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The Impacts of The Systematic, Idiosyncratic Risks and Market Sentiment on China A-Shares Performances

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ABSTRACT

The purposes of this paper are (i) to examine 3 driving factors affecting China A-shares market performance; namely systematic risk, idiosyncratic risk, and market sentiment, and (ii) to investigate the relationship between state-owned enterprise (SOE) & non-SOE and stock returns. In addition, the study also analyze normal condition and the impacts of Sino-US trade war and Covid-19 pandemic. This study employs monthly data which is divided into two parts namely (i) 2004-2020 period and (ii) 2018-2020 period. Multiple classic asset pricing models are employed to investigate the impacts of the 3 driving factors on stock returns. The results showed that these 3 driving factors exert significant influence on China A-shares in 2004-2020, However, the impact of market sentiment is weak during the period 2018-2020. Furthermore, market risks, firm size and B/M factor show great impacts on both SOE and non-SOE, profitability factor affecting non-SOE stock return is more important than investment which improves SOE stock return. This study proposes that investors and companies pay more attention to systematic risk and idiosyncratic risk, which potentially have greater impact on the stock market and to reduce unnecessary economic losses.

JEL Classification: G11, G12, G32

Keywords: China A-shares; Idiosyncratic Risk; Market Sentiment; Ownership Structure; Systematic Risk

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INTRODUCTION

Earlier studies in traditional finance employed Capital Asset Pricing Model (CAPM) to examine systematic risk, while Fama French 3-factor (FF3) and Fama French 5-factor (FF5) models were used to investigate the impact of firm idiosyncratic risk.

Overtime, with the development of behavioral finance, market sentiment has become increasingly more important, but whether it is traditional finance or emerging behavioral finance, the main research is largely focusing on the US stock market. In a study conducted by Ali and Bashir (2022), they reviewed several papers on asset pricing from the Scopus database for 47 years covering from 1973 to 2020. Graphs and tables drawn from the analysis showed that asset pricing is indeed a popular topic of research, but surprisingly, most of the researches focused on the data from United States and other developed countries' stock market. At present there are a few researches on emerging markets. Given such scenario, therefore, this paper aims to fill the research gap by examining the stability of China A-shares market[1] return with respect to systematic risk, idiosyncratic risk, and market sentiment. Apparently, China suffers from a few constraints such as limited transparency, limited financial trading products, and events related to price manipulation. The presence of these shortcomings and deficiencies raises plausible and interesting topic to study as it relates to the stability and performance of asset pricing models in China's A-shares market.

Despite many stock markets and business operations in the world are negatively affected by the Covid-19 pandemic (Utit et al., 2021; Liew, 2020), China was the only country that is showing positive economic growth in 2020. Currently, positioning the country as the world's largest emerging market, China's finance is becoming more and more important. In response of the fierce competition with China, the United States has launched a trade war with China since 2018. Therefore, at this point of time, the current economic environment of the Sino-US trade war and the Covid-19 pandemic, has raised an interesting concern of whether the systematic risk, idiosyncratic risk and market sentiments of China's A-shares be different from those under normal circumstances.

Furthermore, the latest information provided by China Securities Depository and Clearing Corporation Statistical Yearbook 2020, 99% of investors in China A-shares market are retail investors; in which the sheer volume of retail investors makes market sentiment an important part of the research. Therefore, to better understand the issues pertaining to China A-shares, it is very important to combine traditional finance and behavioral finance. Both, State-owned Enterprise (SOE) and non-SOE are the most two important financial components of the China A-shares market. According to Wind Financial Terminal data, at the end of 2021, SOE account for 29% of A shares, while non-SOE accounts for 71%. As such, it is necessary to investigate the relationship between ownership structure and average stock returns.

This paper examines the monthly returns of A-shares listed on the Shanghai and Shenzhen Stock Exchanges (SSE and SZSE) from January 2004 to December 2020, for a period comprising 204 months with a sample size of 3,414 non-financial firms. In examining systematic and idiosyncratic risks, the former includes crude oil prices, exchange rate, inflation, interest rate, and the latter involves firm size, book-to-market (B/M) ratio, profitability, investment and these variables are used to examine their impacts on the stock returns. In addition, this study adopts the method of Baker and Wurgler (2006) to construct a market sentiment index. The CAPM, Single-Index Model (SIM), and Arbitrage Pricing Theory (APT) model are employed to investigate the impacts of the 3 driving factors on stock returns. Gibbons-Ross-Shanken (GRS) test is applied to evaluate the model validity, whilst Fama-French 3 & 5 factors models are adopted to assess the ownership structure. This research is divided into the following two parts. Part one analysis normal condition spans over the period from Jan 2004 to Dec 2020, and the second part spans from Jan 2018 to Dec 2020, which included the Sino-US trade and Covid-19 pandemic incident.

The result shows that these 3 driving factors which will be discussed in this paper exert significant influence on China A-shares in 2004-2020, whilst the impact of market sentiment is weak in 2018-2020. With respect to ownership structure, the market risk and size effect are clearly in both SOE and non-SOE. Secondly, the B/M effect is evident in non-SOE sample for FF3 and for both types of company samples in FF5. Thirdly,

[1] A-shares is issued by company registered and listed in China. The nominal value denominated in China Yuan (CNY) for domestic institutions, organizations, or individual accounts. At the end of December 2020, there exist 4,314 A-shares listed companies. A-shares listed companies account for 99.9% of China's stock market.

the profitability factor affecting non-SOE stock return is more important than investment which improves SOE stock return.

The Fama-French model is an empirically motivated asset pricing model, such as the FF5 model, which is derived from a sample of U.S. stocks from 1963 to 2013 (Fama and French, 2015). Therefore, using the FF5 model, this paper attempts to provide an out-of-sample test from China's A-shares market, to corroborate the comparative evidence of the FF5 model in the international market. In addition, this paper also contributes to the existing literature on empirical testing of FF5 in China's A-shares market in many ways. First, this paper uses more recent data for the last 17 years from January 2004 to December 2020. Most of the FF empirical tests for China A-stocks are outdated and has not been tested long enough. In addition, this study specifically tests the 3-year special period from the Sino-US trade war to the Covid-19 pandemic. Secondly, this study conducts a formal GRS test on the explanatory power of each model for A-shares returns. In contrast, most of the previous studies only compare the mean adjusted R^2 between models and did not use any formal tests for performance evaluation. Finally, we also test the average stock return performance of SOE and non-SOE under the FF3&5 model, which explores the relationship between expected stock returns and ownership structure.

In the final analysis, the study proposes that investors and companies pay more attention to systematic and idiosyncratic risks, which exhibit greater impacts on the A-shares market, and to reduce unnecessary economic losses.

LITERATURE REVIEW

Numerous significant researches have used the classic CAPM model, FF3&5 and other models to test the stock market returns in different countries, with different results.

The applicability of CAPM has always been doubted. For example, Stattman (1980) found a positive relationship between the B/M ratio and the average stock return in the US stock market. In addition, Rosenberg et al. (1985) claimed that in their study of the US stock market during 1980-1984, high B/M companies tend to have higher stock returns than the lower B/M firms. Furthermore, this positive correlation was verified in the Japanese market by Chan et al. (1991). Banz (1981) found the importance of size effect when studying US stock returns, where the stock returns of small companies tend to be higher than those of large companies.

Since the CAPM model has been found less applicable, alternatively, the famous FF3 model appeared. A few researchers has shown that the FF5 model can better explain stock returns than others. The study by of Fama and French (2017) who had tested the FF5 model in 23 developed markets from 1990 to 2015，found that with respect to regional models, the FF5 model generally outperforms the FF3 model in explaining average returns. Similar to Fama and French (2017) findings, Guo et al. (2017) empirically examined the China stock market and found that in asset pricing test, the FF5 model has obvious advantages over the FF3 model. The investment is the redundant factor in explaining the average return of the China stock market because its return is explained by other factors.

Although the above two studies show that the FF5 explanation of stock returns is the best, there are still some studies that have different conclusions about the best model, and they are hopeful of discovering better models. Chiah et al. (2016) examined the Australian stock market from 1982 to 2013, and they found that the model did not fully explain the average returns and they called for a better model for the Australian stock market. Subsequently, Huynh (2017) studied the applicability of the Fame French models to the Australian stock market from 1990–2013 and concluded that the average return of the Australian stock market cannot be perfectly explained by both, the FF3 and FF5 models. In short, the authors suggested finding better models, which is consistent with the conclusions of Chiah et al. (2016).

In the study of the China market, Huang (2019) used the CAPM, Fama and French (1993) 3-factor model, Carhart (1997) 4-factor model, and Fama and French (2015) 5-factor model to study all available stocks in China A-shares market from the 1994 to 2016 period. His research found that the FF5 model outperformed other models in explaining the individual stock returns. However, the addition of investment and profitability factors only slightly improve the performance of the model. Therefore, the author expects that there could have a new better model to explain the China A-shares market. Lalwani and Chakraborty

(2019) conducted a study comparing the effects of FF3, Carhart 4-factor, and FF5 models in developed and developing countries. Among the countries understudied; United States, Australia, Canada, and China, the application of FF5 model performs the best, while for the remaining 6 markets, all 3 models did not perform significantly different. Based on the above research conclusions, Lalwani and Chakraborty (2019) recommended the FF3 model as the most efficient, parsimonious and robust model, but nevertheless, the author still expected to find a better model to explain the China's stock market. Zheng et al. (2020) studied on multi-factor models of stock returns in 9 Asian markets, including China, Japan, and South Korea. The authors constructed a new model using each country's market profitability, investment, momentum, risk premium, size, book-to-market ratio, price-to-earnings ratio, and dividend yield factors. The results of the study showed that the new 8-factor model is better at explaining changes in stock returns than the Fama-French 3-factor model.

Since the results of the above studies are inconclusive on which model is optimal for explaining stock return, many scholars in the above studies are also pursuing for a better model to explain stock returns. In relation to market sentiment and systematic risk, some studies found that market sentiment and some systematic risks, such as crude oil prices, exchange rates, interest rates, and inflation tend to affect the stock market.

Lai et al. (2019) figured out the stock markets were affected by oil price fluctuations. Abdelhedi and Boujelbène (2019) paid attention to the relationship between oil price volatility and China's stock market volatility during the 2014-2016 stock market crash and found that oil price volatility and stock market volatility have the same movement trends during periods of high volatility. Alqahtani et al. (2020) studied the impact of crude oil prices in Gulf Cooperation Council (GCC) countries from 2004 to 2018 and found that the stock returns are very sensitive to changes in the oil prices and has high volatility with oil price returns.

Mroua and Trabelsi (2020) concluded exchange rate fluctuations have a great impact on stock markets of 5 BRICS countries (Brazil, Russia, India, China and South Africa). Xie et al. (2020) conducted a research and understand a single asymmetric Granger causality between the exchange rate and the stock with a sample of 26 economies including China. The research of Wang et al. (2020) showed that exchange rate risk affects decisive influence on the returns of global stock markets.

Empirical study conducted by Mai et al (2020) on the East Asia and the Pacific (EAP). The sample for this study covered the period from 2008 to 2019 and included 12 countries divided into 2 groups: developed markets and less developed markets. In general, the study found that inflation has a negative impact on EAP stock markets，and inflation has a greater impact on less developed countries.

Celik (2020) did an empirical study on the relationship between stock returns and interest rates of 5 Turkish insurance companies from 2009 to 2020. The research method employed the EGARCH(1,1) model to analyze the changes in stock returns over time. The study found that the impact of interest rates on stock returns is negative and significant. In a study by Wang (2020), he examined the role of interest rates in affecting the spillover of crude oil prices on stock returns with data from the 3 international stock markets of the United States, Europe, and Japan. The study found that during periods of low interest rates, the volatility spillover of oil prices is effective for the stock market, and interest rates are positive but not significant for long-term spillovers.

Kim and Suh (2020) discovered that the market sentiment weighted index has a good predictive ability for stock returns with a study on US equity market in 1992 to 2018. Maqsood (2020) studied the impact of market sentiment on the stock market after major local and global events occurred in Hong Kong, US, Pakistan and Turkey, their conclusion was market sentiment should be used to predict stock market changes.

In Summary, firstly, the FF3, FF5, CAPM, and other models are still imperfect because they did not perfectly explain stock returns in many cases. In addition, the contribution of each factor in each model behaves differently in various markets in multiple periods, hence a more appropriate asset pricing model is worth exploring. Secondly, based on the researches discussed in this paper on the stock market on systematic risks and market sentiment such as crude oil prices, exchange rates, interest rates, and inflation, it can be concluded that systematic risks and market sentiment may affect the stock market. In future research, it is possible to combine the CAPM, FF3 and FF5 models with systematic risk and market sentiment to build new models and to see if there is a stronger explanatory power on China A-shares returns.

METHODOLOGY

The study comprises 3 aspects: systematic, idiosyncratic risks and market sentiment. This research is divided into the following two parts. Part one analysis spanning from Jan 2004 to Dec 2020, and part two covered period from Jan 2018 to Dec 2020, inclusive of Sino-US trade war and Covid-19 pandemic in the last 3 years. The companies are stratified into SOE and non-SOE groupings which are then used to investigate and examine the relationship between ownership structure and average stock returns in part one.

Some single and multi-factor models are used to analyze the risks. For instances, some single and multi-factor models such as the CAPM, Single-Index Model (SIM), Arbitrage Pricing Theory (APT) model are employed to analyze the risks. In addition, a Gibbons, Ross and Shanken (GRS) test is applied to test the validity of the models, whilst Fama French (FF) model is adopted to check whether the stock returns are different due to the ownership.

For the impacts of all variables, using APT model[2].

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + o_i Ln(Oil_t) + x_i Ln(Exc_t) + t_i Ln(Int_t) + f_i Inf_t + m_i \mathrm{Sen_t} + e_{it} \quad (1)$$

For the general and the 4-specific systematic risks, using CAPM & APT models respectively.

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + e_{it} \quad (2)$$

$$R_{it} - R_{Ft} = a_i + o_i Ln(Oil_t) + x_i Ln(Exc_t) + t_i Ln(Int_t) + f_i Inf_t + e_{it} \quad (3)$$

For the 4-specific idiosyncratic risks, using APT models.

$$R_{it} - R_{Ft} = a_i + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it} \quad (4)$$

For Market Sentiment index, using SIM.

$$R_{it} - R_{Ft} = a_i + \mathrm{m_i Sen_t} + e_{it} \quad (5)$$

Both of FF3 and FF5 Size-B/M 5*5 grouping are used in the ownership structure analysis of SOE & non-SOE groupings.

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + Ownership_t + e_{it} \quad (6)$$

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + Ownership_t + e_{it} \quad (7)$$

For I = 1,2,3, …, N and t = 1,2,3, …, T.

where, R_{it} = the return of stock i at time t; a = constant term; HML_t = B/M factor at time t; Ln(Int) = logarithmic interest rate at time t; Sen = market sentiment at time t; R_{Mt} = aggregated market return at time t; Ln(Oil) = logarithmic West Texas Intermediate (WTI) crude oil price at time t; $Ownership_t$ = enterprise attributes at time t; R_{Ft} = risk free interest at time t; SMB_t = firm size factor at time t; RMW_t = profitability factor at time t; Inf = inflation rate at time t; e_{it} = residual i at time t; CMA_t = investment factor at time t; and Ln(Exc) = logarithmic CNY/USD exchange rate at time t.

Data

All the monthly data for calculation is sourced from the China Stock Market & Accounting Research (CSMAR) database[3] except ownership, interest[4], and crude oil price, which 3 came from Wind financial terminal, RESSET database, and USA Energy Information Administration (EIA) respectively. In the end of 2020, there exist a total of over 4,000 listed companies in A-shares, after below data preprocessing, 3,414 non-financial firms are extracted. The data preprocessing specifications are as follows:

[2] APT model does not have a fixed formula, but it can be composed of any single or multiple variables from systematic, idiosyncratic risks and market sentiment.

[3] CSMAR is a well-known China database and used by many American Ivy League universities, such as Wharton School of Business, University of Pennsylvania. RESSET is one of well-known financial databases in China as well.

[4] Using the weighted exponential average of the trading date of benchmark interest rate.

i. Sample scope: all A-shares stocks, includes the SSE and SZSE main Boards, small and medium enterprises (SME) Board, ChiNext Boards but except STAR Board, because STAR Board operating from July 2020.
ii. Considering the Wind financial terminal ownership available data from 2004, part one time spanning from Jan 2004 to Dec 2020 with total 204-month data. The part two spanning from Jan 2018 to Dec 2020, total 36-month data with trade war and Covid-19 pandemic.
iii. Adopting the one-year time deposit interest rate as the risk-free interest rate.
iv. Excluding the stock which less than 6 months after IPO.
v. Removing all banking and finance company stocks.
vi. Excluding all PT/ST[5] stock.
vii. Removing the 30% companies with the smallest market value to avoid shell-value contamination in China. Liu et al (2019).
viii. Removing negative book value of equity company.
ix. Removing non-normal trading stocks.
x. Employing consumer price index (CPI) as an inflation rate proxy.

Fama French Models Construction

Mark risk factor R_{Mt}-R_{Ft} is obtained by subtracting the risk-free interest rate from the market return rate.

Table 1 Fama French Model Grouping in A-Shares

Group	SMB_t and HML_t 2×3 group SMB_t and RMW_t 2×3 group SMB_t and CMA_t 2×3 group
Grouping Point	SMB_t: the median of market value of negotiable shares HML_t: percentile 30 &70 of book-to-market ratio of negotiable shares RMW_t: percentile 30 &70 of operating profit margin of negotiable shares CMA_t: percentile 30 &70 of investment ratio of negotiable Shares
Factor Components	$SMB_{FF3}=SMB_{B/M}$ =(SH+SN+SL)/3-(BH+BN+BL)/3 SMB_{OP}=(SR+SN+SW)/3-(BR+BN+BW)/3 SMB_{INV}=(SC+SN+SA)/3-(BC+BN+BA)/3 $SMB_{FF5}=(SMB_{B/M}+SMB_{OP}+SMB_{INV})/3$ HML=(SH+BH)/2-(SL+BL)/2 RMW=(SR+BR)/2-(SW+BW)/2 CMA=(SC+BC)/2-(SA+BA)/2

Source: Fama and French (1993, 2015)

Size factor: small minus big (SMB), B/M factor: high minus low (HML), profitability factor: robust minus weak (RMW), investment factor: conservative minus aggressive (CMA). The end of April is the due date for annual report disclosure of China A-shares, selecting May of year t-1 to April of year t as the financial cycle for FF3&5 models, and the grouping points for these 4 factors are based on the end of year t-1.

Market Sentiment Index Construction

This research adopts the 5 proxies in Table 2 to construct the market sentiment index. Baker and Wurgler (2007) believes that the number of IPOs varies with the business cycle, the IPO data may have rational reason. Therefore, macroeconomic effects need to be eliminated. In this study, 3 macroeconomic variables (Consumer Price Index (CPI), Producer Price Index (PPI), and Business Climate Index (BCI)) are applied to regress these 5 proxies respectively, and the 5 residuals' series obtained are used do principal component analysis to get the final market sentiment index.

Table 2 Proxies of Market Sentiment Index

DCEF	Closed-end fund discount
TURN	Previous month trading volume
IPON	IPO number
IPOR	Return on the first day of IPO
NIA	Previous month new investor accounts

[5] PT/ST stock is Particular Transfer /Special Treatment stock and marketed by supervision department.

Econometric Issues

For heteroscedasticity and autocorrelation, in the following mathematical equation, when the residuals have both heteroscedasticity and autocorrelation[6]. The Newey–West estimator of Q is recorded as

$$Q^* = \frac{1}{T}\sum_{t=1}^{T} e_t^2 \, x_t x_t' + \frac{1}{T}\sum_{l=1}^{L}\sum_{t=l+1}^{T} w_l e_t e_{t-l}(x_t x_{t-l}' + x_{t-l} x_t') \tag{8}$$

$$w_l = 1 - \frac{l}{L+1} \tag{9}$$

For multiple collinear issue, the orthogonal factors can be applied to replace the collineated factor. In FF3&5 models, the orthogonal method will be used.

$$\varepsilon_i = y - \hat{y} \tag{10}$$

For model validity, GRS test[7] is used to test whether the intercept term of multiple asset portfolio models is close to 0. The null hypothesis of GRS statistics is set to define all intercept terms equal to 0. In this study, the investment portfolios will be divided into 5*5 groups with the Size-B/M grouping method of Fama French models for GRS test.

$$GRS = \left(\frac{T}{N}\right)\left(\frac{T-N-L}{T-L-1}\right)\left(\frac{\hat{\alpha}\,'\hat{\Sigma}^{-1}\hat{\alpha}}{1+\bar{\mu}'\;\hat{\Omega}^{-1}\bar{\mu}}\right) \sim F(N, T-N-L) \tag{11}$$

For market sentiment Lead-Lag effect, Baker & Wurgler (2006) used a two-stage principal component analysis method.

FINDINGS

For the asset pricing model to be a qualified model, the efficiency of the model will be better if the absolute value intercept average (A|a|) is closer to 0. (Fama and French, 1993).

Part One in 2004-2020

The GRS test result in Table 3 shows that the best model is the 6-factor model (FF5 + Sen) with the smallest absolute average value intercept (A|a|) of 0.140. A|a| represents the absolute average of the regression intercepts of each portfolio, and mainly the average return of stocks that has not been explained in the model.

However, the top 2 models are the 6-factor model (FF5 + Sen) and the FF5[8], Table 6 shows comparison between those groupings under the Size-B/M 5*5 portfolio, where most of the intercepts of the 6-factor model are lower than FF5. For instance, in the 5 firm size groups, 3 underlined items of the 6-factor model are lower than the FF5. Although, the A|a| value of medium-sized companies is the same in the 6-factor model and FF5, the underlined GRS value of the 6-factor model is smaller. Whilst, in the 5 B/M groups, 4 underlined items of the 6-factor model are lower than the FF5. The GRS test results show that after the introduction of the sentiment factor, the overall A|a| value in Table 3 has decreased, Similarly, the 6-factor model compared with the FF5, the A|a| values in Table 6 have decreased although not all. thus indicating that market sentiment has a significant influence on those A-shares companies[9].

In addition, Table 3 shows the results of the 4-factor model with the 4-specific systematic risks for crude oil, inflation, interest, and exchange rate, which has the highest A|a| value of 36.37[10]. It can be deduced that when comparing with other driving factors, the 4-specific systematic risks are insignificant. Furthermore, the limited impacts of individual systematic and idiosyncratic risks are illustrated in Table 4 and 5.

[6] Newey and West (1987). Vol.55 No.3, Page 703 to 708
[7] Gibbons et al. (1989). Vol.57 No.5, pp. 1121-1152.
[8] Table 3.
[9] The underlined items in Table 6.
[10] Table 3.

Therefore, based on the analysis from the aforementioned tables, it is a proven fact that the 6-factor model (FF5 + Sen) with systematic, idiosyncratic risk and market sentiment can explain stock returns more comprehensively. All the 3 driving factors are important factors for China A-shares return in 2004-2020.

Table 3 GRS Test for the Various Models in 2004-2020

Ranking	5*5 Size-BM portfolios	Models	Risks	A|a|	GRS
1	MKT SMB_{FF5} HML RMWO CMA Sen	FF5+Sen	S-I-E	0.140	1.428
2	MKT SMB_{FF5} HML RMWO CMA	FF5	S-I	0.141	1.429
3	Inf MKT SMB_{FF5} HML RMWO CMA Sen	Inf+FF5+Sen	S-I-E	0.141	1.455
4	Inf MKT SMB_{FF5} HML RMWO CMA	Inf+FF5	S-I	0.142	1.454
5	MKT SMB_{FF3} HML Sen	FF3+Sen	S-I-E	0.144	1.521
6	MKT SMB_{FF3} HML	FF3	S-I	0.145	1.538
7	MKT	CAPM	S	0.243	1.610
8	MKT Sen	CAPM+Sen	S-E	0.246	1.598
9	SMB_{FF5} HML RMWO CMA Sen	5-factor	I-E	0.597	1.472
10	SMB_{FF5} HML RMWO CMA	4-factor	I	0.693	1.514
11	SMB_{FF3} HML Sen	3-factor	I-E	0.851	1.626
12	SMB_{FF3} HML	2-factor	I	0.931	1.659
13	Sen	SIM	E	1.441	1.775
14	Inf Ln(Oil) Ln(Int) Ln(Exc) MKT SMB_{FF5} HML RMWO CMA Sen	10-factor	S-I-E	4.929	1.438
15	Inf Ln(Oil) Ln(Int) Ln(Exc) MKT SMB_{FF3} HML Sen	8-factor	S-I-E	5.467	1.396
16	Inf Ln(Oil) Ln(Int) Ln(Exc)	4-factor	S	36.370	1.898

Note: The abbreviation for systematic, idiosyncratic risk, and market sentiment are S, I, E respectively. Because of multi-collinearity, the RMW factor has been orthogonalized, abbreviated as RMWO.

Table 4 GRS Test for the Specific Idiosyncratic Risk SIM in 2004-2020

Ranking	5*5 Size-BM portfolios	A|a|	GRS
1	SMB_{FF5}	0.945	1.665
2	SMB_{FF3}	0.972	1.694
3	HML	1.487	1.791
4	RMWO	1.488	1.792
5	CMA	1.489	1.855

Table 5 GRS Test for the Specific Systematic Risk SIM in 2004-2020

Ranking	5*5 Size-BM portfolios	A|a|	GRS
1	Inflation	1.494	1.797
2	Ln(Interest rate)	6.134	1.408
3	Ln(Exchange rate)	8.291	1.300
4	Ln(Crude oil)	16.269	1.307

Table 6 Comparison of Top 2 Models in 2004-2020

		Firm Size Grouping				
		Small	2	3	4	Big
6-factor model (FF5+Sen)	A|a|	0.188	0.136	0.143	0.096	0.136
	GRS	1.655	1.121	1.050	0.708	1.087
FF5	A|a|	0.193	0.133	0.143	0.098	0.141
	GRS	1.670	1.103	1.103	0.670	1.185
		B/M Grouping				
		Low	2	3	4	High
6-factor model (FF5+Sen)	A|a|	0.228	0.110	0.144	0.131	0.086
	GRS	1.763	1.140	2.238	1.823	0.417
FF5	A|a|	0.231	0.113	0.145	0.136	0.082
	GRS	1.873	1.217	2.237	1.907	0.418

Part One SOE and non-SOE

For the purpose of investigating the relationship between ownership structure and average stock returns and to make it easier to compare the SOE and the non-SOE performances on the FF3 and FF5 models, FF5 only adopts Size-B/M grouping.

Table 7 and 8 present the FF3 regression results for 5*5 Size-B/M benchmark portfolios for SOE and non-SOE. In Table 9 and 10, there exist FF5 regression results for 5*5 Size-B/M benchmark portfolios for SOE and non-SOE,

With respect to the market risk, in both FF3 and FF5 models, all investment portfolios exceeded the 1% significance test, denoting that the market risk has a great impact. In the FF3 models, the average of MKT coefficient absolute values are 1.015 in SOE and 1.098 in non-SOE respectively. The value of the non-SOE is slightly higher than SOE; suggesting that market risk has a stronger effect on stock return of non-SOE than SOE. Whilst in the FF5 models, the average of MKT coefficients absolute values is 1.034 in SOE and 1.096 in

non-SOE, respectively. Similarly, the same result is evident as in the FF3 model on SOE & non-SOE where the stock return of non-SOE has a higher market risk than SOE.

With regard to the firm-size perspective, in both FF3 and FF5 models, the size effect is crystal clear in both types of companies and there exists a notable trend showing that small size can have higher stock return than the big group. With respect to the book-to-market aspect, in FF3 models, the B/M effect is evident where low B/M company can bring higher stock return in non-SOE; even though the result produces negative value, However, this phenomenon cannot be found in SOE. But in FF5, the B/M effect is evidently significant for both SOE and non-SOE.

From the profitability perspective, the non-SOE has 24 out of 25 RMWO portfolios, which are not significantly different from 0; while in the SOE, the quantity is 10. However, with respect to investment, SOE has 18 CMA portfolios which are not significantly different from 0, and non-SOE is only 6. Therefore, it can be deduced that profitability is more important for the non-SOE company stock return, and SOE preferred investment can improve its stock return.

Finally, the average goodness of fit in SOE FF3 FF5 are 0.919 and 0.922, while in non-SOE FF3 FF5 are 0.873 are 0.881. Given, these results, it can be concluded that FF5 is better than FF3 in both SOE and non-SOE companies.

Table 7 SOE FF3 Model Size-B/M Grouping in 2004-2020

	B/M Ratio				
Size	Low	2	3	4	High
	a (Intercept)				
Small	0.075	-0.051	0.341*	0.131	-0.046
2	-0.393*	-0.095	0.163	0.068	0.161
3	-0.125	-0.198	0.065	-0.330*	-0.089
4	0.066	-0.097	0.001	0.074	-0.067
Big	0.370**	-0.287	-0.302	-0.190	-0.074
	b (MKT Coefficient)				
Small	0.999***	0.952***	0.996***	10***	1.027***
2	1.050***	0.977***	1.019***	0.987***	1.043***
3	0.953***	1.012***	1.055***	1.069***	1.045***
4	0.949***	1.091***	1.044***	1.075***	1.029***
Big	1.006***	1.038***	1.016***	0.965***	0.987***
	s (SMB Coefficient)				
Small	0.931***	0.950***	0.938***	0.971***	0.959***
2	0.763***	0.845***	0.750***	0.993***	0.735***
3	0.641***	0.640***	0.579***	0.642***	0.523***
4	0.261***	0.446***	0.377***	0.316***	0.320***
Big	-0.513***	-0.225***	-0.251***	-0.282***	-0.484***
	h (HML Coefficient)				
Small	-0.350***	-0.098	-0.018	0.139*	0.526***
2	-0.331***	-0.232***	-0.042	0.205***	0.475***
3	-0.623***	-0.266***	-0.035	0.220***	0.476***
4	-0.696***	-0.117	0.041	0.314***	0.564***
Big	-0.758***	-0.163**	0.108	0.452***	0.598***
	Adj-R^2				
Small	0.904	0.929	0.936	0.930	0.933
2	0.927	0.949	0.937	0.930	0.921
3	0.928	0.921	0.930	0.924	0.939
4	0.907	0.917	0.902	0.914	0.921
Big	0.913	0.896	0.861	0.890	0.928

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

Table 8 Non-SOE FF3 Model Size-B/M Grouping in 2004-2020

	B/M Ratio				
Size	Low	2	3	4	High
	a (Intercept)				
Small	0.059	0.674**	0.251	0.343	0.513**
2	-0.146	-0.032	0.246	0.617**	-0.075
3	-0.336	-0.016	0.048	-0.093	0.111
4	-0.319	0.047	-0.365	0.259	-0.425**
Big	0.496*	0.122	0.269	0.209	-0.054
	b (MKT Coefficient)				
Small	1.106***	1.10***	1.124***	1.107***	1.059***
2	1.119***	1.080***	1.102***	1.072***	1.055***
3	1.157***	1.113***	1.095***	1.047***	1.127***
4	1.058***	1.107***	1.101***	1.149***	1.156***
Big	1.027***	1.082***	1.112***	1.083***	1.104***
	s (SMB Coefficient)				
Small	1.467***	1.546***	1.307***	1.381***	1.180***
2	1.204***	1.294***	1.284***	1.110***	1.102***
3	0.988***	1.105***	0.975***	1.169***	0.773***
4	0.826***	0.802***	0.769***	0.696***	0.479***
Big	-0.158	0.060	0.137*	0.204***	0.141
	h (HML Coefficient)				
Small	-0.279***	-0.369***	-0.088	-0.117	0.185
2	-0.635***	-0.257**	-0.108	-0.278***	0.107
3	-0.689***	-0.459***	-0.264**	0.082	0.202**
4	-0.852***	-0.545***	-0.382***	0.023	0.155
Big	-1.111***	-0.489***	0.028	0.388***	0.667***
	Adj-R^2				
Small	0.867	0.867	0.847	0.878	0.878
2	0.872	0.896	0.900	0.893	0.911
3	0.857	0.886	0.890	0.902	0.898
4	0.844	0.865	0.877	0.845	0.916
Big	0.861	0.856	0.845	0.885	0.782

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

Table 9 SOE FF5 Model Size-B/M Grouping in 2004-2020

	B/M Ratio				
Size	Low	2	3	4	High
	a (Intercept)				
Small	0.176	0.019	0.435**	0.20	0.055
2	-0.291	-0.062	0.214	0.095	0.205
3	-0.082	-0.115	0.088	-0.304	-0.073
4	0.132	0.011	0.051	0.123	-0.021
Big	0.388**	-0.219	-0.285	-0.097	-0.025
	b (MKT Coefficient)				
Small	1.034***	0.979***	1.028***	1.027***	1.062***
2	1.083***	0.994***	1.038***	1.005***	1.062***
3	0.970***	1.039***	1.068***	1.083***	1.055***
4	0.967***	1.120***	1.061***	1.090***	1.044***
Big	1.004***	1.051***	1.016***	0.982***	0.992***
	s (SMB Coefficient)				
Small	0.802***	0.869***	0.828***	0.885***	0.827***
2	0.630***	0.807***	0.701***	0.959***	0.682***
3	0.590***	0.542***	0.545***	0.597***	0.497***
4	0.185**	0.326***	0.312***	0.255***	0.252***
Big	-0.535***	-0.306***	-0.262**	-0.378***	-0.536***
	h (HML Coefficient)				
Small	-0.470***	-0.170**	-0.124*	0.067	0.406***
2	-0.459***	-0.253***	-0.089	0.197***	0.434***
3	-0.665***	-0.367***	-0.053	0.199***	0.467***
4	-0.784***	-0.259***	-0.022	0.252***	0.503***
Big	-0.801***	-0.270***	0.077	0.310***	0.513***
	r (RMWO Coefficient)				
Small	-0.122	-0.076	-0.102	-0.216*	-0.384***
2	-0.163	-0.058	0.003	-0.257**	-0.336***
3	-0.110	-0.333***	-0.126	-0.180*	-0.150
4	-0.032	-0.072	-0.288**	-0.297**	-0.305***
Big	-0.094	-0.025	-0.188*	-0.105	0.167
	c (CMA Coefficient)				
Small	0.50***	0.409***	0.485***	0.402***	0.50***
2	0.472***	0.261***	0.316***	0.265*	0.277
3	0.257**	0.395***	0.177*	0.185	0.141
4	0.273**	0.455***	0.231	0.219**	0.203*
Big	-0.027	0.195**	0.022	0.283**	0.090
	Adj-R^2				
Small	0.906	0.932	0.941	0.933	0.939
2	0.929	0.950	0.941	0.932	0.926
3	0.929	0.928	0.929	0.922	0.939
4	0.908	0.923	0.906	0.918	0.923
Big	0.913	0.898	0.861	0.893	0.928

Note: *** p<0.01, ** p<0.05, * p<0.1, Because of multi-collinearity, the RMW factor has been orthogonalized, abbreviated as RMWO.

Table 10 Non-SOE FF5 Model Size-B/M Grouping in 2004-2020

	B/M Ratio				
Size	Low	2	3	4	High
	a (Intercept)				
Small	0.158	0.715**	0.337	0.337	0.548*
2	0.016	0.003	0.212	0.574***	-0.071
3	-0.194	-0.008	0.039	-0.10	0.111
4	-0.275	0.013	-0.337	0.357	-0.373*
Big	0.389*	0.141	0.414	0.251	0.071
	b (MKT Coefficient)				
Small	1.097***	1.10***	1.116***	1.114***	1.060***
2	1.098***	1.081***	1.115***	1.086***	1.061***
3	1.139***	1.119***	1.103***	1.055***	1.132***
4	1.056***	1.119***	1.101***	1.138***	1.151***
Big	1.044***	1.080***	1.089***	1.075***	1.082***
	s (SMB Coefficient)				
Small	1.362***	1.519***	1.215***	1.413***	1.147***
2	1.011***	1.262***	1.346***	1.176***	1.109***
3	0.815***	1.105***	0.993***	1.192***	0.779***
4	0.777***	0.847***	0.736***	0.572***	0.413***
Big	-0.019	0.030	-0.048	0.163*	-0.010
	h (HML Coefficient)				
Small	-0.60***	-0.635***	-0.373***	-0.306***	-0.017
2	-0.992***	-0.476***	-0.248***	-0.380***	-0.049
3	-0.990***	-0.617***	-0.385***	-0.072	0.098
4	-1.015***	-0.609***	-0.517***	-0.183	0.031
Big	-0.966***	-0.517***	-0.161	0.303***	0.495***
	r (RMWO Coefficient)				
Small	-0.456***	-0.465***	-0.684***	-0.491***	-0.408***
2	-0.410***	-0.535***	-0.432***	-0.309**	-0.275**
3	-0.403*	-0.366**	-0.489***	-0.363***	-0.678***
4	-0.439***	-0.385**	-0.457**	-0.534***	-0.251*
Big	-0.415***	-0.206	-0.283*	-0.355***	-0.902***
	c (CMA Coefficient)				
Small	0.370***	0.203	0.325	0.059	0.148
2	0.542***	0.158	-0.041	-0.087	0.053
3	0.465***	0.059	0.002	0.029	0.022
4	0.157	-0.092	0.103	0.310*	0.168
Big	-0.324**	0.050	0.442**	0.159	0.401
	Adj-R^2				
Small	0.876	0.875	0.864	0.887	0.881
2	0.887	0.904	0.907	0.895	0.911
3	0.868	0.887	0.896	0.906	0.914
4	0.849	0.867	0.882	0.855	0.918
Big	0.876	0.857	0.859	0.891	0.816

Note: *** p<0.01, ** p<0.05, * p<0.1, Because of multi-collinearity, the RMW factor has been orthogonalized, abbreviated as RMWO.

Part Two in 2018-2020

With reference to Table 11, in the recent 3 years (2018-2020) during the trade war & Covid-19 pandemic, the 4-factor model (Inf + FF3) is at its optimum with the smallest absolute value intercept average of 0.201.

In Table 11, the gap between the top 2 models that 4-factor model (Inf + FF3) and 3-factor model (Inf + SMB_{FF3} + HML) in A|a| is only 0.001. However, when comparing those groupings under the Size-B/M 5*5 portfolio in Table 14, both 5 firm size and 5 B/M groups, 3 underlined items of the 4-factor model are lower than the 3-factor model. Therefore, it is a proven fact that the 4-factor model (Inf + FF3) model with inflation risk can explain stock returns more comprehensively during the period 2018-2020, and the two specific idiosyncratic risks that affect stock returns are firm size and B/M ratio. Furthermore, the data analysis in Table 13 shows that the 3-specific systematic risks [crude oil, interest, and exchange rate] are insignificant during the period between 2018 to 2020.

Table 11 GRS Test for the Various Models in 2018-2020

Ranking	5*5 Size-BM portfolios	Models	Risks	A|a|	GRS
1	Inf MKT SMB_{FF3} HML	Inf+FF3	S-I	0.201	1.644
2	Inf SMB_{FF3} HML	3-factor	S-I	0.202	1.843
3	MKT SMB_{FF3} HML	FF3	S-I	0.202	1.880
4	SMB_{FF3} HML	2-factor	I	0.221	2.096
5	MKT SMB_{FF5} HMLO RMW CMA	FF5	S-I	0.249	5.847
6	MKT SMB_{FF3} HML Sen	FF3+Sen	S-I-E	0.315	0.891
7	MKT SMB_{FF5} HMLO RMW CMA Sen	FF5+Sen	S-I-E	0.321	2.351
8	SMB_{FF5} HMLO RMW CMA	4-factor	I	0.484	6.570
9	SMB_{FF5} HMLO RMW CMA Sen	5-factor	I-E	0.516	2.706
10	MKT	CAPM	S	0.574	2.173
11	MKT Sen	CAPM+Sen	S-E	0.616	1.260
12	Sen	SIM	E	1.008	1.390
13	SMB_{FF3} HML Sen	3-factor	I-E	1.050	1.032
14	Inf Ln(Oil) Ln(Int) Ln(Exc) MKT SMB_{FF5} HMLO RMW CMA Sen	10-factor	S-I-E	24.729	253.938
15	Inf Ln(Oil) Ln(Int) Ln(Exc) MKT SMB_{FF3} HML Sen	8-factor	S-I-E	26.554	26.273
16	Inf Ln(Oil) Ln(Int) Ln(Exc)	4-factor	S	30.831	1.461

Note: The abbreviation for systematic, idiosyncratic risk, and market sentiment are S, I, E respectively. Because of the multi-collinearity, some of the HML factors in FF5 have been orthogonalized, abbreviated as HMLO.

Table 12 GRS Test for the Specific Idiosyncratic Risk SIM in 2018-2020

Ranking	5*5 Size-BM portfolios	A|a|	GRS
1	$HMLO_{FF5}$	0.374	2.262
2	CMA	0.448	2.034
3	HML_{FF3}	0.729	2.594
4	SMB_{FF5}	0.773	2.382
5	SMB_{FF3}	0.902	2.492
6	RMW	0.934	2.029

Table 13 GRS Test for the Specific Systematic Risk SIM in 2018-2020

Ranking	5*5 Size-BM portfolios	A|a|	GRS
1	Inflation	0.366	2.301
2	Ln(Interest rate)	5.523	1.519
3	Ln(Crude oil)	25.784	1.262
4	Ln(Exchange rate)	37.261	2.040

Table 14 Comparison of Top 2 Models in 2018-2020

		Firm Size Grouping				
		Small	2	3	4	Big
4-factor (Inf+FF3)	A|a|	0.258	0.143	0.322	0.139	0.144
	GRS	0.905	0.784	3.113	0.565	0.437
3-factor (Inf+ SMB_{FF3}+HML)	A|a|	0.282	0.158	0.299	0.116	0.155
	GRS	0.603	0.813	3.040	0.538	0.415
		B/M Grouping				
		Low	2	3	4	High
4-factor (Inf+FF3)	A|a|	0.373	0.149	0.087	0.234	0.164
	GRS	2.972	0.509	0.250	1.597	0.665
3-factor (Inf+ SMB_{FF3}+HML)	A|a|	0.358	0.157	0.110	0.243	0.141
	GRS	2.230	0.507	0.248	1.650	0.589

CONCLUSION

From the perspective of the optimal models in each period, it can be concluded that, both in normal condition and sub-period analysis (2004-2020) or during the Sino-US trade war and Covid-19 pandemic (2018-2020), systematic and idiosyncratic risks have great impacts on A-shares returns. However, in relation to the 4-specific systematic risks (inflation, exchange rate, crude oil and interest), the results of this study proved that those risks do not significantly affect stock return in 2004 to 2020. Whist in 2018 to 2020, the inflation risk significantly impacts on A-shares. In addition, market sentiment has a limited influence on all A-shares from 2004 to 2020. With respect to ownership structure, market risk, firm size and book-to-market factors have great impacts on both SOE and non-SOE, Profitability factor affecting non-SOE stock return is more important than investment which improves SOE stock return. Furthermore, Sino-US trade war and the Covid-19 pandemic have changed the world economic environment, where the classic asset pricing models (SIM, CAPM, APT, Fame French 3 & 5 models) are time sensitive. Through this research, the majority of A-shares investors need to pay attention to the above risks to ensure they can invest in better secured environment.

Table 15 Summary of 3 Driving Factors

<table>
<tr><th colspan="2" rowspan="2">Firm Grouping</th><th colspan="3">Part One 2004-2020</th><th>Part Two 2018-2020</th></tr>
<tr><th>SOE</th><th>non-SOE</th><th>All A-Shares</th><th>All A-Shares</th></tr>
<tr><td colspan="2">Systematic Risk</td><td colspan="2">Market risk is clearly</td><td>Yes,
but crude oil, inflation, interest, and exchange rate are insignificantly</td><td>Yes, and inflation is significantly</td></tr>
<tr><td rowspan="4">Idiosyncratic Risk</td><td>Firm Size</td><td colspan="2" rowspan="2">Size effect is clearly;

B/M effect is evident in non-SOE sample for FF3 and for both types of company samples in FF5</td><td colspan="2" rowspan="2">Yes</td></tr>
<tr><td>B/M</td></tr>
<tr><td>Profitability</td><td colspan="2" rowspan="2">Profitability factor affecting non-SOE stock return is more important than investment which improves SOE stock return</td><td rowspan="2">Yes</td><td rowspan="2"></td></tr>
<tr><td>Investment</td></tr>
<tr><td colspan="2">Market Sentiment</td><td colspan="2"></td><td></td><td></td></tr>
</table>

Nevertheless, there are some limitations of this study, which potentially, may provide directions for other new research in the future. The main limitation of this research is that, due to time and resources constraint, it only focuses on A-shares, and has excluded B-shares. It is important to note that A-shares are issued and traded in China Yuan (CNY), while B-shares are issued and traded in US dollars and Hong Kong dollars. Since B-shares are open to foreign institutional investors, it may be somewhat different from A-shares. In addition, this study only uses domestic local market sentiment, and has not included global market sentiment. Furthermore, to intuitively compare the FF3 and FF5 models, only using the Size-B/M grouping of the FF5 model in this study. Finally, both in Part One and Two, the A|a| values drawn from the best models are not completely close to 0; indicating that there are still some stock market risks that are not well explained by the factors investigated in this study. Future research that includes B-shares and global market sentiment would definitely enhance our understanding of these stock markets and thus will be a significant contribution in the empirical research of the related field.

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