MSc in Applied Economics and Finance

Copenhagen Business School, 2017

An application of the CAPM and the three-factor model in emerging markets Asia

Master's Thesis

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Pages: 119

Characters (without spaces): 171.616

Date: 15.01.2017

Abstract

This paper aims to reexamine the validity of the capital asset pricing model (CAPM) and the three-factor model at domestic and regional level in the four leading emerging markets of Asia: China, India, South Korea and Taiwan.

Emerging markets Asia have gained substantial attention from investors due to their increasing role in the global equity market. However, due to the fact that the investment environment is immature and the degree of market ingration is limited, the results of the CAPM and the three-facor model, which are confirmed in developed markets, may differ for emerging markets. Therefore, this paper aims to find a precise asset pricing model to explain the cross-section of expected stock returns in emerging markets Asia. Our dataset consists of 2,825 securities extracted from Datastream, which are tested using the ordinary least squares (OLS) method.

The results of this paper confirms that custom equal-weighted indices should be used as proxies for the market portfolio, when calculating the market return, due to the limited degree of market integration within the region. Based on the robust results of the paper, the domestic CAPM is recommended to be used in China, whereas the domestic three-factor model should be used in India, South Korea and Taiwan.

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Chapter 1 Introduction

The capital asset pricing model (CAPM) was built on the foundation of Markowitz's modern portfolio theory by William F. Sharpe (1964) & John Lintner (1965). The CAPM implies that market risk, also known as systematic risk,[1] is the only risk to explain expected stock returns.

In financial practice, the CAPM is the dominant model for estimating the expected stock returns (Bruner et al. 2008). Investors use the CAPM to select assets in order to construct an optimal portfolio, whereas firms and banks also use the CAPM when making capital budgeting decisions on borrowing and lending.

In the 1980s, empirical studies started to provide contradicting evidence against the validity of the CAPM (Banz 1981, Chan & Chen 1988, Chan et al. 1991, Fama & French 1992 and Fama & French 1996). Empirical observations in the U.S. confirmed that asset pricing does not solely rely on the market risk as previously suggested, resulting in the CAPM being heavily criticized for being incapable of explaining the variation in stock returns.

In 1992, Fama & French introduced the three-factor model, which is an extension of the CAPM with two additional factors; size[2] and value[3]. The underlying idea of the three-factor model is that low market capitalization[4] (market cap) stocks earn a size premium and stocks with a high book-to-market ratio earn a value premium, since these firms are regarded as riskier. The three-factor model was built based on an empirical statistical approach, whereas the CAPM was theoretically built. Various researchers have reexamined the CAPM and the three-factor model with various developed markets and time periods, providing consistent findings that the three-factor model outperforms the CAPM in developed markets.

[1] Market risk: Market risk or systematic risk, also known as undiversifiable risk, affects the overall market and cannot be mitigated through diversification.
[2] Size: Size in this paper refers to firms' market capitalization.
[3] Value: Value in this paper refers to firms' book-to-market ratio.
[4] Market capitalization: The total market value of a firm's outstanding shares.

After World War II, the degree of integration among equity markets of developed countries has increased, allowing investors to invest in foreign markets. Solnik introduced the global CAPM in 1974 to capture the expected stock returns in integrated markets[5]. The global three-factor model was then introduced by Fama & French in 1998 and further examined by Griffin in 2002. Solnik and Fama & French confirmed that the global CAPM and the global three-factor model are valid only in fully integrated markets, typically in developed countries. In fully integrated markets, the choice between a domestic and a global model should be irrelevant, since only one set of risk factors should exist.

1.1 Problem area and research question

As mentioned above, previous research found an increase in the explanatory power of the CAPM when the size and value factor were added, concluding that the three-factor model could better capture the variation in stock returns. The global three-factor model was also found to be valid in developed markets (Fama & French 1998).

Emerging markets Asia are considered to be immature and relatively segmented. Only a few empirical studies have tested the validity of the CAPM and the three-factor model with both domestic and regional factors. Although emerging markets Asia have become more integrated with developed markets, the regional integration among themselves is still quite limited (Park 2013). Unlike developed markets, the security markets of emerging markets Asia have lower liquidity, are less regulated and offer poor accounting standards (website troweprice 2016).

Recently, emerging markets Asia are experiencing a major transition from being a traditional manufacturing and exporting economy to becoming a domestic consumption-oriented one. The increase in the middle class with higher incomes facilitates the transition process, enabling small firms to earn a higher premium (website SSGA 2015).

[5] Market integration: Market integration occurs when prices among different locations follow similar patterns over a long time period.

It is however questionable whether a value premium exists in emerging markets Asia. For instance, the effect of the book-to-market ratio is weak in China due to the large number of non-tradable stocks, which might not reflect the true value of the firm (Gan et al. 2013).

Observations show that the size premium and the value premium do exist in emerging markets and that the effect of these are in fact stronger than in the U.S. market for the period 2000-2015 (website A wealth of common sense, 2016).

This paper aims to test the performance of the CAPM and the three-factor model at both domestic and regional level, comparing the results with the findings of previous studies. This is carried out by examining the behavior of the CAPM and the three-factor model with stock data of emerging markets Asia, represented by China, India, South Korea and Taiwan. The research question of this paper is as follows:

'Are the factors in the CAPM and the three-factor model country or regional specific when applied in emerging markets Asia?'

To answer the main question above, the following sub-questions will be answered:

1. *Can the domestic and the regional market risk factor in the CAPM explain the expected returns in emerging markets Asia?*
2. *Can the domestic and regional size and value factor improve the performance of the CAPM in emerging markets Asia?*
3. *Do a size and value premium exist in emerging markets Asia?*
4. *Does the degree of market integration have an impact on the performance of the regional CAPM and the regional three-factor model in emerging markets Asia, given that these markets are relatively segmented?*
5. *Does the choice of market portfolio matter in emerging markets Asia?*

Sub-question 1 aims to answer whether the domestic and regional market risk factor is the only source of risk in emerging markets Asia that can explain the expected stock returns.

Sub-question 2 aims to evaluate whether the domestic and regional size and value factors can improve the performance of the CAPM?

Sub-question 3 aims to confirm the presence of a size and value premium in emerging markets Asia.

Sub-question 4 aims to evaluate whether the performance of the regional CAPM and the regional three-factor model can reflect the countries' degree of market integration.

Sub-question 5 aims to verify whether the choice between equal-weighted and publicly listed indices provided by MSCI as proxies for the market portfolio have a substantial impact on the results.

1.2 Delimitation

This paper focuses on two asset pricing models at domestic and regional level; the CAPM and the three-factor model. As mentioned above, the CAPM is the asset-pricing model most commonly used by financial institutions in practice, whereas the three-factor model is plausible in the field of empirical research. Therefore, the motivation of this paper is to compare the performance of these two models through empirical testing.

Fama & French and other researchers have tried to improve the three-factor model by adding new factors such as momentum (Cakici et al. 2013, Melorose et al. 2014 and Fama & French 2015), liquidity (Pástor et al. 2003 and Lischewski & Voronkova 2012) and volatility (French et al. 1987, Adrian & Rosenberg 2008 and Switzer and Picard 2015). Researchers have also tried to identity new factors for a specific country or region. This paper, however, focuses solely on the following factors; market risk, size and value. The paper aims to study the behavior of the traditional CAPM and the traditional three-factor model at domestic and regional level, which has not been widely tested for in emerging markets Asia. Thus, We do not intend to find new factors nor extend the model into a four- or five-factor model.

Emerging markets Asia include eight countries: China, India, South Korea, Taiwan, Thailand, Indonesia, Malaysia and the Philippines (website MSCI). The four latter countries are not included in our sample, since the market cap of China, India, South Korea, and Taiwan accounts for 85% of the emerging markets Asia index (website MSCI 2016). Thus, these four countries have been chosen to represent the region of emerging markets Asia.

The statistical method of this paper consists of simple cross-sectional regressions as done by Fama & MacBeth (1973). If a real relationship between the variables of risks and returns exists, it should shine through regardless of the choice of estimation method (Alexander 2008).

The construction of the factors (market risk, size and value) in the models is based on custom equal-weighted[6] indices. The choice between a value-weighted[7] and an equal-weighted method should not have an impact on the results (Griffin 2002).

1.3 Paper structure

The paper is divided into eight main chapters. At the beginning of each chapter, there will be a short introduction, which serves to explain the purpose of the chapter. Likewise, at the end of each chapter, there will be a sub-conclusion. To create a better overview of the paper, the content of each chapter is shortly listed below:

CHAPTER 1 introduces the topic of the paper and presents the research question, which identifies the objectives that this paper will address. The chapter also includes the methodology, which explains the research process and the analytical tools needed to answer the research question.

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[6] Equal-weighted index: An index of a group of securities computed by calculating a simple average, where smaller firms are given equal weight to larger firm.
[7] Value-weighted index: An index of a group of securities computed by calculating a weighted average of the returns on each security in the index, where the weights are proportional to outstanding market value.

CHAPTER 2 offers a literature review, which serves the purpose of identifying the studies supporting the topic of this paper. The chapter provides information about the historical background and the empirical performance of the CAPM and the three-factor model at domestic and global level with the focus on emerging markets Asia. The chapter also identifies the gap in the literature, which this paper aims to fill in, and supports the analysis of the results in chapter 6.

CHAPTER 3 provides an overview of the characteristics of emerging markets Asia. The chapter focuses on a review of the four countries, market classifications, the presence of a size and value premium and lastly the degree of market integration. The content of this chapter is later used to evaluate whether the performance of the regional CAPM and the regional three-factor model can reflect the degree of market integration within the region. Furthermore, the chapter will also evaluate whether the size and value premium story in the domestic three-factor model is supported by the economic observations in emerging markets Asia.

CHAPTER 4 presents the theoretical framework of the paper, providing a guide on how the results of the paper should be produced and analyzed in chapter 6. The chapter describes the theory and method for the CAPM and the three-factor model at domestic and regional level. It also explains how to construct the factors and portfolios, which are used as inputs for the linear regressions. The chapter also describes the assumptions of Ordinary Least Squares (OLS) and how they should be tested.

CHAPTER 5 provides a data summary of the stock returns of the four countries in our data sample. Particularly, the paper presents a statistical summary of the dependent and independent variables. It is a necessary step to identify the pattern of the data before analyzing the results in chapter 6.

CHAPTER 6 presents the main findings of the paper via an analysis of the CAPM and the three-factor model at both domestic and regional level. A sub-period test analysis will also be carried out to ensure the robustness of the results.

CHAPTER 7 aims to provide a discussion and evaluation of the results, which are presented in chapter 6. The chapter discusses the sensitivity of the results with regards to the choice of the market portfolio proxy. It also discusses the potential problem of data snooping. Lastly, the chapter discusses the limitations of the paper and offers suggestions for further research.

CHAPTER 8 provides a conclusion of the main findings and answers the problem statement of this paper.

1.4 Methodology

The aim of this paper is to examine the performance of the CAPM and the three-factor model at domestic and regional level in emerging markets Asia. First, stock data is extracted from Datastream. The stocks are then divided into portfolios, based on their market cap and book-to-market ratio, whereupon dependent and independent variables are constructed by following the method of Fama & French (1992, 1993 and 1998) and Griffin (2002). Based on these data, cross-sectional linear regressions are run in SAS Enterprise, following the method by Fama & Macbeth (1973). An efficient model should meet the Ordinary Least Squares assumptions and exhibit a high R^2, include significant factors and an insignificant intercept (pricing error). The latter should be insignificant since a significant intercept could imply omitted-variable bias. This case occurs when an important factor is not included in the model, making the model inefficient.

It is important to emphasize that this paper differs from previously published papers regarding the CAPM and the three-factor model. Previous papers only report the statistical test results, whereas this paper goes one step further by evaluating the model performance, not only based on statistical criteria, but also to confirm whether the models' results can reflect the economic phenomena observed in practice. This method is inspired by Lo & Mackinlay (1990), who recommended that factor returns should be analyzed in the light of both statistical significance and economic phenomena in order to avoid data snooping.

A sub-period analysis, covering the second half of the main data for the period 2009-2016 will also be carried out to ensure the robustness of the findings. Another purpose of examining the sub-period results is to confirm whether an improvement of market integration has occurred in emerging markets Asia by observing the global models. Since the governments of the four countries have improved their capital markets in order to attract foreign investors (Hearn 2016), it is expected to find an improvement in the results of the domestic CAPM and the domestic three-factor model in the later period.

This paper aims to confirm that custom equal-weighted indices lead to more precise asset pricing than MSCI indices do. Thus, this paper applies customized equal-weighted market indices in order to improve the performance of the models. The paper will also quickly test the models using the indices provided by MSCI as proxies for the market portfolio.

1.5 Data

The data used in this paper includes both qualitative data and quantitative data. The quantitative data is extracted from Datastream for a 15-year period July 2001 - June 2016. The majority of existing firms in our data have existed for approximately 15 years, which is why this length of period is chosen.

The data consists of firms' monthly total return index, market value, and market-to-book ratio. The market-to-book ratio is then converted into book-to-market. All financial firms are excluded from the dataset, since the high level of leverage, which is common for these firms, do not signal distress as it would have been interpreted for non-financial firms. Furthermore, negative book-to-market ratio firms were excluded from the dataset, since firms with a limited liability structure cannot have negative book values. By not excluding these firms, interpretation would be difficult (Brown et al. 2008).

The qualitative data consists of previous research papers in the field of asset pricing models. These papers are used for understanding the theory and to put other approaches or opinions into perspective. Since this paper aims to be up-to-date with regards to explaining the current situation in emerging markets Asia, the Internet is a natural source for more recent information. Finally, the theory about OLS properties is referred to textbooks and SAS' website.

Chapter 2 Literature review

2.1 Introduction and purpose

Chapter 2 provides a historical introduction of the CAPM and the three-factor model, reviewing the contributions, extensions, limitations and the empirical performance of the models. The purpose of chapter 2 is to provide information that will support the analysis of the findings in chapter 6.

Part 2.2 provides a review of the introduction, limitations, contributions and the empirical performance of the CAPM. Part 2.3 provides a similar review of the three-factor model. Lastly, part 2.4 solely provides a review of the empirical performance of the CAPM and the three-factor model in emerging markets Asia.

2.2 The capital asset pricing model (CAPM)

2.2.1. Model introduction

The capital asset pricing model (CAPM) is a central piece in the theory of financial economics[8]. It was built on the foundation of modern portfolio theory introduced by Markowitz in 1952, providing guidelines to risk averse[9] investors on how to select assets in order to construct a portfolio with maximum return given a certain level of risk.

William Sharpe introduced the CAPM in 1994 to simplify the complexity of implementing the portfolio theory by Markowitz (Sullivan 2006).The CAPM was then further developed and modified by Lintner (1965), Mossin (1966) and Black et al. (1972), the result being the CAPM that we know today.

[8] Financial economics: financial economics is a branch of economics and has two main areas of focus: asset pricing and corporate finance

[9] Risk aversion: risk averse describes an investor who, when faced with two investments with a similar expected return, but different risks, prefers the investment with the lower risk

The International CAPM (ICAPM) was introduced by Solnik in 1974 and was confirmed to be valid in fully integrated markets. The ICAPM should be applied rather than the traditional CAPM when estimating the expected returns of cross-border investments in integrated markets. The expected returns estimated by the ICAPM for cross-border investments were expected to be lower than those estimated by the traditional CAPM due to global diversification, which led to a decrease in portfolio risk.

2.2.2 Criticism

The CAPM has been criticized for its unrealistic assumptions and its limitations in empirical tests. The CAPM is assumed to be a single-period model, which requires a certain level of independence between the price mechanisms in different periods. This assumption is however based on the unrealistic assumption that the demand and supply of agents who live for several periods are the same for all periods (Munk 2013). This assumption can however be removed from the model without significant effects to the set-up of the CAPM (Black et al. 1972). Another crucial assumption that has received a lot of criticism for being unrealistic is that all investors have the same opportunity to borrow and lend at a risk-free rate and can enter any long or short position. Although unrealistic, this assumption cannot be dropped without changing the results substantially (Black et al. 1972).

With regards to empirical tests, Roll (1977) argued that the CAPM was impossible to apply since the true market return[10] (which is an important input in the model) cannot be observed. In practice, a market index is often used as a proxy for the market portfolio, but has been criticized for not representing the real market portfolio. Disagreeing with Roll, researchers Stambaugh (1982) and Huberman et al. (1987) confirmed that the CAPM could be tested using a market index as a proxy of market risk. According to Stambaugh, the inference of the positive linear risk-return relation of the CAPM was not sensitive to the composition of the market index. Even in the case where only 10% of common stocks were presented in the market index, he found the CAPM inference to remain unchanged. In emerging markets, Bruner et al. (2008) argued that the publicly listed market indices were not reliable due to the limited degree of market interaction. He

[10] Market return: The return on the overall theoretical market portfolio, including all assets and having the portfolio weighted for value

recommended that custom value-weighted indices should be used when testing the asset pricing models in emerging markets Asia.

2.2.3 The empirical performance

The CAPM was supported by empirical tests in the U.S., when it was introduced in the 1960s. Since the 1970s, most tests have however provided contradicting evidence against the CAPM.

The CAPM was confirmed to be valid when testing for the U.S stocks for the periods 1926-1968 (Fama & MacBeth 1973) and 1955-1964 (Jensen 1969).

Since the 1970s, the CAPM has been confirmed to fall short in explaining the expected returns (Black et al. 1972, Banz 1981, Reinganum 1981, Lakonishok & Shapiro 1986, Chan & Chen 1988, Chan et al. 1991 and Fama & French 1992). Specifically, Black et al. (1972) found that the expected returns were not proportional to beta. High-beta stocks generated low expected returns and low-beta stocks generated high expected returns, which is different from what the CAPM predicts. Later, however, Black (1993) argued that the difference in results between the empirical CAPM and the theoretical CAPM is an indication of stocks being under- or overpriced. Rational investors, who can borrow or lend money freely, should continue using the CAPM. Furthermore, Fama & French (1992) confirmed that the positive relationship between beta and the expected returns of the CAPM became weak for the period 1941-1990, disappearing in the later period 1963-1990. In 1996, they strongly rejected the CAPM by publishing the paper 'The CAPM is Wanted, Dead or Alive', concluding that beta alone was insufficient in explaining the expected returns of securities.

The global CAPM was also empirically tested for in various markets worldwide and was confirmed to be valid in fully integrated markets, but invalid in semi-segmented markets. Some researchers reached to the conclusion that both domestic and global factors influence stock returns in developed markets (Solnik 1974, Agmon 1974, Lessard 1974, Harvey 1991, Chan et al. 1992, Stulz 1996, Schramm & Wang 1999, Stulz 1999 and O'Brien & Dolde 2000). When the global model is applied in emerging markets Asia, however, it fails to explain the cross-section of average expected returns due to the degree of market segmentation (Harvey 1995).

Bruner et al. (2008) tested the domestic and global CAPM with 14,371 securities in both developed markets and emerging markets for the period 1994-2004. Different with previous studies of the domestic and global CAPM, Bruner et al. used market value weighted indices [11] as market portfolio proxies instead of publicly listed indices, since they argued that listed indices were not suitable in emerging markets Asia due to the segmentation of markets. They found mixed results of the validity of the CAPM. In developed markets, the multi-factor model should be used instead of the CAPM, both at domestic and global level. The choice of market portfolio in developed markets did not have a major impact on the results due to the high degree of market integration. In emerging markets, however, the domestic CAPM could explain the expected stock returns. Here, the choice of market portfolio had a big impact on the model performance.

With the focus on emerging markets Asia, Fin (2008) confirmed the validity of the CAPM and stated that the choice between the domestic and global CAPM depends on International diversification. The regional CAPM should only be used when investors diversify their portfolio internationally.

It is not surprising that the CAPM has failed in empirical tests, since it was originally built to explain the risk-return relation in a simple setting (Munk 2013).

2.3 The Fama French three-factor model

2.3.1 Model introduction

The three-factor model was a result of the CAPM's shortfalls. Among multi-factor models, the three-factor model by Fama & French is today dominant within empirical research (Bodie et al. 2014).

[11] Definition: An index of a group of assets computed by calculating a weighted average of the returns on each asset in the index, where the weights are proportional to the outstanding market value.

Since the 1980s, researchers within finance have proposed several asset-pricing models with the aim to replace the CAPM. The current dominant approach is to identify firm characteristics that can be used as proxies for risk factors (Bodie et al. 2014). Following that approach, Fama & French (1992) verified the joint effect of market risk, size (based on market cap) and value (based on book-to-market ratio), leverage and lastly the earnings ratio through empirical multi-variable tests. They found that size had a negative effect and value had a positive effect on average returns of U.S. stocks listed on New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and National Association of Securities Dealer Automated Quotation (NASDAQ) for the period 1963-1990. The combination of the size and value factor absorbed the effect of leverage and the earnings-price ratio. Size and value together with the market risk premium were concluded to explain the cross-section in average returns.

The concept of the size effect was first introduced by Banz in 1981. He tested the CAPM with stock data from NYSE for the period 1926-1975 and concluded that the model was mispriced. He found a size effect, where small cap stocks had significantly higher risk adjusted returns on average than large cap stocks. His findings were consistent with the findings of Chan & Chen (1991), who tested for the U.S stocks in the period 1956-1985. The economic interpretation is that small firms on average are riskier due to poor performance, inefficiency, high financial leverage and cash-flow problems. Thus, these stocks should earn a return premium to compensate for the additional risk.

The concept of the value effect was first introduced by Rosenberg et al. in 1985. For U.S. stocks in the period 1980-1984, stocks of firms with a high book-to-market ratio earned higher average returns than stocks with a low book-to-market ratio. Later in 1991, Chan et al. found the same evidence for the cross-sectional returns of Japanese stocks, confirming that the book-to-market ratio could explain the average stock returns. Similarly, Munk (2013) argued that if the market value of equity is high relative to its book value, it is probably due to the company having substantial options overtime to boost the growth of the company in the future. Thus growth stocks[12] are less risky than the value stocks.[13]

[12] Growth stocks: Stocks in companies with a low book-to-market ratio
[13] Value stocs: Stocks in companies with a high book-to-market ratio

In 1993 and 1995, Fama & French made further improvements to the three-factor model. In 1993, Fama & French tested the three-factor model by constructing the portfolios to mimic risk factors related to size and value. They confirmed that the size and value factor could explain the variation in stock returns substantially better than the market risk factor could alone. In their paper of 1995, they argued that size and value are reasonable proxies for financial distress.

2.3.2 Criticism

Unlike the CAPM, the three-factor model was built from an empirical statistical approach instead of a theoretical approach. Thus it is questionable whether the two additional factors, size and value, are valid risk proxies capturing the variation in expected returns, or if they are a pure result of data snooping or the biased behavior of investors (Lo & Mackinlay 1990).

Data snooping can be loosely defined as finding patterns in the data that does not actually exist. According to Lo & Mackinlay (1990), data snooping is unavoidable in empirical work. Data snooping bias is associated with testing of financial asset pricing models, where the tested portfolios are formed and sorted on empirically motivated characteristics of assets, such as size. The size effect was not developed from economic theory, but was a result of empirical method confirming a relation between market cap and expected returns. Thus, analysis of the factor effect should not solely rely on statistical significance, but also on economic phenomena. Alexander (2008) agreed, criticizing the favorable results of the three-factor model to be a consequence of data snooping. Furthermore, she argued that skilled practitioners could manipulate the results.

Lakonishok et al. (1994) also believed that the significant results of the three-factor model were a result of data snooping. Similarly, Post & Pim (2004) examined the explanatory power of the CAPM and the three-factor model using U.S. stock data for the period 1930-2002. The results showed that the three-factor model did not increase the explanatory power of the CAPM after 1963. Before 1963, the three-factor model even hurt the explanatory power of the CAPM. He concluded that the existing empirical evidence in the favor of the three-factor model is a result of data snooping.

Ferson et al. (1999) supported the other critics of data snooping, arguing that the market cap and the book-to-market ratio included in the three-factor model by Fama French (1992) had completely no relation with risks. According to Ferson et al., stocks with small cap and high book-to-market ratio always earn higher returns by construction, and the market risk factor of the CAPM is useful in capturing the grand mean. Thus the market risk factor should be included in the three-factor model to explain the mean returns.

In order to detect the data snooping problem, the asset pricing models should be tested for different time periods and for different countries. If a repetitive pattern of the size and value is observed across different samples, data snooping might be present (Barber and Lyon 1997).

Besides the problem of data snooping, the biased behavior of investors is an alternative explanation for the positive return premium of value stocks and the negative premium of growth stocks. Lakonishok et al. (1994), and Haugen (1996) rejected the risk interpretation of the size and value factor. They argued that the value factor has no effect and that it is investors' overreactions to the economic news of corporations that lead to an undervaluation of value stocks. Consistently, Daniel & Titman (1997) also rejected that size and value factors should be regarded as proxies for risk.

2.3.3 The three-factor model development

So far, only the classical three-factor model (from now on referred to as the domestic three-factor model) has been mentioned. Fama & French (1998) and Griffin (2002) extended the model into a global three-factor model. Fama & French first tested a global CAPM and a global two-factor model including only market risk and size with data of 13 countries in both developed and emerging markets for the period 1974-1994. The underlying hypothesis of the global model is that only one set of risk factors should exist globally when markets are integrated.

Fama & French (1998) introduced the global two-factor model including the market risk factor and the value factor based on the theory of the intertemporal capital asset pricing model (ICAPM) by

Merton (1973). They found that expected returns could not solely be explained by the market risk factor in the global CAPM, whereas this was not the case for the global two-factor model. Here, firms with a high book-to-market ratio had higher returns than firms with a low book-to-market ratio in both developed and emerging markets. They concluded that the global two-factor model could explain the expected returns in all countries, and so could the three-factor model. They did however not compare the performance of the domestic and the regional two-factor model.

Applying the same hypothesis as Fama & French (1998), Griffin (2002) tested the performance of the three-factor model at both domestic and global level to confirm whether the global three-factor model could perform as well as the domestic three-factor model in integrated markets. In order to view the effect of the domestic and foreign factors separately in the global three-factor model, Griffin also introduced the International three-factor model, which included three domestic as well as three global factors.

Griffin tested the models with the data from the fully integrated markets such as the U.S, Canada, the United Kingdom and Japan. He found robust evidence in both the main and out-of sample period that the domestic three-factor model performed better than the global and international three-factor model in the fully integrated markets. Griffin concluded that the domestic three-factor model should be used to estimate the expected returns in all types of markets.

2.4 The three-factor model performance in emerging markets Asia

In the Chinese stock market, Wang & Xu (2004) tested the three-factor model with Chinese A stocks for the period 1996-2002. To test the robustness of the three-factor model, the method of cross-sectional regression in Fama-Macbeth 1973 was implemented. They concluded that the value factor was incapable in explaining the cross-sectional differences in stock returns of the Chinese capital market. The size factor was however capable, but its effect had been decreasing. The free float is viewed as a better risk proxy for Chinese stocks, since it signals the quality of corporate governance, future cash flows and investment opportunities of companies.

Testing with the same market, Wu (2011) provided opposite findings with Wang & Xu (2004). He found that the market beta had no explanatory power and provided evidence of a potential value effect, but no significant size effect. The market efficiency of China is however limited, although the government has tried to improve its regulations of their stock markets.

Different with the studies mentioned above, De Groot & Verschoor (2002) reexamined the three-factor model in 5 different markets of Asia, including India, South Korea and Taiwan to prove that the value premium in the three-factor model was not just a result of a specific sample as contented by Black (1993) and Mackinlay (1995). De Groot & Verschoor found evidence that small firms in emerging markets Asia had higher returns than large firms at a certain extent. The value factor had a consistently stronger role than the size factor in capturing the expected stock returns. The value stocks had higher average returns than growth stocks. These findings are consistent with the global findings of the value and size factor.

The most recent study of the three-factor model in emerging markets is carried out by Ebrahim et al. (2014), who tested the model with stock data from Brazil, Turkey, India and China (BTIC countries) for the period 1999-2009. They rejected the argument that a value premium for stocks with a high book-to-market ratio is due to a high level of financial distress as explained by Fama & French (1995). On the contrary, they argued that the value premium was due to the investment pattern of value firms (high book-to-market ratio firms) and growth firms (low book-to-market firms). Growth firms typically held hoard cash. Thus they could delay the undertaking of growth options when subject to poor economic conditions. Consequently, growth firms bear less business risk, and their market valuation and expected return are decreasing. Ebrahim et al. (2014) contended that the value premium was due to economic fundermentals and not due to financial distress.

2.5 The CAPM and three-factor model performance at domestic and global level in emerging markets Asia

The domestic CAPM and the domestic three-factor model were tested with Indian stocks for the period 1997-2007 by Sharma & Mehta (2013). They found that the three-factor model could explain over 90% of the stock returns in the Indian market and that it outperformed the single-factor model, the CAPM, and the two-factor model. Sehgal & Balakrishnan (2013) also tested the CAPM and the three-factor model with Indian stocks for a longer period 1996-2010 than Sharma & Mehta (2013). They confirmed the presence of a strong size and value effect in the Indian stock market. However, the three-factor model did not fully explain the abnormal returns missed by the CAPM.

Cakici et al. (2013) tested the CAPM and the three-factor model at both domestic and global level with a big dataset of several emerging markets in Asia, including China, India, South Korea and Taiwan. The cross-sectional data for period 1990-2011 was applied in the study. Their evidence showed that the domestic factors were superior to global factors in capturing the cross-sectional average returns in emerging markets Asia. Furthermore, they found that the size and value factor were statistically significant in the domestic model. However, the size premium in emerging markets contrast with the findings in the U.S. and global developed markets.

Recently, in 2015, Hakim et al. reexamined the domestic and global CAPM, three-factor and four models using the stock data from BRIC countries (Brazil, Russia, India and China) for the period 2004-2013. The results showed that the choice between the domestic and global model depended on the market behavior. If the market is fully segmented like China, the domestic model should be used. The Indian stock markets behaved inconsistently when applying different asset pricing models; it behaved like a segmented market in the two-factor model and like an integrated market in the four-factor model. They did not conclude how each market behaved when applying the three-factor model.

In short, the empirical evidence of emerging markets Asia showed that the domestic factors are superior to foreign factors in explaining the average expected stocks returns in emerging markets Asia. The effect of the size and value premium is however not always consistent.

2.6 Sub-conclusion

The CAPM is the dominant method for estimating the expected returns in financial practice. However, the model has been criticized for not being able to capture the variation in expected stock returns. As a result, the three-factor model was introduced by Fama & French in 1992. The three-factor model has been proved to outperform the CAPM through empirical tests with stocks from the U.S. and other developed markets. The global CAPM and the global three-factor model were also introduced and confirmed to be valid in fully integrated markets, typically in developed countries.

In emerging markets Asia, there are mixed findings of the CAPM and the three-factor model. The performance varies across different markets and time periods. Both the global CAPM and the global three-factor model are consistently rejected due to the limited degree of market integration.

A limitation of previous studies in emerging markets Asia is that they use publicly listed indices as proxies for the market portfolio. According to Bruner et al. (2008), equal-weighted indices should be used as proxies for the market portfolio due to the limited degree of market integration in emerging markets Asia. His findings however solely relied on the CAPM, not the three-factor model.

Chapter 3 Emerging markets Asia

3.1 Introduction and purpose

Chapter 3 provides an overview of China, India, South Korea and Taiwan, describing the market classifications of the countries and the degree of market integration within the region. The purpose of chapter 3 is to support the analysis of the results in chapter 6, in which the performance of the CAPM and the three-factor model at domestic and regional level are assessed.

Part 3.2 provides an economic overview of China, India, South Korea and Taiwan. Part 3.3 presents the market classifications of the four countries. Part 3.4 provides a number of economic observations regarding the size and value premium in emerging markets Asia. Lastly, part 3.5 provides a description of the degree of market integration within the region.

3.2 Country overview

The term 'emerging markets' was first introduced in the 80s and commonly refers to an economy with a GDP per capita substantially below the advanced world average and growth potential above the global average. 'Emerging markets' and 'developing countries' are two terms that are often used interchangeably (website Financial Times 2016).

Modern financial institutions including banks and capital markets in emerging markets Asia are heavily dependent on government regulation and supervisory authority. The financial institutions are also influenced by former European colonial metropoles and religion, which vary across the region. Recently, modern financial institutions are influenced by the actions by International institutions such as IMF, World Bank and regional development banks. The developing countries in Asia compete to attract foreign investors by standardizing their financial institutions to meet the well-recognized structures of Western formal institutions. The ease of achieving this standardization differs across countries, since they vary in the following areas; differences in accounting standards, auditing, legal and regulatory enforcement of standards (Hearn 2016).

Below, an overview of the four countries (China, India, South Korea and Taiwan) can be found, describing their economic situation.

3.2.1 China

China is the second biggest economy in the world due to its astonishing growth in the past few decades. The population amounts to 1.4 billion and the GDP amounts to USD 17.6 trillion (website Heritage Foundation 2016). Since its introduction to the economic reforms in 1978, the country has become the world's manufacturing hub (website World Bank 2016). China has received inflows of USD 118 billion in 2013, thereby becoming the second largest recipient of foreign investment (website Financial Express 2016).

Two-thirds of the total market cap of China is currently owned by the state and cannot be traded on the exchanges (Wang and Xu 2004). The objective of the Chinese government is to shift the economy towards a more market-oriented economy by increasing the privatization and the liberalization of its stock markets. The Chinese stock markets are not viewed as effective in promoting corporate efficiency, since share prices and corporate results are not correlated. The problem stems from several reasons; poor corporate governance, market manipulation, dubious accounting practices and insider trading problems. Due to the immense government regulation, global norms have been lacking with regards to standards of disclosure and corporate governance. The fact that small investors dominate the market also contributes to the problem, since these investors are engaged in speculation and short-term trading profits (Wu 2011). Due to the investment philosophy and the poor quality of accounting information, the book-to-market ratio does not provide a lot of information in China when compared with more mature markets (Wang & Xu 2004).

3.2.2 India

India is the seventh largest country in the world with population amounting to 1.3 billion and a GDP amounting to USD 7.4 trillion. Numerous non-tariff barriers in India disturb the free float of goods and services. The procurement policies of the Indian government favor domestic firms. The financial sector is dominated by state-owned institutions and foreign participation is limited (website Heritage Foundation 2016). Although the stock market of India has been subject to reforms, the integration with developed stock markets is limited, since developed countries only have a short-term impact on the Indian stock market (Chattopadhyay et al. 2006).

3.2.3 South Korea

South Korea is a member of the four Asian tigers and is the world leader in electronics, telecommunications, automobile production and shipbuilding. The population of South Korea amounts to 50.4 million and the GDP amounts to USD 1.8 billion. The financial sector of South Korea has become competitive and the banking sector remains stable (website Heritage Foundation 2016).

The country replaced its fixed exchange rate system in February 1990, allowing its exchange rate to fluctuate against the dominating currencies, which is important for its trade. In December 1997, when the Asian financial crisis was at its peak, the exchange rate system of South Korea shifted to a totally free-floating mechanism. In the following year, 1998, the country's stock and money markets opened up for foreign-investor ownership. The exchange rate fluctuation generally has an impact on stock markets, since firms' import and export of business are affected by the volatility of the exchange rate (Blenman et al. 2010).

3.2.4 Taiwan

Taiwan is one of the richest countries in Asia with a population amounting to 23.4 million and a GDP of USD 1.1 trillion. In the recent years, the country's strained relationship with China has improved, although this might be challenged after the presidential election in 2016. It is relatively easy to start a company in Taiwan, where no minimum capital is required. The prices in the country are determined by the market, although the government does have a certain impact on some prices such as electricity and pharmaceutical products etc. The financial sector offers a wide range of services and products, but is still fragmented and likely affected by the state (website Heritage Foundation 2016)

3.3 Market classification

The security markets of emerging markets have lower liquidity, are less regulated and offer poorer accounting standards than those of developed markets such as the U.S. and Japan. Emerging markets have received considerable attention from investors due to their rising share of the global economic output and stock market capitalization, as well as favorable demographics and high growth prospects (website troweprice 2016).

The two world leading index providers, Morgan Stanley Capital Index (MSCI) and Financial Times Stock Exchange (FTSE), have both tried to classify countries according to several parameters. Based on the criteria of economic development, size and liquidity requirement and market accessibility, MSCI classifies all markets in the world into the following three categories:

1) Developed countries
2) Emerging markets
3) Frontier Markets

FTSE divides markets into four categories based on a set of more detailed criteria, which is called 'FTSE quality of markets criteria' (website FTSE 2016):

1) Developed markets
2) Advanced emerging markets
3) Secondary emerging markets
4) Frontier markets

Since this paper will mainly focus on emerging markets Asia, more specifically China, India, South Korea and Taiwan, the following table presents the classification of these countries according to MSCI and FTSE.

Table 3.1 MSCI and FTSE market classification

Country	MSCI	FTSE		
	Emerging markets	Developed markets	Advanced emerging markets	Secondary markets
China	x			x
India	x			x
South Korea	x	x		
Taiwan	x		x	

Source: own construction based on the market classification information from website MSCI and FTSE, 2016.

According to MSCI, all four countries are classified in the same emerging markets category. FTSE on the other hand has classified South Korea into the developed markets category, Taiwan into the advanced markets category and finally China and India into the secondary markets category. Up until March 2016, the Chinese authorities have actively increased the accessibility of A markets to foreign investors and eased the conditions of the Qualified Foreign Institutional Investors. FTSE has however measured the effort in the Quality of Market matrix and concluded that China has not advanced from being a secondary emerging market (website FTSE 2016).

3.4 Risk and return

The stock markets of emerging markets Asia generate above average returns. The higher returns stem from the growth in GDP in these markets, which is due to favorable demographics, consumption growth, relatively low debt levels and room for productivity. However, with higher returns also follows higher risks. Investing in emerging markets is commonly associated with currency risk, inflation risk, institutional risk, liquidity risk and political risk (website troweprice 2016).

According to MSCI, emerging markets yielded higher average net returns than developed markets for the period 2001-2015. Among emerging markets, the Asian markets started to earn higher net returns in 2015 (website MSCI 2016).

3.4.1 Observations of size premium

According to the Russell 2000 index, the small cap return premium is declining in the U.S market. From January 2014 - July 2015, small cap firms earned a return of approximately 8%, while big cap firms earn 16% (website Gerstein Fischer 2015). The story is however different for emerging markets, where the transition process enables a return premium to small cap firms.

In the 2000s, developing countries took a role as an exporting and manufacturing base for the rich and developed nations. The weakening of the U.S. dollar made exports more attractive to developed countries. Taking advantage of this economic trend, investors focused on investing in big cap firms such as manufacturing firms and state-owned firms in developing countries. Big firms earned a high return premium and small cap firms' premium was at bay. However, the macroeconomic situation in emerging markets has changed after the financial crisis 2009. The economic trend and policymakers in developing countries have shifted their economies to be more domestic consumption oriented. The exports have been declining due to the re-industrialization in the Western countries. Western countries have been relocating their manufacturing onshore instead of offshore in emerging markets.

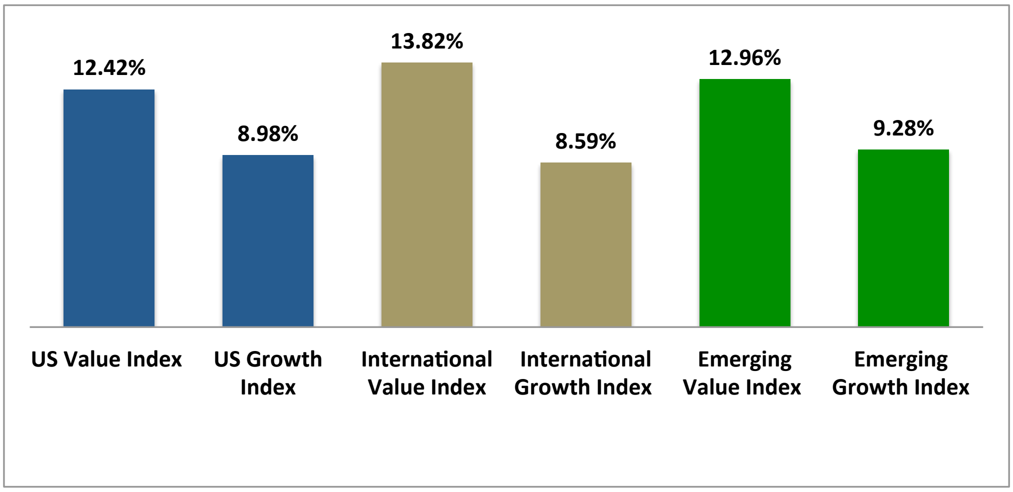
Small firms in emerging markets tend to have lower leverage than big firms. The increase in domestic consumption in developing nations enables small firms to earn a premium. The small-cap companies are favorable to investors due to reasonable valuations, improved earnings, better shareholder value and an enhanced return on equity (ROE). The prevalence of family-owned corporations in emerging markets translates to an attractive dividend income for both small- and large-cap firms in the region (website SSGA 2015).

Compared to big firms in emerging markets Asia, small firms have an advantageous competitive strategy, since they can deploy their scarce resources. Large companies tend to standardize their products and processes, manufacturing through counteract and distant facilities. Small firms are however competitive, since they are generally more flexible and can satisfy customer needs through customization at a lower cost (website Harvard Business Review 2016).

3.4.2 Observations of value premium

Value stocks are stocks with a high book-to-market ratio. In other words, they have a low market price relative to their book value. According to table 3.2, the value premium is present across various markets. The value premium of emerging markets is slightly higher than value premium of the U.S. market by 0.54% (website A wealth of common sense 2016).

Figure 3.2 Fama & French returns on value and growth stocks worldwide



- US Index: Period 1928-2015
- International Index: Period 1975-2015
- Emerging Index: Period 1989-2015

Source: Reproduced from website A wealth of common sense.com, 2016

Table 3.3 Emerging markets performance

Period	MSCI EM	Fama & French EM value	MSCI EM small cap	Fama & French EM small cap value
2005-2015	3.95%	5.27%	6.40%	7.51%
2000-2015	5.85%	9.16%	7.33%	9.15%

Source: Reproduced from website A wealth of common sense.com, 2016

Table 3.3 summarizes the performance of the stocks in emerging markets for 10 and 15 years. Although the value premium has been absent in the U.S. over the past decade, it is still alive in foreign and emerging markets, where small cap stocks have outperformed. to International Monetary Fund (IMF) reported that value stocks have been sold at a deep discount. Since 1995, the price-to-book ratio of stocks in emerging markets has been far below the price-to-book ratio of the stocks in developed markets for the period 1995-2006 (website Financial Times 2016**).

According to IMF, the discounted stocks of emerging markets should however not be regarded as cheap due to the decrease in GDP growth. China is claimed to be the force behind of this declining trend in the GDP in the region (website Bloomberg 2016).

3.5 Market integration

Market integration occurs when domestic investors can invest in foreign assets and foreign investors can invest in domestic assets. In integrated markets, assets with identical risk should generate the same expected rate of return, independent of country (website The National Bureau of Economic Research 2016).

Measuring the degree of market integration is a challenging task. Market liberalization is commonly considered as a prelude to financial integration. Table 3.4 presents the liberalization dates for China, India, South Korea and Taiwan. Although the liberalization of these markets started two decades ago, the changes in regulation have little impact on the functioning of capital markets and the changes in in- and outflows of capital.

Table 3.4 Liberation dates of China, India, South Korea and Taiwan

Country	Liberalization year (1)	Liberalization year (2)
China	1978	-
India	1991	-
South Korea	1991	1998
Taiwan	1987	1998

Source: own construction based on Bensidoun et al. 2008

There are two common methods for measuring the degree of market integration. The first approach is based on the 'ease of doing business' (World Bank). The second approach consists of a combination of the changes in regulation of market liberalization and its impact on investments in practice (Park 2013).

Ease of doing business is an annually published report by World Bank, measuring the regulations that enhance and constrain business activity. The rankings of China, India, South Korea and Taiwan are presented in table 3.5.

Table 3.5 The ease of doing business 2013 - ranking of 185 countries

Country	Ease of doing business (1)	Trading across borders (2)	Protecting investors (3)
China	91	68	100
India	132	127	49
South Korea	8	3	49
Taiwan	16	23	32

Source: Reproduced from World Bank, Doing Business 2013

According to table 3.5, column 2 shows the overall ranking of the countries with regards to the ease of doing business, which is the most important criteria. Column 3 and 4 present the following two sub-criteria: trading across borders and protecting investors. Based on the overall ranking, South Korea is most favorable to International investors (8), followed by Taiwan (16), China (91) and India (132). The ranking is consistent for the first two criteria, ease of doing business and trading across borders, but China is however the least favorable when it comes to protection of investors.

The other method for measuring the market integration is suggested by Park (2013), who combines de jure[14] and de facto[15] in order to measure the degree of integration in emerging markets Asia for the period 1970 to 2010. The de Jure method is used to measure the changes in legal regulations to promote the financial openness or cross-border financial allocation in each

[14] De jure: Based on or according to law
[15] De facto: Existing in fact, although perhaps not formally accepted

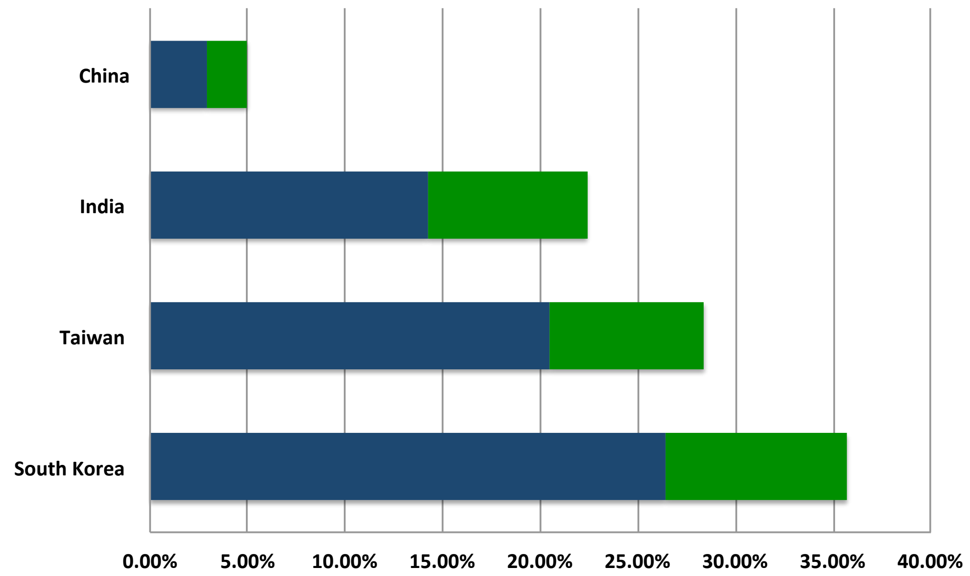
country. The de factor method is used to measure the results of de jure through the actual volume of foreign securities and stocks in the domestic market.

As can be recalled from the previous table with liberalization dates, emerging markets Asia started to deregulate their financial sector in the 1980s in order to promote the degree of market integration. However, only after the Asian financial crisis in 1997 did many Asian markets actively modernize their financial sectors to increase the integration of the domestic and regional markets. Park (2013) concludes that the capital markets of emerging markets Asia have integrated both at regional and global level. Figure 3.6 presents the percentage of variance in individual equity returns explained by global and regional shocks

According to the figure 3.6, the security market of South Korea is mostly affected by regional shocks, followed by India and Taiwan. Global shocks also have the largest effect on South Korea, followed by Taiwan and India. China is least affected by both regional and global shocks. Although the regional integration is still far from completion, the degree of integration in the equity markets of emerging markets Asia is increasing over time. This is especially the case for new industrial economies (NIEs), including China, South Korea and Taiwan from 2009.

According to figure 3.7, the spillovers from the world major economies such as China, the U.S., Japan and the Euro area to the Asian stock markets are presented through the beta coefficient. Before the global financial crisis (GFC), the Asian stock markets had a low degree of spillovers from China compared to the U.S. and Japan. The level of spillovers from China to the Asian stock markets has however increased substantially after the GFC.

Figure 3.6 % variance in individual equity returns explained by global and regional shocks, 1994–2011

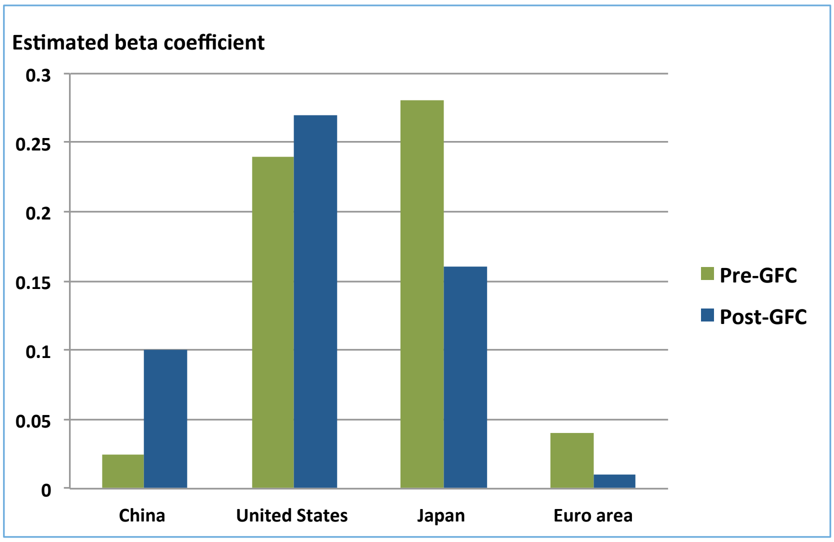


	South Korea	Taiwan	India	China
Global Shock	26.40%	20.50%	14.20%	2.90%
Regional Shock	9.30%	7.90%	8.20%	2.10%

Source: own construction based on Park 2013

According to table 3.8, a rising co-movement of Asian and Chinese markets is consistent with the region's rising business cycle synchronization. Countries with a high level of business synchronization with China have seen their equity markets move more closely with China on average. The figure indicates that the markets of South Korea and Taiwan are more correlated with the Chinese market compared with India (Arslanalp et al. 2016). The findings are consistent with Forbes' article regarding the top 10 China dependent countries (website Forbes 2015). Taiwan is ranked the second and South Korea is ranked the third, whereas India is not even on the top 10.

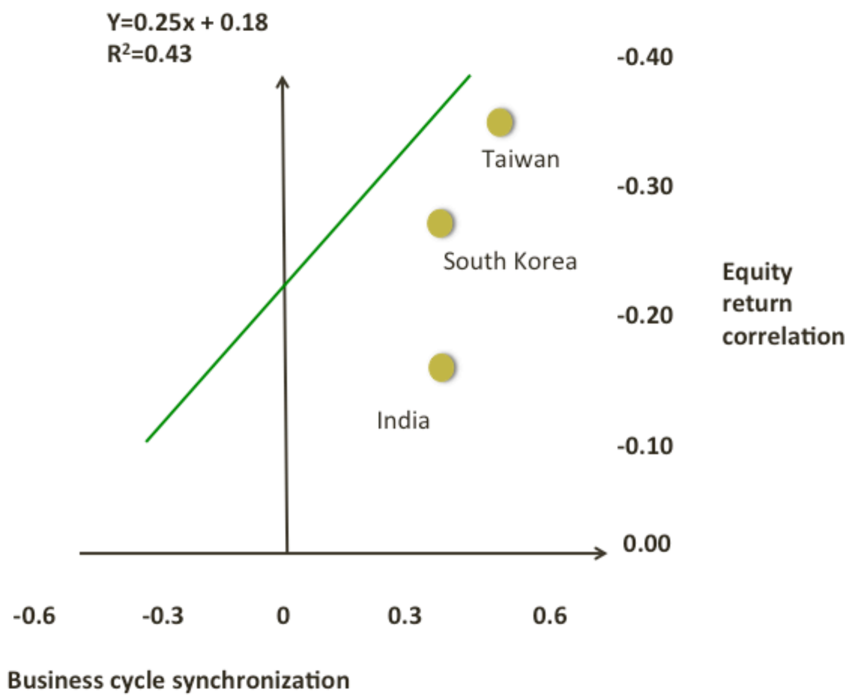
Figure 3.7. Asian stock market sensitivity to systematic economics



- GFC: Global Financial Crisis
- Pre-GFC from 2000-2007
- Post GFC from 2010-2014

Source: Reconstructed from Arslanalp et al. 2016

Figure 3.8 Business cycle synchronization and equity return correlation with China



Source: Reconstructed from Arslanalp et al. 2016

3.6 Sub-conclusion

According to MSCI, the four countries belong to the category emerging markets. FTSE, however, offers a more detailed approach, classifying the countries into different markets. South Korea is classified as a developed market, Taiwan is classified as an advanced emerging market and China and India are both classified as secondary emerging markets.

The equity markets of emerging markets Asia play a more important role in the global equity market due to high-expected returns and the increase in their proportion of market capitalization. The transition from an exporting and manufacturing economy towards a domestic consumption economy among the Asian developing countries enables small firms to start earning a premium. The stock prices in emerging markets have been sold at a cheaper price than the stocks in developed markets.

Emerging markets Asia have become more integrated with the global financial markets, but the degree is still limited. The market integration among China, India, South Korea and Taiwan are shown to be limited and at different levels. The equity markets of South Korea and Taiwan are the most integrated with the regional market, whereas China is the least integrated with the regional market. China is however the biggest economy in the region. Thus, the degree of market integration among the four countries should also be determined by how much the market in each country is affected by China.

Chapter 4 Method

4.1 Introduction and purpose

Chapter 4 provides the method on how to produce and interpret the statistical results of the paper.

Part 4.2 and 4.3 present the theory and the method on how to set up the regressions and how to construct the dependent and independent variables in the CAPM and the three-factor model. Part 4.4 explains the choice of risk-free rate. Part 4.5 explains the choice of time period and data frequency. Part 4.6 explains how the equal-weighted indices as proxies for the market portfolios are constructed. Part 4.7 describes how the market risk factor is constructed. Part 4.8 presents a summary of the ordinary least squares' (OLS) assumptions to ensure that the regressions are efficient and unbiased estimators for the data sample. Lastly, part 4.9 presents the statistical determinants of the model performance.

4.2 The CAPM

4.2.1 The domestic CAPM

The capital asset pricing model (CAPM) provides a formula that estimates the expected return on an asset or a portfolio based on its market risk. The formula is as follows:

$$\mathbf{E(r_i) - r_f = \alpha_i + \beta_{i,domestic}[E(_{m,domestic} - r_f] + \varepsilon_i}$$

α_i : the intercept term (pricing error)

$E(r_i)$: the expected return of asset or portfolio i

r_f : the return on the risk-free asset (risk-free rate)

$E(r_{m,domestic})$: the expected return of the domestic market portfolio

$\beta_{i_{domestic}}$: the domestic beta coefficient

ε_i : the error term of the regression

$R(r_i) - r_f$: the portfolio's expected excess return

$E(r_{m,domesic} - r_f)$: the market risk premium (MRP)

Note that the two terms market risk premium (MRP) and the market risk factor are used interchangeably. Further details of the construction of the market risk premium (MRP) will be presented later in this chapter.

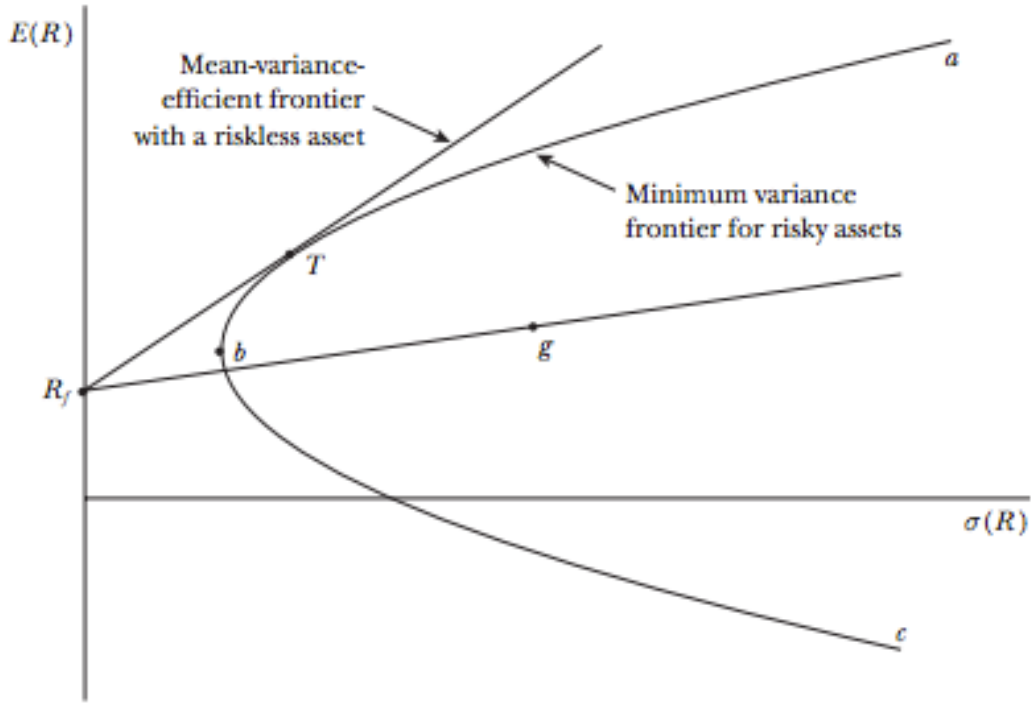
The CAPM is based on the following assumptions (Sharpe & Lintner 1964):

1. All investors are one-period planners who agree on a common input list from security analysis and seek mean-variance optimal portfolios.
2. There is no tax or transaction costs
3. All investors have homogenous expected returns
4. All investors can lend and borrow at risk-free interest rate. There is no restriction for all investors to take any long or short positions.

In the CAPM framework, the expected stock return only depends on its sensitivity to the expected market return. The sensitivity is captured by beta that measures the systematic risk that affects the overall stock markets. Unlike non-systematic risks, systematic risks cannot be mitigated through diversification. According to the CAPM, investors are only interested in portfolios that are mean-variance efficient. Investors aim to minimize the portfolio return variance for a given expected return and maximize expected return for a given variance. Figure 4.1 tells the CAPM story.

The horizontal axis shows the standard deviation of portfolio return, which represents portfolio risk. The vertical axis shows the expected return. The curve is called the minimum variance frontier and is a combination of portfolios of risky assets that minimize return variance at various levels of expected return. The efficient frontier tells a simple story about the minimum variance portfolios; there is a trade-off between expected return and risk. Thus an investor must accept higher risk in order to get a higher expected return. The efficient frontier is only the case in a world that does not allow borrowing and lending at a risk-free rate. Point b is the minimum variance portfolio, and only the portfolios along the curve above this point is mean-variance-efficient. So far we have only explained the story under the assumption of no risk-free borrowing and lending. When this assumption is disregarded, the efficient set turns into a straight line.

Figure 4.1 The CAPM



Source: (Fama & French 2004)

Mean-variance-efficient portfolios now lie on a line swinging from the risk-free rate r_f as far and up as possible to the tangency portfolio T. All efficient portfolios are thus combinations of the risk-free asset and a single risky tangency portfolio, T. At the point r_f, investors only invest in the risk-free security (a portfolio with a risk-free rate of return and zero variance).

According to the CAPM, all investors want to combine the same risky tangency portfolio T with either risk-free lending or borrowing. Since the portfolio T of risky assets is held by all investors, the portfolio must be the value-weight market portfolio of risky assets. The portfolio T can now be considered as a market portfolio M, where each risky asset's weight should correspond to the total market value of all outstanding assets divided by the total market value of all risky assets. The risk-free rate should be set to clear the market for risk-free borrowing and lending (Fama & French 2004).

In short, the CAPM indicates a positive linear relationship between expected stock returns and market risk.

4.2.2 The regional CAPM

The regional CAPM in this paper is based on the theory of Solnik (1974) and Griffin (2002). Solnik (1974) first introduced the International CAPM with the hypothesis that if markets are integrated, the domestic and international CAPM will perform equally well. In the other words, there should only be one set of risk factors to describe expected returns in integrated markets. Solnik's International CAPM is called the world CAPM by Griffin (2002). Since this model is only applied to measure the degree of market integration within the region of emerging market Asia, the model is called the regional CAPM. The formula of the model is based on the paper of Griffin (2002):

$$\mathbf{E(r_i) - r_f = \alpha_i + \beta_{i,regional}[E(r_{m,regional}) - r_f] + \varepsilon_i}$$

α_i : the intercept term (pricing error)

$E(r_i)$: the expected return of asset or portfolio i

r_f : the return on the risk-free asset (risk-free rate)

$E(r_{m,regional})$: the expected return of the regional market portfolio

$\beta_{i,regional}$: the regional beta coefficient

ε_i : the error term of the regression

The construction of the regional market risk factor and the regional market portfolio will be described later in the chapter.

4.3 The three-factor model

4.3.1 The domestic three-factor model

The domestic three-factor model is an extension of the domestic CAPM with two additional factors; size and value. The formula of the model is based on the paper of Fama & French (1993).

$$\mathbf{E(r_i) - r_f = \alpha_i + \beta_{i,domestic}(D.MRP) + s_{i,domestic}^{size}(D.SMB) + h_{i,domestic}^{value}(D.HML) + \varepsilon_i}$$

α_i : the intercept term (pricing error)

$E(r_i)$: the expected return of asset or portfolio i

r_f : the return on the risk-free asset (risk-free rate)

$\beta_{i,domestic}$: the domestic beta coefficient

$s_{i,domestic}$: the domestic size coefficient

$h_{i,domestic}$: the domestic value coefficient

D.MRP : the domestic market risk premium factor

D.SMB : the domestic size factor

D.HML : the domestic value factor

ε_i : the error term of the regression

where D.MRP is defined as the domestic market return minus the risk-free rate.
The domestic size factor, D.SMB (small minus big), captures the difference in returns on small and large cap portfolios. The value factor, HML (high minus low), captures the difference in returns on high and low book-to-market portfolios.

The SML and HML factors are computed by forming six portfolios according to firms' size and book-to-market ratio. First, the stocks in the sample are sorted according to the market cap before computing the market cap median. Stocks that fall into the lower half are classified as small (S) and stocks that fall into the upper half are classified as big (B). When the stocks have been divided into two groups, the firms can be sorted according to the book-to-market ratio for each size group (S and B). This is done by ranking the stocks according to the book-to-market ratio and then computing the 30th and 70th percentile. The bottom 30% stocks are classified as low (L), the top 70% are classified as high (H) and the middle 40% are classified as medium (M). Thus, by combining the two size groups and three value groups we end up having 6 portfolios: small low (SL), small medium (SM), small high (SH), big low (BL), big medium (BM) and big high (BH) (website Kenneth R. French 2016). Figure 4.2 illustrates the construction of factors.

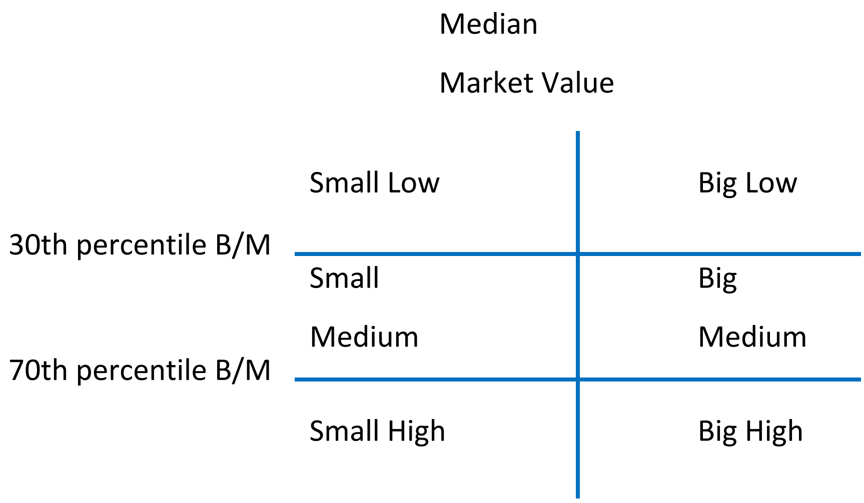
SMB is computed by taking the difference between the simple average return of the three small-stock portfolios (SL, SM, SH) and the simple average return of the three big-stock portfolios (BL, BM, BH).

$$\mathbf{SMB} = \frac{\mathbf{r_{SL} + r_{SM} + r_{SH}}}{\mathbf{3}} - \frac{\mathbf{r_{BL} + r_{BM} + r_{BH}}}{\mathbf{3}}$$

Likewise, HML is computed by taking the difference between the simple average return on the two high book-to-market ratio portfolios and the simple average return of the two low book-to-market ratio portfolios.

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

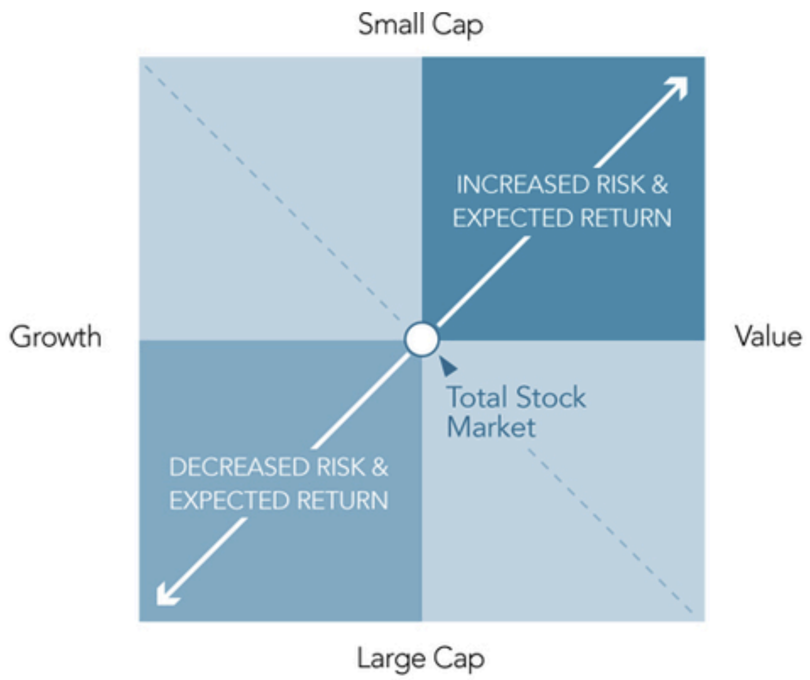
Figure 4.2 Construction of portfolios



Source: own construction based on (Fama & French, 1993)

Figure 4.3 illustrates the relationship of expected stock returns and market risk across different portfolios. Small cap stocks with a high book-to-market ratio (value stocks) are the riskiest. Thus, investors would require compensation through higher expected returns in order to hold these stocks. Big cap stocks with a low book-to-market ratio (growth stocks) are less risky, why investors require a lower expected return.

Figure 4.3 Risk and return



Source: website Financialplaninc 2016

4.3.2 The regional three-factor model

The regional thee-factor model is based on the world three-factor model by Griffin (2002). Similar to the regional CAPM, the regional three-factor model is only applied to measure the degree of market integration within the region of emerging market Asia.

$$\mathbf{E(r_i) - r_f = \alpha_i + \beta_{i,regional} R.MRP + s^{size}_{i,regional} E(R.SMB) + h^{value}_{i,regional} (R.HML) + \varepsilon_i}$$

α_i : the intercept term (pricing error)

$E(r_i)$: the expected return of asset or portfolio i

r_f : the return on the risk-free asset (risk-free rate)

$\beta_{i,regional}$: the regional beta coefficient

$s_{i,regional}$: the regional size coefficient

$h_{I,regional}$: the regional value coefficient

R.MRP : the regional market risk premium factor

R.SMB : the regional size factor

R.HML : the regional value factor

ε_i : the error term of the regression

R.SMB and RHML are computed by pooling the stocks of all four countries together before following the same method for the domestic three-factor model. By pooling the four countries together, we ignore cross-country differences such as those found in accounting conventions (Griffin 2002).

4.3.3 The International three-factor model

The International three-factor model is developed to distinguish between the impact of domestic and foreign factors on expected stock returns of a country. What this model does is to decompose the regional model into its domestic and foreign components. The formula of the model is based on the paper of Griffin (2002).

$$\mathbf{E(r_i) - r_f = \alpha_i + \beta_{i,domestic}(D.MRP) + s^{size}_{i,domestic}E(D.SMB) + h^{value}_{i,domestic}(D.HML) + \beta_{i,foreign}(F.MRP) + s^{size}_{i,foreign}(F.SMB) + \beta^{value}_{i,foreign}(F.HML) + \varepsilon_i}$$

α_i : the intercept term (pricing error)

$E(r_i)$: the expected return of asset or portfolio i

r_f : the return on the risk-free asset (risk-free rate)

$\beta_{i,domestic}$: the domestic beta coefficient

$s_{i,domestic}$: the domestic size coefficient

$h_{I,domestic}$: the domestic value coefficient

$\beta_{i,foreign}$: the foreign beta coefficient

$s_{i,foreign}$: the foreign size coefficient

$h_{I,foreign}$: the foreign value coefficient

D.MRP : the domestic market risk premium factor

D.SMB : the domestic size factor

D.HML : the domestic value factor

F.MRP : the foreign market risk premium factor

F.SMB : the foreign size factor

F.HML : the foreign value factor

ε_i : the error term of the regression

In order to construct the foreign factors of a country, the returns of the other three countries are first pooled together before following the same method as for the domestic three-factor model.

4.4 The risk-free rate r_f

The risk-free rate is the theoretical rate of return associated with zero risk. Although not entirely risk-free, government-issued t-bills are considered as quite riskless. A common proxy for this measure is often the 90-day US treasury t-bill, since it is considered as the most risk-free rate available due to exclusion of maturity, liquidity and default risk (website Ben Etzkorn 2011). Others argue that a 30-year treasury is better since companies are on-going entities.

A 3-month US treasury bill represents the risk-free rate in this paper. The data was converted into U.S. dollars due to two reasons. First, this paper aims to take the perspective of International investors, since USD is the dominating currency in the world capital market.

4.5 Time period and data frequency

Estimation generally becomes more precise as the number of observations increases. Hence, it is preferred to use a long time period as possible. This rule of thumb can however not be applied in the estimation of beta, since the beta changes over time. Thus a too long time period can result in a biased beta.

A 15-year period is chosen due to the fact that the majority of existing firms in our data have existed for approximately 15 years. Furthermore, emerging markets Asia do not have a long history of stock trading and are immature compared with developed markets. Thus, recent data will reflect the stock returns in these markets more accurately (Daves et al. 2000).

The increase of the sample observations can also be achieved by using more frequent trading periods such as daily or weekly returns. This however causes an increase in the amount of noise in the estimation. Thus, monthly data is used for this analysis (Bartholdy and Peare 2005).

4.6 Proxies for market portfolio

According to Roll (1977), the CAPM has never been tested correctly. The challenge is to determine the market portfolio, both theoretically and empirically. It is theoretically unclear which assets should be included and excluded in the market portfolio, and the availability of data limits the number of assets included. Thus, proxies for the market portfolio are required when testing for the CAPM (Fama and French, 2004). A widely used approach is to use an index as a proxy for the market portfolio when testing the CAPM. Using such an index has however been criticized for not representing a true composition of the market portfolio, since it only contains common stocks that are most likely listed on the NYSE (Reilly & Brown, 2012).

Custom equal-weighted indices based on an average of the stocks in our data sample are used as market proxies. This method is justified by two reasons. First, the market portfolio should contain all risky assets, which is not the case for the publicly listed indices. The problem is that the universe underlying published indices is not as broad as our dataset. Second, publicly listed indices often rely on proprietary weighting schemes (Bruner et al. 2008).

Custom equal-weighted indices are used as proxies for the market portfolio to derive our main results. The market risk premium is calculated applying method 1.

Method 1

$$\begin{aligned}
\mathrm{MRP}_{\mathrm{custom.China}} &= \text{equal weighted index}_{\mathrm{China}} - \mathrm{r_f} \\
\mathrm{MRP}_{\mathrm{custom.India}} &= \text{equal weighted index}_{\mathrm{India}} - \mathrm{r_f} \\
\mathrm{MRP}_{\mathrm{custom.South\ Korea}} &= \text{equal weighted index}_{\mathrm{South\ Korea}} - \mathrm{r_f} \\
\mathrm{MRP}_{\mathrm{custom.Taiwan}} &= \text{equal weighted index}_{\mathrm{Taiwan}} - \mathrm{r_f} \\
\mathrm{MRP}_{\mathrm{custom.region}} &= \text{equal weighted index}_{\mathrm{region}} - \mathrm{r_f}
\end{aligned}$$

MSCI indices are later used as proxies for the market portfolio to verify the sensitivity of the results to the choice of market portfolio. The market risk premium is calculated by applying method 2.

Method 2

$$MRP_{MSCI.China} = \text{MSCI index}_{China} - r_f$$
$$MRP_{MSCI.India} = \text{MSCI index}_{India} - r_f$$
$$MRP_{MSCI.South\ Korea} = \text{MSCI index}_{South\ Korea} - r_f$$
$$MRP_{MSCI.Taiwan} = \text{MSCI index}_{Taiwan} - r_f$$
$$MRP_{MSCI.region} = \text{MSCI index}_{region} - r_f$$

4.8 Ordinary Least Square Assumptions

The statistical technique ordinary least squares (OLS) regression, often called linear regression, is used to estimate the unknown parameter, excess return, in the CAPM and three-factor models mentioned above. Following are the underlying assumptions for OLS, which must be met in order for the estimators to be the best linear unbiased estimator (BLUE). In other words $\hat{\beta}$, $\hat{s}$ and $\hat{h}$ are the best linear unbiased estimators for the true parameters β, s and h. 'Best' indicates that the OLS estimator has a minimum variance and implies that the chosen estimator (OLS estimator) is closer to the true value compared to alternative estimators. The relationship should be linear - otherwise, OLS is not applicable. 'Unbiased' is important to stress, since biased estimators with lower variance exist. 'Unbiased' indicates that the true relationship between x and y can be described by the estimated alpha and beta. According to the Markov's theorem, the OLS estimator is BLUE when the following assumptions are met:

1 Linearity

- The OLS regression model is linear in parameters, indicating that the relationship between the dependent variables and the explanatory variables are linear.

- If this assumption is violated, a linear regression might be inappropriate in explaining the relationship.
- Testing method: scatter plots of the dependent variables and the explanatory variables are used to detect nonlinearity. If a curved band or a big wave-shaped curve is observed, the violation of linearity is violated.

2 Autocorrelation

- Autocorrelation is present when the error terms are correlated, indicating that observations are dependent.
- The presence of autocorrelation will inflate the t-statistics by underestimating the standard errors of the coefficients. Hypothesis testing will therefore lead to incorrect conclusions.
- Testing method: This assumption can be tested via null hypothesis testing of no-autocorrelation. In SAS Enterprise package, select Durbin-Watson (DW). A DW value between 1.5 and 2.5 confirms the absence of the first-order autocorrelation.

3 Normal Distribution of error terms

- Normal distribution of error terms implies that the errors are normally distributed with mean zero.
- This assumption insures that the p-values will be efficient due to minimum standard errors.
- Normal distribution of error terms can be detected by plotting residual values in SAS Enterprise.

4 No heteroskedasticity

- No heteroskedascticity is a crucial assumption of the OLS regression model. Non-heteroskedasticity implies that the variance of the error term is constant. Heteroskedasticity can be due to an omitted variable. This occurs when the portion of the omitted effect, which is not included by explanatory variables, may be absorbed by the error term.

- The presence of heteroskedasticity does not cause biased estimators but causes problems of efficiency due to inaccurate standard errors. Consequently, p-values are no longer reliable, resulting in misleading conclusions.
- The test of heteroskedasticity can be detected via White tests, which are default in SAS Enterprise.

5 Multicollinearity

- Multicollinearity implies that the independent variables are strongly collinear. This assumption is only applied for multi-factor regressions.
- If the assumption of no multicollinearity is violated, parameter estimates are wrong.
- No multicollinearity can be tested via variance inflation factor (VIF) tests in SAS Enterprise. If the VIF values exceed 10, multicollinearity is present among independence variables.

Assumptions 1-4 are applied for single-factor regressions such as the CAPM. All 5 assumptions are applied for multi-factor regressions such as the three-factor model. Table 4.6 summarizes these 5 assumptions.

Table 4.6 OLS assumption summary

No.	Assumptions	Test method	Result requirements
1	Linearity	Plotting dependent and independent variables	A graph shows a linear line
2	No-autorotation	Durbin-Watson (DW)	DW falls within a range from 1.5-2.5
3	Normal Distribution	Plotting residuals/ error terms graphically	A graph is equally distributed and centered at 0
4	No heteroskedasticity	p value of Chi-square	p value exceeds 5% (p<5%)
5	No. multicolinearity	Variance inflation factor (VIF)	VIF value is smaller than 10 (VIF< 10)

Source: own construction based SAS and Institute for digital research and education (2016)

For further details of the OLS assumptions, this paper refers the three following websites;

- SAS
- Institute for digital research and education (2016)
- Ohio State University

4.9 Statistical determinants of model performance

The performance of the CAPM and the three-factor models in this paper is evaluated according to the following statistical determinants; R^2, p-value, F-test and intercept values.

4.9.1 R^2

R^2 is the coefficient of determination and provides a descriptive measure of the proportion of the variance in the dependent variable explained by the explanatory variables.

R^2 can take a value from 0-1, where higher values of R^2 indicates a high explanatory power. The R^2 increases whenever a new variable is added to the model. Thus, an increase in R^2 is not necessarily due to an improvement of the fit of the model. To correct this problem in multiple-factor models, adjusted R^2 should be used, since an increase in the number of variables do not necessarily increase the adjusted R^2.

It is important to note the R^2 and the adjusted R^2 do not tell you whether included variables are significant nor whether the movements in the dependent variable is actually caused by the explanatory variables. Neither do the measures tell you whether there is omitted variable bias nor whether the included explanatory variables are appropriate.

4.9.2 p-value

The probability value also known as the p-value is used in in statistical hypothesis testing of a model and its coefficients. A two-tailed null hypothesis test is the most common method, where we test the null hypothesis against an alternative hypothesis. In this paper, the null hypothesis (H_0) is that the true coefficient is equal to 0, and the alternative hypothesis (H_A) is that the true coefficient is different from 0. This can be written as:

$\mathrm{H_0}$: coefficient $= 0$
$\mathrm{H_A}$: coefficient $\neq 0$

In order to reject the null hypothesis, a level of statistical significance is picked. This paper operates with a level of statistical significance of 5%. If the p-value is below 5%, the null hypothesis is rejected, indicating that the coefficient is statistically significant at the 5% level. If the p-value exceeds 5%, we fail to reject the null hypothesis (Stock 2012).

4.9.3 F-test

A F-test is used to test the significance of the coefficients included in a regression model. The F-test checks whether two or more coefficients are jointly equal to 0. The F-test enables us to test for joint hypotheses, which differentiates it from a t-test where a single parameter is tested (Newbold, 2010).

4.9.4 Pricing error

The predicted alpha (intercept) is the pricing error of the asset-pricing models and should equal 0 (Fama & French 1993). Thus, null hypothesis testing of the intercept in our regressions should be carried out. This can be written as:

$\mathrm{H_0}$: intercept $\propto = \mathbf{0}$
$\mathrm{H_A}$: intercept $\propto \neq \mathbf{0}$

If the p-value of the intercept is below 5%, the null hypothesis is rejected and the intercept is concluded to be different from zero at the 5% level of significance. This indicates that the linear regression cannot fully capture the expected stock returns. If the p-value on the other hand exceeds 5%, we fail to reject the null hypothesis at the 5% level. This indicates that the linear regression can fully capture the expected stock returns.

4.10 Sub-conclusion

Chapter 4 presents the theory of CAPM and the three-factor model at domestic and regional level, going through the method of portfolio and factor construction. Portfolios and factors are constructed based on the market cap and the book-to-market ratio.

To ensure the CAPM and the three-factor models are the best linear unbiased estimators (BLUE), the regressions must meet the following OLS assumptions; linearity, normal distributions of error terms, no autocorrelation, no heteroskedasticity and no multicollinearity.

The performance of the models is evaluated according to the following set of statistical determinants; (adjusted) R^2, p-value, F-test and pricing error.

Chapter 5 Data Summary

5.1 Introduction and purpose

Chapter 5 provides a statistical summary of our data sample in order to identify the data pattern. This is a necessary before analyzing the results in chapter 6.

Part 5.2 provides a descriptive data summary of the stock data by country. Part 5.3 presents a summary of the dependent variables. Lastly, part 5.4 provides a summary of the explanatory variables.

5.2 Country data summary

The data in this chapter consists of stock returns, market values (market cap) and book-to-market ratios by country.

The data was extracted from Datastream in week 39 2016, at Copenhagen Business School, covering the period July 2001 - June 2016. All values are converted into U.S. dollars for two reasons. First, U.S. dollars are the dominating currency in the world. Second, the results of most empirical research on the CAPM and the three-factor model have been reported in U.S. dollars. Thus, presenting the results of this paper in the same currency will enable us to compare the results with previous research. The data is extracted as follows:

- Datastream / Time-series / Equity and Indices / Constituent List
- Select: MV, market-to-book value, WC06001 (firm name), TRBC BUSI SEC CODE (industry code), TRBC BUSI SEC NAME (industry name)

All financial service firms consisting of real estate and insurance firms are excluded from the data (Foerster & Sapp 2005) due to their high degree of leverage, which does not signal financial distress (Fama & Macbeth 1973). The firms are sorted by industry according to the Thomas Reuters Business Classifications (TRBC). All firms with an industry code starting with 55 belong to the financial sector and were thus removed from the sample.

In addition, firms with a negative book-to-market ratio were also excluded from the sample, since firms with a limited liability structure cannot have a negative book value. Thus, negative book-to market ratios are difficult for interpretation (Brown et al. 2008).

Table 5.1 Constituent list and number of firms by country

Market	Constituent name	Symbol	# firms listed by Nov. 2016	# firms selected for analysis
China	Shanghai A-Share Index_C	LCHSASHR	1,121	963
India	Nifty 500	LICRI500	501	400
South Korea	KORCOMP	LKORCOMP	769	691
Taiwan	TAIWAN (TAIEX)	LTAIWGHT	845	771
Total firms			3,236	2,825

Source: own construction based on data extracted from Datastream, November 2016

Table 5.1 presents the number of firms on the chosen constituent lists for each country and the number of firms that was selected for the sample. 3,236 firms were extracted from Datastream, however only 2,825 firms were selected for our data sample. Approximately 400 firms were excluded due to either being financial firms or firms with a negative book-to-market ratio.

The data of each country is grouped into 6 portfolios, based on their market cap and book-to-market ratio. The portfolios are as follows: small-low (SL), small-medium (SM), small-high (SH), big-low (BL), big-medium (BM) and big-high (BH).

Table 5.2 presents the number of firms by portfolio and country. The Chinese firms constitute for the majority of the data with 963 firms, whereas the number of firms in India only amounts to 400. The total number of firms in the sample amounts to 2,825 firms. This number exceeds the number of firms in the MSCI index of emerging markets (Asia and Europe) by over one-third. Since the MSCI index only consists of 832 medium- and big-sized firms (MSCI 2016), it is questionable whether the limited number of firms can represent emerging markets Asia. Thus 2,825 firms are included in the sample in order to compute a more accurate proxy for the market portfolio.

Table 5.2 Numbers of firms by portfolio and country

Country	SL	SM	SH	BL	BM	BH	Total
China	138	198	142	191	165	129	**963**
India	68	69	64	79	42	78	**400**
South Korea	104	139	104	103	138	103	**691**
Taiwan	116	153	116	116	154	116	**771**
Total	**426**	**559**	**426**	**489**	**499**	**426**	**2,825**

Source: own construction based on data extracted from Datastream, November 2016

Table 5.3 presents the market cap in million U.S dollars for the portfolios of China, India, South Korea and Taiwan. The market cap of China and India account for the majority of the total market cap of the four markets, 36% and 34% respectively. The market cap of South Korea constitutes for 18% and the Taiwan constitutes for the remaining 12%.

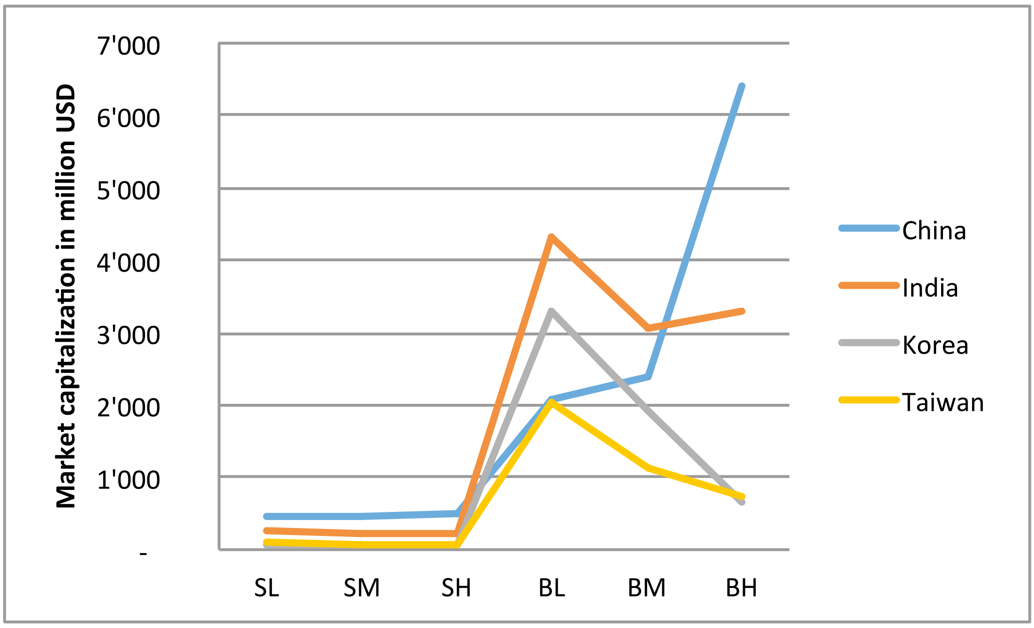
Table 5.3 Market cap by Portfolio and Country (unit in USD million)

Country	SL	SM	SH	BL	BM	BH	Total	Percentage
China	463	459	489	2,066	2,378	6,426	12,281	36%
India	278	225	205	4,304	3,043	3,290	11,345	34%
South Korea	55	57	56	3,300	1,898	650	6,016	18%
Taiwan	99	84	68	2,017	1,145	727	4,140	12%
							33,782	**100%**

Source: own construction based on data extracted from Datastream, November 2016

Figure 5.4 illustrates the market cap of the four countries. The market cap of small firms ranges from USD 55 million to USD 500 million. Among the small firms, China's market cap is the highest, followed by India, Taiwan and lastly South Korea.

Figure 5.4 Market cap by portfolio and country

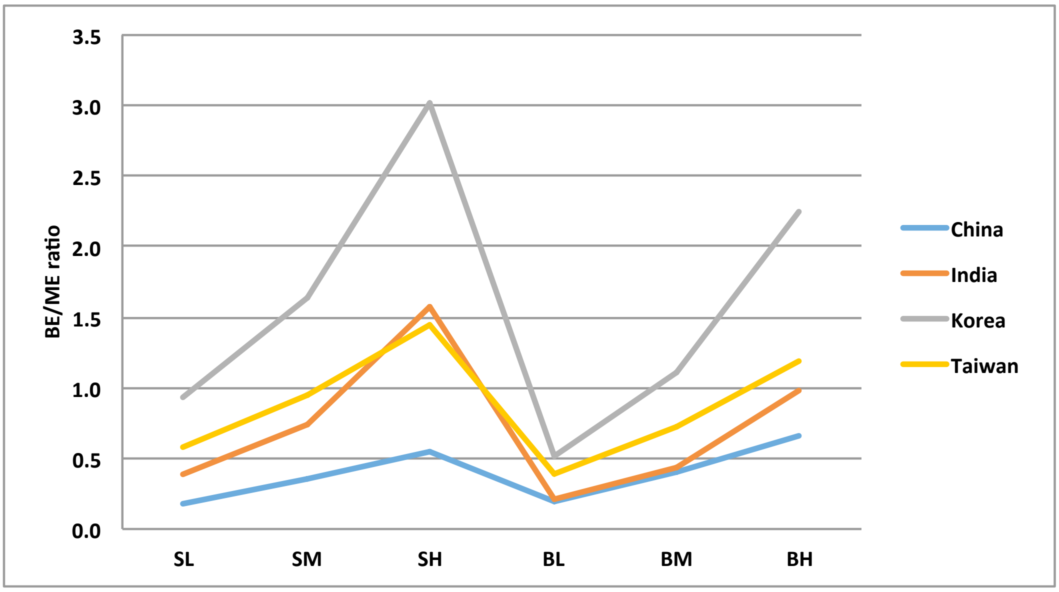


Source: own construction based on data extracted from Datastream, November 2016

For India, South Korea and Taiwan, the highest market cap is found in the BL portfolio, ranging from USD2000 million to USD4000 million. The market cap of China, however, increases with the level of book-to-market value.

Figure 5.5 illustrates the average book-to-market ratio by portfolio and country. Across both low and high book-to-market portfolios (SH and BH), China has the lowest book-to-market ratio, indicating that the Chinese stocks are sold at a high price relative to its book value. The portfolios of South Korea have the highest book-to-market ratio, which indicates the country's stocks are sold at the lowest price relative to its book value among the four countries.

Figure 5.5 Book-to-market ratio by portfolio and country



Source: own construction based on data extracted from Datastream, November 2016

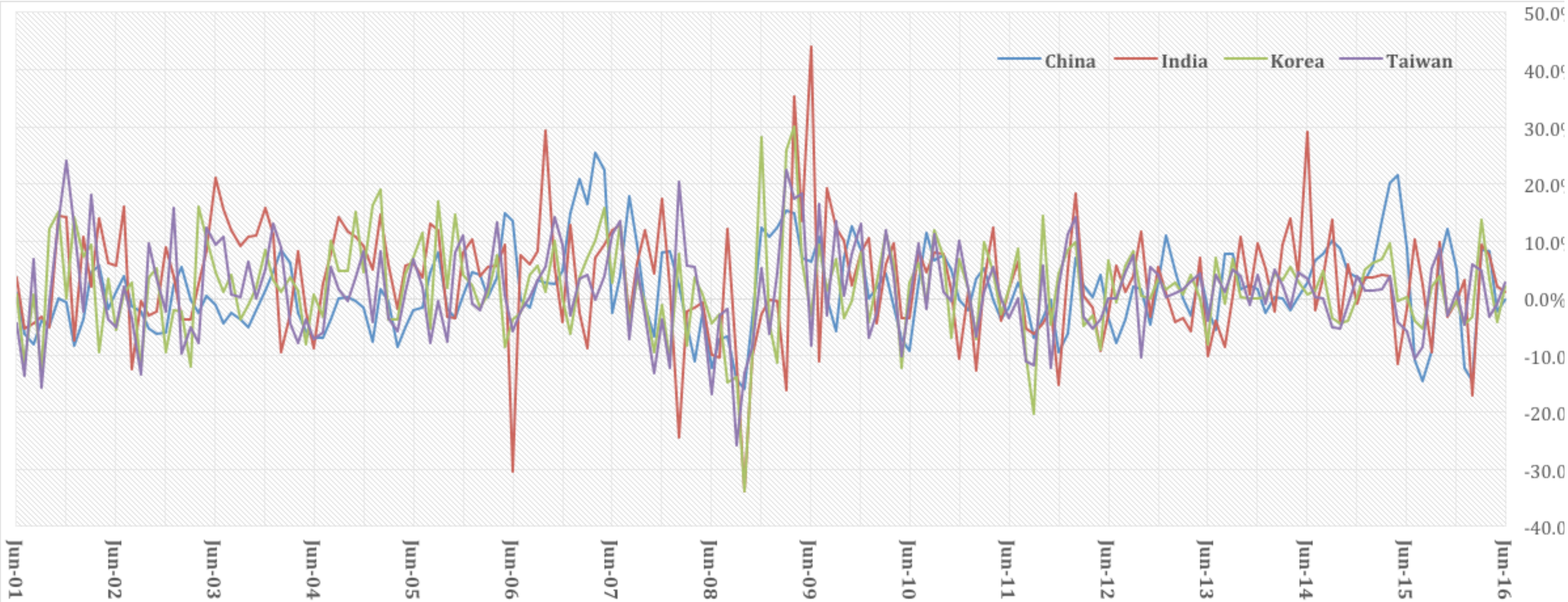
Figure 5.6 illustrates the average monthly excess returns for each country. The figure shows that the stock returns in the four countries are more volatile prior to 2009. The volatility of stock returns reaches its peak during the global financial crisis from end-2008 to mid-2009. The excess returns of all countries became less volatile from 2009 onwards.

It seems like the Asian financial crisis of 2007-2008 have had a strong impact on the excess returns of all four countries. Since mid-2008, the excess returns in the four countries seem to follow a pattern, which was not the case prior to the period. This can be an indication of an increased degree in market integration of the four stock markets after 2008.

Among the four countries, the excess returns of India and Taiwan are the most volatile during the whole sample period. During the global financial crisis, also these two countries were the most vulnerable.

Figure 5.6 Monthly excess returns by country

Source: own construction based on data extracted from Datastream, November 2016

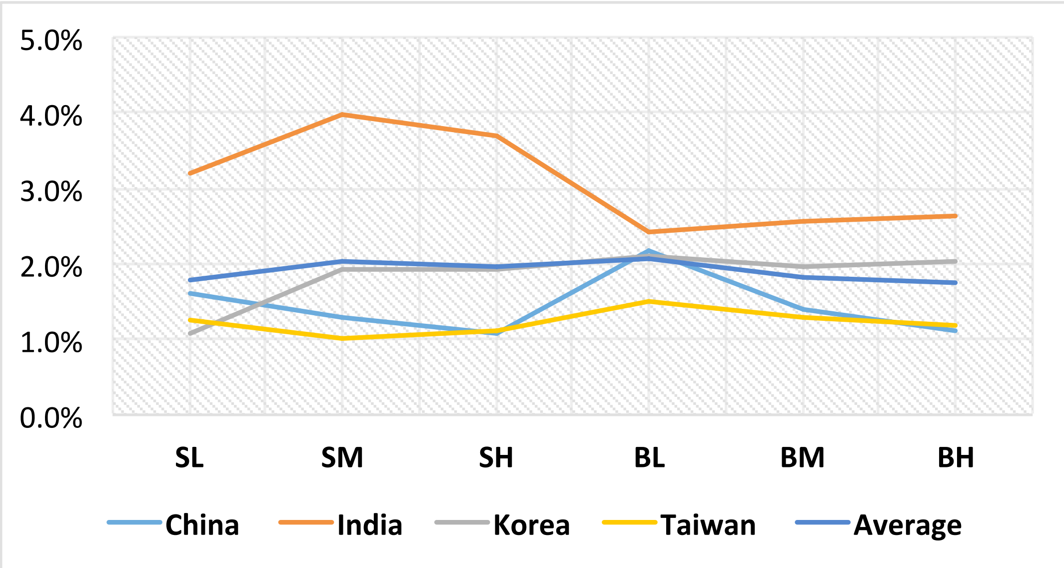


5.3 Dependent variables

This part provides a summary of the excess return and the volatility (standard deviation) by portfolio and country.

Figure 5.7 and 5.8 present the average monthly portfolio excess returns and the standard deviation for each country. India has the highest monthly excess return of 3.1%, followed by South Korea, China and Taiwan. Again, the Indian stock market is confirmed to be the most volatile with a monthly standard deviation of 10.9%, closely followed by China with a monthly standard deviation of 10.1%. The stock markets of South Korea and Taiwan are relatively less volatile than China and India with a monthly average standard deviation of 8.7% and 8.1% respectively.

Figure 5.7 Average monthly excess returns by portfolio and country

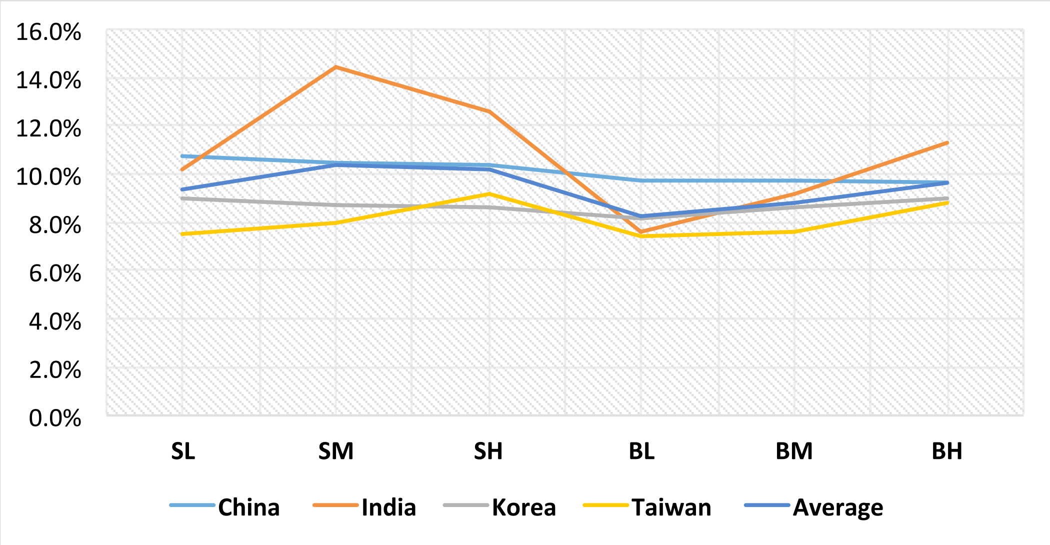


Source: own construction based on data extracted from Datastream, November 2016

The excess return and the volatility for the portfolios do not seem to follow the same pattern across countries. For China, big firms with a low book-to market ratio (BL) generate the highest monthly average excess returns of 2.2%, whereas small portfolios with a high book-to-market value (SH) generate the lowest monthly average excess return of 1.1%.

The monthly standard deviation is higher for the small firms of China, surpassing 10%, which is not the case for the monthly standard deviation of small China firms.

Figure 5.8 Average monthly standard deviation by portfolio and country



Source: own construction based on data extracted from Datastream, November 2016

For India, the portfolios of small firms have clearly higher excess returns than those of big firms, ranging from 3.2%-4% for small firms and 2.4%-2.6% for big firms. Similar to China, the small portfolios are more volatile than the big ones.

For South Korea, the average excess stock returns are quite similar across different portfolios. Overall, the big firms have higher monthly excess returns than small firms. SL portfolios generate the lowest monthly average excess returns of 1.1%.

For Taiwan, the monthly average excess returns follow a similar pattern to those of South Korea; big firms have slightly higher excess returns than small firms, ranging from 1.2%-1.5% for big firms and 1.1%-1.2% for small firms. The most volatile portfolio in Taiwan is SH, the standard deviation being 9.2%.

5.4 Explanatory variables

This part provides the average excess return and correlation summary of explanatory for regressions in this analysis.

Table 5.9 presents the monthly average returns of the explanatory variables by country and region. The explanatory variables are the custom market risk premium (MRP.custom), MSCI market risk premium (MRP.MSCI), small minus big (SMB), high minus low (HML), which are also called factors in the CAPM and the three-factor model. The factor, which plays a role as market risk proxy in this paper, is MRP.custom and alternatively MRP.MSCI. Factors SMB and HML are proxies for firm specific risk.

Table 5.9 Monthly average returns of explanatory variables

Factor	Region	China	India	South Korea	Taiwan
MRP.custom	1.7%	1.4%	1.3%	1.9%	1.2%
MRP.MSCI	0.8%	1.1%	3.1%	1.1%	0.6%
SMB	0.0%	-0.2%	1.1%	-0.4%	-0.2%
HML	-0.1%	-0.8%	0.4%	0.4%	-0.2%

Source: own construction based on data extracted from Datastream, November 2016

According to the classifications of Pearson, a low correlation ranges from (-)0.1 to (-)0.3, a medium correlation ranges from (-)0.3 to (-)0.5 and a high correlation ranges from (-)0.5 to (-)1. When the correlation of two variables exceeds (-)0.7, one should perhaps be disregarded in order to remove multicollinearity as explained in chapter 4 (Tabachnick, B. G., & Fidell, L. S. 1996).

Table 5.10 presents the correlation between the factors of different models. Correlations exceeding (-)0.7 are marked with grey in the table, indicating a strong correlation between China, South Korea and Taiwan's market risk premium with and the regional market risk premium.
The correlation between the Indian and regional market risk premium is however low.
The high correlations between the regional and country market risk factor of China, South Korea and Taiwan may indicate that the three countries are integrated. The low correlation between the

Table 5.10 Correlations of explanatory variables

Note: MRP = Equal-Weighted Index - Risk Free Rate

* Significant at 5%   ** significant at 1%;

Source: own construction based on data extracted from Datastream, November 2016

		Region			China			India			South Korea			Taiwan		
		MRP	SMB	HML	MRP	SMB	HML	MRP	SMB	HML	MRP	SMB	HML	MRP	SMB	HML
Region	MRP	1														
	SMB	-0.1														
	HML	0.0	0.8**													
China	MRP	0.7**	-0.6**	-0.6**												
	SMB	0.2*	-0.2**	-0.5**	0.4**											
	HML	0.0	0.1	0.3**	-0.1	-0.5**										
India	MRP	0.5**	0.0	0.1	0.1	0.0	0.0									
	SMB	0.1	0.1	0.1	0.0	-0.1	0.1	0.5**								
	HML	0.2**	0.1	0.2**	-0.1	-0.1	-0.1	0.6**	0.4**							
South Korea	MRP	0.8**	0.4**	0.5**	0.3**	0.0	0.0	0.3**	0.1	0.1						
	SMB	0.0	0.1	-0.1	0.0	0.1	-0.1	-0.1	0.0	-0.1	0.0					
	HML	0.3**	0.0	0.1	0.2**	-0.1	0.2*	0.1	0.0	0.0	0.2**	-0.2**				
Taiwan	MRP	0.7**	0.4**	0.3**	0.3**	0.0	0.1	0.2*	0.0	0.1	0.6**	-0.1	0.2*			
	SMB	0.1	0.1	-0.1	0.1	0.0	0.1	-0.1	0.1	-0.1	-0.1	0.1	0.1	0.1		
	HML	0.2**	0.1	0.1*	0.1	0.0	0.0	0.1	0.0	0.0	0.1	-0.2*	0.2*	0.4**	0.3**	1.0

Table 5.11 Correlation of explanatory variables

* Significant at 5% ** significant at 1%;

Source: own construction based on data extracted from Datastream, November 2016

		Region			China			India			South Korea			Taiwan		
		MRP	SMB	HML	MRP	SMB	HML	MRP	SMB	HML	MRP	SMB	HML	MRP	SMB	HML
Region	MRP	1														
	SMB	-0.1														
	HML	0.0	0.8**													
China	MRP	0.8**	-0.1	0.0												
	SMB	0.0	-0.2**	-0.5**	0.0											
	HML	-0.1	0.1	0.3**	-0.1	-0.5**										
India	MRP	0.8**	-0.1	0.1	0.6**	-0.1	0.1									
	SMB	0.0	0.1	0.1	0.1	-0.1	0.1	0.1								
	HML	0.4**	0.1	0.2**	0.4**	-0.1	-0.1	0.4**	0.4**							
South Korea	MRP	0.9**	0.0	0.0	0.6**	0.0	-0.1	0.6**	0.1	0.3**						
	SMB	0.0	0.1	-0.1	0.0	0.1	-0.1	0.0	0.0	-0.1	-0.1					
	HML	0.1	0.0	0.1	0.0	-0.1	0.2*	0.1	0.0	0.0	0.1	-0.2**				
Taiwan	MRP	0.8**	-0.1	0.0	0.6**	0.0	0.0	0.6**	0.0	0.2**	0.8**	-0.1	0.0			
	SMB	0.0	0.1	-0.1	-0.1	0.0	0.1	0.0	0.1	-0.1	0.0	0.1	0.1	0.1		
	HML	0.0	0.1	0.1*	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.2*	0.2*	0.1	0.3**	1.0

Indian and regional market risk factor, however, may indicate that India is less integrated with the other three countries. The regional SMB and HML factor are also strongly correlated with a correlation of 0.8, indicating a multicollinearity problem. Whether multicollinearity is present in the regional model will be confirmed through variance inflation tests in chapter 6.

Table 5.11 also presents the correlation between the factors of the different models using MSCI indices as a market portfolio proxy. Correlations exceeding (-)0.7 are marked with grey in the table, indicating a strong correlation between the four countries' market risk premium with the regional market risk premium. The high correlations between the regional and countries' market risk factor may indicate that the three countries are integrated. The regional SMB and HML factor are also strongly correlated with a correlation of 0.8, indicating a multicollinearity problem. Whether multicollinearity is present in the regional model will be confirmed through variance inflation tests in chapter 6.

The pattern in the correlations presented in table 5.10 and 5.11 is similar, except for India, where the high correlation between the Indian and regional market risk premium in table 5.11 indicates a higher integration with the other three countries than suggested in table 5.10.

5.5 Sub-conclusion

The total market cap in the region is constructed from China, India, South Korea and Taiwan. China constitutes for 36%, whereas India constitutes for 34%. South Korea and Taiwan both constitute for 30% of the total market cap in the region.

In general, the excess returns of the four markets were more volatile prior to the global financial crisis. The excess returns did not follow a certain pattern, indicating a low degree of integration within the region. From the financial crisis in 2009 to 2015, the excess returns are less volatile and follow a certain pattern, indicating that the countries have become more integrated. From 2015 onwards, the pattern seems to disappear.

The difference observed in the MSCI and custom market risk premium may indicate that the results are sensitive to the choice between these two market risk proxies.

The high correlation between the market risk premium of the countries and the region overall indicates that the four countries are relatively integrated with one another.

Chapter 6 Analysis

6.1 Introduction and purpose

Chapter 6 answers the research question of the paper by providing an analysis of the CAPM and the three-factor model results at domestic and regional level in the following four countries; China, India, South Korea and Taiwan.

Part 6.2 provides an analysis of the domestic and regional CAPM. Part 6.3 provides an analysis of the domestic, regional and International three-factor model. Part 6.4 compares the statistical results of the domestic CAPM and the domestic three-factor model. Lastly, part 6.5 provides robustness tests for all the models in the paper.

6.2 The CAPM Results

The statistical results of the CAPM regressions are confirmed to be BLUE when the OLS assumptions of linearity, normally distributed error terms, autocorrelation and heteroskedasticity are not violated. The former two are tested using plots in SAS, whereas autocorrelation is tested using a Durbin-Watson test. Lastly, heteroskedasticity is tested using a White test. All the assumptions are met for the CAPM, except for the assumption of heteroskedasticity, which is violated in some portfolios. This is also the case when applying the other models in this chapter. Thus, only White tests will be presented before analyzing the results of each model.

The performance of each model will be evaluated according to the following statistical determinants; statistical significance of the market risk factor, the explanatory power of the model (R^2), F-test and the intercept. The F-test is less 0.0001 for all the models presented in this paper and will thus not be further commented on. Given that the size and value factor are proxies for risk, this paper will first verify the presence of a size and value premium in emerging markets Asia. If a size and value premium do exist, the paper verifies whether the presence of these premiums in the results is consistent with the observations in the market. The regression results of the regional models will be further analyzed in order to confirm whether they can reflect the degree of market integration in emerging markets Asia.

Finally, the results are also brought into comparison with the previous empirical studies of the same markets.

6.2.1 the domestic CAPM

This part provides an analysis of the domestic CAPM to confirm whether the domestic market risk factor is the only source of risk explaining the stock returns in emerging markets Asia.

Before presenting the regression results, White tests detecting the presence of heteroskedasticity will first be reviewed. Table 6.1 presents the White tests of the domestic CAPM for the six portfolios in each country. A p-value of the White test below 0.05 leads to a rejection of homogeneity (heteroskedasticity cannot be rejected at 5%). Thus a p-value above 0.05 is favorable.

According to table 6.1, the p-value overall exceeds 0.05 for all portfolios in China, India, and Taiwan, indicating that heteroskedasticity is not present. The p-value is however below 0.05 for 4 out of 6 portfolios in South Korea, which are marked with grey in the table. The presence of heteroskedasticity in those four portfolios cannot be rejected. Thus, the OLS method is the best linear unbiased estimator (BLUE) for the portfolios in China, India and Taiwan, except for South Korea, where this method is still unbiased, but inefficient. The regression results for the domestic CAPM are presented in table 6.2 below.

Table 6.1 White test for the domestic CAPM

Panel A: China		**Panel B: India**	
Portfolio	White	Portfolio	White
SL	0.41	SL	0.22
SM	0.22	SM	0.05
SH	0.18	SH	0.18
BL	0.45	BL	0.47
BM	0.46	BM	0.16
BH	0.47	BH	0.36

Panel C: South Korea		**Panel D: Taiwan**	
SL	0.35	SL	0.25
SM	0.04	SM	0.12
SH	0.01	SH	0.09
BL	0.13	BL	0.05
BM	0.03	BM	0.36
BH	0.04	BH	0.30

White test p-value > 0.05, the hypothesis of heteroskedasticity is rejected

White test p-value < 0.05, the hypothesis of heteroskedasticity cannot be rejected

According to the statistical determinants, the domestic CAPM is an accurate asset pricing model for measuring the expected stock returns in emerging markets Asia, if it generates a p-value of beta below 0.05, a high R^2 and a pricing error of zero.

The market risk factor is statistically significant at 1% across all six portfolios of China, India, South Korea and Taiwan. The R^2 indicates that the CAPM can capture 87% to 95% of the variance in the expected stock returns. Specifically, the results of South Korea and Taiwan yield the highest average value of R^2, 0.90 and 0.93 respectively. The R^2 of India is the lowest among the four countries. The statistical insignificance of the pricing errors of most portfolios indicates that they cannot be rejected to be different from zero. Only 1-2 portfolios yield significant pricing errors per country. The absolute average of pricing errors for each country is summarized in bold at the bottom of the table. The absolute average pricing error of 0.29% is the highest for China, and the lowest pricing error is found in South Korea and Taiwan. In general, the domestic market risk factor can explain the expected stock returns in the equity markets of China, India and Taiwan. In

South Korea, the domestic risk factor also works well, but keep in mind that the model is not efficient due to the presence of heteroskedasticity.

The beta is positive for all portfolios, confirming the most crucial implication of the CAPM; a linear positive relation between the expected stock returns and the market risk. This finding in emerging markets Asia is consistent with the findings in the U.S. stock market in the 1960s by Fama & MacBeth (1973) an Jensen (1969). Thus, our finding rejects the confirmation of Fama & French (1992), who argued that the positive relation of beta and returns had disappeared.

There is however no specific pattern in the beta coefficients across the portfolios, which differ in market cap and book-to-market ratio.

Therefore, beta does not offer any explanation for the variation in expected stock returns. This finding is consistent with the pervious findings of the U.S. stocks by Banz (1981), Chan & Chen (1991), Rosenberg et al. (1985) and Fama & French (1992).

In short, the domestic CAPM can on average capture 87% to 95% of the variance in the expected stock returns of China, India, South Korea and Taiwan. The model can also be applied for the stock data of South Korea, but is however inefficient.

Table 6.2 Statistic regression results of the domestic CAPM

Dependent variables: excess returns on six stock portfolios formed on size and BTM

β: the slope for the domestic market risk premium factor

Portfolio	Coefficient		R^2
	Pricing Error (α)	β	
Panel A: China			
SL	0.0016	1.05**	0.98
SM	-0.0015	1.04**	0.98
SH	-0.0034*	1.03**	0.99
BL	0.0088**	0.94**	0.92
BM	0.0009	0.96**	0.97
BH	-0.0014	0.91**	0.87
Avg.| α|	**0.0029**	**0.99**	**0.95**
Panel B: India			
SL	0.0022	0.96**	0.92
SM	0.0029	1.19**	0.71
SH	0.0018	1.14**	0.85
BL	0.0022	0.71**	0.90
BM	-0.0008	0.85**	0.90
BH	-0.0065	1.06**	0.92
Avg.| α|	**0.0027**	**0.99**	**0.87**
Panel C: South Korea			
SL	-0.0070*	0.95**	0.76
SM	-0.0001	1.04**	0.96
SH	0.0004	1.00**	0.92
BL	0.0038	0.93**	0.88
BM	0.0009	1.00**	0.94
BH	0.0007	1.05**	0.94
Avg.| α|	**0.0022**	**0.99**	**0.90**
Panel D: Taiwan			
SL	0.0013	0.91**	0.924
SM	-0.0020	0.99**	0.963
SH	-0.0022	1.11**	0.91
BL	0.0044*	0.87**	0.87
BM	0.0015	0.95**	0.96
BH	-0.0012	1.08**	0.95
Avg.| α|	**0.0021**	**0.99**	**0.93**

* Statistically significant as p-value < 0.05

** Statistically significant as p-value < 0.01

6.2.2 The regional CAPM

This part provides an analysis of the performance of the regional CAPM in emerging markets Asia, which are semi-segmented. Furthermore, it examines whether the model's performance can reflect the limited degree of market integration within the region.

Before presenting the regression results, White tests detecting the presence of heteroskedasticity will first be reviewed.

Table 6.3 White test for the regional CAPM

Panel A: China		**Panel B: India**	
Portfolio	White	Portfolio	White
SL	0.189	SL	0.302
SM	0.442	SM	0.162
SH	0.431	SH	0.392
BL	0.565	BL	0.306
BM	0.373	BM	0.361
BH	0.331	BH	0.328

Panel C: South Korea		**Panel D: Taiwan**	
SL	0.425	SL	0.283
SM	0.225	SM	0.071
SH	0.153	SH	0.031
BL	0.046	BL	0.369
BM	0.055	BM	0.121
BH	0.006	BH	0.024

White test p-value > 0.05, the hypothesis of heteroskedasticity is rejected

White test p-value < 0.05, the hypothesis of heteroskedasticity cannot be rejected

According to table 6.3, heteroskedasticity is not present for the portfolios of China and India, since the p-value of the White test overall exceeds 0.05. For South Korea and Taiwan, however, 2 out of 6 portfolios generate a p-value below 0.05. Overall, the OLS assumption tests indicate that the regional CAPM is BLUE. Thus we can move on to analyze the regression results of the regional CAPM.

Table 6.4 presents the regression results of the regional CAPM. A quick view shows that the regional CAPM performs poorly in all four countries. The absolute average of the pricing errors for each country is substantially higher than those of the domestic CAPM. By applying the regional CAPM instead of the domestic CAPM, the pricing errors of the regional CAPM increase by nearly seven times in India and twice in China, South Korea and Taiwan. The highest absolute averages of pricing errors are found in India and China.

The regional market risk coefficient, beta, is statistically significant at 1% across all portfolios in 4 countries, except 2 out of 6 portfolios in Taiwan. However, the R^2 values are low in the 4 countries, falling way below the R^2 values of the domestic CAPM. The regional CAPM can capture 53% of the variance in the expected stock returns of China and Taiwan, 52% of South Korea and only 18% of India. In short, compared to the domestic CAPM, the regional CAPM cannot explain the expected stocks returns in emerging markets Asia. The ranking of the model performance of the 4 countries is as follows; China, Taiwan, South Korea and India.

According to the countries' ease of doing business (table 3.5) and the effect of regional shocks on their equity returns (table 3.6), the degree of market integration for the countries is approximately ranked as follows; South Korea, Taiwan, China and India. The ranking is consistent with how South Korea, Taiwan and India are ranked according to their performance in this paper. China is however an exception. The equity market of China is least integrated with the region, although the results show that the regional CAPM of China performs as well as for Taiwan. This is however not surprising when taking China's size and economic role into consideration. In the Asian region, China is the leading economy with its market cap constituting for 36% of the regional market cap.

The performance of the regional CAPM in India reflects the fact that India is the least integrated with the region. This is expected, since India is more integrated with global markets and less dependent on the Chinese market. Thus, the performance of the regional CAPM can approximately reflect the degree of market integration within the region.

In short, the regional CAPM performs poorly in emerging markets Asia, which are semi-segmented. This finding is consistent with the past studies on the CAPM in emerging market Asia by Harvey (1991), Chan et al. (1992), Stulz (1996), Schramm & Wang (1999), Stulz (1999), O'Brien & Dolde (2000) and Bruner et al. (2008). Different with previous studies, our analysis of the regional CAPM provides a new insight; the degree of market integration has a certain impact on the performance of the regional CAPM. Furthermore, our findings confirm that the correlations of the equity markets within the region have a strong impact on the performance of the regional CAPM.

Table 6.4 Statistic regression results of regional CAPM

Dependent variable: excess returns on six stock portfolios formed on size and BTM, β: the slope for the regional market risk premium factor

Portfolio	Coefficient		R^2
	Pricing Error (α)	β	
Panel A: China			
SL	-0.0046	1.21**	0.51
SM	-0.0077	1.21**	0.53
SH	-0.0095	1.19**	0.53
BL	0.0032	1.09**	0.50
BM	-0.0056	1.16**	0.57
BH	-0.0079	1.11**	0.53
Avg.| α|	**0.0064**	**1.16**	**0.53**
Panel B: India			
SL	0.0197**	0.72**	0.20
SM	0.0260*	0.81**	0.13
SH	0.0242**	0.76**	0.14
BL	0.0146**	0.56**	0.22
BM	0.0142*	0.67**	0.21
BH	0.0130	0.79**	0.19
Avg.| α|	**0.0186**	**0.7192**	**0.18**
Panel C: South Korea			
SL	-0.0039	0.86**	0.36
SM	0.0017	1.04**	0.56
SH	0.0016	1.03**	0.57
BL	0.0055	0.92**	0.51
BM	0.0025	1.01**	0.55
BH	0.0023	1.06**	0.56
Avg.| α|	**0.0029**	**0.9868**	**0.52**
Panel D: Taiwan			
SL	-0.0022	0.86**	0.52
SM	-0.0057	0.93**	0.54
SH	-0.0059	1.01**	0.48
BL	0.0007	0.84**	0.52
BM	-0.0023	0.90	0.55
BH	-0.0053	1.01	0.53
Avg.| α|	**0.0037**	**0.9272**	**0.53**

* Statistically significant as p-value < 0.05 ** Statistically highly significant as p-value < 0.01

Recall that the equity returns of the Chinese stock market has the biggest impact on the equity returns of South Korea, followed by Taiwan and India (figure 3.7 and figure 3.8). The poor

6.2.3 The CAPM summary

The analysis of the domestic CAPM and the regional CAPM shows that the domestic CAPM should be used instead of the regional CAPM. The results of the two models are summarized in table 6.5 to enable a deeper comparison.

Table 6.5 – The CAPM statistical result summary

	CAPM			
Country	Doesmtic		Regional	
	Avg|α|	R^2	Avg|α|	R^2
China	0.0029	0.95	0.0064	0.53
India	0.0027	0.87	0.0186	0.18
South Korea	0.0022	0.90	0.0029	0.52
Taiwan	0.0021	0.93	0.0037	0.53
Avg.	**0.0025**	**0.91**	**0.0079**	**0.44**

According to table 6.5, the domestic CAPM clearly outperforms the regional CAPM due to a lower average of pricing errors and a higher average R^2 across all countries. Compared to the regional CAPM, the explanatory power of the domestic CAPM exceeds by 37%. In addition, the pricing errors have decreased by nearly three times. The results confirm that the domestic CAPM should be applied in emerging markets Asia. This conclusion was also confirmed by previous studies in the emerging markets by Harvey (1995), Bruner et al. (2008) and Hakim et al. (2015).

According to the results, the domestic CAPM is however subject to some limitations. First, the model fails to capture 0.025% of the expected stock returns in the four countries on average. Second, beta cannot explain the variation of expected stock returns across different portfolios. Lastly, the domestic CAPM is not efficent in capturing the expected stock returns in South Korea. Due to these limitations of the CAPM, we will next analyse the performance of the three-factor model to confirm whether the two additional factors, size and value, can improve the performance of the CAPM.

6.3 The three-factor model results

The statistical results of the three-factor model regressions are confirmed to be BLUE when the OLS assumptions of linearity, normally distributed error terms, autocorrelation, heteroskedasticity and multicollinearity are not violated. The first 4 assumptions are tested with the same methods as mentioned for the CAPM. Multicollinearity is tested for multi-factor regressions such as the three-factor model, using variance inflation factors (VIF) tests. Again, all assumptions except for heteroskedasticity is violated in some portfolios. Thus, only White tests will be presented before analyzing the results.

The performance of each model will be evaluated according to the following statistical determinants; statistical significance of the factors (the market risk, size and value factor), the explanatory power of the model (adjusted R^2), and the intercept. The regression results will be further analyzed in order to confirm whether they can reflect the actual financial and economic phenomena in emerging markets Asia. Finally, the results are also brought into comparison with the previous empirical studies of the same markets.

6.3.1 The domestic three-factor model

This part provides an analysis of the domestic three-factor model to confirm whether the domestic market risk, size and value factor can improve the performance of the domestic CAPM.

Before presenting the regression results, White tests detecting the presence of heteroskedasticity will be first reviewed.

According to table 6.6, 4 out of 6 portfolios generate a p-value of the White test below 0.05 for China. Thus, the assumption of no-heteroskedasticity is generally violated when applying the three-factor model in China. For South Korea, the heteroskesdasticty is present in only 1 out of 6 portfolios. Recall that for the heteroskedasticity was present in 4 out of 6 portfolios when applying the domestic CAPM in South Korea. Thus, the domestic three-factor model is more efficient than the domestic CAPM in estimating the expected stock returns of South Korea. Similar to the case of South Korea, heteroskedasticity is not present in 5 out of 6 portfolios in India and Taiwan.

Table 6.6 White test for the domestic three-factor regression

Panel A: China	
Portfolio	White
SL	0.04
SM	0.01
SH	0.07
BL	0.04
BM	0.06
BH	0.04

Panel C: South Korea	
Portfolio	White
SL	0.70
SM	0.08
SH	0.02
BL	0.21
BM	0.70
BH	0.26

Panel B: India	
SL	0.12
SM	0.10
SH	0.16
BL	0.21
BM	0.03
BH	0.39

Panel D: Taiwan	
SL	0.53
SM	0.18
SH	0.35
BL	0.53
BM	0.01
BH	0.09

White test p-value >0.05, the hypothesis of heteroskedasticity is rejected

White test p-value <0.05, the hypothesis of heteroskedasticity cannot be rejected

In general, we can conclude that the domestic three-factor regression is the best linear unbiased estimator for capturing the expected returns in India, South Korea and Taiwan. The domestic three-factor model is however inefficient for China. Next, we will analyze the regression results of the domestic three-factor model, which are presented in table 6.7.

According to table 6.7, the performance of the domestic CAPM is improved when adding the size and value factor. The adjusted R^2 of the domestic three-factor model has increased the explanatory power as follows; 4% in China, 6% in India, 7% in South Korea and 6% in Taiwan. The absolute average of pricing errors in each portfolio has decreased in all countries, except for India. Particularly, the pricing error has decreased as follows: 5 times for China, 1.5 times for South Korea and 2.3 times for Taiwan. The pricing error of India has however increased slightly by the amount of 0.02%. In addition, the domestic market risk, size and the value factor are all significant at 1% across all 6 portfolios in the 4 countries. The presence of the size premium is verified by looking at the pattern of the size coefficients in table 6.7. Most small-cap portfolios (SL, SM and

SH) have a positive size effect, except for the SL portfolio of India, which has a negative size effect. The size effect of big cap portfolios (BL, BM, BH), however, is negative.

In short, the small firms in China, India, South Korea and Taiwan yield a return premium, while big firms have a negative return premium. This finding of a size premium is consistent with the findings by Banz (1981), Chan & Chen (1991) and Fama & French (1992) for the U.S. market prior to 1990. Our findings are however inconsistent with the recent finding of the size premium in the U.S. stock markets after 1991, which is confirmed by Chan & Chen (1991. The observations of the small stocks according to the Russell 2000 Index in the U.S markets also support the finding of Chan & Chen (1991). Russell 2000 Index shows that the small stocks offered a average return of 8% while big stocks offered 16% for the period 2014-2015.

According to Fama & French (2005), the small firms earn a return premium because they are proxies for financial distress factors. Two economic trends supporting the idea of small firms earning higher returns than big firms have been identified in this paper; 1) the shift in economic model in the region from a manufacturing model to a domestic consumption model and 2) small firms in emerging markets Asia have a competitive strategy compared with big firms.

Table 6.7 The domestic three-Factor model

Dependent variable: excess returns on six stock portfolios formed on size and BTM.

β: the slope for the domestic market risk premium factor

s: the slope for the domestic SMB,

h: the slope for the domestic HML

Panel A: China

Portfolio	Coefficient				Adj. R^2
	α (Pricing Error)	β	s	h	
SL	0.0011	0.98**	0.53**	-0.33**	0.99
SM	-0.0001	1.00**	0.38**	-0.01**	0.99
SH	0.0001	1.00**	0.34**	0.28**	1.00
BL	0.0002	1.00**	-0.74**	-0.75**	0.99
BM	-0.0004	1.01**	-0.44**	0.05*	0.99
BH	0.0013	0.98**	-0.55**	0.64**	0.99
Avg.| α|	**0.0005**	**1.00**	**-0.08**	**-0.02**	**0.99**

Panel B: India

SL	0.0010	1.07**	-0.09*	-0.35**	0.93
SM	-0.0057	1.10**	1.29**	-0.75**	0.86
SH	0.0055*	0.82**	0.23**	1.02**	0.92
BL	0.0022*	0.87**	-0.36**	-0.31**	0.96
BM	0.0009	1.00**	-0.55**	-0.09*	0.96
BH	-0.0023	1.13**	-0.67**	0.33**	0.98
Avg.| α|	**0.0029**	**1.00**	**-0.03**	**-0.02**	**0.94**

Panel C: South Korea

SL	-0.0023	1.01**	0.77**	-0.75**	0.97
SM	0.0012	1.03**	0.33**	0.02	0.97
SH	0.0011	0.96**	0.44**	0.47**	0.98
BL	0.0022*	0.97**	-0.63**	-0.46**	0.97
BM	-0.0010	1.02**	-0.54**	-0.12**	0.98
BH	-0.0012	1.02**	-0.30**	0.32**	0.98
Avg.| α|	**0.0015**	**1.00**	**0.01**	**-0.08**	**0.97**

Panel D: Taiwan

SL	0.0003	0.99**	0.48**	-0.48**	0.99
SM	-0.0021**	1.03**	0.44**	-0.26**	0.98
SH	0.0017*	0.97**	0.52**	0.56**	0.99
BL	0.0007	0.99**	-0.53**	-0.51**	0.98
BM	-0.0002	0.99**	-0.48**	-0.11**	0.99
BH	-0.0006	1.01**	-0.56**	0.44**	0.99
Avg.| α|	**0.0009**	**1.00**	**-0.02**	**-0.06**	**0.99**

*statistically significant at p value < 5%   ** statistically significant at p value < 1%

According to table 6.7, the value premium in emerging markets Asia is present. The coefficients of the value factor show a positive relationship between the value premium and the book-to-market ratio. All portfolios with a high-book-to-market ratio earn a positive value premium while portfolios with a low-book-to market ratio earn a negative value premium.

Our findings of the value premium in emerging markets Asia is consistent with the findings of the value premium in the U.S. stock markets by Rosenberg et al. in (1985), Fama & French (1992 and 1993) and in the Japanese stock market by Chan et al. (1991).

Our findings of the size and value premium is also consistent with the results of the studies in India, South Korea, and Taiwan by Sehgal & Balakrishnan (2013) and De Groot & Verschoor (2002).

The magnitude of the value premium in this paper is supported by the observations of the value premium in practice (website A wealth of common sense 2016). The summary in table 3.3 shows that value firms yielded higher returns than growth firms in emerging markets for 26 years in the period 1989-2015. This paper does however not intend to verify whether the value is a proxy for financial distress (Fama & French 2005) or is due to the investment pattern of small firms (Ebrahim et al. 2014).

According to the results of the domestic three-factor model in China, both the size and value factor have a strong significant effect at the 1% level%. China's adjusted R^2 is the highest in the region, amounting to 0.99. In the case of China, despite of the statistical significance of the market cap and book-to-market ratio and the high value of the adjusted R^2 (0.99), the domestic three-factor model cannot be concluded to be an efficient asset pricing model due to the presence of heteroskedasticity in 4 out of 6 portfolios, except for SH and BM portfolios. Thus, the size and value effect cannot be concluded for the Chinese stock market. This result is not surprising when taking the domestic three-factor model performance of China from the previous studies into consideration. The size and value premium have not been consistently confirmed for the Chinese market. The size value was rejected by Wu (2011) and the value premium was rejected by Wang & Xu (2004). Heteroskedasticity can be a result of omitted variables. The omitted variable can be free float factor as suggested by Wang & Xu (2004), since it signals the quality of corporate governance, future cash flows and investment opportunities of companies.

In a short, the domestic size and value factor can improve the performance of the domestic CAPM. The performance of the domestic three-factor model of China cannot be concluded due to the presence of the heteroskedasticity. Overall, the findings confirm the presence of the size and value premium in emerging markets Asia.

6.3.2 The regional three-factor model

Similar to the regional CAPM, this part will provide an analysis of the regional three-factor model to verify whether the regional three-factor model outperforms the regional CAPM. The part also examines whether the model can reflect the degree if market integration in emerging markets Asia. Before presenting the regression results, White tests detecting the presence of heteroskedasticity will first be reviewed.

According to table 6.8, heteroskedasticity is not present in the portfolios of China and India. Heteroskedasticity is however present in 1 out of 6 portfolio in South Korea and 2 out of 6 portfolios in Taiwan. Due to the presence of heteroskedasticity in only a few portfolios, the regional three-factor model is generally concluded to be the best linear unbiased estimator. Next, an analysis of the regional three-factor model will be presented in table 6.9.

According to table 6.9, the performance of the regional three-factor model is worse than the domestic three-factor model. The model is however better than the regional CAPM. The ranking of the model's performance by country is consistent with the ranking of the regional CAPM.

The average adjusted R^2 ranges from 0.36-0.89. The explanatory power is the lowest for India, which is the only country in our sample with an average adjusted R^2 below 0.7. The regional size and regional value factor in India are insignificant in 5 out of 6 and 4 out 6 portfolios, respectively. The regional size effect is significant in 4 out of 6 portfolios in South Korea. In Taiwan, the regional value factor is only significant in 2 out of 6 portfolios. Among the four markets, the regional three-factor model performs best in China, where all three regional factors of market risk, size, and value are highly significant at 1%. The absolute average of adjusted R^2 is the highest among the four markets with a value of 0.89.

Table 6.8 The white test of the regional three-factor model regression

Panel A: China		**Panel C: South Korea**	
Portfolio	White	Portfolio	White
SL	0.13	SL	0.08
SM	0.15	SM	0.15
SH	0.36	SH	0.02
BL	0.26	BL	0.13
BM	0.10	BM	0.06
BH	0.14	BH	0.04

Panel B: India		**Panel D: Taiwan**	
SL	0.42	SL	0.06
SM	0.54	SM	0.03
SH	0.53	SH	0.11
BL	0.21	BL	0.50
BM	0.53	BM	0.09
BH	0.19	BH	0.03

White test p-value >0.05, the hypothesis of heteroskedasticity is rejected

White test p-value <0.05, the hypothesis of heteroskedasticity cannot be rejected

In general, the regional size and value factor have improved the performance of the regional CAPM. The performance of the regional three-factor model has the same ranking by country as for the regional CAPM. The consistency in raking of the two models indicates that the degree of market integration has a certain impact on the performance of the regional asset pricing models.

Table 6.9 The statistical results of regional three-factor model

Dependent variable: excess returns on six stock portfolios formed on size and BTM, β: the slope for the regional market risk premium factor, s: the slope for the regional SMB, h: the slope for the regional HML

Panel A: China

Portfolio	Coefficient				Adj. R^2
	α (Pricing Error)	β	s	h	
SL	-0.0033	-0.41**	-0.92**	1.20**	0.91
SM	-0.0065**	-0.46**	-0.85**	1.20**	0.93
SH	-0.0082**	-0.59**	-0.73**	1.17**	0.91
BL	0.0044	-0.72**	-0.60**	1.06**	0.89
BM	-0.0045	-0.89**	-0.38**	1.13**	0.91
BH	-0.0069*	-1.14**	-0.06**	1.07**	0.80
Avg.| α|	**0.0056**	**-0.7012**	**-0.5908**	**1.1379**	**0.89**

Panel B: India

SL	0.0245**	0.86**	-0.30	0.26	0.35
SM	0.0320**	0.92**	0.34	-0.07	0.17
SH	0.0283**	0.99**	-0.32	0.50	0.31
BL	0.0178**	0.74*	-0.24	0.21	0.45
BM	0.0180**	0.87**	-0.30	0.33**	0.43
BH	0.0173**	1.04**	-0.59*	0.49*	0.43
Avg.| α|	**0.0230**	**0.90**	**-0.23**	**0.29**	**0.36**

Panel C: South Korea

SL	-0.0046	0.87**	0.45*	0.37*	0.53
SM	0.0009	1.04**	0.25*	0.55**	0.77
SH	0.0009	1.03**	0.03	0.64**	0.76
BL	0.0049	0.91**	-0.16	0.80**	0.76
BM	0.0018	1.00**	-0.28*	0.94**	0.83
BH	0.0016	1.06**	-0.27*	0.93**	0.81
Avg.| α|	**0.0024**	**0.99**	**0.00**	**0.71**	**0.74**

Panel D: Taiwan

SL	-0.0029	0.91**	1.25**	-0.36**	0.75
SM	-0.0065*	0.98**	1.28**	-0.33**	0.77
SH	-0.0067	1.05**	1.15**	-0.17	0.66
BL	0.0001	0.88**	0.94**	-0.13	0.71
BM	-0.0030	0.93**	0.92**	-0.08	0.75
BH	-0.0060	1.04**	0.85**	0.02	0.70
Avg.| α|	**0.0042**	**0.97**	**1.07**	**-0.17**	**0.72**

*statistically significant at p-value < 5% ** statistically significant at p-value < 1%

6.3.3 The International three-factor model

In the regional three-factor model, the regional factors are constructed by a combination of domestic and foreign factors. In this part, the effects of the domestic and foreign factors are examined separately in a six-factor model called the International three-factor model.

Before presenting the regression results, White tests detecting the presence of heteroskedasticity will first be reviewed.

Table 6.10 The White test of the international three-factor model

Panel A: China		**Panel C: South Korea**	
Portfolio	White	Portfolio	White
SL	0.25	SL	0.91
SM	0.03	SM	0.62
SH	0.73	SH	0.08
BL	0.18	BL	0.73
BM	0.48	BM	0.82
BH	0.22	BH	0.62
Panel B: India		**Panel D: Taiwan**	
SL	0.08	SL	0.25
SM	0.23	SM	0.75
SH	0.43	SH	0.70
BL	<.0001	BL	0.49
BM	0.15	BM	0.21
BH	0.18	BH	0.78

White test p-value > 0.05, the hypothesis of heteroskedasticity is rejected

White test p-value < 0.05, the hypothesis of heteroskedasticity cannot be rejected

According to table 6.10, heteroskedasticty is not present in the portfolios of South Korea and Taiwan. The assumption of heteroskedasticity is however violated in in 1 out of 6 portfolios in China and India. The International three-factor model is generally concluded to be the best linear unbiased estimator.

Table 6.11 The International three-Factor model

Dependent variable: excess returns on six stock portfolios formed on size and BTM.

β: the slope for the domestic market risk premium factor, s: the slope for the domestic SMB, h: the slope for the domestic HML, F.β: the slope for the foreign market risk premium factor, F.s: the slope for the foreign SMB, F.h: the slope for the foreign HML

Panel A: China								
Portfolio	International Coefficient							Adj. R^2
	α (Pricing Error)	β	s	h	F.β	F.s	F.h	
SL	0.0010	0.98**	0.55**	-0.33**	0.02	-0.04	0.05*	0.99
SM	-0.0002	1.00**	0.38**	-0.01	0.01	0.02	-0.01	0.99
SH	0.0002	1.01**	0.33**	0.28**	-0.02*	0.02	-0.04	1.00
BL	0.0005	1.01**	-0.76**	-0.75**	-0.03*	0.05	-0.05**	0.99
BM	-0.0007	1.00**	-0.43**	0.05*	0.02	-0.03	0.03	0.99
BH	0.0012	0.98**	-0.54**	0.64**	0.01	-0.02	0.03	0.99
Avg.| α|	**0.0006**	**1.00**	**-0.08**	**-0.02**	**0.00**	**0.00**	**0.00**	**0.99**

Panel B: India								
SL	0.0010	1.07**	-0.09	-0.34**	-0.01	-0.03	0.00	0.93
SM	-0.0056	1.11**	1.29**	-0.75**	-0.01	0.03	-0.02	0.86
SH	0.0055	0.81**	0.23**	1.02**	0.02	0.04	0.01	0.92
BL	0.0022	0.87**	-0.36**	-0.31**	0.00	0.00	0.01	0.96
BM	0.0009	1.00**	-0.54**	-0.09*	0.02	0.09	-0.02	0.96
BH	-0.0022	1.13**	-0.68**	0.33**	-0.02	-0.06	0.00	0.98
Avg.| α|	**0.0029**	**1.00**	**-0.03**	**-0.02**	**0.00**	**0.01**	**-0.01**	**0.94**

Panel C: South Korea								
SL	-0.0022	1.03**	0.76**	-0.73**	-0.03	-0.06	0.02	0.97
SM	0.0011	1.02**	0.32**	0.02	0.02	0.08	-0.04	0.97
SH	0.0010	0.95**	0.44**	0.47**	0.02	-0.04	0.03	0.98
BL	0.0021	0.96**	-0.63**	-0.46**	0.02	0.02	-0.01	0.97
BM	-0.0010	1.00**	-0.53**	-0.12**	0.02	-0.02	0.04	0.98
BH	-0.0011	1.04**	-0.31**	0.33**	-0.04	-0.01	-0.02	0.98
Avg.| α|	**0.0014**	**1.00**	**0.01**	**-0.08**	**0.00**	**-0.01**	**0.00**	**0.97**

Panel D: Taiwan								
SL	0.0003	1.00**	0.48**	-0.49**	0.00	-0.03	0.00	0.99
SM	-0.0021*	1.02**	0.44**	-0.25**	0.00	0.05	-0.01	0.98
SH	0.0017*	0.97**	0.53**	0.56**	0.01	-0.03	0.02	0.99
BL	0.0007	0.99**	-0.52**	-0.51**	0.01	-0.01	0.02	0.98
BM	-0.0002	0.99**	-0.47**	-0.11**	0.00	0.00	0.01	0.99
BH	-0.0007	1.01**	-0.57**	0.44**	0.00	0.00	-0.01	0.99
Avg.| α|	**0.0009**	**1.00**	**-0.02**	**-0.06**	**0.00**	**-0.01**	**0.00**	**0.99**

*statistically significant at p-value < 5%

** statistically significant at p-value < 1%

According to table 6.11, foreign factors do not add any explanatory power in the regional three-factor model. In the international three-factor model, the three domestic factors are all significant. However, the foreign factors are insignificant in most portfolios across the four countries. When the domestic and foreign factors are combined to construct the regional factors, the foreign factors hurt the adjusted R^2 value, which might explain the decrease in the adjusted R^2 in the regional three-factor model. The adjusted R^2 in the international three-factor model is the same as the one in the domestic three-factor model, indicating that only domestic factors have an effect.

In short, the foreign factors cannot explain the stock returns of a local stock market in emerging markets Asia, which enhances our confirmation that the regional three-factor model is not efficient in capturing the expected stock returns in semi-segmented markets Asia.

6.3.4 The three-factor model summary

This part provides a deeper comparison of the domestic and regional three three-factor model. The International three-factor model was tested only to confirm the insignificance of the foreign factors. Thus, the results for the International model are not further commented on.

As mentioned above, the domestic market risk, size and value factor are statistically significant in all 6 portfolios in the 4 countries, while the same regional factors are only significant in some portfolios

Table 6.11 A summary of domestic and regional three-factor model

Three-Factor Model				
Country	Doesmtic		Regional	
	Avg|α|	Adj. R^2	Avg|α|	Adj. R^2
China	0.001	0.99	0.01	0.89
India	0.003	0.94	0.02	0.36
South Korea	0.002	0.97	0.00	0.74
Taiwan	0.001	0.99	0.00	0.72
Avg.	**0.001**	**0.97**	**0.01**	**0.68**

According to table 6.11, the domestic three-factor model outperforms the regional three-factor model in China, India, South Korea and Taiwan. Specifically, the domestic three-factor model generates a lower absolute average of pricing errors and a higher adjusted R^2 than those of the regional model. The average of the pricing errors of the domestic model in the 4 countries is 0.1% while it is ten times higher, 1% for the regional model. The domestic model can increase the explanatory power of the regional model by 29%. Therefore, the domestic three-factor model is more useful than the regional three-factor model in emerging markets Asia, which are semi-segmented.

6.4 A summary of the domestic CAPM and the domestic three-factor model

As presented above, the domestic factors are more useful than the global factors in explaining the expected stock returns in emerging markets Asia. This part focuses on comparing the performance of the domestic CAPM and the domestic three-factor model.

Table 6.12 A summary of the domestic CAPM and the domestic three-factor model

Country	CAPM		Three-factor model	
	Avg|α|	R^2	Avg|α|	Adj. R^2
China	0.003	0.95	0.001	0.99
India	0.003	0.87	0.003	0.94
South Korea	0.002	0.90	0.002	0.97
Taiwan	0.002	0.93	0.001	0.99
Avg.	**0.002**	**0.91**	**0.001**	**0.97**

Table 6.12 presents a summary of the performance of the domestic CAPM and the domestic three-factor model with regards to the average of pricing errors and the (adjusted) R^2.
The results show that by adding the two factors, size and value, the domestic three-factor model can provide a higher average explanatory power than the domestic CAPM. By applying the domestic three-factor model in the four countries instead of the domestic CAPM, it decreases the pricing errors by 50% (0.1% versus 0.2%) on average. The pricing error of 0.1% of the domestic three-factor model indicates that the model cannot fully capture the abnormal returns missed by the domestic CAPM. The domestic three-factor model can also increase the explanatory power of the domestic CAPM by 6% on average. The three-factor model did however not fully explain the abnormal returns missed by the domestic CAPM.

In short, the domestic three-factor model should be used to estimate the stock returns of South Korea, Taiwan, and India. The presence of heteroskedasticity in the domestic three-factor model in China, however, indicates that the size and value factor may not be efficient. Thus, the domestic CAPM should be used for the Chinese stock market. Our findings are consistent with the recent findings from previous literature regarding emerging markets, including China, India, Taiwan and South Korea by Sharma & Mehta (2013), Sehgal & Balakrishnan (2013), Wang & Xu (2004), Wu (2011), De Groot & Verschoor (2002) and Cakici et al. (2013)

6.5 Sub-period robustness check

This part presents the results of the CAPM and the three-factor model at domestic and regional level for the sub-period 2009-2016. If the results of the sub-period are consistent with the results in the main period presented above, the findings in this paper will be confirmed to be robust.

The sub-period begins in 2009 when the economies of the developing countries in Asia just experienced the global financial crisis. Thus, this part examines whether an improvement in the efficiency and market integration of the equity markets of China, India, South Korea and Taiwan has occurred through the performance of the CAPM and the three-factor model.

Similar to the case for the main period, the assumptions of linearity, normal distributed of error terms, multicollinearity and autocorrelation are not violated when applying the data set in the sub-period. The assumption of heteroskedasticty is however violated in some portfolios. Only White tests will therefore be presented before analyzing the results of each model.

6.5.1 The domestic and regional CAPM

This part verifies whether the results of the domestic and regional CAPM in the sub-period have improved compared to those of the main period.

White tests detecting the presence of heteroskedasticity will be first reviewed in table 6.13. For the domestic CAPM regression, heteroskedasticity is present in only 2 out of 6 portfolios in South

Korea and in 1 out of 6 portfolios in India. Thus, the domestic CAPM can generally be concluded to be the best linear unbiased estimator. For the regional CAPM, heteroskedasticity is only present in 3 out of 6 portfolios in South Korea. Therefore, the regional CAPM is not efficient in South Korea. The model is however the best linear unbiased estimator for China, India and Taiwan.

Table 6.13 OLS assumption tests for the CAPM

The Domestic CAPM

Panel A: China		Panel B: India
Portfolio	White	White
SL	0.679	0.224
SM	0.735	0.045
SH	0.460	0.177
BL	0.615	0.471
BM	0.453	0.161
BH	0.365	0.357

Panel C: South Korea		Panel D: Taiwan
SL	0.442	0.564
SM	0.246	0.188
SH	0.026	0.309
BL	0.072	0.595
BM	0.007	0.595
BH	0.548	0.432

The regional CAPM

Panel A: China		Panel B: India
Portfolio	White	White
SL	0.900	0.311
SM	0.437	0.273
SH	0.236	0.248
BL	0.798	0.281
BM	0.408	0.289
BH	0.499	0.271

Panel C: South Korea		Panel D: Taiwan
SL	0.162	0.341
SM	0.117	0.128
SH	0.287	0.190
BL	0.049	0.753
BM	0.025	0.091
BH	0.036	0.111

White test p-value > 0.05, the hypothesis of heteroskedasticity is rejected

White test p-value < 0.05, the hypothesis of heteroskedasticity cannot be rejected

The results of the domestic and regional CAPM are analyzed according to the regression results in table 6.14 below.

According to table 6.14, the performance of the domestic CAPM is higher for the stock markets of South Korea and Taiwan compared to the main period. This is however not the case for China and India. The domestic market risk factor is strongly significant at 1% for all portfolios in all the countries. The R^2 in the domestic CAPM remains the same, but the pricing errors have doubled compared to the main period. Similarly, the explanatory power of the domestic CAPM in India has on average increased by 9% compared with the main period. The increase in the R^2 is however offset by the increase in the pricing error by twofold. For the sub-period of South Korea and

Table 6.14 Domestic and Regional CAPM regression results

Dependent variable: excess returns on six stock portfolios formed on size and BTM

β: the slope for the domestic market risk premium factor

Domestic CAPM - sub period 2009-2016			
Panel A: China			
Portfolio	Coefficient		R^2
	α (Pricing Error)	β	
SL	0.0066*	1.03**	0.95
SM	-0.0002	1.04**	0.98
SH	-0.0024	1.03**	0.98
BL	0.0096	0.98**	0.91
BM	-0.0031	0.96**	0.97
BH	-0.0078	0.92**	0.88
Avg.|α|	**0.0050**	**0.99**	**0.95**
Panel B: India			
SL	0.0066**	1.01**	0.98
SM	0.0044**	1.04**	0.98
SH	0.0050	1.17**	0.94
BL	0.0032	0.73**	0.95
BM	-0.0018	0.88**	0.96
BH	-0.0139**	1.11**	0.97
Avg.|α|	**0.0058**	**0.99**	**0.96**
Panel C: South Korea			
SL	0.0014	0.91**	0.91
SM	0.0034*	1.05**	0.97
SH	0.0009	1.02**	0.94
BL	0.0002	0.90**	0.93
BM	-0.0017	1.00**	0.96
BH	-0.0040*	1.05**	0.97
Avg.|α|	**0.0019**	**0.99**	**0.95**
Panel D: Taiwan			
SL	0.0022	0.97**	0.96
SM	-0.0004	1.02**	0.98
SH	-0.0017	1.01**	0.95
BL	0.0044*	0.92**	0.95
BM	0.0044*	0.92**	0.95
BH	-0.0035*	1.06**	0.97
Avg.|α|	**0.0028**	**0.98**	**0.96**

Regional CAPM - sub period 2009-2016			
Panel A: China			
Portfolio	Coefficient		R^2
	Pricing Error	β	
SL	0.0076	1.24**	0.61
SM	0.0012	1.22**	0.59
SH	-0.0009	1.19**	0.59
BL	0.0113	1.11**	0.53
BM	-0.0022	1.16**	0.63
BH	-0.0070	1.10**	0.56
Avg.|α|	**0.0050**	**1.17**	**0.59**
Panel B: India			
SL	0.0141	0.77**	0.23
SM	0.0129	0.75**	0.20
SH	0.0154	0.79**	0.17
BL	0.0083	0.59**	0.24
BM	0.0049	0.66**	0.22
BH	-0.0053	0.83**	0.22
Avg.|α|	**0.0102**	**0.73**	**0.21**
Panel C: South Korea			
SL	0.0002	0.97**	0.63
SM	0.0022	1.10**	0.65
SH	-0.0007	1.10**	0.67
BL	-0.0009	0.95**	0.64
BM	-0.0028	1.04**	0.64
BH	-0.0050	1.09**	0.63
Avg.|α|	**0.0020**	**1.04**	**0.64**
Panel D: Taiwan			
SL	-0.0016	0.83**	0.56
SM	-0.0046	0.88**	0.59
SH	-0.0063	0.91**	0.62
BL	0.0004	0.81**	0.59
BM	-0.0040	0.87**	0.61
BH	-0.0085	0.96**	0.64
Avg.|α|	**0.0043**	**0.88**	**0.60**

*statistically significant at p-value < 5% ** statistically significant at p-value < 1%

Taiwan, the explanatory power of the domestic CAPM is 5% higher for South Korea and 3% higher for Taiwan in comparison with the main period.

The average of absolute average of pricing errors of South Korea remains the same, but is 0.1% higher for Taiwan. The better performance of the CAPM in South Korea and Taiwan in the sub-period may reflect the continuous improvement in their equity markets after the global financial crisis in 2009. The unchanged performance of the domestic CAPM might reflect the limited improvement in the equity markets in China and India.

According to table 6.14, the performance of the regional CAPM in the sub-period is better than for the main period. The market risk factor is stronger, the average explanatory power is 7% higher and the absolute average of pricing errors is 3% lower for the sub-period in comparison with the main period. The results reflect the fact that the degree of market integration has increased within the region after the financial crisis. Thus, the regional model performs better when applied with recent data.

6.5.2 Domestic three-factor model

This part verifies whether the results of the domestic three-factor model in the sub-period have improved compared to those of the main period.

Before presenting the regression results, White tests detecting the presence of heteroskedasticity will be first reviewed. According to table 6.15, the assumption of heteroskedasticity is only violated in 4 out of 6 portfolios in China. Thus, the domestic three-factor model is not sufficient in China, which was also confirmed for the main period. Similar to the main period, the model is confirmed to be BLUE for India, South Korea and Taiwan.

Table 6.15 the White test of the domestic three-factor model

Panel A: China	
Portfolio	White
SL	0.04
SM	0.01
SH	0.07
BL	0.04
BM	0.06
BH	0.04

Panel B: India	
SL	0.88
SM	0.90
SH	0.92
BL	0.62
BM	0.60
BH	0.74

Panel C: South Korea		
Portfolio	DW	White
SL		0.61
SM		0.79
SH		0.33
BL		0.56
BM		0.74
BH		0.12

Panel D: Taiwan		
SL		0.86
SM		0.56
SH		0.25
BL		0.06
BM		0.39
BH		0.62

White test p-value > 0.05, the hypothesis of heteroskedasticity is rejected

White test p-value < 0.05, the hypothesis of heteroskedasticity cannot be rejected

Table 6.16 Domestic three-factor model

Dependent variable: excess returns on six stock portfolios formed on size and BTM.

β: the slope for the domestic market risk premium factor, s: the slope for the domestic SMB, h: the slope for the domestic HML

Portfolio	Coefficient				Adj. R^2
	α (Pricing Error)	β	s	h	
Panel A: China					
SL	0.0016	0.98**	0.48**	-0.32**	0.99
SM	-0.0013	1.00**	0.47**	-0.02	0.99
SH	0.0006	1.00	0.41	0.28	1.00
BL	0.0006	1.00	-0.65	-0.76	0.99
BM	-0.0014	1.00	-0.40	0.07	0.99
BH	0.0017	0.99	-0.59	0.64	0.99
Avg.| α|	**0.0012**	**1.00**	**-0.05**	**-0.02**	**0.99**
Panel B: India					
SL	-0.0010	1.08**	0.33**	-0.48**	0.99
SM	-0.0011	1.03**	0.39**	-0.20**	0.98
SH	0.0032	0.87**	0.80**	0.62**	0.99
BL	0.0012	0.89**	-0.22**	-0.44**	0.98
BM	0.0029	0.99**	-0.57**	-0.08	0.98
BH	-0.0030*	1.10**	-0.70**	0.46**	0.99
Avg.| α|	**0.0021**	**0.99**	**0.01**	**-0.02**	**0.99**
Panel C: South Korea					
SL	-0.0027*	0.98**	0.72**	-0.59**	0.98
SM	0.0023	1.05**	0.29**	-0.02	0.98
SH	0.0001	0.95**	0.54**	0.52**	0.98
BL	0.0012	0.97**	-0.55**	-0.47**	0.98
BM	0.0002	1.01**	-0.54**	-0.04	0.99
BH	-0.0017	1.00**	-0.37**	0.42**	0.99
Avg.| α|	**0.0014**	**0.99**	**0.01**	**-0.03**	**0.98**
Panel D: Taiwan					
SL	-0.0006	1.01**	0.55**	-0.51**	0.99
SM	-0.0008	1.02**	0.44**	-0.09*	0.99
SH	0.0016	0.96**	0.46**	0.53**	0.99
BL	0.0015	0.97**	-0.60**	-0.46**	0.99
BM	-0.0006	1.01**	-0.43**	-0.11**	0.99
BH	-0.0007	1.02**	-0.52**	0.50**	0.99
Avg.| α|	**0.0010**	**1.00**	**-0.02**	**-0.02**	**0.99**

* significant at p-value < 5% ** significant at p-value < 1%

According to table 6.16, there is no clear evidence whether the domestic three-factor model performs better in the sub-period. The average adjusted R^2 is 3% higher and the average of pricing errors remains unchanged when compared to the main period. The size and value effect are still found in India, South Korea and Taiwan. For China, however, all three factors are overall insignificant, indicating that they cannot explain the expected stock returns in China. Thus, the results of the model in China again confirm that the CAPM should be applied for China.

6.5.3 Regional three-factor model

This part verifies whether the results of the regional three-factor model in the sub-period have improved compared to those of the main period.

The OLS assumption tests show that the regional three-factor model regression does not violate any of the 5 assumptions. Thus, the regional three-factor model is concluded to be BLUE.

According to table 6.17, the performance of the regional three-factor model is better for the sub-period in China, but not for the other three countries. The regional size effect is not present in India and South Korea, and the regional value effect is confirmed in all countries. The size and value premium are however not present.

For China, the average adjusted R^2 is 2% higher and the absolute average of pricing errors is 0.015% lower in the sub-period. For India, South Korea and Taiwan, it cannot be concluded whether the model performs better for the sub-period. For India, the average adjusted R^2 is 12% lower and the average of pricing errors is 6% lower for the sub-period in comparison to the main period. For South Korea and Taiwan, the adjusted R^2 highly exceeds the adjusted R^2 of the main period by 11% and 12%, respectively. The absolute average of pricing errors of the two countries is however 0.6% and 0.7% higher for the sub-period.

Table 6.17 The statistic results of the regional three-factor model

Dependent variable: excess returns on six stock portfolios formed on size and BTM.

β: the slope for the regional market risk premium factor, s: the slope for the regional SMB, h: the slope for the regional HML

Portfolio	Coefficient				Adj. R^2
	α (Pricing Error)	β	s	h	
Panel A: China					
SL	0.0000	1.21**	-0.51**	-0.82**	0.92
SM	-0.0062	1.19**	-0.60**	-0.80**	0.93
SH	-0.0067	1.15**	-0.76**	-0.63**	0.92
BL	0.0054	1.07**	1.07**	-0.65**	0.89
BM	-0.0031	1.10**	-1.18**	-0.14	0.92
BH	-0.0037	1.03**	-1.59**	0.28	0.83
Avg.| α|	**0.0042**	**1.13**	**-0.90**	**-0.46**	**0.90**
Panel B: India					
SL	0.0221*	0.74**	-0.76	0.80*	0.25
SM	0.0212	0.71**	-0.82	0.83*	0.22
SH	0.0262	0.75**	-1.01	1.08*	0.20
BL	0.0151*	0.56**	-0.68	0.68*	0.28
BM	0.0132	0.64**	-0.71	0.83*	0.26
BH	0.0046	0.79**	-0.98	0.99*	0.25
Avg.| α|	**0.0171**	**0.70**	**-0.83**	**0.87**	**0.24**
Panel C: South Korea					
SL	0.0069	0.97**	-0.02	0.69**	0.79
SM	0.0103	1.10**	0.03	0.84**	0.87
SH	0.0074	1.10**	-0.08	0.83**	0.85
BL	0.0067	0.95**	-0.10	0.79**	0.83
BM	0.0069	1.04**	-0.24	1.00**	0.87
BH	0.0069	1.07**	-0.44**	1.22**	0.88
Avg.| α|	**0.0075**	**1.04**	**-0.14**	**0.89**	**0.85**
Panel D: Taiwan					
SL	-0.0113**	0.91**	1.84**	-0.92**	0.84
SM	-0.0134**	0.96**	1.80**	-0.84**	0.86
SH	-0.0123**	0.98**	1.48**	-0.55**	0.84
BL	-0.0067	0.87**	1.51**	-0.67**	0.82
BM	-0.0107**	0.94**	1.53**	-0.63**	0.84
BH	-0.0142**	1.02**	1.41**	-0.54**	0.83
Avg.| α|	**0.0114**	**0.95**	**1.59**	**-0.69**	**0.84**

* Significant at p-value < 5% ** Significant at p-value < 1%

The results reflect an improvement in the degree of market integration in China, but not for the other three countries. The ranking of the model's performance by country is consistent with the ranking found for the main period.

6.5.4 International three-factor model

This part verifies whether the results of the International three-factor model in the sub-period have improved compared to those of the main period.

Before presenting the regression results, White tests detecting the presence of heteroskedasticity will be first reviewed. According to table 6.18, heteroskedasticity is only present in 1 out of 6 portfolios in India. The model is generally BLUE.

Table 6.18 The White test of the international three-factor model

Panel A: China			Panel C: South Korea		
	Portfolio	White		Portfolio	White
	SL	0.867		SL	0.623
	SM	0.637		SM	0.953
	SH	0.870		SH	0.620
	BL	0.555		BL	0.909
	BM	0.648		BM	0.818
	BH	0.438		BH	0.519
Panel B: India			**Panel D: Taiwan**		
	SL	0.362		SL	0.696
	SM	0.830		SM	0.863
	SH	0.002		SH	0.416
	BL	0.870		BL	0.463
	BM	0.860		BM	0.285
	BH	0.752		BH	0.398

White test p-value > 0.05, the hypothesis of heteroskedasticity is rejected

White test p-value < 0.05, the hypothesis of heteroskedasticity cannot be rejected

According to table 6.18, the foreign factors do not explain the expected stock returns in all four countries. This is consistent with results of the main period.

Table 6.18 The International three-Factor model

Dependent variable: excess returns on six stock portfolios formed on size and BTM.

β: the slope for the domestic market risk premium factor, s: the slope for the domestic SMB, h: the slope for the domestic HML, F.β: the slope for the foreign market risk premium factor, F.s: the slope for the foreign SMB, F.h: the slope for the foreign HML

Panel A: China

Portfolio	International Coefficient							Adj. R^2
	α (Pricing Error)	β	s	h	F.β	F.s	F.h	
SL	0.0019	0.97**	0.49**	-0.31**	0.04	-0.06	0.07	0.99
SM	-0.0012	1.01**	0.47**	-0.02	-0.01	0.00	-0.01	0.99
SH	0.0003	1.01**	0.40**	0.27**	-0.02	0.04	-0.05	1.00
BL	0.0002	1.02**	-0.68**	-0.77**	-0.04*	0.05	-0.09*	0.99
BM	-0.0011	0.98**	-0.38**	0.08*	0.03	-0.01	0.07	0.99
BH	0.0018	0.98**	-0.58**	0.64**	0.02	-0.05	0.03	0.99
Avg.|α|	**0.0011**	**1.00**	**-0.05**	**-0.02**	**0.00**	**0.00**	**0.00**	**0.99**

Panel B: India

Portfolio	α (Pricing Error)	β	s	h	F.β	F.s	F.h	Adj. R^2
SL	-0.0015	1.08**	0.34**	-0.48**	0.01	0.05	-0.04	0.99
SM	-0.0014	1.04**	0.38**	-0.22**	-0.02	0.03	-0.05	0.98
SH	0.0040*	0.86**	0.80**	0.64**	0.00	-0.06	0.09	0.99
BL	0.0017	0.89**	-0.23**	-0.43**	0.00	-0.07	0.05	0.98
BM	0.0032*	0.99**	-0.56**	-0.09	-0.01	0.04	0.02	0.98
BH	-0.0038**	1.10**	-0.69**	0.46**	0.01	0.04	-0.07	0.99
Avg.|α|	**0.0026**	**0.99**	**0.01**	**-0.02**	**0.00**	**0.00**	**0.00**	**0.99**

Panel C: South Korea

Portfolio	α (Pricing Error)	β	s	h	F.β	F.s	F.h	Adj. R^2
SL	-0.0017	1.00**	0.71**	-0.61**	-0.03	-0.17**	0.09*	0.98
SM	0.0021	1.05**	0.30**	-0.02	-0.01	0.08	-0.03	0.97
SH	-0.0007	0.92**	0.53**	0.54**	0.05	0.10	-0.06	0.98
BL	0.0003	0.94**	-0.55**	-0.46**	0.04	0.12	-0.06	0.98
BM	0.0001	1.00**	-0.54**	-0.03	0.01	0.03	-0.01	0.99
BH	-0.0006	1.03**	-0.37**	0.40**	-0.04	-0.15**	0.08*	0.99
Avg.|α|	**0.0009**	**0.99**	**0.01**	**-0.03**	**0.00**	**0.00**	**0.00**	**0.98**

Panel D: Taiwan

Portfolio	α (Pricing Error)	β	s	h	F.β	F.s	F.h	Adj. R^2
SL	-0.0007	1.01**	0.55**	-0.51**	0.00	-0.03	0.00	0.99
SM	-0.0009	1.03**	0.43**	-0.08	-0.02	0.03	-0.02	0.99
SH	0.0018	0.94**	0.48**	0.51**	0.02	-0.01	0.03	0.99
BL	0.0013	0.95**	-0.59**	-0.47**	0.01	0.03	0.00	0.99
BM	0.0000	1.01**	-0.43**	-0.11**	0.00	-0.05	0.04	0.99
BH	-0.0011	1.02**	-0.53**	0.51**	0.00	0.02	-0.03	0.99
Avg.|α|	**0.0010**	**1.00**	**-0.02**	**-0.03**	**0.00**	**0.00**	**0.00**	**0.99**

* Significant at p-value < 5% ** Significant at p-value < 1%

6.6 Sub-conclusion

Chapter 6 provided an analysis of the CAPM and the three-factor model at domestic and regional level. The results can be summarized as follows.

Domestic factors are confirmed to be superior to regional factors in estimating the expected stock returns in emerging markets Asia due to the limited degree of market integration within the region. The performance of the domestic CAPM confirms that the domestic market risk factor is an important factor that can capture 87% - 95% of the variance in the expected stock returns in each country. The domestic CAPM is however subject to two limitations. First, the model cannot explain approximately 0.025% (monthly) of the missing price errors. It can neither explain the variation in the returns across different portfolios. By adding the domestic size and domestic value factor to the CAPM, the three-factor model shows a substantial improvement. First, the two additional factors are confirmed to be significant, decreasing the pricing errors by 50% and increasing the explanatory power by 6%. The model also has the advantage that it can explain the variation according to firm characteristics. Particularly, small firms and high book-to-market firms are confirmed to earn a premium in emerging markets Asia. Therefore, the domestic three-factor model is more useful than the domestic CAPM in estimating the stock returns in India, South Korea and Taiwan. For the Chinese stock market, the domestic CAPM is more suitable.

The regional CAPM and the regional three-factor model are both confirmed to perform poorly in emerging markets Asia, reflecting the limited degree of market integration within the region. Different with previous studies, our analysis provides new insights; the degree of market integration has a certain impact on the performance of the regional CAPM and the regional three-factor model. Furthermore, our finding shows that the correlations of equity returns among the markets have a strong impact on the performance of the regional models.

The findings of the main period are confirmed to be robust, which is supported by consistent findings of the sub-period. The results of the regional models for the sub-period do not show a clear picture of an improvement in the degree of market integration within the region.

Chapter 7 Discussion

7.1 Introduction and purpose

Chapter 7 provides a discussion of the findings of this paper.

Part 7.2 discusses whether the results are sensitive to the choice of market proxy. Part 7.3 presents an alternative explanation of the findings. Part 7.4 discusses the limitations of this study for future research. Lastly, part 7.5 suggests applications of our results.

7.2 Sensitivity to the choice of market portfolio proxy

The results of this paper are sensitive to the choice of market portfolio proxy. Our results presented in the previous chapter are only valid when an equal-weighted index is used as a market risk proxy. The results will however change substantially when MSCI indices are used, which will be shortly presented in this part.

The following part presents a summary of the performance of the CAPM and the three-factor model. The test results are presented in appendix 7.1 - 7.4.

The OLS assumptions of linearity, normal distributed of error terms, multicollinearity and autocorrelation are not violated. The assumption of heteroskedasticty is however present in 1 out of 6 portfolios of the domestic CAPM and in 3 out of 6 portfolios of the regional CAPM for Taiwan. Thus, the models are BLUE except for the regional CAPM for Taiwan.

The results of the domestic CAPM show that the effect of the MSCI market risk factor is significant in explaining the variance of the expected returns in most portfolios of China, India and Taiwan. The explanatory power is however relatively low when compared with the model's results for the main period in chapter 6. Specifically, the MSCI market risk factor can explain only 3% of the expected returns in China, 6% in Taiwan and 47% in India. In South Korea, the MSCI market risk factor disappears. The domestic CAPM generates 50% higher pricing errors when using MSCI indices. In short, the domestic CAPM using MSCI indices fails to capture the expected stock returns in emerging markets Asia.

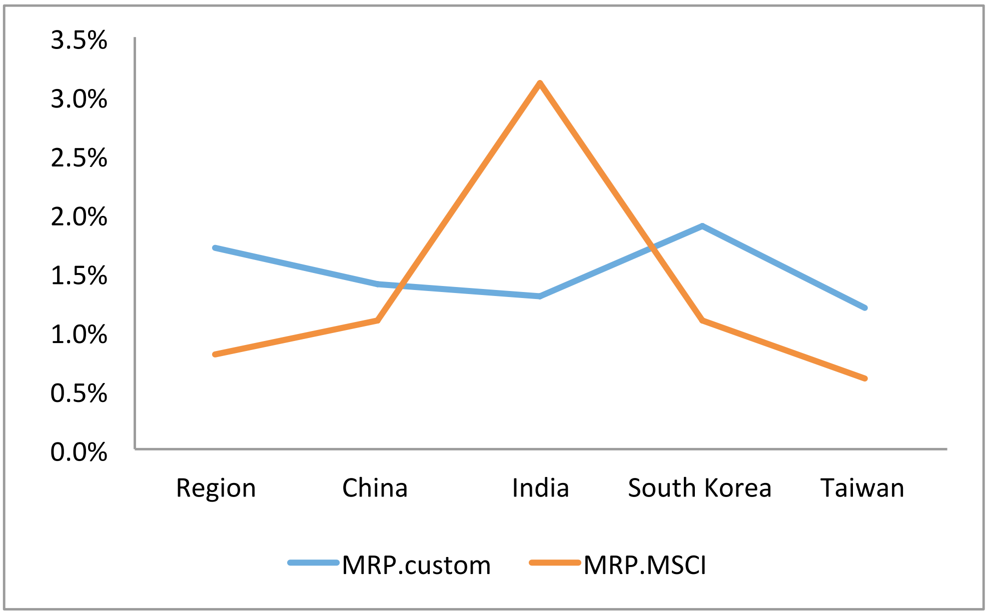
The performance of the regional CAPM is worse than the domestic CAPM due to the 2.5 times higher pricing errors and the 32% lower explanatory power. In addition, the regional MSCI market risk factor is only significant in the portfolios of India; the effect is disappearing in other three countries. In general, the performance of the regional CAPM indicates that the markets in the region is highly segmented.

Also the performance of three-factor model using MSCI indices is worse when compared to the main findings. The effect of the MSCI market risk factor is significant in China, India and Taiwan, except for South Korea. Furthermore, by applying the MSCI market risk factor, the effect of the size and value factor are weakened, especially in Taiwan. On average, the MSCI domestic three-factor model can only explain 33% of the expected stock returns in emerging markets Asia, while its average missing pricing error is 2%, which is 20% higher than that of the domestic three-factor model in the main findings (table 7.2). The presence of a size and value premium is however still confirmed. The performance of the MSCI domestic three-factor model indicates that the market risk factor is the most crucial factor in estimating the returns. By applying the wrong market portfolio proxy, the size and the value factor alone have a weak effect.

The regional three-factor model is surprisingly better compared to the domestic three-factor model with a 9% higher adjusted R^2 on average (table 7.2), although the significance of the three factors is only the case in some portfolios. The market risk factor is significant in India, Taiwan, and South Korea, except for China. The size effect appears in China and Taiwan but not India and South Korea. The value effect is shown in South Korea and China but not in India and Taiwan. In general, the performance of the regional three-factor model indicates the limited degree of market integration in the four countries.

By using the MSCI indices as a market risk proxy, the findings show that neither the CAPM nor the three-factor model at domestic and regional level can offer sufficient information about asset prices in China, India, South Korea and Taiwan. MSCI indices are inaccurate proxies for the market portfolios in emerging markets Asia, since they only include big and medium firms (website MSCI 2016). Furthermore, figure 7.1 shows that the excess returns of the equal-weighted index are below the excess returns of the MSCI index, except for India.

Figure 7.1 Average excess return of custom equal weighted index and MSCI index (monthly)



Source: Self Constructed from Datastream 2016

Our findings indicate that MSCI Indies should not be used as market risk proxies in emerging markets Asia, where the markets are segmented. Instead, equal-weighted market indices should be used. This finding is consistent with the findings by Bruner et al. (2008) for the same market.

7.3 Alternative explanations of the findings

As concluded in the previous chapter, the domestic size and value premium exist in emerging markets Asia. According to Fame & French (1995), small firms and high book-to-market firms earn a return premium due to the higher level of financial distress. This part discusses whether the size and value effect are a result of the factor construction method (Ferson et al. 1999). If the size and value premium are due to the method of factor construction, we should expect the same pattern of higher returns of small firms and high returns of high-book-to-market ratio companies in all portfolios (Barber and Lyon 2007).

After observing the coefficients of the 48 portfolios in the four countries in the main period and the sub-period, we found a consistent pattern that small stocks and high book-to-market ratio stocks generate a higher return premium than big stocks and low-book-to-market ratio stocks. Only 1 out of 48 portfolios or approximately 2% of total portfolios, which is small-low portfolio (SL) in India in the main period, has a negative return premium, which is lower than for the big stock portfolios. With only one portfolio showing a different pattern, the presence of data snooping cannot be rejected.

7.4 Limitations and further research

Although the method of the paper has been carefully selected in order to ensure the reliability and the robustness of the findings, the results are still subject to three limitations.

First, our paper shows that custom equal-weighted market indices are better than MSCI indices as proxies for the market risk in emerging markets Asia. The paper has however not tested the sensitivity of the results to the choice between equal-weighted and a value-weighted indices.

Second, the results of our paper show that the domestic CAPM should be used in the Chinese stock markets instead of the domestic three-factor model. However, our results cannot tell whether one of the factors causes the inefficiency of the three-factor model. Thus, testing a two-factor model excluding either size or value will answer this question.

Third, we indented to analyze the result of the CAPM and the three-factor model at both domestic and regional level with regards to economic phenomena in emerging markets Asia. The performance of the regional CAPM and regional three-factor model was thoroughly analyzed in connection to the countries' degree of market integration in the region.

Whether the size and value premium, which can be explained by financial distress (Fama & French 1995), investment patterns (Ebrahim et al. 2014) and other unknown risk factors in emerging markets Asia, have however not been accounted for in this paper.

For further research on the three-factor model, the three limitations above should be accounted for.

7.5 Application

Based on the results, this paper offers three recommendations regarding the application of the CAPM and the three-factor model in emerging markets Asia.

First, custom equal-weighted indices should be used instead of those provided by MSCI in order to better explain the expected stock returns in emerging markets Asia.

Second, domestic factors should be used when pricing stocks in emerging markets Asia. Although the global models have a low explanatory power, they are still useful in evaluating the degree of market integration of a country. The information of countries' degree of market integration is relevant for investors, who consider a portfolio strategy involving diversification.

Lastly, the domestic CAPM should be used when estimating the stocks returns of China, and the domestic three-factor model should be used when pricing the stocks returns of India, South Korea and Taiwan.

7.6 Sub-conclusion

Our results are sensitive to the choice of proxy for the market portfolio. A custom equal-weighted index should be used as a proxy for the market portfolio in order to ensure the precision of the asset-pricing models. The pattern in the size and value premium are similar for the main period and the sub-sample period, which raises the question whether the significance of these premiums can be alternatively explained by the method of factor construction

Table 7.2. Result summary

Custom Equal Value Market Index

Main period from 2001-2016

	CAPM				**Three-Factor Model**					
Country	Doesmtic CAPM		Regional CAPM		Doesmtic		Regional		International	
	Avg|α|	R^2	Avg|α|	R^2	Avg|α|	Adj. R^2	Avg|α|	Adj. R^2	Avg|α|	Adj. R^2
China	0.003	0.95	0.006	0.53	0.001	0.99	0.006	0.89	0.001	0.99
India	0.003	0.87	0.019	0.18	0.003	0.94	0.023	0.36	0.003	0.94
South Korea	0.002	0.90	0.003	0.52	0.002	0.97	0.002	0.74	0.001	0.97
Taiwan	0.002	0.93	0.004	0.53	0.001	0.99	0.004	0.72	0.001	0.99
Avg.	**0.002**	**0.91**	**0.008**	**0.44**	**0.001**	**0.97**	**0.009**	**0.68**	**0.001**	**0.97**

Sub-period from 2009-2016

	CAPM Sub				**Three-Factor Model**					
Country	Doesmtic		Regional		Doesmtic		Regional		International	
	Avg|α|	R^2	Avg|α|	R^2	Avg|α|	Adj. R^2	Avg|α|	Adj. R^2	Avg|α|	Adj. R^2
China	0.005	0.95	0.005	0.59	0.001	0.99	0.004	0.90	0.001	0.99
India	0.006	0.96	0.010	0.21	0.002	0.99	0.017	0.24	0.003	0.99
South Korea	0.002	0.95	0.002	0.64	0.001	0.98	0.008	0.85	0.001	0.98
Taiwan	0.003	0.96	0.004	0.60	0.001	0.99	0.011	0.84	0.001	0.99
Avg.	**0.004**	**0.95**	**0.005**	**0.51**	**0.001**	**0.99**	**0.010**	**0.71**	**0.001**	**0.99**

MSCI Market Index

MSCI Main period 2001-2016

	CAPM				**Three-Factor Model**			
Country	Doesmtic		Regional		Domestic		Regional	
	Avg|α|	R^2	Avg|α|	R^2	Avg|α|	Adj. R^2	Avg|α|	Adj. R^2
China	0.01	0.03	0.01	0.01	0.02	0.19	0.01	0.58
India	0.02	0.70	0.02	0.42	0.02	0.83	0.01	0.58
South Korea	0.02	0.01	0.02	0.03	0.02	0.10	0.02	0.19
Taiwan	0.01	0.06	0.01	0.03	0.01	0.19	0.02	0.31
Avg.	**0.01**	**0.20**	**0.02**	**0.12**	**0.02**	**0.33**	**0.02**	**0.42**

Chapter 8 Conclusion

The aim of this paper is to answer the following research question:

'Are the factors in the CAPM and the three-factor model country or regional specific when applied in emerging markets Asia?'

The results of this paper are based on a dataset consisting of 2,825 non-financial securities of the four leading countries in emerging markets Asia: China, India, South Korea and Taiwan for the period 2001-2016. Our findings offer new insights on the performance of the CAPM and the three-factor model at domestic and regional level in emerging markets Asia, which are as follows:

First, our findings confirm that the choice of market portfolio is important for the performance of the domestic CAPM and the domestic three-factor model in emerging markets Asia. Equal-weighted indices give a more precise estimation of asset prices than MSCI indices. By applying equal-weighted indices in the domestic CAPM, the model can on average capture 87% - 95% of the variance of the expected stock returns for the main period (2001-2016) and 95% - 96% in the sub-period (2009-2016). However, by applying MSCI indices, the domestic CAPM can only capture 1% - 6% of the variance of the expected stock returns in China, South Korea and Taiwan. The results of the domestic CAPM of India is however less sensitive to the choice of market portfolio. The explanatory power of the domestic CAPM of India is 70% on average when using MSCI indices and 89% when using equal-weighted indices.

Second, our findings confirm that the expected stock returns of emerging markets Asia are more precisely explained by domestic factors than regional factors due to the limited degree of market integration within the region. The domestic market risk factor is confirmed to be useful in explaining the stock returns in China, India, South Korea and Taiwan. The market risk factor, which is the only factor included in the domestic CAPM, is confirmed to explain 87% - 95% of the variance of the stock returns on average. The size and value factor are also confirmed to be significant in explaining the stock returns in China, India, South Korea and Taiwan. By adding the size and value factor to the CAPM, the domestic three-factor model can improve the explanatory power by approximately 6% and reduce the pricing error from 0.2% to 0.1% on average. The pricing error of 0.1% of the domestic three-factor model indicates that the model cannot fully capture the abnormal returns missed by the CAPM. The results of the domestic CAPM and the domestic three-factor model also confirm the presence of a premium of the market risk, size and value factor. The CAPM confirms a positive linear relationship between risk and returns. The three-factor model shows that small market cap firms and high-book-to-market firms earn a premium. The economic transition towards a domestic consumption economy enables small cap firms to earn a premium. Besides confirming the presence of the size premium, the value premium also exists in emerging markets. The argument for the presence of a value premium in emerging markets Asia is however unclear. For India, South Korea and Taiwan, the domestic three-factor model is recommended to be used instead of the domestic CAPM for estimating the expected returns. For China, however, the domestic CAPM is recommended. The presence of a size and value premium in the three-factor model showed to be robust.

Third, our findings of the regional models confirm that the four markets are semi-segmented. The regional CAPM and the regional three-factor model are both insufficient in capturing the expected stock returns. The average explanatory power is 44% for the regional CAPM and 68% for the regional three-factor model. Compared to the domestic CAPM and the domestic three-factor model, the pricing errors of the two regional models are 0.8% higher for the regional CAPM and 0.9% higher for the regional three-factor model. The degree of market integration of each country shows a certain impact on the performance of the regional CAPM and the regional three-factor model. Particularly, the ranking of the regional CAPM and the regional three-factor model's performance is consistent with the degree of market integration by country.

The findings of this paper are relevant for financial practitioners, who seek a precise asset pricing method for estimation of the stock returns in emerging markets Asia. The robust results in this paper showed that the domestic factors should always be used to estimate the stock returns in emerging markets Asia due to the limited degree of market integration within the region. The domestic three-factor model outperforms the domestic CAPM.

Although the paper confirms the presence of a size and value premium in emerging markets Asia, the paper does not account for the type of risk that small cap and high book-to-market stocks are proxies for. For further research, it is recommended to examine whether the size and value factor are proxies for financial distress or due to firms' investment patterns or other unknown risks.

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Appendices

Appendix 7.1 Domestic CAPM

Dependent variables: excess returns on six stock portfolios formed on size and BTM

β: the slope for the domestic market risk premium factor

Portfolio	Coefficient		R^2
	Pricing Error (α)	β	
Panel A: China			
SL	0.010	0.24*	0.03
SM	0.010	0.22*	0.03
SH	0.009	0.20*	0.02
BL	0.019	0.25**	0.04
BM	0.012	0.23**	0.04
BH	0.009	0.21*	0.03
Avg.| α|	**0.012**	**0.23***	**0.03**
Panel B: India			
SL	0.0219*	0.77**	0.47
SM	0.0287**	0.85**	0.29
SH	0.0255**	0.89**	0.41
BL	0.0159**	0.63**	0.57
BM	0.0160**	0.74**	0.53
BH	0.0146*	0.92**	0.54
Avg.| α|	**0.0202**	**0.80**	**0.47**
Panel C: South Korea			
SL	0.0099	0.07	0.00
SM	0.0181**	0.11	0.01
SH	0.0179**	0.12	0.01
BL	0.0197**	0.13	0.02
BM	0.0184**	0.12	0.01
BH	0.0187**	0.15	0.02
Avg.| α|	**0.0171**	**0.12**	**0.01**
Panel D: Taiwan			
SL	0.0111*	0.25**	0.06
SM	0.0085	0.29**	0.07
SH	0.0095	0.31**	0.06
BL	0.0137*	0.24**	0.05
BM	0.0115*	0.27**	0.06
BH	0.0105	0.26**	0.04
Avg.| α|	**0.0108**	**0.27**	**0.06**

* significant at p-value < 5% ** significant at p-value < 1%

Appendix 7.2 The regional CAPM model results

Dependent variable: excess returns on six stock portfolios formed on size and BTM, β: the slope for the regional market risk premium factor

Portfolio	Coefficient		R^2
	Pricing Error (α)	β	
Panel A: China			
SL	0.0143	0.20	0.02
SM	0.0114	0.18	0.01
SH	0.0095	0.88	0.01
BL	0.0203	0.15	0.02
BM	0.0125	0.19	0.02
BH	0.0096	0.17	0.01
Avg.| α|	**0.0129**	**0.29**	**0.01**
Panel B: India			
SL	0,0245**	0,88**	0.34
SM	0,0321**	0,90**	0.18
SH	0,0285**	1,02**	0.30
BL	0,0178**	0,76**	0.45
BM	0,0181**	0,89**	0.43
BH	0,0173**	1,09**	0.42
Avg.| α|	**0.0231**	**0.92**	**0.35**
Panel C: South Korea			
SL	0.0089	0,21*	0.03
SM	0,0175*	0,21*	0.03
SH	0.0172	0.23	0.03
BL	0,0194**	0,21*	0.03
BM	0.0178	0.23	0.03
BH	0,0181**	0,27**	0.04
Avg.| α|	**0.0165**	**0.23**	**0.03**
Panel D: Taiwan			
SL	0,0108*	0,19*	0.03
SM	0.0083	0,22*	0.03
SH	0.0092	0,24*	0.03
BL	0,0133*	0,21*	0.04
BM	0.0110	0,24*	0.04
BH	0.0101	0,22*	0.03
Avg.| α|	**0.0104**	**0.22**	**0.03**

* significant at p-value < 5% ** significant at p-value < 1%

Appendix 7.3 The domestic three-factor model results

Dependent variable: excess returns on six stock portfolios formed on size and BTM, β: the slope for the domestic market risk premium factor, s: the slope for the domestic SMB, h: the slope for the domestic HML

Portfolio	Coefficient				Adj. R^2
	α (Pricing Error)	β	s	h	
Panel A: China					
SL	0.02**	0.26**	2.04**	0.05	0.30
SM	0.02*	0.26*	1.92**	0.38*	0.24
SH	0.02*	0.24*	1.87**	0.67*	0.22
BL	0.02*	0.24**	0.78**	-0.36*	0.13
BM	0.02*	0.26**	1.10**	0.44*	0.10
BH	0.02**	0.26**	0.95**	1.02**	0.15
Avg.|α|	**0.02**	**0.25**	**1.44**	**0.37**	**0.19**
Panel B: India					
SL	0.01**	0.65**	0.55**	0.42**	0.58
SM	0.01	0.71**	1.96**	0.00	0.70
SH	0.02**	0.52**	0.72**	1.58**	0.80
BL	0.01**	0.56**	0.17*	0.28**	0.60
BM	0.01**	0.61**	0.05*	0.61**	0.60
BH	0.01**	0.69**	0.01*	1.12**	0.68
Avg.|α|	**0.01**	**0.62**	**0.58**	**0.67**	**0.66**
Panel C: South Korea					
SL	0.01**	0.1	0.92**	-0.25	0.14
SM	0.02**	0.1	0.49*	0.53**	0.06
SH	0.02**	0.1	0.58**	0.94**	0.17
BL	0.02**	0.1	-0.48**	0.02	0.04
BM	0.02*	0.1	-0.38*	0.38*	0.06
BH	0.02*	0.1	-0.1	0.83**	0.13
Avg.|α|	**0.02**	**0.1**	**0.2**	**0.41**	**0.10**
Panel D: Taiwan					
SL	0.01*	0.23**	0.56*	0.19	0.09
SM	0.01	0.26**	0.51	0.44**	0.14
SH	0.01*	0.24**	0.59*	1.22**	0.41
BL	0.01*	0.24**	-0.45	0.16	0.05
BM	0.01*	0.26**	-0.41	0.55	0.13
BH	0.01*	0.23**	-0.48	1.13**	0.30
Avg.|α|	**0.01**	**0.24**	**0.05**	**0.61**	**0.19**

* significant at p-value < 5%   ** significant at p-value < 1%

Appendix 7.4 The Regional three-factor model result

Dependent variable: excess returns on six stock portfolios formed on size and BTM, β: the slope for the regional market risk premium factor, s: the slope for the regional SMB, h: the slope for the regional HML

Portfolio	Coefficient				Adj. R^2
	α (Pricing Error)	β	s	h	
Panel A: China					
SL	0.02*	0.21*	-0.6*	-0.81**	0.42
SM	0.01*	0.18*	-0.70*	-0.72**	0.42
SH	0.01	0.14	-0.84*	-0.59**	0.41
BL	0.02**	0.16*	-0.93**	-0.48**	0.43
BM	0.01*	0.16	-1.13**	-0.25	0.37
BH	0.01	0.11	-1.38**	0.07	0.31
Avg.| α|	**0.01**	**0.16**	**-0.93**	**-0.46**	**0.39**
Panel B: India					
SL	0.02**	0.86**	-0.30	0.26	0.34
SM	0.03**	0.91**	0.34	-0.07	0.17
SH	0.03**	0.99**	-0.32	0.50**	0.31
BL	0.02**	0.74**	-0.24	0.21	0.45
BM	0.02**	0.87**	-0.30	0.33*	0.43
BH	0.02**	1.04**	-0.59*	0.49*	0.43
Avg.| α|	**0.02**	**0.90**	**-0.23**	**0.29**	**0.35**
Panel C: South Korea					
SL	-0.005	0.87**	0.48*	0.37*	0.53
SM	0.001	1.04**	0.25	0.55**	0.77
SH	0.001	1.03**	0.03	0.64**	0.76
BL	0.005	0.91**	-0.16	0.80**	0.76
BM	0.002	1.00**	-0.28	0.94**	0.83
BH	0.002	1.06**	-0.27*	0.94**	0.81
Avg.| α|	**0.001**	**0.99**	**0.00**	**0.71**	**0.74**
Panel D: Taiwan					
SL	0.01*	0.25**	1.13**	-0.30	0.21
SM	0.01	0.27**	1.16**	-0.27	0.22
SH	0.01	0.28**	1.00**	-0.11	0.17
BL	0.01**	0.24**	0.82**	-0.07	0.19
BM	0.01*	0.27**	0.80**	-0.03	0.20
BH	0.01	0.24**	0.69*	0.10	0.16
Avg.| α|	**0.01**	**0.26**	**0.93**	**-0.11**	**0.19**

* significant at p-value < 5%   ** significant at p-value < 1%