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EXPLAINING THE TIME SERIES AND CROSS-SECTION VARIATIONS OF RETURNS: THE MEXICAN STOCK MARKET

DOCTORAL DISSERTATION

JORGE ENRIQUE VELARDE CHAPA

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EXPLAINING THE TIME SERIES AND CROSS-SECTION VARIATIONS OF RETURNS: THE MEXICAN STOCK MARKET

by

Jorge Enrique Velarde Chapa

Dissertation

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EXPLAINING THE TIME SERIES AND CROSS-SECTION VARIATIONS

OF RETURNS: THE MEXICAN STOCK MARKET

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DEDICATED

TO

MY BELOVED WIFE YAMILLE

OUR BEAUTIFUL DAUGHTER JOCELYN, WHO HAS BROUGHT A SHINING LIGHT TO OUR LIVES

MY MOTHER BERTHA FOR HIS LOVING CARE

MY FATHER ENRIQUE FOR BEING A ROLE MODEL IN MY LIFE

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EXPLAINING THE TIME SERIES AND CROSS-SECTION VARIATIONS OF RETURNS: THE MEXICAN STOCK MARKET

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ABSTRACT OF DISSERTATION

The main objective of this dissertation is to propose an Asset Pricing Model that identifies the risk factors explaining the time series and cross-section variations in the returns of the Mexican Stock Market. This analysis sheds a deeper understanding about the behavior of the returns in the Mexican Stock Market, provides foreign and local investors with new elements in order to better identify attractive investments and will enable portfolio managers to enhance their analysis when determining the optimal degree of risk exposure. The CAPM, Multi-Factor Pricing Model and the Characteristic Model were tested; grouping the stock returns according to the market betas, size and book-to-market value. The sample covered a time period from 1987 to 2001, divided in sub-periods, to evaluate the economic and financial shocks, the opening of Mexico's economy through trade agreements, and

the Mexican financial deregulation. The results suggest that the CAPM and Multi-Factor Pricing Model that include the risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993), do not explain the time series and cross-section variations of the Mexican Stock returns. When testing different risk factors and the portfolios are constructed by market betas then the excess market return, the default risk and the U.S. real interest rate can better explain cross-section variations of the average returns between 1987 and 2001. But, when the portfolios are formed according to the market size and book-to-market value, the evidence found sustains that variations in returns are captured by different risk factors according to different business conditions. From 1987 until 1994, the excess market return, size mimicking portfolio, book-to-market mimicking portfolio and exchange rate give a better explanation for the variation of the average returns. Furthermore, from 1995 until 2001, the excess market return, size mimicking portfolio, book-to-market mimicking portfolio and the default risk offer a better explanation. The evidence presented to test the Characteristic Model was not sufficient in order to discriminate between a Factor or Characteristic Model. Nonetheless, since this may be the first study which tests the model in the Mexican Stock Market, I proposed some future lines of research in this area.

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CHAPTER 1

INTRODUCTION AND GENERAL CHARACTERISTICS OF THE RESEARCH

1.1. INTRODUCTION

During the 1980s and early 1990s, most of the Latin American countries experienced high levels of protectionism and government controls that made those markets unattractive to invest in (Edwards 1998). Mexico is a prime example, since in 1983 it was one of the most closed economies, with 100% protection on the economy by the federal government and high financial regulation[1].

There have been foundational changes in this tendency recently. These countries have been carrying out reforms and establishing new economic, political and financial structures in order to create a more attractive environment that could help increase investment levels (Edwards 1998 and Yilmaz 2001).

The main features of the Mexican reform programs were three: (a) an opening of the economy to international markets. Mexico joined the General Agreement on Tariffs and Trade (GATT) in 1986, the Asia Pacific Economic Cooperation (APEC) in 1993, and the North American Free Trade Agreement (NAFTA) in 1994. (b) A drastic privatization and deregulation process and (c) a liberalization of the exchange rate supported by a restrictive fiscal and monetary policy (Edwards 1997).

[1] Yilmaz (2001) provides a list of liberalization dates for sixteen other Emerging Markets.

The new reforms have made these markets a feasible alternative for foreign and local investors (Henry 2000). However, as a result of the investors being able to diversify their portfolios internationally, stock markets returns now are affected by international and local risk, such as macroeconomic, market and political factors (Chen and Khan 1997 and Krugman 1999).

As a result of these changes, the concern to clearly understand how these risk factors behave in Mexico is important, because this could allow investors to make better financial decisions in order to yield more attractive returns on their investments.

1.2. RESEARCH TOPIC

The trade-off between risk factors and stock returns has been an issue of several investigations in developed countries (Yilmaz 2001). The Capital Asset Pricing Model (CAPM), Multi-Factor Pricing Model and Characteristic Model are some of the main models used to explain this relationship.

The origin of the CAPM is attributed to four authors. Markowitz (1952) proposed that investors select their portfolio maximizing its expected return and minimizing its variance. Sharpe (1964) argued that equilibrium exists in a simple linear relation between the expected return and the return's standard deviation. He emphasized the necessity of obtaining an equilibrium condition in the capital markets for an efficient combination of risky assets. Lintner (1965) developed this equilibrium

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British Stock Market using different portfolio ordering techniques, such as betas and size.

He and Ng (1994) explored whether size and book-to-market value are proxies for macroeconomic risk factors or measures of stock risk exposure to distress. Fama and French (1992) investigated the roles of market beta, size, earnings-to-price ratio (EP), leverage and book-to-market value in average stock returns. Fama and French (1993) identified common risk factors in stocks and bond returns, considering additional variables like size, book-to-market value and EP value. Lakonishok, Shleifer and Vishny (1994) suggested that the high returns associated with high book-to-market values are generated by investors who incorrectly extrapolate the past earnings growth rates of firms.

Recently, Daniel and Titman (1997) and Daniel, Titman and Wei (2001) examined other alternatives to the CAPM and Multi-Factor Pricing Model, arguing that past research can not distinguish the Risk Factor Models from the Characteristic Model. The new model that they propose specifies that the expected returns of assets are directly related to their characteristics, such as liquidity and lines of business, which may have nothing to do with the covariance structure of returns.

The Characteristic Model rejects the three-factor model developed by Fama and French (1993). Thus, Davis, Fama and French (2000) developed a more powerful test extending their sample data. They found favorable results for the three-factor

model, arguing that the results of Daniel and Titman (1997) only work for a short sample period.

Different methodologies, such as time series regressions and cross-section regressions have been used to test the CAPM, Multi-Factor Pricing Model and Characteristic Model. One of the earliest procedures used was carried out by Lintner (1965) and Sharpe and Copper (1972), and more formal tests were developed by Black, Jensen and Scholes (1972), Fama and MacBeth (1973) and Daniel and Titman (1997). The implementation of these methodologies will be explained in detail in the methodology section

In spite of the fact that the CAPM, Multi-Factor Model and the Characteristic Model have been extensively analyzed in developed countries, their results do not imply that they are adequate to the Mexican Stock Market. This research considers that there is a need to better understand the trade-off between risk factors and stock returns in Mexico, in view of the fact that the country has been facing economic and financial structural changes during recent years. Furthermore, this dissertation perceives that an empirical study of these models in the Mexican Stock Market will allow me to identify the cross-section and time series patterns existent in stock returns. Hence, the research topic in this dissertation will be to test the validity of the Sharpe-Lintner CAPM, the Multi-Factor Pricing Model developed by Ross (1976) and the Characteristic Model proposed by Daniel and Titman (1997) in the Mexican Stock Market.

1.3. OBJECTIVE

My general objective will be to propose an Asset Pricing Model that identifies the risk factors that explain the returns in the Mexican Stock Market. To fulfill this general objective, it will be necessary to satisfy the following specific objectives:

1. Test the Capital Asset Pricing Model (CAPM).
2. Test the Multi-Factor Pricing Model.
3. Test the Characteristic Model.
4. Explore if stock returns can be explained by risk factors that are similar to those that have been documented for developed stock markets.
5. Examine the relationship between stock returns and the CAPM anomalies, such as size and book-to-market value.
6. Examine which risk factors are more important in the Mexican Stock Market returns: local or international factors; and if their relevance remains stable under different business conditions and different portfolio ordering techniques.

1.4. RESEARCH QUESTIONS AND HYPOTHESIS

In order to fulfill the aforementioned specific objectives, I will answer the following research questions by testing different hypotheses.

Does the CAPM apply to Emerging Markets? Would the Multi-Factor Pricing Model behave in a similar fashion in developed equity markets and emerging equity

markets? Are the risk factors identified in developed equity markets adequate to explain the returns in emerging markets? These are all questions that will be discussed by studying the behavior of the CAPM and Multi-Factor Pricing Model in the Mexican Stock Market. I will test the following hypotheses to answer these questions:

HYPOTHESIS 1: The CAPM is the right model to explain the Mexican Stock Market returns from 1987 to 2001

HYPOTHESIS 2: The risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993) for the U.S. Stock Market are also adequate to explain stock market returns in the Mexican Stock Market[3].

Are the risk factors that explain cross-section returns the same that explain time series returns? Are international and political factors as well as macroeconomic and market factors adequate to explain stock market returns? Are the risk factors in Mexican Stock Market returns primarily local or do they have international components as well? These questions are related to the importance of different risk factors. I will try to find an answer to these questions testing the following hypotheses:

[3] Table 2.4 shows the risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993).

HYPOTHESIS 3: Besides the macroeconomic and market risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993), exchange rate factors, international factors and political factors are also a source of risk to explain returns in the Mexican Stock Market.

HYPOTHESIS 4: The risk factors that explain Cross-Section returns in the Mexican Stock Market are the same that explain time series portfolio returns.

I will answer the following research questions about the CAPM anomalies and the Characteristic Model: Are risk factors related to firm characteristics? Does the Multi-Factor Pricing Model explain the CAPM anomalies? Is the identified model a characteristic model or a risk factor model? In relation to these questions I defined the subsequent hypotheses:

HYPOTHESIS 5: In the Mexican Stock Market, the Multi-Factor Pricing Model better explains the cross-section relation between average return and the characteristics than the CAPM.

HYPOTHESIS 6: The Characteristic Model better explains the returns than the Multi-Factor Pricing Model in the Mexican Stock Market.

With reference to structural changes in the Mexican Stock Market, I have established questions such as: Is the variation in returns related to business conditions? Are the risk factor betas stable in different periods? Are different portfolios influenced by different risk factors? In order to test structural changes, I defined the following hypothesis:

HYPOTHESIS 7: In the Mexican Stock Market, local and international risk factor betas are stable under different business conditions and different portfolio ordering techniques.

1.5. CONTRIBUTION AND LIMITATIONS

Developing an empirical analysis to test the CAPM, Multi-Factor Pricing Model and Characteristic Model in the Mexican Stock Market represents an important contribution in three different dimensions. Firstly, its contribution to the financial literature. In Mexico there is a lack of literature about these models (the little available includes Herrera 1992, Herrera and Lockwood, 1994, Bailey and Peter 1995, and Cervantes 1999)[4] and most of them analyze the influence of local and international factors on expected returns at an aggregate country level (Hervey 1995, Bekaert and Harvey 1997, Claessens, Dasguptaand Glen 1998 and Rouwenhorst 1999). My dissertation will include only individual stock returns from Mexico and it

will be perhaps the first to include macroeconomic variables, market variables, political event variables and international variables as local and international risk factors[5]. Hence, I hope to provide new insights that will foster more research in the Mexican Stock Market.

Another contribution is related to investment project decisions. Even though most of the analysis on the CAPM, Multi-Factor Pricing Model and Characteristic Model use advanced mathematics and econometrics, these models are of interest for investors in new projects and for firms planning a merger and/or acquisition as an expansion strategy. These models help identify projects with better investment opportunities and high returns, and also support hedging against specific risks.

Yet there is not a consensus about which is the best model needed to calculate the cost of equity. The CAPM is the most frequently used model to obtain this variable. However, it has been criticized because just one risk factor is considered. I will propose an Asset Pricing Model as an alternative, which will consider different risk factors that will estimate a much more accurate cost of equity.

Our results can help us to know the risk factors and thus choosing the optimum business mix that would enable making better investment decisions, anticipating any economic problems firms may face. When management knows about

[4] There is other literature that analyzes in Mexico the market efficiency hypothesis: Ortiz (1980), Haugen, Ortiz and Arjona (1985), Junco and Sanchez (1990), Johnson (1992), Hakim(1992), Bhattacharya, Daouk, Jorgenson and Kehr, (1999).
[5] The macroeconomic, market and political variables will be regarded as local factors.

the market risks they will face, their investment decisions could result in higher gains and reduce risks.

Finally, I will contribute in the area of strategic portfolio management. Given that I will use two methodologies in my analysis, time series analysis (long-term) and cross-section analysis (short-term), and since I will divide my entire sample into sub-periods, it will allow to identify which risk factors are relevant for returns in the long and short-term and which are relevant in different business conditions. These could help managers design portfolio strategies as a function of risks due to different time spans and events associated with structural changes. Likewise, they would have additional signals to know when to rebalance the portfolios throughout time.

In summary, as has been noted, the main motive for studying the CAPM, the Multi-Factors Pricing Model and Characteristic Model is that they shed new evidence to further develop literature about the Mexican Stock Market. Furthermore, such a study would provide foreign and local investors with new elements to identify attractive investments and enable portfolio managers to make a better analysis to choose the optimal degree of risk exposure.

The limitation in my dissertation is the small number of firms in the sample and historical dates. Consequently, the number of portfolios constructed will be smaller in relation to the other analyses carried out in developed markets, making it difficult to use some methodologies that are applied for other markets. However, with the objective of minimizing this limitation, the sample will include all individual

stocks traded in the Mexican Stock Market since 1987, which will allow to understand and identify the risk factors in a better way.

1.6. ORGANIZATION OF THE DISSERTATION

The dissertation is organized as follows: Chapter 2 describes the methods and tests used to perform empirical research in pricing models. The period of study and the data base used are also described in this chapter. Chapter 3 presents the results of time series analysis and cross-section analysis to test the CAPM. Chapter 4 shows the empirical analysis for the Multi-Factor Pricing Model. Chapter 5 contains the result of having analyzed the size and book-to-market effects. Chapter 6 presents the empirical results for the Characteristic Model. Finally, the general conclusions and futures lines of research are presented in Chapter 7.

CHAPTER 2

METHODOLOGY AND DATA DESCIPTIONS

2.1. INTRODUCTION

The goal of this chapter is to review the methodology and the data base used to test the seven hypotheses proposed in Chapter 1. Section 2.2 presents the methodology to test the CAPM, Multi-Factor Pricing Model and Characteristic Model. Section 2.3 gives a description of the period of study. Section 2.4 presents the stock market variables expressed as the returns to be explained and Section 2.5 presents the risk factors variables that represent the explanatory variables. Finally, Section 2.6 analyze the behavior of each variable.

2.2. METHODOLOGY

The first methodologies developed to test a relationship between stock market returns and risk were carried out by Lintner (L) (1965) and Sharpe and Copper (SC) (1972). Their objectives were to test whether stocks with higher betas have higher returns and whether the Sharpe-Lintner CAPM applies when the intercept equals the risk-free rate and the beta equals the excess market return.

Recently, more careful tests have been developed, arguing that these first two methodologies did not perform a formal test of the outcome and that two major bias problems are present: (a) error-in–variables bias: beta estimates from first pass

regressions suffer from measurement errors, and (b) sample selection bias: the variance of the residuals is correlated with beta coefficients of the stocks.

The time series and cross-section regression approach of Black, Jensen and Scholes (BJS) (1972) and the cross-section regression approach of Fama and MacBeth (FM) (1973) were the first research works to develop a formal test of the CAPM. It was decided the use FM and BJS in this dissertation, since they are the most common methodologies used in the literature to explain whether there is a relationship between risk factors and stock returns[6]. Furthermore, they performed formal tests of the outcome and they are not affected by the error-in-variables bias and the sample selection bias.

The method used to minimize the errors-in-variables, and thus to increase the precision of the betas, is to group individual stocks into portfolios. Shake (1992) argues that this approach reduces errors especially in small samples. Whereas, in order to correct sample selection bias, these methodologies use instrumental variables to rank the stocks and group them into the portfolios. This procedure minimizes the spread in betas across portfolios.

Finally, another methodology that will be used is Daniel and Titman's (1997) methodology (DT). The objective will be to test whether a Multi-Factor Pricing Model or a Characteristic Model explains the Mexican Stock Market returns. The implementation is very similar to the FM, but with the main difference that it will be

constructing portfolios with similar characteristics but with different risk factor betas, in order to determine if covariance or characteristics determine the expected returns.

In these three methodologies, in order to test the relationship between risk factors and stock returns as well as to evaluate the hypotheses and how the models fit the data, the following diagnostic tests will be applied to the estimated parameters:

The first test will be the Wald test statistic (W_O) that assumes a large-sample distribution. Likewise, I will assume a finite-sample distribution using the adjusted Wald test (W_a), proposed by MacKinlay (1987) and Gibbon, Ross and Shanken (1989). They proved that it has an *F-distribution.*

$$W_o = \alpha_T^T [Var(\alpha_T)]^{-1} \alpha_T \sim \chi_N^2$$

$$W_a = \frac{(T-N-1)}{N}\left[1+\frac{\mu_{mT}^2}{\sigma_{mT}^2}\right]\alpha_T^T \sum^{-1} \alpha_T \sim F_{N,(T-N-1)}$$

$$W_a = \frac{(T-N-1)}{N}\left[\frac{\frac{\mu_q^2}{\sigma} - \frac{\mu_m^2}{\sigma}}{1-\frac{\mu_m^2}{\sigma_m^2}}\right] \sim F_{N,(T-N-1)}$$

Another test that will be used is a version of the LR_1 test, developed by MacKinlay (1995). It is based on the logarithm of the likelihood ratio. He argued that the power of the *F-statistic* test diminishes when normality affects the finite-sample

[6] Chen, Roll and Ross (1986), Chen, Chan and Heish (1995), Clare and Thomas (1994), He and Ng (1994) and Fama and French (1992) used the FM. Fama and French (1993) besides using FM, also used BJS's methodology.

distribution. Hence, he proposed that when the unconstrained model is compared against a constrained model, the power of the test improves substantially.

$$LR_1 = T\left[\log\left|\sum\nolimits_T^*\right| - \log\left|\sum\nolimits_T\right|\right] \sim \chi_N^2$$

The adjustment in the LR_1 test suggested by Jobson and Korkie (1982) will also be considered in my analysis (LR_2), since this test has the advantage of better finite-sample properties and eliminates the error-in-variables bias.

$$LR_2 = \left(T - \frac{N}{2} - 2\right)\left[\log\left|\sum\nolimits_T^*\right| - \log\left|\sum\nolimits_T\right|\right] \sim \chi_N^2$$

Additionally to the above tests, I will consider statistics or tests such as: the slopes, signs, R^2 values, standard errors and t-statistic test. In this last test, in order to eliminate the errors-in-variables bias, I will also adjust standard errors using the Shaken (1992) approach. Besides, Chow's breakpoint test will be used to test whether different business conditions in the sample exist.

2.3. PERIOD OF STUDY

The database of stock prices and risk factors variables that I will use covers a period spanning from January 1987 to December 2001. Furthermore, with the purpose of testing whether the results are substantially affected by structural changes, the entire sample will be divided into four sub-periods. The sub-periods from January 1987 to December 1994 and from January 1995 to December 2001 will evaluate the economic and financial shock which took place during December 1994 and the effect

that the Mexican economy became more open since NAFTA was implemented in 1994. The sub-periods from January 1987 to May 1989 and from June 1989 to December 2001 will evaluate the impact of the Mexican financial liberalization, which started in May 1989 (Levine and Zervos 1994).

2.4. STOCK MARKET VARIABLES

During the 1987-2001 period, 176 firms issued stocks in the Mexican Stock Market. Nevertheless there are 66 other stocks trading in the market as a result of 54 firms issuing multiple classes of the same stock, which will be also included in my study in order to minimize survivorship bias. The total sample in this study will consist of 242 individual stock price series. Table 2.1 shows the number of stocks that belong to each class of stock.

The distinction between the classes of stock is mainly institutional in nature and is dictated by government policy with the goal of using corporate control as the type of voting rights and differentiate between foreign and domestic traders. This differentiation induces market segmentation and the assigning of different prices to the same stock in different groups. It is important to say that 24 percent of stocks in my sample are limited exclusively to Mexican investors[7], and the other 76 percent are open to foreign investors.

TABLE 2.1
Stocks by Class

This table shows the number of stock that belongs to each class of stock. The means of each class is as follows: * Nominative stocks. 1 Stocks that represent fixed capital. 2 Stocks that represent variable capital A Limited exclusively to Mexican individuals or Mexican-controlled institutions. They have full voting rights. They must represent the majority of voting shares. B For Mexicans and/or foreigners. Full voting rights, but cannot collectively represent the majority of voting shares. C For Mexicans and/or foreigners. It has limited voting rights. L Subscribed for Mexicans and/or foreigners. It has limited voting rights. They function like a preferred stock in the sense that they receive a constant dividend. O For Mexicans and/or foreigners. V Non-restricted. They are very similar to the B series. The "V" stands for "voting". The following classes of series are characterized by the combination of two or more series. CPO Certificates of Ordinary Participation. They are sets of "A" and other unrestricted series with voting rights that depend on the proportion of "A" to the total. The combination and proportion depends on each firm. ACP Set of "A" series. Provisional certificate. BCP Set of "B" series. Provisional certificate. CCP Set of "C" series. Provisional certificate. UB Set of "B" series. "U" stands for units. UBC Set of "B" and "C" series. UBD Set of "B" and "D" series. UBD Set of "B" and "D" series. UBL Set of "B" and "L" series. A1 Set of "A" and "1" series. A2 Set of "A" and "2" series. B1 Set of "B" and "1" series. C1 Set of "C" and "1" series.

Class	Stocks	Class	Stocks
B	78	UB	3
A	53	UBL	2
*	32	CCP	2
L	19	V	2
O	14	A2	1
CPO	8	ACP	1
C	6	C1	1
1	4	UBC	1
2	4	UBD	1
A1	3	ULD	1
B1	3		
BCP	3	TOTAL	242

The firms included in the sample selected operate in a wide variety of economic sectors. Table 2.2 presents the number of stocks for each sector. The highest number of stocks belongs to the services sector with 132 stocks, being the most important firms retailers, banks and financial firms being with 94. The sector with the smallest number of stocks belongs to the agriculture and industrial sectors with 2 and 108 stocks respectively.

[7] Stock Clases: A, A1, A2, ACP

TABLE 2.2
Stocks by Sectors

This table shows the number of stock that belongs to each sector from 1987 to 2001. The database includes industrial, retail, service and banks companies.

	Stocks		Stocks
Industrial Sector	108	Service Sector	132
Mining	3	Retail	36
Food and beverages	29	Communication and transportation	17
Textiles, apparel and leather	7	Tourism and hotels	8
Chemicals	6	Banks and financial Firms	58
Paper, pulp and timber	4	Entertainment	3
Steel Plants	4		
Metallurgy	4		
Transportation machinery and equipment	5	Various	10
Motor vehicles and parts	6		
Electrical equipment, appliances and components	2	Agriculture	2
Software and computer services	1		
Cement and construction	21		
Conglomerates	16	TOTAL STOCKS	242

Relating to the additions and deletions of stocks in my sample, Table 2.3 shows that on average 16 stocks enter and 2 stocks exit per year due to mergers, bankruptcies, de-listings, or new listings. These additions and deletions could marginally increase the volatility in Mexican stock market returns, which is justified by hypotheses related to information signaling, price-pressure, information cost and liquidity (Bechmann 2002). The inclusion of a stock in a sample on average leads to higher returns immediately following the announcement, and deletions lead to negative returns that continue after the date of change (Chakrabarti, Huang, Jayaraman, Lee 2002).

TABLE 2.3
Stock Sample Characteristics and their Stability Through Time

This table describes the distribution through time of the stock database. In panel A, the number of active stocks by year and the entrances and exits are shown. Panel B shows the stock sample characteristics

Panel A: Distribution through time of the sample

	Number of Stocks		Number of Stocks in December of each Year
	Entrances	Exits	
1987	49	0	49
1988	11	0	60
1989	4	0	64
1990	8	0	72
1991	27	0	99
1992	25	0	124
1993	31	1	154
1994	37	0	191
1995	4	5	190
1996	13	0	203
1997	18	6	215
1998	6	3	218
1999	3	7	214
2000	2	8	208
2001	4	3	209
Average	16	2	151
Total	242	33	

Panel B: Stock Sample Characteristics

Total Sample	
Number of firms that issue at least one stock	176
Number of different stock classes (54 firms)	66
Total stocks available in sample period	242
Observations Available for each Stock	
Average	108
Maximum	180
Minimum	5

Table 2.3 also shows that in the early months of the sample not all 242 stocks are already listed, pushing downward the number of stocks in the analysis. However, the number of stocks showed a tendency to increase over the sample period, starting in 1989 with 49 stocks and finishing in 2001 with 209 stocks. On average, 151 stocks were listed per year, with a minimum of 49 stocks in 1987 and a maximum of 218

stocks in 1998. It important to notice that after 1998 there are fewer stocks than those of the previous years due to structural changes in the Mexican banking sector, which caused that the market began to shrink. During these years, 60% of the stocks in my database are banking stocks.

My sample period from 1987 to 2001 contains 180 months. On average, the stocks contain 108 observations available for each monthly series, with a maximum of 180 observations and a minimum of 5 observations.

In order to reduce survivorship bias and de-listing bias to be included in the sample, a stock must have traded in the examined interval at least once over the sample period, even though some stocks have minimal trading or are only traded for a short period, the stock that exits in the examined interval will also be considered.

I will group the individual stock series in portfolios, where the classification variables will be the stock market betas, book-to-market value and size (a stock's price times shares outstanding). Since I have a total sample of 242 individual stocks, the number of portfolios will be limited between 4 to 10 and the number of stocks in each portfolio will consist of a minimum of 5 stocks.

This decision was taken considering the observation of Campbell, Lo and MacKinlay (1997). They argue that the size and power of the tests are better off when they are carried out with a small number of portfolios, perhaps no larger than ten, and when the maximum number of time series observations available is 60. Likewise,

Vaihekoski (2000) recommends the inclusion of at least five or more assets in a portfolio when analyzing Emerging Stock Markets.

The database contains monthly closing prices adjusted for any corporate actions that artificially affect stock prices. These corporate actions include such measures as paying off dividends, either in cash or with more stocks, the issuing of shares of stock and splitting the price in order to have a more marketable stock price. The returns are computed in terms of continuously compounded monthly growth rates according to the following equation:

$$R_t = [\ln(P_t) - \ln(P_{t-1})] - 1$$

The reasons for using continuously compounded returns instead of percentage returns is due to the fact that log returns reduce the bias in returns induced by bid/ask spread and price discreteness (Mucklow 1994), the heteroskedasticity found in most stock return series is reduced and the compound returns often exhibit a higher degree of normality than percentage returns (Vaihekoski 2000).

Infosel Inversionista, Finsat, Economatica and the Emerging Market Data Base (EMDB) of the International Financial Corporation will supply the database of monthly adjusted closing prices.

2.5. RISK FACTORS VARIABLES

The literature about the empirical evidence of a relationship between the stock returns and risk factors is very limited, and it is often contradictory with respect to the

number and the type of variables to be included in the model. Appendix A shows twenty articles that were surveyed to identify the most common risk factors used in the literature, resulting in the identification of 49 different variables that could be classified as macroeconomic indicators, market indicators, and firm characteristic indicators.

However, although 49 variables were identified, some of them measure the same risk or they are not measured in Mexico. Thus, I will use only a total of 24 variables, which are classified as local and international risk factors. Most of them were identified as risk factors in the U.S. stock market by Chen, Chan and Heish (1985), Chen, Roll and Ross (1986), Fama and French (1993), He and Ng (1994), Clare and Thomas (1994), Bailey and Chung (1995), Cervantes (1999), Roll (1984), and Jedadeesh and Titman (1993). Table 2.4 lists the definitions of the risk factors. Panel A describes the basic series that will not be used as risk factors. Panel B describes the derived series obtained from the basic series, which will be used as risk factors.

TABLE 2.4
Risk Factors: Definitions

Panel A describes the basic series that will not be used as risk factors and Panel B describes the series derived from the basic series, which will be used as risk factors. The Mexican and US Interest rate (SCETES, LCETES, CPP, CP and TBILLN) are expressed in annual terms, but they were changed to monthly terms with the following formula, where i is the interest rate: $((1+i)^{(1/12)})-1)$. CRR: Chen, Roll and Ross (1986), CCH: Chen, Chan and Heish (1985), HN: He and Ng (1994), CT: Clare and Thomas (1994) and FF: Fama and Franch (1993)

Panel A: Basic Series

Symbol	Variable	Definition or Source
IMX	Inflation	Monthly Logarithmic Change of Mexican Consumer Price Index
IUS	Inflation (US)	Monthly Logarithmic Change of U.S. Consumer Price Index
SCETES	Nominal Mexican Treasury Bill	Monthly Returns on 28 days bills
LCETES	Nominal Mexican Treasury Bill	Monthly Returns on 90, 181and 365 days bills
CP	Nominal Commercial Paper Rate	Monthly Returns on Commercial Paper Issues (28 days)
TBILLN	Nominal US Treasury Bills (US)	Monthly Return on 3-month bills
DJ	Value Weighed Equity (US)	U.S. Stock Market Index (Dow Jones Index)
EX	Free Exchange Rates	Peso/Dollar Exchange Rate
EXO	Official Exchange Rate	Peso/Dollar Exchange Rate
PFEX	Free Market Premium for Dollars	Bailey and Chung (1995)
IP	Industrial Production	Industrial Production Index
RS	Retail Sales	Sales in commercial establishments (consumption)
EMP	IMSS Employment	IMSS Personal Registrant
M2R	M2 Real	Monetary Supply (M2Nominal / IMX)
OP	Oil price	Mexican Crude Oil. (US dollars per barrel)
OPF	Future Oil Price	Future Oil Price

TABLE 2.4 - Continued

Panel B: Derived Series			
Symbol	Variable	Definition	Author
	Local Risk Factors		
	Macroeconomic Variables		
INFM	Change in Inflation	$\log[IMX_t] - \log[IMX_{t-1}]$	CT
DEI	Change in Expected Inflation	Fama and Gibbons (1984)	CRR, CCH, HN
UI	Unexpected Inflation	Fama and Gibbons (1984)	CRR, CCH, HN
IPM	Monthly Change in Industrial Production	$\log[IP_t] - \log[IP_{t-1}]$	CRR, CCH
RSM	Change in Retail Sale	$\log[RS_t] - \log[RS_{t-1}]$	CRR, CT
EMPM	Change in Employment	$\log[EMP_t] - \log[EMP_{t-1}]$	CT
M2RM	Change in Money Supply	$\log[M2R_t] - \log[M2R_{t-1}]$	CT
	Market Variables		
TERM	Term Structure	$LCETES_t - SCETES_{t-1}$	CRR, CCH, HN, CT, FF
DEF	Default Risk	$CP_t - SCETES_{t-1}$	CRR, CCH, HN, CT, FF
LQMP	Liquidity Proxy	Roll (1984)	
MOP	Momentum Mimicking Portfolio	Jedadeesh and Titman (1993)	
MRM	Change in Mexican Stock Market Index	$\log[MR_t] - \log[MR_{t-1}]$	CRR, CCH
EMR	Excess Market Return	$MRM_t - SCETES_t$	FF, CT
SMB	Size Mimicking Portfolio	Fama and French (1993)	FF
HML	Book-to-Market Mimicking Portfolio	Fama and French (1993)	FF
	Political Risk Variables		
POLITIC	Credit risk	Bailey and Chung (1995)	
POLIDUM	DUMMY: Political Event	Mexican Political Events	Appendix C
	International Risk Factors		
TBILLR	Real interest US (ex post)	$T\text{-}Bill_{t-1} - IUS_t$	CT
DJM	Change in U.S. Stock Market Index	$\log[DJ_t] - \log[DJ_{t-1}]$	CRR, CCH
OPM	Change in Oil Price	$\log[OP_t] - \log[OP_{t-1}]$	CRR, CT
OPFM	Change in Future Oil Price	$\log[OPF_t] - \log[OPF_{t-1}]$	CRR, CT
EXM	Change in Exchange Rate	$\log[EX_t] - \log[EX_{t-1}]$	CT
DPEXM	Probability of Devaluation	Bailey and Chung (1995)	
EXMP	Exchange Rate Mimicking Portfolio	Cervantes (1999)	

The local risk factors will be measured using macroeconomic, market and political risk variables. The macroeconomic variables include inflation, unexpected inflation, expected inflation, industrial production, retail sales, employment and money supply. Term structure, default risk, liquidity proxy, momentum mimicking

portfolio, Mexican stock market index, excess market return, size mimicking portfolio (SMB) and book-to-market mimicking portfolio (HML) will be considered as market variables. The political risk will include two variables: credit risk and a dummy variable.

International risk factors, on the other hand, will be measured by the US interest rate, US stock market index[8], oil price, future oil prices, change in the exchange rate, probability of currency devaluation and exchange rate mimicking portfolio.

The National Institute of Statistics, Geography and Computing (INEGI) and the Mexican Central Bank (BANXICO) will supply the local risk factors and international risk factors. All variables will be measured in terms of continuously compounded monthly growth rates, except for the expected and unexpected inflation, SMB and HML portfolios, exchange rate, liquidity proxy, momentum mimicking portfolio, political risk, term structure and default risk.

Unexpected and expected inflation. To obtain the unexpected and expected inflation we first obtain the ex-post real interest rate for Mexico and the US, applying the following Fisher equation:

$$IR_{(t-1)} = E[RHO_{(t)} \mid t\text{-}1\ ] + E[I_{(t)} \mid t\text{-}1\ ] \qquad (2.1)$$

[8] Dow Jones Index was selected like US stock market, since it has a correlation of 0.969 with the Mexican stock market. It is higher than the correlation of 0.910 and 0.959 with Nasdaq and S&P 500.

Where $I_{(t)}$ is the monthly realized inflation for period *t*. $RHO_{(t)}$ denotes the ex-post real interest rate applicable in period *t,* and $IR_{(t-1)}$ denotes the interest rate known at the end of period *t-1* and applying in period *t*.

By using the equation (2.1) and substituting the interest rates and the inflation of Mexico and US, the ex-post real interest rate for each country can be obtained. The ex-post interest rates are represented as:

$$E[RHO(t) \mid t\text{-}1\ ]\ ] = SCETESR = SCETES(t\text{-}1)\text{-}IMX(t) \tag{2.2}$$

$$E[RHO(t) \mid t\text{-}1\ ]\ ] = TBILLR = TBILLN(t\text{-}1) - IUS(t) \tag{2.3}$$

Then, the Fama and Gibbons's (1984) methodology was used to obtain the unexpected and expected inflation. They determined that the inflation rate for period *t* can be expressed as:

$$I_{(t)} = -ER_{(t-1)} + IR_{(t-1)} + \eta_{(t)} \tag{2.4}$$

Where $I_{(t)}$ is the inflation applicable in period *t*. $ER_{(t-1)}$ is the expected real return. $IR_{(t-1)}$ is the interest rate and $\eta_{(t)}$ is the unexpected inflation.

Using equation (2.4) and the evidence of Fama and Gibbons (1984), the following inflation-interest rate regression is estimated as:

$$IMX_{(t)} = \alpha_{(t-1)} + \beta\ SCETES_{(t-1)} + \eta_t \tag{2.5}$$

This regression presumes that the intercept $\alpha_{(t-1)}$ is the negative of the estimate of the expected real returns $ER_{(t-1)}$ and in addition, is consistent with the hypothesis that the estimate of β is close to one, allowing a random walk intercept.

The fitted values of regression (2.5) are henceforth labeled as $EI_{(t-1)}$ and are the estimate of the ex ante monthly expected inflation rate. The regression residuals $\eta_{(t)}$, which have all the information not considered by $EI_{(t-1)}$, are henceforth labeled $UI_{(t)}$ and represent the unexpected inflation. Finally, the change in the expected inflation is obtained through the following equation:

$$DEI_{(t)} = EI_{(t+1)} - EI_{(t)} \qquad (2.6)$$

This variable is subscript *t* because it is unknown at the end of the month *t-1*, and also has an influence separated from the unexpected inflation.

SMB (small minus big size) and HML (high minus low B/M) Portfolios. Keeping in mind that Banz (1981) found that stocks of smaller firms that have a lack of information are to be perceived by investors as riskier investments, and Fama and French's (1992) arguments that book-to-market value is related with earnings which influences a strong positive relation between average return and book-to-market value, I formed two portfolios to mimic the premium that could result from these two firm characteristics, thus explaining whether there is a relationship with the expected returns.

In June of each year, starting at 1987 through 2001, all individual stocks are ranked on size, breaking the stocks into two equally sized groups, small firms (S) and

big firms (B). Furthermore, at the end of each December I sorted S and B groups by book-to-market value, breaking each two groups in three book-to-market groups, low (L), medium (M) and high (H).

Considering the intersections of two size groups and three book-to-market groups, I constructed six equally weighed portfolios: SL, SM, SH, BL, BM and BH. For example, the SL portfolio includes firms in the small size group that are also in the low book-to-market group, the BH portfolio includes firms in the big size group that are also in the high book-to-market group, and so on.

These six portfolios are used to construct the SMB and HML variables. SMB is the difference between the average of the returns on the three small size stock portfolios (SL+SM+SH)/3 and the three big size stock portfolios (BL+BM+BH)/3. This difference tries to measure the risk factor in returns related to size effect. HML is the difference between the average of the returns on the two high book-to-market stock portfolios (SH+BH)/2 and the two low book-to-market stock portfolios (SL+BL)/2. This difference allows capturing the risk factor in returns related to book-to-market effect.

Exchange Rate. The volatility of the exchange rate is an important factor risk emphasized by Bailey and Chung (1995) and Choi, Hikari and Takezawa (1998) in Emerging Markets, since the exchange rate is significantly volatile for the exporting firms and cash flows are adversely affected by the appreciation in the real value of the domestic currency, which affect the stock price negatively.

For this reason, three variables that measure the exchange rate effect on expected returns will be used: the change in exchange rate, the probability of devaluation and the exchange rate portfolio.

We used the Bailey and Chung's (1995) methodology to measure the probability of devaluation. This measure is the spread between free and official exchange rate divided by the official exchange rate. The argument is that any change in this variable incorporates the probability of increased capital controls, the pressure of flight capital given political and economic uncertainty and the expectations about forthcoming currency devaluations.

$$DPEXM = (EX-EXO) / EXO \qquad (2.7)$$

Another variable used to measure the exchange rate effect is the exchange rate mimicking portfolio (EXMP). Cervantes (1999) was the first study using this factor. He argues that exchange rate risk is due to import or export transactions and debt in US dollars, which affects firms in different ways depending on their position in the international markets. Firms with higher international transactions are more affected by volatilities in the exchange rate than firms with lower international transactions. The objective of this variable is to measure whether there exists a premium resulting from this different exposed exchange rate.

In order to calculate the exchange rate mimicking portfolio (EXMP), each December, from 1987 to 2001, the betas are obtained running a regression for each

individual stock returns on change in exchange rate. Each year the individual stocks were sorted by their beta to form three equally weighed portfolios. The portfolio EX1 and EX3 have the highest positive and negative beta loading respectively, and both are formed by firms with higher exposed exchange rates. Portfolio EX2 contains firms with lower beta loading. Therefore, they have a lower exposed exchange rate. The exchange rate mimicking portfolio (EXMP) was formed taking a long position in (EX1+EX3)/2 and a short position in EX2.

Liquidity Proxy. Market factors, like liquidity, are one of the most important factors that investors look for in a stock market because markets with high liquidity allow flexibility to switch from expensive stocks to cheap stocks rapidly in order to obtain higher returns. The liquidity of a company's shares increases with trading volume, so only sufficiently large companies may effectively gain the liquidity benefits.

Roll (1984) argues that the spread between the price of buy (bid) and sell (ask) is a good proxy of liquidity, since the stock price volatility and liquidity increase in similar ways when the spread is higher. This relationship is a consequence of the fact that the bid-ask spread captures the effect on transaction prices. However, it is important to consider that this methodology assumes a marker information-wise efficient and zero trading cost, which it is not necessarily true in a real stock market.

Considering these relations, the Roll's (1984) bid-ask spread is used like a liquidity proxy and it is calculated using the following formula:

$$LQMP = 2\sqrt{-Cov(R_t, R_{t-1})} \quad (2.8)$$

Momentum Mimicking Portfolio. One of the first to consider the momentum factors were Jegadeesh and Titman (1993). They assumed that a correlation between present returns and past returns exists, documenting the momentum strategy of buying stocks with higher returns over the previous 3 to 13 months and selling stocks with lower returns over the same time period earns profits of about one percent per month for the following year. In order to test whether a premium is generated by this strategy in the Mexican stock market, I constructed a Momentum Portfolio.

Each December, from 1987 to 2001, the stocks were sorted by annual returns to form next year's three equally weighed portfolios. The portfolio MO1 includes firms with higher returns and portfolio MO3 includes firms with lower returns. The momentum mimicking portfolio (MOP) was formed using a long position in MO1 and a short position in MO3.

Political Risk. Firms that are particularly sensitive to economic conditions may be exposed to political risks due to their broad impact on the economy, which, similar to the exchange rate, is reflected directly in their cash flow and, therefore, on stock prices. We are going to measure the political risk as the monthly return spread between a dollar bond issued by the Mexican government and the TBILLS.

$$POLITIC = SCETES/EX - TBILLS \quad (2.9)$$

This measure assumes the Bailey and Chung's (1995) hypothesis that credit risk and political risk are positively correlated. When political risk declines, the probability of sovereign default decreases and Mexican dollar bonds experience price appreciation relative to US Treasury debt. Thus, POLITIC increases as political risk decreases.

Another variable used as political risk is a dummy variable, which represents a relevant political event and zero otherwise. Appendix B shows the list of political events taken into account.

Term Structure and Default Risk. Since the unexpected change in interest rates and the economic conditions that change the likelihood of default are risk factors that have an influence on stock returns, Chen, Roll and Ross (1986) use variables like TERM and DEF to help explain these risks.

We calculate TERM as the difference between the long-term government bond (LCETES) and the one-month government bond (SCETES). DEF is obtained as the difference between long-term corporate bonds and the long-term government bond (LCETES). In Mexico there is no historical information about the long-term corporate bond. For this reason, we used the commercial paper issued by corporations as a proxy for this bond.

2.6. DATA DESCRIPTIVE STATISTICS

In Table 2.5, the correlation coefficients among the risk factors are shown. In general, the correlations are not large except between risk factors that have a close relation. Risk factors such as UI, DEF, TERM, TBILLR, DPEXM, IMX, EXM and M2RM are influenced or use inflation (IMX) in their calculation, which increases their correlation between 0.803 and 0.284

Another group that has a high correlation corresponds to series that were calculated using similar variables, starting with the oil price (OPM) and future oil price (OPFM) that have a correlation of 0.909. Other are all stock market variables as Mexican stock market (MRM), Dow Jones (DJM), SMB, HML, excess market return (EMR), liquidity (LQMP) and momentum (MOP), which present a correlation between 0.230 to 0.992. Finally, a correlation between 0.267 and 0.938 exists between the exchange rate variables (EXM, DPEXM) and series that have an influence in the economic activity, such as industrial production (IPY, IPM), retail sales (RSM), employment (EMPM) and politics (POLITIC).

TABLE 2.5
Correlation Matrix: Risk Factors

The correlation coefficient between each risk factor is present in this table. The time period is from 1987 through 2001. The means for each risk factor are shown in Table 2.4.

Symbol	DEI	UI	IPY	IPM	MRM	DJM	RSM	OPM	OPFM	TERM	DEF	SMB
UI	0.58											
IPY	0.06	0.02										
IPM	-0.05	-0.13	0.19									
MRM	-0.10	-0.02	-0.20	0.10								
DJM	-0.04	-0.03	-0.07	-0.04	0.41							
RSM	-0.04	-0.12	0.10	0.11	-0.10	-0.05						
OPM	0.03	-0.11	0.00	0.10	0.05	-0.10	-0.14					
OPFM	0.06	-0.07	0.04	0.13	0.06	-0.11	-0.15	0.91				
TERM	0.80	0.64	0.19	-0.03	-0.03	-0.11	-0.04	0.06	0.08			
DEF	0.10	0.13	-0.19	-0.04	-0.20	0.09	0.00	0.03	-0.01	-0.11		
SMB	-0.10	-0.04	-0.01	-0.10	-0.09	-0.35	-0.03	0.11	0.08	0.02	0.03	
HML	-0.04	-0.04	0.07	0.04	-0.30	0.01	-0.16	0.06	0.07	-0.13	0.09	-0.24
EMR	-0.12	-0.04	-0.19	0.10	0.99	0.41	-0.10	0.05	0.06	-0.05	-0.17	-0.10
TBILLR	0.37	0.28	-0.01	0.03	-0.10	-0.11	-0.10	-0.03	-0.01	0.37	0.17	0.23
EMPM	-0.08	-0.07	0.05	0.01	-0.20	-0.19	-0.08	-0.03	-0.02	0.04	0.06	0.32
M2RM	0.15	-0.01	0.11	-0.10	-0.21	0.07	0.25	-0.25	-0.31	0.10	-0.11	-0.10
EXM	-0.02	-0.17	0.36	0.20	0.03	-0.01	0.08	0.04	0.03	0.16	-0.28	0.03
DPEXM	-0.31	-0.58	0.11	0.08	0.07	0.02	0.52	0.02	-0.01	-0.25	-0.11	-0.03
EXMP	0.03	0.10	-0.10	-0.08	0.25	0.11	0.08	-0.10	-0.11	0.10	-0.04	-0.23
LQMP	-0.23	-0.21	-0.07	-0.04	0.47	0.29	0.01	-0.03	-0.04	-0.21	-0.01	-0.15
MOP	0.13	0.17	0.04	0.07	0.00	0.23	-0.03	-0.18	-0.12	0.17	0.01	-0.12
POLITIC	-0.35	-0.22	-0.05	-0.06	0.19	0.17	0.05	0.05	0.05	-0.34	-0.19	-0.22
POLIDUM	0.06	0.09	0.02	-0.07	-0.10	0.07	0.06	-0.07	-0.10	0.01	0.17	-0.04
IMX	0.18	0.57	-0.11	-0.06	0.22	0.04	-0.09	-0.07	-0.02	0.29	-0.12	0.08

Symbol	HML	EMR	EXM	DPEXM	TBILLR	EMPM	M2RM	EXMP	LQMP	MOP	POLITIC	POLIDUM
EMR	-0.32											
TBILLR	-0.08	-0.13										
EMPM	0.00	-0.20	0.66									
M2RM	0.04	-0.22	0.08	0.00								
EXM	-0.10	0.02	-0.02	0.02	0.13							
DPEXM	-0.19	0.10	-0.19	-0.01	0.15	0.27						
EXMP	-0.11	0.24	0.00	-0.07	0.13	0.04	0.01					
LQMP	0.02	0.49	-0.16	-0.01	-0.08	-0.02	0.22	-0.02				
MOP	0.18	-0.05	0.11	0.08	0.04	0.01	-0.06	0.07	-0.05			
POLITIC	0.14	0.19	-0.94	-0.68	-0.08	-0.02	0.07	0.03	0.11	-0.04		
POLIDUM	-0.03	-0.09	-0.03	-0.07	0.12	-0.05	-0.06	0.01	-0.03	0.09	0.00	
IMX	0.06	0.11	0.32	-0.05	0.02	-0.06	-0.45	0.07	-0.18	0.30	-0.05	-0.03

Summary of descriptive statistics of risk factors are reported in Table 2.6. Except for U.S. real interest rate (TBILLR) and industrial production (IPM), according to the Jarque-Bera statistic, all series have a normal distribution. In relation to TBILLR and IPM, the normal distribution graph is adequate and kurtosis is higher than three, concluding that these variables could have a tendency to behave like a normal distribution, although normality is rejected by the Jarque-Bera statistic.

TABLE 2.6
Risk Factors Description

This table presents the descriptive statistics for each risk factor over the 1987 through 2001 period.

	Ob.	Mean	Median	Maximum	Minimum	Std. Dev.	Jarque-Bera	Probability
DEI	180	-0.037	-0.038	1.956	-2.865	0.462	1176.9	0.000
UI	180	-0.010	-0.017	6.998	-4.250	1.286	606.1	0.000
IPY	180	3.876	4.680	15.370	-14.740	5.519	32.7	0.000
IPM	180	0.376	-0.205	11.300	-10.590	4.428	1.8	0.409
MRM	180	2.366	1.790	83.490	-42.820	11.765	5115.8	0.000
DJM	180	0.984	1.560	12.950	-26.420	4.640	404.3	0.000
RSM	180	-0.228	2.380	37.820	-108.610	18.141	425.5	0.000
OPM	180	0.228	0.685	46.510	-28.100	9.426	89.7	0.000
OPFM	180	0.306	0.340	38.030	-19.450	7.640	71.3	0.000
TERM	180	0.040	0.048	1.847	-3.043	0.493	1075.5	0.000
DEF	180	0.210	0.183	1.022	-0.132	0.182	150.7	0.000
SMB	180	-0.067	-1.000	27.829	-12.478	5.617	119.4	0.000
HML	180	-0.135	-0.302	35.635	-41.744	7.163	814.3	0.000
EMR	180	0.092	-0.300	77.700	-48.900	11.478	4631.5	0.000
TBILLR	180	0.171	0.171	0.588	-0.392	0.179	3.1	0.211
EMPM	180	0.367	0.435	4.710	-2.130	0.853	77.4	0.000
M2RM	180	0.522	0.790	4.740	-10.990	1.951	491.2	0.000
EXM	180	1.329	0.200	58.090	-11.210	5.297	42442.1	0.000
DPEXM	180	-0.008	0.000	24.250	-11.860	3.110	4312.7	0.000
EXMP	180	-0.208	-0.115	6.150	-10.590	2.843	13.6	0.001
LQMP	180	0.045	-0.065	31.230	-66.750	9.269	3764.5	0.000
MOP	180	1.381	1.970	30.170	-30.540	6.288	200.8	0.000
POLITIC	180	0.704	0.839	17.311	-35.441	3.781	18062.2	0.000
POLIDUM	180	0.201	0.000	1.000	0.000	0.402	64.8	0.000
IMX	180	1.979	1.193	14.378	-0.065	2.276	844.0	0.000

Another important point is that HML and SMB means are negative, inverse to the size and book-to-market effects. This could mean that the mimic premium of these characteristics is not measured. However, the real reason is due to financial market liberalization, a more open economy and the Mexican financial crisis of December 1994.

Table 2.7 supports these reasons. For example, Panel A illustrates how the financial market liberalization starting in May 1989 affects the premium of the size and book-to-market mimicking portfolios. These effects are documented by Cervantes (1999) and Patro and Wald (2001). In the Mexican stock market for the period from 1989 to 1998, Cervantes (1999) found a negative average return of -1.08 for SMB and -3.54 for HML. Patro and Wald (2001) found before the start of the financial liberalization positive average returns of 5.26 and 10.78 in SMB and HML respectively and negative average returns of -1.58 and –1.67 after the start of the liberalization. They argued that when markets are liberalized, securities that were originally subject to the national risk price are re-priced according to the world market price of risk, which caused those stocks returns to increase during liberalization and decline afterwards, because the firms' cash flow is now dispersed in the world market while previously it was not.

TABLE 2.7
Effect of Open Economy, Financial Crisis and Financial Liberalization on SMB and HML

Panel A reports for different authors, the average for the small minus big (SMB) size mimicking portfolio returns and high minus low (HML) book-to-market mimicking portfolio returns. Each author has a different sample: Cervantes (1999) July 1989 to December 1998 and Patro and Wald (2001) January 1982 to December 2000. Panel B reports our result. The HML and SMB averages are shown before 1994 when the Mexican economy was more closed and the average after 1994 when the Mexican economy is more open, also the average is shown before and after 1995 when the Mexican economic and financial crisis occurred. FTA means Free Trade Agreements. Our sample is from January 1987 to December 2001.

Panel A: Financial liberalization effects: Different authors				
	1989-1998		1985-1988	1989-1992
	Cervantes (1999)		Patro and Wald (2001)	
SMB	-1.08		5.26	-1.58
HML	-3.54		10.78	-1.67
Panel B: Opening economy and Mexican economic and financial crisis effects				
	1987 – 1993	1994-2001	1987-1994	1995-2001
	Before FTA's	After FTA's	Before Crisis	After Crisis
SMB	0.35	-0.44	0.56	-0.79
HML	0.36	-0.65	0.55	-1.01

Between 1994 and 2003, Mexico has become the country with the largest network of Free Trade Agreements (FTA's) in the world. Mexico's network of FTA's comprises 43 countries on three different continents. With the objective to prove that a more open economy has influence on the HML and SMB means, Panel B shows the HML and SMB means before 1994 when the Mexico was a closed economy and the means after 1994 when Mexico opened its economy. Here is clear that before, both variables are positives in 0.35 and 0.36 and afterwards they are negatives in -0.44 and -0.65 respectively. This may be a consequence of the fact that an open economy gives new opportunities for large firms to compete in a wider world, leaving the small firms in disadvantage compared to their international competitors. Cervantes (1999) and

Francis, Hasan and Hunter (2001) found similar results, arguing that this differential in returns between large and small firms is due to the fact that large firms had more growth than the small firms after Mexico signed the NAFTA in 1994.

Panel B also illustrates that during the Mexican financial crisis of December 1994, the same phenomenon happened. Before the financial crisis, the average of HML and SMB are positives in 0.55 and 0.56 respectively. After the crisis, the average are negatives in -1.01 and -0.79. Patro and Wald (2001) studied 18 emerging markets, finding that only Mexico has negative SMB premiums due to the Mexican financial crisis of 1994. In other way, Cervantes (1999) reports also a negative HML premium after a currency crisis, since in these situations the investors change their preferences for low risk stocks (low book-to-market) to avoid distressed firms (high book-to-market).

Table 2.8 displays the autocorrelation and Dickey-Fuller stationary test over the entire sample period, 1987 to 2001. The autocorrelation was tested using the Ljung-Box Q-statistics and their p-values. We found that except for Dow Jones (DJ), HML and the Dummy political event (POLIDUM), all variables have not autocorrelation.

The absence of autocorrelation in the risk factors is advantageous for the FM and BJS's methodologies, since a decrease in the error-in-variables problem that bias the estimates of the loadings of the stock returns on these risk factors could bias downward the estimates of the statistical significance.

Similarly, the Dickey Fuller unit root test was carried out to examine the stationary of each of the risk factors. This test showed that all variables are stationary, including Dow Jones, HML and Dummy political event, which means that statistical inferences can be made.

TABLE 2.8
Autocorrelation: Risk Factors

This table displays the autocorrelation and Dickey-Fuller stationary statistic (DF) over the entire sample period, 1987 - 2001. We used the MacKinnon critical values for rejection of hypothesis of a unit root. Argument Dickey Fuller: 1% -3.4720, 5% -2.8794, 10% -2.5762. The null hypothesis (nonstationary series) of a unit root is rejected if DF < Critical Values

	Lags				DF*		Lags				DF*
	1	6	7	12			1	6	7	12	
DEI	0.431	-0.170	-0.061	0.015	-7.412	EMR	0.570	0.082	0.040	0.002	-5.949
	0.000	0.000	0.000	0.000			0.000	0.000	0.000	0.000	
UI	0.678	0.159	0.099	0.114	-3.863	TBILLR	0.237	0.081	0.187	0.094	-4.602
	0.000	0.000	0.000	0.000			0.002	0.009	0.001	0.001	
IPY	0.693	0.230	0.064	-0.272	-4.087	EMPM	0.220	0.018	-0.017	0.258	-4.321
	0.000	0.000	0.000	0.000			0.003	0.004	0.008	0.000	
IPM	-0.547	-0.249	0.179	0.531	-6.795	M2RM	0.169	-0.032	0.064	0.322	-5.187
	0.000	0.000	0.000	0.000			0.024	0.115	0.139	0.002	
MRM	0.574	0.112	0.071	0.049	-6.371	EXM	0.093	-0.024	0.044	-0.050	-5.005
	0.000	0.000	0.000	0.000			0.214	0.174	0.230	0.251	
DJM	-0.011	-0.052	0.100	0.011	-6.710	DPEXM	-0.363	-0.042	-0.011	0.067	-8.825
	0.885	0.533	0.436	0.738			0.000	0.000	0.000	0.000	
RSM	-0.289	-0.147	0.163	0.765	-7.585	EXMP	-0.173	0.065	-0.059	0.053	-5.152
	0.000	0.000	0.000	0.000			0.061	0.170	0.220	0.272	
OPM	0.385	-0.138	-0.086	0.040	-7.433	LQMP	0.288	-0.138	0.018	-0.030	-7.807
	0.000	0.000	0.000	0.000			0.000	0.000	0.000	0.000	
OPFM	0.250	-0.044	-0.049	0.006	-7.542	MOP	0.182	-0.111	-0.105	0.013	-6.715
	0.001	0.000	0.000	0.000			0.019	0.010	0.009	0.027	
TERM	0.640	-0.058	-0.032	-0.154	-5.061	POLITIC	0.010	-0.119	-0.009	-0.050	-6.083
	0.000	0.000	0.000	0.000			0.890	0.060	0.098	0.179	
DEF	0.805	0.442	0.439	0.274	-2.672	POLIDUM	-0.003	0.033	0.103	0.146	-5.285
	0.000	0.000	0.000	0.000			0.969	0.853	0.711	0.304	
SMB	0.108	-0.148	-0.064	-0.019	-5.311	IMX	0.883	0.439	0.385	0.210	-3.089
	0.150	0.039	0.051	0.012			0.000	0.000	0.000	0.000	
HML	0.137	0.032	-0.142	-0.062	-5.323						
	0.069	0.516	0.261	0.260							

CHAPTER 3

CAPITAL ASSET PRICING MODEL

3.1. INTRODUCTION

The academic debate about the usefulness of the CAPM developed by Sharpe (1964), Lintner (1965) and Black (1972) is one of the most important problems in modern finance. Chapter 2 explain the most important research works developed in the U.S. stock market that give empirical evidence for rejecting this model. In this chapter, the objective is to test the Sharpe-Lintner and Black versions of CAPM in the Mexican Stock Market using a time series and cross-section analysis. The final purpose will be to test the following hypotheses:

H_1: The CAPM is the right model to explain the Mexican Stock Market return from 1987 to 2001.

H_4: The risk factors that explain cross-section returns in the Mexican Stock Market are the same that explain time series portfolio returns.

Furthermore, in order to test hypothesis seven referring to how the results are affected by structural changes, the time series and cross-section analysis are developed by grouping the individual stocks into portfolios according to their betas on a market index. Moreover, the period of study from 1987 to 2001 is divided in different sub-periods.

H_7: In the Mexican Stock Market, local and international risk factor betas are stable under different business conditions and different portfolio ordering techniques.

The methodology implemented to perform the analysis is the time-series and cross-section regression approach of Black, Jensen and Scholes (BJS) (1972) and the cross-section regression approach of Fama and MacBeth (FM) (1973).

In Section 3.2 the results of time series analysis are explained. Section 3.3 presents the cross-section analysis. The main remarks of this chapter are presented in the last section.

3.2. TIME SERIES ANALYSIS

The objective of the time series regression approach of BJS is to test the zero-intercept restriction of Sharpe-Lintner CAPM (Ho: $\alpha = 0$ Ha: $\alpha \neq 0$) and the zero-beta restriction of the Black version of the CAPM (Ho: $\alpha = (1-\beta)(R_z-R_f)$ Ha: $\alpha \neq (1-\beta)(R_z-R_f)$).

The Sharpe-Lintern CAPM is tested using simple t-test statistics on the coefficient estimated of the following asset pricing model:

$$R_{it} = \alpha_i + R_f(1-\beta) + \beta_i R_{mt} + \epsilon_{it} \qquad (3.1)$$

where, R_{mt} is the return on the market portfolio, R_{it} is the return on the portfolios, R_f is the risk-free return and α and β are the estimated coefficients.

The Black version is more complicated to test, since it is necessary to observe that when $\beta > 1$, the intercepts tend to be negative and when $\beta < 1$, the intercepts tend to be positive (Miller and Scholes, 1972). The implication of the zero-beta form of the CAPM is that the expected return of asset *i* in excess is linearly related to its beta, which is represented by a two factor model, such as:

$$R_{it} = R_z(1-\beta) + \beta_i R_{mt} + \epsilon_{it} \qquad (3.2)$$

R_z is the return on the minimum-variance zero-beta portfolio. If the zero-beta restriction of the Black version really explains security prices, then for rearranging equation (3.1) and (3.2) to eliminate $\beta_i R_{mt}$ and solving for α, the implication is:

$$\alpha_i = (1-\beta)(R_z - R_f) \qquad (3.3)$$

This is exactly what I want to test in the empirical results, since if β is less than 1, α should be positive; and if β is greater than 1, α should be negative. This test assumes that $(R_z - R_f)$ is positive in efficient markets and negative in inefficient markets. (Black, 1972).

The empirical implementation of the time-series regression approach of BJS involves the following two-step procedure: (1) In order to control the error-in-variables and selection bias problem, the available stocks were added into beta-portfolios. In doing so, the precision of the resulting beta estimates was increased. The entire sample period spanning from 1987 to 2001 is divided into 10 different sub-periods, as is described in Table 3.1. Individual stock betas are estimated in each sub-

period and stocks are subsequently ranked according to those estimates. Furthermore, stocks are grouped by deciles to create 10 portfolios per period.

TABLE 3.1
Portfolio Formation and Testing Period

This table shows the sub-periods used to estimate the individual stock betas, the portfolio formation year and the testing period for the CAPM

Sub-Periods and Beta Estimation	1987-1991	1988-1992	1989-1993	1990-1994	1991-1995	1992-1996	1993-1997	1994-1998	1995-1999	1996-2000
Ranking Stocks and Portfolio Formation	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Testing Period	1992-2001									

(2) Considering the testing period from 1992-2001, I calculated the least squared estimates of parameters α and β for each of the 10 portfolios, considering the following time-series market model regression, that is, the empirical form of the CAPM:

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \epsilon_{it} \qquad (3.4)$$

This is the empirical form of the CAPM. The excess portfolio returns are the dependent variables ($R_{it} - R_{ft}$) and the excess market return (EMR) is the independent variable ($R_{mt} - R_{ft}$).

Portfolio statistics and estimated time series parameters (α_i , β_i) are summarized in Table 3.2. Portfolio one contains the highest risk stocks and portfolio 10 contains the lowest risk stocks, which is consistent with the estimate risk coefficients range (β_i) that moves from 1.963 to 0.403. We can mention that the model explains well excess returns, since the autocorrelation $r(e_t,e_{t-1})$ appears to be quite small, and the correlation between portfolios and market returns $r(R_i,R_m)$ are, as

expected, quite high; supporting the structure of the linear equation as a good explanation of security returns.

I used the t-statistic values to test the zero-intercept restriction (Ho: $\alpha = 0$ Ha: $\alpha \neq 0$) of the Sharpe-Lintner CAPM, finding inconclusive results due to the fact that 2 to 10 of the coefficients have t-statistics values above 1.980, rejecting the null hypothesis at 95 percent level, and 5 to 10 of the coefficients are stadistically different to zero at a 90 percent level.

With regard to the Black Version of CAPM, it is interesting to point out that the result in Table 3.2 does not support the zero-beta restriction because the intercepts (α_i) are consistently negative for the low-risk portfolios (lower betas) and consistently positive for the high-risk portfolios (higher betas). Furthermore, the high risk portfolio (P1) has lower excess market returns (($R_{mt} - R_{ft}$) than low risk portfolio (P10), which is contrary to Black's (1972) assumptions, but consistent with the negative relation between risk and returns observed by Chen, Roll and Ross (1986), Poon and Taylor (1991) and Chan, Chen and Hsieh (1986). They argue that this negative relation could be induced by a positive size-beta relationship and a negative size-return relationship, which I will analyze more deeply in the cross-section analysis.

TABLE 3.2
Time Series Regressions: Black, Jensen and Scholes Methodology
1992-2001

This table shows the statistics to test the CAPM in the testing periods from 1992 to 2001. We use the Black, Jensen and Scholes Methodology. First, I included the available stocks into ten beta-portfolios where portfolio one contains the highest risk stocks and portfolio 10 contains the lowest risk stocks. Second, I regressed for the testing period from 1992-2001 the time-series market model: $R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \epsilon_{it}$ to estimate the coefficients α and β for each of the 10 portfolios. The excess portfolio returns are the dependent variables ($R_{it} - R_{ft}$) and the excess market return is the independent variable ($R_{mt} - R_{ft}$). This table shows the coefficients, t-statistic values, correlations, average excess portfolio returns (R_{it}-R_{ft}) and standard deviation. R_i = Excess portfolio returns, R_m = Excess market return, r = correlation coefficient, SD= Standard deviation. * and ** indicate significance at 95 and 90 percent level respectively

	Portfolio Formed on Pre-Ranking β									
	P1 (High)	P2	P3	P4	P5	P6	P7	P8	P9	P10 (Low)
β_1	1.963	1.529	1.383	1.154	1.037	0.867	0.535	0.438	0.308	0.403
t-stat	21.28*	22.06*	22.42*	20.31*	16.94*	11.90*	7.24*	6.92*	4.43*	5.21*
α_1	0.349	0.679	0.633	0.417	0.288	0.044	-0.560	-1.118	-0.623	-1.002
t-stat	0.699	1.810**	1.895**	1.357	0.868	0.111	-1.399	-3.263**	-1.656**	-2.391**
$r(R_{it},R_{mt})$	0.895	0.902	0.904	0.887	0.848	0.747	0.565	0.547	0.386	0.441
$r(e_t,e_{t-1})$	-0.068	0.170	-0.048	-0.140	-0.114	0.148	0.286	-0.046	-0.032	-0.105
SD(e)	5.119	3.846	3.423	3.154	3.398	4.042	4.102	3.514	3.859	4.299
R_{it}-R_{ft}	-2.453	-1.503	-1.341	-1.230	-1.193	-1.194	-1.323	-1.744	-1.063	-1.578
$SD(R_{it})$	11.500	8.892	8.018	6.827	6.415	6.084	4.970	4.199	4.183	4.791

Due to the existence of inconsistency with the CAPM proposed by Sharpe-Lintner and Black in the relation between risk market and returns, I divided the entire sample in two sub-periods, 1992-1994 and 1995-2001, in order to test the stability of these models before and after the opening of the Mexican economy and the 1995 economic and financial shock.

Table 3.3 shows evidence that in sub-period 1992-1994, the null hypothesis stating that the intercept must be zero (Ho: $\alpha = 0$ Ha: $\alpha \neq 0$) could be accepted. There are 10 to 10 intercepts that are statistically equal to zero at 95 percent level, which is identical to what is predicted by Sharp-Lintner CAPM. However, this model is not

correct in sub-period 1995-2001, given that there are 6 to 10 intercepts that are different to zero at 95 percent level.

TABLE 3.3
Time Series Regressions: Black, Jensen and Scholes Methodology
1992-1994 and 1995-2001

This table shows the statistics to test the CAPM in the sub-period from 1992 to 1994 and 1995 to 2001. I use the Black, Jensen and Scholes Methodology, First, we aggregated the available stocks into ten beta-portfolios where portfolio one contains the highest risk stocks and portfolio 10 contains the lowest risk stocks. Second, I regress for each sub-periods 1992-1994, 1995-2001 the time-series market model: $R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \epsilon_{it}$ to estimate the coefficients α and β for each of the 10 portfolios. The excess portfolio returns are the dependent variables ($R_{it} - R_{ft}$) and the excess market return is the independent variable ($R_{mt} - R_{ft}$). This table shows for each sub-periods the coefficients, t-statistic values and average excess portfolio returns ($R_{it}-R_{ft}$) and standard deviation. * and ** indicate significance at 95 and 90 percent level respectively.

Sub-	Portfolio Formed on Pre-Ranking β									
Periods	P1 (High)	P2	P3	P4	P5	P6	P7	P8	P9	P10 (Low)
					β_I					
1992-1994	1.840	1.608	1.491	1.099	1.064	1.001	0.557	0.312	0.065	0.267
1995-2001	2.065	1.566	1.367	1.213	1.015	0.769	0.489	0.445	0.396	0.433
					t-stat (β_i)					
1992-1994	11.981*	14.025*	10.440*	11.939*	8.920*	8.781*	3.252*	3.791*	0.442	1.776**
1995-2001	17.670*	18.191*	20.128*	16.767*	13.508*	8.264*	6.015*	5.263*	4.957*	4.573*
					α_i					
1992-1994	-0.814	-0.795	0.037	-0.396	0.540	1.035	0.263	-0.195	-0.465	-0.487
1995-2001	1.144	1.428	0.850	0.939	0.115	-0.665	-1.050	-1.503	-0.447	-1.145
					t-stat (α_i)					
1992-1994	-1.124	-1.472	0.056	-0.914	0.960	1.926**	0.327	-0.503	-0.668	-0.688
1995-2001	1.715**	2.906*	2.193*	2.274*	0.269	-1.253	-2.263*	-3.113*	-0.981	-2.118*
					$R_{it}-R_{ft}$					
1992-1994	-0.011	-0.094	0.688	0.083	1.004	1.471	0.506	-0.059	-0.436	-0.371
1995-2001	-3.580	-2.153	-2.277	-1.836	-2.207	-2.424	-2.168	-2.521	-1.352	-2.135

Regarding the Black version of the CAPM, this model predicted that when β >1, the intercepts must be negative and when β<1 the intercepts must be positive. The result in Table 3.3 shed inconclusive results about these predictions. From 1992 to 1994, this relation only appears in portfolios 1, 2, 4 and 7. From 1995 to 2001 the relation is inverse; in portfolios from 1 to 5 the β are higher than one but the

intercepts are positive and the portfolios from 6 to 10 the β are lower than one but the intercepts are negative.

In short, the time series test discussed in this section reject the zero-beta restriction of the Black version of the CAPM ($\alpha = (1-\beta)(R_z-R_f)$) in the entire testing period and two sub-periods; and the zero-intercept restriction of Sharpe-Lintner ($\alpha = 0$) is favorable only for the 1992-1994 period. These results shed evidence to reject our hypothesis that from 1987 to 2001, the CAPM is the right model to explain Mexican Stock Market returns, as well as to shed some evidence to reject hypothesis seven, referring to that in the Mexican Stock Market, local and international risk factor betas are stable in different time periods and different portfolio ordering techniques.

3.3. CROSS-SECTION ANALYSIS

Although the time series test discussed provide evidence to reject the CAPM, they cannot be used to test formally the linearity of the relation between average returns and risk. Hence, I implemented in this section the BJS and FM cross-section regressions to test if excess market return ($EMR=R_{mt} - R_{ft}$) could explain the cross-section variation across stock returns.

Given the results in Table 3.2 and 3.3, the implementation of BJS cross-section regressions involve regressing the returns (R_i) against the betas (β_i) for each

portfolio, in order to estimate the cross-section parameters regression (γ_0, γ_1) for the entire testing sample and sub-periods.

$$R_i - R_f = \gamma_0 + \gamma_1 \beta_i + \epsilon_i$$

The traditional form of the CAPM implies that the intercept (γ_0) should be equal to zero and the slope (γ_1) should be equal to the excess market return (EMR=$R_m - R_f$). Table 3.4 presents the estimated coefficients (γ_0, γ_1), theoretical values (R_f, R_m-R_f) and t-statistic values.

The Sharpe-Lintner CAPM is not rejected in the sub-period from 1992 to 1994, which is in line with Table 3.3. The intercept (γ_0) is equal to zero with a t-statistic value of -0.022 and the slope (γ_1) with a value of 0.308 and a t-statistic of 0.083 is statistically equal to excess market return (EMR=R_m-R_f), which has a theoretical value of 0.432. The other sub-periods, including the entire testing period, in no case γ_1 and γ_0, observed a relation significantly equal to their theoretical value. Therefore, the Sharpe Lintner CAPM is rejected in these periods.

TABLE 3.4
Cross-Sectional Regressions: Black, Jensen and Scholes Methodology
1992-2001, 1992-1994 and 1995-2001

This table shows the statistics to test the CAPM in the testing periods from 1992 to 2001 and in sub-periods from 1992 to 1994 and 1995 to 2001. I use the Black, Jensen and Scholes Methodology. Considering returns (R_i) and betas (β_i) obtained in Table 3.2 and 3.3, I regress for testing period 1992-2001 and sub-periods 1992-1994 and 1995-2001 the cross-section regression: $R_i - R_f = \gamma_0 + \gamma_1 \beta_i + \epsilon_i$ to estimate the coefficients γ_0 and γ_1. Panel A shows for testing period and sub-periods the coefficients and t-statistic values. Panel B shows the theoretical values for γ_0 and γ_1. R_{it} = portfolio returns, R_{mt} = market return, r = correlation coefficient, SD= Standard deviation, and * indicate significance at 99 percent level.

	Testing Period	Sub-periods	
	1992-2001	1992-1994	1995-2001
Panel A: Coefficient estimate			
γ_1	-0.376	0.308	-0.594
t-statistic$_{(Ho: \gamma_1 = Rmt-Rft)}$	-0.636	0.083	-1.018
γ_0 (intercept)	-1.101	-0.008	-1.685
t-statistic$_{(Ho: \gamma_0 = 0)}$	-4.536*	-0.022	-5.393*
Panel B: Theoretical Values			
$R_{mt} - R_{ft}$	-1.431	0.432	-2.291
Intercept	0.000	0.000	0.000
$SD(R_{mt} - R_{ft})$	5.245	4.754	5.266

As has been noted, there is a consistency in the results obtained in time series and cross-section analysis shows in Table 3.2, 3.3 and 3.4 that the Sharpe-Lintner CAPM presents no failure from 1992-1994. This could be interpreted according to Bekaert, Erb, Hervey and Viskanta (1998): (a) During these years, the liberalization of the Mexican stock market started to mature, initializing in May 1989, (b) an economic stability existed in Mexico between 1992-1994 and (c) from 1992-1994, the Mexican Stock Market observed a positive average return of 0.432 and the lowest standard deviation of 4.754, as shown in Table 3.4. With regard to entire periods and sub-periods like 1995-2001 where the CAPM fails, the risk perspectives of the Mexican Stock Market were different: (a) economic and financial shocks existed after

1994, (b) the financial market was more controlled before 1989 and (c) negative average returns and higher standard deviations were observed as shown Panel B in Table 3.4.

Another important point in Table 3.4 is the positive sign in the slope for 1992-1994, unlike the other periods which show a negative sign. The negative sign can be also observed in Table 3.2 and 3.3, where the high risk portfolios (P1) have lower returns (R_i) and low risk portfolios (P10) have higher returns (R_i). As an example, Table 3.2 presents the testing period a negative relation from portfolio 1 to 10. The betas go from 1.963 to 0.403 and the portfolio returns from –2.453 to –1.578. Table 3.4 presents this negative relation in the negative sign of the slope (γ_1) for the testing period (-0.376). Conversely, Table 3.3 presents in the period from 1992-1994 a positive relation from portfolio 1 to 10. The betas go from 1.840 to 0.267 and the portfolio returns from –0.011 to –0.371. Table 3.4 presents this positive relation in the positive sign of the slope (γ_1) of the sub-period 1992-1994 (0.308).

These findings indicate that except for 1992-1994, there is no market beta effect in the Mexican Stock Market, which is consistent with those found by Fama and French (1992) in the US Stock Market and Elfakhan, Lockwood and Zaher (1998) in the Canadian Stock Market.

In order to test the robustness of Sharpe-Lintner CAPM in addition to BJS cross-section test, I implemented the FM methodology, which performs cross-section regressions on a month-by-month basis. The empirical implementation involves the

following three-step procedure: (1) Following BJS's methodology to control the error-in-variables and selection bias problem, the available stocks will be included into 10 beta-portfolios. (2) Given the portfolios and testing period selected from 1992-2001, the following time series regression, using the Ordinary Least Squares (OLS), were estimated.

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \epsilon_{it} \quad (3.5)$$

The excess portfolio returns ($R_{it} - R_{ft}$) are the dependent variables and the excess market returns represent the independent variables (EMR=$R_{mt} - R_{ft}$). (3) Having formed portfolios according to (1), having run the time-series regressions shown in and (2) assuming that the betas results are given, they are used as independent variables to be run for each month of 1992 the following cross-sectional regressions:

$$R_{it} = \gamma_o + \gamma_{it} \beta_i + \eta_{it} \quad (3.6)$$

to obtain a time series with parameters γ_o and γ_{it}. The portfolio return estimation is rolled forward one calendar year at a time to give new beta estimates as in (2) and hence new γ_{it}'s as in (3) are obtained for the next year. Repeating steps from (2) to (3) for each year in the testing sample, a time series of the parameter's estimates (γ_{it}) are consequently generated from 1992 to 2001.

Given the time series of parameters estimated (γ_o γ_i) in order to test if there are statistically differences from zero, Table 3.5 reports for testing period and sub-periods, the time series average of γ's and t-statistics values, which are calculated as following:

$$\hat{\gamma}_i = \frac{1}{T}\sum_{t=1}^{T}\hat{\gamma}_{jt} \qquad \hat{\sigma}^2_{\gamma_j} = \frac{1}{T(T-1)}\sum_{t=1}^{T}(\hat{\gamma}_{\gamma_j} - \hat{\gamma}_{\gamma})^2 \qquad t-stat = \frac{\hat{\gamma}_i}{\hat{\sigma}_{\gamma_j}}$$

The results are a bit inconsistent compared with Tables 3.2, 3.3 and 3.4 to explain the cross-section variations in returns. The null hypothesis of the zero-intercept restriction of Sharpe-Lintner CAPM (Ho: $\alpha = 0$ Ha: $\alpha \neq 0$) is not clearly accepted. However, even so, two interesting observations emerge contrasting with Table 3.5. First, the intercepts are statistically different to zero at 95 percent level, except the entire testing period. Therefore, there is an inconsistency in the 1995-2001 period. Table 3.4 has an intercept statistically different to zero and Table 3.5 shows an intercept equal to zero.

TABLE 3.5
Cross-Sectional Regressions: Fama-MacBeth Methodology
1992-2001, 1992-1994 and 1995-2001

This table presents the statistics to test the CAPM in the testing period from 1992 to 2001 and in sub-periods from 1992 to 1994 and 1995 to 2001. I use the Fama and MacBeth Methodology. First, I aggregated the available stocks into ten beta-portfolios where portfolio one contains the highest risk stocks and portfolio 10 contains the lowest risk stocks. Second, I regress for testing period 1992-2001 the time series regression: $R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \epsilon_{it}$ to estimate the coefficients α_i and β_i for each of the 10 portfolios. The excess portfolio returns are the dependent variables ($R_{it} - R_{ft}$), and the excess market return (EMR) is the independent variable ($R_{mt} - R_{ft}$). Third, The betas estimated (β_i) are used as independent variables to regress for each month in 1992 the cross-section regressions $R_{it} = \gamma_o + \gamma_{it}\beta_i + \eta_{it}$ in order to estimate the coefficients (γ_{it}). Fourth, the beta-portfolios return estimation is rolled forward one calendar year at a time to give new beta estimates (β_i). Hence, new γ_{it}'s are obtained for the next year. Five, repeating these steps in the sample, a time series of the parameter's estimates (γ_{it}) are consequently generated from 1992 to 2001. These steps were repeated each sub-period. The table shows the time series average of γ's and *t*-statistics values. * indicate significance at 99 percent level respectively

Periods	Coefficients	
	γ_o	γ_i
1992-2001	-0.086	-1.427
1992-1994	-0.127	0.436
1995-2001	-0.033	-2.287
	t-stat	
1992-2001	4.336*	-2.891*
1992-1994	-1.282	0.533
1995-2001	-0.275	-3.826*

Second, except for the 1992-1994 period, all betas are significantly different from zero at 95 percent level; conversely to the result obtained in Table 3.3 and 3.4. However, in spite of this significance in the periods 1992-2001 and 1995-2001, the result must be taken with caution because the negative relationship between excess market return (EMR) and the average returns still is inconsistent with the traditional form of the CAPM model.

This inconsistency in the sign has been also found by Chen, Roll and Ross (1986), Poon and Taylor (1991) and Chan, Chen and Hsieh (1985). They argue that if we have two firms of roughly the same size, the one with the higher market beta would have lower expected returns. Table 3.6 shows that a possible explanation of this argument about the negative sign is that it could be induced by the positive size-beta relationship (0.519) and negative size-returns relationship (-0.061), which causes a negative beta-return relationship (-0.514).

Boundoukh, Richardson and Smith (1993) give other explanations of the negative sign in excess market return (EMR). They claim that a negative sign is associated with periods of high inflation and downward term structures. Table 3.6 shows evidence of this argument since a negative return-term structure relationship (-0.180) and negative return-inflation relationship (-0.171) are present in the testing and sub-periods.

TABLE 3.6
Correlation Matrix: 1992- 2001

The correlation coefficient between return, size, market beta, term structure (TERM) and market return (EMR) are presented in this table. The time period is from 1992 through 2001.

	BETA	RETURNS		EMR	TERM
RETURNS	-0.514		TERM	-0.180	
SIZE	0.519	-0.061	IMX	-0.171	0.874

3.4. CONCLUSIONS

As noted in this chapter, the evidence does not allow us to explain the time series and cross-section variations in the Mexican Stock Market returns. If we apply the time series and cross-section regression approach of BJS, our results reject the zero-beta restriction of the Black version of the CAPM ($\alpha = (1-\beta)(R_z-R_f)$) in the entire testing period and two sub-periods; and the zero-intercept restriction of Sharpe-Lintner CAPM ($\alpha = 0$) is favorable only for 1992-1994 period. Nevertheless, when is the cross-section regression approach of FM is applied, in no case the Sharpe-Lintner CAPM is predicted.

It is true that these result provides evidence for not accepting hypothesis one, four and seven. However, these results are important since they give evidence that other risk factors could exist to explain the cross-section variation in returns as well as the evolution of returns through time in the Mexican Stock Market.

CHAPTER 4

MULTI-FACTOR PRICING MODEL

4.1. INTRODUCTION

The Multi-Factor Pricing Model was proposed as an alternative to the CAPM in order to include more than one risk factor to explain the expected returns. In these chapter the Multi-Factor Pricing Models to test are the ones developed by Chen, Roll and Ross (CRR) (1986) and Fama and French (FF) (1993).

CRR proposed different macroeconomic variables such as change in industrial production (IPM), the spread between the yield on short-term and long term government bonds (TERM), the spread between low and high-grade bonds (DEF), change in expected inflation (DEI), change in unexpected inflation (UI), future oil prices (OPFM) and real consumption (RSM) as risk factors to explain stock returns. Whereas, FF proposed the three factor model that includes the excess market return (EMR), size mimicking portfolio (SMB), and book-to-market mimicking portfolio (HML).

In addition to these risk factor, other set of risk factors that measure the effect of exposure to currency, the international risk and the political risk are used to test the model. The purpose of including these risk factors is to test if these factors identified in the U.S. stock market are the same as those of the Mexican stock market, or if there are other risk factors that explain the expected return. The objective will be to test the following hypotheses:

H_2: The risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993) for the US Stock Market are also adequate to explain stock market returns in the Mexican Stock Market.

H_3: Besides the macroeconomic and market risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993), exchange rate factors, international factors and political factors are also a source of risk to explain returns in the Mexican Stock Market.

4.2. ESTIMATION AND TESTING OF THE MODEL

In order to examine whether the Multi-Factor Pricing Model explains the cross-section return variations in the Mexican Stock Market, I implemented the FM methodology performed in Chapter 2 on portfolios constructed according to their betas, but with different risk factors.

Table 4.1 presents the results of the implementation of FM cross-section regressions, which include the three FF risk factors and seven CRR risk factors. The pricing theory holds that in order to correctly explain the cross-section variation in returns, the intercept must be equal to zero and the risk factors betas must be different to zero. Thus, I tested these hypotheses in the cross-section regressions by focusing in the t-statistics values of each estimated coefficient.

TABLE 4.1
Cross-Sectional Regressions: Fama-MacBeth Methodology
Fama and French-Chen, Roll and Ross Risk Factors, 1992 - 2001

We use the Fama and MacBeth Methodology. First, I aggregated the available stocks into ten beta-portfolios where portfolio one contains the highest risk stocks and portfolio 10 contains the lowest risk stocks. Second, I regress for testing period 1992-1996 the ten excess portfolio returns ($R_{it} - R_{ft}$) against the risk factors identified by Fama and French (1993) and Chen, Roll and Ross (1986) to estimate the coefficients α_i and β_i's for each of the ten portfolios. The regression are the following:

FFTRF: $R_{it} - R_{ft} = \alpha + \beta\ EMR + \beta_s\ SMB + \beta_h\ HML + \epsilon_t$

CRR1: $R_{it} - R_{ft} = \alpha + \beta\ EMR + \beta_i\ IPM + \beta_e\ DEI + \beta_u\ UI + \beta_t\ TERM + \beta_d\ DEF + \epsilon_t$

CRR2: $R_{it} - R_{ft} = \alpha + \beta_i\ IPM + \beta_e\ DEI + \beta_u\ UI + \beta_t\ TERM + \beta_d\ DEF + \epsilon_t$

CRR3: $R_{it} - R_{ft} = \alpha + \beta_i\ IPM + \beta_e\ DEI + \beta_u\ UI + \beta_t\ TERM + \beta_d\ DEF + \beta_r\ RSM + + \epsilon_t$

CRR4: $R_{it} - R_{ft} = \alpha + \beta_i\ IPM + \beta_e\ DEI + \beta_u\ UI + \beta_t\ TERM + \beta_d\ DEF + \beta_o\ OPFM + + \epsilon_t$

Chen, Roll and Ross (1986) risk factors: Change in industrial production (IPM), the spread between the yield on short-term and long term government bonds (TERM), the spread between low and high-grade bonds (DEF), change in expected inflation (DEI), change in unexpected inflation (UI), oil prices future (OPFM) and real consumption (RSM) as risk factors to explain stock returns. Fama and French (1993) risk factors: excess market return (EMR), size mimicking portfolio (SMB), and book-to-market mimicking portfolio (HML). Third, the estimated betas (βi) are used as independent variables to regress for each month in 1997 the cross-sectional regressions $R_{it} = \gamma_o + \gamma_{it}\beta_i \ldots\ldots \gamma_{nt}\beta_n + \eta_{it}$ in order to estimate the coefficients (γ_{it}). Fourth, the beta-portfolios return estimation is rolled forward one calendar year at a time to give new beta estimates (β_i). Hence, new γ_{it}'s are obtained for the next year. Five, repeating these steps in the sample, a time series of the parameter's estimates (γ_{it}) are consequently generated from 1997 to 2001. The table shows the time series average of γ's and *t*-statistics values under coefficient. FFTRF: Fama and French three risk factor model CRR: Chen, Roll and Ross models. *, ** and *** indicate significance at 99, 95 and 90 percent level respectively.

	FFTRF	CRR1	CRR2	CRR3	CRR4
Intercept (α)	0.387	0.280	0.373	0.355	0.413
	0.859	0.745	1.033	0.739	1.147
EMR	-1.844	-1.946			
	-2.615*	-2.731*			
IPM		0.139	1.657	3.184	1.752
		0.067	0.895	1.540	0.782
DEI		0.130	0.226	0.294	0.111
		0.647	1.162	1.588	0.506
UI		0.367	0.157	0.187	-0.094
		0.757	0.366	0.416	-0.204
TERM		0.008	0.114	0.168	0.084
		0.069	1.090	1.649	0.707
DEF		0.128	0.196	0.171	0.209
		1.211	1.909**	1.40	2.058*
SMB	-0.686				
	-0.804				
HML	-1.738				
	-1.310				
RSM				-1.063	
				-0.115	
OPFM					-1.084
					-0.220

The CRR risk factors were used to estimate the same four cross-section regressions (CRR1, CRR2, CRR3 and CRR4) that they estimated in their analysis. The t-statistic values between 0.739 and 1.147 give evidence that all intercepts are positive and statistically equal to zero at 99 percent confidence level. However, it does not suffice to explain the cross-section variation of average returns since the risk factor betas are not all statistically different to zero.

In the cross-section regression that included EMR (CRR1), this happens to be the only risk factor statistically different from zero at 99 percent level. When EMR is excluded (CRR2), the only risk factor with positive sign and statistically different to zero at 95 percent level is DEF. In the cross-section regression that replaces EMR by RSM (CRR3), the risk factor do not explain the cross-section variation of average returns. Regarding the cross-section regression that excludes EMR to be replaced by OPFM (CRR4), the most interesting observation is that DEF has a positive sign and is the only risk factor statistically different from zero at 99 percent level.

The consistency in the significance and in the positive sign of DEF observed in Table 4.1 could reflect that it is a proxy of business conditions measured by the degree of risk aversion implicit in stock prices. One interpretation of this result is that when the business conditions are poor, the spreads are likely to be high and then the returns are high, and when the business conditions are strong, the default spreads are likely to be low and then the returns are low (Fama and French, 1989).

With regard to the cross-section regressions that included three risk factors proposed by FF (FFTRF), the intercept value is indistinguishable from zero at the 95 percent level and, except by EMR with a t-statistic value of –2.615, the risk factors SMB and HML results show inability to capture the cross-section of average returns missed by the Sharpe-Lintner CAPM at 99 percent level.

We have shown that except by DEF and EMR, the results in Table 4.1 give evidence that the risk factors proposed by CRR and FF are not adequate to explain the cross-section variation in Mexican stock market returns when the portfolios are formed by beta. In fact, it could be attributed to the fact that the behavior of the Mexican market returns differ substantially from the behavior of US market returns, in areas such as tax system, market microstructure, improvements in market structures and the opening of markets to foreign investors (Claessens, Dasgupta and Glen, 1998).

One alternative to improve the explanation of the cross-section variation in the average returns is to include perhaps only EMR and DEF, which are risk factors more correlated with the Mexican stock returns.

Table 4.2 shows twelve cross-section regressions where excess portfolio returns are regressed against EMR and DEF, as well as against all risk factors that were described in Chapter 2 in Table 2.4 Panel B[9]. We selected proxies to measure the effect of exposure to currency (IMX, M2RM, DPEXMM EXMP, EXM),

[9] Different regressions were run taking into account all risk factors showed in Table 2.4 Panel B. The regressions that are not successful are not shown, but are available from the author on request.

international markets (TBILLR, DJM, MOP, LQMP), and political risk (POLITIC, POLIDUM).

Cross-section regression 1 (R1) reports the results of included EMR and DEF to explain the cross-section variation of average returns. It is true that both risk factors are significantly different from zero with a t-statistic value of –2.609 and 3.804, respectively. However, the intercept still is statistically different to zero with a t-statistic value of 2.277. Therefore, the hypothesis that holds the pricing theory that the intercept must be equal to zero is not accepted.

TABLE 4.2
Cross-Sectional Regressions: Fama-MacBeth Methodology
Other Risk Factors, 1992 – 2001

We use the Fama and MacBeth Methodology. First, I aggregated the available stocks into ten beta-portfolios where portfolio one contains the highest risk stocks and portfolio 10 contains the lowest risk stocks. Second, I regressed for testing period 1992-2001 the ten excess portfolio returns (R_{it} - R_{ft}) against the following risk factors: excess market return (EMR), default risk (DEF), inflation (IMX), change in monetary supply (M2RM), probability of devaluation (DPEXM), exchange rate portfolio (Long-Short) (EXMP), change in exchange rate (EXM), US real interest (TBILLR), change in U.S. stock market index (DJM), momentum portfolio (MOP), political event proxy (POLITIC), Dummy political event (POLIDUM), liquidity proxy (LQMP). Third, the betas estimated (βi) are used as independent variables to regress for each month in 1992 the cross-sectional regressions $R_{it} = \gamma_o + \gamma_{it}\beta_i \ldots\ldots \gamma_{nt}\beta_n + \eta_{it}$ in order to estimate the coefficients (γ_{it}). Fourth, the beta-portfolios return estimation is rolled forward one calendar year at a time to give new beta estimates (β_i). Hence, new γ_{it}'s are obtained for the next year. Five, repeating these steps in the sample, a time series of the parameter's estimates (γ_{it}) are consequently generated from 1997 to 2001. The table shows the time series average of γ's and *t*-statistics values under coefficient. * and ** indicate significance at 95 and 90 percent level respectively.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
Intercept	0.590	0.365	0.574	0.389	0.573	0.731	-0.143	0.481	0.533	0.543	0.458	0.520
	*2.277**	*1.254*	*1.919***	*1.269*	*2.528**	*2.563**	*-0.428*	*1.991**	*1.796*	*2.264**	*1.683*	*1.913**
EMR	-1.819	-1.878*	-0.459	-0.468	-0.482	-0.420	-1.790	-0.452	-0.475	-0.345	-0.465	-0.463
	*-2.61**	*-2.677**	*-0.643*	*-0.662*	*-0.683*	*-0.597*	*-1.666*	*-0.635*	*-0.671*	*-0.482*	*-0.654*	*-0.663*
DEF	0.251	0.171	0.133	0.095	0.103	0.174	0.078	0.096	0.092	0.098	0.089	0.124
	*3.804**	*2.078**	*1.459*	*1.132*	*1.518*	*2.136*	*0.729*	*1.357*	*1.439*	*1.434*	*1.269*	*1.742*
		0.191	0.167	0.634	0.029	-0.872	-1.949	0.652	0.558	-0.150	1.355	-0.029
		*2.279**	*0.201*	*1.907***	*0.052*	*-0.680*	*-1.477*	*0.915*	*0.251*	*-0.134*	*1.045*	*-0.142*
		TBILLR	**DJM**	**IMX**	**M2RM**	**MOP**	**DPEXM**	**EXMP**	**EXM**	**LQMP**	**POLITIC**	**POLIDUM**

From cross-section regression 2 to 12 (R2 to R12), the risk factors that measure the effect of exposure to currency, international markets and political risk are included. I found no evidence to explain the cross-section variation of average returns in regressions from 3 to 12. The risk factors included in these regressions are not statistically different from zero at 95 percent level and they absorb the significance in EMR and DEF, pushing down their t-statistics values.

Otherwise, when EMR, DEF and TBILLR are included in regression 2, the results give evidence to explain the cross-section variation in returns. These risk factors have the correct sign, they have t-statistic values of –2.677, 2.078 and 2.279, respectively, which are statistically different from zero at 95 percent level, and the intercept is statistically equal to zero with a t-statistic of 1.254. Hence, these are the best factors to explain the cross-section returns in the Mexican Stock Market from 1992 to 2001, since they do not reject the hypothesis hold by pricing theory that the intercept must be equal to zero and the risk factors betas must be different to zero.

4.3. CONCLUSIONS

In summary, this chapter showed that a Multi-Factor Pricing Model that includes EMR, DEF and TBILLR as risk factors, have more significant explanatory power in the Mexican Stock Market returns than the Multi-Factor Pricing Models that include the FF and CRR risk factors. These results provide evidence for not accepting hypothesis two, given that the risk factors identified by CRR and FF are not adequate

to explain the Mexican stock market and provide evidence in favor of hypothesis three, because there is an international factor that better explains the returns. Therefore, I can conclude that the results are quite the opposite as those documented in the US stock market, which gives evidence of how risk factors are priced differently simply by crossing an international border.

CHAPTER 5

SIZE AND BOOK-TO-MARKET EFFECTS

5.1. INTRODUCTION

In Chapter 3 and 4, in order to test the CAPM and Multi-Factor Pricing Model, portfolios were formed according to their betas on a market index. The main results are easy to summarize: (a) the time series (BJS) and cross-section test (FM) do not support the CAPM, (b) the risk factors identified by CRR and FF in the US stock market do not affect in the same manner the stock returns in the Mexican Stock Market, and (c), the risk factors excess market return (EMR), default risk (DEF) and U.S. interest rate (TBILLR) better explain the cross-section stock market returns in the Mexican Stock Market.

The results were not surprising. In the US stock market there are several empirical research where the results do not support the CAPM. The most important is the Fama and French (1992), which provided evidence that average returns on US stocks are not related to beta.

The inconsistency in the CAPM has been attributed to the possibility that various proxies for the market portfolio do not fully capture all of the relevant risk factors in the economy. According to this argument, some research explains that the most noteworthy violation of the CAPM result in the fact that the cross-section differences in stock returns are related to some stock characteristics, such as size and

book-to-market value. The justification is because the stock characteristics are highly correlated with the sensitivities of stock to risk factors not captured by proxies for the market portfolio.

A negative correlation between size and stock returns was documented by Banz (1981). He finds that market equity, size (a stock's price times shares outstanding), adds to the explanation of the cross-section of average returns provided by market Betas. Average returns on small stocks are too high given their market beta estimates, and average returns on large stocks are too low. The correlation between book-to-market (BM) value and stock returns was documented by Stattman (1980) and Rosemberg, Reid and Lanstein (1992), finding that average returns on US stocks are positively related to the book-to-market value, and by Chan, Hamao and Lakonishok (1991), who found that this characteristic also has a strong role in explaining the cross-section of average returns on Japanese stocks.

These two characteristics, size and book-to-market value, together with market beta, can be regarded as different ways of extracting information from stock prices about the cross-section of expected stock returns (Ball, 1978, Keim, 1983).

Given the argument that the inconsistency in the CAPM and Multi-Factor Pricing Model could be the result of the cross-section differences in stock returns that are related with some stock characteristics. The first objective in this chapter will be to test the cross-section relation between average return and size and book-to-market

value[10]. The other objective will be to test again the CAPM and Multi-Factor Pricing Model to give an economic explanation of the cross-section variation captured by size and Book-to-Market value.

In section 5.2, the cross-section relation between average return and the characteristics is tested using an univariate, cross-section, and joint tests. In Section 5.3, the interaction between size and book-to-market value is presented. In Section 5.4, I discussed whether the cross-section relation between average return and the characteristics can be explained by one factor CAPM or by a Multi-Factor Pricing Model. Finally, the conclusions are discussed in Section 5.5. At the end of these chapter I will answer to hypotheses five and seven:

H_5: In the Mexican Stock Market, the Multi-Factor Pricing Model better explains the cross-section relation between average return and the characteristics than the CAPM.

H_7: In the Mexican Stock Market, local and international risk factor betas are stable under different business conditions and different portfolio ordering techniques.

The technique employed by Fama and French (1992) is implemented to test the cross-section relation between average return and the characteristics. I follow the technique employed by Fama and French (1993) to perform a time series analysis in order to test the CAPM and Multi-Factor Pricing Model; taking into account the risk

[10] We selected only these characteristics given that Fama and French (1992) found that these market characteristics also capture the cross-sectional variation in return associated with earning to price ratio and debt to equity ratio. The objective in this chapter is not to test these relations.

factors proposed by CRR and FF, as well as the risk factors described in Chapter 2 in Table 2.4 Panel B.

Unlike chapters 3 and 4, where the portfolios were formed only according to their betas on a market index, in this chapter, one-dimension portfolios on size and book-to-market value and bi-dimensional portfolios on size-book-to-market value are formed.

The portfolios are analyzed for the entire period, 1987-2001, and two sub-periods, 1987-1994 and 1995-2001. This is in order to test the stability of the results before and after the Mexican economic opening and the 1995 economic and financial shock. In some cases, to test the robustness of results obtained from these sub-periods, I will use the sub-periods from January 1987 to May 1989 and June 1990 to December 2001 to evaluate the impact of the Mexican financial liberalization, which started in May, 1989.

5.2. CROSS-SECTION RELATION BETWEEN AVERAGE RETURNS AND STOCK MARKET CHARACTERISTICS

In order to give evidence about the cross-section relation between average returns and the size and book-to-market value characteristics, we provide three tests following the technique employed by Fama and French (1992).

First, an univariate test will examine the independent effects of each variables without controlling the effects of the other. It will be built four equally weighed size

portfolios and four equally weighed book-to-market value portfolios. Second, a cross-section test will be based on cross-section regressions, using size-book-to-market portfolios as dependent variables and market betas as independent variables. This is a more formal test in comparison with the univariate test which is an informal test. Third, a joint test will examine the independent effects of each variable, while controlling the effects of the other. I will examine returns for portfolios that are formed first categorizing the firms according to size and then according to book-to-market value within size categories.

5.2.1 UNIVARIATE TEST

In order to implement the univariate test, four one-dimensional portfolios are formed on the basis of ranked values of size, book-to-market value and pre-ranking betas. It is important to mention that only four portfolios were formed on each stock characteristic because the Mexican Stock Market is smaller than the US stock market.

The portfolio formation process is similar to Fama and French (1992). First, at the end of June of year t to the end of June of year t+1, the individual stocks are ranked in size. Second, each stock is broken into four equally size group. Finally, four monthly and equally weighed portfolio returns for July of year t to June of year t+1 are calculated. These steps were repeated for pre-ranking beta and book-to-market value in order to obtain the other one-dimension portfolios.

Table 5.1 shows the properties for these portfolios. Panel A presents the size portfolio characteristics. The first evidence found is that when portfolios are formed on size alone, from the entire period we observe positive relation between size and average returns. This finding is opposed to the evidence of Banz (1981) and Fama and French (1992). A second evidence in Table 5.1 is that a strong positive relation between average return and market betas exist. Average returns raise from 0.08 per month for the smallest size portfolio to 0.30 for the largest. Post ranking betas also increase across the two size portfolios, from 0.72 for the smallest size to 1.39 for the largest. Thus, a simple size sort seems to support the Sharpe-Lintner-Black model (SLB) prediction of a positive relation between Beta and average returns. But the cross-section relation between size and average returns is converse to the theory.

Panel B presents the results when portfolios are formed on book-to-market value alone. The more striking evidence is the strong positive relation between average return and book-to-market value. The average returns rise from -0.20 for the lowest book-to-market portfolio to 0.54 for the highest, a difference of 0.74. This spread is three time as large as the difference of 0.22 between the average monthly returns on the smallest and largest size portfolios. We could conclude that book-to-market value capture cross-section variation in average returns that is related to relative distress and that in no case the SLB is support, since the relation between betas and returns is negative.

Panel C shows for the entire period the pre-ranking market beta portfolio characteristics. The results produce a wider range of betas (from 0.24 for the smallest portfolio to 1.84 for the largest) than the portfolios formed on size (from 0.72 for the smallest portfolio to 1.39 for the largest). Unlike the size portfolio, the beta-sorted portfolios do not support the SLB model, since there is not a positive relation between beta and returns. There is little spread (0.01) in average returns across the beta portfolios, and there is no obvious cross-section relation between market beta and average returns. These results confirm Reinganum's (1981) evidence that for market beta-sorted portfolios, there is no relation between betas and returns, since the evidence shows a negative relation between beta and returns.

TABLE 5.1
Properties of Portfolios Formed on Size, Book-to-Market Value and Pre-Ranking Market Beta

For the entire period 1987-2001, at the end of June of each year t, 4 one-dimensional portfolios are formed on the basis of ranked values of size, book-to-market or pre-ranking Betas. The pre-ranking Betas use 5 year of monthly return ending in June of t. I calculated portfolio monthly equally-weighed return for July of year t to June of year t+1, and then reformed the portfolios in June of t+1.
The return is the time series average of the monthly equally-weighed portfolio return, in percent terms. Beta is the time series average of the monthly portfolio betas. Stocks are assigned the post-ranking beta of the size-beta portfolio they are in at the end of June of year t. These individual firm betas are the computed average of the monthly beta for each portfolio for July of year t to June of year t+1.

	Low	High	Difference
Panel A: Portfolios Formed on Size			
Returns	0.08	0.30	-0.22
Betas	0.72	1.39	-0.66
Panel B: Portfolios Formed on Book-to-Market Value			
Returns	-0.20	0.54	-0.74
Betas	1.30	0.94	0.37
Panel C: Portfolios Formed on Pre-Ranking Market Beta			
Returns	0.07	0.06	0.01
Betas	0.24	1.84	-1.60

In order to examine whether the results obtained are special from 1992 to 2001, or whether the cross-section relation is influenced by the economic conditions, I also analyzed the one-dimension portfolio formed on the basis of ranked values of size, book-to-market value and pre-ranking market betas for two sub-periods and contrasted these results with the entire period.

Table 5.2 presents those results, which were not consistent with the entire period. Panel A shows that the results of size portfolios for 1995-2001 are similar to the entire period, but for 1992-1994 the evidence is different; namely, there is a persistence of a negative relation between size and returns and does not support the SLB predictions. Thus, a negative relation between returns and betas was observed. It is important to say that in this last sub-period the, result is not conclusive, since the differences between size, returns and beta are flat.

Panel B shows that for 1992-1994 and 1995-2001, the book-to-market portfolio have a strong positive relation between average return and book-to-market and the SLB does not support similar results obtained in the entire period.

Finally, for the pre-ranking market beta portfolio, only from 1992 to 1994 the SLB is a support since a positive relation between returns and betas was observed. This favorable result could be attributed that to this period is stability, unlike to 1995-2001, where the economy was unstable and does not support the SLB. Similarly to entire period, in both sub-periods, there is wider range of betas than the portfolios formed on size.

TABLE 5.2
Properties of Portfolios Formed on Size, Book-to-Market Value and Pre-Ranking Market Beta

This table presents the portfolios for sub-periods from 1992 to 1994 and 1995 to 2001. At the end of June of each year t, 4 uni-dimensional portfolios are formed on the basis of ranked values of size, book-to-market and pre-ranking Betas. The pre-ranking Betas use 5 year of monthly return ending in June of t. I calculated each portfolio's monthly equal-weighed return for July of year t to June of year t+1, and then reformed the portfolios in June of t+1.
The average return is the time series average of the monthly equally-weighed portfolio return, in percent terms. Beta is the time series average of the monthly portfolio betas. Stocks are assigned the post-ranking beta of the size-beta portfolio they are in at the end of June of year t. These individual firm betas are average to compute the monthly beta for each portfolio for July of year t to June of year t+1.

	Low	High	Difference
Panel A: Portfolios Formed on Size			
		1992-1994	
Returns	1.60	1.42	0.18
Betas	0.67	1.49	-0.82
		1995-2001	
Returns	-0.56	-0.18	-0.39
Betas	0.75	1.34	-0.59
Panel B: Portfolios Formed on Book-to-Market Value			
		1992-1994	
Returns	0.94	1.89	-0.95
Betas	1.44	0.85	0.59
		1995-2001	
Returns	-0.69	-0.04	-0.65
Betas	1.24	0.98	0.27
Panel C: Portfolios Formed on Pre-Ranking Market Beta			
		1992-1994	
Returns	0.84	1.60	-0.77
Betas	0.24	1.94	-1.69
		1995-2001	
Returns	-0.20	-0.49	0.29
Betas	0.24	1.80	-1.57

Up to here, the results can be summarized in four inferences: First, in the entire period and sub-periods, the cross-section relation between average return and book-to-market value are similar to those obtained by Fama and French (1992). Second, from 1992 to 1994, the cross-section relation between average return and

size is similar to those obtained by Fama and French (1992) and from 1995 to 2001 and 1992 to 2001 the cross-section relation is the opposite. These converse result could cause that in down market periods, like 1995, investors could increase their investment in high size firms in order to protect its investment.

Third, in the entire period and from 1995-2001, there is no cross-section relation between average return and pre-ranking market beta such as Fama and French (1992) argued. Moreover, from 1992 to 1994 there is a cross-section relation. The argument in these results relate to the fact that this last period was economically stable. Fourth, when I contrasted the cross-section relations, I found that the cross-section relation between average return and book-to-market is most important and strong since the positive relation is constant throughout the years and periods. Furthermore, the cross-section relation of size and beta with the average returns depends on economic stability. During an unstable period, the result are converse to the theory and during stable periods, the theory applies.

Although these results give an explanation of the cross-section relations, the test used was informal. With the purpose of obtaining a more robustness result in the next section, a more formal test will be used.

5.2.2 CROSS-SECTION TEST

To test the robustness of the cross-section relation between average return and stock market characteristics found in Table 5.1 and 5.2 with an univariate tests, I implemented the Fama and Macbeth (FM) (1973) methodology, which performs cross-section regression on a month by month basis. The empirical implementation of this methodology follows the same four-step procedure implemented in Chapter 3 to test if the average returns are explained by a one factor CAPM.

Table 5.3 shows form 1992-2001, 1992-1994 and 1995-2001 the time series averages of slopes and t-statistics values obtained from the cross-section regressions. These statistics provide standard FM tests for determining which characteristics, size or book-to-market value, better explain the cross-section average returns.

TABLE 5.3
Cross-Sectional Analysis: Fama-Macbeth Methodology
Results from Month by Month Regressions of Stock Returns on Beta, Size and Book-to-Market

This table shows the average slopes and t-statistics from 1992 to 2001 and sub-periods from 1992 to 1994 and 1995 to 2001. Stocks are assigned the post-ranking beta of the size-beta portfolio they are in at the end of June of year t. The Firm size (SIZE) is measured in June of year t.
Book-to-market (BM) is measured in December of year t-1. Excess market return (EMR) is measured on January of year t. In the regressions, these values of the explanatory variables for individual stocks are matched with stock returns for the months from July of year t to June of year t+1. The average slope is the time series average of the monthly regression slopes and the t-statistic is the average slope divided by its time series average standard error.

	1992-2001		1992-1994		1995-2001	
	Means	t(std)	Means	t(std)	Means	t(std)
			$R_{it}-R_{ft} = a + bEMR + \epsilon_t$			
a	0.08	1.48	-0.11	-1.46	0.15	2.09
b	-0.11	-0.32	0.80	1.28***	-0.44	-1.02
			$R_{it}-R_{ft} = a + sSIZE + \epsilon_t$			
a	0.00	0.63	0.01	0.84	0.00	0.55
s	0.11	0.82	0.16	1.00	0.09	0.70
			$R_{it}-R_{ft} = a + mBM + \epsilon_t$			
a	0.01	0.68	-0.02	-0.63	0.02	1.94
m	-0.03	-1.52**	-0.02	-0.82	-0.03	-2.94*
			$R_{it}-R_{ft} = a + sSIZE + mBM + \epsilon_t$			
a	0.00	0.20	0.00	-0.10	0.00	0.30
s	0.03	0.26	-0.03	-0.20	0.04	0.47
m	-0.02	-1.18	0.00	-0.11	-0.02	-3.86*

Their interpretation of the entire period can be summarized in three ways: First, the regression in Table 5.3 does not show strong evidence that size helps to explain the cross-section of average returns. Even so, some results are similar to the ones found in Table 5.3 and 5.2. The average slope from the monthly regressions of returns on size alone is 0.11, but it is not statistically different to zero. It is true that the size is not significant to explain the cross-section of average stock returns, but the reliable positive relation is consistent with those found in Table 5.1.

Secondly, Table 5.3 shows that the monthly regressions of returns on book-to-market value alone, help to explain the cross-section of average returns at 90 percent

confidence level, with a negative sign in the average slope. The sign is converse in comparison with our result in Table 5.1 and with the evidence of Fama and French (1992).

It is important to mention that when the size and book-to-market are included in the same regression to explain the cross-section of average return, the same relation as when are included alone persists. Thus, the size and book-to-market value are robust alone, but together do not explain the cross-section of average stock returns.

Third, when the excess market return is represented by the independent variable, the market beta does not help to explain the cross-section average returns, which is consistent to those found in Table 5.3. The average slope has a negative sign (-0.11), which is a sufficient reason to say that is inconsistent with CAPM and the t-statistic of (-0.32), meaning that it is not statistically different to zero at a 95 percent level.

In order to test the robustness of the entire period, Table 5.3 also shows the average FM slopes for two sub-periods, before and after the 1994 crisis. If we analyze in sub-periods 1995-2001 the regressions of returns on size alone, book-to-market alone and when they are included together, I found exactly the same effect from 1992-2001. Book-to-market has a negative sign and explains the cross-section average returns, size has a positive sign and it do not explain the cross-section

average returns, and the market beta has a negative sign and it does not explain the cross-section average returns.

Unlike the entire period and 1995-2001, the results from the 1992-1994 period are different. Beta is marginally different at an 80 percent level with a positive sign, consistent with CAPM. This result is very similar to the one found in Table 5.2. The size is not statistically significant at a 90 percent confidence level and the sign is converse to the one obtained in Table 5.2. The book-to-market value does not offer much hope of consistency, given that the average slope is not significant and the negative sign is not consistent with Table 5.2. The economic changes experimented in Mexico during 1994 and 1995 explain this difference in result with respect to the entire period and the sub-period 1995-2001. In Chapter 3 these effects were explained in detail.

In summary, the empirical results of the univariate test and cross-section test are easy to summarize as follows: a) Except for 1992-1994, the cross-section test shows that the book-to-market value is consistently the most powerful for explaining the cross-section of average stock returns. It is similar to what was found by Fama and French (1992) but not in relation with Table 5.1 and 5.2. b) The size does not offer much hope for explaining the cross-section of average stock returns, but the positive signs in size slopes consistently reveals a converse evidence to the one found by Fama and French (1992) in the US stock market. c) The beta does not explain the

cross-section of average stock returns since it is only marginally consistent from 1992-1994.

In a nutshell, book-to-market value has more power to explain the average returns on Mexican Stock Market; size has a low power explaining the returns, which is converse form the average return, and the market beta is not consistent with CAPM.

5.2.3 JOINT TEST

In order to give more robustness to the low power to explain the cross-section return by size and to explain with more power the negative relation between book-to-market value and average return, a joint test is implemented in this section to examine the independent effect of each characteristic while controlling for the effects of the other.

In the joint test, the cross-section relation between average return and size and book-to-market value is tested with an average return matrix. This matrix is a simple picture of the two-dimensional variation in average returns that result when the two size deciles are each subdivided into two portfolios based on ranked values of book-to-market value for individual stocks.

The average return matrix gives more information and is more robust than the cross-section regressions showed in Table 5.3. Furthermore, it is more reliable than the univariate test presented in Table 5.1 and 5.2. Controlling for size, book-to-

market value capture strong variation in average returns, and controlling for book-to-market value, size effect capture strong variation in average returns.

The constructions of average return matrix showed in Table 5.4 are based in sorting the market size and book-to-market value, following the next methodology.

Given that the Mexican stock market is smaller than the US stock market, the number of portfolios created on the basis of size and book-to-market value were four with a minimum of 9 stocks in each portfolio. The portfolio formation process is similar to Fama and French (1992). In June of each year *t*, from 1987 to 2001, all individual stocks are ranked in size, breaking the stocks into two equally size groups, small firms (S) and big firms (B). After this, at the end of each December *t-1*, I sorted S and B groups by book-to-market value, breaking each two groups into two book-to-market groups, low (L) and high (H). Considering the intersections of two size groups and two book-to-market value groups, I constructed four equally weighed portfolios SL, SH, BL and BH. The SL portfolio includes firms in the small size group that are also in the low book-to-market value group. BH portfolio includes firms in the big size group that are also in the high book-to-market value group, and so on.

Table 5.4 shows the average excess returns for the entire period and sub-periods 1987-1994 and 1995-2001. In addition to these sub-periods, the sub-periods from January 1997 to May 1989 and form June 1989 to December 2001 were included in order to give more robustness to the joint test and more validity to the results obtained in the original sub-periods.

The stock portfolios in the entire sample produce a wide range of average excess returns, ranging from 0.21 to 0.64 per month. The portfolio behavior reveals by both, size and book-to-market value, an opposite evidence to the one found by Fama and French (1992) in the US stock market, but is consistent with the cross-section regression showed in Table 5.3. For example, the average excess returns have a positive relation with size. For the low book-to-market value portfolios, the returns increase from 0.34 to 0.64 and for the high book-to-market from 0.21 to 0.31, whereas the average excess returns have a negative relation with book-to-market value, for the small size portfolios the returns decrease from 0.34 to 0.21 and for the big size from 0.64 to 0.31.

TABLE 5.4
Average Excess Portfolio Returns Formed on the Basis of Size and Book-to-Market Value

In June of each year t (t= 1987 to 2001), all individual stocks are ranked by size, breaking the stocks into two equally sized groups, small firms (S) and big firms (B). After this, at the end of each December *t-1*, I sorted S and B groups by book-to-market value, breaking each two groups in two book-to-market groups, low (L) and high (H). Considering the intersections of two size groups and two book-to-market groups, I constructed four equally weighed portfolios SL, SH, BL and BH. This table presents the average excess portfolio returns and standard deviations for the entire period and four sub-periods, January 1987- December 1994, January 1995-December 2001 and January 1987 – May 1989, June 1990- December2001.

Size	Book-to-Market			
	Low	High	Low	High
	Means Excess Returns		Standard Deviations	
	Entire Sample: 1987 - 2001			
Small	0.34	0.21	9.56	7.29
Big	0.64	0.31	8.93	11.73
	Sub-period 1987 – 1994: Before Crisis 1994			
Small	2.11	2.37	11.84	8.56
Big	1.80	2.13	10.29	14.04
	Sub-Period 1995 - 2001: After Crisis 1994			
Small	-1.63	-2.20	5.52	4.48
Big	-0.65	-1.73	6.94	8.03
	Sub-Period 1987 – April 1989: Before Liberalization			
Small	3.83	4.05	21.56	15.35
Big	0.85	3.95	15.53	24.91
	Sub-Period May 1989 – 2001 After Liberalization			
Small	-0.25	-0.44	5.26	4.51
Big	0.53	-0.31	7.30	7.40

The behavior of average excess returns in the sub-periods gives evidence that the business conditions observed in the Mexican Stock Market are associated to the reverse behavior found in the entire period as much in cross-section regressions showed in Table 5.3 as in the average return matrix presented in Table 5.4.

The sub-periods before the financial liberalization and Mexican crisis show that the behavior of average excess returns are consistent with the evidence found by

Fama and French (1992) and different to those found in Table 5.3. The average excess returns decrease with increases in size and increase with increases in book-to-market value. As an example, before the Mexican crisis, when the size increases in the small book-to-market portfolios, the average excess returns decrease from 2.11 to 1.80 and in the high book-to-market portfolios decrease from 2.37 to 2.13. Nevertheless, when the book-to-market increases in the small size portfolios, the average excess returns increase form 2.11 to 2.37 and in the big size portfolios increase from 1.80 to 2.13.

Conversely, the behavior in average excess returns after the financial liberalization and the Mexican crisis is reversed, but in line with cross-section regressions that were carried out in Table 5.3. As an illustration, after the Mexican crisis, if the size increases, then average excess return increase from -1.63 to -0.65 and from -2.20 to -1.73 in low and high book-to-market value portfolios respectively. Nonetheless, if the book-to-market value increases, then average excess returns decrease from -1.63 to -2.20 and from -0.65 to -1.73 for the small and big size portfolios respectively. These size and book-to-market value effects have a similar behavior if the average excess returns before and after the financial liberalization is observed.

The contrasting behavior of average excess returns in two different business conditions is not a coincidence. Rather, it is as a consequence of rational time variation in expected returns such as business returns, investment opportunities and

risk aversion change through time, which causes small firms to tend to under perform during economic contraction or structural changes. This is how it behaves after the Mexican crisis and financial liberalization, but outperforms during periods of economic expansions, which is observed before the financial deregulation and Mexican crisis (Patro and Wald, 2001).

Table 5.4 also shows four portfolios in the entire periods and sub-periods which produce excess returns that show less than 1.645 errors from zero, due to stock returns that have high standard deviations that cause the portfolios not being reliably different from zero (Merton 1980). Nevertheless, it is not a problem since the risk factors will absorb most of the high volatility of stock returns, making the tests on the intercepts in the time-series regression quite precise.

In short, the outcome suggests that the results obtained in the univariant test are not conclusive, since it is not consistent with the cross-section test and joint test. Furthermore, this test is less formal that the other two tests. The results obtained in the joint test and cross-section test are more relevant and conclusive, since there are more formal test and in both cases, the results are the same. The size and book-to-market explain with a positive and negative sign respectively the cross-section of average stock returns, even when they are controlled for the effects of the other.

5.3. THE INTERACTION BETWEEN SIZE AND BOOK-TO-MARKET

The negative relationship between size and book-to-market value in the average return matrix is not just a coincidence. The average of the monthly correlation between the cross-sections of size and book-to-market for individual stocks is -0.423. The negative correlation is also apparent in the average values of size and book-to-market value as shown in Table 5.5, which was obtained from the portfolios sorted on size or book-to-market value in Table 5.1

TABLE 5.5
Average Size and Book-to-Market Value of Test Portfolios

For the entire period from 1987 to 2001, the portfolios are formed based on size and book-to-market. This table presents the average size and book-to-market for each portfolio. The numbers are expressed in logarithms.

	Low	High	Difference
	Panel A: Portfolios Formed on Size		
Size	19.54	25.75	6.22
	Panel B: Portfolios Formed on Book-to-Market Value		
Book-to-Market	0.4	2.3	1.9

The negative correlation between size and book-to-market value affects the regressions in Table 5.3. The average slope from the monthly regression of returns on size alone is 0.11, but when is included together with book-to-market value, the average slope is 0.03, smaller than when included alone. Similarly, including size in the regressions raises the average slope on book-to-market from –0.03 to –0.02.

Thus, part of the size effect in the simple regressions is due to the fact that small size stocks are more likely to have small book-to-market values and part of the simple book-to-market value effects is due to the fact that high book-to-market stocks tend to be small

The main results in section 5.2 and 5.3 are easy to summarize. It is true that we have to provide concrete evidence that size and book-to-market value better explain the cross-section returns than market beta in the Mexican Stock Market. However, the results do not give an economically satisfying answer. This economic explanation is part of the material for the next section, where the main objective is to give an answer to the next question that Fama and French (1992) proposed: What is the economic explanation for the roles of size and book-to-market equity in average returns?

5.4 ROLES OF SIZE AND BOOK-TO-MARKET VALUE IN AVERAGE RETURNS: ECONOMIC EXPLANATION

The test implemented in the last sections impose a rational asset-pricing framework on the relation between average return and size and book-to-market value, but they are not economically satisfying. Now, the purpose in this section is to give an economic explication for the average returns of size- book-to-market portfolios obtained in above section.

The technique employed by Fama and French (1993) is used to perform a time series analysis in order to examine whether the CAPM is the adequate model to give the economic explanation for the roles of size and book-to-market value in average returns or whether a Multi-Factor Pricing Model gives a better explication.

I analyzed the time series approach employed by Fama and French (1993) in three parts. First, the risk factors coefficients are used to explain whether the risk factors capture common variation in stock returns. Second, the intercept from the time series regressions is used to test whether the risk factors explain the cross-section variation in returns. Third, the sub-periods are used to validate whether the business conditions affect the explanation power of common and cross-sectional variation in excess returns.

In order to explain the common and cross-section variations of average stock return inside of size-book-to-market portfolio, in the first place, once more the CAPM developed by Sharpe and Lintner , the three-factor model and two-factor model proposed by Fama and French (1993) are tested in entire periods and sub-periods.

Model 1 Sharpe-Lintner CAPM: $R_{it} - R_{ft} = \alpha + \beta\, EMR_t + \epsilon t$
Model 2 Three Factor Model: $R_{it} - R_{ft} = \alpha + \beta EMR_t + \beta_s SMB_t + \beta_h HML_t + \epsilon_t$
Model 3 Two Factor Model: $R_{it} - R_{ft} = \alpha + \beta_s SMB_t + \beta_h HML_t + \epsilon_t$

Table 5.6 shows that the Sharp-Lintner CAPM captures the common variation in stock returns at a 99 percent level with t-statistic values above 15. However, the R^2 shows values between 0.57 to 0.78, which leaves some variations in stock returns still without explanation.

On the contrary, in the absence of competition from EMR, but including only the mimicking portfolios SMB and HML, these have little power to explain the common variations in excess returns. It is true that the coefficients are statistically different to zero at 99 percent levels. However, R^2 values are between 0.12 and 0.54 and are substantially lower than in the case when only EMR is included.

With regard to the three factor model, Table 5.6 shows that when EMR is included together with SMB and HML, each of the three risk factors captures more strongly the common variations in excess returns than when they are used individually. In all cases, the risk factors increase their t-statistics values and in view of those EMR slopes, they are more than 24 standard errors from zero, SMB are greater than 6 and HML are more than five standard errors from zero. These risk factors are statistically different from zero at the 99 percent level. In fact, adding SMB and HML in the Sharpe-Lintner CAPM results in large increases in R^2. When EMR is only included, the R^2 is between 0.57 to 0.78, whereas the three-factor regressions show greater R^2 values between 0.81 to 0.91.

TABLA 5.6
Regressions of Excess Portfolio Returns on the Excess Market Return, Size Mimicking Portfolio and Book-to-Market Mimicking Portfolio

I regressed for the entire period 1987-2001 the following time series regressions to estimate the coefficients α_i and β's for each of the four portfolios (SL, SH, BL and BH).

$$R_{it} - R_{ft} = a + bEMR_t + \epsilon_t$$
$$R_{it} - R_{ft} = a + sSMB_t + hHML_t + \epsilon_t$$
$$R_{it} - R_{ft} = a + bEMR_t + sSMB_t + hHML_t + \epsilon_t$$

$R_{it} - R_{ft}$ is the excess return in each of the four portfolios, EMR is the excess market portfolio, SMB (small minus big) the size mimicking portfolio is the difference of each month between the simple average of the percent returns on the three small-stock portfolios (SL, SM, SH) and the simple average of the returns on the three big-stock portfolios (BL, BM, BH). HML (high minus low) the book-to-market mimicking portfolio is the difference of each month between the simple average of the percent returns on the two high-BM portfolios (SH, BH) and the simple average of the returns on the two low-BM portfolios (SL and BL). This table shows for each regression the coefficients (β's), t-statistics values, R^2 and standard deviations s(e). * and ** indicate significance at 99 and 95 percent level respectively.

Size	Book-to-Market				Book-to-Market			
	Low	High	Low	High	Low	High	Low	High
	$R_{it}-R_{ft} = a+bEMR+ \epsilon_t$				$R_{it}-R_{ft} = a+bEMR+sSMB+hHML+ \epsilon_t$			
	b		t(b)		B		t(b)	
Small	1.03	0.71	20.27*	15.10*	1.15	0.87	24.70*	25.45*
Big	1.00	1.33	23.65*	24.64*	0.78	1.23	25.68*	28.22*
	R^2		s(e)		S		t(s)	
Small	0.70	0.57	5.26	4.84	0.46	0.45	6.55*	8.79*
Big	0.76	0.78	4.39	5.58	-0.69	-0.42	-14.98*	-6.42*
	$R_{it}-R_{ft} = a+sSMB+hHML+ \epsilon_t$				H		t(h)	
	s		t(s)		-0.31	0.52	-5.99*	13.94*
Small	-0.35	-0.16	-2.61*	-1.57*	-0.26	0.49	-7.84*	10.40*
Big	-1.23	-1.28	-13.83*	-9.30*	R^2		s(e)	
	h		t(h)		0.81	0.82	4.28	3.12
Small	-0.45	0.41	-4.19*	5.07*	0.91	0.89	2.78	3.97
Big	-0.36	0.34	-4.96*	3.02*				
	R^2		s(e)					
Small	0.12	0.15	9.12	6.82				
Big	0.54	0.37	6.11	9.43				

The three factor model shows that SMB clearly captures shared variation in stock returns that is not present in EMR and HML, whereas HML captures shared variation in stock returns not present in EMR and SMB. The slope on SMB, the mimicking return for the size factor, is systematically related to size, due to a monotonous decrease from smaller to bigger size, in the low book-to-market value decrease from 0.46 to –0.69 and in the high book-to-market from 0.45 to –0.42. Similarly, the slopes on HML, the mimicking return for the book-to-market factor, are systematically related to book-to-market, since the slopes increase monotonously from strong negative values to strong positive values. In the small size stocks, the HML slopes increase from –0.31 to 0.52 and in the big size stocks the slopes increase from –0.26 to 0.49.

So far, the regression slopes and R^2 values in Tables 5.6 establish that EMR, SMB and HML are risk factors that better capture the common variation in excess returns. We next test whether these risk factors explain the cross-section of average excess returns by focusing on the intercept estimates. If the pricing theory holds, the true intercepts must be equal to zero. We test this restriction in two ways. We examined the t-statistic values to test each individual intercept and used the Wald test statistic and Wald adjusted test statistic proposed by Gibbons, Ross and Shaken (GRS) (1989) to jointly test all the intercepts.

Table 5.7 presents the intercepts for the three models above. In the Sharpe-Lintner CAPM, all intercepts are positive and significant at the 99 percent confidence

level, which casts evidence that EMR does not suffice to explain the cross-section of average excess returns. This result shows that EMR is left without explaining the cross-section variation in average excess return that is related to size and book-to-market value, given that the intercepts present the size and book-to-market effect in a reverse form. The intercepts increase with size from 1.29 to 1.52 and 0.86 to 1.47 in the low and high book-to-market portfolios, respectively , whereas the intercepts decrease with book-to-market from 1.29 to 0.86 and 1.52 to 1.47 in the small and big size portfolios, respectively.

When only adding SMB and HML, the size and book-to-market value effects are absorbed and pushes the intercepts equal to zero. However, this is not sufficient evidence to explain the cross-section of average excess returns given that the R^2 values in Table 5.6 are relatively lower (0.12 to 0.54). With regard to the intercepts in the three factor model, they are positive, significant at the 99 percent level and show in a lesser level the reverse size and book-to-market value effect, given the signal that these model does not explain the cross-section variation in the average excess returns.

TABLA 5.7

Testing the Intercepts of Excess Portfolio Returns on Excess Market Return, Size Mimicking Portfolio and Book-to-Market Mimicking Portfolio

This table shows in Panel A the intercepts (α_i), t-statistics and Panel B shows the Wald statistic and GRS statistic tests, which were obtained from regressing for the entire period 1987-2001 the following time series regressions for each of the four portfolios (SL, SH, BL and BH). * and ** indicate significance at 99 and 95 percent level respectively.

$$R_{it} - R_{ft} = a + bEMR_t + \epsilon_t$$
$$R_{it} - R_{ft} = a + sSMB_t + hHML_t + \epsilon_t$$
$$R_{it} - R_{ft} = a + bEMR_t + sSMB_t + hHML_t + \epsilon_t$$

Size	Panel A				Panel B		
	Book-to-Market					Wald Test	GRS Statistic
	Low	High	Low	High			
	Intercept		t(a)				
	(i) $R_{it} - R_{ft} = a+bEMR+ \epsilon_t$						
Small	1.29	0.86	3.23*	2.33**			
Big	1.52	1.47	4.54*	3.46*	(i)	40.4*	9.8*
	(ii) $R_{it} - R_{ft} = a+sSMB+hHML+ \epsilon_t$						
Small	0.32	0.16	0.47	0.31	(ii)	0.4	0.1
Big	0.40	0.00	0.85	-0.01			
	(iii) $R_{it} - R_{ft} = a+bEMR+sSMB+hHML+ \epsilon_t$				(iii)	39.2*	9.5*
Small	1.51	1.06	4.63*	4.43*			
Big	1.20	1.26	5.65*	4.15*			

Table 5.7 shows also the Wald statistic and GRS statistic to test the hypothesis that all the intercepts produced by the risk factors are equal to zero. Sharpe-Lintner CAPM and the three factor model reject this hypothesis, while the model that included SMB and HML accept the hypothesis, given the evidence that explains the cross-section variations in the returns, but with a low power to explain the common variation in stock excess returns.

According to Table 5.6 and 5.7, the three risk factors model identified by Fama and French (1993), explain the common variations in stock returns of size-

book-to-market portfolios better than the other two models, but it is not sufficient to explain the cross-section variation of average excess returns.

As noted above, our results continue being consistent with Chapter 3 and 4, since again the CAPM, three-factor model and two-factor model are not adequate to explain the returns of the size-book-to-market portfolios, which goes in line when the portfolios were formed according to Beta. However, these results are important because it is evidence that in the Mexican Stock Market might possibly exist other risk factors to give an economic explication for the roles of size and book-to-market value in average returns.

In order to test these argument, I included five additional models to see whether there exists other risk factors that explain the common and cross-section variation. Model 4 will include the risk factors identified in Chapter 4 to explain the cross-section variation in excess returns when the portfolios are formed according to their betas and Models 5a, 5b, 6a and 6b will describe how default risk (DEF) absorbs the effect of the change of the exchange rate (EXM) and political risk (POLITIC) and how the change in exchange rate (EXM) absorbs the effect of default risk (DEF) and political risk (POLITIC)[11].

Model 4: $R_{it} - R_{ft} = \alpha + \beta\, EMR_t + \beta_d DEF_t + \beta_t TBILL_t$
Model 5a: $R_{it} - R_{ft} = \alpha + \beta\, EMR_t + \beta_s SMB_t + \beta_h HML_t + \beta_d DEF_t + \epsilon_t$
Model 5b: $R_{it} - R_{ft} = \alpha + \beta\, EMR_t + \beta_s SMB_t + \beta_h HML_t + \beta_e EXM_t + \beta_p POLITIC_t + \epsilon_t$
Model 6a: $R_{it} - R_{ft} = \alpha + \beta\, EMR_t + \beta_s SMB_t + \beta_h HML_t + \beta_e EXM_t + \epsilon_t$
Model 6b: $R_{it} - R_{ft} = \alpha + \beta\, EMR_t + \beta_s SMB_t + \beta_h HML_t + \beta_d DEF_t + \beta_p POLITIC_t + \epsilon_t$

[11] Different regressions were run taking into account all risk factors showed in Table 2.4 Panel B. The regressions that are not successful are not shown, but are available from the author on request

About Model 4, it is true that in Chapter 4 we identified that EMR, DEF and TBILLR better explain the cross-section variation in excess returns when the portfolios are formed according to their betas. However, the results showed in Table 5.8 test that these risk factors are not appropriate to explain the common and cross-section variations in returns when the portfolios are formed according to size and book-to-market value. Most of the risk factors coefficients are not significantly different to zero, except by EMR, where all coefficients are significant at a 99 percent level. Besides, some individual intercepts are not significantly equal to zero at a 95 percent level. The hypothesis that all the intercepts jointly are equal to zero at 95 percent level is not accepted with a Wald and GRS statistic value of 14.9 and 3.6 respectively.

TABLE 5.8
Regressions of Excess Portfolio Returns on the Excess Market Return, Default Risk and U.S. Interest Rate

I regress for the entire 1987-2001 period the following time series regression:

$$R_{it} - R_{ft} = a + bEMR_t + dDEF_t + tTBILLR_t + \epsilon_t$$

The coefficients α_i and β's were estimated for each of the four portfolios (SL, SH, BL and BH). $R_{it} - R_{ft}$ is the excess returns in each of the four portfolios, EMR is the excess market portfolio, DEF is the default risk calculated as the spread between commercial paper rate and one-month CETES rate, and TBILLR is the US real interest rate. This table shows in Panel A the coefficients (β's), t-statistics values, R^2 and standard deviations s(e). Panel B shows the intercepts (α_i), t-statistics values and Wald-GRS statistics values. * and ** indicate significance at 99 and 95 percent level respectively.

Size	Panel A				Panel B			
	Book-to-Market				Book-to-Market			
	Low	High	Low	High	Low	High	Low	High
	b		t(b)					
Small	1.02	0.69	19.61*	14.48*				
Big	1.02	1.34	23.90*	24.33*				
	d		t(s)		Intercept		t-statistic	
Small	-2.82	-1.18	-1.26	-0.58	2.03**	1.54	2.66*	2.20**
Big	-1.52	-2.03	-0.83	-0.86	1.01	1.32	1.63	1.64
	t		t(h)					
Small	-0.89	-2.56	-0.39	-1.22	Wald Test		14.9*	
Big	4.77	3.31	2.56**	1.37	GRS Statistic		3.6*	
	R^2		s(e)					
Small	0.71	0.57	5.27	4.84				
Big	0.77	0.78	4.31	5.56				

Regarding Models 5a and 6a, the results are not very different. Table 5.9 gives evidence that neither DEF nor EXM add value explaining the common variations of stock excess returns. The R^2 are the same as in Table 5.6 and the coefficients with t-statistic values between 0.58 and -1.86 are not all statistically different from zero at a 95 percent level. They do not also improve the explanation of cross-section variations, since all intercepts are statistically different to zero at the 99 percent level

and the Wald statistic and GRS statistic reject the fact that all coefficients are jointly equal to zero.

TABLA 5.9

Regressions of Excess Portfolio Returns on the Excess Market Return, Size Mimicking Portfolio, Book-to-Market Mimicking Portfolio, Default Risk and Exchange Rate

I regressed for the entire 1987-2001 period the following time series regressions to estimate the coefficients α_i and β's for each of the four portfolios (SL, SH, BL and BH).

Panel A: $R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+dDEF_t+ \epsilon_t$

Panel B: $R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+eEXM_t+ \epsilon_t$

$R_{it} - R_{ft}$ is the excess return in each of the four portfolios, EMR is the excess market portfolio, SMB (small minus big) the size mimicking portfolio is the difference for each month between the simple average of the percent returns on the three small-stock portfolios (SL, SM, SH) and the simple average of the returns on the three big-stock portfolios (BL, BM, BH). HML (high minus low) the book-to-market mimicking portfolio is the difference for each month between the simple average of the percent returns on the two high-BM portfolios (SH, BH) and the simple average of the returns on the two low-BM portfolios (SL and BL), DEF is the default risk calculated as the spread between commercial paper rate and one-month CETES rate and EXM is the monthly change in peso-dollar exchange rate. This table shows in Panel A and B for each regression the coefficients (β's), intercepts (αi), t-statistics values, R^2, standard deviations s(e), Wald statistic and GRS statistic tests. *, ** and *** indicate significance at 99, 95 and 90 percent level respectively.

Size	Panel A: $R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+dDEF_t+ \epsilon_t$				Panel B $R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+eEXM_t+ \epsilon_t$			
	Book-to-Market				Book-to-Market			
	Low	High	Low	High	Low	High	Low	High
	b		t(b)		b		t(b)	
Small	1.15	0.87	24.66*	25.45*	1.17	0.87	24.46*	24.77*
Big	0.78	1.22	25.58*	28.28*	0.79	1.23	25.51*	27.55*
	s		t(s)		s		t(s)	
Small	0.47	0.46	6.63*	8.89*	0.45	0.45	6.42*	8.69*
Big	-0.68	-0.42	-14.93*	-6.38*	-0.69	-0.43	-15.19*	-6.47*
	h		t(h)		h		t(h)	
Small	-0.30	0.52	-5.92*	14.08*	-0.30	0.52	-5.89*	13.92*
Big	-0.26	0.50	-7.77*	10.56*	-0.26	0.50	-7.75*	10.43*
	d		t(d)		e		t(e)	
Small	-2.55	-2.15	-1.43	-1.65***	0.11	0.03	1.64	0.58
Big	-1.16	-3.07	-0.99	-1.86***	0.08	0.05	1.83***	0.87
	R^2		s(e)		R^2		s(e)	
Small	0.81	0.82	4.27	3.11	0.81	0.82	4.26	3.13
Big	0.91	0.89	2.78	3.95	0.91	0.89	2.76	3.98
	Intercept		t-statistic		Intercept		t-statistic	
Small	2.04	1.50	4.14*	4.18*	1.39	1.03	4.18*	4.18*
Big	1.44	1.90	4.47*	4.15*	1.11	1.20	5.14*	3.85*
Wald Test	32.2*				33.1*			
GRS Statistic	7.8*				8.0*			

For the remainder of this section, the entire sample is divided in sub-periods to examine whether the results obtained in the risk factors coefficients are related to business conditions and whether they improve the explanation of the common and cross-sectional variation in stock returns.

First, in order to test the hypothesis that in the entire period there is no different business conditions, the chow breakpoint test is carried out in the three factor model and the two models that include DEF and EXM. I took as breakpoints the Mexican financial liberalization occurred in May 1989 and the economic and financial shock presented in December 1994. Table 5.10 shows the two statistics used for the chow breakpoint test, F-statistic and log likelihood ratio. In the three models before and after the start of the financial liberalization in May 1989, both statistics reject the null hypothesis of no different business conditions at a 99 percent level. If we test the same hypothesis before and after December 1994, the results are less consistent. The three factor model only rejects the hypothesis in one of four portfolios at a 99 percent level. In all portfolios, the model that includes DEF rejects the hypothesis of no different business condition at 90 or 99 percent level. The model that includes EXM only rejects the hypothesis in two of four portfolios at 90 and 99 percent level.

TABLE 5.10
Stability Test: Chow Breakpoint Test

This table shows two statistics for the Chow breakpoint test: F-statistic and Log likelihood ratio. The test is implemented for three different models and two breakpoints: May 1989 and January 1995

$R_{it}-R_{ft} = a+bEMR_t + \epsilon_t$

$R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+dDEF_t+ \epsilon_t$

$R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+eEXM_t+ \epsilon_t$

The idea of the breakpoint Chow test is to fit the equation separately for each sub-sample and to see whether there are significant differences in the estimated equations. A significant difference indicates a structural change in the relationship. Ho: No structural Changes Ha: Structural Changes. The test procedure is to reject the null hypothesis that there is no different business conditions. Namely, if Fc exceeds F* with k and n-2k df. The F* are: F-stat 10% (1.94) 5% (2.37) 1% (3.32) and Chi-Square: 10% (7.77) 5% (9.48) 1% (13.27). *, ** and *** indicate significance at 99, 95 and 90 percent level respectively

	May 1989				January 1995			
	SL	SH	BL	BH	SL	SH	BL	BH
$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t+ \epsilon_t$								
F-statistic	9.1*	8.4*	20.2*	26.5*	0.5	0.7	6.9	1.4
Log likelihood ratio	34.6*	32.2*	69.1*	86.0*	2.0	3.0	26.6*	5.6
$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t + dDEF_t + \epsilon_t$								
F- statistic	8.5*	8.0*	19.8*	23.2	2.9**	3.5*	7.9*	6.5*
Log likelihood ratio	40.1*	38.2*	82.3*	93.1	14.9*	17.8*	37.6*	31.5*
$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t + eEXM_t + \epsilon_t$								
F- statistic	7.1*	6.6*	18.2*	21.1*	2.9**	0.9	12.5*	1.4
Log likelihood ratio	34.0*	32.1*	76.8*	86.6*	15.0*	4.7	56.3*	7.2

Given the chow test result, in order to validate that the business conditions before and after of the economic and financial crisis and the Mexican economic opening experienced in 1994 does not influence the result in the three factor models, I tested these models in two different sub-periods before and after December 1994[12].

Table 5.11 shows the results. In both sub-periods, the coefficient of the three factor model explains the common variations, but the cross-section variations are not explained, since all individual intercepts and the intercepts jointly are not statistically equal to zero. These results indicate that this model does not improve the explanation

[12] I tested also these models before and after the financial liberalization started in May 1989. The results were very similar, and they are available from the author on request

of cross-section variations when tested by sub-periods, which coincides with the insignificance of different business conditions found in the chow test, conversely to the other two models.

TABLA 5.11
Regressions of Excess Portfolio Returns on the Excess Market Return, Size Mimicking Portfolio and Book-to-Market Mimicking Portfolio

I regressed for each sub-period (1987-1994, 1995-2001) the following time series regression:

$$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t + \epsilon_t$$

The coefficients α_i and β's were estimated for each of the four portfolios (SL, SH, BL and BH). $R_{it}-R_{ft}$ is the excess return in each of the four portfolios, EMR is the excess market portfolio, SMB (small minus big) the size mimicking portfolio is the difference for each month between the simple average of the percent returns on the three small-stock portfolios (SL, SM, SH) and the simple average of the returns on the three big-stock portfolios (BL, BM, BH). HML (high minus low) the book-to-market mimicking portfolio is the difference for each month between the simple average of the percent returns on the two high-BM portfolios (SH, BH) and the simple average of the returns on the two low-BM portfolios (SL and BL). This table shows for each sub-period the coefficients (β's), intercepts (α_i), t-statistics values, R^2, standard deviations s(e), Wald statistic and GRS statistic tests. * and ** indicate significance at 99 and 90 percent level respectively

Size	Before Financial and Economic Shock: 1987-1994				After Financial and Economic Shock: January 1995-2001			
	Book-to-Market				Book-to-Market			
	Low	High	Low	High	Low	High	Low	High
	b		t(b)		b		t(b)	
Small	1.15	0.85	16.37*	16.95*	1.11	0.87	19.82*	19.29*
Big	0.70	1.27	17.08*	19.59*	0.93	1.08	22.11*	21.76*
	s		t(s)		s		t(s)	
Small	0.49	0.44	4.19*	5.31*	0.36	0.43	5.62*	8.39*
Big	-0.79	-0.32	-11.63*	-2.96*	-0.56	-0.62	-11.71*	-10.97*
	h		t(h)		h		t(h)	
Small	-0.32	0.52	-4.21*	9.71*	-0.30	0.45	-4.81*	8.92*
Big	-0.30	0.53	-6.88*	7.65*	-0.29	0.41	-6.09*	7.38*
	R^2		s(e)		R^2		s(e)	
Small	0.79	0.79	5.52	3.96	0.86	0.86	2.14	1.73
Big	0.91	0.87	3.23	5.09	0.95	0.95	1.62	1.91
	Intercepts							
Small	1.83	1.38	3.16*	3.32*	0.98	0.61	3.28*	2.55*
Big	2.02	1.16	5.98*	2.17*	0.80	0.71	3.56*	2.67*
Wald Test	22.3*				11.0*			
GRS Statistic	5.3*				2.6**			

With regard to the models that contain EXM and DEF, where the chow test accepted the hypothesis that there exist different business conditions, they also are validated in the two sub-periods. Table 5.12 Panel A reports that for sub-period 1987-1994, the common variations and cross-section variations of average returns are better explained by EMR, SMB, HML and EXM. The signs are correct and the t-statistic values for the estimated coefficients of EMR, SMB, HML in all portfolios are significantly different from zero at a 99 percent level, while in two portfolios, the coefficients of EXM are significantly different from zero at a 99 percent level and the other two portfolios have a low significance at 90 percent level. For each individual intercept, the t-statistic allows only in two portfolios (SL and BH) to accept the hypothesis that individual intercepts are statistically equal to zero at a 95 percent confidence. However, with a Wald statistic value of 7.54 and GRS statistic value of 1.78, it allows to accept the hypothesis that all intercepts jointly are statistically equal to zero at a 87 percent level.

In contrast, for the sub-period from 1995-2001, the best risk factors that explain the common and cross-section variations of returns are EMR, SMB, HML and DEF. Table 5.12 Panel B presents that all coefficient signs are correct and significantly different from zero at the 99 or 95 percent level. Furthermore, for each individual intercept, the t-statistic values are between 1.36 and 0.01, which allows accepting the hypothesis that all intercepts are statistically equal to zero at a 95 percent level. It also confirms with the Wald statistic value of 0.84 and GRS statistic

value of 0.20 what allows to accept the hypothesis. Namely, that all intercepts jointly are statistically equal to zero at a 99 percent level.

TABLA 5.12
Regressions of Excess Portfolio Returns on the Excess Market Return, Size Mimicking Portfolio, Book-to-Market Mimicking Portfolio, Default Risk and Exchange Rate

I regress for each sub-period (1987-1994, 1995-2001) the following time series regressions to estimate the coefficients α_i and β's for each of the four portfolios (SL, SH, BL and BH).

$$R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+eEXM_t+\epsilon_t$$
$$R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+dDEF_t+\epsilon_t$$

$R_{it}-R_{ft}$ is the excess return in each of the four portfolios, EMR is the excess market portfolio, SMB (small minus big) the size mimicking portfolio is the difference for each month between the simple average of the percent returns on the three small-stock portfolios (SL, SM, SH) and the simple average of the returns on the three big-stock portfolios (BL, BM, BH). HML (high minus low) the book-to-market mimicking portfolio is the difference for each month between the simple average of the percent returns on the two high-BM portfolios (SH, BH) and the simple average of the returns on the two low-BM portfolios (SL and BL). DEF is the default risk calculated as the spread between commercial paper rate and one-month CETES rate and EXM is the monthly change in peso-dollar exchange rate. This table shows for each sub-period the coefficients (β's), intercepts (α_i), t-statistics values, R^2, standard deviations s(e), Wald statistic and GRS statistic tests. * and ** indicate significance at 99 and 90 percent level respectively.

	a	t(a)	b	t(b)	s	t(s)	h	t(h)	e	t(e)	R^2
						Panel A					
					$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t + eEXM_t + \epsilon_t$						
					Before Financial and Economic Shock: 1987- 1994						
SL	0.93	1.48	1.23	17.13*	0.49	4.38*	-0.28	-3.79*	0.66	3.09*	0.81
SH	1.13	2.42*	0.87	16.28*	0.44	5.32*	0.53	9.76*	0.18	1.61**	0.80
BL	1.25	3.66*	0.77	19.58*	-0.79	-13.01*	-0.27	-6.71*	0.57	4.84*	0.92
BH	0.84	1.39	1.30	18.77*	-0.32	-2.96*	0.54	7.74*	0.23	1.63**	0.87
Wald Test	7.54										
GRS test	1.78										
					After Financial and Economic Shock: 1995 - 2001						
SL	0.98	3.26*	1.12	18.71*	0.36	5.56*	-0.30	-4.76*	0.02	0.48	0.86
SH	0.61	2.53*	0.87	18.07*	0.43	8.32*	0.45	8.86*	0.00	0.14	0.86
BL	0.80	3.55*	0.94	20.82*	-0.56	-11.65*	-0.29	-6.03*	0.01	0.42	0.95
BH	0.71	2.66*	1.09	20.58*	-0.62	-10.94*	0.41	7.36*	0.02	0.59	0.95
Wald Test	11.58										
GRS test	2.72										

TABLA 5.12 – Continued

	a	t(a)	b	t(b)	s	t(s)	h	t(h)	d	t(d)	R^2
						Panel B					
					$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t + dDEF_t + + \epsilon_t$						
					Before Financial and Economic Shock: 1987- 1994						
SL	3.93	4.27*	1.15	16.99*	0.52	4.59*	-0.32	-4.45*	-9.59	-2.87*	0.81
SH	3.01	4.60*	0.85	17.74*	0.47	5.82*	0.52	10.09*	-7.47	-3.14*	0.81
BL	3.08	5.65*	0.70	17.52*	-0.78	-11.69*	-0.30	-7.13*	-4.82	-2.44**	0.91
BH	3.78	4.62*	1.27	21.14*	-0.28	-2.83*	0.52	8.16*	-11.95	-4.02*	0.89
Wald Test	36.63*										
GRS test	8.67*										
					After Financial and Economic Shock: 1995 – 2001						
SL	0.49	1.34	1.14	20.27*	0.38	6.00*	-0.33	-5.32*	2.76	2.23**	0.87
SH	0.18	0.62	0.90	19.90*	0.45	8.90*	0.42	8.34*	2.43	2.44**	0.87
BL	0.37	1.36	0.96	22.90*	-0.55	-11.70*	-0.32	-6.77*	2.44	2.64*	0.95
BH	0.01	0.03	1.13	23.78*	-0.60	-11.28*	0.36	6.83*	3.95	3.78*	0.96
Wald Test	0.84										
GRS test	0.20										

We have identified that DEF and EXM are important individually in different periods. However, both risks have influence in both periods, including the political risk (POLITIC). In order to test the relationship between DEF, EXM and POLITIC in different periods, we will explore how DEF absorbs the effect of EXM and POLITIC and how EXM absorbs the effect of DEF and POLITIC in each sub-period. Table 5.13 Panel A gives evidence that from 1987 to 1994, DEF and POLITIC are significantly different to zero at 99 percent level for the same period that EXM in Table 5.12. Apart from the correlation between these three risk factors presented in Table 5.14, it indicates that EXM has a higher correlation with DEF (-0.320) and POLITIC (-0.779), which is an indication that EXM absorbs the effect in the other two variables.

TABLA 5.13

Regressions of Excess Portfolio Returns on the Excess Market Return, Size Mimicking Portfolio, Book-to-Market Mimicking Portfolio, Default Risk, Exchange Rate and Political Risk

I regressed for each sub-period (1987-1994, 1995-2001) the following time series regressions to estimate the coefficients α_i and β's for each of the four portfolios (SL, SH, BL and BH).

$$R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+dDEF_t+ pPOLITIC_t + \epsilon_t$$

$$R_{it}-R_{ft} = a+bEMR_t+sSMB_t+hHML_t+eEXM_t+ pPOLITIC_t + \epsilon_t$$

$R_{it}-R_{ft}$ is the excess return in each of the four portfolios, EMR is the excess market portfolio, SMB (small minus big) the size mimicking portfolio is the difference for each month between the simple average of the percent returns on the three small-stock portfolios (SL, SM, SH) and the simple average of the returns on the three big-stock portfolios (BL, BM, BH). HML (high minus low) the book-to-market mimicking portfolio is the difference for each month between the simple average of the percent returns on the two high-B/M portfolios (SH, BH) and the simple average of the returns on the two low-B/M portfolios (SL and BL). DEF is the default risk calculated as the spread between commercial paper rate and one-month CETES rate and EXM is the monthly change in peso-dollar exchange rate. POLITIC is the monthly return spread between a dollar bond issued by the Mexican and U.S. government. This table shows for each sub-period the coefficients (β's), intercepts (α_i), t-statistics values, R^2, standard deviations s(e), Wald statistic and GRS statistic tests. *,** and *** indicate significance at 99, 95 and 90 percent level respectively

	a	t(a)	b	t(b)	S	t(s)	h	t(h)	d	t(d)	P	t(p)	R^2
						Panel A							
						$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t + dDEF_t + pPOLITIC_t + \epsilon_t$							
						Before Financial and Economic Shock: 1987 - 1994							
SL	3.51	3.71*	1.10	15.04*	0.51	4.56*	-0.37	-4.80*	-9.48	-2.86*	0.58	1.69***	0.81
SH	2.73	4.05*	0.82	15.74*	0.46	5.80*	0.48	8.77*	-7.38	-3.13*	0.39	1.61***	0.82
BL	3.40	6.15*	0.74	17.26*	-0.77	-11.83*	-0.27	-5.87*	-4.91	-2.53*	-0.43	-2.19**	0.92
BH	2.72	3.69*	1.14	20.05*	-0.30	-3.49*	0.40	6.55*	-11.65	-4.51*	1.44	5.41*	0.92
Wald Test	30.0*												
GRS test	5.6*												
						After Financial and Economic Shock: 1995 – 2001							
SL	0.36	0.93	1.12	18.83*	0.38	6.05*	-0.34	-5.39*	3.02	2.37*	0.05	0.89	0.87
SH	0.07	0.22	0.88	18.47*	0.45	8.96*	0.41	8.04*	2.66	2.61*	0.04	1.01	0.87
BL	0.29	1.01	0.95	21.33*	-0.54	-11.54*	-0.32	-6.77*	2.59	2.73*	0.03	0.73	0.95
BH	-0.18	-0.55	1.10	22.16*	-0.59	-11.20*	0.35	6.53*	4.34	4.08*	0.07	1.61*	0.96
Wald Test	0.19												
GRS test	0.04												

TABLA 5.13 - Continued

	a	t(a)	b	t(b)	s	t(s)	h	t(h)	e	t(e)	p	t(p)	R^2
						Panel B							
						$R_{it}-R_{ft} = a + bEMR_t + sSMB_t + hHML_t + eEXM_t + pPOLITIC_t + \epsilon_t$							
						Before Financial and Economic Shock: 1987- 1994							
SL	-3.16	-4.44*	1.13	19.91*	0.44	5.16*	-0.46	-7.54*	2.10	8.49*	3.08	7.82*	0.89
SH	-0.69	-1.08	0.83	16.24*	0.42	5.46*	0.45	8.19*	0.82	3.69*	1.38	3.88*	0.83
BL	0.52	1.04	0.75	18.98*	-0.80	-13.34*	-0.30	-7.07*	0.82	4.80*	0.55	2.02**	0.93
BH	-4.31	-8.84*	1.17	30.18*	-0.37	-6.31*	0.31	7.44*	2.05	12.08*	3.89	14.39*	0.96
Wald Test	13.69*												
GRS test	0.00												
						After Financial and Economic Shock: 1995 – 2001							
SL	0.03	0.08	1.08	18.79*	0.37	6.03*	-0.35	-5.70*	0.40	3.13*	0.57	3.11*	0.88
SH	0.10	0.78	0.85	17.70*	0.44	8.59*	0.42	8.10*	0.22	1.99**	0.31	2.03**	0.86
BL	0.35	1.07	0.92	20.42*	-0.56	-11.73*	-0.31	-6.43*	0.20	1.95**	0.27	1.91**	0.95
BH	-0.54	-1.60	1.05	22.26*	-0.61	-12.29*	0.34	6.69*	0.53	5.05*	0.76	5.06*	0.96
Wald Test	0.00												
GRS test	0.00												

In a similar manner, but in sub-periods from 1995 to 2001, Table 5.13 Panel B shows that EXM and POLITIC are significantly different to zero at a 99 or 90 percent level, such as DEF in Table 5.12 and the correlation calculated between these variables in Table 5.14. They indicate that DEF has a higher correlation with EXM (0.383) and POLITIC (0.248). Thus, it could confirm that DEF absorbs the effect included in EXM and POLITIC.

TABLE 5.14
Risk Factors Correlations: 1987-1994 and 1995-2001

This table presents the correlation coefficient. EMR is the excess market portfolio, SMB is the size mimicking portfolio, HML the book-to-market mimicking portfolio, DEF the default risk, EXM is the monthly change in peso-dollar exchange rate, POLITIC is the monthly return spread between a dollar bond issued by the Mexican and U.S. government and TERM is the interest rate term structures.

	EMR	SMB	HML	DEF	TERM	EXM	EMR	SMB	HML	DEF	TERM	EXM
	Before Financial and Economic Shock: 1987-1994						After Financial and Economic Shock: 1995-2001					
SMB	-0.455						-0.581					
HML	-0.115	-0.148					-0.004	0.006				
DEF	-0.053	0.109	-0.041				-0.199	0.014	0.236			
TERM	-0.080	0.023	-0.082	-0.212			-0.259	0.024	-0.192	0.069		
EXM	-0.373	0.205	-0.125	-0.320	0.532		-0.431	0.286	-0.033	0.383	0.431	
POLITIC	0.370	-0.210	0.315	-0.051	-0.456	-0.779	0.473	-0.318	0.101	-0.248	-0.452	-0.966

Finally, contrasting Table 5.12, 5.13 and 5.14 and considering the relationships between DEF, EXM and POLITIC, I can conclude that in the sub-period from 1987 to 1994, the Multi-Factor Pricing Model that includes the risk factors EMR, SMB, HML and EXM gives a better economic explication for the common and cross-section variation of average returns in size-book-to-market portfolios than EMR, SMB, HML, DEF and POLITIC, given that the signs are correct and significantly different to zero around 90 or 99 percent level. Moreover, it is true that Table 5.14 shows that EMR has a higher correlation with EXM (-0.373) than DEF (-0.053) and POLITIC (0.370). However, the correlation between EMR and EXM is a consequence of 1987. If this year would be excluded, the correlation is pushed down at 0.033 and only in 1997 the correlation would be 0.696.

In contrast, in the sub-period from 1995 to 2001, the Multi-Factor Pricing Model that includes the risk factors EMR, SMB, HML and DEF gives a better economic explication for the common and cross-section variation of average returns in size-book-to-market portfolios than EMR, SMB, HML, EXM and POLITIC, given that all signs in the coefficients are correct, significantly different to zero at a 99 or 90 percent level and the EMR has a lower correlation with DEF (0.199) than EXM (-0.431) and POLITIC (0.473).

5.5. CONCLUSIONS

The evidence presented in this chapter allows to accept hypothesis five, given that in the Mexican Stock Market the Multi-Factor Pricing Model has a better explanatory power of the cross-section relation between average return and the characteristics than the CAPM, which continue being consistent with what was found in Chapter 3 and 4. In fact, the evidence also confirms and gives more robustness for not accepting hypothesis two because the risk factor identified by Chen, Roll and Ross (1986) and Fama and French (1993) are not adequate to explain the average returns.

With regard to hypothesis seven, this is not accepted. I presented evidence that the average returns are explained by different risk factors in different time periods and portfolio ordering techniques. Chapter 4 gives evidence that the risk factors, excess market return (EMR), default risk (DEF) and U.S. interest rate (TBILLR)

better explain the cross-section variation in average returns when the portfolios are formed according to their betas. Nevertheless, in this chapter where the portfolios were formed according to size and book-to-market value, the average returns are not explained by these risk factors; in fact they change in different time periods.

In sub-period from 1987 to 1994, the risk factors excess market return (EMR), size mimicking portfolio (SMB), book-to-market mimicking portfolio (HML) and the change in exchange rate (EXM) give a better economic explication for the common and cross-section variation of average returns in size-book-to-market portfolios. In contrast, in sub-period from 1995 to 2001, the risk factors excess market return (EMR), size mimicking portfolio (SMB), book-to-market mimicking portfolio (HML) and default risk (DEF) give a better economic explication for these portfolios.

CHAPTER 6

CHARACTERISTIC MODEL

6.1. INTRODUCTION

So far, I have presented evidence against the CAPM, inclining in favor of the Multi-Factor Pricing Model to explain returns in the Mexican Stock Market, and evidence about how the size and book-to-market value better explain the cross-section returns than market beta in the Mexican Stock Market.

My analysis only has provided a risk explication. However, recently there has been a debate over whether the risk explanation is correct or whether a characteristic base explication is more appropriate. Some studies suggest caution in pursuing the risk explanation. Brennan, Chordia and Subrahmanyam (1998) show that the return predictability of many company-specific characteristics, including size and book-to-market value, persist even after returns are risk adjusted by the Fama and French three factor model. This implies that the Fama and French three factor model is not specified appropriately or that there are no risk related influences in stock returns. Hence, Daniel and Titman (1997) proposed a characteristic based explanation as alternatives to the risk explanation. They suggest that instead of a risk-return trade-off, average stock returns are related to certain company characteristics due to behavioral reasons. They argue that past research sometimes can not distinguish the

risk factor models from the characteristic model, questioning whether the return patterns of mimicking factor portfolios (i.e. SMB and HML) are, in fact, consistent with a factor model. They directly test whether the high returns of mimicking factor portfolios can be attributed to their factor loading or whether there are attributed to their characteristics.

To test the characteristic base explanation, Daniel and Titman (1997) formed two sorts of portfolios for the period from 1963 to 1993: 1) Characteristic balanced portfolios, which are zero-cost portfolios for which the long and short positions include stocks with similar book-to-market value and size, but are constructed to have high negative loadings on one of the three factors, HML, SMB or EMR. 2) Factor balanced portfolio, which have zero loadings on each of the three factors, but are tilted towards high book-to-market or small stocks. These portfolios are constructed by first forming a characteristic balanced portfolio, and adding long and short positions in the HML, SMB and EMR so as to set the factor loadings to zero. In all cases, they demonstrate that the characteristic balanced portfolios have returns close to zero. This implies that an asset's risk factor loading is not compensated by return and contradicts the Fama and French three factor model. Daniel and Titman (1997) reject the factor model for the U.S. stocks.

Davis, Fama, and French (2000) apply the Daniel and Titman (1997) approach, but in a more extended US sample period (1929–1997). The analysis confirmed similar results in the same sample period as Daniel and Titman (1997).

However, over the longer period the result favors the Fama and French three factor model. Their suggestion that Daniel and Titman (1997) results are specific to their sample period and over the extended sample period, the factor model provides a better explanation of the book-to-market effect in the US. To obtain further sample evidence, Daniel, Titman and Wei (2001) apply the Daniel and Titman tests to a Japanese sample over the 1975–1997 period. Tests on portfolios last sorted on HML loading clearly reject the three factor model. Daniel, Titman and Wei (2001) offer two reasons why not all tests are able to reject the factor model in favor of the characteristics model when the former is false. First, the characteristic attributed return needs to be high and not too variable in the sample period. Second, ex-ante factor loadings must be able to predict ex-post factor loadings and must not be too highly correlated with the level of characteristics.

The propose of this chapter is to test the following hypothesis and shed new evidence in the Mexican Stock Market about whether the variation of Mexican stock returns are explained by a risk or characteristic base explanation:

H_6: The Characteristic Model better explain the returns than the Multi-Factor Pricing Model in the Mexican Stock Market.

The remainder of this chapter is organized as follows: Section 6.2, explains the methodology I adopted to test the hypothesis. Section 6.3 presents the empirical results I adopted to test the hypothesis in three different models. Section 6.4 shows the conclusions when comparing our results with other similar studies.

6.2. METHODOLOGY: TESTING CHARACTERISTIC VERSUS FACTOR MODEL

Daniel and Titman (1997) suggest that the way to distinguish between risk and characteristics explanation is to identify stocks of equivalent characteristics but with differing factor loadings. I implemented this by building characteristic and factor balanced portfolios based on the intersections of groups of stocks sorted independently on book-to-market value, size, and ex-ante factor loadings estimated before the portfolio construction. These portfolios post-construction return patterns allow us to determine if the factor explanation or its characteristic alternative better explains the size and book-to-market premiums.

The Characteristic-Balance (CB) Portfolios are zero-cost portfolios for which the long and short positions include stocks with similar book-to-market value and size, but are constructed to have large loadings on one of five risk factors selected, excess market return (EMR), size mimicking portfolio (SMB), book-to-market mimicking portfolio (HML), change in exchange rate (EXM) and default risk (DEF).

Following Daniel and Titman (1997) the CB portfolios are built from the intersection of triple independent sorts on size, book-to-market value and the ex-ante factor loadings on each of the five factors: EMR, SMB, HML, DEF and EXM. The steps to build these portfolios are: First, the ex-ante factor loading is estimated by applying in an independent way the Fama and French three factor model and by

applying our two four-factor model to the return of each stock using between 7 and 42 monthly returns before the end of December of year t-1. I did not use the month –6 to 0 observation to estimate these loadings because the factor portfolios are formed based on stock prices existing 6 months previously.

Second, in June of each year *t*, all individual stocks are ranked in size, breaking the stocks into two equally sized group, small firms (S) and big firms (B). After this, at the end of each December *t-1*, I sort S and B groups by book-to-market, breaking each two groups in three book-to-market groups, low (L), medium (M) and high (H). Considering the intersections of two size groups and three book-to-market groups, I constructed six equally weighed portfolios SL, SM, SH, BL, BM and BH (2 x3). Finally, each of these six portfolios is subdivided into two portfolios based on a selected ex-ante factor loading (EMR, SMB, HML, DEF or EXM) to obtain 12 equally value-weighed portfolios triple sorted ($2 \times 3 \times 2$) by size, book-to-market value and ex-ante loadings, SL1, SL2, SM1, SM2, SH1, SH2, BL1, BL2, BM1, BM2, BH1 and BH2. Each of the six groups is subdivided into two portfolios based on perforation loadings, because the number of stocks is not large. The resulting set of portfolios consists of stocks with approximately the same size and book-to-market value but with different ex-ante factor loadings. For example, the SL1 portfolio includes firms in the small size group that are also in the low book-to-market group, but with low ex-ante loadings. The SL2 portfolio includes firms in the small size

group that are also in the low book-to-market group, but with high ex-ante factor loading, and so on.

Third, to obtain the CB portfolios, six zero-investment portfolios are built with long positions in high ex-ante factor loading stocks and short positions in low ex-ante factor loading stocks, but with similar level of size and book-to-market value on both long and short sides. Within each of the six combinations of book-to-market and size characteristics (SL, SM, SH, BL, BM, BH), I obtain a spread in return between the highest and lowest ex-ante factor loading within each six characteristic combination (e.g. SL2SL1=SL2-SL1), to obtain six CB portfolios expected returns, SL2SL1, SM2SM1, SH2SH1, BL2BL1, BM2BM1, BH2BH1. Additionally to these portfolios, a combined characteristic-balance portfolio expected return is built which is the average return across the book-to-market value and size portfolios, [(SL2SL1+ SM2SM1+SH2SH1+BL2BL1+BM2BM1+BH2BH1)/6]

With regard to Factor-Balance (FB) Portfolios, they are portfolios which have zero loadings on each of the three factors, but are tilted towards high book-to-market value or small stocks. The FB portfolio expected return are built regressing the seven CB portfolio returns on the Fama and French three factor model and on our two four-factor model. The intercepts in each model represent the expected returns of the FB portfolio, since it corresponds to buying the combined CB portfolio and selling the zero investment factor-mimicking portfolios in quantities given by their estimated regression coefficients.

After forming the CB and FB portfolios the hypothesis is formally tested, analyzing the expected returns obtained in both portfolios. Since the test involves simply testing whether the expected return of both portfolio is different from zero, the power of their tests is based only on the expected t-statistic under the alternative hypothesis.

The Multi-Factor Pricing Model implies that the expected returns on the CB portfolios should have positive average returns, because these portfolios are designed to have a high loading on one of the risk factors; but that the FB portfolios should average zero, since they have zero factor loadings[13].

In contrast, the Characteristic Model implies that the expected returns on the CB portfolios should have zero average returns because these portfolios are long and short asset with approximately equal characteristics; but that the FB portfolios should average negative since factor risk is not rewarded and the intercept estimate the return to a portfolio balanced on factors but short on characteristics.

6.3 EMPIRICAL RESULTS

This section presents the empirical results obtained from implementing the technique employed by Daniel and Titman (1997) in two models found in Chapter 5, which gives the better economic risk explication for the common and cross-section

[13] The intercept represent the returns of a portfolio that is factor-balanced, we will sometimes refer to the intercepts as the mean return on factor-balance portfolios

variation of average returns in size- book-to-market portfolios, as well as in the three factor model provided by Fama and French (1993). These regressions are:

$$Rit\text{-}Rft = \alpha + \beta EMR + \beta s\ SMB_t + \beta s\ HML_t + \epsilon_t \qquad 1987\text{-}2001 \qquad (6.1)$$

$$Rit\text{-}Rft = \alpha + \beta\ EMR_t + \beta s\ SMB_t + \beta h\ HML_t + \beta e\ EXR_t + \epsilon_t \qquad 1987\text{-}1994 \qquad (6.2)$$

$$Rit\text{-}Rft = \alpha + \beta\ EMRt + \beta s\ SMBt + \beta h\ HMLt + \beta d\ DEFt + \epsilon t \qquad 1995\text{-}2001 \qquad (6.3)$$

6.3.1 FAMA AND FRENCH THREE FACTOR MODEL.

Table 6.1 shows descriptive results for CB and FB portfolios formed with size, book-to-market and the HML factor loading sorts. Panel A shows the average ex-ante HML loading for each portfolio. Notice the steady increase of ex-ante HML loading from low to high portfolio. The wide split in value between ex-ante HML loadings of the lowest and highest portfolio implies that the CB portfolios I constructed have long positions in stocks with extremely high past exposure to the HML risk factor relative to the short positions.

TABLE 6.1
Mean Monthly Returns, Ex-Ante Betas, Ex-Post Betas, and Ex-Post Intercept for 12 Portfolios Formed on the Basis of Size, Book-to-Market and HML Factor Loading

Twelve equally-weighed portfolios are constructed as the intersection of stocks independently sorted on size, book-to-market value, and HML factor loading (2x3x2). The HML factor loading is the ex-ante βh factor loading which is estimated from the following Fama-French three factor time series regression, using between 7 and 45 monthly returns before December t-1.

$$R_{it}-R_{ft} = \alpha + \beta\, EMR + \beta s\, SMB + \beta h\, HML + \epsilon_t$$

Panel A reports the ex-ante βh factor loading in each of 12 portfolios over the period 1987–2001. Panel B reports the means monthly equally-weighed excess return form each of 12 portfolios. Panel C and D report the intercept and ex-post βh factor loading from 12 portfolios returns on Fama-French time series regression. SZ =1 include stocks with lowest size, and SZ =2 are with higher size. BM=1 include stocks with lowest book-to-market, BM=2 with medium, and BM=3 with higher. FLP=Low include stocks with lowest factor loading portfolio, and FLP (Factor Loading Portfolio) = High with higher factor loading portfolio. For example, SZ=1, BM=1 and FLP=Low, is a portfolio that includes stocks with lowest size, lowest book-to-market, and lowest factor loading portfolio. Average is the average across book-to-market and size portfolios within HML loading portfolio.

		Panel A: Ex-ante βh		Panel B: Mean Excess Return (%)	
Portfolio		FLP		FLP	
SZ	BM	Low	High	Low	High
1	1	-0.70	0.88	-2.70	-2.49
1	2	-0.40	0.58	-0.59	-2.13
1	3	-0.57	1.07	-0.39	-0.57
2	1	-0.62	0.34	-1.45	-1.45
2	2	-0.77	0.46	-0.65	-1.42
2	3	-0.41	2.88	-0.89	-0.93
Average		-0.58	1.04	-1.11	-1.50
		Panel C: Ex-post βh		Panel D: Ex-post Intercept	
Portfolio		FLP		FLP	
SZ	BM	Low	High	Low	High
1	1	-0.76	-0.65	-0.51	0.35
1	2	0.08	0.06	0.68	-0.91
1	3	0.67	0.45	0.23	-0.11
2	1	-0.44	-0.31	0.16	-0.15
2	2	0.11	-0.05	0.13	-0.09
2	3	0.22	0.49	0.26	-0.13
Average		-0.02	0.00	0.15	-0.18

Panel B shows that the mean excess returns of portfolios do not consistently increase from the low to high ex-ante HML loading in any of the book-to-market and size combinations. This indicates that stocks with high covariance with HML in the past are not rewarded by higher return in the future even before risk adjustment.

Panel C shows ex-post HML loadings for the portfolios of book-to-market and size combinations obtained by running a Fama and French (1993) three-factor model regression on the constructed portfolios' ex-post returns. The last row shows a slow increase of average ex-post HML loading from low to high portfolio (-0.02 vs 0.0), corresponding to the ex-ante ranking. Consistent with Daniel and Titman (1997) and Daniel, Titman and Wei (2001), this implies that ex-ante HML loadings do generally predict ex-post HML loadings. Along with the evidence in Panel B, this implies that the ex-post HML loading's relation with return is weak even before risk adjustment. This gives direct evidence against the factor explanation, which predicts that exposure to factor risk should be rewarded by return.

Table 6.2 presents the result for CB and FB portfolio. The first column reports the mean excess return of the CB portfolio and the other columns report the regression results of seven CB portfolio returns on the Fama and French three factor model and their t-statistic, where the intercept represents the means excess returns of the FB portfolios. The last row shows the combined CB portfolio, which is the average of all CB portfolios of different book-to-market and size combinations.

TABLE 6.2
Mean Monthly Returns and Regression Results from the Characteristic Balanced Portfolios Three Factor Model - HML Factor Loading Sorted Portfolios

This table presents for sample period 1987-2001, the mean monthly returns, the coefficients estimated and t-statistics from the following time-series regression of 6 characteristic-balance portfolios returns on the excess market, SMB and HML portfolio returns:

$$R_{sz,bm,fl}-R_{ft} = \alpha + \beta\, EMR + \beta s\, SMB + \beta h\, HML + \epsilon_t$$

$R_{sz,bm,fl}-R_{ft}$ are the nine characteristic-balance portfolios. These nine portfolios are constructed as: First, twelve equally-weighed portfolios are constructed as the intersection of stocks independently sorted on book-to-market value, size and HML factor loading (2x3x2). The HML factor loading is the ex-ante βh factor loading which is estimated from the Fama-French time series regression, using between 7 and 45 monthly returns before December t-1, and second, from these 12 portfolios 6 characteristic-balance portfolios were constructed having a long position in the portfolio with high pre-formation factor loading and a short position in the portfolio with low pre-formation factor loading. Mean is the means returns of this nine characteristic-balance portfolio, and combined are the average return across book-to-market and size portfolios within HML loading portfolio. The first column is the CB portfolio average return and the intercept is the FB portfolio average returns. * denotes significance at 95 percent level, and ** denotes significance at 90 percent levels.

Portfolio		Characteristic-Balance Portfolio					t-statistics				
SZ	BM	Mean	a	β	βs	βh	Mean	a	β	βs	Bh
1	1	0.21	0.85	0.56	0.22	0.10	0.24	1.17	3.02*	1.19	0.55
1	2	-1.53	-1.59	-0.08	0.12	-0.02	-2.38*	-2.93*	-0.61	0.90	-0.11
1	3	0.47	-0.34	-0.31	-0.14	-0.23	0.70	-0.50	-1.82*	-0.84	-1.30
2	1	0.00	-0.32	-0.11	-0.06	0.13	0.00	-0.65	-0.93	-0.45	1.06
2	2	-0.78	-0.21	0.24	0.22	-0.16	-0.78	-0.38	1.69*	1.58**	-1.12
2	3	-0.05	-0.39	0.00	-0.06	0.27	-0.05	-0.85	0.02	-0.48	2.28*
Combined		-0.39	-0.33	0.05	0.05	0.02	-0.61	-1.37**	0.77	0.86	0.26

The factor model predicts that the mean excess return of the combined CB portfolio should be positive and the FB portfolio predicts that intercept of the regression should be zero. The characteristics model predicts that the mean excess return of the combined CB portfolio should be zero and the FB portfolio predicts that the intercept should be negative. The actual result shows that the combined CB portfolio has an insignificantly negative mean excess return -0.39, t-stat = -0.61, and an intercept that is negative and marginally significant at 90 percent level -0.33, t-stat

= -1.37, thus supporting the characteristics model. Finally, the ex-post HML loading of the combined CB portfolio is positive, but not significant (0.02, t-stat = 0.26). Although is not significant, this could indicate that the low combined CB portfolio means excess return is not due to failure to obtain a wide spread in ex-post HML loading but is more likely due to the limited relation between ex-post HML loading and return. Hence, the overall conclusion is not to reject the hypothesis that the Characteristic Model has a better explanatory power of returns than the Multi-Factor Pricing Model in the Mexican Stock Market.

In other way, I also constructed a set of CB and FB portfolios in the same manner described above, but rather than using the pre-formation HML factor loading, I considered SMB and EMR factor loadings. Table 6.3 provides the means average returns of the CB portfolios and the coefficients and t-statistics for the regression of the six CB portfolio returns on the three factors; where the intercept again represents the means excess returns of the FB portfolios.

TABLE 6.3
Mean Monthly Returns and Regression Results from the Characteristic Balanced Portfolios Three Factor Model - SMB Factor Loading Sorted Portfolios

The set of CB and FB portfolios presented in this table were obtained in the same manner described in Table 6.2, but rather than using the pre-formation HML factor loading, I considered the pre-formation SMB factor loadings. * denotes significance at 95 percent level, and ** denotes significance at 90 percent levels. The sample period is from 1987 to 2001

Portfolio		Characteristic-Balance Portfolio					t-statistics				
SZ	BM	Mean	a	β	βs	βh	Mean	a	β	βs	βh
1	1	-0.80	-0.63	0.17	0.22	0.09	-0.94	-0.87	0.90	1.19	0.46
1	2	0.00	-0.90	-0.59	-0.53	0.00	-0.01	-1.63**	-4.21*	-3.82*	0.02
1	3	0.52	0.53	0.07	-0.06	0.05	0.82	0.94	0.47	-0.41	0.34
2	1	-1.22	-0.98	-0.21	0.63	-0.28	-1.28**	-1.99	-1.70*	5.05*	-2.25*
2	2	-0.81	-1.06	-0.18	0.16	0.05	-0.81	-1.73	-1.13	1.04	0.34
2	3	0.23	-0.46	-0.29	0.08	0.27	0.24	-0.83	-2.05*	0.57	1.95*
Combined		-0.35	-0.58	-0.17	0.08	0.03	-0.54	-2.42*	-2.83*	1.37**	0.51

The conclusions are, for SMB factor loading sorted, I will not reject the hypothesis that the Characteristic Model has a better explanatory power of returns than the Multi-Factor Pricing Model in the Mexican Stock Market. The CB portfolio average return is –0.35 with a t-statistic that is statistically equal to zero (t-stat = -0.54), which is identical to what is predicted by the characteristic model. This result is more evident if the FB portfolio average returns (intercept) is analyzed. The Characteristic Model suggests that the intercepts should be negative, the results show an intercept of -0.58 statistically significant at 95 percent level (t-stat = -2.42). Thus again, I do not reject the hypothesis in favor of the Characteristic Model.

The results presented in Table 6.4 are the same, except I used the EMR loadings. In contrast to the book-to-market and size premiums, here I can not produce a conclusive discrimination between the Factor Model and Characteristic Model.

When the CB portfolio average return is analyzed, it is statistically equal to zero (t-stat = -0.73), identical to what was predicted by the characteristic model. However, the FB portfolio average returns proxy by intercept is positive (0.10) and statistically different to zero (t-stat = 0.37), which is not similar to the predicted, neither Factor Model nor Characteristic Model.

TABLE 6.4
Mean Monthly Returns and Regression Results From the Characteristic Balanced Portfolios Three Factor Model - EMR Factor Loading Sorted Portfolios

The set of CB and FB portfolios presented in this table were obtained in the same manner described in Table 6.2, but rather than using the pre-formation HML factor loading, I considered the pre-formation EMR factor loadings. * denotes significance at 95 percent level, and ** denotes significance at 90 percent levels. The sample period is from 1987 to 2001

Portfolio		Characteristic-Balance Portfolio					t-statistics				
SZ	BM	Mean	a	β	βs	βh	Mean	a	β	βs	βh
1	1	0.08	1.80	0.93	0.21	-0.38	0.09	2.24*	4.58*	1.02	-1.86*
1	2	-1.16	-0.77	0.37	-0.05	0.06	-1.81*	-1.52**	2.89*	-0.39	0.47
1	3	-0.79	-0.49	0.05	-0.19	-0.23	-1.18	-0.75	0.29	-1.14	-1.39**
2	1	-0.32	-0.37	0.16	-0.28	0.16	-0.33	-0.64	1.11	-1.94*	1.07
2	2	-0.39	0.25	0.55	-0.03	0.05	-0.38	0.46	4.07*	-0.23	0.37
2	3	-0.32	0.19	0.49	-0.18	0.07	-0.32	0.34	3.52*	-1.30**	0.47
Combined		-0.48	0.10	0.43	-0.09	-0.05	-0.73	0.37	6.27*	-1.27	-0.68

6.3.2 FOUR FACTOR MODEL: EMR, SMB, HML, EXM

In Chapter 5 it was found that from 1987 to 1994 the risk factors EMR, SMB, HML and EXM give a better economic explanation for the common and cross-section variation of average returns in size- book-to-market portfolios. I applied this model the same methodology used in the Fama and French three factor model in order to identify whether the returns are better explained by this Multi-Factor Pricing Model

that includes four risk factors or whether the returns are better explained by a Characteristic Model

Table 16.5 present results for CB and FB portfolios formed with size, book-to-market value, and HML factor loading sort. Panel A reports the average ex-ante HML loading to each portfolio. Again we see a steady increase of ex-ante HML loading from the lowest to the highest portfolio, indicating that we have obtained a wide spread in factor loadings in each size and book-to-market value combination. Panels B and C again show that ex-ante factor loading does not predict mean excess return well in spite of its good prediction of ex-post factor loading.

TABLE 6.5
Mean Monthly Returns, Ex-Ante Betas, Ex-Post Betas, and Ex-Post Intercept for 12 Portfolios Formed on the Basis of Size, Book-to-Market, Exchange Rate and HML Factor Loading

Twelve equally-weighed portfolios are constructed as the intersection of stocks independently sorted on size, book-to-market value, and HML factor loading (2x3x2). The HML factor loading is the ex-ante βh factor loading, which is estimated from the following four factor time series regression, using between 7 and 45 monthly returns before December t-1

$$R_{it}\text{-}RF_{ft} = \alpha + \beta\, EMR_t + \beta s\, SMB_t + \beta h\, HML_t + \beta e\, EXM_t + \epsilon_t$$

Panel A reports the ex-ante βh factor loading in each of 12 portfolios over the sample period 1987–1994. Panel B reports the means monthly equally-weighed excess return form each of 12 portfolios. Panel C and D report the intercept and ex-post βh factor loading from 12 portfolios returns on four factor time series regression. SZ =1 include stocks with lowest size, and SZ =2 are with higher size. BM=1 include stocks with lowest book-to-market, BM=2 with medium, and BM=3 with higher. FLP=Low include stocks with lowest factor loading portfolio, and FLP (Factor Loading Portfolio)=High with higher factor loading portfolio. For example, SZ=1, BM=1 and FLP=Low, is a portfolio that includes stocks with lowest size, lowest book-to-market, and lowest factor loading portfolio. Average is the average across book-to-market and size portfolios within HML loading portfolio.

		Panel A: Ex-ante βh		Panel B: Mean Excess Return (%)	
Portfolio		FLP		FLP	
SZ	BM	Low	High	Low	High
1	1	-0.76	0.41	-0.61	-0.26
1	2	-0.75	0.84	1.31	-0.40
1	3	-0.50	0.84	1.42	0.80
2	1	-0.71	0.40	0.29	-0.52
2	2	-1.16	0.64	1.19	0.09
2	3	-0.59	0.61	0.14	1.42
Average		-0.74	0.62	0.62	0.19
		Panel C: Ex-post βh		Panel D: Ex-post Intercept	
Portfolio		FLP		FLP	
SZ	BM	Low	High	Low	High
1	1	-0.52	-0.69	-1.42	0.06
1	2	-0.04	-0.18	1.18	-0.77
1	3	0.77	0.48	-0.08	0.24
2	1	-0.66	-0.29	1.80	-0.66
2	2	0.28	-0.08	-0.32	-0.68
2	3	0.12	0.54	0.29	0.07
Average		-0.01	-0.04	0.23	-0.28

This is evidence against the factor explanation is due to the fact that it implies that portfolios exposed to higher HML risk are not automatically compensated by

higher return. However, when I test this evidence more formally with the CB and FB portfolio, I can not discriminate between the Factor or Characteristic Model. Table 6.6 proves this further by showing that the combined CB portfolio average return is -0.44 with a t-statistic that is statistically equally to zero (-0.46), which is identical to what is predicted by the Characteristic Model. Nevertheless, if we see the FB portfolio average returns (intercept), the intercept is statistically equal to zero (t-stat = -0.97) supporting the Characteristic Model. Hence, we can not produce a conclusive contest between the Factor Model and the Characteristic Model.

TABLE 6.6
Mean Monthly Returns and Regression Results from the Characteristic Balanced Portfolios
Four Factor Model - HML factor loading sorted portfolios

This table presents for sample period 1987-1994 the mean monthly returns and the coefficients estimated and t-statistics from the following time-series regression of 6 characteristic-balance portfolio returns on the excess market, SMB portfolio, HML portfolio and EXM:

$$R_{sz,bm,fl}-R_{ft}= \alpha + \beta\, EMR_t + \beta s\, SMB_t + \beta h\, HML_t + \beta e\, EXM_t + \epsilon t$$

$R_{sz,bm,fl}$-RF_t are the nine characteristic-balance portfolios. These nine portfolios are constructed as follows: First, twelve equally-weighed portfolios are constructed as the intersection of stocks independently sorted on book-to - market value, size and HML factor loading (2x3x2). The HML factor loading is the ex-ante βh factor loading which is estimated from the four factor time series regression, using between 7 and 45 monthly returns before December t-1, and second, from these 12 portfolios were constructed 6 characteristic-balance portfolios having a long position in the portfolio with high pre-formation factor loading and a short position in the portfolio with low pre-formation factor loading. Mean is the means returns of these nine characteristic-balance portfolio, and combined is the average return across book-to-market and size portfolios within HML loading portfolio. The first column are the CB portfolio average return and the intercept are the FB portfolio average returns. * denotes significance at)5 percent level, and ** denotes significance at 90 percent levels.

Portfolio		Characteristic-Balance Portfolio						t-statistics					
SZ	BM	Mean	a	β	βs	βh	βe	Mean	a	β	βs	βh	βe
1	1	0.35	1.48	1.02	0.51	-0.17	-7.05	0.35	1.19	3.08*	1.63*	-0.72	-1.74*
1	2	-1.71	-1.95	-0.27	-0.20	-0.14	2.52	-1.67*	-1.68*	-0.86	-0.68	-0.63	0.66
1	3	1.50	-0.56	0.93	0.58	0.42	4.80	1.17	-0.27	1.67*	1.12	1.04	0.71
2	1	-0.81	-2.45	0.00	-0.28	0.37	5.86	-0.52	-2.41*	-0.02	-1.08	1.88*	1.76*
2	2	-1.10	-0.36	-0.16	0.04	-0.35	-1.34	-0.64	-0.25	-0.41	0.12	-1.26	-0.28
2	3	1.28	-0.21	-0.06	-0.51	0.42	5.20	0.81	-0.18	-0.20	-1.73*	1.83*	1.35**
Combined		-0.44	-0.53	-0.12	-0.25	-0.03	0.97	-0.46	-0.97	-0.81	-1.83*	-0.26	0.54

Table 6.7 replicates this analysis on CB and FB portfolios sorted by SMB, EMR and EXM factor loadings. The results do not change, I can not discriminate between a Factor Model or Characteristic Model. For the SMB factor loading sorted, it reveals that the means return on the CB portfolio is zero (t-stat = -0.04), identical to what is predicted by the Characteristic Model. However, the mean return of the FB portfolio (intercept) is 0.59 with a t-statistic of –1.31, which is not similar to the predicted, neither by the Factor Model nor the Characteristic Model. Panel B and C show the results for the portfolios sorted by EMR and EXM respectively. The results are the same. The mean return on the CB portfolios is in favor of the Characteristic model, and the mean return on the FB portfolios is in favor of the Factor Model.

TABLE 6.7
Mean Monthly Returns and Regression Results from the Characteristic Balanced Portfolios Four Factor Model - SMB, EMR, EXR factor loading sorted portfolios

The set of CB and FB portfolios presented in this table were obtained in the same manner as described in Table 6.6, but rather than using the pre-formation HML factor loading, I considered in Panel A the pre-formation SMB factor loadings, Panel B the pre-formation EMR factor loadings and Panel C the pre-formation EXR factor loadings. The sample period spans from 1987 to 1994. * denotes significance at 95 percent level, and ** denotes significance at 90 percent levels.

Panel A: SMB factor loading sorted portfolios

Portfolio		Characteristic-Balance Portfolio						t-statistics					
SZ	BM	Mean	a	β	Bs	βh	ße	Mean	a	β	βs	βh	ße
1	1	-0.30	0.91	-0.87	-0.36	0.47	-5.42	-0.29	0.61	-2.21	-0.97	1.62**	-1.12
1	2	0.09	0.78	-0.04	-0.17	-0.03	-2.84	0.08	0.71	-0.14	-0.61	-0.15	-0.79
1	3	-1.18	-0.07	-0.20	-0.02	-0.72	-1.10	-1.05	-0.05	-0.50	-0.06	-2.41*	-0.22
2	1	-1.37	1.40	0.28	1.23	-0.40	-11.99	-0.84	1.27	0.94	4.42*	-1.86*	-3.31*
2	2	0.06	2.66	0.08	0.64	0.16	-13.11	0.03	1.77*	0.20	1.70*	0.55	-2.68*
2	3	-0.78	-2.04	-0.93	-0.80	0.42	6.37	-0.51	-2.05*	-3.48*	-3.18*	2.19*	1.95*
Combined		-0.04	0.59	-0.27	0.01	0.25	-3.36	-0.04	1.31	-2.23*	0.09	2.82*	-2.29*

Panel B: EMR factor loading sorted portfolios

Portfolio		Characteristic-Balance Portfolio						t-statistics					
SZ	BM	Mean	a	β	Bs	βh	ße	Mean	a	β	βs	βh	ße
1	1	1.33	0.95	0.62	0.08	0.22	-0.87	1.26	0.62	1.54**	0.21	0.74	-0.17
1	2	-0.41	-1.70	0.11	-0.22	0.14	5.02	-0.40	-1.59**	0.39	-0.83	0.70	1.44*
1	3	1.11	0.09	0.40	0.68	0.97	-1.28	0.92	0.05	0.89	1.62	2.99*	-0.23
2	1	-0.73	-0.29	0.73	0.44	0.10	-4.45	-0.45	-0.20	1.82*	1.16	0.33	-0.91
2	2	1.14	1.98	0.43	0.15	0.23	-6.07	0.67	1.64*	1.34**	0.50	0.97	-1.54*
2	3	-1.29	-1.66	-0.17	-0.47	0.06	2.08	-0.83	-1.35**	-0.51	-1.52**	0.23	0.52
Combined		-0.03	-0.18	0.17	-0.20	-0.02	0.47	-0.03	-0.30	1.07	-1.30**	-0.13	0.24

Panel C: EXR factor loading sorted portfolios

Portfolio		Characteristic-Balance Portfolio						t-statistics					
SZ	BM	Mean	a	β	βs	βh	ße	Mean	a	β	βs	βh	ße
1	1	-0.81	1.01	-0.20	-0.17	0.27	-8.99	-0.78	0.66	-0.49	-0.43	0.91	-1.80*
1	2	1.13	-0.67	0.10	-0.25	0.20	7.09	1.08	-0.57	0.32	-0.86	0.87	1.85*
1	3	-1.29	-1.58	0.49	0.97	0.60	-3.23	-1.16	-1.18	1.36*	2.88*	2.29*	-0.73
2	1	0.64	1.22	-0.43	-0.65	0.14	-1.93	0.40	0.93	-1.22	-1.98*	0.56	-0.45
2	2	0.76	-0.86	0.19	-0.15	-0.06	7.25	0.45	-0.74	0.61	-0.50	-0.25	1.90*
2	3	-0.64	0.22	0.31	0.60	-0.09	-4.55	-0.40	0.14	0.77	1.57**	-0.30	-0.91
Combined		0.27	0.45	-0.04	-0.20	-0.04	-0.40	0.29	0.78	-0.28	-1.36**	-0.36	-0.21

6.3.3 FOUR FACTOR MODEL: EMR, SMB, HML, DEF

In the sub-period from 1995 to 2001 EMR, SMB, HML and DEF were identified as better factors to explain the common and cross-section variation in stock returns. Here we used this model, to build again the CB and FB portfolios to discriminate between the Factor Model and Characteristic Model. Table 6.8 from Panel A to D shows the results for CB and FB portfolios sorted by HML, SMB, EMR, DEF factors loading respectively. Again, our results are not consistent in favor of one model. The mean return on the CB portfolios are in favor of the Characteristic Model, and the mean return on the FB portfolios are in favor of the factor model.

TABLE 6.8
Characteristic and Factor Balance Portfolios Returns
Four Factor Model - EMR, HML, SMB and DEF factor loading sorted portfolios

This table presents for sample period 1995-2001 the mean monthly returns, intercept estimated and t-statistics from the following time-series regression of 6 characteristic-balance portfolios returns on the excess market, SMB portfolio, HML portfolio and DEF:

$$R_{sz,bm,fl}-R_{ft} = \alpha + \beta\, EMR_t + \beta s\, SMB_t + \beta h\, HML_t + \beta d\, DEF_t + \epsilon t$$

$R_{sz,bm,fl}-R_{ft}$ are the nine characteristic-balance portfolios. These nine portfolios are constructed as follows: Panel A, B, C and D present the CB and FB portfolios when EMR, HML, SMB and DEF are used as factor loading to build the portfolios. If I selected the DEF factor loading, first, twelve equally-weighed portfolios are constructed as the intersection of stocks independently sorted on book-to-market value, size and DEF factor loading (2x3x2). The DEF factor loading is the ex-ante βd factor loading which is estimated from the four factor time series regression, using between 7 and 45 monthly returns before December t-1. Second, from these 12 portfolios 6 characteristic-balance portfolios were constructed having a long position in the portfolio with high pre-formation factor loading and a short position in the portfolio with low pre-formation factor loading. Mean is the means returns of these nine characteristic-balance portfolio, and combined are the average return across book-to-market and size portfolios within DEF loading portfolio. These steps are repeated for each factor loading selected. The first two columns are the CB portfolio average return and the second two columns are the FB portfolio average returns (intercept). * denotes significance at 95 percent level, and ** denotes significance at 90 percent levels.

Panel A: HML factor loading portfolios						Panel B: SMB factor loading portfolios			
Portfolio		CB Portfolio		FB Portfolio		CB Portfolio		FB Portfolio	
SZ	BM	Mean	t-stat	a	t-stat	Mean	t-stat	a	t-stat
1	1	0.73	0.64	1.74	1.46**	-0.88	-0.77	0.06	0.05
1	2	-0.66	-0.83	0.00	0.00	0.12	0.15	-1.57	-1.56**
1	3	-0.15	-0.19	0.27	0.27	-0.07	-0.09	-0.58	-0.67
2	1	-0.35	-0.30	0.66	0.88	-0.77	-0.65	-0.07	-0.08
2	2	-0.67	-0.56	0.61	0.74	-0.90	-0.74	0.36	0.40
2	3	-0.39	-0.33	-0.84	-1.06	0.67	0.55	-0.10	-0.11
Combined		-0.20	-0.25	0.32	0.89	-0.28	-0.35	-0.12	-0.31
Panel C: EMR factor loading portfolios						Panel D: DEF factor loading portfolios			
Portfolio		CB Portfolio		FB Portfolio		CB Portfolio		FB Portfolio	
SZ	BM	Mean	t-stat	a	t-stat	Mean	t-stat	a	t-stat
1	1	-0.20	-0.16	1.02	0.73	0.73	0.62	1.00	0.81
1	2	-0.60	-0.75	-1.98	-2.23**	-0.19	-0.24	0.61	0.68
1	3	1.00	1.32**	0.64	0.70	0.67	0.83	0.29	0.28
2	1	0.10	0.09	1.26	1.37**	0.42	0.37	0.88	0.99
2	2	-1.22	-0.99	0.01	0.02	0.49	0.41	0.53	0.67
2	3	-0.36	-0.30	0.50	0.55	0.28	0.23	-0.19	-0.20
Combined		-0.55	-0.67	0.03	0.07	0.18	0.22	0.42	0.94

6.4 CONCLUSIONS

In this section I compare the empirical findings in Daniel and Titman (1997), Davis, Fama and French (1999), Daniel, Titman and Wei (2001) and Lee, Liu and Strong (2001) against my own research under a common methodology.

The first column of Table 6.9 reports the results of Daniel and Titman (1997) on a US sample from July 1973 to December 1993. In the case of FB portfolios for market premium, SMB, and HML, they favor the characteristics model.

In the second column the result obtained by Davis, Fama and French (2000) is presented. They apply the same test to a longer US sample, July 1929 to June 1997. Here the FB portfolio pertaining to book-to-market value shows an insignificant return. Hence, they favor a risk explanation and claim that the characteristic model found by Daniel and Titman (1997) is sample specific. Nevertheless, the CB portfolio based on book-to-market value yields an insignificant return, indicating that their test lacks power within their sample to differentiate the effects of characteristics and covariance on the value premium. They do not report findings for portfolios last sorted on SMB loadings. Thus, it is unclear whether the size effect over their complete sample period is due to characteristics or risk explanation. Finally, for the excess market return, their results reject the risk explanation since the relevant FB portfolio yields significant returns over the complete sample period. Hence, the results of Davis, Fama and French (2001) do not completely rescue the covariance risk explanation.

The third column gives the results of Daniel, Titman and Wei (2001) applied to Japan. These results clearly show that the book-to-market value in Japan is due to characteristics explanation rather than factor explanation. For the excess market return and size, their test has insufficient power to discriminate between the characteristic and factor model. The four column shows the results of Lee, Liu and Strong (2001) on the UK stock market. They show that the size premium is attributed to the characteristic, but the tests lacks power in the case of the book-to-market value and excess market return

Finally, my results are shown in the last three columns. It is important to mention that these results are obtained from an emerging economy, Mexican Stock Market; and the other results were obtained from stock markets well-developed with a very active trade.

I first tested the Fama and French three factor model from 1987 to 2001. In the case of CB portfolios for market premium, SMB, and HML, the results are in favor of Characteristics Model and in the case of FB portfolios, except by market premium where we can not discriminate between Characteristic and Factor Model, SMB and HML are in favor of the Characteristic Model, results very similar as those obtained by Daniel and Titman (1997). In contrast, we apply this methodology in my two four Factor Model in two different periods. Here, results are not consistent in the CB and FB portfolios. In both models, the test with CB portfolios are in favor of the characteristic model and when is tested with FB portfolios the factor model is correct.

Hence, it is not possible to discriminate between a characteristic or factor explanation.

TABLE 6.9
Comparison of Empirical Findings across Independent Studies

The table shows a summary of the Characteristic-Balanced (CB) portfolios and the Factor-Balanced (FB) portfolios of four independent studies (including my dissertation) applying a similar methodology: the multi-dimensionally sorted portfolio approach of Daniel and Titman (1997, 1998). BM x SZ x SMB indicates a CB portfolio last sorted on SMB loadings, and so on. In all cases, the abnormal returns on the FB portfolios are estimated as the intercepts of ex-post Fama and French model regressions of corresponding CB portfolios. C: evidence supporting characteristics explanation. The t-statistics are presented below of the data.

		Independent Studies						
Author:		Daniel and Titman (1997)	Davis, Fama and French (2000)	Daniel, Titman and Wei (2001)	Lee, Liu and Strong (2001)	My Dissertation Mexican Stock Market		
Country:		US	US	Japan	UK	Mexico		
Period:		Jul 73 to Dec 93	Jul 29 to Jun 97	Oct 75 to Dec 97	Jul 1977 to Jun 00	Jul 87 to Dec 01	Jul 87 to Dec 94	Jan 95 to Dec 94
Number of Portfolios:		3x3x5=45	33333=27	3x3x5=45	2x2x5=20	2x3x2=12	2x3x2=12	2x3x2=12
BMxSZxSMB	CB			0.015	-0.10	-0.35	-0.28	-0.04
				0.12	-0.54	-0.54	-0.35	-0.04
	FB	-0.258		-0.148	-0.30	-0.58	-0.12	0.59
		-1.68		-1.37	-2.07	-2.42	-0.31	1.37
BMxSZxHML	CB		0.12	0.183	-0.03	-0.39	-0.2	-0.44
			1.56	1.23	-0.20	-0.61	-0.25	-0.46
	FB	-0.354	-1.06	-0.205	-0.20	-0.33	0.32	-0.53
		-2.23	-0.83	-1.80	-1.22	-1.37	0.89	-0.97
BMxSZxEMR	CB			0.165	0.09	-0.48	-0.55	-0.03
				1.11	0.45	-0.73	-0.67	-0.03
	FB	-0.474	-0.22	0.083	-0.20	0.10	0.03	-0.18
		-2.19	-2.32	0.62	-1.42	0.37	0.07	-0.30
BMxSZxEXR	CB						0.18	
							0.22	
	FB						0.42	
							0.94	
BMxSZxDEF	CB							0.27
								0.29
	FB							0.45
								0.78

Since the models do not favor one model, I suggest three possible explications to these results. 1) The number of assets. Daniel, Titman and Wei (2000) argue that because the tests to discriminate between Factor or Characteristic Model involve simply testing whether the average return of FB and CB portfolios is different from zero, the power of this tests is based only on the t-statistic, which depends on three variables: first, the standard errors of the average returns of the CB or FB portfolios, second, the ability to form CB portfolios with high and low factor loadings, and third, the expected return of the characteristic sorted portfolio. Variables 1 and 2 are influenced by the number of assets, larger portfolios are generally more diversified and thus have lower return variance, whereas small portfolios are less diversified with higher returns variance. Thus, it will be impossible to form well-diversified portfolios with very few stocks. The last variable, expected return of the characteristic sorted portfolio, requires asset where there is a strong book-to-market effect. 2) Sample Period. Davis, Fama and French (2000) show that more extended sample periods will produce more powerful tests of the Characteristic Model against the factor model. Their argument is that the sample size helps to increase the power since the spreads in the characteristic and risk factors could be more obvious.

3) Sorting out sort[14]. Berk (1998) explains how Daniel and Titman (1997) sorting stocks into test portfolios, in combination with poorly designed tests, can lead to incorrect discrimination between Characteristic or Factor Models. He gives two

[14] I implemented these argument. In all case the results are in favor to Factor Model. These results are not presented here.

arguments. First, if stocks are sorted into groups with similar book-to-market value, there may be little variation in the true factor loadings or in the expected returns. Hence, a second sort on estimated loadings might divide stocks into groups according to a measurement error, and might thus produce no variation in average returns or in true factor loadings. Second, he shows that a regression of average returns on the measured loadings would suffer from an errors-in-variables problem that would bias the coefficients on the measured loadings downward, which could, in turn, lead to a false rejection of the factor model.

Finally, the evidence presented in this chapter is not sufficient to test hypothesis six stating that the Characteristic Model has a better explanatory power of returns than the Multi-Factor Pricing Model in the Mexican Stock Market. However, even though the evidence can not discriminate between these models, these are potentially important. There is a new area of research in the Mexican Stock Market and specially to test whether the number of asset sample, sample period and sorting out are arguments in favor or against our results, or whether there are other arguments to identify the correct model for the Mexican Stock Market.

CHAPTER 7

GENERAL CONCLUSIONS AND FUTURE LINES OF RESEARCH

The main objective in this dissertation was to propose an Asset Pricing Model that identifies the risk factors that explain the returns in the Mexican Stock Market. This represents an important contribution because it gives new evidence to learn more about the behavior of the returns in the Mexican Stock Market. Furthermore, it provides to foreign and local investors, new elements to identify attractive investments and allows portfolio managers to make better analyses in order to choose the optimal degree of risk exposure.

To fulfill this objective, I tested the three main asset pricing models developed in the financial literature. The Sharpe-Lintner and Blacks versions of the CAPM, the Multi-Factor Pricing Model that includes risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993) in the US stock market and other risk factors more representative of the Mexican stock market, and the Characteristic Model proposed by Daniel and Titman (1997).

The methodologies adopted were the time series and cross-section regression approach of Black, Jensen and Scholes (1972), the cross-section regression approach of Fama and MacBeth (1973) and the characteristic methodology developed by Daniel and Titman (1997). The portfolio ordering techniques were two, according to the stock market betas and based on sort on market size and book-to-market values. The analysis covered a time period from 1987 to 2001, divided in four sub-periods.

From 1987 to 1994 and 1995 to 2001 evaluating the economic and financial shock which took place in 1994 and the effect that the Mexican market becomes more open since 1994. From 1987 to 1989 and 1990 to 2001 to evaluate the impact of the Mexican financial liberalization.

Our results are easy to summarize and give answer to my hypotheses. The first hypothesis says that the CAPM is the right model to explain the Mexican Stock Market returns from 1987 to 2001. The evidence presented suggests that the first hypothesis is rejected. The Sharpe-Lintner and Black versions of the CAPM were regressed against ten portfolios grouped according to their market betas and against four portfolios grouped according to size and book-to-market value, in all cases the time series and cross-section variations in returns are not explained by excess market returns.

The second hypothesis states that the risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993) in the US Stock Market are adequate to explain stock market returns in the Mexican Stock Market. Our result give evidence to reject this hypothesis, given that the risk factors identify by Chen, Roll and Ross (1987) and Fama and French (1993) do not affect the Mexican stock market returns in the manner described by these authors.

The third hypothesis states that risk factors identified by Chen, Roll and Ross (1986) and Fama and French (1993), international and political factors are also a source of risk to explain returns in the Mexican Stock Market. This hypothesis is not

rejected because the evidence found shows that if international and political risk factors, such as US real interest rate (TBILLR), exchange rate (EXM) and political risk (POLITIC) are included together with the Fama and French (1993) and Chen, Roll and Ross (1986) risk factors, such as excess market return (EMR), size mimicking portfolio (SMB), book-to-market mimicking portfolio (HML) and default risk (DEF), the Mexican Stock Market returns are explained in a better way.

Hypothesis four mentions that the risk factors that explain cross-section returns are the same that explain time series portfolio returns and hypothesis seven sustains that in the Mexican Stock Market, local and international risk factor betas are stable under different business conditions and different portfolio ordering techniques. The evidence presented rejects these hypotheses.

I found that the excess market return (EMR), default risk (DEF) and US real interest rate (TBILLR), better explain the cross-section variations in stock returns when the portfolios are formed according to their market betas; and the excess market return (EMR), size mimicking portfolio (SMB), book-to-market mimicking portfolio (HML), default risk (DEF), exchange rate (EXM) and political risk (POLITIC) better explain the times series variations in stock returns when the portfolios are formed according to the market size and book-to-market value.

Furthermore, I give evidence that sustains that there exists a difference in the sensibility of risk factors according to business conditions. From 1987 to 1994, the excess market return (EMR), size mimicking portfolio (SMB), book-to-market

mimicking portfolio (HML) and exchange rate (EXM) give a better economic explication for the common and cross-section variation of average returns, and from 1995 to 2001 the excess market return (EMR), size mimicking portfolio (SMB), book-to-market mimicking portfolio (HML) and default risk (DEF) give a better economic explication.

The fifth hypothesis says that in the Mexican Stock Market, the Multi-Factor Pricing Model better explains the cross-section relation between average return and the characteristics than the CAPM. I presented evidence that allowed to accept the hypothesis. The size and book-to-market value better explain the cross-section returns than market betas in the Mexican Stock Market. In fact, these returns can be explained with a Multi-Factor Pricing Model that includes the excess market return (EMR), size mimicking portfolio (SMB), book-to-market mimicking portfolio (HML), default risk (DEF), exchange rate (EXM) and political risk (POLITIC) as risk factors.

Moreover, the evidence presented was not sufficient to accept or reject hypothesis six that the Characteristic Model better explains the returns than the Multi-Factor Pricing Model in the Mexican Stock Market.

In summary, the results found in the present dissertation give answer to each hypothesis and it fulfilled the overall objective. However, some evidence provides new areas of further research.

I give evidence that the Multi-Factor Pricing Model gives a better explanatory power of the cross-section average returns in the Mexican Stock Market and there exists a difference in the sensibility of risk factors according to business conditions. A future line of research could be to expand the set of asset returns to be explained, such as including corporate and government bond returns. It is important to test, because new evidence about the integration of the Mexican Stock Market can be obtained. If the Mexican Stock Market is an integrated market , the Multi-Factor Pricing Model should also explain bond returns.

The present dissertation provided evidence for not accepting the CAPM. An interesting analysis could be to evaluate if the results are influenced by the sensitivity of other anomalies, such as earning to price value, debt to equity value, past return effect and January effect.

Another line of research is not just included in the market beta or characteristic-based factors such as size and book-to-market to evaluate the CAPM, the Multi-Factor Model and the Characteristic Model. To consider the industry characteristics could be important since the market beta, size and book-to-market are highly correlated within the industries.

Finally, the evidence presented was not sufficient to discriminate between a Factor Model or Characteristic Model. More investigation about this topic is important. We suggest looking for evidence about the role that the number of assets in each portfolio would have, test if more extended sample periods produce more

powerful tests of the Characteristic Model against the Factor Model, and evaluate the influence that Berk's (2000) critique could have on Daniel and Titman's Methodology. They suggest that an asset pricing model's explanatory power is reduced if it is tested within individual portfolios constructed by sorting stocks based on return predicting variables.

Appendix A

TABLA A.1
Survey Papers: Macroeconomic, Financial Market and Characteristic Risk Factors.

This table shows the most important articles that relate the stock returns with different risk factors. I identified three different kinds of common risk factors used in the literature. Panel A presents the macroeconomic risk factors, Panel B presents the financial market risk factor, and Panel C shows the characteristic risk factors.

Panel A: Macroeconomic Risk Factors	
Inflation	Bodie (1976), Beenstock and Chan (1988)[1], Clare and Thomas (1994)[1], Flannery and Protopapadakis (1999)
Unexpected inflation	Fama (1981), Geske and Roll (1983), Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Burmeister, Roll and Ross (1994), He and Ng (1994), Priestley (1996)[1]
Expected inflation	Fama (1981), Geske and Roll (1983), Chen, Roll and Ross (1986), Chan, Chen and Hsieh (1985), He and Ng (1994), Priestley (1996)[1]
Producer price index	Beenstock and Chan (1988) [1], Flannery and Protopapadakis (1999)
Industrial production	Fama (1981), Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Beenstock and Chan (1988)[1], Schwert (1989), Chen (1991), Clare and Thomas (1994)[1], Beenstock and Chan (1988)[1]
Gross Domestic Production	Beenstock and Chan (1988)[1], Chen (1991), Burmeister, Roll and Ross (1994), Flannery and Protopapadakis (1999)
Industrial stoppages	Beenstock and Chan (1988)[1]
Construction spending	Flannery and Protopapadakis (1999)
New home sales and housing starts	Flannery and Protopapadakis (1999)
Unemployment	Geske and Roll (1983), Clare and Thomas (1994)[1], Flannery and Protopapadakis (1999)
Employment	Clare and Thomas (1994)[1], Flannery and Protopapadakis (1999)
Money supply	Fama (1981), Pearce and Roley (1983), Beenstock and Chan (1988)[1], Priestley (1996)[1], Flannery and Protopapadakis (1999)
Expected money stock.	Pearce and Roley (1983)
Personal income	Flannery and Protopapadakis (1999)
Personal consumption	Chen, Roll and Ross (1986), Chen (1991), Flannery and Protopapadakis (1999)
Consumer credit	Flannery and Protopapadakis (1999)
Retail sales	Beenstock and Chan (1988)[1], Clare and Thomas (1994)[1], Flannery and Protopapadakis (1999), Priestley (1996)[1]
Exchange rate	Clare and Thomas (1994)[1], Priestley (1996)[1]
Balance of trade	Flannery and Protopapadakis (1999)
Current account	Clare and Thomas (1994)[1]
Relative export price	Beenstock and Chan (1988)[1]
Export index	Beenstock and Chan (1988)[1]
Gold price	Clare and Thomas (1994)[1]
Oil price	Chen, Roll and Ross (1986), Clare and Thomas (1994)[1], Priestley (1996)[1]
Federal government tax	Geske and Roll (1983)
Leading indicators	Flannery and Protopapadakis (1999)

[1] International Research: UK Stock Market.

TABLA A.1 - Continued
Survey Papers: Macroeconomic, Financial Market and Characteristic Risk Factors.

Panel B: Financial Market Risk Factors	
Treasury-bill rate	Bodie (1976), Fama (1981), Geske and Roll (1983), Beenstock and Chan (1988)[1] Chen (1991), Clare and Thomas (1994)[1], Hodrick, Tat-Chee Ng and Sengmueller (1999)[3]
Long government bonds	Clare and Thomas (1994)[1]
Short government bonds	Clare and Thomas (1994) [1]
Excess return: Return market portfolio less Tbill	Fama and French (1993), Fama and French (1996)
Term Structure	Hodrick, Ng and Sengmueller (1999)[3], Burmeister, Roll and Ross (1994), Schwert (1989), Chen (1991), Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Fama and French (1989), Fama and French (1993), Clare and Thomas (1994)[1], He and Ng (1994), Priestley (1996)[1]
Default Risk	Fama and French (1993), Burmeister, Roll and Ross (1994), Fama and French (1989), Chen (1991), Schwert (1989), Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Clare and Thomas (1994), He and Ng (1994), Priestley (1996)[1]
Standard and Poor Index	Burmeister, Roll and Ross (1994)
Value and equally weighted market portfolios	Clare and Thomas (1994), Priestley (1996)[1], Brennan, Chordia and Subrahmanyam (1998), Hodrick, Ng and Sengmueller (1999)[3], Chan, Chen and Hsieh (1985), Chen, Roll and Ross (1986), Chen (1991)
Size mimicking portfolio	Fama and French (1993), Fama and French (1996)
Book-to-market mimicking portfolio	Fama and French (1993), Fama and French (1996)

Panel C: Characteristic Risk Factors	
Book-to-market	Brennan, Chordia and Subrahmanyam (1998), Fama and French (1998)[2]
Cash flow to price	Fama and French (1998)[2]
Corporate earnings	Geske and Roll (1983)
Dividend earnings	Hodrick, Ng and Sengmueller (1999)[3]
Dividend yield	Schwert (1989), Fama and French (1989), Chen (1991), Brennan, Chordia and Subrahmanyam (1998), Fama and French (1998)[2], Hodrick, Ng and Sengmueller (1999)[3]
Dollar trading volume	Brennan, Chordia and Subrahmanyam (1998)
Earning to price	Fama and French (1998)[2]
Consolidate yield / dividends	Clare and Thomas (1994)[1]
Debenture	Clare and Thomas (1994)[1]
Private sector bank lending	Clare and Thomas (1994)[1]
Return on capital.	Fama (1981)
Ratio of capital expenditures	Fama (1981)

[1] International Research: UK Stock Market
[2] International Research: US and 12 countries from Europe, Australia, Far East [3] International Research: G7

Appendix B

TABLA B.1
Relevant Political Events

This is the list of relevant political events taken into account to construct the dummy political event variable.

Presidential Elections	Price Stabilization Plans
	December 1987
July 1988	December 1988
August 1994	May 1990
July 2000	November 1990
	November 1991
	September 1992

Insurrections and Guerrillas	
January 1994	Chiapas uprising.
March 1994	Presidential candidate Luis Donaldo Colosio assassinated
June 1994	Resignation of the secretary of interior
September 1994	Murder of PRI's national leader
October 1994	Deputy attorney general accused of conspiracy
November 1994	Intensified instability in Chiapas
February 1995	Intensified instability in Chiapas
June 1995	Intensified instability in Chiapas
June 1996	The EPR emerges in Guerrero
August 1996	Guerrilla attack in Oaxaca brings about political uncertainty.
October 1996	EPR attacks Guerrero
November 1996	Confrontation between EPR and Police in Oaxaca
May 1997	EPR attacks Guerrero
June 1998	ERPI and EPR attacked Guerrero
September 1999	EPR attacks Guerrero
October 2001	Murder of Digna Ochoa: Human Rights.

Other Political Events	
May 1989	Start of the Financial Liberalization
July 1990	Mexico approves debt/nature conversion program aimed at increasing expenditures to education, environment, and social programs
August 1992	Mexico, Canada and U.S. announce consensus on NAFTA
June 1993	Announced that Central Bank would be granted independence
August 1993	President Clinton signed NAFTA and sends it to Congress.
March 1995	Mexican officials announce new economic plan
September 1995	President Zedillo announces new economic program
October 1996	"Pacto" alliance between business, government, and labor renewed, establishing economic, price, and wage targets for 1997
December 1997	Uncertainty and turbulence in Asia stock markets.
November 1998	Uncertainty about FOBAPROA and 1999 government budget
December 1998	Negotiations between PRI and PAN to create the IPAB and uncertainty about the 1999 federal budget
April 2001	Uncertainty about the fiscal reform

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