COMMON RISK FACTORS IN THE RETURNS OF STOCKS TRADING IN THE ISTANBUL STOCK EXCHANGE

A Master's Thesis

By

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Ankara
June 2011

To My Uncle Rahmi “The Great Thinker”

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Graduate School of Economics and Social Sciences
of
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by

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science in Management.

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ABSTRACT

COMMON RISK FACTORS IN THE RETURNS OF STOCKS TRADING IN THE ISTANBUL STOCK EXCHANGE

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June 2011

This study investigates the stocks trading in the Istanbul Stock Exchange for the years between 1997 and 2010 in an attempt to determine the common risk factors that capture the variation in stock returns. Time-series regressions are conducted to test the performance of the Fama & French (1993) three-factor model on a sample of 201 non-financial firms. Furthermore, an additional factor (FIP) is introduced and used to measure the effect of foreign investor participation on the common variation in stock returns in the Turkish market. Finally, considering the two financial crises in 2001 and 2008, different results in the sub-periods are examined; and structural break tests are performed using the dummy variable technique and Chow's (1960) methodology. The results prove that three-factor model is superior to the Capital Asset Pricing Model (CAPM) although the effects of size and book-to-market factors are weak. The excess return on the market portfolio is found to be statistically significant for all model specifications and in each sub-period. The inclusion of the foreign investor participation factor improves the explanatory power of the Fama & French model only slightly; thus it has relatively less impact on the Turkish stock market despite its statistical significance. No structural break is determined for the crisis breakpoints for almost all of the portfolios; thus the model is proven to be robust.

Keywords: Asset pricing, Fama-French model, Istanbul Stock Exchange

ÖZET

İSTANBUL MENKUL KIYMETLER BORSASINDA İŞLEM GÖREN HİSSE SENETLERİNİN GETİRİLERİ ÜZERİNDEKİ ORTAK RİSK FAKTÖRLERİ

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Bu çalışmada İstanbul Menkul Kıymetler Borsası'nda 1997-2010 yılları arasında işlem gören hisse senetleri incelenmiş ve hisse senedi getirilerini açıklayan ortak (sistematik) risk faktörlerinin belirlenmesi amaçlanmıştır. Zaman serisi analiz yöntemi kullanılarak Fama & French (1993) üç faktör modelinin performansı mali sektöre dahil olmayan 201 firma üzerinde test edilmiştir. Ayrıca ilave bir risk faktörü (FIP) vasıtasıyla yabancı yatırımcıların piyasaya katılımının hisse senedi getirilerinin değişkenliği üzerindeki etkisi araştırılmıştır. Son olarak 2001 ve 2008 yıllarındaki finansal krizler göz önüne alınarak alt dönemler incelenmiş; dummy değişken tekniği ve Chow(1960) metodu kullanılarak yapısal kırılma testleri gerçekleştirilmiştir. Sonuçlar üç faktör modelinin Sermaye Varlıkları Fiyatlama Modeli'nden (SVFM) daha başarılı olduğunu; bununla birlikte piyasa değeri ve defter değeri/piyasa değeri etkilerinin zayıf olduğunu göstermiştir. Tüm hisseleri içeren piyasa portföyünün artık getirisinin bütün modeller ve tüm alt dönemler için istatistiki açıdan anlamlı bir faktör olduğu bulunmuştur. Yabancı yatırımcı katılım faktörü Fama & French modelinin sonuçlarını çok az geliştirmiştir; dolayısıyla bu faktör istatistiki açıdan anlamlı olmasına rağmen Türkiye piyasasında nispeten zayıf bir etkiye sahiptir. Neredeyse hiçbir portföy için yapısal kırılmaya rastlanmamıştır ve böylece modelin güvenilir olduğu gösterilmiştir.

Anahtar Kelimeler: Varlık fiyatlandırması, Fama-French modeli, İstanbul Menkul Kıymetler Borsası

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The topic of asset pricing is a fundamental research area within the finance literature. The pricing of equities has attracted the interest of numerous researchers and maintained its popularity since the early 1950s. Along with the rise of globalization in financial markets and the tremendous increase in the information technology; this strand of research has gained even more importance both within the academia and the business world for its practical implications. In the last decades, an extensive amount of research has focused on the financial markets in search of an empirically successful model for explaining the common variation in average stock returns.

The Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Black (1972) is one of the first and most influential models developed for this purpose; which states that there is a linear relationship between market return and average stock returns. However by the discovery of additional priced risk factors in the stock market; the CAPM has been shown to be misspecified and empirically inadequate for the US market. Thus, several researchers have attempted to come up with stronger models of asset pricing.

In their two famous papers, Fama & French (1992, 1993) develop a three-factor model which incorporates the mimicking factors SMB (small minus big) & HML (high minus low) as proxies for size and book-to market effects besides the market factor. The superiority of this model to the CAPM in explaining the common variation of average stock returns is proven to be sound for the US market.

The application of the three-factor model in the developed markets generally provides supportive evidence. Fama & French (1998) reveals the presence of a value premium (higher returns for high book-to-market stocks) for 12 EAFE countries including Japan, Great Britain, France, Germany, Italy, the Netherlands, Belgium, Switzerland, Sweden, Australia, Hong Kong and Singapore. Bauer et al. (2010) investigate 16 European markets and show that the three-factor model performs better than the CAPM and the size effect is persistent throughout Europe. Additional studies on individual countries which use time-series or cross-sectional approaches also confirm the superiority of the Fama & French model over the CAPM.

On the other hand, the evidence in the emerging markets remains ambiguous both because of the limited number of studies and the poor quality of available data as indicated by Rouwenhorst (1999). Some of the studies on the emerging markets report only a size effect but no BE/ME effect such as Herrera & Lockwood (1994); Wang & Xu (2004) and Hearn et al. (2010). Conversely some others show that only BE/ME effect is present in a number of countries (Anderson et al., 2003; Hart et al., 2003). Furthermore, there are studies which discover both of these effects such as Claessens et al. (1995) and Rouwenhorst (1999). To sum up, the evidence in the emerging markets is mixed and the results are muddied because of the problems with the accessibility of data.

The investigations in the Turkish stock market are also inadequate and most of these studies either suffer from unavailability of data or very short periods of investigation. Akdeniz et al. (2000) use the cross-sectional approach to investigate the years between 1992 and 1998; and report weak size and BE/ME effects in the Turkish market. All of the studies employing time-series methodology for the examination the stock returns in the ISE confirm that the three-factor model performs better. Among these studies Aksu & Onder (2003) and Misirli & Alper (2010) consider shorter investigation periods than the period considered in this thesis. Doganay (2006) and Yuksel et al. (2010) on the other hand use the logarithmic computation method for calculating stock returns; which causes overestimation of the returns and leads to suspicious results. The shortcomings of these studies imply that it is a necessity to perform a comprehensive application of the Fama & French model in the Turkish stock market.

The ambiguous results from the studies mentioned above reveals a gap in the literature. There is still a significant need for testing the Fama & French model in an emerging market setting. The Istanbul Stock Exchange (ISE) is a good candidate for such research being a highly volatile securities exchange and reflecting the basic characteristics of the emerging markets. This thesis tries to fill in the gap by investigating whether the Fama & French (1993) three-factor model is successful in explaining the common variation in stock returns trading in the ISE. It contributes to the literature by considering the longest investigation period until now and conducting robustness checks to remove the possibility of sample-specific results. Finally this thesis introduces a unique variable (FIP – foreign investor participation) and tests whether it is a common risk factor in the stock market. The effect of the FIP on the average returns is tested since the foreigner participation is commonly perceived to be an important factor in Turkey. The Credit Default Swap (CDS), country specific risk, exchange rate volatility and aggregate (index) volatility are also examined as additional explanatory variables in this study but found to have no effect on the average returns[1].

The main hypothesis of this thesis is that the Fama & French three-factor model should be able to explain the common variation in stock returns better than the CAPM. As a secondary research question, the significance of the foreign investor participation effect in the stock market is examined. This thesis also uses different approaches to prove that the model is sound in the sub-periods and there is no structural break during the period of investigation.

The performances of different models are measured using the time-series regression approach of Black et al. (1972). The coefficients and R^2 values are interpreted and the cross-sectional implications of intercept terms (Jensen's (1968) alpha) are considered. The Gibbons et al. (1989) methodology is used to comment on the pricing errors produced by these models. This thesis examines

[1] The results could be supplied upon request from the author.

the sub-periods as well as the full sample to make sure that the results are not sample-specific. Finally it conducts structural break tests employing the dummy variable technique and Chow's (1960) methodology; and using the 2001 and 2008 crises as breakpoints. This study investigates a sample of 111 to 201 stocks trading in the ISE between 1997 and 2010. The financial firms and negative book value firms are excluded from the sample in order to estimate the size and BE/ME effects appropriately. The delisted stocks on the other hand are included to avoid a possible survivorship bias.

The outcome from the time-series regressions reveals that the Fama & French three-factor model outperforms the CAPM. The market beta is proven to be significant for all model specifications and in each sub-period; whereas the SMB and HML are shown to be weakly related to the common variation in average returns. The inclusion of the foreign investor participation factor only slightly improves the results; thus it has relatively less impact on the Turkish stock market despite its statistical significance. The intercept values (Jensen's alpha) and F-test results indicate that the CAPM produces significant pricing errors but the three-factor model has lower pricing errors. The inclusion of the FIP reduces the pricing bias even more. Finally the structural break tests find no parameter instability between pre-crisis and post-crisis periods.

The thesis is organized as follows: Chapter 2 describes the Istanbul Stock Exchange and provides information about the two recent financial crises experienced in Turkey. Chapter 3 reviews the literature on asset pricing with an emphasis on the Fama & French three-factor model and its applications in both developed and emerging markets. Chapter 4 introduces the data and methodology used in this study. Chapter 5 presents the empirical results from both informal tests and the time-series regressions; and finally Chapter 6 concludes.

CHAPTER II

ISTANBUL STOCK EXCHANGE AND THE FINANCIAL CRISES

The Istanbul Stock Exchange (ISE) was established in January 1986 as the main organized securities exchange in Turkey. Except for the futures and options which are traded on TURKDEX (Turkish Derivatives Exchange); all of the stock market, bond market, emerging companies market and foreign securities market instruments are traded on this autonomous and computerized public organization. The stock market securities include equities, exchange traded funds, warrants and investment trusts whereas government bonds, treasury bills, corporate bonds and repos are traded as the instruments of the bond market. Turkish Eurobonds are the main constituent of the foreign securities market. The emerging companies market was established in 2010 for the purpose of giving the opportunity to small firms to get listed on the exchange.

Being the most developed and liquid securities exchange in the region, the ISE was the top seventh among emerging markets in terms of its trade volume of 426 billion US dollars in 2010. The ISE ranked 14th in total market capitalization with

308 billion US dollars in 2010 among emerging markets. In 2009, the market capitalization of companies was 36.7 % of total gross domestic product (GDP). As of the second quarter of 2011, there are 433 equities being traded in the ISE including the exchange traded funds. 251 of these equities belong to the national market, 129 to the collective products market and 41 to the secondary national market. Without the inclusion of ETFs, there are 331 stocks traded in the ISE.

The ISE is widely known in the international capital markets and is recognized by the U.S. Securities and Exchange Commission. There is strong foreign participation in the ISE including both the institutional and individual investors where the share of foreign investors in total market capitalization was 68% in 2010. In terms of trading volume, the share of foreign investors was 31% for the same year. The net inflow on the other hand is on average only 0.42% of the total trade volume.

The Istanbul Stock Exchange has been a growing securities exchange since the financial liberalization, deregulation and privatization started taking place in Turkey in 1983; and is continuing to increase its attractiveness with the rise in the equity trading culture within the country and the region. For the investigation in this thesis, ISE is a good candidate since it reflects the basic characteristics of an emerging market. The average of monthly stock returns is 3.93% for the period covered in this study and the monthly standard deviation of the stock returns is more than 15%; which are considerably high as expected in an emerging market.

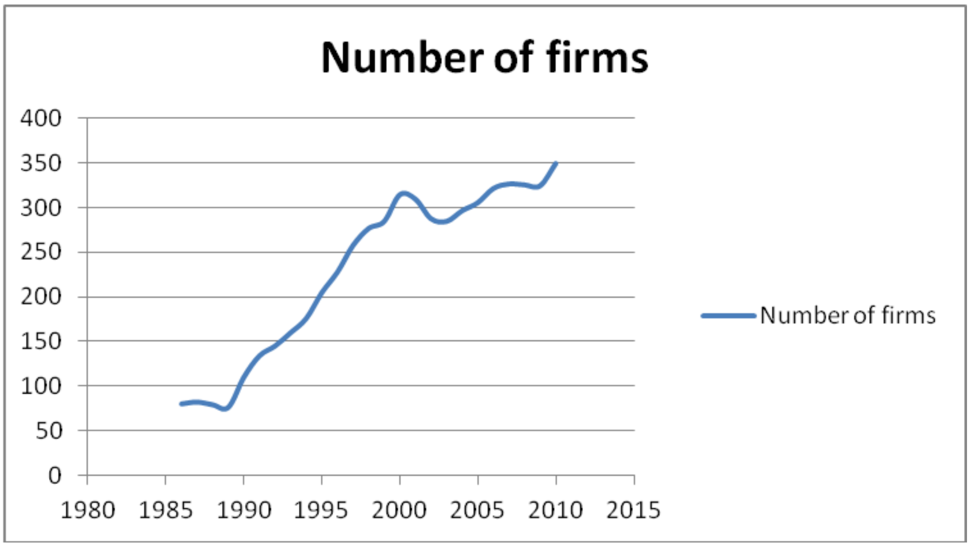


Figure 1: Number of firms

Source: ISE website

Figure 2: Total market capitalization

Source: ISE website

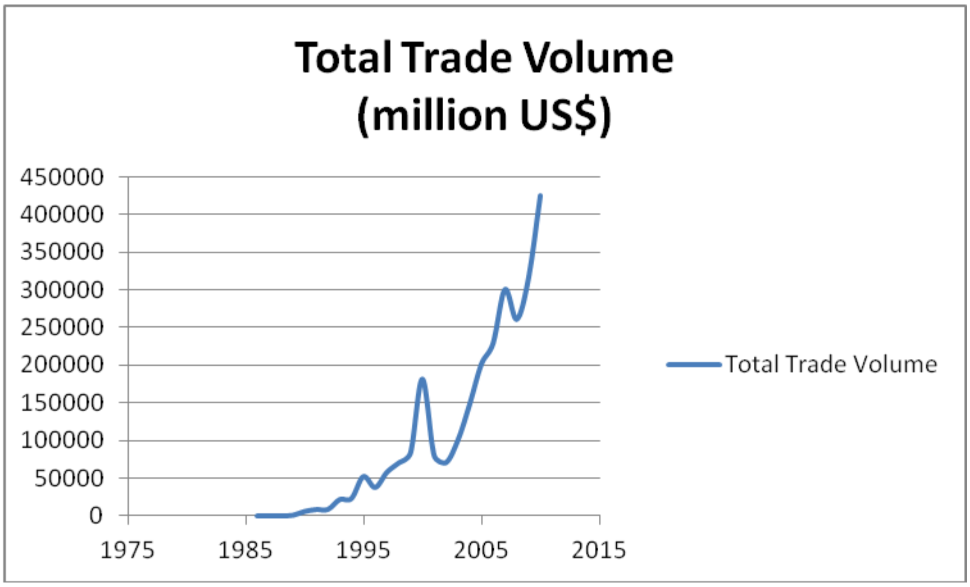


Figure 3: Total trade volume

Source: ISE website

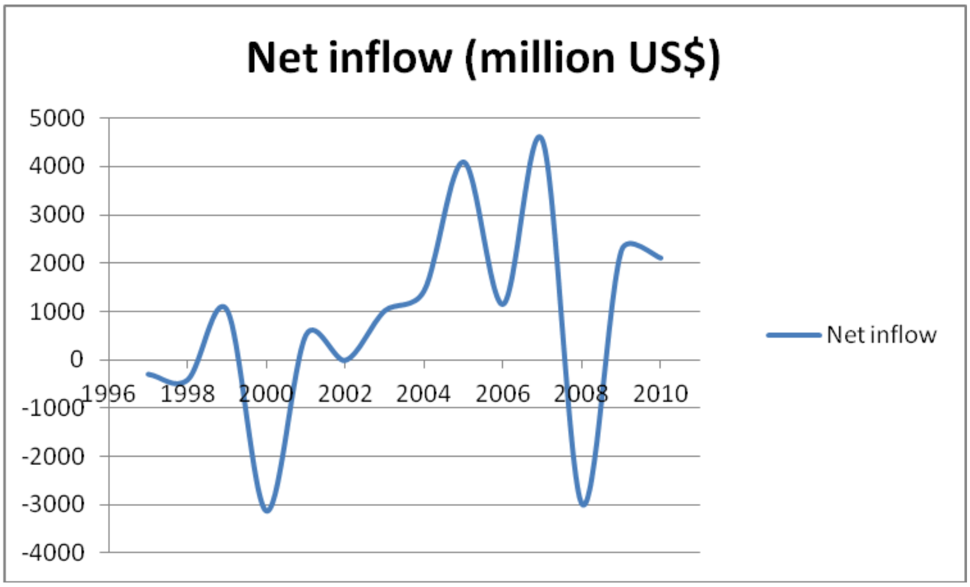


Figure 4: Net inflow

Source: ISE website

The financial crises Turkey has suffered from during the investigation period are emphasized in this study. The first one was a severe financial crisis in 2001 which was mainly resulted from the fragile financial system in the country. The poor performing macroeconomic indicators such as the high current deficit and high inflation levels made the country inevitably pursue an IMF supported economic program at the beginning of 2000. Despite some improvements due to the implementation of this program during the year, the current deficit was already too high and the financing mechanism of this deficit relied on non-transparent and poorly regulated domestic banking sector. The banks were collecting deposits to lend the government with high interest rates through government debt instruments (GDIs); however it was not sustainable for those banks to borrow with shorter maturities and lend for longer terms. This financing mechanism triggered the high interest rates so that overnight interest rates reached 80% in November 2000. Right after the announcement that the crawling peg exchange system had been left; the currency crisis burst in the beginning of 2001 with the rapid depreciation of the Turkish Lira (TL) of almost 40% against US dollars. The stock market fell by 17% in February 2001 which is the date considered as the starting month of the crisis. The GDP growth rate (adjusted for inflation) was - 6.95% for the second quarter of 2001. As a remedy to this disaster, Banking Regulation and Supervision Agency (BRSA) were formed and it started a restructuring program in the banking sector. The full recovery is assumed to be completed in December 2003, when the overall market return increased above the pre-crisis levels.

The global financial crisis in 2007 has affected almost every country although the magnitude of the effect has varied. Also known as the mortgage crisis, it was originated in the US and its roots went back to the beginning of 2000. The low interest rates and lax lending conditions for mortgage loans increased the demand for real estate; thus the prices increased in the 2000s. The mortgages were included in financial products through the securitization process. Unfortunately the borrowers of these mortgages could not repay their loans when the low interest rates had increased. The decreased real estate prices made the financial products including these mortgages very risky and it became very hard for the investors to trade these products since the risks could not be assessed appropriately. The securitization process and the high leveraged financial system made the crisis inevitable. After the collapse of Lehman Brothers, the US Federal Reserve has lent many banks and other financial institutions to avoid defaults; and also many acquisitions in the financial sector have occurred. The crisis caused a high decline in credit volume thus a severe recession followed. Even though the banking sector in Turkey was strong in terms of its balance sheets; there was a significant decline after the crisis in the funds from abroad which were available to both banks and big firms. This decline was directly reflected to the credits for the real sector and consequently the GDP growth rate fell to -% 4.7 in 2009 which was 4.7% in 2007. The ISE-100 index almost lost 50% of its value during 2008. The crisis period is assumed in this study to last until the end of 2010.

CHAPTER III

LITERATURE REVIEW

1. The CAPM

Over the past 50 years many approaches have come into the stage resulting in the creation of different asset pricing theories and the investigation of their empirical tests. The Capital Asset Pricing Model (CAPM) is the most recognized among these theories which is developed by Sharpe (1964), Lintner (1965) and Black (1972). The essential claim of this model is that the excess return on an individual stock is only related to its market beta; which is the coefficient derived from the regression of average returns on a risk premium of the overall market excess return. Supporting the mean-variance efficiency hypothesis of Markowitz (1959); the model argues that beta should construct a basic linear relationship between systematic risk and return. It also implies that the market beta, measuring the sensitivity of a stock return against the market return, is the only explanatory variable for the prediction of excess returns. Despite the presence of strong empirical evidence against these claims; the CAPM is still used in many applications in finance and for educational reasons within the academia.

The most important line of criticism against Sharpe (1964), Lintner (1965) and Black (1972) model (which will be referred as SLB hereafter) targets its inability to explain the cross-section of expected returns. This finding is usually associated with the existence of possible common risk factors that are not captured by beta. These factors include ME (market equity, size or market capitalization), BE/ME (book-to-market ratio), leverage and E/P (earnings over price ratio). There are many other firm-specific, macroeconomic and behavioral factors that have been considered in the literature. However this thesis will focus on the mentioned factors because it uses the methodology of Fama & French (1993) paper; where the effects of these factors are investigated.

Banz (1981) first introduces the size effect as an additional significant factor besides the market beta to explain the cross-section of expected returns. In his seminal paper, ME is defined as the product of market price and the number of outstanding shares, and it is shown to be a relevant factor in explaining the average returns. For a given level of beta, the stocks with lower market capitalization are demonstrated to have higher returns. Banz (1981) also points out that the size effect is concentrated in the smallest ME quintiles. The BE/ME effect is discovered by Stattman (1980) and Rosenberg et al. (1985). In these two influential papers it is proven that BE/ME, which is the ratio of a firm's book value over market value, is one of the factors that explain the cross-section of average returns. It is shown that the returns increase with higher BE/ME levels. The stocks with higher book values relative to their market equity are also called value stocks in the literature; while the low book-to-market ratio stocks are defined as the growth stocks. The higher average returns on the value stocks, namely the value premium, is shown to be persistent internationally (Fama & French, 1998). This is basically resulted from the expectation of higher risk incurred by holding these stocks. The leverage effect is an addition of Bhandari (1988) where a positive relation between returns and debt to equity ratio is uncovered. The leverage effect is explanatory when it is included with the market beta and also controlled for the size effect. Finally the E/P effect is documented by Basu (1983) and Ball (1978) where risk-adjusted returns increase with increasing E/P. This effect also persists in a model where market beta and size factors are taken into account.

2. Cross-section of Expected Returns

The very early contradictions for the explanatory power of market beta are presented by Reinganum (1981) and Lakonishok & Shapiro (1986). They find that the market beta is not systematically related to the average returns; while the size effect is significant in the cross-sectional regressions. In the 1990s, two lines of research have come into stage for improvements in asset pricing. The first strand of research is the time-series approaches which determine the time variation in betas and offer conditional models such as the papers by Ferson & Harvey (1993) and Jagannathan & Wang (1996). However Ghysels (1998) shows that these models produce larger pricing errors because the beta risk is essentially misspecified. The second strand of research explores for additional risk factors in the cross-section of expected returns. Several researchers have investigated macroeconomic or firm-specific variables as candidates for capturing the systematic risk for stock returns.

One important investigation on the misspecification of CAPM is made by Fama & French (1992) for the period between 1963 and 1990. They test the cross-sectional relations between the average returns and the four factors (size, BE/ME, leverage and E/P) along with the market beta. The purpose is an exploration for further evidence supporting the claims against the beta-return relationship demonstrated in earlier work; and to find which factors are acting as proxies for risk. They examine the stocks in a portfolio context and thus make it possible to observe the effects of different factors separately and in interaction. Hence, they demonstrate which factors are absorbing the effect of others and standing as the true explanatory variables.

Fama & French (1992) first conduct some informal tests to gain preliminary evidence. They first create portfolios formed on size and beta alone. The average returns for the size portfolios both support the SLB model and the size effect of Banz (1981). However by sorting stocks on beta alone, no relation between betas and average returns is observed in line with the results of Reinganum (1981). As a simple method to disentangle the size and beta effects, they create portfolios formed both on size and beta; and find that the spread of betas increase in each size group without having any relation to size. Therefore the average returns of these portfolios provide the opportunity of observing the size and beta effects separately. The calculated average values indicate that the returns are decreasing with size but not related to the market betas. The result of this preliminary estimation casts doubt on the validity of SLB model, documenting that there is no effect of betas on average returns when the size effect is taken apart.

They also create portfolios formed on BE/ME, E/P and leverage. The outcome shows that there is a U-shape pattern (decreasing from the lowest E/P quintile to the middle and then increasing to the highest) in the average returns for E/P portfolios; which is a consistent result with the literature. For BE/ME portfolios, they observe a positive and stronger relation with returns compared to the size effect. The variation in betas for different BE/ME quintiles is again insignificant and therefore contradicts the SLB model's findings. Finally they investigate the interaction between size and book-to-market effects by constructing two-pass portfolios for them. The result is a positive and strong relation with returns for BE/ME ratio and a negative one for size; controlling one variable for another.

Next they conduct cross-sectional regressions using the Fama & Macbeth (1973) methodology. The average monthly returns are regressed on the aforementioned factors and the average values of the slopes are calculated. In any of the combinations of factors, size effect is always significant and beta has no explanatory power on the cross-section of expected returns. Considering the BE/ME ratio, the effect is again always significant and it is stronger than the size effect when returns are regressed on these two variables alone or together. The case of leverage and E/P ratio is quite interesting on the other hand. They use two leverage ratios which are the natural logarithms of market leverage (A/ME) and book leverage (A/BE). The slopes of these two variables have opposite signs and almost same absolute values. The authors show that BE/ME factor absorbs the effect of these leverage factors; emphasizing that the difference of the two variables is equal to the natural logarithm of the book-to-market ratio. The E/P effect has the U-shaped pattern again supporting the preliminary evidence. Although it has a significant effect on his own; being regressed with size and BE/ME factors, E/P ratio loses its explanatory power. The effect for negative E/P stocks is absorbed by the size factor; whereas for positive E/P stocks the BE/ME ratio wipes out the effect.

The robustness tests including the sub-period examinations and January seasonals check support the results leaving no caveat. The cross-sectional inspection of returns clarify that the SLB model is not correctly specified and there is no significant relation between average returns and market beta. On the contrary, the size and BE/ME effects have strong explanatory power on equity returns absorbing the effects of leverage and E/P.

3. Common Variation in Average Returns

Fama & French (1993) extends the previous analysis on the cross-sectional asset returns by adding bond returns as dependent variables and two term-structure factors as independent variables. The stock market factors in this study are the excess market return and two mimicking portfolio returns. The first mimicking factor is SMB (small minus big); which is the difference between average returns of small size portfolios and big size portfolios. The second is HML (high minus low); which is the difference between average returns of high BE/ME and low BE/ME portfolios. These factors are zero-investment portfolio returns that are proxies for size and BE/ME effects respectively. The bond-market factor TERM is the spread between long-term government bond and t-bill returns; and DEF is the difference between long term government and corporate bond returns. The dependent variables are from 25 portfolios formed on size and BE/ME for stocks; and 5 bond portfolios; two are for government bonds and three for corporate bonds. In this study, the authors intend to find the shared effect of the stock market and bond market factors; assuming the markets to be integrated. Responding to Roll's (1977) critique; the idea here is to include all assets (stocks and bonds) in the market portfolio.

They also apply a different methodology compared to Fama & French (1992). Instead of the Fama & Macbeth (1973) procedure, they use the time-series regression method of Black et al. (1972); where they regress the excess returns on the aforementioned factors and interpret the slopes from these regressions as sensitivities to those factors. By using this approach they aim to uncover the causes of common variation in average returns by interpreting the slopes and R^2 values. They also intend to examine the intercepts (Jensen's (1968) alpha) from the regressions and find out the cross-sectional implications of different factor combinations. Jensen's alpha measures the abnormal return on a stock or portfolio.

The preliminary evidence supports the findings of the earlier studies. The average returns are positively related with BE/ME ratio and negatively with size. Hence, they perform time-series regressions in order to discover which factors are responsible for the common variation in returns. Having the market return as the only factor; the model captures most of the variation in stock returns. However the R^2 values between 0.7 and 0.9 indicate that there should be some other explanatory variables. Considering only the SMB and HML factors, again a considerable percentage of returns up to 0.65 can be explained. However, adding all three factors together remarkably increases the explanatory power of the model compared to the previous two regressions. The t-values of market return, SMB and HML are highly significant for each portfolio. Moreover the SMB slopes are negatively related with size and HML slopes are positively related with BE/ME ratios. In the three-factor model, almost all of the R^2 values are above 0.9. They also find that the bond market factors have explanatory power on stock returns, but this effect is absorbed by the overall market return. The addition of TERM and DEF to the stock market factors does not provide better results; and the three-factor model suffices.

In order to observe the cross-sectional effects of the factors, they focus on the intercept (Jensen's alpha) values. The intercepts should be statistically indifferent from zero as a proof that the factors are able to explain the cross-section of average returns according to Merton (1973) and Ross (1976). When the market return is the only explanatory variable, the intercepts increase from low BE/ME quintiles to high BE/ME and decrease from small size quintiles to big size; thus it is obvious that SMB and HML factors are affecting the returns. Regression only on these two variables produce similar and large intercepts with significant values; which indicates that these factors are able to explain the cross-section of returns but not the excess returns. Including all factors in the model diminishes the intercepts to values very close to zero. Therefore the three-factor model is satisfactory in explaining the cross-section of returns. They interpret that the market factor is necessary for explaining the difference between stock returns and the risk-free rate; however SMB and HML are the proxies for the risk factors for average returns. Fama & French (1993) also conduct an F-test for checking whether the intercepts are jointly equal to zero using the methodology of Gibbons et al. (1989). The results show that the test is rejected for all of the three model specifications indicating significant pricing errors but the lowest probability level is for the three-factor model. The rejection of the joint equality of intercepts to zero for the model including market factor, SMB and HML is interpreted to be due to the lack of size effect in the lowest BE/ME quintile. Still, the GRS F-test points out that the three-factor model is better at explaining the cross-section of average returns.

The robustness checks include the investigation for the predictability of residuals, the January seasonals effect, the spurious results due to the usage of the portfolios formed in the same manner on the both sides of the regression (split-sample tests) and the outcomes for the portfolios formed on E/P and D/P (dividend over price ratio). The authors conclude that although the January seasonals and split-sample tests weaken the previous findings, the model remains sound. The three stock market factors, namely overall excess market return, SMB and HML are sufficient to explain both the common variation in returns and the cross-section of average returns. The mimicking portfolios are priced factors affecting the stock returns and the market factor is responsible for the difference between stock returns and risk-free rate (t-bill rate) connecting the stock and bond markets.

4. International Evidence – Developed Markets

There is an extensive literature on the international applications of the three-factor model or the measurement of the size and BE/ME effects on the average stock returns. The evidence from the developed markets is generally supportive of the US market findings; especially in the studies that the time-series regression methods are employed. Fama & French (1998) use a two-factor model with market beta and BE/ME ratio to investigate the value premium for 12 EAFE countries (Japan, Great Britain, France, Germany, Italy, the Netherlands, Belgium, Switzerland, Sweden, Australia, Hong Kong and Singapore) plus the US. They find that the BE/ME effect (value premium) is present in twelve of the thirteen most important markets and the two factor model performs better than the international CAPM with a global market portfolio return. In another comprehensive study Bauer et al. (2010) focus on 16 European markets and show that the three-factor model has higher explanatory power for the common variation in the merged data of European stock returns. The size effect is persistent in Europe in contrast to the US market.

There are also a significant number of studies on individual developed countries. For the UK stock market Agarwal & Poshakwale (2010) find strong evidence of size and BE/ME effects from the time-series regressions. The results of Bagella et al. (2010); Miles & Timmermann (1996) and Leledakis & Davidson (2001) are generally supportive of this finding although the effects are shown to be weak or non-existent for some sub-periods in the UK. Several studies revealed that the three-factor model performs better than CAPM in the Australian market where a strong size effect is persistent; however the model's explanatory power is partial and the pricing errors are large (Gharghori et al., 2009; Gaunt, 2004; Kassimatis, 2008). The studies by De Pena et al. (2010) and Jareno (2008) find a strong size effect and weak BE/ME effect in the Spanish stock market. Finally for Hong Kong and Singapore, Shum & Tang (2005) show that Fama & French model outperforms the CAPM; but the coefficients of the mimicking factors are not significant in some cases.

The cross-sectional investigations have mixed results: Doeswijk (1997) discovers a value premium in the Dutch market but no size effect; Amel-Zadeh (2011) reports the existence of size anomaly for the German market; Novak & Petr (2010) proves the both effects to be significant in the Stockholm Stock Exchange; and finally the two studies on the Hong Kong stock exchange prop up the explanatory power of both effects and provides contradictory evidence against the SLB model (Lam & Spyrou, 2003; Ho et al., 2000). To sum up, almost all of the time-series investigations and most of the cross-sectional tests for the developed countries support the superiority of the three-factor model over the CAPM.

5. International Evidence – Emerging Markets

Shifting the focus towards developing countries including the emerging and frontier markets; the empirical studies are observed to be concentrated on specific regions of the world and the evidence is muddied because of the insufficient data. The previously mentioned Fama & French (1998) paper also takes the emerging markets into consideration and reports the presence of size and BE/ME effects in

16 markets. However they do not report any regression results because of the shortness of the period investigated and the high volatility of returns.

The research on the factors responsible for the common variation in average returns which takes individual countries into account is mostly focused on South-East Asia (Pacific Basin Markets). Wang & Xu (2004) report a size effect but no BE/ME effect and they link this result to the speculative nature of the Chinese market and the poor accounting standards; while for a more recent period Lin & Chen (2008) conduct asset pricing tests for both Shangai and Shenzhen stock markets of China and find different results. They show that the coefficients for the market, SMB and HML portfolios are significant and the intercepts are not; which is an indication of the success of three-factor model in these markets. Jung et al. (2009) demonstrate the improvement for the addition of the two mimicking factors in the Korean market; however the joint tests on intercepts produce lower pricing errors for the one-factor model (CAPM). Investigating the seven Pacific Basin stock markets (Japan, Hong Kong, South Korea, Malaysia, Thailand, Indonesia and Singapore); Chen & Fang (2009) find supporting evidence for the strength of the Fama & French model in comparison with the SLB model; with a stronger size premium rather than value. For the Taiwanese market, Shum & Tang (2005) confirm the superiority of the three-factor model but they show that the mimicking factors are weak predictors. For a more recent period all three factors are shown to be significant for the same market (Chou & Wang, 2007). The Pakistan stock market provides supportive evidence where the size and book-to-market factors are priced and market factor is insignificant (Iqbal et al., 2010). The Stock Exchange of Mauritius is shown by Bundoo (2008) to be another example where the three-factor model holds. Examining most of the states in Africa Hearn (2009, 2011) and Hearn et al. (2010) report a significant size effect for these markets. Confirming these studies the investigation on the Johannesberg Stock Market by Basiewicz & Auret (2010) glorify the three-factor model by discovering a high explanatory power and low pricing errors. Finally Grandes et al. (2010) clarify the invalidity of the model for Latin American markets.

The cross-sectional tests that do not consider the time variation in returns yield ambiguous results. For instance Claessens et al. (1995) report size and value premium for 19 emerging markets but in many countries the factors have opposite signs compared to the coefficients for developed markets. This is probably due to the weakness of cross sectional tests against outliers as interpreted by Fama & French (1998). Hart et al. (2003) document a significant value premium but no size effect using data from 32 emerging markets. They also emphasize that the value trading strategy should be used at once for all emerging markets since the results are unsound for individual countries. Rouwenhorst (1999) investigates 20 emerging markets and shows the significant relation between returns and size, BE/ME and momentum factors. He clarifies that the market beta has no effect on the cross-section of returns. Chen et al. (2010) provide evidence of the validity of the three-factor model but with weaker predictability for China. Mukherji et al. (1997) discover positive value and size premiums for the Korean market and Chae & Yang (2008) confirm this finding in their examination of several factors in the same market. Herrera & Lockwood (1994) document a size effect for Mexico and they report that the market factor is also priced. As a final example Anderson et al. (2003) find evidence for the value premium in Mongolian stock market which is an interesting case where the stocks are bought in exchange of vouchers during the privatization program.

Regarding the evidence presented above for both studies allowing time variation in returns and ones only exploring the cross-sectional effects; the outcomes are mixed. Still, in most of the cases at least one of the size or BE/ME effects exist and the three-factor model almost always performs better than the SLB specification of CAPM. One important problem with the emerging market applications of the three-factor model is that most of the studies use the data from IFC Emerging Markets database which is not reliable at all. This data consists of an insufficient number of stocks for individual countries (biased towards large and frequently traded ones), includes missing or incorrect data and presents survivorship bias (Rouwenhorst, 1999). Furthermore most of the aforementioned work focus on shorter periods compared to the developed country studies. Thus there is still a very limited number of studies in the literature that precisely test the Fama & French three-factor model in an emerging market setting; and this fact creates room for the investigation in this paper.

6. Evidence from the Turkish Stock Market

The asset pricing literature includes only a few papers that apply Fama & French methodologies to the Istanbul Stock Exchange. Yet these studies either focus on a short data range or lack some of the tests or remain unreliable in terms of the variable calculation.

Akdeniz et al. (2000) is the first paper to investigate the cross-sectional variation in stock returns for the Turkish market. They use the Fama & French (1992) approach but also make some modifications in the estimation method because of the small number of stocks and the short period of investigation. They include the adjusted returns of 80 to 150 stocks between 1992 and 1998 for the analysis. The post-ranking betas are calculated using the returns of previous 24 months rather than 60 months of Fama & French (1992) because of the limitations of the dataset. Furthermore they form the portfolios each month instead of each year. Before conducting the asset pricing tests, they provide some preliminary evidence. For the portfolios formed only on beta, the average returns are shown to have no relation with the market betas; while the firm specific values (size, BE/ME and E/P) also do not exhibit a pattern across the quintiles. On the other hand, portfolios formed only on size have decreasing returns from the smallest to the largest except for the second sub-period and the BE/ME values are negatively related with size. The formation of the size-beta portfolios reveals that there is a size effect despite its weakness and there is no relation at all between betas and average returns. Sorting the stocks on BE/ME ratio shows that the average returns increase with higher BE/ME values and the relation is very strong in the first sub-period. Tabulating the size and BE/ME together, the effect of one variable becomes weaker while controlling for another and this is interpreted by the authors to be due to the reduction in the sample size. They also control for the E/P ratio and find that its effect is absorbed by the other factors. After presenting these descriptive statistics; Akdeniz et al. (2000) conduct Fama & Macbeth (1973) regressions. The stock returns are regressed on the relevant factors each month and the average slopes are computed. The results show that excess market return is not priced even when it is the only independent variable. The size and BE/ME effects exist for the whole sample but they are rejected for the second sub-sample. They think that the rejection might be due to the self-destruction process of the anomalies because of the similar investor behaviour or it is simply a sample-specific result. Hence they leave the floor to new research covering a longer time period.

The working research paper by Aksu & Onder (2003) on the other hand, employs the Fama & French (1993) methodology. The authors test the three-factor model in comparison with the CAPM for the 1993-1997 period and also search for any relation between the firm-specific factors and macroeconomic fundamentals. They replicate the Fama & French portfolio design with using 16 portfolios instead of 25; and they regress the average returns on the factors both individually and in a portfolio context. The summary statistics reveal that there is a weak BE/ME effect and relatively a strong size effect for the period. The time-series regressions of individual stocks show that the three-factor model does not perform better than the model with market and SMB factors; and the coefficient on HML in the three-factor model is not significant. This outcome confirms the preliminary findings of the strong size effect. The authors interpret that the absence of the BE/ME effect in the time-series regressions might be due to the high correlation between excess market return and HML. The test is repeated using the 16 portfolio returns as dependent variables and the three-factor model is shown to have higher explanatory power than the CAPM with increased R^2 values; though almost half of the coefficients for the both mimicking portfolios remain insignificant. The model is proven to be better at explaining the returns on firms with high book-to-market ratio and small capitalization. To sum up, Aksu &Onder (2003) discover a relatively strong size effect and a weak BE/ME effect for the Turkish market; yet these results are from a working paper which is focused on a very short period of time.

The first complete application of the Fama & French (1993) model to the Turkish stock market is made by Doganay (2006). He investigates the years between 1995 and 2005 with an almost exact replication of the model. The time-series regression output points out that the 25 portfolios and especially portfolios with smaller size and higher BE/ME are explained better by the three-factor model. The coefficients on SMB and HML are related with size and BE/ME respectively and most of them are significant. The author finds that intercept values are individually insignificant which is presented as a proof of the model's explanatory power; yet he does not perform an F-test to measure the joint equality of intercepts to zero. The relatively low R^2 values for the 25 portfolios in comparison with the results for the US market are interpreted by the author to be a sign of the underdevelopment of the financial markets, macroeconomic instability and problems with corporate governance in Turkey; which lead to higher unsystematic risk. Overall, this study confirms the three-factor model's superiority over CAPM, even though the mimicking portfolio factors are weakly effective and the market beta is priced. Still there are some points which cast doubt on the findings of Doganay (2006). First, he includes the financial firms as well as the non-financials to increase the number of firms in the sample; which is not appropriate since the high leverage of the former might distort the results. Second, he uses the actual book equity values in June for portfolio formation. This is not intuitive because the effect of the financial statement information is considered to be lagged as it is stated by Fama & French (1992, 1993). Finally the lack of joint F-test for the intercepts leaves the pricing error of the model poorly explained. All of the weaknesses explained above create the need for a better examination of the Turkish stock market.

A more recent and extended study by Yuksel et al. (2010) uses both Fama & French (1992) and Fama & French (1993) procedures for analyzing the period between 2000 and 2007; while including the liquidity as an additional risk factor in the model. They estimate the post-ranking betas by regressing the previous 36 months' stock returns on the market return. The dependent variables are 12 portfolios formed on size, book-to-market ratio and liquidity (measured by share turnover rate). The cross-sectional regression results show that the average returns are not significantly related to beta or size (unlike the relation to size in the period covered by Akdeniz et al., 2000). On the other hand BE/ME and liquidity variables are priced factors; regardless of whether they are either single independent variables in the model or included with the three other factors. The time-series regressions reveal that all of the included factors have explanatory power with significant coefficients. The slopes are related with size, BE/ME and liquidity. The R^2 values indicate that three-factor model explains the average returns much better than the CAPM but adding the liquidity as a fourth factor just makes a slight contribution. The intercept (Jensen's alpha) values from the regressions with one-factor and three-factor models exhibit a decreasing pattern from the illiquid portfolios to liquid portfolios. This trend disappears in the four-factor model as another supportive evidence for the liquidity effect. The authors also conduct a GRS F-test for each model specification and find out that the joint equality of intercept values to zero is not rejected only when the liquidity is included as a factor. Finally they control for January seasonals and discover no significant effect. In short, Yuksel et al. (2010) make an extensive analysis and conclude that three-factor model has more explanatory power compared to the CAPM and adding the liquidity factor to the model increases its explanatory power even more. On the other hand, the Fama & Macbeth (1973) regressions reject the size as a priced factor for the sample. One line of criticism against the findings of this paper might target the calculation method of stock returns and market return. The authors use the difference between the natural logarithm of the prices; which might not be a good method for the Turkish stock market. In order to capture the high volatility in returns, calculating the percentage changes would be a safer method. In order to shed light on this issue, the difference between log and percentage returns will be discussed in the later chapters. Another weakness of this paper is that the authors form only twelve portfolios which divide the sample into only two size and three BE/ME groups; and thus they are not able to observe the relation between risk factors and firm characteristics perfectly.

Finally Misirli & Alper (2010) examine the Istanbul Stock Exchange by both using multivariate and cross-sectional tests. They investigate the effect of coskewness after comparing the three-factor model with the CAPM. They form 16 Fama & French portfolios for the 1999-2005 period and estimate the post-ranking betas using 36 month rolling-windows. Based on the descriptive statistics they state that the coskewness measures are significant for size and industry portfolios;

but the relation is weak between size-BE/ME portfolios and coskewness. They demonstrate the existence of size and BE/ME effects for the average excess returns and find out that the size premium can be explained by the coskewness measures. Next, they compare the models in terms of the pricing bias using GRS f-test methodology in time-series regressions. The three-factor model is shown to decrease the pricing error; although the hypothesis of joint equality of intercepts to zero is rejected for all specifications. The inclusion of the coskewness factor improves the F-statistic; but only a little over the three-factor model. Finally the cross-sectional regressions reveal that the model with market return and coskewness factor is superior to the SLB specification of the CAPM but not to the Fama & French model. The authors interpret that this result is probably because the same financial risk is reflected by the Fama & French factors and the conditional coskewness measure. Nevertheless this paper also confirms the better performance of the three-factor model despite its focus on the effect of another variable on the expected returns.

The time-series regression results of the studies mentioned above more or less complement each other; while there is contradiction in terms of the cross-sectional results. These studies give a broad picture of the risk factors in the Istanbul Stock Exchange but have their own shortcomings. First of all, almost all of them have relatively short time periods of investigation; which makes it necessary to perform an extended analysis for this market. Furthermore no sub-period analysis is carried out except for the examination by Akdeniz et al. (2000); thus a possibility of sample-specific results remains unresolved. The risk-free rate data used in these studies is also problematic; since it is either the imperfect proxy of Turkish

Central Bank overnight rate or a series gathered from the Treasury Department of Turkey for the irregularly issued t-bill returns. Thus a more detailed evaluation of the asset pricing tests with a more trustworthy dataset would explain the drivers of expected returns in Istanbul Stock Exchange accurately; and this is what this thesis intends to do.

CHAPTER IV

DATA & METHODOLOGY

1. Data

This study focuses on the period between 1997 and 2010 for investigating the stock returns trading in the Istanbul Stock Exchange. The earlier years are not included because of either the insufficiency or the poor quality of data for most of the variables. The financial firms such as banks, holding companies, investment trusts and insurance companies are excluded from the sample; since the highly levered capital structure of these firms would distort the results. In order to measure the book-to-market effect accurately, the firms with negative book values are also excluded. For each year t, the market equity for the June of year t and book-to-market value for the December of year t-1 are required for a stock to be included in the sample. All firms are assumed to have December fiscal year-ends in line with the previous literature. Fama & French (1992) show that; the usage of actual fiscal year-end values does not alter the results significantly. The delisted stocks are also included to prevent a possible survivorship bias. The number of companies in the sample ranges from a minimum of 111 (in 1997) to a maximum of 201 (in 2010) after these modifications.

The monthly stock prices are downloaded from DATASTREAM; which are the closing prices adjusted for stock splits, cash dividends and stock dividends. The ISE-100 index values are also downloaded from the same source to be used as a proxy for the market portfolio. The percentage monthly returns for these variables are calculated; since the logarithmic difference underestimates the returns on stocks in a highly volatile market such as the ISE. The unadjusted prices of stocks and the number of outstanding shares are gathered from DATASTREAM and their product is used as the market equity. The book-to-market ratio from DATASTREAM is dependable only after 1998; thus it is merged with the data downloaded from the ISE website for 1997 and 1998. The additional factor to the Fama & French model used in this study, the "FIP", is the monthly difference of total foreign purchases and sales of equity divided by the total trade volume. This variable is constructed from the ISE website and used as a proxy for foreign investor participation. The risk-free rate is the most problematic variable for any investigation on the ISE. Most of the studies use the overnight interbank rates from the Central Bank of Turkey website or datasets derived from the returns of the irregularly issued treasury bills. The usage of overnight rate is not trustable since it is not a good proxy at all for the crisis periods. This study is the first to use the interpolated t-bill return series from the "Global Financial Data" database which seems to be the most reliable short-term risk-free rate measure available for the Turkish market. This unique risk-free rate series provides the opportunity to come up with more reliable results compared to the previous studies.

2. Portfolio Formation

For the informal tests; portfolios are first formed on size and BE/ME alone. These portfolios provide the opportunity of observing the individual effects of these variables on the cross-section of average stock returns. The size portfolios are formed in the following way: In each year "t" at the end of June, stocks are sorted with respect to their size and the sorted stocks are divided into five quintiles. The stocks in each quintile form a size portfolio. After creating the size portfolios; the average return and book-to-market ratio are calculated for the stocks in each portfolio from July of year t to June of year t+1. The time-series averages of these values are used to provide preliminary evidence of the relation between size and average return or BE/ME. The same procedure is used for creating BE/ME portfolios and exploring the relation of BE/ME to average return and size. The market equity for June of the respective year is used for forming portfolios whereas December t-1 values are used for the book-to-market ratio. The reason for allowing six months of lag for BE/ME effect is that the impact of the financial statement announcements is not immediate.

After analyzing the individual effects of these factors, a deeper insight can be achieved by investigating the interaction between the effects. Using two-pass sorts for the variables, the effect of one factor is examined while controlling for the other factor. For this purpose size-BE/ME portfolios are formed and the effects of these variables are disentangled from each other. The stocks are first ranked on their market equity and grouped into five quintiles. Then, the stocks in each size quintile are sorted with respect to their book-to-market ratios and five BE/ME portfolios are formed for one size quintile. The outcome of this process is 25 portfolios each of which belongs to one size and one BE/ME group. The average returns for these portfolios are calculated again for the 12 months beginning in July of the respective year and the time-series averages including all years in the sample are computed.

The time-series tests are performed with the portfolios. The dependent variables for all model specifications are the excess returns ($R_{it} - R_{ft}$) on the 25 size-BE/ME portfolios. These portfolios are formed at June of each year "t" as discussed previously. The excess returns on a portfolio are calculated for each year from July of year t to the June of year t+1; and this process is repeated. The reason for using size-BE/ME portfolios in the regressions is to see whether the mimicking factors explain the common variation in returns related to size and book-to-market ratio.

Pricing ability of four explanatory variables is investigated in this study. Among these, excess market return and the foreign investor participation (FIP) variables are formed independently from the portfolio context. The market factor is simply the difference between the return on the ISE-100 index and the risk-free t-bill rate. FIP is the difference between monthly purchases and sales of total equity by foreigners divided by the total monthly trade volume in the ISE. Umutlu et al. (2008) also use net inflow as a proxy for foreign investor participation; however they normalize this variable by the total market capitalization instead of total volume. In this study the monthly trading volume is used for normalization in order to calculate the net inflow activity as a share of that month's total trading activity.

The FIP is hypothesized as a risk factor because the foreigner participation is commonly perceived in Turkey to have an important impact on the stock market. The huge amount of capital inflows are expected to be related with the rise of the stock market and the capital outflows are thought to be related with the fall of the market. This thesis intends to clarify whether it is the case by including the FIP as an explanatory variable in the time-series regressions.

The third and fourth factors on the other hand, are mimicking portfolios which are discovered by Fama & French (1993). SMB (small minus big) proxies the size effect whereas HML (high minus low) proxies the book-to-market effect. In order to construct these variables six portfolios are formed using the same procedure for the 5x5 portfolios mentioned before. The stocks are first sorted on size each year and divided into two groups called small and big (S and L). Then these groups are sub-divided into three BE/ME groups where the stocks within the lowest BE/ME fraction (30%) are called low (L); the stocks in the middle (40%) are named medium (M); and the stocks with highest book-to-market ratio (30%) are defined as high (H). Hence six portfolios are created (S/L, S/M, S/H, B/L, B/M, B/H); which contain stocks in different size and BE/ME groups. The SMB factor is produced for each month by calculating the difference between the average returns on small portfolios (S/L, S/M, S/H) and the average returns on big portfolios (B/L, B/M, B/H). The HML is similarly the difference between the average returns on the high (S/H, B/H) and low (S/L, B/L) portfolios. These two factors mimic the effects of size and book-to-market ratio. The procedure used for computing SMB and HML disentangles the impacts of the two mimicked risk factors.

3. Methodology

This study employs the time-series regression method of Black et al. (1972) following Fama & French (1993). The first model used in the tests is the classical specification of static CAPM (Sharpe, 1964; Lintner, 1965; Black, 1972):

$$(R_{it} - R_{ft}) = \alpha_i + \beta_i * (R_{mt} - R_{ft}) + \varepsilon_{it} \quad \textbf{(1)}$$

For the tests excess returns on the 25 size and BE/ME portfolios are regressed on the excess market returns. The statistical significance of the coefficient of market excess return and R^2 are reported. Including the mimicking Fama & French portfolios of SMB & HML with the market factor, the three-factor model is produced:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_i * (R_{mt} - R_{ft}) + s_i(SMB_t) + h_i(HML_t) + \varepsilon_{it} \quad \textbf{(2)}$$

Finally the FIP variable is added to these factors and the four-factor model is created:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_i * (R_{mt} - R_{ft}) + s_i(SMB_t) + h_i(HML_t) + f_i(FIP_t) + \varepsilon_{it} \quad \textbf{(3)}$$

For investigating the effects of the explanatory variables in more detail, the models with excess market return and FIP; and SMB and HML are also considered. These additional model specifications are as follows:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_i * (R_{mt} - R_{ft}) + f_i(FIP_t) + \varepsilon_{it} \quad \textbf{(4)}$$

$$(R_{it} - R_{ft}) = \alpha_i + s_i(SMB_t) + h_i(HML_t) + \varepsilon_{it} \quad \textbf{(5)}$$

After performing the time-series regressions and analyzing the statistical significance of the coefficients and R^2 values; the pricing errors of the models are investigated. The examination of the intercept values (Jensen's alpha) provides evidence of the cross-sectional explanatory power of the models. High values of intercepts indicate large pricing errors. This study also employs a joint F-test on the intercept values of all size and BE/ME portfolios following the methodology of Gibbons et al. (1989) in order to check whether they are jointly equal to zero. The test statistic is:

$$[T/N][(T-N-L)/(T-L-1)](1+\overline{f}_i^{'}\hat{\Omega}^{-1}\overline{f}_i)^{-1}(\hat{\alpha}^{'}\hat{\Sigma}^{-1}\hat{\alpha}) \sim F(N, T-N-L) \quad \textbf{(6)}$$

In the above equation T stands for the sample size, N for the number of portfolios and L for the number of factors. The matrix of factor values for the considered model is denoted with f whereas **Ω** is the variance-covariance matrix for these factors. α stands for the intercept values derived from the regressions for each portfolio. Finally ∑ is the variance-covariance matrix for the residual matrix produced from the 25 regressions of the size-BM portfolios on the relevant factors. The Gibbons, Ross & Shanken (GRS hereafter) F-test rejects the null hypothesis of the joint equality of intercepts to zero if the test result exceeds the critical F value. This method provides a direct evidence for the existence of pricing bias in the regressions.

In order to check for any structural breaks in the study period; a step-by-step procedure is employed. First, the sample period is divided into sub-periods considering the two financial crises in 2001 and 2008 as break points. The informal tests and time-series regressions are repeated for the sub-periods and the results are presented. Next, a dummy variable is added to the models where it takes the value of 1 for the months within a crisis period. The crisis periods are defined as the months between February 2001 and December 2003; and January 2008 and December 2010. Finally, as a structural break test, the methodology developed by Chow (1960) is applied. This approach controls for the parameter stability by testing whether the coefficients in the model are equal for two sub-periods. The test statistic is as follows:

$$\frac{[RSS_f-(RSS_1+RSS_2)]/(L+1)]}{[(RSS_1+RSS_2)/[T_1+T_2-2(L+1)]} \sim F\left(L+1, T_1+T_2-2(L+1)\right) \qquad \textbf{(7)}$$

The RSS variables are the residual sum of squares for the full period and sub-periods respectively. T is for the sample size in the sub-periods and L is the number of factors. Chow test rejects the null hypothesis of the equality of coefficients for the two sub-periods if the test result exceeds the critical F value. This method provides a direct evidence for the existence of a structural break during the investigation period.

CHAPTER V

EMPIRICAL RESULTS

1. Descriptive Statistics and Informal Tests

In an attempt to gather preliminary evidence before conducting the formal tests, this section uses different portfolio formations. The individual effects of size and book-to-market factors and their effects in interaction are analyzed. Furthermore, the descriptive statistics for the dependent and explanatory variables in the time-series regressions are demonstrated.

First, the portfolios are formed on size for both the full sample and the sub-periods which will be examined in the formal tests. Table 1 reveals that the average returns are negatively related with market equity; however the average returns do not monotonically decrease with increasing size. The return on the second smallest portfolio is lower than expected for all sub-periods. This inconsistency weakens the size effect but it is still persistent for all intervals except for the first sub-period. The relation between average returns and size is stronger in the post-crisis periods. For instance the spread between the smallest and biggest portfolio returns reaches 2.2% for the post-2001 period. Table 1 also shows that there is a negative relation between size and BE/ME.

Second, the portfolios are formed on book-to-market ratio. The individual effect of BE/ME is stronger than size effect for the full sample period; although it weakens for the later sub-periods. The average returns generally increase with the increase in the BE/ME across portfolios. The spread between the average returns of the highest and lowest BE/ME portfolios ranges between 0.52% and 2.03%. The negative relation between size and book-to-market ratio is observed again in Table 2.

Sub-dividing the five size quintiles into five BE/ME quintiles; the two-pass portfolios are produced and the average returns are presented in Table 3. Hence the interaction of size and BE/ME effects is unraveled. Except for the lowest BE/ME quintile, the average returns decrease with increasing size in each quintile for the full sample; which is a consistent result with the literature (Fama & French, 1992; Akdeniz et al., 2000). Within each size quintile the average returns increase with increasing BE/ME. Nevertheless the returns across portfolios do not change monotonically. The results for the sub-periods are generally supportive; although the size effect disappears in the first sub-period. On the other hand BE/ME effect vanishes for the third size quintile after the first sub-period and there is no BE/ME effect in the largest size quintile for the pre-2008 period. The two-dimensional examination shows that controlling for BE/ME effect the size effect is still weakly persistent; and controlling for size effect the BE/ME effect is also weakly persistent. All of the results from the informal tests considering the size and BE/ME effects alone or in interaction supports the earlier evidence from the US market (Fama & French, 1992). However, the size and book-to-market effects are shown to be weaker for the Turkish market confirming Akdeniz et al. (2000).

The descriptive statistics for the dependent variables (25 size-BE/ME portfolios) for the time-series regressions are shown in Table 4. The average monthly returns for these portfolios have a wide range from 2.41% to 5.59%. The standard deviations of the returns on the portfolios are quite high reaching up to 18.45%. Both the range of means and the standard deviations more than doubles the findings of Fama & French (1993). However the time-series regressions shall prove that the proposed common risk factors capture most of the variation. The t-values for the average returns on each portfolio are significant indicating that the average returns are statistically different from zero.

The mean values in Table 5 are the average values for the common factors which will be included in the regressions. Among these variables excess market return, SMB and HML are all returns whereas FIP is totally different being the net capital inflow normalized by the total trade volume. The mean values for all factors are quite low compared to the average returns on the portfolios. The market factor and SMB are statistically indifferent from zero, while the HML and FIP are statistically significant. The standard deviation of the market factor is quite higher than the standard deviation of the remaining explanatory variables. Investigation of the autocorrelations for first, second and twelfth lags show that there is no considerable autocorrelation in any of the factors. Looking at the correlations, it

Table 1: Portfolios formed on size					
Panel A: Full Sample (January 1997 - December 2010)					
	ME1	ME2	ME3	ME4	ME5
Return	4.57%	3.79%	4.32%	3.55%	3.43%
ME	11216	29626	65025	153805	1235322
B/M	1.0473	1.0449	0.8603	0.6429	0.5237
Panel B: Sub Sample 1 (January 1997 - January 2001)					
	ME1	ME2	ME3	ME4	ME5
Return	6.65%	6.01%	6.40%	6.11%	6.63%
ME	3197	8019	16210	34610	253558
B/M	0.98	0.8143	0.5966	0.4959	0.3236
Panel C: Sub Sample 2 (February 2001 - December 2003)					
	ME1	ME2	ME3	ME4	ME5
Return	5.25%	3.63%	4.20%	3.42%	3.05%
ME	9825	22844	48038	100538	792406
B/M	0.9468	0.7636	0.6395	0.439	0.3187
Panel D: Sub Sample 3 (January 2004 - December 2007)					
	ME1	ME2	ME3	ME4	ME5
Return	3.10%	2.69%	3.38%	2.26%	1.92%
ME	15783	40997	89079	206381	1624776
B/M	1.0451	1.1682	1.0216	0.732	0.6479
Panel E: Sub Sample 4 (January 2008 - December 2010)					
	ME1	ME2	ME3	ME4	ME5
Return	3.05%	2.40%	2.85%	1.92%	1.47%
ME	17396	50468	115909	297730	2482952
B/M	1.2395	1.4681	1.2189	0.9223	0.8299

Table 2: Portfolios formed on book-to-market					
Panel A: Full Sample (January 1997 - December 2010)					
	BM1	BM2	BM3	BM4	BM5
Return	3.26%	3.72%	3.83%	4.26%	4.61%
ME	640436	410060	211169	138791	108706
B/M	0.2258	0.4661	0.677	0.9428	1.7942
Panel B: Sub Sample 1 (January 1997 - January 2001)					
	BM1	BM2	BM3	BM4	BM5
Return	5.51%	6.18%	6.47%	6.53%	7.25%
ME	170361	81084	32165	28143	14310
B/M	0.1548	0.3309	0.472	0.6864	1.5645
Panel C: Sub Sample 2 (February 2001 - December 2003)					
	BM1	BM2	BM3	BM4	BM5
Return	2.38%	3.60%	4.04%	4.93%	4.41%
ME	385481	352962	148034	58263	50080
B/M	0.1402	0.343	0.5117	0.7142	1.388
Panel D: Sub Sample 3 (January 2004 - December 2007)					
	BM1	BM2	BM3	BM4	BM5
Return	2.30%	2.64%	2.32%	2.79%	3.35%
ME	778564	582859	242417	206046	170010
B/M	0.282	0.5578	0.7871	1.072	1.9046
Panel E: Sub Sample 4 (January 2008 - December 2010)					
	BM1	BM2	BM3	BM4	BM5
Return	2.35%	1.94%	2.02%	2.48%	2.87%
ME	1343962	682947	474532	278013	212447
B/M	0.331	0.6476	0.9696	1.3419	2.3547

Each year the size (BE/ME) values are sorted in June in ascending order and divided into 5 quintiles. The stocks in each quintile form the portfolios for the respective year. The portfolio ME (BE/ME) is the simple average of the market equities (book-to-market ratios) of these stocks. The average returns are calculated for the 12 months beginning in the July of that year and presented as percentages. For size and BE/ME values for year t; the market equity in June of year t and book-to-market ratio in December of year t-1 are used. Size values are in billion TLs. The time-series average of returns, market equities and book-to-market ratios are the simple average of the values within the respective sample. Panel A presents the full sample results while Panel B to E presents the sub-period results.

Table 3: Portfolios formed on size and book-to-market						
Panel A: Full Sample (January 1997 - December 2010)						
	All	Low-BM	BM2	BM3	BM4	High-BM
All	3.86%	3.26%	3.72%	3.83%	4.26%	4.61%
Small-ME	4.57%	3.21%	4.30%	5.23%	4.27%	5.59%
ME2	3.79%	3.52%	3.65%	3.31%	4.24%	4.19%
ME3	4.32%	4.59%	4.48%	4.04%	4.04%	4.56%
ME4	3.55%	2.41%	3.54%	3.88%	3.62%	4.30%
Big-ME	3.43%	3.66%	3.06%	3.05%	3.37%	4.04%
Panel B: Sub Sample 1 (January 1997 - January 2001)						
	All	Low-BM	BM2	BM3	BM4	High-BM
All	6.25%	5.51%	6.18%	6.47%	6.53%	7.25%
Small-ME	6.65%	4.78%	6.80%	7.24%	6.03%	7.75%
ME2	6.01%	6.53%	5.77%	5.25%	5.80%	6.75%
ME3	6.40%	4.78%	6.43%	6.61%	6.04%	8.55%
ME4	6.11%	5.78%	5.88%	6.89%	5.63%	6.63%
Big-ME	6.63%	5.96%	6.71%	5.86%	7.12%	7.66%
Panel C: Sub Sample 2 (February 2001 - December 2003)						
	All	Low-BM	BM2	BM3	BM4	High-BM
All	3.97%	2.38%	3.60%	4.04%	4.93%	4.41%
Small-ME	5.25%	4.22%	4.33%	7.12%	4.61%	6.17%
ME2	3.63%	3.15%	3.68%	3.88%	3.52%	3.52%
ME3	4.20%	4.18%	6.33%	3.03%	3.65%	4.17%
ME4	3.42%	0.11%	2.93%	4.27%	4.11%	5.31%
Big-ME	3.05%	3.16%	2.24%	2.66%	3.51%	3.49%
Panel D: Sub Sample 3 (January 2004 - December 2007)						
	All	Low-BM	BM2	BM3	BM4	High-BM
All	2.49%	2.30%	2.64%	2.32%	2.79%	3.35%
Small-ME	3.10%	2.25%	2.45%	3.24%	3.10%	4.26%
ME2	2.69%	2.45%	2.42%	2.03%	3.55%	3.06%
ME3	3.38%	4.04%	2.85%	3.59%	3.48%	2.75%
ME4	2.26%	1.29%	3.13%	1.70%	2.25%	2.94%
Big-ME	1.92%	2.83%	1.69%	1.79%	1.44%	2.03%
Panel E: Sub Sample 4 (January 2008 - December 2010)						
	All	Low-BM	BM2	BM3	BM4	High-BM
All	2.31%	2.35%	1.94%	2.02%	2.48%	2.87%
Small-ME	3.05%	1.37%	3.33%	3.29%	3.12%	3.88%
ME2	2.40%	1.21%	2.38%	1.83%	3.74%	2.85%
ME3	2.85%	5.44%	2.22%	2.13%	2.45%	1.94%
ME4	1.92%	1.56%	1.47%	2.30%	2.26%	1.94%
Big-ME	1.47%	2.13%	0.73%	1.30%	0.71%	2.34%

Each year the size values are sorted in June in ascending order and divided into 5 quintiles. Then these quintiles are sub-divided into 5 book-to-market quintiles by sorting BE/ME values in ascending order within each size quintile and collecting them into 5 groups. The stocks in each size-BE/ME quintile form the portfolios for the respective year. The average returns are calculated for the 12 months beginning in the July of that year and presented as percentages. The time-series average of returns is the simple average of the values within the sample. For size and BE/ME values for year t; the market equity in June of year t and book-to-market ratio in December of year t-1 are used. Panel A presents the full sample results while Panel B to E presents the sub-period results.

	Table 4: Descriptive statistics for dependent variables									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	Means					Standard Deviations				
Small-ME	3.21%	4.30%	5.23%	4.27%	5.59%	13.96%	14.97%	15.08%	15.31%	18.13%
ME2	3.52%	3.65%	3.31%	4.24%	4.19%	15.29%	14.69%	15.10%	16.54%	15.64%
ME3	4.59%	4.48%	4.04%	4.04%	4.56%	18.45%	16.51%	15.09%	14.62%	16.41%
ME4	2.41%	3.54%	3.88%	3.62%	4.30%	15.23%	14.16%	14.87%	14.75%	15.70%
Big-ME	3.66%	3.06%	3.05%	3.37%	4.04%	14.20%	14.13%	15.57%	15.61%	15.59%
	t-statistics for means									
Small-ME	2.98	3.72	4.49	3.62	4.00					
ME2	2.99	3.22	2.84	3.32	3.47					
ME3	3.22	3.52	3.47	3.58	3.61					
ME4	2.05	3.24	3.38	3.19	3.55					
Big-ME	3.34	2.81	2.54	2.80	3.36					

The mean values are the simple average returns for the size-BE/ME portfolios for the full sample period. The standard deviations are again for each portfolio for the full sample. The t-statistic is $\frac{\bar{x}-0}{\frac{s}{\sqrt{N}}}$ where $\bar{x}$ stands for the time-series average of portfolio returns, s for the standard deviation of the portfolio and N for the sample size.

Table 5: Descriptive statistics for independent variables										
				Autocorrelations for different lags			Correlations			
	Mean	StDev	t-statistic	1	2	12	RM-RF	SMB	HML	FIP
RM-RF	0.69%	15.03%	0.60	-0.03	-0.03	0.04	1.00			
SMB	0.61%	5.33%	1.49	0.09	0.05	-0.02	0.13	1.00		
HML	0.84%	4.45%	2.44	0.15	0.05	-0.12	-0.29	0.04	1.00	
FIP	0.42%	2.01%	2.68	0.19	0.05	-0.07	-0.41	0.20	0.15	1.00

The mean values are the average risk-premiums of the factors for the full sample. The standard deviation is again for the full sample. The t-statistic is $\frac{\bar{x}-0}{\frac{s}{\sqrt{N}}}$ where $\bar{x}$ stands for the time-series average of portfolio returns, s for the standard deviation of the portfolio and N for the sample size. The autocorrelations are for 1,2 and 12 lags.

can be inferred that none of the factor pairs have high correlation among each other.

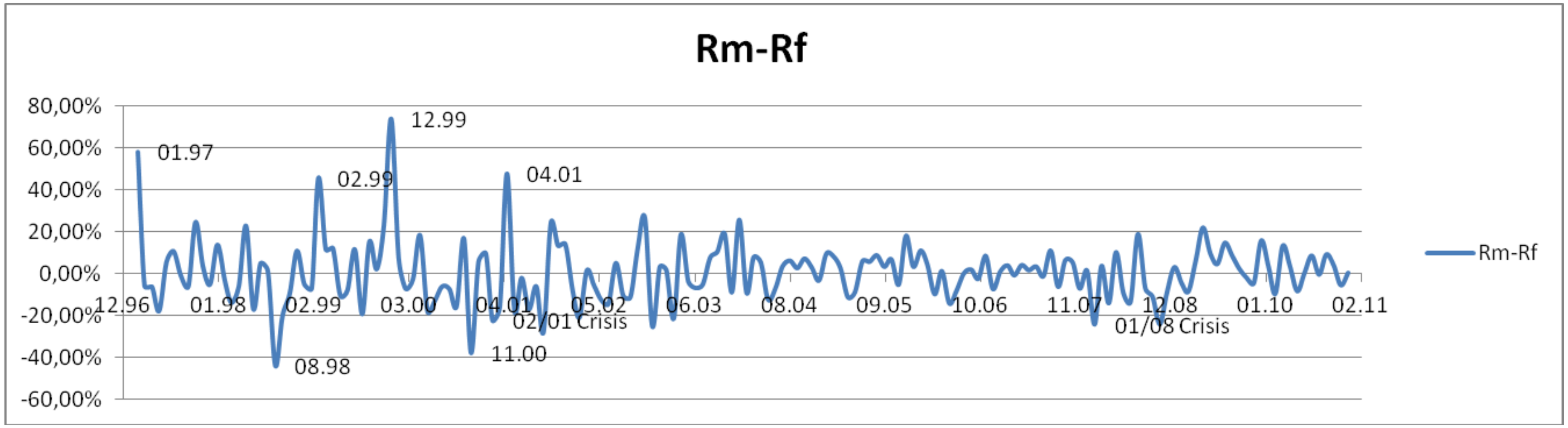
The explanatory variables are plotted against time for the study period and presented in Figure 5 and Figure 6. There are large outlier values for excess market return, SMB and HML for certain common dates. The crisis breakpoints of February 2001 and January 2008 are apparent only in the excess market return graph. The FIP is the least volatile factor which does not share any common pattern with the other factors.

2. Time-series Regressions and Robustness Checks

In this section, the time-series regressions are performed for each model specification and the outcomes are compared. The adjusted-R^2 values indicate the percentage of common variation in stock returns that is explained by each model for each portfolio. Thus, it is a variable used as a direct evidence for comparing the performance of different models. The signs, values and statistical significance (t-values) of the coefficients on different factors are also directly points to the existence and degree of the effects of the tested factors.

2.1. The one-factor model

The first model to be tested is the SLB specification of the CAPM. The excess returns on the 25 portfolios formed on size and book-to-market ratio are regressed



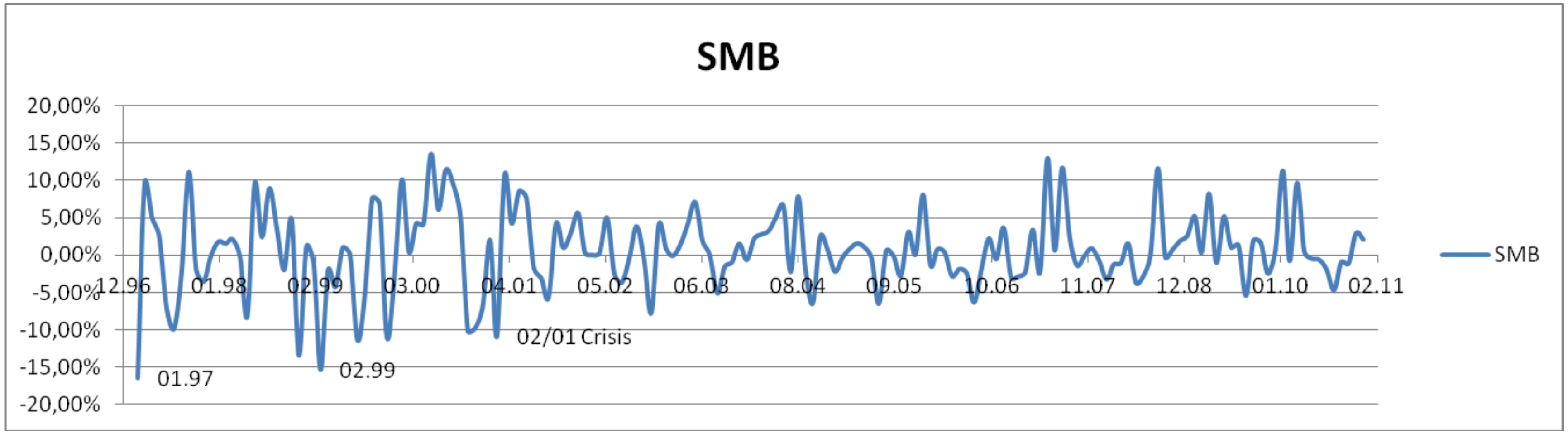


Figure 5: Rm-Rf & SMB

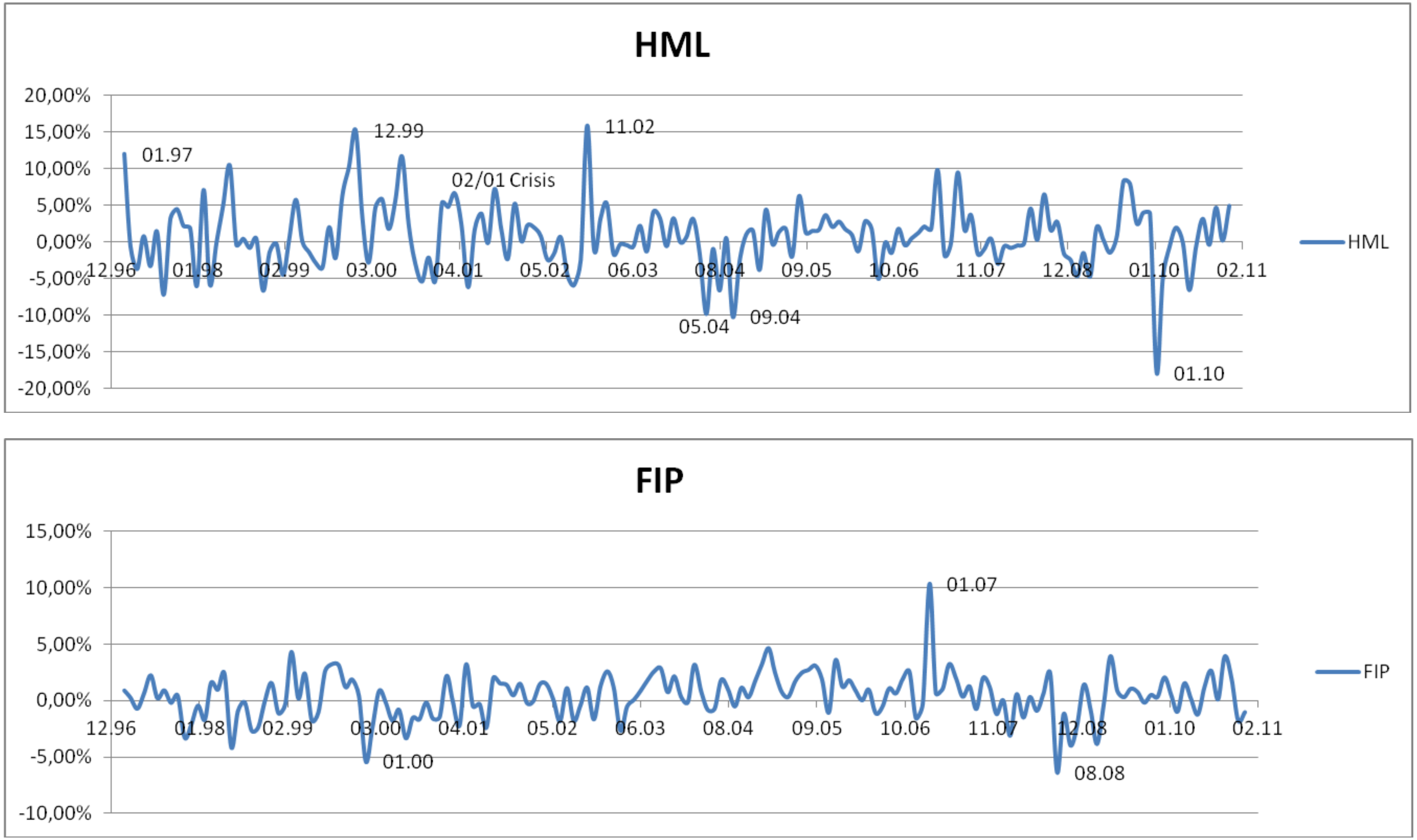


Figure 6: HML & FIP

only on the excess market return. The results presented in Table 6 show that the market factor is priced in the ISE when it is considered alone. The coefficients on the market factor (betas) are highly significant where the minimum t-value takes the value of 8.46. Furthermore, the betas are always below 1 for size-BE/ME portfolios. This is probably because the firms with higher beta values are mostly financial firms (especially banks and holding companies) which are excluded from the sample. The R^2 values that range between 0.3 and 0.84 imply that additional factors (such as SMB & HML) could improve the explanatory power of the model for explaining the variation in stock returns. The R^2 values are lower for smaller-size portfolios within each BE/ME group; which points out for a considerable size effect. Table 6 also shows that the biggest size portfolios have the higher R^2 values. One possible explanation for this result is that the foreign investors mostly trade the stocks of big size manufacturing companies; and the CAPM is able to explain the highly professional trading activity of these institutional investors. The previous studies on the Turkish market using log-returns such as Doganay (2006) and Yuksel et al. (2010) find higher R^2 values exceeding 0.90 for the one-factor model. The underestimation of returns by the logarithmic computation is probably responsible for the high R^2 values. On the other hand, Aksu & Onder (2003) uses the percentage returns and come up with closer R^2 values with the findings in this study.

2.2. The model with SMB & HML

Next, the two-factor model with two mimicking portfolios is considered. Without the market portfolio, the model loses its explanatory power drastically as seen in Table 7. The R^2 values are considerably low; 60% of them are below 0.10, and the highest is 0.28 for the smallest size and highest BE/ME portfolio. These values are significantly lower compared to the US market findings (Fama & French, 1993). On the other hand, 80% of the coefficients on HML and more than half of the coefficients on SMB are significant. These results indicate that the mimicking portfolios are priced risk factors in the market; but their effect is not strong compared to the market factor's effect. Especially firms with low book-to-market ratios are generally less affected from these factors; which is contradictory to the US market evidence (Fama & French, 1993). Furthermore the coefficients on SMB decrease from small-size portfolios to big-size monotonically; which shows that the SMB factor is directly related to size. Likewise the HML slopes increase from low BE/ME to high BE/ME portfolios monotonically; indicating a direct relationship between this factor and book-to-market ratio. The relation between size & SMB and BE/ME & HML are in line with the results in Fama & French (1993).

2.3. Fama & French three-factor model

The three-factor model including excess market return, SMB and HML is much better in explaining the common variation in stock returns compared to the previous two models. The slopes on the market factor (market betas) are statistically significant at the 1% level in Table 8. In the presence of the mimicking portfolios; the strong effect of market beta is persistent. Except the biggest size group; almost all of the coefficients on SMB are significant. The SMB slopes are monotonically decreasing from the small-size quintiles to big-size quintiles; which shows that they are related to the size of the portfolios. The coefficients on HML factor are mostly significant except for the quintiles where the slopes change from negative values to positive values in line with the results of Fama & French (1993). The slopes are related to book-to-market ratio of the portfolios; since they increase from low-BE/ME quintiles to high-BE/ME quintiles. The significant coefficients on the SMB & HML with their relation to size and BE/ME ratio clarifies that these two factors capture a considerable portion of the common variation in stock returns that is not explained by the market beta. Still, confirming the evidence from the previous two-factor model, the size and BE/ME effects are not as strong as they are in the developed markets (Fama & French, 1993; Bauer et al., 2010).

The R^2 values from the regressions are another evidence of the better performance of the three-factor model with respect to the CAPM. Almost all of the R^2 values improve with the inclusion of the mimicking portfolios. For instance, the lowest R^2 of the one-factor model increases tremendously from 0.30 to 0.59 in the three-factor model. The R^2 of 14 portfolios are above 0.7 for the Fama & French model; whereas only 8 of them were above this level for the CAPM. Especially the excess returns on the portfolios in the smaller size quintiles are explained much better pointing out a stronger size effect than BE/ME effect. The evidence from R^2

Table 6: Time series regression for one-factor model (The CAPM)

Time series regression results for:

R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)

SIZE QUANTILES	B/M QUINTILES									
	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.57	0.73	0.64	0.76	0.66	10.18	14.42	10.92	14.35	8.46
ME2	0.75	0.76	0.76	0.87	0.85	14.49	16.11	15.22	16.55	18.99
ME3	0.83	0.88	0.86	0.82	0.85	11.77	17.67	22.56	21.09	16.49
ME4	0.83	0.75	0.79	0.83	0.89	19.04	17.38	17.54	21.54	22.06
Big-ME	0.72	0.83	0.94	0.93	0.94	15.34	26.77	30.14	27.70	30.06
	R^2					**s(e)**				
Small-ME	0.38	0.55	0.41	0.55	0.30	0.11	0.10	0.11	0.10	0.15
ME2	0.56	0.61	0.58	0.62	0.68	0.10	0.09	0.10	0.10	0.09
ME3	0.45	0.65	0.75	0.73	0.62	0.14	0.10	0.07	0.08	0.10
ME4	0.68	0.64	0.65	0.73	0.74	0.08	0.08	0.09	0.08	0.08
Big-ME	0.58	0.81	0.84	0.82	0.84	0.09	0.06	0.06	0.06	0.06

The excess stock returns on 25 size-BE/ME portfolios are regressed on the excess market return for the full sample period between July 1997 and December 2010. The portfolios are formed in each year t using the market equity in June t and the book-to-market ratio in December t-1. The stocks are first divided into 5 ME quintiles and then sub-divided into 5 BE/ME quintiles. The returns for 12 months beginning in July of year t are calculated for these portfolios. In the table, "b" stands for market beta and t(b) represents the t-value of the beta. "s(e)" is the standard error of residuals and "R^2" is the adjusted r-squared value.

Table 7: Time series regression for two-factor model (SMB & HML)

Time series regression results for:

R(t)-RF(t) = a + s SMB(t) + h HML(t) + e(t)

	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	s					**t(s)**				
Small-ME	0.79	0.48	0.63	0.69	1.22	4.08	2.29	2.97	3.40	5.40
ME2	0.52	0.45	0.42	0.41	0.21	2.37	2.18	1.99	1.81	0.97
ME3	0.25	0.03	-0.16	-0.10	0.22	0.92	0.12	-0.78	-0.52	0.99
ME4	-0.14	-0.22	-0.37	-0.29	-0.51	-0.64	-1.08	-1.80	-1.42	-2.43
Big-ME	-0.72	-0.68	-0.59	-0.45	-0.76	-3.66	-3.53	-2.77	-2.12	-3.74
	h					**t(h)**				
Small-ME	0.03	0.66	0.45	1.19	1.75	0.12	2.65	1.80	4.85	6.48
ME2	0.29	0.76	0.92	1.16	1.20	1.09	3.10	3.65	4.25	4.69
ME3	-0.20	0.88	1.02	1.09	1.23	-0.62	3.18	4.11	4.54	4.61
ME4	0.40	0.65	0.80	0.96	1.03	1.54	2.70	3.25	3.95	4.06
Big-ME	0.17	0.57	0.80	0.92	1.04	0.74	2.46	3.11	3.60	4.27
	R^2					**s(e)**				
Small-ME	0.08	0.05	0.05	0.15	0.28	0.13	0.14	0.14	0.14	0.15
ME2	0.03	0.06	0.08	0.10	0.11	0.15	0.14	0.14	0.16	0.15
ME3	0.00	0.05	0.09	0.10	0.10	0.18	0.16	0.14	0.14	0.15
ME4	0.01	0.04	0.07	0.09	0.12	0.15	0.14	0.14	0.14	0.15
Big-ME	0.07	0.10	0.09	0.09	0.17	0.14	0.13	0.15	0.15	0.14

The excess stock returns on 25 size-BE/ME portfolios are regressed on the two stock market factors (SMB & HML) for the full sample period between July 1997 and December 2010. The portfolios are formed in each year t using the market equity in June t and the book-to-market ratio in December t-1. The stocks are first divided into 5 ME quintiles and then sub-divided into 5 BE/ME quintiles. The returns for 12 months beginning in July of year t are calculated for these portfolios. The two stock market factors are created by using 6 portfolios; which are formed in the same way with the dependent variables, but by dividing the stocks into 2 size groups and then sub-dividing them into 3 BE/ME groups (S/L, S/M, S/H, B/L, B/M, B/H). The SMB is the difference between the average returns of (S/L, S/M, S/H) and (B/L, B/M, B/H). Likewise the HML is the difference between the average returns of (S/H, B/H) and (S/L, B/L). In the table, “s” stands for the coefficient on the SMB factor and “h” for the coefficient on the HML factor. The t(.) represents the t-value of the respective variable from the regression. “s(e)” is the standard error of residuals and “R^2” is the adjusted r-squared value.

	Table 8: Time series regression for three-factor model (Rm-Rf, SMB & HML) Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.73	0.82	0.75	0.82	0.72	15.87	17.85	13.91	19.23	11.28
ME2	0.89	0.84	0.83	0.93	0.89	19.75	20.14	17.99	19.50	21.34
ME3	0.99	0.92	0.88	0.83	0.88	14.85	18.42	22.53	21.27	17.86
ME4	0.90	0.78	0.79	0.84	0.87	20.26	16.99	16.43	20.62	20.35
Big-ME	0.73	0.83	0.94	0.93	0.90	15.01	25.15	28.08	26.12	27.72
	s					**t(s)**				
Small-ME	1.27	1.01	1.11	1.23	1.68	10.07	8.05	7.55	10.50	9.65
ME2	1.09	1.00	0.95	1.01	0.78	8.92	8.72	7.60	7.83	6.90
ME3	0.89	0.63	0.41	0.43	0.79	4.90	4.59	3.83	4.07	5.89
ME4	0.44	0.29	0.14	0.25	0.05	3.66	2.30	1.06	2.29	0.42
Big-ME	-0.25	-0.14	0.02	0.15	-0.18	-1.89	-1.56	0.20	1.55	-2.04
	h					**t(h)**				
Small-ME	-0.59	-0.03	-0.18	0.49	1.14	-3.91	-0.23	-1.03	3.47	5.41
ME2	-0.47	0.05	0.22	0.38	0.45	-3.16	0.36	1.43	2.43	3.28
ME3	-1.04	0.10	0.28	0.38	0.48	-4.75	0.62	2.20	2.99	3.01
ME4	-0.36	-0.01	0.14	0.25	0.29	-2.45	-0.06	0.86	1.89	2.10
Big-ME	-0.44	-0.14	0.00	0.13	0.28	-2.78	-1.27	-0.02	1.13	2.66
	R^2					**s(e)**				
Small-ME	0.64	0.68	0.56	0.74	0.59	0.08	0.08	0.10	0.08	0.12
ME2	0.71	0.73	0.69	0.73	0.76	0.08	0.08	0.08	0.09	0.08
ME3	0.57	0.69	0.78	0.76	0.69	0.12	0.09	0.07	0.07	0.09
ME4	0.71	0.65	0.65	0.75	0.75	0.08	0.08	0.09	0.07	0.08
Big-ME	0.61	0.81	0.84	0.82	0.85	0.09	0.06	0.06	0.06	0.06

The excess stock returns on 25 size-BE/ME portfolios are regressed on the excess market return and two stock market factors (SMB & HML) for the full sample period between July 1997 and December 2010. The portfolios are formed in each year t using the market equity in June t and the book-to-market ratio in December t-1. The stocks are first divided into 5 ME quintiles and then sub-divided into 5 BE/ME quintiles. The returns for 12 months beginning in July of year t are calculated for these portfolios. The two stock market factors are created by using 6 portfolios; which are formed in the same way with the dependent variables, but by dividing the stocks into 2 size groups and then sub-dividing them into 3 BE/ME groups (S/L, S/M, S/H, B/L, B/M, B/H). The SMB is the difference between the average returns of (S/L, S/M, S/H) and (B/L, B/M, B/H). Likewise the HML is the difference between the average returns of (S/H, B/H) and (S/L, B/L). In the table, "b" stands for market beta, "s" for the coefficient on the SMB factor and "h" for the coefficient on the HML factor. The t(.) represents the t-value of the respective variable from the regression. "s(e)" is the standard error of residuals and "R^2" is the adjusted r-squared value.

values emphasizes the superiority of the three-factor model; though the explanatory power of the model remains weak in comparison with the developed market results (Fama & French, 1993; Bauer et al., 2010). The outcome from the three-factor model confirms the findings of previous studies on the Turkish market, although the R^2 values found are lower compared to the studies using log-returns in the calculations (Doganay, 2006; Yuksel et al., 2010).

2.4. Cross-sectional implications

The time-series regression results show that the excess market return, SMB and HML are priced risk factors in the market which capture the common variation in stock returns. In order to comment on the cross-sectional explanatory power of the models, the intercept values (Jensen's alphas) are examined. A model is adequate in explaining the cross-section of average returns if the intercept values are statistically indifferent from zero. In Table 9 contradicting the Fama & French (1993) results, the intercepts from the regression of excess returns on the market factor alone are small and statistically insignificant; such that their relation to size and book-to-market ratio are barely identified. The intercepts do not monotonically increase or decrease across the size or book-to-market quintiles. However highest BE/ME portfolios have larger intercepts than the lowest, and smallest size portfolios have larger intercepts than the biggest; thus the need for size and BE/ME factors for explaining the cross-section of returns is reinforced. This pattern disappears in the two-factor and three-factor models confirming the significant effect of the mimicking portfolios. The very small intercepts for each model are evidence of the cross-sectional explanatory power of the three stock market factors. The most important implication of the Jensen's alpha investigation here is that the intercept values get even smaller for switching to the three-factor model from the CAPM. This is a supportive result for the use of the Fama & French model.

The joint equality of the intercept terms to zero is tested using the Gibbons et al. (1989) methodology and the outcomes are presented in Table 10. The p-values from the GRS test support the results in the Jensen's alpha analysis. The one-factor model is rejected at the 10% level; meaning that the market beta alone is not able to explain the cross-section of average returns at this significance level. The two-factor and three-factor models are not rejected having lower F-statistic values. The cross-sectional explanatory power of the two-factor model is surprising but it confirms the findings in Yuksel et al. (2010). The highest p-value for the rejection of the models belongs to the three-factor model; thus it performs best in explaining the cross-section of average returns. The GRS F-test reveals that Fama & French model produces lower pricing errors than the CAPM.

For the US market, all of the three models are rejected by the joint F-test (Fama & French, 1993), however the three-factor model is the model with the lowest pricing bias. Contradicting the results in this study; Yuksel et al. (2010) and Misirli & Alper (2010) found that both CAPM and three-factor model are rejected by the GRS F-test. Nevertheless these studies use logarithmic computation method for calculating the returns which is probably responsible for different outcomes. Their findings also support that the three-factor model produces lower pricing errors.

	Table 9: Jensen's alphas B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)									
	a					t(a)				
Small-ME	-0.001	0.009	0.019	0.009	0.022	-0.10	1.18	2.16	1.09	1.91
ME2	0.001	0.002	-0.001	0.007	0.007	0.14	0.33	-0.14	0.95	1.05
ME3	0.011	0.010	0.005	0.006	0.011	1.06	1.33	0.95	0.99	1.41
ME4	-0.011	0.001	0.004	0.002	0.008	-1.62	0.19	0.66	0.27	1.30
Big-ME	0.003	-0.004	-0.005	-0.002	0.005	0.39	-0.87	-1.05	-0.33	1.07
	R(t)-RF(t) = a + s SMB(t) + h HML(t) + e(t)									
	a					t(a)				
Small-ME	-0.002	0.006	0.016	0.000	0.005	-0.18	0.49	1.38	-0.03	0.40
ME2	0.001	-0.002	-0.006	0.001	0.002	0.06	-0.14	-0.53	0.10	0.14
ME3	0.017	0.008	0.004	0.003	0.005	1.17	0.66	0.34	0.28	0.42
ME4	-0.007	0.002	0.005	0.001	0.009	-0.62	0.22	0.49	0.10	0.74
Big-ME	0.011	0.001	-0.001	0.000	0.007	1.00	0.11	-0.12	-0.01	0.67
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	a					t(a)				
Small-ME	-0.005	0.002	0.013	-0.004	0.002	-0.71	0.37	1.65	-0.57	0.24
ME2	-0.003	-0.005	-0.009	-0.002	-0.002	-0.41	-0.80	-1.39	-0.34	-0.29
ME3	0.013	0.005	0.001	0.000	0.002	1.39	0.67	0.09	-0.02	0.25
ME4	-0.011	-0.001	0.002	-0.002	0.005	-1.69	-0.09	0.35	-0.36	0.85
Big-ME	0.008	-0.002	-0.005	-0.004	0.004	1.13	-0.43	-1.04	-0.72	0.86

The intercept values from the regressions of 25 size-BE/ME portfolios on the common risk factors are denoted with a; and the t-values for intercepts are denoted with t(a). The models specifications are the CAPM, the two-factor model (with SMB & HML) and the three-factor model (with market factor, SMB & HML).

	Table 10: GRS F-test results			
	RM-RF	SMB & HML	RM-RF, SMB & HML	RM-RF, SMB, HML & FIP
F-Statistic:	1.45	1.18	1.17	1.15
p-value:	0.09	0.27	0.28	0.30

The GRS F-statistic is: $[T/N][(T-N-L)/(T-L-1)](1+\bar{f}_i^{'}\hat{\Omega}^{-1}\bar{f}_i)^{-1}(\hat{\alpha}^{'}\hat{\Sigma}^{-1}\hat{\alpha}) \sim F(N, T-N-L)$.

The test is conducted for the following models: The CAPM, the two-factor model (with SMB & HML), the three-factor model (with market factor, SMB & HML) and the four-factor model (with market factor, SMB, HML & FIP).

2.5. The foreign investor participation and the four-factor model

By introducing an additional proxy variable (FIP) to the three-factor model, this section intends to reveal the effect of the strong foreigner participation in the ISE. The FIP is the difference between monthly purchases and sales of stocks by foreigners normalized by the total monthly trade volume. Table 11 presents the results where there is no remarkable change in the coefficients for the former three stock market factors and their significance. All of the coefficients on FIP have negative signs; which is probably the case because the foreigners buy when the market is down and sell when it is up. The negative and relatively high correlation between the market factor and FIP also confirms this interpretation (see Table 5). More than half of the FIP slopes are insignificant; nevertheless this factor's significance is not lower than the HML. The R^2 values in the four-factor model are slightly above the three-factor model's R^2 values. Particularly there is improvement in the small-size high-BE/ME portfolios and big-size low-BE/ME portfolios. The results in Table 11 show that the foreign investor participation effect is significantly priced in the market; but this factor has a minor effect on the common variation in stock returns. The intercept values from the regression are again trivial and statistically indifferent from zero as they were in the three-factor model (see Appendix A). The GRS F-statistic for the four-factor model is lower than the three-factor model as seen in Table 10; therefore the inclusion of FIP reduces the pricing bias.

In order to understand the role of foreign investor participation better, an additional model is employed. This model includes the FIP and the excess market return as two explanatory variables. Most of the coefficients on the FIP are significant as seen in Table 12. The loss of significance for the FIP slope in the four-factor model is probably because FIP mostly reflects the same financial risk reflected by the three stock market factors. The R^2 values are slightly improved for the CAPM with the inclusion of FIP.

2.6. Robustness checks

Turkey has suffered from two severe economic crises in 2001 and 2008. The beginning dates of these crises are determined as breakpoints and the sample period is divided into four sub-periods for deeper analysis. The sub-period intervals are: January 1997 – January 2001; February 2001 – December 2003; January 2004 – December 2007; and January 2008 – December 2010. These intervals provide the opportunity of comparing the pre-crisis and post-crisis implications of the factor models. The regression results which are presented in Appendix B show that the market betas are significant for all models and in each sub-period. The coefficients on SMB factor are significant for most of the portfolios in each period; thus the size effect is persistent. The only exception to this result is the outcome in the last sub-period for the four-factor model; where the size effect vanishes.

On the other hand, HML slopes lose much of their significance after the first sub-period; especially in the post-crisis intervals. The FIP factor derives most of its significance from the 2001 post-crisis period and it has no effect at all on the common variation of stock returns in the 2008 pre-crisis period. The sub-period analysis on the coefficients has two important implications: First, the size effect is

	Table 11: Time series regression for four-factor model (Rm-Rf, SMB, HML & FIP) Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + f FIP(t) + e(t)									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.76	0.86	0.79	0.87	0.78	15.11	17.18	13.33	18.81	11.14
ME2	0.91	0.87	0.87	0.98	0.92	18.42	18.83	17.31	18.93	20.25
ME3	1.05	0.95	0.90	0.85	0.94	14.45	17.41	21.18	19.94	17.94
ME4	0.94	0.81	0.83	0.88	0.91	19.52	16.10	15.96	19.92	19.52
Big-ME	0.80	0.86	0.96	0.95	0.92	15.47	23.71	26.10	24.34	25.84
	s					**t(s)**				
Small-ME	1.23	0.96	1.07	1.17	1.62	9.61	7.57	7.13	9.96	9.15
ME2	1.07	0.97	0.90	0.95	0.74	8.53	8.32	7.13	7.31	6.46
ME3	0.82	0.59	0.38	0.41	0.71	4.45	4.23	3.48	3.74	5.30
ME4	0.39	0.25	0.08	0.20	0.00	3.20	1.98	0.64	1.83	0.02
Big-ME	-0.34	-0.17	0.00	0.12	-0.20	-2.57	-1.87	-0.04	1.26	-2.27
	h					**t(h)**				
Small-ME	-0.63	-0.08	-0.22	0.44	1.08	-4.10	-0.51	-1.25	3.11	5.10
ME2	-0.49	0.03	0.17	0.33	0.41	-3.28	0.19	1.13	2.09	3.01
ME3	-1.10	0.07	0.25	0.36	0.41	-5.03	0.40	1.97	2.76	2.59
ME4	-0.40	-0.04	0.09	0.21	0.25	-2.76	-0.27	0.55	1.55	1.80
Big-ME	-0.52	-0.17	-0.02	0.11	0.26	-3.33	-1.51	-0.21	0.93	2.44
	f					**t(f)**				
Small-ME	-0.54	-0.71	-0.64	-0.84	-0.97	-1.48	-1.94	-1.49	-2.49	-1.91
ME2	-0.37	-0.39	-0.71	-0.86	-0.57	-1.04	-1.15	-1.94	-2.30	-1.71
ME3	-1.04	-0.57	-0.45	-0.41	-1.17	-1.97	-1.42	-1.45	-1.31	-3.06
ME4	-0.75	-0.52	-0.79	-0.72	-0.68	-2.13	-1.42	-2.07	-2.24	-2.00
Big-ME	-1.27	-0.44	-0.33	-0.36	-0.34	-3.35	-1.66	-1.21	-1.27	-1.32
	R^2					**s(e)**				
Small-ME	0.64	0.68	0.57	0.75	0.60	0.08	0.08	0.10	0.08	0.12
ME2	0.71	0.73	0.69	0.73	0.77	0.08	0.08	0.08	0.09	0.08
ME3	0.58	0.69	0.78	0.76	0.71	0.12	0.09	0.07	0.07	0.09
ME4	0.72	0.65	0.65	0.75	0.75	0.08	0.08	0.09	0.07	0.08
Big-ME	0.63	0.82	0.84	0.82	0.85	0.09	0.06	0.06	0.06	0.06

The excess stock returns on 25 size-BE/ME portfolios are regressed on the excess market return, two stock market factors (SMB & HML) and the foreign investor participation factor (FIP) for the full sample period between July 1997 and December 2010. The portfolios are formed in each year t using the market equity in June t and the book-to-market ratio in December t-1. The stocks are first divided into 5 ME quintiles and then sub-divided into 5 BE/ME quintiles. The returns for 12 months beginning in July of year t are calculated for these portfolios. The two stock market factors are created by using 6 portfolios; which are formed in the same way with the dependent variables, but by dividing the stocks into 2 size groups and then sub-dividing them into 3 BE/ME groups (S/L, S/M, S/H, B/L, B/M, B/H). The SMB is the difference between the average returns of (S/L, S/M, S/H) and (B/L, B/M, B/H). Likewise the HML is the difference between the average returns of (S/H, B/H) and (S/L, B/L). The FIP is the monthly difference of total foreign purchases and sales of equity divided by the total trade volume. In the table, "b" stands for market beta, "s" for the coefficient on the SMB factor, "h" for the coefficient on the HML factor and "f" for the coefficient on the FIP factor. The t(.) represents the t-value of the respective variable from the regression. "s(e)" is the standard error of residuals and "R^2" is the adjusted r-squared value.

Table 12: Time series regression for the additional model (Rm-Rf & FIP)

Time series regression results for:

R(t)-RF(t) = a + b [RM(t)-RF(t)] + f FIP(t) + e(t)

	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.63	0.80	0.71	0.85	0.79	10.23	14.58	11.03	15.17	9.42
ME2	0.80	0.81	0.83	0.95	0.92	13.96	15.78	15.44	16.98	18.88
ME3	0.89	0.93	0.91	0.87	0.95	11.54	17.10	21.65	20.29	17.40
ME4	0.88	0.79	0.84	0.89	0.93	18.38	16.55	17.04	21.08	21.15
Big-ME	0.77	0.85	0.96	0.95	0.96	15.03	24.62	27.72	25.83	27.66
	f					**t(f)**				
Small-ME	-1.02	-1.22	-1.16	-1.64	-2.24	-2.20	-2.97	-2.42	-3.92	-3.55
ME2	-0.80	-0.93	-1.27	-1.51	-1.12	-1.87	-2.42	-3.14	-3.58	-3.08
ME3	-1.12	-0.92	-0.75	-0.76	-1.71	-1.94	-2.26	-2.38	-2.36	-4.20
ME4	-0.83	-0.64	-0.86	-0.90	-0.77	-2.32	-1.81	-2.35	-2.87	-2.32
Big-ME	-0.90	-0.29	-0.32	-0.47	-0.32	-2.35	-1.11	-1.22	-1.69	-1.23
	R^2					**s(e)**				
Small-ME	0.39	0.57	0.43	0.59	0.34	0.11	0.10	0.11	0.10	0.15
ME2	0.56	0.62	0.60	0.65	0.70	0.10	0.09	0.09	0.10	0.09
ME3	0.46	0.66	0.76	0.73	0.65	0.14	0.09	0.07	0.07	0.10
ME4	0.69	0.65	0.66	0.75	0.75	0.08	0.08	0.09	0.07	0.08
Big-ME	0.59	0.81	0.84	0.82	0.84	0.09	0.06	0.06	0.06	0.06

The excess stock returns on 25 size-BE/ME portfolios are regressed on the excess market return and the foreign investor participation factor (FIP) for the full sample period between July 1997 and December 2010. The portfolios are formed in each year t using the market equity in June t and the book-to-market ratio in December t-1. The stocks are first divided into 5 ME quintiles and then sub-divided into 5 BE/ME quintiles. The returns for 12 months beginning in July of year t are calculated for these portfolios. The FIP is the monthly difference of total foreign purchases and sales of equity divided by the total trade volume. In the table, “b” stands for market beta and “f” for the coefficient on the FIP factor. The t(.) represents the t-value of the respective variable from the regression. “s(e)” is the standard error of residuals and “R^2” is the adjusted r-squared value.

relatively stronger than the BE/ME effect for each sub-period. Second, the BE/ME effect is more apparent in the periods before the crises whereas the size and foreign investor participation are stronger in the post-crisis intervals.

The examination of the R^2 values reveals that the three-factor model is superior to the CAPM in each sub-period; while the four-factor model outperforms the three-factor model only in the post-crisis periods. All of the models produce better results after the 2008 crisis than before this event. There is no significant difference on average in the explanatory power of the models considering the 2001 crisis as a breakpoint; however there are considerable differences in the R^2 values among different portfolios. The GRS F-test outcomes presented in Appendix C show that the three-factor model produce smaller pricing errors except for the third sub-period (2004-2007); and four-factor model performs better than three-factor model only in the periods after the crises.

The different results in the sub-periods create the need for conducting structural break tests. This study uses two procedures in search of a possible structural break. Firstly, the dummy variable technique is used; where the dummy variable takes the value of 1 for the crisis periods and 0 otherwise. The significance of the coefficients on this variable is used to determine whether there is a significant impact of the crisis periods on the common variation of stock returns. The regressions are conducted for the full-sample, and the periods of 1997-2003 and 2004-2010. t-values from the regressions with different model specifications are presented in Table 13; where none of the coefficients has statistical significance. Therefore no relationship is observed between crisis periods and average returns.

The second procedure uses a structural break test developed by Chow (1960). This approach tests the null hypothesis of the joint equality of coefficients including the intercept values between different periods. There is a structural break for the investigated period if the F-statistic exceeds the critical value. The results in Table 14 show that in the sub-period between 1997 and 2003 the Chow test rejects the equality of the coefficients only for 5 of the portfolios for the three-factor model; and 6 of the portfolios for the four-factor model at 10% level of significance. Selecting the 2008 crisis as a break point, the null hypothesis is not rejected at all. Thus it can be concluded that there is no parameter instability for both periods considering the 2001 and 2008 financial crises.

Table 13: Dummy test

R(t)-RF(t) = a + b [RM(t)-RF(t)] + d DUMMY(t) + e(t)														
1997 - 2010					1997 - 2003					2004-2010				
t(d)					**t(d)**					**t(d)**				
0.70	0.93	1.13	0.99	0.47	0.79	0.31	0.95	0.65	0.34	0.20	1.21	0.69	0.90	0.36
-0.03	0.86	0.99	0.92	0.55	-0.06	0.49	0.71	0.53	0.15	0.06	0.82	0.77	0.83	0.80
1.34	1.42	-0.02	0.59	-0.10	1.28	1.39	0.04	0.64	-0.27	0.75	0.44	-0.11	0.16	0.29
-0.20	-0.03	0.97	1.43	1.12	-0.99	0.14	0.32	1.01	1.13	1.01	-0.30	1.54	1.06	0.25
0.32	-0.31	0.84	0.41	0.73	0.25	-0.54	0.42	0.09	-0.19	0.18	0.27	0.86	0.70	1.77
R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + d DUMMY(t) + e(t)														
1997 - 2010					1997 - 2003					2004-2010				
t(d)					**t(d)**					**t(d)**				
0.48	0.74	0.97	0.81	0.16	0.79	0.06	0.84	0.43	0.03	-0.21	1.10	0.49	0.77	0.16
-0.42	0.64	0.81	0.73	0.32	-0.34	0.26	0.53	0.28	-0.17	-0.25	0.66	0.64	0.67	0.65
1.32	1.30	-0.20	0.44	-0.39	1.19	1.28	-0.17	0.46	-0.61	0.63	0.26	-0.25	0.15	0.18
-0.36	-0.13	0.92	1.35	1.11	-1.13	0.03	0.26	0.91	1.08	0.93	-0.41	1.45	0.97	0.19
0.43	-0.24	0.83	0.34	0.83	0.29	-0.47	0.39	-0.03	-0.18	0.20	0.24	0.79	0.63	1.74
R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + f FIP(t) + d DUMMY(t) + e(t)														
1997 - 2010					1997 - 2003					2004-2010				
t(d)					**t(d)**					**t(d)**				
0.41	0.64	0.90	0.70	0.06	1.28	0.08	1.26	0.82	0.46	-0.68	0.37	-0.03	-0.25	-0.46
-0.47	0.58	0.71	0.62	0.23	-0.08	0.43	1.07	1.04	0.11	-0.38	0.19	0.27	0.90	0.33
1.23	1.23	-0.28	0.37	-0.56	1.91	1.57	0.31	0.97	-0.05	0.72	0.24	-0.15	-0.05	-0.24
-0.48	-0.20	0.82	1.25	1.01	-0.79	0.32	0.60	1.52	1.36	0.45	-0.99	0.88	0.47	-0.50
0.27	-0.32	0.77	0.28	0.77	1.37	-0.23	0.37	0.44	-0.09	-0.25	0.03	0.18	0.72	1.29

The dummy variable takes the value of one between February 2001 – December 2003 and January 2008 – December 2010; and zero otherwise. The t-values for the dummy are denoted with t(d). The models specifications are the CAPM, the three-factor model (with market factor, SMB & HML) and the four-factor model (with market factor, SMB, HML & FIP).

Table 14: Chow test

	Size1 BM1	Size1 BM2	Size1 BM3	Size1 BM4	Size1 BM5	Size2 BM1	Size2 BM2	Size2 BM3	Size2 BM4	Size2 BM5	Size3 BM1	Size3 BM2	Size3 BM3	Size3 BM4	Size3 BM5	Size4 BM1	Size4 BM2	Size4 BM3	Size4 BM4	Size4 BM5	Size5 BM1	Size5 BM2	Size5 BM3	Size5 BM4	Size5 BM5
The CAPM for the period 1997-2003																									
Chow Statistic=	0.60	0.37	0.74	0.21	0.68	0.52	0.89	0.39	0.31	0.80	1.29	0.96	0.00	0.32	0.29	1.87	0.34	0.05	1.20	2.07	0.35	0.25	1.43	1.04	4.15
P-values=	0.55	0.69	0.48	0.81	0.51	0.60	0.42	0.68	0.73	0.45	0.28	0.39	1.00	0.73	0.75	0.16	0.71	0.95	0.31	0.13	0.71	0.78	0.25	0.36	0.02
3 factor model for the period 1997-2003																									
Chow Statistic=	0.67	0.43	2.15	0.82	0.47	0.60	0.19	0.80	1.97	1.08	5.81	0.61	1.21	0.73	1.27	3.97	0.85	0.39	0.69	2.51	0.28	0.36	1.50	0.91	2.25
P-values=	0.61	0.78	0.08	0.52	0.76	0.67	0.94	0.53	0.11	0.37	0.00	0.66	0.32	0.58	0.29	0.01	0.50	0.81	0.60	0.05	0.89	0.83	0.21	0.46	0.07
4 factor model for the period 1997-2003																									
Chow Statistic=	0.99	0.63	2.52	1.99	0.77	0.57	0.56	1.66	2.35	1.13	6.94	1.56	1.34	1.12	1.20	4.14	0.85	0.56	1.66	2.76	0.83	1.26	1.96	0.95	3.13
P-values=	0.42	0.64	0.05	0.10	0.55	0.69	0.69	0.17	0.06	0.35	0.00	0.19	0.26	0.36	0.32	0.00	0.50	0.70	0.17	0.03	0.51	0.29	0.11	0.44	0.02
The CAPM for the period 2004-2010																									
Chow Statistic=	0.40	0.73	0.25	0.88	0.46	0.30	2.82	0.54	1.02	1.21	0.45	0.21	0.09	0.58	0.13	0.93	0.05	1.54	0.66	0.08	0.81	1.07	0.85	0.73	1.86
P-values=	0.67	0.49	0.78	0.42	0.64	0.75	0.07	0.59	0.36	0.30	0.64	0.81	0.92	0.56	0.88	0.40	0.95	0.22	0.52	0.92	0.45	0.35	0.43	0.48	0.16
3 factor model for the period 2004-2010																									
Chow Statistic=	1.08	0.75	0.22	0.22	1.55	0.35	1.04	1.34	0.38	0.52	0.21	0.10	0.08	0.41	0.07	0.92	0.27	0.99	0.64	0.18	1.07	0.46	0.91	0.28	1.33
P-values=	0.37	0.56	0.93	0.92	0.20	0.84	0.39	0.26	0.82	0.72	0.93	0.98	0.99	0.80	0.99	0.46	0.90	0.42	0.63	0.95	0.38	0.76	0.46	0.89	0.27
4 factor model for the period 2004-2010																									
Chow Statistic=	1.16	0.44	0.41	0.57	1.61	0.51	1.21	1.06	0.34	0.84	0.19	0.62	0.07	0.37	0.06	0.49	1.13	0.53	0.56	0.10	0.76	0.90	0.54	0.25	1.31
P-values=	0.34	0.82	0.84	0.72	0.17	0.77	0.31	0.39	0.89	0.52	0.96	0.69	1.00	0.87	1.00	0.78	0.35	0.75	0.73	0.99	0.58	0.49	0.74	0.94	0.27

The test is conducted for the following models: The CAPM, the three-factor model (with market factor, SMB & HML) and the four-factor model (with market factor, SMB, HML & FIP). The Chow test statistic is:

$$\frac{[RSS_f-(RSS_1+RSS_2)]/(L+1)}{[(RSS_1+RSS_2)/[T_1+T_2-2(L+1)]} \sim F\left(L+1, T_1+T_2-2(L+1)\right)$$

CHAPTER VI

CONCLUSION

This thesis explores the common risk factors in the ISE stock returns by using the time-series regression approach following Fama & French (1993). The data for 201 non-financial firms are used in the study covering the period between 1997 and 2010. The time-series regression results show that the market beta is statistically significant at levels lower than 5% whether it is considered alone or with other risk factors. On the other hand, the size and book-to-market effects are confirmed to be persistent in the ISE; and they are found to be weakly related to the common variation in stock returns. In short, the first finding of this study is that the Fama & French three-factor model outperforms the CAPM in the Istanbul Stock Exchange.

Second, the FIP (foreign investor participation) is shown to be a priced risk factor in the ISE. However it does not have a considerable impact in practical terms contrary to the common perception that the capital inflows and outflows are directly related with the rise and fall of the Turkish stock market. The FIP improves the three-factor model's explanatory power only slightly; and more than half of the coefficients on this variable are found to be insignificant. The participation of institutional foreign investors proxy for a global risk factor in the Turkish stock market. Still the relatively weaker impact of the FIP clarifies that the investors should not necessarily fear from capital flows.

Finally the sub-period investigations reveal that the BE/ME effect is stronger in the pre-crisis periods while the size and foreign participation effects are powerful in the periods after the crises. The four-factor model with the inclusion of the FIP performs better than the three-factor model only in the post-crisis periods. The sub-period examinations reveal that the results vary between different intervals; however the outcomes of the dummy technique and Chow test show no sign of a structural break considering the 2001 and 2008 crises as two breakpoints.

The findings in this thesis have direct implications for portfolio managers, investors and finance departments of corporations. The asset pricing models are very important to the fund managers who use them for portfolio selection strategies. Furthermore these models are used by investors widely for evaluating the performance of the portfolios composed of different stocks. The success of the models is also essential for firms when estimating the cost of capital. This thesis shows empirically that the three-factor model performs better than CAPM; and the four-factor model improves the explanatory power only slightly. Thus, for all of the purposes mentioned above, it is the most wise to use the Fama & French three-factor model instead of the CAPM although the market beta explains a substantial portion of the variation in stock returns. The four-factor model has a marginal effect on stock returns and thus is a slightly better tool for the fund managers, investors and people working at corporate finance departments.

In conclusion this thesis contributes to the literature in a variety of ways. First of all, it covers the longest time period among the studies investigating the common variation in stock returns trading in the ISE. Furthermore it discovers a new common risk factor, the foreign investor participation, and shows that this factor has only marginal effect on the average stock returns. Finally this thesis considers the relation between financial crises in Turkey and the explanatory power of the Fama & French model for the first time; and proves that the model is sound in terms of parameter stability.

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APPENDICES

APPENDIX A: Jensen's alpha for additional model specifications

SIZE QUANTILES	B/M QUINTILES									
	Low BM	BM_2	BM_3	BM_4	High BM	Low BM	BM_2	BM_3	BM_4	High BM
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + f FIP(t) + e(t)									
	a					**t(a)**				
Small-ME	0.003	0.014	0.023	0.015	0.031	0.35	1.79	2.64	1.91	2.65
ME_2	0.004	0.006	0.004	0.013	0.011	0.52	0.82	0.50	1.69	1.68
ME_3	0.015	0.013	0.008	0.009	0.017	1.44	1.78	1.43	1.46	2.30
ME_4	-0.007	0.004	0.008	0.005	0.011	-1.13	0.56	1.13	0.85	1.77
Big-ME	0.006	-0.003	-0.004	0.000	0.006	0.87	-0.63	-0.78	0.02	1.29
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + f FIP(t) + e(t)									
	a					**t(a)**				
Small-ME	-0.002	0.006	0.016	0.000	0.007	-0.31	0.85	1.98	0.07	0.71
ME_2	-0.001	-0.003	-0.006	0.002	0.001	-0.13	-0.48	-0.86	0.25	0.15
ME_3	0.018	0.008	0.003	0.002	0.007	1.85	1.01	0.46	0.31	1.02
ME_4	-0.007	0.002	0.006	0.001	0.008	-1.11	0.27	0.87	0.21	1.34
Big-ME	0.014	0.000	-0.003	-0.002	0.006	1.98	0.01	-0.70	-0.38	1.16

APPENDIX B: Time-series regression results for sub-periods

January 1997 – January 2001:

	Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.49	0.71	0.63	0.75	0.54	5.30	7.67	7.27	7.56	3.93
ME2	0.68	0.69	0.72	0.91	0.80	7.52	8.70	8.71	9.51	9.14
ME3	0.87	0.89	0.87	0.84	0.90	12.09	10.43	13.21	13.65	8.72
ME4	0.89	0.78	0.79	0.79	0.97	13.40	9.58	8.49	11.58	12.89
Big-ME	0.76	0.84	1.00	0.95	1.03	12.83	14.34	17.19	16.02	18.13
	R^2					**s(e)**				
Small-ME	0.36	0.55	0.52	0.54	0.23	0.13	0.13	0.12	0.14	0.20
ME2	0.54	0.61	0.61	0.65	0.63	0.13	0.11	0.12	0.14	0.13
ME3	0.75	0.69	0.78	0.79	0.61	0.10	0.12	0.10	0.09	0.15
ME4	0.79	0.65	0.60	0.73	0.77	0.10	0.12	0.13	0.10	0.11
Big-ME	0.77	0.81	0.86	0.84	0.87	0.09	0.08	0.08	0.09	0.08

	Time series regression results for: $R(t)-RF(t) = a + b\,[RM(t)-RF(t)] + s\,SMB(t) + h\,HML(t) + e(t)$									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.77	0.83	0.74	0.88	0.55	8.15	8.62	7.51	10.20	4.21
ME2	0.90	0.83	0.87	1.01	0.79	9.63	10.37	10.37	11.62	9.15
ME3	0.83	0.93	0.83	0.91	0.99	9.84	9.00	11.13	13.47	8.91
ME4	0.91	0.78	0.70	0.77	0.84	10.66	7.70	5.87	9.00	9.14
Big-ME	0.74	0.79	0.95	0.95	0.89	9.49	10.44	12.50	12.83	13.21
	s					**t(s)**				
Small-ME	1.27	1.05	0.85	1.31	1.19	5.25	4.27	3.36	5.93	3.58
ME2	1.24	1.02	1.07	1.16	0.68	5.18	4.99	4.98	5.21	3.07
ME3	0.26	0.54	0.25	0.63	1.00	1.19	2.05	1.34	3.62	3.54
ME4	0.25	0.33	-0.11	0.19	-0.25	1.15	1.27	-0.35	0.86	-1.04
Big-ME	-0.09	-0.21	-0.15	0.22	-0.42	-0.45	-1.09	-0.76	1.19	-2.46
	h					**t(h)**				
Small-ME	-0.80	0.48	0.24	0.80	1.84	-2.35	1.40	0.69	2.58	3.95
ME2	-0.18	0.25	0.28	0.91	1.19	-0.53	0.88	0.93	2.91	3.83
ME3	0.82	0.48	0.87	0.33	0.81	2.73	1.29	3.27	1.37	2.05
ME4	0.23	0.49	0.73	0.47	0.93	0.74	1.34	1.72	1.52	2.82
Big-ME	0.05	0.08	0.32	0.44	0.66	0.18	0.30	1.20	1.68	2.75
	R^2					**s(e)**				
Small-ME	0.59	0.70	0.62	0.79	0.58	0.11	0.11	0.11	0.10	0.15
ME2	0.70	0.76	0.76	0.83	0.78	0.10	0.09	0.09	0.10	0.10
ME3	0.80	0.73	0.84	0.85	0.73	0.09	0.11	0.08	0.08	0.12
ME4	0.79	0.68	0.61	0.75	0.80	0.10	0.11	0.13	0.10	0.10
Big-ME	0.76	0.81	0.86	0.85	0.89	0.09	0.08	0.08	0.08	0.08

	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)									
	a					**t(a)**				
Small-ME	-0.012	0.004	0.010	-0.004	0.017	-0.63	0.22	0.57	-0.21	0.59
ME2	0.002	-0.006	-0.012	-0.010	0.002	0.11	-0.36	-0.68	-0.49	0.10
ME3	-0.019	-0.003	-0.001	-0.006	0.018	-1.29	-0.17	-0.07	-0.46	0.84
ME4	-0.010	-0.006	0.004	-0.009	-0.003	-0.69	-0.38	0.18	-0.64	-0.17
Big-ME	-0.005	0.001	-0.011	0.003	0.007	-0.43	0.07	-0.90	0.22	0.58
	R(t)-RF(t) = a + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	-0.010	-0.007	0.002	-0.020	-0.009	-0.41	-0.28	0.09	-0.78	-0.35
ME2	-0.003	-0.015	-0.021	-0.027	-0.016	-0.12	-0.61	-0.84	-0.94	-0.66
ME3	-0.032	-0.013	-0.014	-0.015	0.003	-1.30	-0.46	-0.60	-0.59	0.09
ME4	-0.016	-0.015	-0.006	-0.017	-0.015	-0.61	-0.61	-0.25	-0.74	-0.58
Big-ME	-0.008	-0.002	-0.017	-0.006	-0.002	-0.37	-0.09	-0.66	-0.23	-0.09
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	-0.007	-0.004	0.005	-0.017	-0.007	-0.47	-0.27	0.29	-1.20	-0.32
ME2	0.000	-0.012	-0.018	-0.023	-0.013	0.00	-0.90	-1.31	-1.62	-0.92
ME3	-0.029	-0.010	-0.011	-0.011	0.006	-2.08	-0.58	-0.91	-1.03	0.34
ME4	-0.013	-0.013	-0.004	-0.015	-0.012	-0.91	-0.76	-0.20	-1.04	-0.78
Big-ME	-0.006	0.001	-0.014	-0.003	0.001	-0.43	0.05	-1.11	-0.23	0.09

	Time series regression results for: $R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + f FIP(t) + e(t)$									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.81	0.82	0.78	0.89	0.58	8.07	7.87	7.42	9.52	4.18
ME2	0.92	0.83	0.90	1.08	0.81	9.14	9.58	10.06	12.01	8.66
ME3	0.89	0.93	0.87	0.93	1.04	10.27	8.38	11.24	12.99	8.90
ME4	0.92	0.81	0.72	0.80	0.86	10.03	7.44	5.66	8.79	8.78
Big-ME	0.82	0.78	0.93	0.98	0.87	10.48	9.58	11.42	12.57	12.08
	s					**t(s)**				
Small-ME	1.20	1.08	0.77	1.30	1.12	4.75	4.19	2.95	5.60	3.23
ME2	1.20	1.03	1.01	1.03	0.65	4.80	4.77	4.53	4.63	2.81
ME3	0.13	0.53	0.16	0.58	0.89	0.62	1.93	0.85	3.21	3.07
ME4	0.23	0.28	-0.16	0.13	-0.29	0.99	1.02	-0.49	0.56	-1.20
Big-ME	-0.24	-0.19	-0.11	0.16	-0.39	-1.21	-0.95	-0.55	0.80	-2.17
	h					**t(h)**				
Small-ME	-0.89	0.52	0.15	0.78	1.76	-2.56	1.45	0.42	2.44	3.66
ME2	-0.22	0.26	0.21	0.76	1.16	-0.63	0.87	0.68	2.45	3.60
ME3	0.68	0.47	0.76	0.27	0.68	2.27	1.23	2.85	1.10	1.70
ME4	0.20	0.42	0.67	0.39	0.87	0.63	1.13	1.53	1.24	2.56
Big-ME	-0.12	0.11	0.37	0.36	0.70	-0.45	0.37	1.31	1.35	2.82
	f					**t(f)**				
Small-ME	-1.05	0.40	-1.02	-0.13	-0.92	-1.15	0.42	-1.06	-0.15	-0.72
ME2	-0.48	0.08	-0.79	-1.69	-0.36	-0.52	0.10	-0.97	-2.07	-0.42
ME3	-1.63	-0.07	-1.20	-0.66	-1.44	-2.06	-0.07	-1.69	-1.01	-1.35
ME4	-0.32	-0.71	-0.64	-0.84	-0.65	-0.38	-0.72	-0.55	-1.01	-0.73
Big-ME	-1.95	0.26	0.48	-0.91	0.45	-2.74	0.35	0.65	-1.28	0.69
	R^2					**s(e)**				
Small-ME	0.59	0.70	0.62	0.78	0.58	0.11	0.11	0.11	0.10	0.15
ME2	0.70	0.75	0.76	0.84	0.78	0.11	0.09	0.09	0.09	0.10
ME3	0.81	0.72	0.84	0.85	0.74	0.09	0.12	0.08	0.08	0.12
ME4	0.79	0.67	0.60	0.75	0.80	0.10	0.11	0.13	0.10	0.10
Big-ME	0.79	0.80	0.86	0.86	0.89	0.08	0.09	0.09	0.08	0.08

February 2001 – December 2003:

	Time series regression results for: $R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)$									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.60	0.82	0.51	0.74	0.78	6.24	8.89	3.78	6.76	5.28
ME2	0.83	0.85	0.80	0.83	0.97	8.30	8.47	6.40	9.37	13.71
ME3	0.75	0.90	0.87	0.79	0.79	7.45	8.24	14.21	12.92	9.25
ME4	0.70	0.68	0.80	0.92	0.78	7.25	8.96	11.36	12.31	10.43
Big-ME	0.68	0.88	0.86	0.82	0.78	8.66	15.01	16.60	12.79	14.74
	R^2					**s(e)**				
Small-ME	0.53	0.70	0.28	0.57	0.44	0.10	0.09	0.14	0.11	0.15
ME2	0.67	0.68	0.54	0.72	0.85	0.10	0.10	0.13	0.09	0.07
ME3	0.62	0.66	0.86	0.83	0.71	0.10	0.11	0.06	0.06	0.09
ME4	0.60	0.70	0.79	0.82	0.76	0.10	0.08	0.07	0.08	0.08
Big-ME	0.68	0.87	0.89	0.83	0.86	0.08	0.06	0.05	0.06	0.05

	Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.65	0.84	0.53	0.69	0.72	7.89	9.81	4.51	7.37	5.16
ME2	0.88	0.83	0.75	0.83	0.95	10.96	9.34	6.70	9.24	13.21
ME3	0.83	0.88	0.87	0.78	0.79	9.56	7.99	13.69	12.18	9.50
ME4	0.72	0.70	0.80	0.87	0.76	8.96	8.74	10.58	11.91	10.13
Big-ME	0.69	0.89	0.85	0.81	0.76	8.36	14.63	16.39	11.90	13.75
	s					**t(s)**				
Small-ME	0.74	0.94	1.63	1.55	1.64	2.25	2.74	3.48	4.11	2.93
ME2	0.93	1.35	1.64	0.62	0.50	2.88	3.79	3.66	1.73	1.72
ME3	0.31	0.92	0.33	0.33	0.85	0.88	2.10	1.30	1.28	2.57
ME4	1.25	0.08	0.01	0.18	0.62	3.89	0.25	0.03	0.63	2.08
Big-ME	-0.43	-0.31	0.45	-0.09	0.06	-1.31	-1.28	2.16	-0.33	0.28
	h					**t(h)**				
Small-ME	-0.85	-0.22	-0.22	0.83	1.07	-2.25	-0.55	-0.41	1.92	1.68
ME2	-0.89	0.45	0.96	0.01	0.23	-2.42	1.10	1.88	0.03	0.71
ME3	-1.32	0.46	0.00	0.22	0.14	-3.32	0.91	-0.01	0.77	0.36
ME4	-0.23	-0.31	0.01	0.83	0.37	-0.63	-0.84	0.03	2.49	1.09
Big-ME	-0.12	-0.25	0.21	0.10	0.31	-0.31	-0.91	0.88	0.31	1.24
	R^2					**s(e)**				
Small-ME	0.67	0.76	0.49	0.70	0.54	0.08	0.08	0.11	0.09	0.14
ME2	0.80	0.77	0.66	0.73	0.85	0.08	0.09	0.11	0.09	0.07
ME3	0.73	0.69	0.86	0.83	0.75	0.08	0.11	0.06	0.06	0.08
ME4	0.75	0.69	0.78	0.84	0.78	0.08	0.08	0.07	0.07	0.07
Big-ME	0.68	0.87	0.90	0.82	0.86	0.08	0.06	0.05	0.07	0.05

	B/M QUINTILES									
	Low BM	BM_2	BM_3	BM_4	High BM	Low BM	BM_2	BM_3	BM_4	High BM
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)									
SIZE QUANTILES	**a**					**t(a)**				
Small-ME	0.009	0.012	0.037	0.014	0.030	0.55	0.78	1.61	0.76	1.20
ME_2	0.001	0.006	0.008	0.004	0.006	0.04	0.36	0.36	0.28	0.47
ME_3	0.010	0.033	0.000	0.005	0.010	0.59	1.77	-0.02	0.50	0.71
ME_4	-0.031	-0.003	0.011	0.011	0.022	-1.88	-0.24	0.95	0.87	1.70
Big-ME	-0.001	-0.008	-0.004	0.004	0.003	-0.05	-0.80	-0.45	0.37	0.38
	R(t)-RF(t) = a + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	-0.005	-0.018	0.010	-0.031	-0.020	-0.21	-0.58	0.37	-1.12	-0.60
ME_2	-0.022	-0.037	-0.042	-0.026	-0.030	-0.68	-1.18	-1.35	-0.84	-0.91
ME_3	0.001	-0.007	-0.029	-0.024	-0.022	0.03	-0.22	-0.96	-0.87	-0.76
ME_4	-0.060	-0.020	-0.013	-0.028	-0.011	-2.21	-0.77	-0.43	-0.90	-0.41
Big-ME	-0.016	-0.028	-0.036	-0.021	-0.024	-0.60	-0.92	-1.25	-0.72	-0.91
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	0.014	0.007	0.026	-0.011	0.001	0.92	0.45	1.19	-0.62	0.04
ME_2	0.005	-0.012	-0.020	-0.001	-0.002	0.32	-0.73	-0.97	-0.08	-0.15
ME_3	0.026	0.019	-0.003	-0.001	0.001	1.59	0.92	-0.26	-0.06	0.07
ME_4	-0.039	0.000	0.011	-0.002	0.011	-2.63	0.03	0.81	-0.14	0.81
Big-ME	0.005	-0.002	-0.011	0.004	-0.001	0.31	-0.16	-1.13	0.28	-0.14

	Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + f FIP(t) + e(t)									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.71	0.87	0.60	0.80	0.83	8.20	9.29	4.74	8.55	5.65
ME2	0.91	0.88	0.86	0.91	0.99	10.35	9.21	7.45	9.68	12.68
ME3	0.91	0.98	0.89	0.84	0.86	10.07	8.72	12.60	12.62	9.84
ME4	0.78	0.73	0.86	0.96	0.80	9.18	8.28	10.95	14.04	9.84
Big-ME	0.79	0.96	0.88	0.85	0.81	9.84	15.98	15.94	11.46	14.12
	s					**t(s)**				
Small-ME	0.63	0.88	1.51	1.37	1.45	1.96	2.52	3.21	3.93	2.65
ME2	0.87	1.26	1.46	0.49	0.43	2.65	3.53	3.41	1.41	1.48
ME3	0.17	0.74	0.30	0.23	0.74	0.52	1.78	1.16	0.93	2.28
ME4	1.14	0.03	-0.10	0.02	0.55	3.62	0.09	-0.34	0.08	1.83
Big-ME	-0.60	-0.43	0.39	-0.15	-0.02	-2.02	-1.93	1.88	-0.55	-0.10
	h					**t(h)**				
Small-ME	-0.95	-0.27	-0.33	0.66	0.90	-2.58	-0.68	-0.63	1.67	1.44
ME2	-0.94	0.36	0.79	-0.11	0.17	-2.51	0.89	1.63	-0.28	0.52
ME3	-1.44	0.29	-0.03	0.13	0.03	-3.78	0.61	-0.09	0.47	0.08
ME4	-0.33	-0.35	-0.09	0.67	0.31	-0.91	-0.95	-0.27	2.33	0.89
Big-ME	-0.27	-0.36	0.15	0.04	0.24	-0.81	-1.42	0.65	0.12	0.97
	f					**t(f)**				
Small-ME	-1.72	-0.89	-1.92	-2.83	-2.97	-1.80	-0.87	-1.39	-2.77	-1.84
ME2	-0.84	-1.43	-2.85	-2.07	-1.05	-0.87	-1.36	-2.27	-2.03	-1.23
ME3	-2.08	-2.82	-0.41	-1.55	-1.82	-2.11	-2.29	-0.54	-2.13	-1.92
ME4	-1.63	-0.78	-1.71	-2.57	-1.09	-1.76	-0.81	-2.00	-3.44	-1.23
Big-ME	-2.66	-1.87	-0.93	-0.98	-1.32	-3.04	-2.84	-1.53	-1.22	-2.11
	R^2					**s(e)**				
Small-ME	0.70	0.76	0.51	0.76	0.57	0.08	0.08	0.11	0.08	0.13
ME2	0.80	0.77	0.70	0.76	0.85	0.08	0.09	0.10	0.08	0.07
ME3	0.76	0.72	0.85	0.85	0.77	0.08	0.10	0.06	0.06	0.08
ME4	0.76	0.69	0.80	0.88	0.78	0.08	0.08	0.07	0.06	0.07
Big-ME	0.75	0.89	0.90	0.82	0.88	0.07	0.05	0.05	0.07	0.05

January 2004 – December 2007:

	Time series regression results for: $R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)$									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.69	0.66	0.87	0.72	1.06	3.38	4.24	4.45	5.28	4.01
ME2	0.77	0.60	0.91	0.64	0.70	5.20	4.17	7.22	3.91	6.33
ME3	0.69	0.78	0.78	0.95	0.70	2.71	5.66	5.91	6.70	5.17
ME4	0.71	0.77	0.69	0.91	0.85	6.14	6.36	6.65	9.38	8.43
Big-ME	0.84	0.65	0.80	0.92	0.85	3.49	9.30	10.90	10.86	10.32
	R^2					**s(e)**				
Small-ME	0.18	0.27	0.29	0.36	0.24	0.10	0.08	0.09	0.07	0.13
ME2	0.36	0.26	0.52	0.23	0.45	0.07	0.07	0.06	0.08	0.05
ME3	0.12	0.40	0.42	0.48	0.35	0.12	0.07	0.06	0.07	0.07
ME4	0.44	0.46	0.48	0.65	0.60	0.06	0.06	0.05	0.05	0.05
Big-ME	0.19	0.65	0.71	0.71	0.69	0.12	0.03	0.04	0.04	0.04

SIZE QUANTILES	Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	B/M QUINTILES									
	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.84	0.75	0.96	0.75	1.04	5.96	5.23	5.76	6.54	5.69
ME2	0.84	0.65	0.96	0.70	0.75	6.07	4.87	7.86	4.74	7.40
ME3	0.93	0.82	0.81	0.95	0.70	5.22	6.08	6.24	6.53	5.22
ME4	0.77	0.79	0.74	0.92	0.87	7.19	6.31	7.24	9.09	8.34
Big-ME	0.94	0.67	0.82	0.94	0.85	4.40	9.64	11.15	10.77	9.93
	s					**t(s)**				
Small-ME	1.74	0.75	1.34	0.94	2.01	7.14	3.00	4.61	4.73	6.33
ME2	0.62	0.75	0.43	1.03	0.65	2.58	3.23	2.05	4.04	3.70
ME3	1.45	0.53	0.54	0.28	0.43	4.73	2.25	2.39	1.12	1.85
ME4	0.13	0.06	0.28	0.11	0.09	0.68	0.29	1.61	0.65	0.48
Big-ME	-0.49	-0.05	-0.06	0.05	0.01	-1.31	-0.40	-0.51	0.35	0.10
	h					**t(h)**				
Small-ME	-0.82	-0.61	-0.36	0.10	1.20	-3.06	-2.22	-1.13	0.45	3.44
ME2	-0.54	-0.24	-0.39	-0.09	-0.16	-2.04	-0.94	-1.66	-0.32	-0.85
ME3	-2.00	-0.22	-0.04	0.23	0.16	-5.92	-0.85	-0.18	0.81	0.63
ME4	-0.67	-0.19	-0.37	0.01	-0.16	-3.28	-0.81	-1.92	0.06	-0.79
Big-ME	-1.47	-0.26	-0.25	-0.18	-0.01	-3.59	-1.95	-1.78	-1.06	-0.04
	R^2					**s(e)**				
Small-ME	0.63	0.41	0.50	0.56	0.65	0.07	0.07	0.08	0.05	0.09
ME2	0.45	0.38	0.56	0.41	0.57	0.07	0.06	0.06	0.07	0.05
ME3	0.58	0.44	0.46	0.48	0.38	0.08	0.06	0.06	0.07	0.06
ME4	0.53	0.44	0.52	0.64	0.59	0.05	0.06	0.05	0.05	0.05
Big-ME	0.37	0.66	0.72	0.71	0.68	0.10	0.03	0.03	0.04	0.04

	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)									
	a					**t(a)**				
Small-ME	0.001	0.003	0.008	0.009	0.016	0.04	0.26	0.60	0.92	0.88
ME2	0.002	0.003	-0.004	0.014	0.009	0.17	0.34	-0.46	1.21	1.09
ME3	0.019	0.006	0.013	0.010	0.006	1.04	0.58	1.39	0.98	0.58
ME4	-0.009	0.009	-0.005	-0.002	0.006	-1.12	1.01	-0.67	-0.28	0.80
Big-ME	0.005	-0.004	-0.005	-0.010	-0.003	0.28	-0.91	-1.01	-1.70	-0.59
	R(t)-RF(t) = a + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	0.000	0.008	0.011	0.010	0.008	0.02	0.64	0.69	0.87	0.49
ME2	0.009	0.006	0.005	0.015	0.013	0.66	0.52	0.36	1.17	1.21
ME3	0.026	0.012	0.018	0.017	0.009	1.67	0.91	1.46	1.23	0.79
ME4	0.001	0.018	0.003	0.007	0.015	0.10	1.47	0.24	0.61	1.31
Big-ME	0.025	0.004	0.005	0.000	0.006	1.38	0.50	0.52	0.03	0.54
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	-0.009	0.000	0.000	0.002	-0.003	-0.89	-0.01	0.00	0.19	-0.24
ME2	-0.001	-0.001	-0.006	0.007	0.005	-0.06	-0.11	-0.66	0.67	0.63
ME3	0.016	0.003	0.009	0.007	0.002	1.27	0.27	1.00	0.67	0.18
ME4	-0.007	0.009	-0.006	-0.003	0.006	-0.97	1.01	-0.76	-0.40	0.78
Big-ME	0.014	-0.003	-0.004	-0.010	-0.003	0.94	-0.63	-0.72	-1.59	-0.58

SIZE QUANTILES	Time series regression results for: $R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + f FIP(t) + e(t)$									
	B/M QUINTILES									
	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.86	0.82	1.06	0.88	1.20	5.04	4.71	5.26	6.49	5.51
ME2	0.82	0.69	0.95	0.64	0.72	4.85	4.27	6.36	3.61	5.85
ME3	0.90	0.75	0.79	0.95	0.77	4.16	4.59	4.98	5.38	4.69
ME4	0.82	0.85	0.77	0.95	0.97	6.30	5.63	6.20	7.81	7.94
Big-ME	1.06	0.65	0.86	0.91	0.83	4.11	7.72	9.67	8.61	7.94
	s					**t(s)**				
Small-ME	1.73	0.71	1.29	0.88	1.92	6.89	2.79	4.35	4.43	6.02
ME2	0.63	0.73	0.44	1.05	0.66	2.56	3.05	2.03	4.03	3.68
ME3	1.47	0.56	0.55	0.28	0.40	4.64	2.35	2.37	1.08	1.67
ME4	0.10	0.03	0.27	0.09	0.03	0.54	0.14	1.48	0.52	0.18
Big-ME	-0.55	-0.04	-0.08	0.07	0.03	-1.44	-0.31	-0.64	0.43	0.17
	h					**t(h)**				
Small-ME	-0.82	-0.59	-0.33	0.14	1.25	-2.98	-2.11	-1.02	0.64	3.60
ME2	-0.55	-0.23	-0.39	-0.11	-0.17	-2.03	-0.88	-1.66	-0.38	-0.89
ME3	-2.01	-0.24	-0.05	0.23	0.18	-5.85	-0.93	-0.20	0.80	0.69
ME4	-0.66	-0.17	-0.36	0.02	-0.12	-3.16	-0.71	-1.84	0.12	-0.62
Big-ME	-1.43	-0.27	-0.24	-0.19	-0.01	-3.46	-1.96	-1.67	-1.10	-0.09
	f					**t(f)**				
Small-ME	-0.15	-0.45	-0.65	-0.84	-1.07	-0.25	-0.71	-0.88	-1.70	-1.33
ME2	0.16	-0.27	0.10	0.36	0.19	0.26	-0.45	0.19	0.54	0.43
ME3	0.20	0.47	0.16	-0.01	-0.41	0.25	0.79	0.28	-0.02	-0.68
ME4	-0.31	-0.41	-0.20	-0.25	-0.72	-0.65	-0.74	-0.44	-0.56	-1.59
Big-ME	-0.80	0.12	-0.26	0.19	0.16	-0.83	0.38	-0.79	0.49	0.43
	R^2					**s(e)**				
Small-ME	0.62	0.40	0.50	0.58	0.66	0.07	0.07	0.08	0.05	0.09
ME2	0.44	0.37	0.55	0.41	0.56	0.07	0.06	0.06	0.07	0.05
ME3	0.57	0.44	0.45	0.47	0.37	0.09	0.06	0.06	0.07	0.06
ME4	0.52	0.43	0.51	0.63	0.60	0.05	0.06	0.05	0.05	0.05
Big-ME	0.37	0.65	0.72	0.70	0.67	0.10	0.03	0.04	0.04	0.04

January 2008 – December 2010:

	Time series regression results for: $R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)$									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.91	0.69	0.92	0.88	0.79	6.05	5.74	6.33	8.46	4.55
ME2	0.93	0.99	0.79	0.89	0.92	6.43	9.38	7.31	7.17	8.23
ME3	0.93	0.87	0.85	0.75	0.77	2.93	7.46	7.84	6.07	7.92
ME4	0.87	0.79	0.81	0.84	0.80	6.67	7.40	8.92	7.76	8.72
Big-ME	0.51	0.81	0.92	1.05	0.94	4.77	9.90	10.68	11.95	12.70
	R^2					**s(e)**				
Small-ME	0.50	0.48	0.53	0.67	0.36	0.10	0.08	0.09	0.07	0.11
ME2	0.54	0.71	0.60	0.59	0.66	0.09	0.07	0.07	0.08	0.07
ME3	0.18	0.61	0.63	0.51	0.64	0.21	0.08	0.07	0.08	0.06
ME4	0.55	0.61	0.69	0.63	0.68	0.08	0.07	0.06	0.07	0.06
Big-ME	0.38	0.73	0.76	0.80	0.82	0.07	0.05	0.06	0.06	0.05

	Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	0.82	0.63	0.87	0.82	0.65	7.11	6.58	6.98	9.18	5.22
ME2	0.88	0.96	0.74	0.84	0.87	7.77	9.64	7.29	7.06	8.20
ME3	0.88	0.84	0.83	0.72	0.73	3.80	7.84	7.45	5.78	7.64
ME4	0.84	0.79	0.78	0.82	0.79	7.32	7.61	8.68	7.50	8.25
Big-ME	0.55	0.82	0.90	1.05	0.92	5.58	9.76	10.41	11.69	12.26
	s					**t(s)**				
Small-ME	1.65	1.11	1.05	1.00	2.18	4.90	3.94	2.88	3.82	6.02
ME2	1.00	0.59	0.85	0.74	0.80	3.01	2.00	2.87	2.13	2.56
ME3	1.64	0.63	0.35	0.34	0.60	2.41	2.03	1.07	0.92	2.13
ME4	0.70	0.18	0.47	0.43	0.24	2.09	0.61	1.78	1.33	0.85
Big-ME	-0.38	-0.09	0.33	0.06	0.24	-1.30	-0.37	1.31	0.24	1.10
	h					**t(h)**				
Small-ME	-0.05	-0.26	-0.47	0.09	0.57	-0.17	-1.09	-1.49	0.38	1.83
ME2	-0.72	-0.25	0.19	-0.06	0.09	-2.50	-0.98	0.76	-0.21	0.34
ME3	-2.34	-0.39	-0.03	0.51	0.20	-4.00	-1.44	-0.09	1.63	0.84
ME4	-0.58	-0.48	-0.01	-0.13	0.03	-2.00	-1.84	-0.06	-0.46	0.11
Big-ME	-0.79	-0.26	-0.11	-0.25	0.27	-3.17	-1.23	-0.50	-1.10	1.41
	R^2					**s(e)**				
Small-ME	0.72	0.68	0.67	0.77	0.68	0.07	0.06	0.08	0.06	0.08
ME2	0.72	0.75	0.66	0.63	0.70	0.07	0.06	0.06	0.08	0.07
ME3	0.58	0.68	0.63	0.52	0.66	0.15	0.07	0.07	0.08	0.06
ME4	0.67	0.64	0.71	0.64	0.67	0.07	0.07	0.06	0.07	0.06
Big-ME	0.50	0.73	0.77	0.80	0.82	0.06	0.05	0.06	0.06	0.05

	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + e(t)									
	a					**t(a)**				
Small-ME	0.003	0.023	0.022	0.021	0.028	0.19	1.77	1.42	1.83	1.52
ME2	0.002	0.013	0.008	0.027	0.018	0.10	1.15	0.67	2.01	1.48
ME3	0.044	0.012	0.011	0.014	0.009	1.27	0.93	0.92	1.05	0.86
ME4	0.005	0.004	0.013	0.012	0.009	0.36	0.37	1.28	1.03	0.90
Big-ME	0.011	-0.003	0.002	-0.004	0.013	0.97	-0.35	0.27	-0.38	1.60
	R(t)-RF(t) = a + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	-0.019	0.008	0.007	0.005	0.000	-0.93	0.52	0.34	0.28	0.01
ME2	-0.012	0.002	-0.006	0.014	0.004	-0.58	0.10	-0.31	0.69	0.22
ME3	0.027	0.001	0.003	0.005	-0.002	0.88	0.07	0.13	0.28	-0.10
ME4	-0.006	-0.001	0.003	0.003	0.002	-0.27	-0.04	0.18	0.17	0.11
Big-ME	0.014	-0.006	-0.006	-0.009	0.005	0.93	-0.33	-0.29	-0.42	0.23
	R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + e(t)									
	a					**t(a)**				
Small-ME	-0.014	0.012	0.012	0.010	0.004	-1.12	1.11	0.88	0.98	0.27
ME2	-0.007	0.007	-0.002	0.019	0.009	-0.59	0.67	-0.14	1.43	0.78
ME3	0.032	0.006	0.007	0.009	0.002	1.23	0.50	0.57	0.67	0.20
ME4	-0.001	0.003	0.008	0.008	0.006	-0.08	0.30	0.76	0.65	0.60
Big-ME	0.017	-0.002	-0.001	-0.004	0.010	1.56	-0.16	-0.08	-0.37	1.15

	Time series regression results for: R(t)-RF(t) = a + b [RM(t)-RF(t)] + s SMB(t) + h HML(t) + f FIP(t) + e(t)									
	B/M QUINTILES									
SIZE QUANTILES	Low BM	BM2	BM3	BM4	High BM	Low BM	BM2	BM3	BM4	High BM
	b					**t(b)**				
Small-ME	1.12	0.92	1.19	1.19	0.98	5.05	5.05	4.93	7.27	4.10
ME2	1.09	1.27	0.91	0.77	1.13	4.82	6.67	4.52	3.21	5.44
ME3	0.77	1.09	0.86	0.86	0.86	1.64	5.24	3.83	3.45	4.53
ME4	0.95	1.18	0.95	1.04	0.92	4.11	6.16	5.31	4.83	4.82
Big-ME	0.59	1.01	1.05	1.06	1.13	2.95	6.17	6.11	5.84	7.79
	s					**t(s)**				
Small-ME	1.20	0.67	0.58	0.46	1.69	2.76	1.89	1.23	1.46	3.62
ME2	0.71	0.13	0.60	0.85	0.42	1.61	0.36	1.53	1.82	1.04
ME3	1.81	0.26	0.30	0.13	0.40	1.99	0.64	0.69	0.27	1.08
ME4	0.55	-0.39	0.23	0.10	0.05	1.22	-1.06	0.66	0.25	0.13
Big-ME	-0.43	-0.37	0.12	0.05	-0.06	-1.10	-1.17	0.35	0.16	-0.23
	h					**t(h)**				
Small-ME	-0.27	-0.47	-0.70	-0.17	0.33	-0.85	-1.83	-2.04	-0.76	0.98
ME2	-0.86	-0.47	0.07	-0.01	-0.09	-2.71	-1.73	0.25	-0.03	-0.31
ME3	-2.25	-0.57	-0.05	0.41	0.11	-3.42	-1.93	-0.15	1.17	0.40
ME4	-0.65	-0.76	-0.13	-0.28	-0.07	-2.01	-2.81	-0.52	-0.93	-0.25
Big-ME	-0.81	-0.40	-0.21	-0.25	0.12	-2.90	-1.72	-0.88	-1.00	0.58
	f					**t(f)**				
Small-ME	-1.87	-1.79	-1.97	-2.24	-2.05	-1.59	-1.86	-1.54	-2.59	-1.62
ME2	-1.23	-1.88	-1.04	0.44	-1.57	-1.04	-1.87	-0.98	0.35	-1.43
ME3	0.71	-1.55	-0.19	-0.85	-0.81	0.29	-1.41	-0.16	-0.64	-0.81
ME4	-0.64	-2.40	-1.00	-1.34	-0.79	-0.53	-2.37	-1.06	-1.18	-0.79
Big-ME	-0.21	-1.18	-0.89	-0.04	-1.27	-0.20	-1.36	-0.99	-0.04	-1.66
	R^2					**s(e)**				
Small-ME	0.74	0.70	0.68	0.80	0.70	0.07	0.06	0.08	0.05	0.08
ME2	0.72	0.77	0.66	0.62	0.71	0.07	0.06	0.06	0.08	0.07
ME3	0.57	0.69	0.62	0.51	0.66	0.15	0.07	0.07	0.08	0.06
ME4	0.66	0.69	0.71	0.64	0.67	0.07	0.06	0.06	0.07	0.06
Big-ME	0.49	0.74	0.77	0.79	0.83	0.06	0.05	0.06	0.06	0.05

APPENDIX C: GRS F-test results for sub-periods

January 1997 – January 2001:

	GRS F-test results for different models			
	RM-RF	SMB & HML	RM-RF, SMB & HML	RM-RF, SMB, HML & FIP
F-Statistic:	0.70	0.55	0.60	0.72
p-value:	0.81	0.92	0.89	0.79

February 2001 – December 2003:

	GRS F-test results for different models			
	RM-RF	SMB & HML	RM-RF, SMB & HML	RM-RF, SMB, HML & FIP
F-Statistic:	1.47	1.13	1.01	0.90
p-value:	0.28	0.46	0.54	0.61

January 2004 – December 2007:

	GRS F-test results for different models			
	RM-RF	SMB & HML	RM-RF, SMB & HML	RM-RF, SMB, HML & FIP
F-Statistic:	0.46	0.52	0.51	0.61
p-value:	0.97	0.94	0.94	0.88

January 2008 – December 2010:

	GRS F-test results for different models			
	RM-RF	SMB & HML	RM-RF, SMB & HML	RM-RF, SMB, HML & FIP
F-Statistic:	1.17	1.27	1.13	1.12
p-value:	0.41	0.37	0.46	0.48