Industry Prosperity and Stock Return: Evidence from China's Real Estate Industry

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Abstract. The influencing factors of capital asset pricing have been a hot topic in academic research, yet the practice of incorporating industry prosperity into factor models for quantitative analysis is limited. By creating a new factor based on the National Real Estate Climate Index and adding it to the Fama-French three-factor model (FF3), this study focuses on China's real estate sector and examines the impact of industry prosperity on capital asset pricing. Empirical findings from the real estate sector of China's A-share market include: (1) The FF3 shows good applicability, with a positive market premium, a negative size premium and a negative value premium; (2) A rise in industry prosperity has a significant negative impact on the excess returns for the next period on low book-to-market stocks and large-cap stocks with a medium book-to-market ratio; (3) Industry prosperity has some interactive effects on the FF3 factors. The objectives of this study are to fill the research gap, to support investment strategy optimization, and to serve as a guide for policy practices.

Keywords: Capital Asset Pricing, Industry Prosperity, Fama-French Three-Factor Model, Real Estate Industry.

1. Introduction

The real estate sector, one of the pillars of China's economy, plays a critical role in the stability of the nation's financial system. Recently, the industry has shifted from a period of rapid growth to one of normalized regulatory oversight, with its performance drawing continuous attention from both investors and policymakers.

In academic research, identifying key drivers of stock returns remains a central focus. Markowitz introduced Modern Portfolio Theory (MPT) through mean-variance analysis, laying the groundwork for contemporary financial studies [1]. Building on this, Sharpe, Lintner, and Mossin developed the Capital Asset Pricing Model (CAPM), which proposes a linear relationship between systematic risk and expected stock returns [2-4]. However, the oversimplification of this single-factor model limits its effectiveness in empirical settings, and the emergence of various anomalies prompts further research into asset pricing. Fama and French expanded CAPM by incorporating size and value factors, creating a three-factor model (FF3) that enhanced the explanatory power for asset returns [5]. Later, Fama and French introduced a five-factor model (FF5) by adding profitability and investment factors to the FF3 [6]. Zhao et al. examined the applicability of the FF5 in China's stock market, finding that unlike evidence found in the U.S. market, Chinese stock returns were not adequately captured by the two additional factors, suggesting that the three-factor model is more fitting for the A-share market in China [7].

In the field of asset pricing, while the connection between the stock market and industry factors has received some attention, the practice of incorporating industry prosperity into factor models for quantitative research is limited. Considering the inadequacy of existing research, this study uses China's real estate industry as research object and conducts multivariate regression analysis on the monthly excess returns on stocks by adding an industry prosperity factor to FF3. Beside this, the study explores the interactive effects between industry prosperity and the FF3 factors.

The marginal contribution of this study lies in filling the research gap, supporting investment strategy optimization, and serving as a guide for policy practices.

2. Research Design

2.1. Data Source and Samples

Taking into account the fact that a structured framework for financial reporting in China was not fully realized until about 1999, and the marketization of China's real estate industry didn't take place until the housing reform in 1998, this study selects data from January 2000 to September 2024. Based on the industry classification by SWS Research, a total of 118 stocks in the real estate sector of China's A-share market are used as the sample for analysis.

The data of the National Real Estate Climate Index (NRECI) are from the iFinD Financial Data Terminal. This data is monthly released by the National Bureau of Statistics of China, with 2012 as the base year, and it can comprehensively reflect the prosperity of the national real estate industry. Other data used in the study all comes from the CSMAR Database.

To mitigate the impact of outliers on the model estimation results, this study performs a 1% bilateral winsorization on the raw data before conducting empirical analysis.

2.2. Introduction of Models

2.2.1. FF3

The FF3 is built upon the CAPM by adding the size factor (SMB) and the value factor (HML) to the market factor (MKT), and can be presented as follows:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}MKT_t + \beta_{i2}SMB_t + \beta_{i3}HML_t + e_{it} \quad (1)$$

2.2.2. Introducing the industry prosperity factor into the FF3

To investigate the relationship between industry prosperity and excess stock returns, the industry prosperity factor is added to the FF3, constructing the following model:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}MKT_t + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}lnNRECI_{t-1} + e_{it} \quad (2)$$

2.2.3. Introducing the industry prosperity factor and the interaction terms into the FF3

Because the pricing impact that the traditional FF3 factors have on excess stock returns may vary under different levels of industry prosperity, the following models are constructed to capture the interactive effects:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}MKT_t + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}lnNRECI_{t-1} + \beta_{i5}MKT_t * lnNRECI_{t-1} + e_{it} \quad (3)$$

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}MKT_t + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}lnNRECI_{t-1} + \beta_{i6}SMB_t * lnNRECI_{t-1} + e_{it} \quad (4)$$

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}MKT_t + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}lnNRECI_{t-1} + \beta_{i7}HML_t * lnNRECI_{t-1} + e_{it} \quad (5)$$

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}MKT_t + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}lnNRECI_{t-1} + \beta_{i5}MKT_t * lnNRECI_{t-1} + \beta_{i6}SMB_t * lnNRECI_{t-1} + \beta_{i7}HML_t * lnNRECI_{t-1} + e_{it} \quad (6)$$

In the models, R_{it} represents the return (monthly current-value-weighted aggregated market return with cash dividend reinvested) on stock i at time t. MKT_t is the market factor, representing the difference between the market portfolio return weighted by circulating market capitalization of each firm at time t and the risk-free rate (monthly data converted from annualized risk-free interest rate, which is the one-year lump-sum deposit & withdrawal time deposit interest rate, based on compound interest calculation), i.e., $R_{mt} - R_{ft}$. SMB_t is the size factor, representing the difference in return between small-cap and large-cap stocks at time t. HML_t is the value factor, representing the difference in return between high book-to-market and low book-to-market stocks at time t.

$lnNRECI_{t-1}$ is the industry prosperity factor, representing the logarithm of the National Real Estate Climate Index at time t-1, which is in first-order lag form to address potential endogeneity issues in the model. $\alpha_i, \beta_{i1}, \beta_{i2}, \beta_{i3}, \beta_{i4}, \beta_{i5}, \beta_{i6}, \beta_{i7}$ represent the correlation coefficients. e_{it} denotes the residuals.

2.3. Construction of the Portfolios and the Risk Factors

The study draws on the methodology of Fama and French and employs a 2×3 framework [5]. For each month, stocks are segmented into two groups based on the median circulating market capitalization. Additionally, they are divided into three groups using the 30th and 70th percentile cutoffs of the book-to-market ratio (calculated by dividing the total equity reported in the last fiscal year's financial statements by the circulating market capitalization in each month). This classification yields a total of six distinct investment portfolios. The details of constructing the portfolios are presented in Table 1. The procedures of building the size and value factors are shown in Table 2.

Table 1. Construction of the Portfolios

Group		Book-to-Market Ratio		
		H (30%)	M (40%)	L (30%)
Market Value	S (50%)	SH	SM	SL
	B (50%)	BH	BM	BL

Table 2. Construction of the Size and Value Factors

Small – Big	SMB = $\frac{1}{3}$ (SH + SM + SL) - $\frac{1}{3}$ (BH + BM +BL)
High – Medium – Low	HML = $\frac{1}{2}$ (SH + BH) - $\frac{1}{2}$ (SL + BL)

3. Empirical Analysis and Results

3.1. Descriptive Statistics and Correlation Test

3.1.1. Descriptive statistics of the risk factors

Table 3. Descriptive Statistics of the Risk Factors

Stats	MKT	SMB	HML	lnNRECI
N	29903	29903	29903	29903
Mean	0.0146	-0.00449	-0.00611	4.608
SD	0.0991	0.0340	0.0248	0.0418
Min	-0.425	-0.577	-0.370	4.520
Max	0.841	0.370	0.577	4.693

As presented in Table 3, the average value of MKT is positive, signaling a positive market premium. This implies that, overall, Chinese real estate stocks are profitable.

The negative mean value of SMB indicates a negative size premium, meaning that small-cap stocks in the real estate sector tend to underperform large-cap stocks. This finding contradicts the "Small Firm Effect" described by Banz [8]. A possible explanation could be the distinctive features of the real estate industry. Due to the high capital requirements for real estate development, a "Matthew effect" may occur, where larger companies, with more advantageous financial resources, market position, and brand influence, are better able to generate higher returns compared to their smaller counterparts.

Similarly, the negative mean value of HML points to a negative value premium, suggesting that high book-to-market stocks in the real estate sector yield lower returns than low book-to-market stocks. This contradicts the "Book-to-Market Effect" identified by Stattman [9]. Qiu also observed this pattern in Chinese real estate stocks [10].

3.1.2. Descriptive statistics of the excess returns on different portfolios

Table 4. Descriptive Statistics of the Excess Returns on Different Portfolios

Portfolios	Obs	Mean	Std. Dev.	Min	Max
SH	3913	-.003	.11	-.381	.529
SM	5911	.007	.106	-.419	.515
SL	5062	.016	.118	-.419	.589
BH	4929	.003	.107	-.345	1.14
BM	6308	.013	.101	-.337	.812
BL	3780	.03	.117	-.343	.622

As indicated in Table 4, the average excess returns on five of the six portfolios are positive, except for the SH portfolio. This suggests that, overall, the real estate sector of China's A-share market has performed well. When comparing different portfolios within the same group of book-to-market ratio, the B- portfolios consistently show higher average returns and lower standard deviations than the S-portfolios, indicating that large-cap stocks offer better investment returns with lower risk. Within the same group of circulating market capitalization, the average returns for the -H, -M, and -L portfolios increase sequentially, indicating that stocks with a lower book-to-market ratio have superior investment returns. The standard deviations for the -M, -H, and -L portfolios increase in sequence, suggesting that medium book-to-market stocks carry the lowest investment risk, followed by high book-to-market stocks, while low book-to-market stocks present the highest investment risk.

3.1.3. Correlation analysis of the risk factors

Table 5. Correlation Matrix of the Factors

Factors	MKT	SMB	HML	lnNRECI
MKT	1.000			
SMB	-0.118	1.000		
HML	0.080	-0.158	1.000	
lnNRECI	-0.134	-0.005	0.009	1.000

Table 5 shows that the absolute values of all correlation coefficients are less than 0.2, suggesting that there's no substitutability among the factors and multicollinearity is not a concern for regression analysis.

The correlation coefficient between MKT and SMB is -0.087, while that between MKT and HML is 0.080. This implies that better market performance is associated with lower size premium and higher value premium for Chinese real estate stocks.

Additionally, the correlation coefficient between lnNRECI and SMB is -0.005, and that between lnNRECI and HML is 0.009. This indicates that higher industry prosperity is linked to lower size premium and higher value premium for Chinese real estate stocks.

3.2. Regression Analysis

3.2.1. The explanation of the excess returns on stocks by FF3

Regression analysis is conducted on the full sample using Model (1), and the results are presented in Table 6. Additionally, regression analysis is separately performed on six investment portfolios using Model (1), with the outcomes shown in Table 7.

Table 6. Aggregate Estimation Findings of Model (1)

MKT	0.950***
	(154.31)
SMB	0.440***
	(24.32)
HML	-0.146***
	(-5.90)
_cons	-0.00328***
	(-5.14)
N	29900

Note: t statistics in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001.

As shown in Table 6, when conducting regression analysis on the full sample using Model (1), the regression coefficients for MKT, SMB, and HML are all statistically significant. This indicates that all three factors are the primary determinants affecting the excess returns on stocks, and the FF3 is well applicable for the real estate sector in China's A-share market. Among them, the regression coefficients for MKT and SMB are positive, while the regression coefficient for HML is negative. This suggests that, overall, the excess returns on Chinese real estate stocks are positively correlated with market premium and size premium, and negatively correlated with value premium.

Table 7. Estimation Findings of Model (1) by Different Portfolios

	SH	SM	SL	BH	BM	BL
MKT	0.832***	0.873***	0.876***	0.892***	0.865***	0.896***
	(94.11)	(125.10)	(100.84)	(125.44)	(137.37)	(88.16)
SMB	1.091***	1.057***	1.179***	0.0915***	-0.287***	-0.368***
	(40.37)	(50.03)	(41.66)	(4.05)	(-16.14)	(-12.35)
HML	0.536***	0.196***	-0.644***	0.924***	0.0749*	-1.068***
	(14.75)	(6.23)	(-18.39)	(33.23)	(2.56)	(-28.21)
_cons	-0.00735***	0.000491	0.00296**	-0.00340***	-0.000483	0.00591***
	(-7.96)	(0.68)	(3.24)	(-4.77)	(-0.75)	(5.74)
N	3913	5911	5062	4929	6308	3780

Note: t statistics in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001.

As shown in Table 7, the regression coefficient of MKT is positive in the regression of excess returns for any investment portfolio, indicating that the performance of Chinese real estate stocks is positively influenced by the overall market trend. Within the same group of book-to-market ratio, the regression coefficients of SMB for the S- portfolios are consistently higher than the B- portfolios, suggesting that small-cap stocks are more significantly affected by the negative size premium, and large-cap stocks exhibit better overall returns. Within the same group of circulating market capitalization, the regression coefficients of HML for the -H, -M, and -L portfolios decrease in order, indicating that high book-to-market stocks are more significantly affected by the negative value premium, while low book-to-market stocks have better overall returns.

From the intercept terms, it can be known that all investment portfolios except for the SM and BM show significant abnormal returns, indicating that in the real estate sector of China's A-share market, the FF3 can better explain the excess returns on medium book-to-market stocks. For other portfolios, there exist other factors that can significantly affect the excess returns in addition to the FF3 factors.

3.2.2. The impact of industry prosperity on the excess returns

Regression analysis is conducted on six investment portfolios respectively using Model (2). The results are shown in Table 8.

Table 8. Estimation Findings of Model (2) by Different Portfolios

	SH	SM	SL	BH	BM	BL
MKT	0.830***	0.874***	0.871***	0.891***	0.861***	0.893***
	(92.92)	(124.11)	(99.55)	(124.27)	(135.60)	(87.14)
SMB	1.089***	1.057***	1.178***	0.0913***	-0.288***	-0.368***
	(40.31)	(50.03)	(41.70)	(4.04)	(-16.22)	(-12.38)
HML	0.535***	0.195***	-0.639***	0.924***	0.0783**	-1.069***
	(14.71)	(6.20)	(-18.27)	(33.23)	(2.68)	(-28.25)
lnNRECI	-0.0400	0.0115	-0.0812***	-0.00678	-0.0714***	-0.0540*
	(-1.82)	(0.71)	(-3.92)	(-0.43)	(-4.77)	(-2.28)
_cons	0.177	-0.0523	0.377***	0.0279	0.329***	0.255*
	(1.75)	(-0.71)	(3.95)	(0.38)	(4.76)	(2.33)
N	3913	5911	5062	4929	6308	3780

Note: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 8 shows that in Model (2), the coefficient of the industry prosperity factor is not significant when regressing the excess returns for the SH, SM, or BH portfolios. However, for the SL, BM, or BL portfolios, this coefficient is significantly negative. This indicates that in China's real estate sector, an increase in industry prosperity does not affect the excess returns on high book-to-market stocks or small-cap stocks with a medium book-to-market ratio. However, it has a significant negative impact on the excess returns for the next period on low book-to-market stocks and large-cap stocks with a medium book-to-market ratio. According to Jiang et al., this outcome may stem from investor expectations [11]. As the prosperity of China's real estate industry rises, investors may particularly raise their expectations for the performance of low book-to-market stocks and large-cap stocks with a medium book-to-market ratio. This heightened expectation inflates the current valuations of these stocks, leading to lower future returns.

3.2.3. Analysis of the interactive effects of industry prosperity on the FF3 factors

Regression analysis is conducted on the full sample using Model (3) – Model (6), and the results are presented in Table 9.

Table 9. Estimation Findings of Model (3) – Model (6)

	Model (3)	Model (4)	Model (5)	Model (6)
MKT	2.654***	0.950***	0.949***	2.427***
	(4.13)	(152.93)	(152.46)	(3.73)
SMB	0.439***	-8.794***	0.443***	-8.689***
	(24.24)	(-4.45)	(24.17)	(-4.21)
HML	-0.151***	-0.167***	2.477	-1.737
	(-6.09)	(-6.65)	(0.96)	(-0.64)
lnNRECI	-0.000630	0.00774	-0.00840	0.0134
	(-0.04)	(0.52)	(-0.56)	(0.86)
MKT*lnNRECI	-0.371**			-0.321*
	(-2.65)			(-2.27)
SMB*lnNRECI		2.006***		1.982***
		(4.67)		(4.43)
HML*lnNRECI			-0.570	0.340
			(-1.02)	(0.58)
_cons	-0.000577	-0.0390	0.0354	-0.0654
	(-0.01)	(-0.57)	(0.51)	(-0.91)
N	29900	29900	29900	29900

Note: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As shown in Table 9, the regression coefficient of MKT*lnNRECI is significantly negative and is opposite in sign to the coefficient of the original market factor, suggesting that industry prosperity has a significant weakening effect on the pricing impact of the market factor. The regression coefficient of SMB*lnNRECI is significantly positive and is the same sign as the coefficient of the original size factor, suggesting that industry prosperity has a significant strengthening effect on the pricing impact of the size factor. The regression coefficient of HML*lnNRECI is not significant, suggesting that industry prosperity has no obvious effect on the pricing impact of the value factor.

4. Conclusion

This study focuses on China's real estate industry and examines the impact of industry prosperity on capital asset pricing. A new factor built upon the National Real Estate Climate Index is incorporated into the Fama-French three-factor model (FF3) to conduct the analysis. Key findings from the real estate sector of China's A-share market include: (1) The FF3 shows good applicability, with a positive market premium, a negative size premium and a negative value premium; (2) A rise in industry prosperity does not affect the excess returns on high book-to-market stocks or small-cap stocks with a medium book-to-market ratio, but it has a significant negative impact on the excess returns for the next period on low book-to-market stocks and large-cap stocks with a medium book-to-market ratio; (3) Industry prosperity has some interactive effects on the FF3 factors, mainly by weakening the pricing impact of the market factor and strengthening the pricing impact of the size factor.

It is worth noting that the findings may not be applicable to other industries or regions as this study only selects data from China's real estate industry. Future research could broaden the scope of the

study by examining industries other than China's real estate sector to further explore how industry prosperity affects capital asset pricing.

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