly deteriorating in fundamentals. At one particular time, HML is the same for every portfolio, but β_{HML} varies for different portfolios. When β_{HML} is less than 0, it means the effect of factor HML to stock return is negative, i.e., make it less risky than average. That indicates this portfolio belongs to a firm or industry with a low BM ratio, thus have more growth opportunities. Otherwise, when β_{HML} is greater than 0, it means this portfolio belongs to a high BM-ratio firm, which has less growth opportunity.

2.3 Fama-french five-factor model theory

To make an improvement, Fama and French added profitability factors and investment style factors that have explanatory power for stock returns and then set up a five-factor model.

The basic form of the model is:

$$E(R_i) - R_f = \beta_M (E(R_M) - R_f) + \beta_{SMB} SMB + \beta_{HML} HML + \beta_{RMW} RMW + \beta_{CMA} CMA \quad (3)$$

$E(R_i)$ is the actual rate of return of the portfolio, R_f is the risk-free rate of return, $E(R_M)$ is the rate of return of the market risk portfolio. RMW (robust-minus-weak) is the rate of return on the profitability factor. CMA (conservatively-minus-aggressively) is the return rate of investment patterns

factor. β_M represents the coefficient of risk in the stock portfolio market. β_{RMW} and β_{CMA} respectively refer to the coefficient of profitability factor and investment style factor.

The two additional factors are RMW and CMA.

RMW is the profitability factor, which is the return on most profitable firms minus the return on least profitable firms. It normally is positive, which shows profitable firms actually give higher risk-adjust returns than the unprofitable firms because profitable firms are considered riskier thus, investors require a higher return to them. That may be because high profitability reflects high business leverage, which means high fixed cost and dividends need to pay for a fixed cost. It will also make company managers less aggressive and pioneering and lead to increased competition and suffer public opinion attacks. Those make firms with high profitability riskier. In another way, it can also be explained by profitable companies always give shareholders a higher return, as they have enough profit to pay the dividends. At one particular time, RMW is the same for every portfolio, but β_{RMW} differ for different portfolios. β_{RMW} is less than 0 means this factor RMW have a negative effect on this stock return, that shows profitability factor make this stock less risky than average. That implies this portfolio belongs to an unprofitable firm or industry. Otherwise, β_{RMW} is greater than 0 means this portfolio belongs to a profitable firm.

CMA is the investment patterns factor, which is the return on firms that invest conservatively minus firms that invest aggressively. It normally is positive, which shows firms that invest conservatively actually give higher risk-adjust returns than the firms invest aggressively. Investment patterns can be shown as a reinvestment rate and can reflect company managers' confidence and the company's reproduction capacity. If the company invest conservatively, it means the company's reinvestment rate is low and it is lack of reproduction or sustainable capacity. Those make this firm riskier and require a higher return. β_{CMA} is less than 0 means this portfolio belongs to a firm or industry that reinvest aggressively, and β_{CMA} is greater than 0 means this portfolio belongs to a firm invest conservatively, which normally are firms' lack of reproduction capacity.

3. Method

3.1 Model building

Use the Fama-French 3-factor theory and Fama-French 5-factor theory above to build empirical models as following:

$$E(R_i) - R_f = \beta_M (E(R_M) - R_f) + \beta_{SMB}SMB + \beta_{HML}HML + u \quad (4)$$

$$E(R_i) - R_f = \beta_M (E(R_M) - R_f) + \beta_{SMB}SMB + \beta_{HML}HML + \beta_{RMW}RMW + \beta_{CMA}CMA + u \quad (5)$$

3.2 Data selection and description

The data in this article is selected from the database of Kenneth R. French's web [11], which is the data provided by French, who is one of the founders of the Fama-French model. The data is based on the relevant information of the US stock market.

For the right-hand side, factor MKT is the exceed market return, which equals to $R_m - R_f$. It is the value-weighted return of all CRSP firms incorporated in the US and listed on the NYSE, AMEX, or NASDAQ. Those CRSP firms are firms with CRSP share code of 10 or 11 at the beginning of month t, good shares and price data at the beginning of t and good return data for t. Use the return for t minus the one-month Treasury bill rate, which gets from Ibbotson Associates.

For other factors on the right-hand side, they are respectively constructed by using the 6 value-weighted portfolios formed on size and book-to-market, the 6 value-weight portfolios formed on size and operating profitability, and the 6 value-weight portfolios formed on size and investment. Stock returns use to construct HML, RMW, and CMA includes all NYSE, AMEX, and NASDAQ stocks for July of year t to June of t+1. They selected stocks. Those chosen stocks are stocks with market equity data can get for December of t-1 and June of t, and have (positive) book equity data for t-1 (for SMB, HML, and RMW). They also have non-missing revenues and at least one of the following: cost of goods sold, selling, general and administrative expenses, or interest expense for t-1 (for SMB and

RMW), and total assets data for t-2 and t-1 (for SMB and CMA). Then use those data to calculate factors as follows.

SMB is the average return on the nine small stock portfolios minus the average return on the nine big stock portfolios. They calculate SMB as following:

$$SMB_{(B/M)} = 1/3 (\text{Small Value} + \text{Small Neutral} + \text{Small Growth}) - 1/3 (\text{Big Value} + \text{Big Neutral} + \text{Big Growth}) \quad (6)$$

$$SMB_{(OP)} = 1/3 (\text{Small Robust} + \text{Small Neutral} + \text{Small Weak}) - 1/3 (\text{Big Robust} + \text{Big Neutral} + \text{Big Weak}) \quad (7)$$

$$SMB_{(INV)} = 1/3 (\text{Small Conservative} + \text{Small Neutral} + \text{Small Aggressive}) - 1/3 (\text{Big Conservative} + \text{Big Neutral} + \text{Big Aggressive}) \quad (8)$$

$$\text{Then SMB} = 1/3 (SMB_{(B/M)} + SMB_{(OP)} + SMB_{(INV)}) \quad (9)$$

HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios,

$$HML = 1/2 (\text{Small Value} + \text{Big Value}) - 1/2 (\text{Small Growth} + \text{Big Growth}) \quad (10)$$

RMW (Robust Minus Weak) is the average return on the two robust operating profitability portfolios minus the average return on the two weak operating profitability portfolios,

$$RMW = 1/2 (\text{Small Robust} + \text{Big Robust}) - 1/2 (\text{Small Weak} + \text{Big Weak}) \quad (11)$$

CMA (Conservative Minus Aggressive) is the average return on the two conservative investment portfolios minus the average return on the two aggressive investment portfolios,

$$CMA = 1/2 (\text{Small Conservative} + \text{Big Conservative}) - 1/2 (\text{Small Aggressive} + \text{Big Aggressive}) \quad (12)$$

On the left-hand side, R_f is a one-month Treasury bill rate which gets from Ibbotson Associates. R_i is the value-weighted average return of stocks in each industry. They assign each NYSE, AMEX, and NASDAQ stock to an industry portfolio at the end of June of year t based on its four-digit SIC code at that time. They then compute returns from July of t to June of t+1. In this paper, we choose the energy industry, which includes oil, gas, coal extraction and products. And high-tech industry, which includes business equipment (computers, software and electronic equipment). More specific, industrial controls; computer integrated systems design; services such as computer programming and data processing; services like information retrieval.

4. Result and discussion.

4.1 Empirical results

By using the data given by the website and running the regression of the empirical model based on the theory, we can get the results.

Table 1 Application of the three-factor model in the energy industry

	<i>Intercept</i>	<i>MKT</i>	<i>SMB</i>	<i>HML</i>
coefficient	-0.24274	1.08347	0.64602	0.49939
t-stastic	-1.034	19.236	8.083	5.913
P-value	0.301	< 2e-16	2.91e-15	5.33e-09
$R^2 = 0.4535$		Adjust $R^2 = 0.4511$		

Table 2 Application of the five-factor model in the energy industry

	<i>Intercept</i>	<i>MKT</i>	<i>SMB</i>	<i>HML</i>	<i>RMW</i>	<i>CMA</i>
coefficient	-0.29948	1.10625	0.66096	0.41609	0.06745	0.18140
t-stastic	-1.241	18.452	7.866	3.600	0.573	1.050
P-value	0.215201	<2e-16	1.46e-14	0.000341	0.5668	0.29412

$R^2 = 0.4545$	$\text{Adjust } R^2 = 0.4505$
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From the empirical results, it is accessible to evaluate the efficiency of two models in the energy sector and get the estimation of each factor in the energy industry. First, we focus on the validity and efficiency of the 3-factor and 5-factor models in the energy industry. As shown in the Table 1 and 2, for the energy industry, at the 5-factor model, the two factors: RMW, which means the profitability and CMA, which means the investment pattern, are not significant, and even not significant at 10%. It was conducted because the t-statistic of them is greater than 1.96 and the p-value is large. So RMW and CMA don't have much explanatory power for the stock return in the energy industry in the US market.

And the other three factors MKT, SMB, HML, as mentioned in theory, except some special period, those factors themselves are normally positive in the data. The effect of these three factors on the expected return is statistically significant because t-statistic >3 and the p-value is extremely small, which means they do affect the stock return. So MKT, SMB, HML have good power to explain the return of the investment.

We can look at the overall model and compare the effectiveness 3-factor model and the 5-factor model in the energy industry by looking at R^2 . From the regression result, by adding RMW and CMA, although R^2 increases roughly, adjust- R^2 actually decreases from 0.4511 to 0.4505. The adjusted R^2 of the three-factor model is larger than the five-factor, indicating that the five-factor reduces the degree of freedom, and generates multicollinearity between the factors, so the goodness of fit decreases. That means the three-factor model has higher explanatory power than the five-factor model, and also means RMW and CMA are redundant factors. Overall, the three-factor model has a better explanation for the return on investment and is more applicable to evaluate the stock return in the energy industry than the five-factor model.

Second, we look at each coefficient of parameters. In both the three-factor model and five-factor model, MKT, SMB, HML are significant. $\beta_M > 1$ means the energy industry is more sensitive to the macroeconomic variables than the overall US stock market. $\beta_{SMB} > 0$ means firms in the energy industry are on average small firms that have a low market value, and it increases stock returns. $\beta_{HML} > 0$ means firms in the energy industry are on average have high book-to-market-ratio, which means they normally value stock and don't have much growth opportunity. That increases stock returns. The factors RMW and CMA are not significant for the energy industry, so the coefficients for them are not meaningful.

Table 3 Application of the three-factor model in the high-tech industry

	<i>Intercept</i>	<i>MKT</i>	<i>SMB</i>	<i>HML</i>
coefficient	0.23243	1.13302	1.31312	-0.45357
t-stastic	1.85	37.59	30.71	-10.04
P-value	0.0647	$< 2e-16$	$< 2e-16$	$< 2e-16$
$R^2 = 0.8456$		$\text{Adjust } R^2 = 0.8449$		

Table 4 Application of the five-factor model in the high-tech industry

	<i>Intercept</i>	<i>MKT</i>	<i>SMB</i>	<i>HML</i>	<i>RMW</i>	<i>CMA</i>
coeffic ient	0.52207	1.05078	1.12056	-0.26946	-0.6489	-0.3872
t-stastic	4.417	35.801	28.454	-4.763	-11.261	-4.578
P-value	1.16e-05	$<2e-16$	$<2e-16$	2.34e-06	$<2e-16$	5.60e-06
$R^2 = 0.871$			$\text{Adjust } R^2 = 0.87$			

These empirical results shown in Table 3 and 4 allow to evaluate the efficiency of two models and analyse coefficients in the high-technology industry.

First, focus on the validity and efficiency of the 3-factor and 5-factor models in the high-technology industry. All five factors, which include RMW and CMA, are significant in both models because all t-statistic > 3 and p-value are really small.

And for the overall model, the five-factor model has a higher adjust- R^2 than the three-factor model (0.87 and 0.8449), which means the five-factor model has better goodness of fit and has greater explanatory power in the high-tech industry. The five-factor model is more appropriate to evaluate the stock return in the high-tech industry than the three-factor model.

Second, we look at each coefficient of parameters. In both the three-factor model and five-factor model, MKT, SMB, HML, RMW, CMA are significant. $\beta_M > 1$ means the high-tech industry is more sensitive to the macroeconomic variables than the overall US stock market. $\beta_{SMB} > 0$ means firms in the high-tech industry are on average small firms that have low market value. $\beta_{HML} < 0$ means stocks of firms in the high-tech industry are on average have low book-to-market-ratio. They are normally growth stock and have much growth opportunity, which makes them less risky. Because of market efficiency, that makes stock returns decrease. $\beta_{RMW} < 0$ means firms in the high-tech industry are, on average, not profitable enough. That decreases stock returns. $\beta_{CMA} < 0$ means firms in the high-tech industry are, on average, invest aggressively and have high reproduction ability. Then compare the energy industry and high-tech industry by using the results:

As for the effectiveness of Fama-French models: it's more applicable to use the five-factor model to evaluate the stocks in the high-tech industry, but applicable to use the three-factor model in the energy industry, which mainly because RMW and CMA are redundancy factors.

And as for the overall exploratory power: the return of high-tech industry stocks is more applicable to use Fama-French models, as its R^2 is approximately 87%, and the goodness of fit for energy stocks is only about 45%.

As for the significance of parameters: MKT, SMB, HML are all significant for each industry. RMW and CMA are not significant for stocks in the energy industry but are significant for stocks in the high-tech industry.

As for the direction and size of the coefficients: β_M is greater than 1 for both industries. β_{SMB} are both greater than 0. But β_{HML} is greater than 0 in the energy industry and less than 0 in the high-tech industry.

4.2 Reason discussion

(1) Effectiveness of two model

The different main finding of the application of the three-factor and five-factor models in energy and high-tech industries is that RMW and CMA are statistically significant in the high-tech industry but not significant in the energy industry.

For their insignificance in the energy industry, it has some reasons. First, the energy market has a high degree of monopoly; most stocks sold by listed companies are state-owned enterprises or very large companies. The energy sector, such as gas and coal networks, are natural monopolies, which means its competing network is not built by the economy. Many governments also give monopoly power to utility energy companies to achieve economies of scale and reduce costs. And because monopoly power, the market is lack of competition, several monopoly companies can control the market by supply and demand force by changing the price. So the need to raise money is not so high. The company's management doesn't need to adjust the stock pricing as the change of profitability and investment in a short-term period. They have the confidence to control the market. Second, because the demand for energy is quite stable and energy such as gas or coal can be regarded as necessity goods worldwide. So the investors are confident to believe stock price won't change a lot. Even if the company is not profitable at one particular time, instead of selling shares in a hurry, they are willing to hold it in the long run. That reduces the difference between profitable and unprofitable companies.

Third, centralization of control and ownership. Despite the gradual diversification of equity and investment entities in the energy industry, control and ownership are still highly concentrated. On the one hand, most of the control of corporate shares in the industry is concentrated in the hands of a few large companies; on the other hand, the internal shareholding of the company is highly concentrated in the hands of a few large shareholders. Therefore, the stock ownership and control of energy enterprises are mainly in the hands of a few main shareholders of large main enterprises. Individual investors and transactions don't play an important role in the energy market. Those main shareholders

tend to hold shares for the long-term. And the profitability and investment pattern are factors that affect the stock price via effecting the short-term performance of the company. So the stock price doesn't change because of them. In addition, because of centralization, the stock's turnover speed is low and the price is stable. Last but not least, in many countries, the motivation of owning energy is normally not making a profit. In several countries, the reorganization of energy companies and the change and diversification of shareholders are mostly driven by the government. Therefore, the change of shareholders and stock transactions is mainly subject to government control, and there is little impact on personal profit-making needs. So the profitability and reproduction ability shown by investment patterns don't have much efficiency.

In contrast, the RMW and CMA are significant for the high-tech industry. As an emerging industry, the high-tech industry has obvious product diversification, rapid development, and a high elimination rate. Therefore, its stock pricing is affected by corporate profitability and reinvestment rate, which reflect the reproductive ability. First, for high-tech industries, resources and energy consumption is low, which means they are not scared and not stable. Products in the high-tech industries are diversified and softwarealized. So they have small batch size, fast replacement and high added value. As a result, companies are renewed quickly and face a high risk of being eliminated. Therefore, their market value is highly related to their profitability and sustainability. Companies that lack development prospects and development opportunities have a high rate of elimination, so these companies have a high risk and high return on demand. Second, the shareholder dispersion rate is high. Equity holders are diversified and the degree of monopoly is low. Therefore, the stock turnover rate is high, and the change in return on investment depends on the investor's prediction of the enterprise. Therefore, the stock price changes with the characteristics of the company itself, and fluctuates greatly. The stock price depends on the company's performance of the short-term that can be shown by profitability (RMW) and sustainability (CMA). Thus, they affect expected return.

Then we look at the direction of the effect of RMW and CMA. The factor RMW is normally positive because a high level of profitability can bring higher shareholder returns. Companies always increase shareholder returns by increasing profits. It can be explained in another way that highly profitable companies may face high risk because they usually have high financial and business leverage, which will lead to high risk. So the shareholders will require a higher return. And for the high-tech industry, the effect of RMW, which is β_{RMW} is negative, which means the factor RMW reduces return in the high-tech industry, which means the high-tech industry has overall insufficient profitability. This may be because this is an emerging industry with insufficient development experience and insufficient financial support. But because β_{CMA} is negative, which means the high technology industry has high sustainability and reproduction ability.

Several policy recommendations for governments can be given. First, they should particularly strengthen our support for high-tech industries. The development of high-tech enterprises needs financial support, and the stock market can meet the financing needs of enterprises on the backside. Second, they should strengthen the supervision of the stock markets of various countries to prevent and a crackdown on insider trading and manipulative manipulation of stock prices. According to the analysis of the five-factor model, it is found that the stock market of high-tech industrial enterprises faces greater risks and more risk factors. Therefore, in order to ensure the stable development of the stock market of high-tech enterprises, policies need to increase their support. Therefore, intensifying the supervision of the stock market will not only promote the healthy development of the stock market of listed companies with high-tech concept stocks but also have an important role in promoting the economic development of the entire country.

For companies, all enterprises should strengthen the management of surplus quality, improve the accounting system and the efficiency of investment of enterprises in order to promote a rapid and healthy development, which can protect and enhance the interests of investors. They also should optimize the ownership structure. Strengthen the checks and balances among shareholders. They can reduce the controlling share of major shareholders by reducing the controlling share of major shareholders according to the actual situation, so as to avoid the situation of absolute control of major shareholders. Increase the separation of control and cash flow rights to improve shareholder returns.

For the high-tech industry, in addition, the company needs to focus on its profitability and focus on sustainable development. Strengthen the research and development of new technologies, seek more development opportunities, and increase shareholder returns.

(2) Other factors of two industries

For other coefficients, β_{MKT} is both greater than one, which means those two industries are both more sensitive than the market. The energy sector is sensitive to the business cycle because they work in a more cyclical fashion and the company operation are highly depends on macro variables such as weather and seasons, so the return of the stock is also unstable. In addition, macroeconomy variables also are reflected. For example, a high-interest rate, low GDP will lead to decreased sales in vehicles, which is not necessary and thus lower consumption of the petroleum industry. The high-tech industry is also sensitive but less sensitive than the energy industry. β_{SMB} are both greater than zero, which means those two industries have relatively low market value. That may because the energy industry is a monopoly and only have a few big companies, so the total market share is low. It also is shown in the actual US stock market. The energy industry's market share ranks about 13, not high. And the high-tech industry is an emerging industry and is not popular historically and not mature enough today.

The effect of HML, which means book-to-market ratio and implies the growth opportunity, is of different directions for those two industries.

β_{HML} is positive in the energy industry. That shows the energy industry is value stock with high BM and do not have growth opportunity. It is noticeable that in our chosen data, it only includes the traditional energy of gas, oil and coal, not other kinds of energy. The introduction of new technology gives more chances and less cost to produce new energy. On the contrary, the oil price is increasingly driven by the market—meanwhile, a changing climate increase people's awareness of protecting the environment. As a result, traditional energy resource such as oil and gas that are included in the given data is getting less popular. Investors are encouraged to look for new energy sources. Renewable and natural gas growth significant and gradually replace traditional sources. So the traditional energy provided is less and less attractive, and the market value of that is getting lower. So BM is high and these stocks are riskier, thus require a higher return.

On the opposite, β_{HML} is negative in the high-tech industry. That shows the high-tech industry is growing stock with low BM and does have much growth opportunity. With the rapid development of economic globalization, the resource-consuming and labor-intensive economy are no longer attractive. The development of the economy needs to be driven by high-tech industries, which is the most valuable sector of the economic field. AI and cloud computing are dominating technology headlines and grow fast in recent years. For example, 51% of participants to Deloitte's "Global State of AI in the Enterprise, 2nd Edition" survey expected to boost their AI investments by 10% or more in 2019, and 80% indicated these investments had driven ROI of 10% or more. Financial support and government support in most countries help high-tech companies to grow. So the firms in the high-tech industries normally have high growth opportunities and easy to seek more investment, so they face less this kind of risk and require lower returns.

β_{HML} are significant in both industries but have different signs indicate those two industries are facing different growth opportunities.

5. Conclusion

This article uses the Fama-French model to test the applicability and effectiveness of impact factors in the energy and high-tech industries. Through the monthly data of 1963.7-2020.2, use empirical methods and compare the results. Then conclude the applicability of the three-factor and five-factor models in listed companies.

This article first compares the difference between the average returns of the three and five factors in the energy industry. It is found that the RMW and CMA factors are redundant factors in the interpretation of the energy industry return rate and do not have strong explanatory power, so the three-factor model is more effective when evaluating the energy industry. This may be due to the strong monopoly of the energy industry and the concentration of equity distribution, and the fact that most

companies are controlled by the government. On the contrary, for high-tech companies, CMA and RMW are no longer redundant factors, but have the better explanatory ability, and can provide a more accurate analysis of the yield of the listed stock market. This may be due to the high degree of diversification and rapid development of products in the high-tech industry, so the profitability and sustainability of the enterprise are particularly important and the five-factor model is better.

As for other factors, these two industries are both sensitive to macro-economy variables change than the market average level; and they are both of low market value. The difference is high-tech industries have higher growth opportunities than the energy industry and they affect the return in opposite ways.

For companies, they should enhance the returns of shareholders and optimize the ownership structure. High-tech firms should, in particular, focus on profitability and reinvestment rate. For countries, there should be more financial support and market supervision for high-tech industries, thereby improving the sustainability of the entire industry, increasing stock prices, and attracting more investment. This plays an important role in the economic development of the country.

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