

Empirical Research of Fama-French Five Factor Model in Real Estate Industry-Before and After the COVID-19

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Abstract: This research uses Fama-French Five Factor Model to evaluate the influence of the COVID-19 and employs qualitative analysis to directly link movements in the real estate sector to shifts in the stock market. According to the findings, both the market factors and SMB have a good explanatory power. The significance of HML remains unchanged following the outbreak, whereas that of RMW and CMA shifts, which indicates the still limited explanatory capability of Fama-French Five Factor model in China's real estate industry.

Keywords: Real Estate Industry; Fama-French Five-Factor Model; COVID-19

1. Introduction

Estimating a stock portfolio's performance is important to investors who want to better manage financial risk. What factors determine the return rate of the stock portfolio is a long-standing topic. Fama and French successfully introduced the five-factor(FF-5) model in 2015^[1], which has been widely accepted by the academic world. However, the model's explanatory power in different nations has also been hotly debated, which is extremely contentious due to potential disparities in securities market development.

Given China's diversify and the unbalanced stock market, selecting real estate industry, a generally established industry, to test the applicability of the FF-5 model can be potential for improved applicability.

Meanwhile, COVID-19 has brought great uncertainty to the economy, posing hurdles to the model's applicability. However, few studies has been conducted to assess the impact of the pandemic on the Chinese stock market using the FF-5 model. To close the gap in this area, this paper will test the FF-5 model in China's real estate industry and explain the differences in factor's explanatory power.

2. Literature review

Fama-French Five Factor model is the latest and widely accepted asset pricing theory^[1]. Nonetheless, the samples of FF-5 models are based on the US securities market, raising questions about their continued applicability to foreign stock markets.

In China, empirical research can not reach a consistent result. Comparing the applicability at the level of the whole stock market, Zhao, Yan, & Zhang(2016) found that RMW and CMA are redundant factors and FF-3 model is more suitable in China's^[2]. However, in different periods of the Chinese securities market, the FF-5 model can strongly explain the results and performs better than CAPM and the FF-3 model^[3], according to Li, et al.(2017).

The inconsistent conclusion is mainly because the disparities between Chinese and American stock markets are not taken into account. Since China's industries are diverse with different growth paths, it is vital to discuss individual industries to fully comprehend how each factor affects asset pricing. Ma, Y.(2018) found that the FF-5 model has a some explanatory power on the returns of the Internet and related service companies^[4], which indicates that selecting a relatively mature industry for research may increase the applicability.

As a pillar of China's economic development, the real estate industry has long been a concern for scholars. The real estate sector has a complex relationship with more than 60 other industries, and changes in one of these industries will have an impact on businesses both upstream and downstream (Xu, X., 2012)^[5]. Therefore, the real estate industry is more appropriate to be studied as a specific object because of its maturity and leading role. According to Shen and Lu(2008), there is a lag of around two quarters between the increase in real estate values and the increase in stock prices^[6]. It provides the potential of using changes in the real estate market as a direct explanation for changes in the stock market.

In conclusion, domestic empirical researches on the FF-5 model have yet to provide a consistent outcome, and industry-specific research is still lacking. Meanwhile, the pandemic's unpredictability offers fresh hurdles to the FF-5 model's applicability. As a result, this article will focus on applying the FF-5 model to analyze the pandemic strike in China's real estate industry, and utilize the market movement to explain the underlying causes for the shift in factors' explanatory power.

3. Research methods

3.1 Data selection

The data needed are gathered from WIND and 118 stocks are remaining in the sample range. Focusing on the impact of COVID-19, this research selects the periods from 1 May 2018 to 28 February 2020 as the Fore-COVID-19 period and the periods from 1 March 2020 to 31 December 2021 as the After-COVID-19 period.

3.2 Model Interpretation and Factor Calculating Method

The model adopted in this research is Fama-French Five Factor Model:

$$R_{it} - R_{ft} = a_i + b_i(R_{Mt} - R_{ft}) + s_iSMB_t + h_iHML_t + r_iRMW_t + c_iCMA_t + e_{it}$$

In this equation, Ri reflects the return rate on asset i; Rf reflects the risk-free return rate; Rm reflects the market return rate; Rm-Rf reflects the market risk premium; SMB stands for the size factor; HML is the book-to-market factor; RMW is the profitability factor and CMA is the investment style factor. This paper use the 2x3 method to build the five factors and explanatory variables, referring to the Fama and French(2015)^[1].

4. Results

Table 1. Linear regression result of FF-5 model before the pandemic

$R_{it} - R_{ft} = a_i + b_i(R_{Mt} - R_{ft}) + s_iSMB_t + h_iHML_t + r_iRMW_t + c_iCMA_t + e_{it}$									
size	B/M			OP			Inv		
	L	M	H	L	M	H	L	M	H
	a								
S	-0.0005	-0.0005	-0.0002	-0.0002	-0.0002	-0.0005	-0.0004	-0.0002	-0.0005
(t)	(-0.78)	(-0.78)	(-0.27)	(-0.39)	(-0.40)	(-0.77)	(-0.61)	(-0.26)	(-0.75)
B	-0.0004	-0.0002	-0.0004	-0.0006	-0.0002	-0.0003	-0.0003	-0.0005	-0.0001
(t)	(-0.60)	(-0.31)	(-0.65)	(-0.86)	(-0.29)	(-0.49)	(-0.39)	(-0.74)	(-0.23)
	b								
S	0.4569***	0.4609***	0.4617***	0.4548***	0.4713***	0.4488***	0.4663***	0.4444***	0.4779***
(t)	(10.96)	(11.07)	(10.89)	(10.80)	(11.60)	(10.14)	(11.72)	(10.30)	(11.07)
B	0.4746***	0.4411***	0.4698***	0.4625***	0.4291***	0.4684***	0.4855***	0.4383***	0.4739***
(t)	(10.93)	(11.24)	(10.70)	(10.81)	(9.83)	(11.76)	(10.88)	(10.79)	(11.55)
	s								
S	0.6593***	0.6958***	0.7212***	0.6584***	0.6778***	0.7364***	0.5553***	0.7025***	0.8158***
(t)	(7.48)	(7.90)	(8.04)	(7.39)	(7.89)	(7.87)	(6.60)	(7.70)	(8.93)
B	-0.2259***	-0.4358***	-0.2878***	-0.3799***	-0.0982	-0.4579***	-0.1475	-0.3365***	-0.4080***
(t)	(-2.46)	(-5.25)	(-3.10)	(-4.20)	(-1.06)	(-5.44)	(-1.56)	(-3.92)	(-4.70)
	h								
S	-0.1054	0.3550***	0.7979***	0.4244***	0.1982*	0.5570***	0.3353***	0.3550***	0.4297***
(t)	(-0.91)	(3.05)	(6.73)	(3.61)	(1.75)	(4.50)	(3.01)	(2.95)	(3.56)
B	-0.0260	0.2395**	1.0707***	0.4524***	0.2600**	0.3198***	0.4308***	0.2635**	0.3363***
(t)	(-0.21)	(2.18)	(8.73)	(3.78)	(2.13)	(2.87)	(3.45)	(2.32)	(2.93)
	r								
S	-0.3081***	-0.2424***	-0.1538	-0.4164***	-0.3110***	0.1761*	-0.2435***	-0.1492	-0.3751***
(t)	(-3.34)	(-2.63)	(-1.64)	(-4.46)	(-3.45)	(1.80)	(-2.76)	(-1.56)	(-3.92)
B	-0.1503	0.0538	-0.3046***	-1.2798***	-0.1819*	0.1278	-0.1499	-0.1201	-0.0183
(t)	(-1.56)	(0.62)	(-3.13)	(-13.49)	(-1.88)	(1.45)	(-1.51)	(-1.33)	(-0.20)
	c								
S	-0.5936***	-0.5895***	-0.5682***	-0.5445***	-0.6264***	-0.5535***	-0.2384**	-0.5561***	-1.0658***
(t)	(-4.91)	(-4.88)	(-4.62)	(-4.45)	(-5.31)	(-4.31)	(-2.06)	(-4.44)	(-8.50)
B	-0.6192***	-0.7204***	-0.6446***	-0.7421***	-0.5206***	-0.7331***	0.2075	-0.5984***	-0.9651***
(t)	(-4.91)	(-6.32)	(-5.06)	(-5.97)	(-4.11)	(-6.34)	(1.60)	(-5.07)	(-8.10)

Table 2. Linear regression result of FF-5 model after the pandemic

$$R_{it} - R_{ft} = a_i + b_i(R_{M,t} - R_{ft}) + s_iSMB_t + h_iHML_t + r_iRMW_t + c_iCMA_t + e_{it}$$

size	B/M			OP			Inv		
	L	M	H	L	M	H	L	M	H
	a			a			a		
S	0.0003	0.0003	-0.0000	0.0003**	0.0001	0.0002	0.0003	0.0002	0.0001
(t)	(1.16)	(1.36)	(-0.01)	(2.09)	(0.45)	(0.61)	(1.63)	(0.84)	(0.39)
B	-0.0001	0.0002	0.0002	0.0001	-0.0001	0.0002**	0.0001	-0.0001	0.0003*
(t)	(-0.34)	(1.57)	(0.60)	(0.24)	(-0.24)	(2.06)	(0.47)	(-0.59)	(1.77)
	b			b			b		
S	1.0296***	0.9728***	1.0034***	1.0184***	0.9818***	1.0013***	0.9928***	1.0490***	0.9301***
(t)	(55.44)	(51.16)	(53.93)	(72.97)	(53.65)	(42.10)	(66.94)	(59.32)	(42.23)
B	0.9910***	0.9969***	1.0172***	0.9998***	0.9649***	1.0169***	0.9538***	0.9959***	1.0165***
(t)	(50.28)	(83.37)	(40.71)	(44.18)	(46.96)	(104.00)	(40.26)	(66.27)	(66.88)
	s			s			s		
S	0.7282***	0.8570***	0.8377***	0.7973***	0.7992***	0.8537***	0.7481***	0.8249***	0.8715***
(t)	(26.56)	(30.53)	(30.50)	(38.70)	(29.58)	(24.32)	(34.16)	(31.59)	(26.80)
B	0.0153	-0.1601***	-0.0942**	-0.1298***	0.0834***	-0.1861***	0.005	-0.0882***	-0.1185***
(t)	(0.52)	(-9.07)	(-2.55)	(-3.88)	(2.75)	(-12.90)	(0.14)	(-3.98)	(-5.28)
	h			h			h		
S	-0.2439***	0.0726**	0.5250***	0.025	-0.0111	0.4247***	0.0213	0.1145***	0.2090***
(t)	(-7.56)	(2.20)	(16.25)	(1.03)	(-0.35)	(10.29)	(0.83)	(3.73)	(5.47)
B	-0.3766***	-0.1175***	0.8544***	0.2792***	0.1042***	-0.1205***	0.1106***	0.0136	-0.0772***
(t)	(-11.01)	(-5.66)	(19.70)	(7.11)	(2.92)	(-7.10)	(2.69)	(0.52)	(-2.92)
	r			r			r		
S	-0.3220***	-0.3445***	-0.1381***	-0.5117***	-0.3282***	0.1846***	-0.2857***	-0.2595***	-0.2926***
(t)	(-10.93)	(-11.42)	(-4.68)	(-23.11)	(-11.31)	(4.89)	(-12.14)	(-9.25)	(-8.38)
B	-0.0702**	0.1557***	-0.2541***	-1.0362***	-0.1916***	0.2675***	-0.0178	0.0476**	-0.0109
(t)	(-2.25)	(8.21)	(-6.41)	(-28.87)	(-5.88)	(17.25)	(-0.47)	(2.00)	(-0.45)
	c			c			c		
S	0.1673***	0.0181	0.0463	0.1196***	0.0495	0.0324	0.3615***	0.0818**	-0.3888***
(t)	(4.22)	(0.45)	(1.17)	(4.02)	(1.27)	(0.64)	(11.42)	(2.17)	(-8.27)
B	0.0359	-0.0668***	0.1570***	-0.0967**	0.0415	-0.0095	0.9105***	0.0986***	-0.3392***
(t)	(0.85)	(-2.62)	(2.94)	(-2.00)	(0.95)	(-0.45)	(18.01)	(3.08)	(-10.46)

Note: *** p<0.01, ** p<0.05, * p<0.1

The findings of multiple regression before and after the epidemic are shown above. The constant terms are not significant in both periods, indicating that the FF-5 model can well explain the expected returns of these portfolios. The coefficients of market factor, SMB, and HML stay at the same significance level after the outbreak of the COVID-19, while it changes for RMW and CMA. In terms of the magnitude of each coefficient, the coefficients of the market factor, SMB, and CMA increase whereas those of HML and RMW decrease.

Overall, these results show that the COVID-19 has a huge influence on the model's performance.

5. Discussion

5.1 Rm-Rf coefficient

At the 1% significance level, the market factor's coefficients are all statistically significant, demonstrating that the market risk premium is still the key factor explaining excess return in the FF-5 model. The coefficients of the market factor grew significantly under the influence of the COVID-19, from 0.46 to 1.0(117.4%), indicating that the real estate's sensitivity to market risk increased dramatically.

COVID-19 has had a significant influence on investment and land transactions, resulting in the increased capital tightness in the real estate industry and the worsening real estate market's overall performance. Consequently, the real estate industry has grown increasingly vulnerable to market hazards due to the market's overall downward trajectory following the COVID-19.

5.2 SMB coefficient

In terms of significance, only two coefficients of SMB fail the significance test in each period, which indicates that SMB contributes some explanatory power to the excess return. In terms of the magnitude of the coefficients, the coefficient and the value of SMB decreases as the size of the company increases, indicating that the explanatory power of SMB decreases. This result is similar to the previous research, as stocks with small size are easier to be manipulated due to their smaller market value and need a higher return rate to compensate for this risk.

5.3 HML coefficient

As more portfolios not passing the significance test and smaller coefficients, the explanatory power of HML is weaker. There are two portfolios not passing the significant test before the COVID-19, while there are four portfolios insignificant after. However, its coefficient decreases significantly from 0.31 to 0.1, indicating that investors are more focusing on stocks with a low book-to-market ratio.

Known as growth stocks, stocks with low book-to-market ratio are potential for better growth when the market interest rates fall substantially. With the modification of real estate policies and the assistance of financial resources, systematic risks will decrease, and with a low value of assessment, growth stocks will still have a strong return potential once the real estate market stabilizes in the future.

5.4 RMW & CMA coefficients

RMW has a negative overall effect, indicating that improving profitability will lower the company's risk exposure. Meanwhile, RMW becomes significant after the COVID-19, showing that investors place a higher value on profitability. Contrary to RMW, CMA becomes an insignificant factor. In addition, the absolute value of CMA's coefficients also decreases, which also demonstrates the losing importance of investors' risk preference.

The FF-5 model does not perfectly describe China's real estate stock market, as seen by the significance change in RMW and CMA. For the A-share market, where the investor structure is mostly made up of individual investors, the operating conditions and development prospects of companies are frequently disregarded. From a market perspective, due to China's stock market's relatively short growth time, the problem of information asymmetry and frequent malicious speculation exacerbates the inefficiency of the market. The RMW and CMA are less effective in China's stock market because of this .

6. Conclusion

This paper set out to analyze the impact of COVID-19 on the explanatory power of the FF-5 model and each factor in China's real estate industry. Multiple regression analysis revealed that COVID-19 has afflicted China's stock market, and plays an important role in the change in the FF-5 model's performance. The result showed that both the market factor and SMB have a relatively strong explanatory power. The significance of HML remains unchanged after the pandemic, whereas the significance of RMW and CMA changes under the impact of the pandemic. This change reflects the still limited explanatory power at present. In addition, this research provides qualitative analysis, as it uses the performance in the real estate market to explain the changes in factors' explanatory power.

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