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**FAMA FRENCH FIVE-FACTOR MODEL: EVIDENCE FROM VIET NAM  
STOCK MARKET**

Master's Thesis in  
Accounting and Finance

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**ABSTRACT**

The study investigates the explanatory power of the Five-factor model. I will find out: Does market risk fully explain the average stock returns? Whether the Fama – French five-factor model has the ability to capture the average stock returns in Viet Nam Stock market during the period from 2011 to 2015 and whether Investment factor and Profitability factor are relevant.

The data in question is from 1/1/2011 to 31/12/2015. The Data included all listed stocks on Ha Noi Stock Exchange (HNX) and Ho Chi Minh Stock Exchange (HOSE)– the two stock exchanges of Viet Nam. The reason for choosing the period in question is to avoid the impact of financial crisis and real estate bubble in Viet Nam in 2008 and 2009.

Results show that the explanatory power of CAPM, three-factor model, and five-factor model are quite disappointing. The five-factor model has the highest R-square, but it is only 34 percent. From CAPM model to five-factor model, the R-square increases gradually and insignificantly. Two added variables (RMW and CMA) are not significant in explaining the stock returns. RMW and CMA are insignificant in capturing the variation of other factors. The results also indicate that RMW and CMA largely absorb the effects of other factors. The five-factor model has superior explanatory power over the large size portfolio, high book to market ratio portfolio, robust profitability portfolio, and aggressive investment portfolio.

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**KEYWORDS:** Five-factor model, Viet Nam stock market, Fama-French



## 1. INTRODUCTION

Over the past 50 years, many economists have been trying to explain the anomalies in the stock returns. A huge number of models have been created with the effort to explain and to predict the stock returns. Sharpe (1964) and John Lintner (1965) introduced the CAPM model which addressed the relationship between the market risk and a specific stock return. After the development of CAPM model, a lot of researches have been conducted to validate the model and their authors find no evidence to support CAPM model. Fama and French (2004) also confirmed this conclusion. Motivated by Banz study (1981), they used all nonfinancial firms in the NYSE, AMEX, and NASDAQ returns from 1962 to 1989 to find the factors that affect the stock return, including  $\beta$ , the size of the firm, leverage, book to market equity, and earning-prices ratios. In 1993, Fama and French developed the three-factor model which included only  $\beta$ , size and book to market ratio. We can say Fama – French three factor model plays a very important role in academic research. Most of the following models are based on Fama – French three-factor model as a basic model to develop theory. In 2015, Fama and French suggested adding two more variables to construct five-factor models. But the efficiency of the five- factor is still a question.

### 1.1. Intended contribution

The motivation for this topic comes from the question about the explanatory power of the five-factor model in the emerging markets. Many authors have tested the model in the developed stock markets and neglected the emerging markets. The explanatory power of the model may be affected by the survivorship bias and specific characteristics of the developed markets. Nowadays, the emerging markets play an important role in the investment world. Emerging markets can be used to hedge risk and earn profit. For that reasons, I choose this topic. Before me, Nhu Nguyen, Ulku Numan and Zhang Ji (2015) conducted the same research in Viet nam but only with one double sorted portfolio (Size and a combination of book-to-market, profitability and investment). To come to a complete conclusion, I test the five model in all possible double-sorted portfolios,

including size and a combination of book-to-market, profitability and investment; book-to-market and a combination of size, profitability and investment; profitability and a combination of size, book-to-market and investment; investment and a combination of size, book-to-market and profitability. The study may suggest what portfolios the five-factor model can be applied to most efficiently based on the R-square.

## **1.2. Problem statement**

The hypothesis tested can be written as follow:

H1: Does market risk fully explain the variation in stock returns?

H2: Whether the Fama – French five-factor model has the ability to capture the average stock returns in Viet Nam Stock market during the period from 2011 to 2015.

H3: Whether Investment factor and Profitability factor are relevant.

## **1.3. Structure of the study**

The master thesis has seven chapters. Chapter 1 provides the overview of the study and the motivation for the study. Chapter 2 focuses on literature review. Chapter 2 provides a brief look on the history of the development of Fama-French factor model as well as other researches that validate the explanatory power of Fama-French factor model. Chapter 3 is about market efficiency theory. Chapter 4 gives a quick look on the Viet Nam Stock Market – the establishment, performance, and problems. Chapter 5 describes the data and methodology used in the study. And the heart of the study is chapter 6 – Empirical results. Chapter 6 states my regression results on Viet Nam Stock Market data. After describing the main descriptive statistics, the empirical results have two parts: empirical results on single sorted portfolio and empirical results on all possible double-

sorted portfolios. The final chapter summarizes the empirical results and indicates some limitations.

## 2. LITERATURE REVIEW

For many years, many researchers and investors have tried to predict or explain the average stock returns. Numerous factors and models have been created to capture the anomalies, but no model fully succeeds. One of the basic assumptions of the financial world is “market efficiency”. Due to the assumption, the stock returns follow the random walk, we can not predict the future returns base on the past returns. But is our financial market truly efficient?

There are many factors that can affect the stock returns, and one of the famous models capturing factors is the model of Fama – French five factor model. But, at first, we have to mention the capital asset pricing model (CAPM). William Sharpe (1964) and John Lintner (1965) is the two people that gave birth to the CAPM. The main idea of the CAPM model is to use the market risk ( $\beta$ ) to explain the anomalies of the stock returns. Each different stocks will have a different  $\beta$  due to their risk. A change in the market leads to a change in an individual stock after. The CAPM opens a new way to explain the stock returns. In fact, the model with only Beta ( $\beta$ ) as a variable seems to be too simple. A lot of research has proven that the prediction power of CAPM is limited. The early tests rejected the CAPM model of Sharpe and Lintner. It does have a relation between the beta and average return, but the relation is too flat. Black, Jensen and Scholes (1972) conducted some empirical tests on CAPM model. They used the monthly price, dividend, and adjusted price and dividend information for all securities listed on the New York Stock Exchange during the period from January 1926 to March 1966. To reduce the noise and measurement errors, they divided the data into groups by using ranked beta of five years previous monthly data. The empirical results show that high beta securities have negative intercepts and low beta securities have positive intercepts. This result contradicts to the prediction of the traditional CAPM. Moreover, the intercepts and beta are not consistent over the sub-periods. The expected excess returns are not proportional to their beta. Fama and French (1992a, 1993) also confirmed the conclusion. They used all nonfinancial firms returns data in NYSE, AMEX and NASDAQ over the period 1962 - 1989. They found that their empirical results were consistent with the CAPM model but

not economically satisfying. When controlling the size of the companies, there was no relation between Beta and the average return.

Based on the irrelevance of the CAPM model, Fama and French (1992a) added more new variables to the traditional CAPM. They used the non-financial firm returns data of the NYSE, AMEX, and NASDAQ from CRSP and merged with COMPUSTAT annual industrial financial statement. The period in question is from 1962 to 1989. They found a strong relation between average return and book to market ratio. The negative and high book to market ratio indicates a poor earning results (Fama-French 1992a: 441). Moreover, when the portfolios are formed on size alone, size negatively correlates with the average return (Fama-French 1992a: 433). The empirical tests show that average returns decrease from 1.64% per month for the smallest size portfolio to 0.9% per month for the biggest size portfolio. But, this relation may be affected by the positive relation between Beta ratio and size. To the extent of the Fama-French (1992a) work, Fama-French expanded their work. They did not focus only on stock returns, but also added term structure variables and used time-series test (the previous tests are cross section test). They created a five-factor model (beta, size factors, value factors, maturity of bonds factors and default risk factors). The empirical results show that the three-factor model (beta, size factors, value factors) does as well as the five-factor models in explaining the stock returns overtime (Fama French 1993: 54).

In following years, many articles debated about the explanatory power of the three-factor model and the evidence are mixed. Daniel and Titman (1997) used monthly data over the period from 1963 to 1993 of NYSE, AMEX and NASDAQ. Their findings did not support the Fama-French conclusion. They stated that factor loadings (book to market, size) do not explain the higher returns of small book to market ratio stocks over the high book to market ratio stock. These factors may act as proxies for other characteristics that affect the stock returns. Further, they found that market beta has no explanatory power even after controlling size and value factor (Daniel and Titman 1997: 29)

In contrast, Faff (2001) used both daily and monthly data from the Australian Stock Market. He found the evidence that strongly supports the Fama-French model. However,



when he took into account the risk premia produced by their frame work, the results' quality went down. He argued the CAPM model is the simple version of Fama-French three-factor model.

Same results, Petkova (2006) supported the Fama-French three-factor model. He used monthly data for the period from 1963 to 2001 of US stock market. He found that the two factors (high minus low, small minus big) were strongly correlated with the excess market return. HML proxies the term surprise factor while SMB proxies the default surprise factor (Petkova 2006: 610). However, three-factor model is not the best model to explain the asset's return variances.

Most of the time, research is conducted mainly in developed markets, but is Fama-French three factor true with emerging markets? Karasneh and Al-Mwalla (2011) conducted the research to find the evidence support the three-factor model in emerging market. They used a long period from June 1999 to June 2010. They gathered data on the Amman Stock market. The study found no evidence that supports the explanatory power of the CAPM model. In contrast, Fama-French model explained the variation of the stock return better. Both SMB and HML add the explanatory effect of the stock beta. Achieving the same results, in another research, Le (2015) conducts the Fama-French three factor model on Viet Nam Stock Market. He gathered data on the two stock exchange of Viet Nam from July 2006 to October 2014. He finds that the size and book to market factors add explanatory power to the traditional CAPM.

In 2015, Fama-French developed a new model by introducing two new variables – profitability and investment factors to the three-factor model, but the empirical results show that the two added variables are redundant. Fama and French used the data on NYSE, Amex and NASDAQ stock data on the period from July 1963 to December 2013. The Profitability factor and Investment factor are defined as the differences between average returns on eight portfolios which are constructed in the same way with the SMB and HML factors. The empirical results are quite disappointing. The  $R^2$  for small and big portfolio are low, 0.57 for big portfolio and 0.67 for small stocks (Fama French 2015: 30). The five-factor model fails to capture the variation in small stocks returns. In another

research, with the hope of applying five-factor model in Viet Nam stock market, Nguyen, et al (2015) achieves the same results. They confirmed that the five-factor model has better explanatory power than the CAPM and three-factor model. The  $R^2$  increases significantly from 74% of CAPM model to 89.58 % of three-factor model and 90 % of five-factor models. Concerning to the  $R^2$ , the explanatory power of five-factor model and three-factor model is similar.

### 3. MARKET EFFICIENCY

#### 3.1. Market efficiency hypothesis

Market efficiency hypothesis is one of the most important hypotheses in the financial world. In 1953, Maurice Kendall examined the predictability of the stock returns based on the current information. He discovered that the future stock returns are unpredictable, or say in another way, the stock returns follow a random walk. The stock prices should reflect all available information.

But what causes the stock returns' unpredictability? Bodie, Kane and Marcus (2014) stated that competition is the source of efficiency. In stock market all over the world, there are numerous investors who continuously buy and sell stock to earn profit from changes in the stock prices. They use a myriad of sources of information and methods to determine future stock prices. When a piece of information is revealed, investors use it immediately on their prediction and valuation, and through the activity of buying and selling, stock prices reflect the new information. New information is the cause of changes in stock prices.

#### 3.2. Type of Market efficiency

Based on the availability of information, there are three degrees of the efficiency of the market: Weak, semi- strong and strong form.

❖ **Weak form:** The weak form hypothesis states that stock prices reflect all available information that can be extracted from current data such as volume trading, financial statements, history of stock prices (Bodie et al 2014: 353). We can not find a helpful model or trend by studying history prices. All available information is already exploited by investors.

❖ **Semi-Strong form:** At a higher level, stock prices reflect all information regarding to the future of a company (Bodie et al 2014: 354).

❖ **Strong form:** Usually, some types of information are only available to the insiders of a company, such as director, CEO, CFO. If the weak form hypothesis implies stock prices reflect only public information, the strong form emphasizes that stock prices also reflect the information that is available to the insiders.

The common thing among three version of market efficiency hypothesis is the stock prices reflect information. Only new information affects the changes of stock price.

### 3.3. Implications of market efficiency hypothesis

Bodie et al (2014) described some implications of the market efficiency as follows:

❖ **Technical analysis:** Technical analysis is to study the fluctuation of stock prices in the past. By doing that, researchers hope they can find a trend or a model for stock returns. The weak version implies technical analysis is useless. Stock prices follow the random walk, changes of the stock returns are unpredictable and no model can be applied to predict future returns.

❖ **Fundamental analysis:** Fundamental analysis studies fundamental information of a company such as revenue, total assets and macro- economic information to determine the true price of a stock. Base on the true price, investors decide to buy or sell because they believe in the future the price of stock will get back to its true price. But the problem is that not all information is available to public to analyze. Even when the current market is semi-strong version, it is really hard to make a fair judgment about the true price and how long it takes for the stock price to move to the true price.

❖ **Active and passive portfolio management:** In an efficient market, no one can beat the market. Because all information is immediately reflected via stock prices, no one can earn superior earnings.

## 4. VIET NAM STOCK MARKET

### 4.1. The establishment and development of Viet Nam stock market

Before the establishment of two stock markets – Ho Chi Minh Stock exchange and Ha Noi stock exchange, the demands for capital of Vietnamese enterprises are mainly met by commercial banks. To meet growing demands for money of Vietnamese enterprise, Ho Chi Minh Stock Exchange (HOSE) and Ha Noi Stock Exchange (HNX) were established in 2000 and in 2005. Only big companies that have more than 80 billion VND are listed on HOSE. The medium and small companies are listed on HNX. One of the noticeable features of Viet Nam stock market is the UPcom. With the effort to centralize transactions of unlisted stocks, Upcom was born in 2009. Over 16 years, the number of listed companies in Viet Nam stock market increases from 2 companies in 2000 to 438 in 2015.

**Table 1. Sector Summary in 2015**

Number	Sectors	Number of Company listed	ROA	ROE	Beta	Market capitalization (VND billion)
1	Real Estate	58	4%	8%	0.7	188,467
2	Rubber	9	8%	14%	0.6	12,633
3	Security	20	4%	7%	1.1	34,873
4	Telecommunication	24	6%	12%	0.5	19,188
5	Services - Tourism	14	14%	17%	0.3	13,481
6	Chemicals	21	10%	15%	0.6	28,527

7	Education	23	6%	8%	0	2,377
8	Mineral Mining	28	3%	4%	0.5	26,312
9	Energy	19	9%	15%	0.7	94,663
10	Banking -Insurance	16	1%	9%	1.2	425,588
11	Steel	14	5%	11%	0.8	32,030
12	Petroleum	31	7%	12%	1.3	67,766
13	Plastics - Wrapping	20	11%	19%	0.5	22,392
14	Manufacturing	38	11%	18%	0.4	52,720
15	Consumer Food	28	22%	30%	0.6	202,233
16	Commercials trading	21	5%	12%	0.6	19,155
17	Sea Food	19	4%	11%	0.6	14,831
18	Transport	45	9%	16%	0.6	48,552
19	Construction materials.	46	11%	20%	0.7	45,353
20	Construction	76	5%	13%	0.7	163,485

Source: <http://www.cophieu68.vn/>

In 2015, the whole market capitalization is 1,514,626 billion VND. Banking and Insurance is the biggest industry whose market capitalization is 425,588 in 2015. In general, all sectors are aggressive to the change of the market with positive beta. Petroleum has the highest beta which is 1.3. All other sectors' beta are around 0.5.

Consumer food has the highest ROA and ROE which are 22% and 30%. Despite having the highest market capitalization, Banking and Insurance sector has lowest ROA with only 1%. The reason is bad debt. After a two- year period of real estate bubble, the whole banking sector now is struggling to deal with bad debts. Provision for bad debts has erased a large proportion of the profit of this sector.

#### 4.2. The performance of Viet Nam Stock Market

**Chart 1. VN index history price and trading volume**



**Source: VNDIRECT**

As we can see on the chart, Viet Nam Stock market reached the peak of 1,165 points in 2007 and 2008 – two year of explosive growth. Many investors put their money into the stock market. The trading volume increased significantly by five times compared to 2006. In the middle of 2008 and 2009, the market saw a dramatic drop in stock price and trading



volume. The VN index bottomed at 263 points, dropping by nearly 4.4 times compared to the highest point. The drop wave continued until 2010 and the market gradually recovered. But until now, the market is quite silent. There are not many noticeable fluctuations and the VN index remains around 400 and 600 points.

### **4.3. Problems of Viet Nam Stock Market**

Transparency is the biggest problem of Viet Nam stock market. Many companies manipulate their financial reports to meet the investors' demands. J&V medical instrument is an example. Before being audited in 2015, the company announced their net profit was 4 billion Viet Nam Dong for the fiscal year, but the report of auditor showed a loss of 623 billion VND. Moreover, Vietnamese companies do not strictly follow the requirement of publishing financial reports. The Law system is not strong enough to prevent companies from breaking the publication rule. Sometimes, it is really hard to find out needed information on the website of a company.

Market manipulation is another problem. In Viet Nam stock market, stock prices do not always follow the demand and supply of the market. Stock prices are manipulated by many groups of investors. By leverage trading, a group of investors can borrow a huge amount of money to invest in one stock, then by continuously buying more with a large volume, the stock price increases. In turn, they use the bought stocks as collateral to borrow more capital from bank and use this amount of money to buy more stocks. By that way, stock prices are put up higher than their true value. In 2016, Kim Nguyen Thi My was fined 550 million VND because of her activities of manipulating the stock code PDR. Many cases relating to stock price manipulation in Viet Nam are recorded. In addition, The managers of investment funds usually have a close relationship with the CEO of some big companies. They have information ahead the market, so that they can cut loss before a bad event. Manipulation and insider information are threatening the efficiency of Viet Nam stock market.

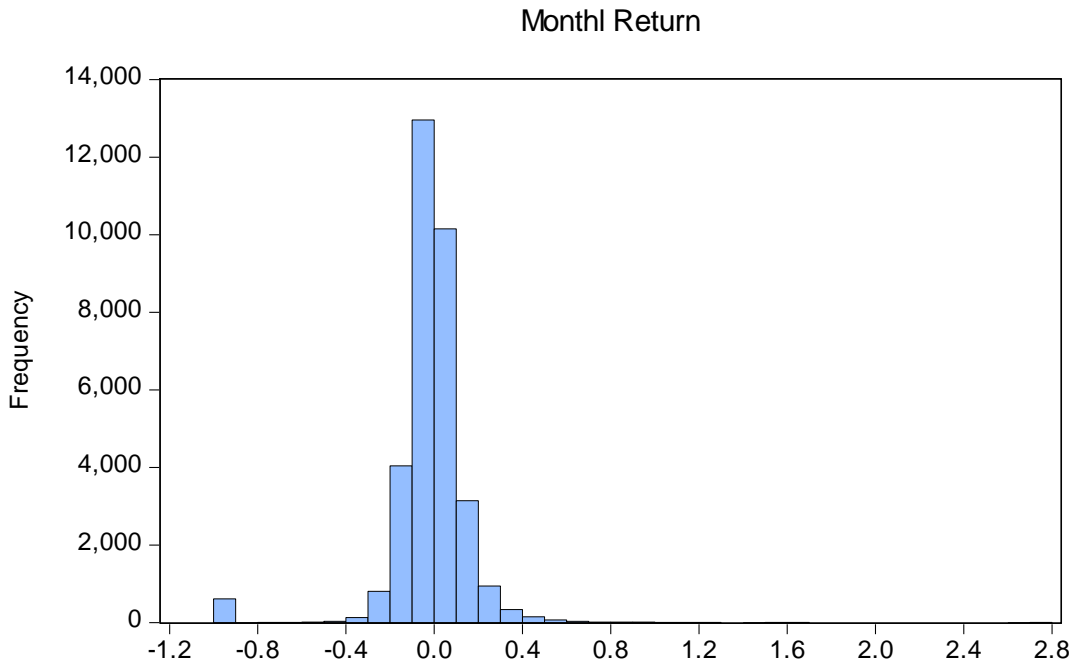
## **5. DATA AND METHODOLOGY**

The purpose of this chapter is to describe the data and methodology that are used. Firstly, this section presents how data are gathered and the source of the data. It also explains how variables are chosen and calculated. Finally, the heart of this section is the methodology. This chapter will discuss in detail how the analyses are conducted.

### **5.1. Data**

The analyses of this study are conducted on all common stocks listed on Ho Chi Minh Stock Exchange and Ha Noi Stock Exchange (including Upcom – Stock exchange for unlisted stocks). The source of Data is DataStream Database. All the variables are adjusted daily closing stock prices, return on equity, total asset, market value of the listed companies and market to book ratio.

The period of the data is from 1/1/2011 to 31/12/2015. The reason for choosing the period in question is to avoid the impact of the global financial crisis that started in 2008 and the burst of Viet Nam real estate bubble in 2008. As we can see from the chart 1, Viet Nam Stock market reached the peak of 1,165 points in 2007 and 2008 – two year of explosive growth. But from 2009 to 2010, the market saw a dramatic drop in stock price and trading volume. Only from the middle of 2010, the stock market began to recover and the VNindex fluctuates around 400 and 600. I believe the global financial crisis and the burst of Viet Nam real estate bubble have negative effects on the willingness to take more risk. Investors are pessimistic about the future of Viet Nam's economy and become more risk averse. This may distorts the investment of investors. Except for the adjusted closing stock prices that are gathered daily, the other variables are gathered quarterly due to the availability of the data source.

**Chart 2. The distribution of average monthly stock returns.**

As we can see from the Distribution graph of monthly return, the monthly returns focus mainly around - 50% to 50%. I remove all the stock returns that are above 50% in absolute term from the data to remove noise. The companies that are delisted from 2011 to 2015 are also removed.

**Table 2. Descriptive variables of Viet Nam stock market**

*Market value (in trillion VND), total asset (in trillion VND), ROE and Book to market are the average value calculated on 31/12. Volume trading (in millions of shares) is the total volume trading in both Ha Noi and Ho Chi Minh Stock Market.*

<b>Year</b>	<b>The Number of listed companies</b>	<b>Market value</b>	<b>Total asset</b>	<b>Volume trading</b>	<b>ROE (%)</b>	<b>Book to market ratio (times)</b>
2011	421	525	2,394	11.27	15	2.06

2012	442	752	3,206	18.77	10	1.91
2013	425	939	3,499	22.09	9	1.58
2014	460	1,114	4,007	40.16	9	1.27
2015	438	1,290	4,807	18.83	5	1.37

The number of listed companies are increasing over time, from 421 in 2011 to 438 in 2015, but compared to other developed markets, such as Singapore Exchange (over 766 listed companies), the number of listed companies in Viet Nam is quite small. Moreover, the market value is so small in comparison with book value. But the gap between the two value seems to decrease. In 2011, the book to market ratio is 2, but in 2015 the number decreases to 1.37. Regarding volume trading, except in 2014, the total volume trading fluctuates around 20 million shares.

## 5.2. Methodology

Basically, I follow strictly the methodology that is used in the Fama-French five-factor models research (2015). The main purpose of this study is to examine a number of stock return models including CAPM model, three-factor model, and five-factor model.

### a. CAPM model

$$R_{pt} - R_{ft} = a_0 + \beta_1 [R_{mt} - R_{ft}]$$

$R_{pt}$ : the monthly stock return of stock p at the time t

$R_{ft}$ : the risk-free rate at time t

$R_{mt}$ : the market return at time t

To calculate the monthly stock returns, firstly, I calculate the average of daily closing stock prices in a month. The monthly stock return is the change in the average stock price of this month and the previous month.

Applying the same method, I choose HNX index and VN index as the market index. Market return is the average rate of return of HN index and VN index. Risk-free rate is the interest rate of the ten – year government bond.

### b. Fama-French Three factor model

$$R_{pt}-R_{ft} = a_0 + \beta_1 [R_{mt} - R_{ft}] + \beta_2 \text{SMB}_t + \beta_3 \text{HML}_t + \varepsilon$$

Some research finds that CAPM does not fully explain the variation in stock returns. Developing from the CAPM, Fama and French added two more variables that mimicked the impact of size and value factor.

#### ❖ Size factor (SMB)

To calculate the size factor, I applied the 2x3 sort in Fama-French (2015: 36). Data are sorted based on Size and B/M, or Size and OP, or Size and Inv. To form a size portfolio of the quarter t, stocks are sorted by the market value of the equity of the quarter t-1. The break point is the median point. Then, we have two portfolios: SMALL and LARGE. Next steps, to create  $\text{SMB}_{B/M}$ , in each portfolio (SMALL AND LARGE), the stocks continue to be sorted by Book to market ratio to create SH, SN, SL, BH, BN and BL. The breakpoints are 30% and 70%. To create  $\text{SMB}_{OP}$ , in each portfolio (SMALL AND LARGE), the stocks are sorted by ROE to create SR, SN, SW, BR, BN and BW. The breakpoints are 30% and 70%. To create  $\text{SMB}_{Inv}$ , in each portfolio (SMALL AND LARGE), the stocks are sorted by percentage of asset change to create SC, SN, SA, BC, BN and BA. SMB is the average of  $\text{SMB}_{B/M}$ ,  $\text{SMB}_{OP}$  and  $\text{SMB}_{Inv}$ .

SMB factor is created by the formulas below:

$$\text{SMB}_{B/M} = \frac{SH+SN+SL}{3} - \frac{BH+BN+BL}{3}$$

$$\text{SMB}_{OP} = \frac{SR+SN+SW}{3} - \frac{BR+BN+BW}{3}$$

$$\text{SMB}_{Inv} = \frac{SC+SN+SA}{3} - \frac{BC+BN+BA}{3}$$

$$\text{SMB} = (\text{SMB}_{B/M} + \text{SMB}_{OP} + \text{SMB}_{Inv}) * 1/3$$

### ❖ Value factor

Applying the same method, the SMALL and LARGE portfolio are sorted by book to market ratio into two small subgroups: HIGH and LOW. The Value factor – HML is the difference between average stock returns of the HIGH portfolio and LOW portfolio

$$\text{HML} = \frac{SH - SL}{2} + \frac{BH - BL}{2}$$

### c. Fama-French five factor model

$$R_{pt} - R_{ft} = a_0 + \beta_1 [R_{mt} - R_{ft}] + \beta_2 \text{SMB}_t + \beta_3 \text{HML}_t + \beta_4 \text{RMW}_t + \beta_5 \text{CMA}_t + \varepsilon$$

The two more factors added are Profitability factor and Investment factors.

### ❖ Profitability factor (RMW)

To calculate this factor, I use the annual return on equity. To form the portfolio in year t-1, the stocks are sorted by ROE into High profitability (Robust) and Low profitability portfolios (Weak). The break point is the median point.

$$\text{RMW} = \frac{SR - SW}{2} + \frac{BR - BW}{2}$$

Profitability factor is defined as the difference between average stock returns of the robust and weak portfolio.

### ❖ Investment factor (CMA)

For portfolios formed in year t, I use the change of total asset in the year t-1 compared to year t-2. Some research uses the changes in the total equity, such as Nguyen et al (2015), but I believe to reflect fully the investment of a company, using just changes in total equity are not enough. In fact, the investment of one company is reflected via their assets.

Their scale reflects their power in their industry, and it may be transmitted to the stock prices. So, all stocks are sorted into Conservative (low investment) and Aggressive Portfolio (high investment). The Investment factor (CMA) is the difference between average stock returns of the Conservative and Aggressive portfolio.

$$CMA = \frac{SC - SA}{2} + \frac{BC - BA}{2}$$

**Table 3. Summary statistics for Fama – French five-factor model.**

Variables	Mean	Median	Std.dev	Skewness	Kurtosis	Min	Max
<b>Rm - Rf</b>	-9.2%	-9.2%	6.03%	-0.02	-0.94	-21%	4 %
<b>HML</b>	0.29%	-0.09%	5.14%	1.40	2.98	-4.91%	9.67%
<b>SMB</b>	-0.28%	-0.26%	1.71%	0.91	3.31	-4%	7%
<b>RMW</b>	0.62%	0.83%	1.78%	-0.34	0.49	-4.79%	4.58%
<b>CMA</b>	-0.30%	-0.37%	1.1%	0.80	1.66	-2.26%	3.56%

**Table 4. Correlation table**

	<b>HML</b>	<b>SMB</b>	<b>RMW</b>	<b>CMA</b>	<b>Rm - Rf</b>
<b>HML</b>	1				
<b>SMB</b>	0.20	1			
<b>RMW</b>	-0.66	-0.15	1		
<b>CMA</b>	0.39	0.42	-0.50	1	
<b>Rm - Rf</b>	0.49	-0.35	-0.55	0.03	1

Table 4 shows the correlation among variables. Consistent with Nguyen et al (2015), the table shows that the small companies seem to be more profitable with negative correlation between RMW and SMB. It is quite surprising that small firms have a negative correlation with market premium. Small firms in Viet Nam tend to be less sensitive to the market change than big companies. The profit factor is negatively correlated with the other

variables. Except for the correlation with HML, the correlation of the RMW with other factors is consistent with Fama French (2015) report. Also, it seems that there is no correlation between CMA and  $R_m - R_f$  factor. RMW and CMA are strongly negatively correlated. It means low investment company tends to have higher profit.



## 6. EMPIRICAL RESULTS

These parts show my empirical results. There are two main parts: Descriptive statistics and Empirical results. In the first part, I will show the characteristics of value weighted single sorted portfolio, so that we can have an overview of the data. The descriptive statistics also provide the average stock returns of one double-sorted portfolio (sorted by size first and then by other factors (book to market ratio, ROE, and investment)). In the next part, firstly, I present the empirical results of single sorted portfolios of CAPM, three-factor model and five-factor models. The purpose is to watch the changes in R-square and to answer whether Five-factor model does better than three-factor model. Then, I will implement the same process applied to single sorted portfolio with double-sorted portfolios. I will run the regression on all possible double-sorted portfolios. In the previous study, Nguyen et al (2015) implements their study on only size and other factors sorted portfolio (First, the data are sorted by size and then by other factors, including book to market ratio, ROE, and percentage of asset change). My purpose is to study the five-factor model in all possible double-sorted portfolio and to answer whether five-factor model can be applied efficiently to a typical double-sorted portfolio. Finally, I run the regression of one factor on the other four, so that the relationship among factors in the model may suggest an explanation for the empirical results.

### 6.1. Descriptive statistics.

**Table 5. Characteristics of Value weighted single sorted portfolio**

	HML			Profitability			Investment		
	Low	Ave	High	Weak	Ave	Robust	Conser	Ave	Aggr
Return	-0.60%	-0.34%	0.28%	-0.40%	-0.43%	0.13%	-0.30%	-0.27%	-0.15%
B/M	0.51	1.21	2.09	0.94	1.8	1.1	1.38	1.31	1.15
Profit	10.61%	13.62%	4.69%	-3%	7.2%	24.1%	4.18%	11.12%	13.55%

Inv	11.00%	7.85%	3.05%	5.30%	5.95%	10.87%	-11.80%	2.73%	28.46%
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In the first three columns, the HML factors are presented in the order from low HML to high HML. Similarly, profitability factor and investment factors are presented in the same order, from low value to high value. Table 5 show the average value of sorted portfolios (stock returns, book to market ratio, roe and investment). On the whole, stocks with higher book to market, higher profitability have higher returns. The univariate results support the dividend discount model which states that the higher book to market and profitability (ROE) implies higher stock returns. Except for investment categories, the result is consistent with the findings of Nguyen et al (2015:14) and Fama – French (2015a). Table 5 also dictates high investment implies higher returns, while Fama – French (2015a: 34) shows a declining trend in stock returns from conservative portfolio to aggressive portfolio. Results in table 5 imply investing more on assets will increase value of stock.

**Table 6. Stock returns of double-sorted portfolio**

*The table represents the average stock returns of different double-sorted portfolios. At first, the data are sorted into three size-sorted portfolios based on the market value: small, medium and large. In Column (1), (2), (3), the three size-sorted portfolios are sorted by book to market ratios from low book to market ratio to high book to market ratio. Then, I calculate the average stock returns of the size and book to market sorted portfolios. In Column (4), (5), (6), the three size-sorted portfolios are sorted by ROE from less profit (weak) to high profit (robust). I calculate the average stock returns of the size and profitability sorted portfolios. In Column (7), (8), (9), the three size-sorted portfolios are then sorted by percentage of asset change. After that, I calculate the average stock returns of the size and investment sorted portfolios.*

	Book to Market			Profitability			Investment		
	Low (1)	Average (2)	High (3)	Weak (4)	Average (5)	Robust (6)	Conser. (7)	Average (8)	Aggr. (9)
Small	-0.30%	-0.22%	-0.04%	-0.88%	-0.98%	0.46%	-0.67%	-0.30%	0.27%
Medium	-0.36%	-0.49%	-0.51%	-0.98%	-0.71%	0.33%	-0.63%	-0.25%	-0.49%
Large	-0.50%	-0.44%	0.02%	-0.53%	-0.20%	-0.19%	-0.47%	-0.19%	-0.26%

Table 6 shows the characteristics of the double-sorted portfolios. With small sizes and large size portfolios, the results confirm the finding in table 5. The higher the book to market ratio is, the higher the stock return is. Higher ROE and Investment also imply higher stock returns. For medium size portfolios, the results seem to be contrast and inconsistent. Higher book to market implies lower stock returns, while higher ROE implies higher stock returns. In column (7), (8), (9) there is no clear relationship between stock returns and the change of investment.

In contrary to Nguyen et al (2015) and Fama-French (2015a), there is no clear size effect in table 6. Holding book to market fixed, stock returns decrease as size increases. Similarly, when we fix the profitability at weak and robust profitability portfolios in column (4) and (5), the stock returns reduce their value as size increases. But for average profitability portfolio, the stock returns increase as size increase (from -0.98% to -0.2%). As size increases, stock returns of conservative investment portfolios (column (7)) and average investment portfolios (column (8)) increase, while aggressive portfolios' stock returns decrease. However, in general, small cap stocks have the highest stock returns.

## 6.2. Empirical results

### 6.2.1. Single Sorted portfolio

**Table 7. Single sorted Portfolio regression results**

*The table tests the ability of CAPM, three- and five-factor models to explain monthly excess returns.*

	<b>Intercept</b>	<b>Rm – Rf</b>	<b>SMB</b>	<b>HML</b>	<b>RMW</b>	<b>CMA</b>	<b>R<sup>2</sup></b>
<b>CAPM</b>							
Coef	0.124	1.285					32.17%
P-value	0.000	0.0000					
<b>Three-factor model</b>							
Coef	0.106	1.137	0.345	0.67			34.16%
P-value	0.0000	0.0000	0.0457	0.000			
<b>Five factor model</b>							
Coef	0.1087	1.158	0.291	0.67	0.1905	0.394	34.21%
P-value	0.0000	0.0000	0.12	0.000	0.5	0.26	

Table 7 demonstrates the regression results. On the whole, the explanatory power of the three models is disappointed. Five-factor model has the highest R-square, but it is only 34 percent. These results are lower than the results in Nguyen et al research (2015) whose highest R-square is 90 percent. From CAPM model to five-factor model, the R-square increases gradually and insignificantly. The CAPM model explains only 32 percent of the changes in stock returns. The zero value of the model's p-value implies market excess returns is statistically significant and meaningful in explaining the stock returns. R-square of three-factor model is 34.16 percent, approximately 2% higher than R-square of CAPM model. While HML (value factor) is significant at 1% level of significance, SMB (size factor) is only significant at 5% level of significance. Surprisingly, in five-factor model, the SMB factor are not statistically significant while its p-value is only 0.12%. The R-square of the five-factor model nearly does not change. Two added variables (RMW and CMA) are not significant in explaining the stock returns. Their p-values are 0.5 and 0.26. Consistent with Fama-French (2015a), the five-factor model is not better than three-factor model and the two new variables seem to be redundant.

### **6.2.2. Double sorted portfolios**

#### **a. Sorted by size and other criteria.**

**Table 8. Double sorted (Size and Book to Market ratio, Profitability, Investment) regression results**

*The data are firstly sorted by Size into Small, Medium and Large portfolio. The breakpoint is 30% and 70%. And then three sorted portfolios are then sorted by one of the remain factors (book to market ratio, profitability, and investment). Column Low is the regression results for portfolios of stocks sorted on size (Small, Medium and Large) and low book-to-market ratio. Column Ave (below Book-to-market) is the regression results for portfolios of stocks sorted on size (Small, Medium and Large) and average book-to-market ratio. Column High is the regression results for portfolios of stocks sorted on size (Small, Medium and Large) and high book-to-market ratio. Column Weak is the regression results for portfolios of stocks sorted on size (Small, Medium and Large) and low profitability ratio. Column Ave (below Profitability) is the regression results for portfolios of stocks sorted on size (Small, Medium and Large) and average profitability ratio. Column Robust is the regression results for portfolios of stocks sorted on size (Small, Medium and Large) and high profitability ratio. Column Cons is the regression results for portfolios of stocks sorted on size (Small, Medium and Large) and low investment ratio. Column Ave (below Investment) is the regression results for portfolio of stocks sorted on size (Small, Medium and Large) and average investment ratio. Column Aggr is the regression results for portfolio of stocks sorted on size (Small, Medium and Large) and high investment ratio. In parentheses is p-value.*

	BOOK TO MARKET			PROFITABILITY			INVESTMENT		
	LOW	AVE	HIGH	WEAK	AVE	ROBUS	CONS.	AVE	AGGR
<b>PANEL A: CAPM MODEL</b>									
<b>INTERCEPT</b>									

	BOOK TO MARKET			PROFITABILITY			INVESTMENT		
	LOW	AVE	HIGH	WEAK	AVE	ROBUS	CONS.	AVE	AGGR
<b>SMALL</b>	0.046 (0.000)	0.049 (0.00)	0.0706 (0.000)	0.0518 (0.000)	0.0518 (0.000)	0.0629 (0.000)	0.0501 (0.000)	0.0457 (0.000)	0.0681 (0.000)
<b>MEDIUM</b>	0.0529 (0.000)	0.0694 (0.000)	0.083 (0.000)	0.0757 (0.000)	0.064 (0.000)	0.0652 (0.000)	0.0641 (0.000)	0.0719 (0.000)	0.069 (0.000)
<b>LARGE</b>	0.0560 (0.000)	0.0716 (0.000)	0.09489 (0.000)	0.08271 (0.000)	0.0768 (0.000)	0.06193 (0.000)	0.0763 (0.000)	0.07279 (0.000)	0.0728 (0.000)
<b>RM - RF</b>									
<b>SMALL</b>	0.578 (0.000)	0.579 (0.000)	0.758 (0.000)	0.7439 (0.000)	0.6649 (0.000)	0.6319 (0.000)	0.624 (0.000)	0.5569 (0.000)	0.7266 (0.000)
<b>MEDIUM</b>	0.6068 (0.000)	0.7969 (0.000)	0.9424 (0.000)	0.9143 (0.000)	0.7620 (0.000)	0.6640 (0.000)	0.7543 (0.000)	0.7969 (0.000)	0.7923 (0.000)
<b>LARGE</b>	0.6533 (0.000)	0.8155 (0.000)	1.014 (0.000)	0.9415 (0.000)	0.8461 (0.000)	0.68372 (0.000)	0.8664 (0.000)	0.800 (0.000)	0.8096 (0.000)
<b>R SQUARE</b>									
<b>SMALL</b>	5.70%	7.53%	15.67%	9.33%	9.56%	12.34%	9.70%	6.60%	13.73%
<b>MEDIUM</b>	11.45%	23.10%	28.83%	22.15%	21.72%	17.23%	18.91%	22.46%	19.59%
<b>LARGE</b>	17.80%	26.99%	34.43%	27.66%	27.23%	23.60%	26.12%	26.20%	26.02%
<b>PANEL B: THREE FACTOR MODEL</b>									

	BOOK TO MARKET			PROFITABILITY			INVESTMENT		
	LOW	AVE	HIGH	WEAK	AVE	ROBUS	CONS.	AVE	AGGR
<b>INTERCEPT</b>									
<b>SMALL</b>	0.05 (0.000)	0.057 (0.000)	0.054 (0.000)	0.0442 (0.000)	0.0449 (0.000)	0.0555 (0.000)	0.0442 (0.000)	0.0460 (0.000)	0.0554 (0.000)
<b>MEDIUM</b>	0.0579 (0.000)	0.0600 (0.000)	0.0524 (0.000)	0.0588 (0.000)	0.0532 (0.000)	0.0581 (0.000)	0.0528 (0.000)	0.0593 (0.000)	0.0580 (0.000)
<b>LARGE</b>	0.0579 (0.000)	0.0599 (0.000)	0.0663 (0.000)	0.0663 (0.000)	0.0637 (0.000)	0.0535 (0.000)	0.0601 (0.000)	0.0593 (0.000)	0.0645 (0.000)
<b>RM - RF</b>									
<b>SMALL</b>	0.6196 (0.000)	0.63 (0.000)	0.5893 (0.000)	0.6361 (0.000)	0.5775 (0.000)	0.5535 (0.000)	0.5438 (0.000)	0.543 (0.000)	0.5927 (0.000)
<b>MEDIUM</b>	0.6483 (0.000)	0.7052 (0.047)	0.6514 (0.000)	0.7488 (0.000)	0.6567 (0.000)	0.5970 (0.000)	0.6422 (0.000)	0.6769 (0.000)	0.6861 (0.000)
<b>LARGE</b>	0.6754 (0.000)	0.7134 (0.000)	0.7493 (0.000)	0.7902 (0.000)	0.7301 (0.000)	0.6126 (0.000)	0.7194 (0.000)	0.6804 (0.000)	0.7379 (0.000)
<b>SMB</b>									
<b>SMALL</b>	0.4332 (0.0764)	0.5307 (0.001)	0.8706 (0.000)	0.4815 (0.024)	0.7338 (0.000)	0.4812 (0.000)	0.5235 (0.000)	0.6669 (0.001)	0.7203 (0.205)
<b>MEDIUM</b>	0.2757 (0.012)	0.1782 (0.047)	0.0915 (0.337)	0.1028 (0.058)	0.3084 (0.041)	0.0243 (0.7845)	0.3219 (0.001)	0.0855 (0.401)	0.1308 (0.205)
<b>LARGE</b>	-0.2229 (0.007)	-0.4512 (0.000)	-0.2361 (0.011)	-0.1356 (0.192)	-0.3828 (0.000)	-0.3972 (0.0046)	-0.2565 (0.009)	-0.3192 (0.000)	-0.339 (0.001)

	BOOK TO MARKET			PROFITABILITY			INVESTMENT		
	LOW	AVE	HIGH	WEAK	AVE	ROBUS	CONS.	AVE	AGGR
<b>HML</b>									
<b>SMALL</b>	0.1252 (0.602)	0.1573 (0.170)	1.0356 (0.000)	0.7992 (0.000)	0.6806 (0.000)	0.50689 (0.000)	0.6286 (0.000)	0.4099 (0.0038)	0.8273 (0.000)
<b>MEDIUM</b>	-0.096 (0.251)	0.4681 (0.000)	1.3497 (0.000)	0.8505 (0.000)	0.5373 (0.000)	0.19068 (0.000)	0.6049 (0.00)	0.5680 (0.000)	0.5165 (0.000)
<b>LARGE</b>	-0.1698 (0.009)	0.3097 (0.000)	1.1080 (0.000)	0.6333 (0.000)	0.3938 (0.000)	0.2682 (0.0015)	0.5749 (0.000)	0.4315 (0.000)	0.2119 (0.001)
<b>R SQUARE</b>									
<b>SMALL</b>	6.19%	8.04%	23.58%	12.20%	12.74%	14.78%	12.10%	8.50%	19.10%
<b>MEDIUM</b>	11.60%	24.66%	38.10%	25.79%	23.85%	17.82%	21.57%	24.34%	21.08%
<b>LARGE</b>	18.28%	27.73%	40.10%	29.38%	28.07%	24.18%	27.60%	27.26%	26.40%
<b>PANEL C: FIVE FACTOR MODEL</b>									
<b>INTERCEPT</b>									
<b>SMALL</b>	0.0494 (0.000)	0.0491 (0.000)	0.0574 (0.000)	0.0478 (0.000)	0.0443 (0.000)	0.05824 (0.000)	0.0475 (0.000)	0.0460 (0.000)	0.0562 (0.000)
<b>MEDIUM</b>	0.0599 (0.000)	0.0616 (0.000)	0.0523 (0.000)	0.0584 (0.000)	0.0538 (0.0000)	0.0615 (0.000)	0.0551 (0.000)	0.06087 (0.000)	0.0576 (0.000)



	BOOK TO MARKET			PROFITABILITY			INVESTMENT		
	LOW	AVE	HIGH	WEAK	AVE	ROBUS	CONS.	AVE	AGGR
<b>LARGE</b>	0.0602 (0.000)	0.0601 (0.000)	0.0662 (0.000)	0.0656 (0.000)	0.0646 (0.000)	0.05599 (0.000)	0.0619 (0.000)	0.06003 (0.000)	0.0644 (0.000)
<b>RM - RF</b>									
<b>SMALL</b>	0.5390 (0.000)	0.5238 (0.000)	0.6328 (0.000)	0.6049 (0.000)	0.5245 (0.000)	0.6222 (0.000)	0.5521 (0.000)	0.5278 (0.000)	0.6139 (0.000)
<b>MEDIUM</b>	0.6879 (0.000)	0.74388 (0.000)	0.6432 (0.000)	0.7141 (0.000)	0.6712 (0.000)	0.6886 (0.000)	0.663 (0.000)	0.7051 (0.000)	0.7067 (0.000)
<b>LARGE</b>	0.7014 (0.000)	0.7210 (0.000)	0.7207 (0.000)	0.7383 (0.000)	0.7284 (0.000)	0.6748 (0.000)	0.7120 (0.000)	0.688 (0.000)	0.7427 (0.000)
<b>SMB</b>									
<b>SMALL</b>	0.3267 (0.0214)	0.3522 (0.046)	0.8301 (0.000)	0.1944 (0.367)	0.5907 (0.001)	0.5502 (0.000)	0.3852 (0.012)	0.6291 (0.005)	0.7428 (0.040)
<b>MEDIUM</b>	0.2802 (0.017)	0.2046 (0.032)	0.072 (0.455)	0.2238 (0.054)	0.2196 (0.036)	0.1155 (0.2228)	0.2469 (0.019)	0.0834 (0.431)	0.2238 (0.040)
<b>LARGE</b>	-0.2781 (0.001)	-0.4401 (0.000)	-0.3234 (0.001)	-0.255 (0.017)	-0.4389 (0.000)	-0.345 (0.000)	-0.3897 (0.000)	-0.033 (0.000)	-0.318 (0.000)
<b>HML</b>									
<b>SMALL</b>	-0.2898 (0.299)	0.0527 (0.672)	0.1077 (0.000)	0.44178 (0.022)	0.5061 (0.000)	0.6669 (0.000)	0.5324 (0.000)	0.3489 (0.028)	0.8793 (0.000)
<b>MEDIUM</b>	-0.025 (0.787)	0.5553 (0.000)	1.3204 (0.00)	0.72489 (0.000)	0.5694 (0.000)	0.53366 (0.000)	0.5839 (0.000)	0.6148 (0.000)	0.6233 (0.000)

	BOOK TO MARKET			PROFITABILITY			INVESTMENT		
	LOW	AVE	HIGH	WEAK	AVE	ROBUS	CONS.	AVE	AGGR
<b>LARGE</b>	-0.1665 (0.028)	0.3313 (0.000)	0.9922 (0.000)	0.4515 (0.000)	0.3481 (0.000)	0.3370 (0.000)	0.4613 (0.000)	0.4363 (0.000)	0.2352 (0.002)
<b>RMW</b>									
<b>SMALL</b>	-0.7826 (0.035)	-0.4175 (0.040)	0.3550 (0.013)	-0.4779 (0.110)	-0.4755 (0.024)	0.6048 (0.000)	-0.013 (0.947)	-0.1527 (0.532)	0.1853 (0.105)
<b>MEDIUM</b>	0.3433 (0.014)	0.3482 (0.003)	-0.0810 (0.488)	-0.3438 (0.013)	0.1298 (0.275)	0.8331 (0.000)	0.1452 (0.256)	0.24322 (0.038)	0.2208 (0.105)
<b>LARGE</b>	0.2019 (0.077)	0.0711 (0.511)	-0.2891 (0.001)	-0.5079 (0.000)	-0.0415 (0.070)	0.5651 (0.000)	-0.1262 (0.279)	0.0668 (0.535)	0.0511 (0.652)
<b>CMA</b>									
<b>SMALL</b>	0.4248 (0.375)	-0.0086 (0.975)	0.4572 (0.019)	1.1911 (0.002)	0.3592 (0.215)	0.1257 (0.5221)	0.8022 (0.002)	0.1136 (0.743)	0.0268 (0.118)
<b>MEDIUM</b>	0.2276 (0.235)	0.1219 (0.471)	0.0367 (0.818)	0.1684 (0.379)	0.0469 (0.777)	0.1580 (0.3479)	0.4657 (0.007)	0.1855 (0.276)	-0.2917 (0.118)
<b>LARGE</b>	0.4106 (0.010)	-0.0035 (0.980)	0.2128 (0.183)	0.2151 (0.222)	0.2396 (0.112)	0.1585 (0.2774)	0.5511 (0.001)	0.1088 (0.478)	-0.0576 (0.711)
<b>R SQUARE</b>									
<b>SMALL</b>	6.82%	8.23%	23.70%	13.33%	13.12%	15.22%	12.49%	8.53%	19.14%
<b>MEDIUM</b>	11.37%	24.82%	38.11%	25.98%	23.87%	18.86%	21.71%	24.42%	21.26%

	BOOK TO MARKET			PROFITABILITY			INVESTMENT		
	LOW	AVE	HIGH	WEAK	AVE	ROBUS	CONS.	AVE	AGGR
<b>LARGE</b>	18.42%	27.77%	40.37%	29.85%	28.14%	24.78%	27.94%	27.27%	26.40%

Table 8 shows the detail results of size and other factors sorted portfolios. Firstly, all data are sorted by size into three categories: Small, medium and Large. After that, each category is sorted by three other criteria (book to market, profitability, investment). The testing period is from 1/1/2011 to 31/1/2/2015. Panel A states the results of CAPM model, panel B shows the results of Three - factor model, while panel C shows the results of the Five – factor model. The p-values are given in the parenthesis.

In the summary results of the models, the test statistics shows a significant intercept in all portfolios whose value is around 5 percent. The explanatory power of the three models is quite poor. The highest R-square is 40 percent for large size – high book to market sorted portfolio. The large size portfolios are better explained with higher R-square than Small and Medium size portfolios. This results are consistent with Nguyen et al (2015).

In Panel A, market excess return is effective in explaining the variation of stock returns. The impact of market excess return is higher in large portfolio. Consistent with Nguyen et al (2015), the coefficients of market risk factor of large portfolio are higher than these of small and medium portfolio. Concerning to the other criteria, high book to market ratio - and weak profitability portfolios are more sensitive to the market movement. They have higher  $R_m - R_f$  coefficients. The trend in size and investment sorted portfolios is not clear. Contrary to Nguyen et al (2015), small and medium size categories show an increase in the degree of sensitivity with the market when the degree of investment increases. Meanwhile, the large category moves in the reversed direction. The large size – conservative investment portfolio has a coefficient of 0.866, while the large size – aggressive investment portfolio has a coefficient of 0.81. Less investment companies seem to be more sensitive to the market change.

Adding two more variables (SMB and HML) improve slightly the explanatory power. The average R-square increases from 18.95 % to 21.3%. In general, all three variables are statistically significant at 5%. Stock returns are positively related to the excess market returns factor and value factor. Regarding to size factor (SMB), the large size category shows a negative relationship between stock returns and size factor. In addition, the size factor poorly explains the stock returns of medium size portfolio. The p-values of size factor are also bigger than p-values of excess market returns factor and value factor. Except for medium size – average book to market portfolio, medium size – average profitability portfolio and medium size – conservative investment portfolio, the coefficients of size factor in others sub-portfolios in medium size category are not significant at 5%. These results are quite surprising. Both Nguyen et al (2015) and Al-Mwalla & Karasneh (2011) support the role of size factors in explaining the stock returns.

Panel C shows the five-factor model regression results. Overall, five-factor model is not better than three factor model in explaining the stock returns. If we calculate the average R-square of all portfolios in each model, there is no significant improvement in average R-square which is 21.55% compared to 21.3% of three-factor model. In Nguyen et al (2015) and Fama-French (2015a,2015b), three-factor model sees a high abnormal return (intercept), but the problem is lessened in five-factor model. Compare to CAPM model in Panel B, five-factor model and three-factor model in panel B and C show no positive sign of reduction in abnormal return. The abnormal returns are approximately constant. So, the addition of variables to CAPM model does not help explain the abnormal returns. Similar to three-factor model, SMB is not significant in small and medium size portfolios but large size portfolios. Investment factor (CMA) is redundant. Most of the time, its p-values are above 5 percent. One noticeable thing is that profitability factor (RMW) is useless in explaining the stock returns of the size and investment sorted portfolios. The lowest p-value is 11 percent. Similarly, CMA does not help explain the stock returns. CMA is significant only with Conservative investment portfolio. RMW is better than CMA when RMW is significant with size and book to market sorted portfolios, size and profitability sorted portfolios, but RMW is fruitless with size and investment sorted portfolio. The signs of RMW coefficients are not consistent. RMW coefficients are

positive most of the time except weak profitability portfolios. This point implies unprofitable companies produce more stock returns. The reason may be the risk. Due to high risk of default, the stocks of this companies offer more than the other profitable companies' stock.

One question in Fama-French (2015a) is that is HML redundant? Fama and French (2015a) report that HML is redundant for describing U.S. average returns during the 1962-2013 period, but it is not redundant for explaining average returns in other regions (Fama and French, 2015b) during the 1990-2014 period. Consistent with Nguyen et al (2015) and Fama-French (2015b) in Asia region, the results of this study confirm the relevance of HML factor. Except for low book to market portfolios, all other portfolios indicate a strong relationship between HML factor and stock returns. The HML factor is approximately significant at 1 percent.

#### **b. Sorted by Book to market ratio and other factors**

**Table 9. Double sorted (Book to Market and Size, Profitability, Investment) regression results.**

*The data are firstly sorted by book to market ratio into low, average and high portfolio. The breakpoint is 30% and 70%. And then three sorted portfolios are sorted by one of the remain factors (Size, profitability, and investment). Column Small is the regression results for portfolios of stocks sorted on book to market ratio (Low, Average and High) and small size. Column Ave is the regression results for portfolios of stocks sorted on book to market ratio (Low, Average and High) and average size. Column Large is the regression results for portfolios of stocks sorted on book to market ratio (Low, Average and High) and large size. Column Weak is the regression results for portfolios of stocks sorted on book to market ratio (Low, Average and High) and low profitability ratio. Column Ave (below Profitability) is the regression results for portfolios of stocks sorted on book to market ratio (Low, Average and High) and average profitability ratio. Column Robust is the regression results for portfolios of stocks sorted on book to market ratio (Low, Average and High) and high profitability ratio. Column Cons is the regression results for portfolios of stocks sorted on book to market ratio (Low, Average and High)*

and low investment ratio. Column Ave (below Investment) is the regression results for portfolio of stocks sorted on book to market ratio (Low, Average and High) and average investment ratio. Column Aggr is the regression results for portfolio of stocks sorted on book to market ratio (Low, Average and High) and high investment ratio.

	SIZE			PROFITABILITY			INVESTMENT		
	SMAL	AVE	LARGE	WEAK	AVE	ROBUST	CONSR	AV	AGGR
<b>PANEL A: CAPM MODEL</b>									
<b>INTERCEPT</b>									
<b>LOW</b>	0.052	0.052	0.063	0.044	0.053	0.077	0.051	0.045	0.056
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AVERAGE</b>	0.076	0.064	0.065	0.067	0.067	0.065	0.060	0.065	0.074
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>HIGH</b>	0.083	0.077	0.062	0.084	0.082	0.077	0.076	0.082	0.086
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>LOW</b>	0.744	0.665	0.634	0.586	0.683	0.811	0.707	0.562	0.603
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AVERAGE</b>	0.914	0.762	0.663	0.818	0.736	0.686	0.706	0.694	0.845
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>HIGH</b>	0.941	0.846	0.684	0.977	0.886	0.810	0.859	0.881	0.942
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>R SQUARE</b>									
<b>LOW</b>	0.093	0.096	0.124	0.056	0.105	0.253	0.116	0.087	0.115
<b>AVERAGE</b>	0.221	0.217	0.203	0.202	0.215	0.197	0.189	0.193	0.229
<b>HIGH</b>	0.276	0.272	0.236	0.242	0.240	0.252	0.208	0.251	0.275
<b>PANEL B: THREE FACTOR MODEL</b>									
<b>INTERCEPT</b>									
<b>LOW</b>	0.044	0.045	0.056	0.051	0.057	0.053	0.053	0.045	0.061



	SIZE			PROFITABILITY			INVESTMENT		
	SMAL	AVE	LARGE	WEAK	AVE	ROBUST	CONSR	AV	AGGR
<b>R SQUARE</b>									
<b>LOW</b>	0.122	0.127	0.148	0.065	0.108	0.311	0.118	0.087	0.117
<b>AVERAGE</b>	0.258	0.238	0.178	0.207	0.218	0.206	0.197	0.197	0.235
<b>HIGH</b>	0.294	0.281	0.242	0.318	0.322	0.311	0.277	0.335	0.340
<b>PANEL C: FIVE FACTOR MODEL</b>									
<b>INTERCEPT</b>									
<b>LOW</b>	0.048	0.044	0.058	0.049	0.056	0.055	0.057	0.046	0.061
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AVERAGE</b>	0.058	0.054	0.061	0.060	0.065	0.055	0.572	0.060	0.062
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>HIGH</b>	0.066	0.065	0.056	0.060	0.060	0.055	0.060	0.058	0.057
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>LOW</b>	0.605	0.525	0.624	0.533	0.666	0.636	0.723	0.536	0.670
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AVERAGE</b>	0.714	0.671	0.688	0.712	0.744	0.650	0.673	0.669	0.767
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>HIGH</b>	0.738	0.728	0.675	0.707	0.657	0.634	0.684	0.651	0.670
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SMB</b>									
<b>LOW</b>	0.195	0.591	0.537	0.48	0.363	0.054	0.015	-0.201	0.108
<b>P-value</b>	0.368	0.000	0.000	0.054	0.032	0.552	0.928	0.185	0.366
<b>AVERAGE</b>	0.225	0.222	0.114	0.051	0.036	0.015	0.099	0.027	-0.027
<b>P-value</b>	0.054	0.034	0.226	0.641	0.705	0.872	0.316	0.776	0.788
<b>HIGH</b>	-0.258	-0.438	-0.345	0.3	0.351	0.054	0.276	0.303	0.093
<b>P-value</b>	0.017	0.000	0.000	0.006	0.001	0.565	0.009	0.003	0.348



	SIZE			PROFITABILITY			INVESTMENT		
	SMAL	AVE	LARGE	WEAK	AVE	ROBUST	CONSR	AV	AGGR
<b>HML</b>									
<b>LOW</b>	0.442	0.506	0.668	-0.529	-0.083	1.154	-0.161	-0.129	-0.148
<b>P-value</b>	0.000	0.000	0.000	0.047	0.524	0.000	0.306	0.271	0.119
<b>AVERAGE</b>	0.725	0.568	0.534	0.145	0.271	0.629	0.254	0.320	0.472
<b>P-value</b>	0.000	0.000	0.000	0.109	0.000	0.000	0.001	0.000	0.000
<b>HIGH</b>	0.453	0.349	0.337	1.083	1.149	1.155	0.981	1.207	1.207
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RMW</b>									
<b>LOW</b>	-0.478	-0.476	0.610	-1.206	-0.404	0.474	-0.131	-0.226	0.141
<b>P-value</b>	-0.111	0.025	0.000	0.001	0.000	0.000	0.521	0.219	0.331
<b>AVERAGE</b>	-0.344	0.131	0.832	-0.470	0.416	0.631	0.125	0.280	0.165
<b>P-value</b>	0.013	0.272	0.000	0.001	0.000	0.000	0.3017	0.016	0.196
<b>HIGH</b>	-0.506	-0.042	0.565	-0.307	0.016	0.473	0.159	0.108	-0.064
<b>P-value</b>	0.000	0.703	0.000	0.025	0.898	0.000	0.235	0.361	0.605
<b>CMA</b>									
<b>LOW</b>	1.191	0.359	0.129	0.466	0.097	-0.031	0.989	0.478	0.025
<b>P-value</b>	0.003	-0.216	-0.512	0.336	0.720	0.837	0.001	0.478	0.902
<b>AVERAGE</b>	0.167	0.046	0.160	-0.018	0.347	-0.194	0.583	0.050	-0.507
<b>P-value</b>	0.385	0.783	0.342	0.922	0.034	0.222	0.001	0.760	0.005
<b>HIGH</b>	0.218	0.238	0.159	0.567	0.394	-0.031	1.144	0.187	-0.339
<b>P-value</b>	0.215	0.115	0.276	0.003	0.023	0.840	0.000	0.261	0.043
<b>R SQUARE</b>									
<b>LOW</b>	0.133	0.131	0.152	0.079	0.110	0.315	0.125	0.090	0.117
<b>AVERAGE</b>	0.260	0.239	0.188	0.210	0.221	0.215	0.200	0.198	0.238
<b>HIGH</b>	0.298	0.281	0.248	0.322	0.324	0.315	0.284	0.335	0.341

Table 9 shows the results of a different sorted portfolio. If in the previous part, the data are sorted by Size first, in this part the data are sorted by book to market ratio first. From CAPM model to Five - factor model, the intercept is still statistically significant at 1%. In addition, market excess returns still play an important role in explaining the stock returns. CAPM model have lowest average R-square which is merely 19.1%. The changes of coefficients of market excess return are clearest in Book to market – Size sorted portfolios. The coefficients decrease from small size to big size and increase from low book to market ratio to high market ratio. The lowest coefficient is 0.634, while the highest coefficient is 0.941. These results imply small size and high book to market ratio exposure the most to the changes of the market. Furthermore, the explanatory power is better in high book to market ratio than in low book to market ratio.

In three factor model, the explanatory power is improved. The average R square of all portfolios increases by 3 percent to 21.7%. However, the two added variables (HML and SMB) are not really effective in explaining the stock returns. HML is not significant with average book to market sorted portfolio. Like the previous part, SMB is fruitless with Investment sorted portfolio. SMB is not significant at all with aggressive investment.

Five factor model does no better in reducing the abnormal returns. The intercepts of the model are still around 5 percent. The average R square improved by 0.4 percent, from 21.7 percent to 22.1 percent. SMB still can not explain the stock returns of investment portfolios, neither RMW does. CMA continues to prove to be fruitless. Most of the time CMA is not significant.

### **c. Sorted by Profitability and other factors**

#### **Table 10. Double sorted (Profitability and Size, Book to Market, Investment) regression results**

*The data are firstly sorted by ROE into weak, average and robust portfolio. The breakpoint is 30% and 70%. And then three sorted portfolios are sorted by one of the remain factors (Size, book to market ratio and investment). Column Small is the regression results for portfolios of stocks sorted on profitability (weak, average, robust)*

*and small size. Column Ave is the regression results for portfolios of stocks sorted on profitability (weak, average, robust) and average size. Column Large is the regression results for portfolios of stocks sorted on profitability (weak, average, robust) and large size. Column Low is the regression results for portfolios of stocks sorted on profitability (weak, average, robust) and low book to market ratio. Column Ave is the regression results for portfolios of stocks sorted on profitability (weak, average, robust) and average book to market ratio. Column high is the regression results for portfolios of stocks sorted on profitability (weak, average, robust) and high book to market ratio. Column Cons is the regression results for portfolios of stocks sorted on profitability (weak, average, robust) and low investment ratio. Column Ave (below Investment) is the regression results for portfolio of stocks sorted on profitability (weak, average, robust) and average investment ratio. Column Aggr is the regression results for portfolio of stocks sorted on profitability (weak, average, robust) and high investment ratio.*

	SIZE			BOOK TO MARKET			INVESTMENT		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	CONSR	AV	AGGR
<b>PANEL A: CAPM MODEL</b>									
<b>INTERCEPT</b>									
<b>WEAK</b>	0.054	0.056	0.067	0.046	0.050	0.071	0.054	0.017	0.067
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
<b>AVERAGE</b>	0.067	0.071	0.067	0.114	0.072	0.083	0.071	0.071	0.067
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.070	0.071	0.081	0.006	0.072	0.095	0.070	0.071	0.009
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>WEAK</b>	0.611	0.605	0.736	0.583	0.577	0.761	0.611	0.138	0.736
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000
<b>AVERAGE</b>	0.764	0.804	0.769	0.607	0.815	0.942	0.810	0.810	0.769
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.794	0.804	0.880	0.073	0.815	1.013	0.794	0.804	0.095

	SIZE			BOOK TO MARKET			INVESTMENT		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	CONSR	AV	AGGR
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>R SQUARE</b>									
<b>WEAK</b>	0.061	0.089	0.156	0.055	0.076	0.157	0.061	0.003	0.156
<b>AVERAGE</b>	0.182	0.243	0.217	0.114	0.270	0.288	0.211	0.211	0.217
<b>ROBUST</b>	0.229	0.243	0.322	0.020	0.270	0.344	0.229	0.243	0.035
<b>PANEL B: THREE FACTOR MODEL</b>									
<b>INTERCEPT</b>									
<b>WEAK</b>	0.063	0.055	0.057	0.052	0.051	0.055	0.063	0.018	0.057
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AVERAGE</b>	0.056	0.060	0.056	0.058	0.060	0.052	0.058	0.058	0.056
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.062	0.060	0.063	0.006	0.060	0.066	0.062	0.060	0.007
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>WEAK</b>	0.710	0.569	0.627	0.645	0.577	0.592	0.710	0.135	0.627
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.059	0.000
<b>AVERAGE</b>	0.656	0.699	0.668	0.648	0.713	0.651	0.681	0.681	0.668
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.716	0.699	0.721	0.075	0.713	0.749	0.716	0.699	0.077
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SMB</b>									
<b>WEAK</b>	0.222	0.972	0.546	0.501	0.432	0.873	0.795	0.207	0.546
<b>P-value</b>	0.001	0.000	0.000	0.043	0.011	0.000	0.001	0.256	0.000
<b>AVERAGE</b>	0.381	-0.258	-0.015	0.276	-0.45	0.09	0.174	0.174	-0.015
<b>P-value</b>	0.000	0.007	0.878	0.013	0.000	0.339	0.090	0.090	0.878
<b>ROBUST</b>	-0.027	-0.258	-0.642	-0.027	-0.45	-0.237	-0.027	-	-0.072

	SIZE			BOOK TO MARKET			INVESTMENT		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	CONSR	AV	AGGR
<b>P-value</b>	0.777	0.007	0.000	0.010	0.000	0.012	0.777	0.007	0.000
<b>HML</b>									
<b>WEAK</b>	0.064	0.481	0.671	0.072	0.169	1.034	0.064	0.094	0.671
<b>P-value</b>	0.787	0.001	0.000	0.766	0.138	0.000	0.787	0.511	0.000
<b>AVERAGE</b>	0.603	0.385	0.450	-0.096	0.310	1.350	0.635	0.635	0.450
<b>P-value</b>	0.000	0.000	0.000	0.252	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.342	0.385	0.502	-0.018	0.310	1.109	0.342	0.385	0.056
<b>P-value</b>	0.000	0.000	0.000	0.020	0.000	0.000	0.000	0.000	0.000
<b>R SQUARE</b>									
<b>WEAK</b>	0.074	0.124	0.191	0.060	0.081	0.236	0.074	0.004	0.191
<b>AVERAGE</b>	0.209	0.250	0.228	0.116	0.277	0.381	0.234	0.234	0.228
<b>ROBUST</b>	0.235	0.250	0.339	0.020	0.277	0.401	0.235	0.250	0.037
<b>PANEL C: FIVE FACTOR MODEL</b>									
<b>INTERCEPT</b>									
<b>WEAK</b>	0.063	0.056	0.057	0.049	0.049	0.058	0.063	0.021	0.057
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000
<b>AVERAGE</b>	0.057	0.060	0.057	0.060	0.060	0.052	0.060	0.060	0.057
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.063	0.060	0.064	0.007	0.060	0.066	0.063	0.059	0.007
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>WEAK</b>	0.651	0.576	0.645	0.551	0.524	0.636	0.651	0.224	0.645
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000
<b>AVERAGE</b>	0.664	0.679	0.683	0.688	0.721	0.643	0.727	0.727	0.683
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.727	0.679	0.736	0.078	0.721	0.720	0.727	0.679	0.079

	SIZE			BOOK TO MARKET			INVESTMENT		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	CONSR	AV	AGGR
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SMB</b>									
<b>WEAK</b>	0.648	0.885	0.552	0.417	0.351	0.837	0.648	0.303	0.552
<b>P-value</b>	0.012	0.000	0.000	0.114	0.047	0.000	0.012	0.131	0.000
<b>AVERAGE</b>	0.378	-0.315	0.003	0.279	-0.441	0.072	0.174	0.174	0.003
<b>P-value</b>	0.001	0.002	0.971	0.017	0.000	0.456	0.106	0.106	0.971
<b>ROBUST</b>	-0.078	-0.315	-0.66	-0.033	-0.441	-0.324	-0.078	-	-0.072
<b>P-value</b>	0.437	0.002	0.000	0.003	0.000	0.001	0.437	0.002	0.058
<b>HML</b>									
<b>WEAK</b>	-0.3171	0.4218	0.707	-0.330	0.066	1.080	-0.317	0.264	0.707
<b>P-value</b>	0.2426	0.007	0.000	0.240	0.595	0.000	0.243	0.053	0.000
<b>AVERAGE</b>	0.614	0.306	0.490	-0.026	0.332	1.321	0.713	0.713	0.490
<b>P-value</b>	0.000	0.000	0.000	0.790	0.000	0.000	0.000	0.000	0.000
<b>ROBUST</b>	0.323	0.306	0.514	-0.017	0.332	0.993	0.323	0.306	0.058
<b>P-value</b>	0.000	0.000	0.000	0.054	0.000	0.000	0.000	0.000	0.000
<b>RMW</b>									
<b>WEAK</b>	-0.613	0.001	0.161	-0.841	-0.395	0.359	-0.613	0.694	0.161
<b>P-value</b>	0.107	0.998	0.239	0.025	0.051	0.013	0.107	0.006	0.239
<b>AVERAGE</b>	0.066	-0.202	0.140	0.343	0.072	-0.083	0.401	0.401	0.140
<b>P-value</b>	0.621	0.071	0.264	0.015	0.498	0.481	0.001	0.001	0.264
<b>ROBUST</b>	0.074	-0.202	0.121	0.024	0.072	-0.290	0.074	-	0.014
<b>P-value</b>	0.533	0.071	0.259	0.073	0.498	0.010	0.533	0.072	0.286
<b>CMA</b>									
<b>WEAK</b>	0.633	0.480	0.088	0.246	0.010	0.439	0.633	0.227	0.088
<b>P-value</b>	0.191	0.171	0.645	0.620	0.973	0.026	0.191	0.462	0.645
<b>AVERAGE</b>	0.060	0.139	0.009	0.227	-0.003	0.036	0.297	0.297	0.009

	SIZE			BOOK TO MARKET			INVESTMENT		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	CONSR	AV	AGGR
<b>P-value</b>	0.734	0.393	0.960	0.236	0.985	0.823	0.098	0.098	0.960
<b>ROBUST</b>	0.299	0.139	0.174	0.046	-0.003	0.213	0.299	0.138	0.017
<b>P-value</b>	0.070	0.393	0.247	0.017	0.985	0.184	0.070	0.395	0.371

Table 10 is another combination of double-sorted portfolio. The data are firstly sorted by ROE, and then by other factors. In general, the explanatory power of this combination is worse than the other two previous combinations. The average R-square which is 17.4% of CAPM model in average and 19.5 % of five-factor model, does not significantly improve. The problem of abnormal returns still exists in table 10. Overall, the five-factor model and three-factor model explain better the investment and robust profitability sorted portfolio.

In the three-factor mode, there is a negative relationship between SMB and stock returns of high-profit companies. The results suggest high-profit companies with small cap do better. Market excess return and abnormal return are still significant at 1%. Market excess return's coefficient does not show a clear trend except Profitability – Investment sorted portfolios. Low investment companies expose more to market movements. Similar to market excess return, SMB's coefficients are higher for low investment companies and lower for strongly invested companies. Concerning to HML, the factor is not significant in weak profitability – small size-sorted portfolios, weak profitability – low book to market sorted portfolio and weak profitability – low investment sorted portfolio.

The addition of two more variables does not help boost the explanatory power. RMW and CMA are not significant most of the time. Specially, CMA is no use explaining the stock returns of low profitability portfolios and average profitability portfolios. RMW is only effective with low book to market sorted portfolio, high book to market sorted portfolios and average investment sorted portfolio.

**d. Sorted by Investment and other factors**

**Table 11. Double sorted (Investment and Size, Book to Market, Profitability) regression results**

*The data are firstly sorted by Percentage change of total asset into conservative, average and aggressive portfolio. The breakpoint is 30% and 70%. And then three sorted portfolios are sorted by one of the remain factors (Size, book to market ratio and Profitability). Column Small is the regression results for portfolios of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and small size. Column Ave is the regression results for portfolios of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and average size. Column Large is the regression results for portfolios of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and large size. Column Low is the regression results for portfolios of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and low book to market ratio. Column Ave is the regression results for portfolios of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and average book to market ratio. Column high is the regression results for portfolios of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and high book to market ratio. Column weak is the regression results for portfolios of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and low profitability. Column Ave is the regression results for portfolio of stocks sorted on Percentage change of total asset (conservative, average and aggressive) and average profitability. Column Aggr is the regression results for portfolio of stocks sorted Percentage change of total asset (conservative, average and aggressive) and high profitability.*

	SIZE			BOOK TO MARKET			PROFITABILITY		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	WEAK	AVE	ROBUST
<b>PANEL A: CAPM MODEL</b>									
<b>INTERCEPT</b>									
<b>CONSR</b>	0.055	0.065	0.076	0.057	0.052	0.083	0.054	0.054	0.067
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AV</b>	0.064	0.064	0.073	0.057	0.064	0.079	0.067	0.071	0.067



	SIZE			BOOK TO MARKET			PROFITABILITY		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	WEAK	AVE	ROBUST
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.064	0.070	0.075	0.049	0.072	0.084	0.070	0.071	0.081
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>CONSR</b>	0.631	0.713	0.888	0.704	0.647	0.900	0.611	0.578	0.736
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AV</b>	0.733	0.723	0.802	0.642	0.714	0.890	0.764	0.810	0.769
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.733	0.798	0.848	0.569	0.803	0.936	0.794	0.804	0.880
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>R SQUARE</b>									
<b>LOW</b>	7.2%	13.2%	25.9%	11.5%	12.3%	21.7%	6.1%	7.4%	15.6%
<b>MEDIUM</b>	16.7%	18.2%	25.4%	13.8%	19.9%	25.9%	18.2%	21.1%	21.7%
<b>HIGH</b>	16.7%	21.0%	27.4%	11.1%	22.5%	28.8%	22.9%	24.3%	32.2%
<b>PANEL B: THREE FACTOR MODEL</b>									
<b>INTERCEPT</b>									
<b>CONSR</b>	0.051	0.057	0.063	0.054	0.049	0.065	0.063	0.049	0.057
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AV</b>	0.048	0.052	0.060	0.059	0.054	0.048	0.056	0.058	0.056
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.048	0.059	0.067	0.054	0.066	0.060	0.062	0.060	0.063
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>CONSR</b>	0.574	0.629	0.758	0.670	0.610	0.720	0.710	0.512	0.627
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AV</b>	0.583	0.606	0.679	0.660	0.620	0.596	0.656	0.681	0.668
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.583	0.698	0.778	0.613	0.749	0.709	0.716	0.699	0.721
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SMB</b>									
<b>CONSR</b>	0.816	0.723	0.138	0.225	0.057	0.75	0.795	0.63	0.546
<b>P-value</b>	0.000	0.000	0.185	0.152	0.646	0.000	0.001	0.000	0.000
<b>AV</b>	0.288	0.123	-0.228	0.054	-0.018	0.069	0.381	0.174	-0.015
<b>P-value</b>	0.021	0.216	0.015	0.656	0.829	0.490	0.000	0.090	0.878
<b>AGGR</b>	0.288	-0.12	-0.387	0.015	-0.135	-0.114	-0.027	-0.255	-0.642
<b>P-value</b>	0.021	0.232	0.000	0.875	0.158	0.253	0.777	0.007	0.000
<b>HML</b>									
<b>CONSR</b>	0.680	0.547	0.625	0.268	0.157	1.052	0.064	0.507	0.671

	SIZE			BOOK TO MARKET			PROFITABILITY		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	WEAK	AVE	ROBUST
<b>P-value</b>	0.000	0.000	0.000	0.043	0.063	0.000	0.787	0.000	0.000
<b>AV</b>	0.793	0.564	0.474	-0.064	0.412	1.347	0.603	0.635	0.450
<b>P-value</b>	0.000	0.000	0.000	0.459	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.793	0.409	0.193	-0.192	0.198	0.980	0.342	0.385	0.502
<b>P-value</b>	0.000	0.000	0.005	0.017	0.005	0.000	0.000	0.000	0.000
<b>R SQUARE</b>									
<b>LOW</b>	11.6%	16.5%	28.1%	12.1%	12.5%	29.0%	7.4%	9.4%	19.1%
<b>MEDIUM</b>	20.4%	20.1%	26.6%	13.8%	20.9%	35.2%	20.9%	23.4%	22.8%
<b>HIGH</b>	20.4%	21.8%	27.8%	11.3%	22.7%	33.4%	23.5%	25.0%	33.9%
<b>PANEL C: FIVE FACTOR MODEL</b>									
<b>INTERCEPT</b>									
<b>CONSR</b>	0.059	0.061	0.065	0.057	0.047	0.070	0.063	0.050	0.057
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AV</b>	0.047	0.642	0.060	0.060	0.056	0.047	0.057	0.060	0.057
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.047	0.059	0.068	0.054	0.066	0.059	0.063	0.059	0.064
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>RM - RF</b>									
<b>CONSR</b>	0.649	0.654	0.766	0.677	0.572	0.770	0.651	0.510	0.645
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AV</b>	0.564	0.055	0.686	0.660	0.670	0.578	0.664	0.727	0.683
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.564	0.712	0.790	0.625	0.773	0.701	0.727	0.679	0.736
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SMB</b>									
<b>CONSR</b>	0.633	0.54	0.063	0.051	-0.03	0.579	0.648	0.567	0.552
<b>P-value</b>	0.001	0.000	0.562	0.760	0.815	0.000	0.012	0.001	0.000
<b>AV</b>	0.267	0.075	-0.237	-0.003	-0.009	0.072	0.378	0.174	0.003
<b>P-value</b>	0.033	0.461	0.016	0.980	0.933	0.476	0.001	0.106	0.971
<b>AGGR</b>	0.267	-0.033	-0.402	0.024	-0.039	-0.057	-0.078	-0.315	-0.66
<b>P-value</b>	0.033	0.744	0.010	0.830	0.689	0.575	0.437	0.002	0.000
<b>HML</b>									
<b>CONSR</b>	0.571	0.451	0.580	0.116	0.059	1.007	-0.317	0.465	0.707
<b>P-value</b>	0.001	0.000	0.000	0.454	0.522	0.000	0.243	0.000	0.000
<b>AV</b>	0.740	0.590	0.480	-0.104	0.506	1.319	0.614	0.713	0.490
<b>P-value</b>	0.000	0.000	0.000	0.288	0.000	0.000	0.000	0.000	0.000
<b>AGGR</b>	0.740	0.500	0.101	-0.168	0.312	1.010	0.323	0.306	0.514
<b>P-value</b>	0.000	0.000	0.381	0.065	0.000	0.000	0.000	0.000	0.000

	SIZE			BOOK TO MARKET			PROFITABILITY		
	SMALL	AVE	LARGE	LOW	AVE	HIGH	WEAK	AVE	ROBUST
<b>RMW</b>									
<b>CONSR</b>	0.332	0.115	0.029	-0.026	-0.303	0.353	-0.613	-0.033	0.161
<b>P-value</b>	0.127	0.470	0.808	0.891	0.047	0.010	0.107	0.877	0.239
<b>AV</b>	-0.201	0.284	0.058	-0.026	0.438	-0.152	0.066	0.401	0.140
<b>P-value</b>	0.231	0.023	0.596	0.876	0.000	0.195	0.621	0.001	0.264
<b>AGGR</b>	-0.201	0.162	0.101	0.097	0.255	-0.043	0.074	-0.201	0.121
<b>P-value</b>	0.231	0.208	0.381	0.483	0.034	0.726	0.533	0.072	0.259
<b>CMA</b>									
<b>CONSR</b>	1.037	0.961	0.384	0.703	0.128	1.078	0.633	0.317	0.088
<b>P-value</b>	0.001	0.000	0.023	0.011	0.533	0.000	0.191	0.259	0.645
<b>AV</b>	-0.017	0.427	0.080	0.297	0.260	-0.126	0.060	0.297	0.009
<b>P-value</b>	0.936	0.014	0.612	0.165	0.108	0.447	0.734	0.098	0.960
<b>AGGR</b>	-0.017	-0.301	0.155	0.034	-0.274	-0.302	0.299	0.138	0.259
<b>P-value</b>	0.936	0.084	0.349	0.863	0.107	0.074	0.070	0.395	0.247
<b>R SQUARE</b>									
<b>LOW</b>	12.1%	17.0%	28.2%	12.4%	12.7%	29.6%	8.0%	9.5%	19.1%
<b>MEDIUM</b>	20.4%	20.2%	26.6%	13.9%	21.2%	35.2%	20.9%	23.6%	22.8%
<b>HIGH</b>	20.4%	21.9%	27.8%	11.3%	22.9%	33.4%	23.6%	25.1%	34.0%

Table 9 illustrates the last combination of double-sorted portfolio. At first, the data are sorted by percentage change in investment into Conservative, Average and Aggressive portfolio. In each sub-portfolio, the data continue to be sorted by size, book to market ratio and ROE. In general, the explanatory power is higher in aggressive investment portfolio. CAPM model has the lowest average R-square among other ways of sorting data which is only 5 percent. Table 9 also sees a significant improvement of average R square, from 5% of CAPM model to 21.1 % of three-factor model and 21.3% of five-factor model. But the problem of high abnormal return is still not resolved. The abnormal return seems to be higher and significant at 1%. The five-factor model is not better than three-factor model. Similar to table 8, SMB is seldom significant at 5%. RMW and CMA do not help improve the explanatory power of the model.

**e. Testing a Fama-French factor by regressing the remaining variables of the five factor model?**

**Table 12. Testing a Fama-French factor by regressing the remaining variables of the five- factor model.**

	<b>RMF</b>	<b>SMB</b>	<b>HML</b>	<b>RMW</b>	<b>CMA</b>
Constant	-0.09363 (0.000)	-0.04366 (0.000)	0.02468 (0.000)	-0.00397 (0.000)	-0.0048 (0.0682)
SMB	-1.076 (0.000)		0.30786 (0.000)	0.14406 (0.000)	0.1614 (0.0546)
HML	0.67847 (0.000)	0.54576 (0.000)		-0.36894 (0.000)	0.04240 (0.5472)
RMW	-1.80063 (0.000)	-0.19587 (0.0437)	-0.74890 (0.000)		-0.3200 (0.0355)
CMA	-1.08649 (0.000)	1.45110 (0.000)	0.15605 (0.0178)	0.0274 (0.0181)	
RMF		-0.40219 (0.000)	0.14300 (0.000)	-0.04030 (0.000)	-0.044577 (0.0841)
R-square	53%	30%	56%	44%	40.6%

To further test of the relationship of the factor, I run regression of each factor on the other four factors. Table 12 depicts the results. As we can see, the RMF can explain all the other factors. The highest absolute coefficient value of RMF is 0.402 when SMB is dependent variable, and 30 percent of SMB can be explained by other factors. The absolute coefficient value of CMA is highest, which is 0.75. When CMA changes by 1 percent, the SMB factor changes by 1.45 percent. However, the R-square when SMB is the dependent variable is smallest. The highest R-square is 56% when HML is dependent variable. Both CMA and RMW are significant at 5 % in capturing the variation of other three factor. The relationship between CMA, RMW and other factors may be the reason for poor explanatory power of five-factor model compared to three-factor model. RMW and CMA largely absorb the effects of other factors.

## 7. CONCLUSION

The study investigates the explanatory power of the Five-factor model. For many years, many researchers have tried to find out a model that can explain the variations of stock returns. CAPM model is the first model suggesting using market excess return to explain the stock returns. Inspired by CAPM model, Fama and French developed a new model by adding two variables: Size factor and Value factor. But is the model effective? The evidence is mixed. Many studies found that the three factors are not sufficient enough to explain the abnormal returns and variation of stock returns. In 2015, Fama and French added two more variables: Profitability factor and Investment factors with the hope of capturing better results. But the two new variables seem to be redundant.

With the motivation of confirming the trueness of the five-factor model, I conduct the study in Viet Nam Stock Market. Before me, Nguyen et al (2015) conducted the same research but only with one double sorted portfolio (Size and other factors). To come to a complete conclusion, I test the five model in all possible double-sorted portfolios. The data in question is from 1/1/2011 to 31/12/2015. The Data included all listed stocks on Ha Noi Stock Index (HNX) and Ho Chi Minh Stock Index (HOSE)– the two stock exchanges of Viet Nam. Viet Nam stock market is young compared to other stock markets. Established in 2000, the Viet Nam Stock Market experienced a turbulent period from 2007 to 2009 and recover from 2010 until now. The reason for choosing the period in question is to avoid the impact of financial crisis and the burst of real estate bubble in 2008 and 2009.

Following the method used in Nguyen et al (2015) and Fama-French (2015a), I use the average returns of HNindex and VNindex to form the market return. Vnindex represents a basket of listed stocks on HOSE and it indicates the fluctuation of price of stock listed on HOSE. HNindex represents for stocks on Hanoi Stock Exchange. Unlike Nguyen et al (2015), I use the change in total assets as the proxy for investment. Daily closing stock prices are used to calculate the average monthly stock prices, after that to calculate the average monthly stock returns.

The purpose of the study is to test whether five-factor model is effective in explaining the stock returns. By comparing the changes in R-square, I want to find out do five-factor model and three-factor model are better than CAPM model and which is the best model in explaining the stock returns? Lastly, in which portfolio the five-factor model is the most effective. In general, the explanatory power of CAPM, three-factor model, and five-factor model are quite disappointing. Regarding single sorted portfolio, five-factor model has the highest R-square, but it is only 34 percent. From CAPM model to five-factor model, the R-square increases gradually and insignificantly. Two added variables (RMW and CMA) are not significant in explaining the stock returns. Their p-values are 0.5 and 0.26 for single sorted portfolio. Consistent with Fama-French (2015a), the five-factor model is not better than three-factor model (the R-square increase only 2% from 32% of three-factor model to 34 % of five-factor model). Turn to double sorted portfolio, the results are not better. The first double sorted portfolio is Size and other factors sorted portfolios. The highest R-square is 40 percent for Large size – high book to market sorted portfolio. Added two more variables improve slightly the explanatory power. The average R-square increases from 18.95 % to 21.3% (table 8). The biggest improvement in average R-square is from CAPM model to three-factor model. The five-factor model has no significantly higher R-square than three-factor model. One problem is the abnormal returns. If Nguyen et al (2015) and Fama-French (2015a,2015b) research find that the abnormal returns reduce the scale in five-factor model, my study find that abnormal returns seem to be constant, five-factor model and three-factor model can not help explain the abnormal returns. The prominent variable is market excess returns. The market excess factor is always significant at 1% and has positive relationship with stock returns. In another test, RMW and CMA prove to be significant in capturing the variation of other factors. This result indicates that RMW and CMA largely absorb the effects of other factors.

The five-factor model has superior explanatory power over the large size portfolios, high book to market ratio, robust profitability portfolio and Aggressive portfolio.

Finally, consistent to Fama-French (2015a, 2015b) and Nguyen et al (2015), the HML is relevant. The coefficients of HML is statistically significant over the data.

Evidently, this study has some limitations. In this study, I took only the period of 5 years. The short period may not reflect fully the fluctuation of Viet Nam Stock Market. Viet Nam stock market also has some problems with market manipulation, transparency and low quality of the financial reports which may affect the quality of data. The study eliminated all data of delisted companies over the period in question. This may create survivorship bias.

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