The Best Asset Pricing Model for Estimating Cost of Equity: Evidence from the Stock Exchange of Tunisia

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Abstract

The Capital Asset Pricing Model (CAPM) has dominated finance theory for over thirty years; it suggests that the market beta alone is sufficient to explain security returns. However evidence shows that the cross-section of stock returns cannot be described solely by the one-factor CAPM. Therefore, the idea is to add other factors in order to complete the beta in explaining the price movements in the stock exchange. The Arbitrage Pricing Theory (APT) has been proposed as the first multifactor successor to the CAPM without being a real success. Later, researchers (Banz, 1981; Rosenberg et al., 1985; Jegadeesh and Titman, 1993) support that average stock returns are related to some fundamental factors such as size, book-to-market equity and momentum. Alternative studies come as a response to the poor performance of the standard CAPM. They argue that investors choose their portfolio by using not only the first two moments but also the skewness and kurtosis. The main contribution of this paper is to choose between the CAPM, the Fama&French asset pricing model (TPFM) and the Four Factor Pricing Model (FFPM) adding the third and fourth moments to estimate the cost of equity of Tunisian listed firms. The selection of the best model is based on Information Criteria: the Akaike Information Criteria (AIC) and the Schwartz Information Criteria (SIC). The simple FFPM of Cahart turned out to be the selected model. Therefore, we used the random coefficient model of Swamy to account for inter-individual heterogeneity and to estimate the coefficients on the FFPM factors. The final results show that costs of equity estimated by the simple FFPM differ by more than 4 percent across the six industries, ranging between 4.33 percent for agro-alimentary sector and 8.55 percent for insurance companies.

JEL classification: G12; G32
Keywords: Cost of equity; CAPM; TFPM; FFPM; Skewness; Kurtosis; Random-coefficient models.

1. Introduction

The estimation of cost of equity is crucial for many financial decisions such as investment decisions, portfolio management, capital budgeting, and performance evaluation. The mostly used model for estimating a firm's weighted average cost of capital (WACC) is the classic version of Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1966) as reported by Graham and Harvey (2001)

This CAPM indicates that the cross-sectional variation in expected returns is explained only by market beta. However, evidence (Fama and French, 1992; Strong and Xu, 1997; Jagannathan and Wang, 1996; Lettau and Ludvigson, 2001, among others) shows that the cross-section of stock returns cannot be fully described by the one factor unconditional beta. Numerous studies have established that, alongside market beta, average stock returns are related to size (Banz, 1981), earning/price (Basu, 1983), book-to-market equity (Rosenberg et al., 1985), and past sales growth (Lakonishok et al., 1994). Stock returns are also found to display long term reversals (DeBondt and Thaler, 1985) and short-term momentum (Jegadeesh and Titman, 1993).

To address these anomalies, scholars have examined the performance of alternative models that better explain stock returns. In the asset pricing literature, these models take three separate directions: (1) multifactor models that add some factors to the market return, such as the intertemporal CAPM of Merton (1973) and the Fama&French Models; (2) the Arbitrage Pricing Theory of Ross (1977) and (3) the nonparametric models that criticize the linearity of the CAPM such as in Bansal and Viswanathan (1993) and add additional moments illustrated by Harvey and Siddique (2000) and Dittmar (2002).

Fama and French (1992) found that two variables size and the book-to-market ratio provide a better explanation of the cross-section of average returns than the CAPM. As a consequence, Fama and French (1993) have extended the one factor model to a three-factor model, adding average stock returns sensitivities to size and book-to-market equity ratio. It turned out that the three-factor Pricing Model (TFPM) captures most market anomalies except the momentum anomaly (Fama and French,1996; Asness,1997). Jegadeesh and Titman (1993, 2001) argue that there is substantial evidence that indicates that stocks that perform the best (worst) over a three to 12 months period tend to continue to perform well (poorly) over the subsequent three to 12 month period. Momentum trading strategies that exploit this phenomenon have been consistently profitable in the United States and in most developed markets. Therefore, Carhart (1997) proposes a four factors pricing model (FFPM) adding the momentum to the Fama&French model to explain average stock returns. Although these multifactor models come to answer criticisms addressed to the single factor model, they still suffer from the problem that the additional factors are not motivated by theory.

Alternative studies come to give an answer to the poor performance of the standard CAPM. They develop the three-moment CAPM, where investors consider skewness during their portfolio choice, in addition to the two moments of the classic CAPM. Dittmar (2002) extend the three-moment CAPM to a four-moment CAPM adding the kurtosis to investor preferences. Harvey and Siddique (2000) and Dittmar (2002) provide evidence that extension to the CAPM that allow portfolio preference to include skewness and kurtosis lead to superior performance.

The main objective of this paper is to select the best asset pricing model for explaining the expected returns in the Tunisian Stock Exchange (TSE) out the different models defined above. So, we evaluate the performance of diverse asset pricing models using the Schwartz and Akaike indicators. The best model will be chosen to estimate cost of equity of firms listed in the TSE. Our study makes four contributions to the literature. First, few papers compare different models to estimate cost of equity in the finance literature. Besides, to our knowledge, there are no studies that consider the three and four factor pricing models augmented with skewness and kurtosis factors to estimate cost of equity. Second, this comparison is not only across models, but also across different market return proxies. In fact, we tried to select the best asset pricing model but also to check whether it is better to use an equal-weighted index or a value-weighted index. Third, prior studies use the popular $\overline{R}^2$ to compare the performance of different models, we use information criteria such as AIC and SC measures. Fourth, the econometric approach is also interesting which is based on random-coefficient model in the context of panel data analysis which is useful to estimate coefficients by sector within the same framework and accounting on the same time for heterogeneity.

This research highlighted that both indexes (BVMT and Tunindex) and criteria (AIC and SC) lead to the same best asset pricing model, that is the FFPM of Carhart (1997). Compared to prior studies (see table 4), the momentum premium (8.88%) is the largest premium in the TSE and bigger than the one found in other developed and developing markets. The value premium is much smaller (2.88%) relative to the other premiums and is sensibly below what other stock markets display. Surprisingly, size premium is negative (-3.40%) and it is in disagreement with previous literature where small firms require more returns Also, the banking sector is more exposed to market risk than other sectors in the TSE and the most short-term performing among the others candidate sectors. Finally, we find that costs of equity using FFPM is comprised between 4.33% for the agro-alimentary sector and 8.55% for insurance companies with a smaller spread compared to 10% found by Fama&French (1996).

The remainder of the paper is organized as follows. Section 2 presents the Tunisian financial system. Section 3 describes the data and methodology. The empirical results are presented in section 4. The final section contains concluding comments.

2. The institutional setting

The Tunisian financial sector consisted mainly of an under-developed stock market, commercial banks, insurance companies, leasing firms and mutual funds. The Stock market has been set up in 1969 in Tunisia, but its role and contribution to the economy is still very limited.

The stock market was reformed according to international standards in 1994. The CMF ("Conseil du Marché Financier") was created with the same role devoted to the SEC in the United States. Parallel to this, the STICODEVAM was set up to act as a clearing corporation and central depository for the market. In addition, all trades are required to be processed through brokers. In April 1998 a new share index weighted by market capitalisation was introduced to the Tunisian Stock Exchange. The new index is dominated by financial companies such as Banque de L'Habitat, Amen Bank and BIAT.

To spur the process of listing, the Tunisian government has proposed a bunch of fiscal measures. For example, companies will get a 15 percent in their corporate income tax for a period of five years when they list at least 30 percent of their capital in the stock exchange. Besides, all the capital gains and dividends earned by individual investors in the TSE are free of taxes. Despite all these incentives to develop the TSE, only forty-seven companies currently have their stock listed in 2007.

Foreigners can participate within the limits of 50 percent of the offering of a company. Above 50 percent, a central bank approval is necessary. As the market grows foreign investors are expected to play a proportionally important role. If the Tunisian market is recovering today, it is undoubtedly thanks to a massive foreign buying and most of these foreign investors in Tunis Stock Exchange are coming from the Gulf countries. Foreign investors have bought up to 29 percent of the Tunisian market capitalization.

Overall, the market remains small with total capitalization of about $ 4000 million in 2006 but has performed remarkably well in 2006 with a price-to-earnings ratio reaching 19.

3. Data and methodology

3.1. Data sources

We examine the monthly returns from four basic factors $R_m - R_f$, SMB, HML and WML on the Tunisian Stock Exchange (TSE) from July 2000 to June 2005. Our sample consists of six industry that are, banking, insurance, industry, leasing, agro-alimentary, and real estate. We include in our cost of equity calculation only industries containing more than two companies.[1] Monthly prices are adjusted for dividends, splits and share issues. Company annual reports are obtained from the TSE electronic data. As a risk free rate, we use the Tunisian Money Market Rate (TMM), which is available for each month and it is obtained from the Central Bank electronic database. We compute two measures of market returns using two market indices: (i) the equally-weighted return, the BVMT index; and (ii) the value-weighted return, the Tunindex.

3.2. Portfolio formation

To be included in a portfolio, a firm must be trading in the TSE from $\text{December}_{t\text{-}1}$ and June_t and it must have a fiscal year ending on December 31 which is the case of all listed companies in the TSE. The number of firms that answer these conditions ranges from 41 in 2000 to 46 in 2005. Size (ME) is measured as the stock's price times the number of shares outstanding as of June of each year and not in December. A period of six months, from December t-1 to June t, is not arbitrarily chosen. Actually, the Tunisian listed firms must publish their financial statements within three months. However, some companies make it even after five or six months. So our choice of six months is sufficient to account for market reaction to the information revealed in the annual reports. The market value and book value of equity used to compute BE/ME for year t are the December_{t-1} values. Accordingly, the stock returns from $\text{July } 1_t$ to $\text{June } 31_{t+1}$ are calculated for portfolio based on December_{t-1} BE/ME values and June_t sizes.

We reproduce the Fama and French (1993) technique in the construction of the six size-BE/ME portfolios. The stocks in the simple are first sorted each year from smallest to largest in terms of market capitalization. The median TSE size is then used to split TSE stocks into two groups, small (S) and big (B). The firms are again and independently sorted, each year, into three book-to-market equity groups designed as low (L), medium (M), and high (H). The

BE/ME partitioning is based on the breakpoints for the bottom 30 percent (low), middle 40 percent (medium), and the top 30 percent (high) of the ranked values of BE/ME for TSE stocks. Book equity is computed as the book value of stockholder's equity. Firms with negative BE/ME are excluded when calculating the breakpoints for BE/ME portfolios. From the intersections of the two size and three BE/ME groups, we form the six size-BE/ME portfolios: S/L, S/M, S/H, B/L, BE/ME and B/H.[22]

Following L'Her et al. (2004), we compute the momentum factor following the book-to-market factor. Stocks above the 30 percent prior performance breakpoint are designed W (winner), the middle 40 percent are designed N (neutral) and the firms below the 30 percent prior performance breakpoint are designed L (loser). We form six size-performance portfolios that are S/L, S/N, S/W, B/L, B/N and B/W.

The two ranking are redone each year and the number of firms in each of the twelve (two groups of six portfolios) portfolios varies due to the modifications in the size, book-to-market equity values and performance of the TSE listed companies. Each of the two six portfolio groups are used to compute the risk premiums associated to small size (SMB), high book-to-market equity (HML) and winner portfolio (WML). For each month, SMB is the difference between the simple average of the returns on the three small-stock portfolios (S/L, S/M, and S/H) and the average of the returns on the three big-stock portfolios (B/L, BE/ME, and B/H). HML is the difference between the simple average of the returns on the two high-BE/ME portfolios (S/H and B/H) and the average of the returns on the two low-BE/ME portfolios (S/L and B/L). WML is the difference between the simple average of the returns on the two winner portfolios (S/W and B/W) and the average of the returns on the two loser portfolios (S/L and B/L).

3.3. Theoretical and econometric modelling

Most practitioners favour the one factor model (CAPM) for estimating cost of equity (see, for example, Bruner et al., 1998) and Graham and Harvey (2001)). The CAPM stipulate that the expected return on an asset i, which is for our case the cost of equity for industry i, $i = 1,...,n$ is given by:

$$E(R_i) = R_f + \beta_i^M [E(R_m) - R_f] \qquad (1)$$

[2] For example, S/L is the small size and low book-to-market equity portfolio.

where R_i is the return on asset i, R_f is the risk-free interest rate, R_m is the return on the market portfolio, and $\beta_i^M = \frac{\text{cov}(R_i, R_M)}{\sigma_M^2}$ is the systematic risk of asset i relative to the market portfolio. The coefficient β_i^M, therefore, is estimated by the following time-series regression of the monthly average excess returns to an industry i, $R_{it} - R_{ft}$, against monthly excess market returns, $R_{mt} - R_{ft}$, both measured from July *t-1* to June *t* each year.

$$(2) \qquad R_{it} - R_{ft} = \alpha_i + \beta_i^M [R_{mt} - R_{ft}] + \varepsilon_{it} \qquad i = 1,...,n \text{ and } t = 1,...,T$$

Where $\beta_i^M = \frac{\text{cov}(R_i, R_I)}{\sigma_M^2}$ is the systematic risk of asset i.

Fama and French (2004) conclude that the weaknesses of the CAPM approach imply that most applications of the model are invalid. According to the theoretical CAPM, investors have preferences over the mean and the variance of portfolio returns. However, there is large evidence showing that the returns distribution cannot be sufficiently explained by mean and variance alone. Kraus and Lintzenberg (1976) propose the next moment-skewness as an additional factor. Harvey and Siddique (2000) explain that investors prefer portfolios that are right-skewed to portfolios that are left-skewed. Therefore, assets with more left-skewed returns are less desirable and should require higher expected returns, and vice versa. This leads us to consider the three-moment CAPM (SCAPM), where the expected return on stock i is defined by the following expression:

$$(3) \qquad E(R_i) - R_f = b_1[E(R_m) - R_f] + b_2[E(R_m) - R_f]^2$$

Where b_1 and b_2 are the slopes in the following regression:

$$(4) \qquad R_{it} - R_{ft} = \alpha_i + b_1[R_{mt} - R_{ft}] + b_2[R_{mt} - R_{ft}]^2 + \varepsilon_{it} \qquad i = 1,...,n \text{ and } t = 1,...,T$$

Dittmar (2002) extends the preference of the investor to allow for skewness and kurtosis. The fourth moment, kurtosis, is intended to capture the probability of outcomes that are highly divergent from the mean, that are extreme outcomes. Darlington (1970) describes kurtosis as the degree to which, for a given variance, a distribution is weighted toward its tails. Hence, according to the four-moment CAPM (KCAPM), the expected return on stock i is defined by the following expression:

$$(5) \qquad E(R_i) - R_f = b_1[E(R_m) - R_f] + b_2[E(R_m) - R_f]^2 + b_3[E(R_m) - R_f]^3$$

Where b_1, b_2 and b_3 are the slopes in the following regression:

$$(6) \qquad R_{it} - R_{ft} = \alpha_i + b_1[R_{mt} - R_{ft}] + b_2[R_{mt} - R_{ft}]^2 + b_3[R_{mt} - R_{ft}]^3 + \varepsilon_{it}$$

$$i = 1,\ldots,n \text{ and } t = 1,\ldots,T$$

Fama and French (1993, 1996) propose a three-factor model in which an asset's expected return depends on the sensitivity of its return to the market return and the returns on two portfolios meant to mimic additional risk factors relative to size and BE/ME equity. The expected-return equation of the three-factor model on stock i, $i = 1,\ldots,n$ is given by:

$$(7) \qquad E(R_i) - R_f = b_i[E(R_m) - R_f] + s_i E(SMB) + h_i E(HML)$$

Where b_i, s_i and h_i are the slopes in the regression:

$$(8) \qquad R_i - R_f = \alpha_i + b_i[R_m - R_f] + s_i SMB + h_i HML + \varepsilon_i$$

$$i = 1,\ldots,n \text{ and } t = 1,\ldots,T$$

Using SMB to explain returns is in accordance with the evidence of Huberman and Kandel (1987). They assert correlation between returns and small stocks that is not detected by the market return. Furthermore, considering HML to expect stock returns is in agreement with the evidence of Chan and Chen (1991). They affirm correlation between returns and relative firm distress measured by BE/ME ratio that is not captured by the market portfolio.

The four-factor pricing model of Carhart (1997) states that the excess return of a security is explained by the market portfolio and three factors designed to mimic risk variables related to size, book-to-market (BE/ME) and momentum. According to the FFPM, stocks' excess returns are equal to:

$$(9) \qquad E(R_i) - R_f = b_i[E(R_m) - R_f] + s_i E(SMB) + h_i E(HML) + w_i E(WML)$$

Where b_i, s_i, h_i and w_i are the slopes in the regression:

$$(10) \qquad R_i - R_f = \alpha_i + b_i[R_m - R_f] + s_i SMB + h_i HML + w_i WML + \varepsilon_i$$

$$i = 1,\ldots,n \text{ and } t = 1,\ldots,T$$

Using WML to explain returns is in line with the evidence of Jegadeesh and Titman (1993) showing association between returns and stock previous performance that is not detected by the market portfolio, size and distress factors. Actually, they argue that strategies that involve taking a long position in well performing stocks on the basis of past performance over the previous 3-12 months tend to produce significantly positive abnormal returns of about 1 percent per month for the following year.

One of the main contribution of this paper is to extend the TFPM and the FFPM to introduce the skewness and the kurtosis to these two linear multifactor models. Hence, we obtain the STFPM, KTFPM, SFFPM and KFFPM. Having introduced the skewness to the TFPM, the expected-return equation of the three-moment TFPM (STFPM) on stock i, $i = 1,...,n$ is given by:

$$(11) \qquad E(R_i) - R_f = b_{1i}[E(R_m) - R_f] + b_{2i}[E(R_m) - R_f]^2 + s_i E(SMB) + h_i E(HML)$$

Where b_{1i}, b_{2i}, s_i and h_i are the slopes in the regression:

$$(12) \qquad R_i - R_f = \alpha_i + b_{1i}[R_m - R_f] + b_{2i}[R_m - R_f]^2 + s_i SMB + h_i HML + \varepsilon_i$$

$$i = 1,...,n \text{ and } t = 1,...,T$$

We extend the three-moment TFPM to the four-moment TFPM (KTFPM) by including the kurtosis factor. Stocks' excess returns are equal to:

$$(13) \qquad E(R_i) - R_f = b_{1i}[E(R_m) - R_f] + b_{2i}[E(R_m) - R_f]^2 + b_{3i}[E(R_m) - R_f]^3 + s_i E(SMB) + h_i E(HML)$$

Where b_{1i}, b_{2i}, s_i and h_i are the slopes in the regression:

$$(14) \qquad R_i - R_f = \alpha_i + b_{1i}[R_m - R_f] + b_{2i}[R_m - R_f]^2 + b_{3i}[R_m - R_f]^3 + s_i SMB + h_i HML + \varepsilon_i$$

$$i = 1,...,n \text{ and } t = 1,...,T$$

Also, we add the skewness factor to the FFPM, and the expected-return equation of the four-moment FFPM (SFFPM) on stock i, $i = 1,...,n$ is given by:

$$(15) \qquad E(R_i) - R_f = b_{1i}[E(R_m) - R_f] + b_{2i}[E(R_m) - R_f]^2 + s_i E(SMB) + h_i E(HML) + w_i E(WML)$$

Where b_{1i}, b_{2i}, s_i, h_i and w_i are the slopes in the regression:

$$(16) \qquad R_i - R_f = \alpha_i + b_{1i}[R_m - R_f] + b_{2i}[R_m - R_f]^2 + s_i SMB + h_i HML + w_i WML + \varepsilon_i$$

$$i = 1,...,n \text{ and } t = 1,...,T$$

We expand the three-moment FFPM to the four-moment FFPM (KFFPM) by including the kurtosis factor. Stocks' excess returns are equal to:

$$(17) \qquad E(R_i) - R_f = b_{1i}[E(R_m) - R_f] + b_{2i}[E(R_m) - R_f]^2 + b_{3i}[E(R_m) - R_f]^3 + s_i E(SMB) + h_i E(HML) + w_i E(WML)$$

Where b_{1i}, b_{2i}, b_{3i}, s_i, h_i and w_i are the slopes in the regression:

$$(18) \qquad R_i - R_f = \alpha_i + b_{1i}[R_m - R_f] + b_{2i}[R_m - R_f]^2 + b_{3i}[R_m - R_f]^3 + s_i SMB + h_i HML + w_i WML + \varepsilon_i$$

$$i = 1,...,n \text{ and } t = 1,...,T$$

In order to select the best model among the nine models presented above in explaining the cross-section of Tunisian stock returns, we use two criteria: Akaike's Information Criterion (AIC) and Schwarz Criterion (SC). These formal specification criteria are designed to help in the selection of the better of alternate models. We calculate the AIC and SC for each model, the lower values indicate the best model performance.

Generally, prior studies (Bryant and Eleswarapu (1997), Bartholdy and Peare (2002), and Drew and Veeraraghavan (2003)) use the popular $\overline{R}^2$ to compare the performance of two or several models. The best estimation model is the one that gives the highest $\overline{R}^2$. The AIC and SC criteria present interesting alternatives to the popular $\overline{R}^2$. Both criteria tend to penalize the addition of another explanatory variable more than $\overline{R}^2$ does. Therefore, AIC and SC will quite often be minimized by an equation with fewer independent variables than the ones that maximize $\overline{R}^2$.[3]

Fletcher and Kihanda (2005) evaluate the pricing ability of seven stochastic discount factor models in UK stock returns using the Hansen and Jegannathan (1997) distance

[3] Note that even though AIC and SC are developed independently to maximize different object functions, their equations are quite similar.

measure. They find that the conditional four-moment CAPM is the best performer among the candidate models in terms of the lowest Hansen and Jegannathan (1997) distance measure. Barnes and Lopez (2006) use the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) to distinguish the best model also among seven asset pricing model. For our study, we calculate AIC and SC measures for the different candidate models, and the model which display the lower value, will be considered as the best among the nine models.

After choosing the best asset pricing model, we turn to use it for estimating the cost of equity of Tunisian listed firms by estimating the coefficient pertaining to each factor. To account for inter-individual heterogeneity, we estimate specific coefficients relative to the best model according to the random-coefficient model of Swamy (1970) within the context of panel data. Actually, fixed-effects models integrate panel specific heterogeneity by providing each panel only with its own constant term but all panels share common slope parameters. Hence, random-coefficient models come to answer to this limit. In fact, random-coefficients models are more general in that they permit each panel to have its own vector of slopes randomly drawn from a distribution common to all panels. Following Swamy (1970), the random-coefficients model takes the form

$$y_i = X_i\theta_i + \varepsilon_i \tag{17}$$

Where $i = 1,...,n$ denotes panels, that are industries in our case, $y_i = R_i - R_f$, a $T_i \times 1$ vector of observations for the *i*th industry, which indicates the same dependent variable in the nine models presented below (CAPM, SCAPM, KCAPM, TFPM, STFPM, KTFPM, FFPM, SFFPM, and KFFPM). X_i is a $T_i \times k$ matrix containing the time series observations of explanatory variables of industry i.[4] θ_i is a $k \times 1$ vector of parameters specific (coefficients) to each panel.[55] ε_i is a $T_i \times 1$ vector of errors, and specifically, this error term vector is distributed with mean zero and variance $\sigma_{ii} I$, $i = 1,...,n$.

To be permitted to exploit the random-coefficient model of Swamy, we must verify the condition of variation of the coefficient across the cross-sectional units. So, we must provide evidence that the regression coefficients obtained are varying across cross-sectional units. Many tests exist to prove if the panel-specific coefficients differ significantly from one

[4] For example, this matrix with dimension $T_i \times 2$ is defined by $X_i = [S \quad R_m - R_f]$ for the CAPM. *S* is a $T_i \times 1$ vector of ones.

[5] $\theta_i = [\alpha_i \quad \beta_i]$ for the CAPM.

another. For our study, we choose one available testing procedure to test whether or not the coefficient vectors θ_i are all equal to the mean vector θ, under the null hypothesis:

$$(18) \qquad H_0 : \theta_1 = ... = \theta_n = \theta$$

The statistic test developed by Swamy (1970) is asymptotically distributed χ^2 with $(k \times (n-1))$ degrees of freedom under the null hypothesis and is defined as:

$$(19) \qquad \chi^2 = \sum_{i=1}^{n} (\hat{\theta}_i - \hat{\theta}^*)' \left\{ \hat{\sigma}_{ii}^{-1} X_i^{'} X_i \right\} (\hat{\theta}_i - \hat{\theta}^*)$$

Where

$$(20) \qquad \hat{\theta}^* = \left\{ \sum_{i=1}^{n} \hat{\sigma}_{ii}^{-1} (X_i^{'} X_i) \right\}^{-1} \left\{ \sum_{i=1}^{n} \hat{\sigma}_{ii}^{-1} (X_i^{'} X_i) \hat{\theta}_i \right\}$$

The individual coefficient vectors will be considered as fixed in case the null hypothesis (H_0) is verified; this means that coefficients are all identical across industries and equal to the mean. Therefore, to confirm the variation of the coefficient vectors, the null hypothesis above must be rejected. In this case, we could adopt random-coefficients models to estimate the coefficients specific to each panel.

4. Empirical results

We begin our analysis by selecting the best model capturing the stock returns variation across industries. Therefore, we proceed by calculating the AIC and SC measures for each of the nine models. For this purpose, two different indices are considered: the equally-weighted index, the BVMT; and the value-weighted index, the Tunindex.

Table 1 reports the results from the two measures of market returns. Results show that the standard CAPM leads to better pricing performance over the SCAPM and KCAPM. Considering the BVMT index, the AIC and SC measures increase form -5.723 and -5.701 for the classic CAPM to -5.717 and -5.669 for the four-moment CAPM, respectively. The same results are displayed for the TFPM and the FFPM; it means that including moments over the mean and variance deteriorate slightly the power of explaining the stock returns. In other words, it means that investors in the TSE do not consider other factors over the mean and variance of portfolio returns for their investment choice. Adding the book-to-market equity and momentum to the classic CAPM, slightly improves the ability of these factors to explain stock returns in the TSE. The difference becomes obvious when we compare the CAPM with the FFPM with the AIC criteria.

Finally, table 1 reports that the FFPM have better performance than the other eight models; it realizes the lowest AIC and SC measures, that are -5.770 and -5.716 for the BVMT index and -5.806 and -5.751 for the Tunindex, respectively. Hence, the FFPM of Carhart (1997) will be selected, for the rest of the study, to compute the cost of equity for the Tunisian listed companies.

<Insert table 1 near here>

Table 2 reports the monthly average excess returns for the dependent and the independent variables of the FFPM for 60 months between July 2001 and June 2005. The dependent variable is the monthly average excess returns for the six industries $(R_i - R_f)$. The explanatory variables are the monthly excess market returns considering the Tunindex $R_m - R_f$ [6], the excess returns relative to small size (SMB), high book-to-market equity (HML) and winner portfolios (WML).

Although premiums for market risk, small size, relative distress, and momentum are expected to be positive, results in table 3 show that these four risk factors, $R_m - R_f$, SMB, HML, and WML are negative in 38, 30, 27, and 24 of the 60 months under study, respectively. So we obtain a negative monthly size premium (-0.3%) which is not significant. Fama and French (1996) study the three-factor model and they report that HML is negative in only ten of the thirty years studied, $R_m - R_f$ is also negative ten times, and SMB is negative nine times. However, the study of Asku and Önder (2000), on the Turkish stock exchange, shows negative proportions of premiums during the 52 months of study rather similar to our study. $R_m - R_f$, SMB, and HML are negative in 27, 19, and 24 of the 52 months under study. Recently, L'Her et al. (2004) partition FFPM monthly excess returns relatively to months to examine seasonality in returns for the period of July 1960-April 2001, on the Canadian stock market. They document that $R_m - R_f$, SMB, HML, and WML are negative for 4, 3, 4, and 2, respectively, of the 12 months under study; the proportion of negative returns is less than the one obtained in the TSE. The number of negative excess returns relatively high for the risk factors (SMB, HML, and WML) implies that there is not a perfect effect of size, BE/ME, and momentum in the TSE.

<Insert table 2 near here>

[6] We select the Tunindex for the estimation because it gives the best results for the information criteria and it is best suited for theoretical consideration in the asset pricing literature.

Table 3 reports the four annualised risk premiums $R_m - R_f$, SMB, HML, and WML. The market premium (5.89%) is positive and very close to the one found by Fama and French (5.94%). Compared to prior studies (see table 4), the momentum premium (8.88%) is the largest premium in the TSE and bigger than the one found in other developed and developing markets. The value premium is much smaller (2.88%) relative to the other premiums and is sensibly below what other stock markets display. Surprisingly, size premium is negative (-3.40%) and it is in disagreement with previous literature where small firms require more returns. This result is mainly due to the composition of big firms in the TSE. Indeed, banks are the biggest firms listed in the TSE and are suffering form bad operating performance linked to the importance in their portfolio of non-performing loans (in 2005, non-performing loans represent almost 23% of the total loans in the bank assets).

The standard deviation for SMB premium is the largest one with 5.54%, followed by WML premium (5.31%), the HML premium (4.01%), and the market premium (3.17%). Overall, these standard deviation values of risk premiums are low relatively to those reported by prior studies (see table 4).

Summarizing the previous results, one could say that size, book-to-market and momentum premiums cannot present a perfect arbitrage opportunity since the premiums are far of being significant.

<Insert table 3 & 4 near here>

Once we obtained the time series of the monthly four risk factors, we begin our estimation by evaluating coefficients relative to each of the four premiums. In order to apply the random-coefficient model of Swamy (1970), we must first check if the panel-specific coefficients differ significantly from one another. Chi-square test provides empirical results that reject of the null hypothesis H_0 (absence of heterogeneity). Indeed, the estimated value for the statistic test is 51.71, which is above the corresponding critical value of chi-square (41.34). Therefore, the coefficient vectors θ_i are not considered as all equal and we can estimate specific coefficients to each of the 29 candidate firms, using the econometric methodology presented in the previous section.

An examination of the beta of sectors in table 5 reveals that banking sector is the most exposed industry to market risk with a beta of 0.59. Conversely, insurance sector displays the lowest mean beta of 0.47 ranking as the least exposed sector to market risk in the TSE. The coefficients related to size are mostly negative and relatively low, given that coefficients related to SMB vary from -0.07 for agro-alimentary industry to 0.14 for Investment institutions, which means that Tunisian listed firms are weakly exposed to size premium. Besides, except banking and manufacturing sectors, coefficients associated to HML factor are positive and with relatively high values, ranging from 0.33 (Investment institutions) to 0.40 (Leasing companies). This finding proves that most of the firms listed in the TSE are value stocks in the period under study. The coefficients associated to momentum are mainly negative and relatively small (inferior to 0.5 in absolute value) indicating that Tunisian firms display negative subsequent short-term performance albeit small in size after performing badly in the 12 preceding months. However, results in table 6 show bank's positive sensitivity to the performance registered in the past year means that Tunisian banking sector stocks are the most short-term successful firms in the TSE during the period of study.

<Insert table 5 near here>

The cost of equity will be estimated for each sector of the sample. Accordingly to FFPM approach, the used formula is defined as follows:

$$(22) \qquad E(R_{s0}) = R_{f0} + \hat{b}_i[\overline{(R_m - R_f}] + \hat{s}_i\,\overline{SMB} + \hat{h}_i\,\overline{HML} + \hat{w}_i\,\overline{WML} \qquad s = 1,...,6$$

Where R_{s0} is the cost of equity of sector s computed at June 2006. Moreover, we use the money market rate (TMM) observed at June 2006 as the risk free rate R_{f0}, that is equal to 5 percent. $\overline{R_m - R_f}$, $\overline{SMB}$, $\overline{HML}$ et $\overline{WML}$ are, respectively, the annualised average market, size, book-to-market and momentum premiums over the study period July 2000-June 2005, presented in table 3.

The results relative to the estimation of cost of equity for the 6 sectors at the 30th June 2006 are reported in table 6. The evidence shows that costs of equity estimated by the four-factor pricing model vary from 4.33% for agro-alimentary sector to 8.55% for insurance companies. This cross-industry variation is lower than reported by Fama and French (1993). For example, they found that a five-year TFPM cost of equity's for 27 industries ranges from

0.09% to 11.16%. Part of the low costs dispersion can be explained by the relatively small number of industries listed in TSE.

Although agro-alimentary sector is composed by relatively big and value stocks ($s_i = -0.07$ and $h_i = 0.36$), its cost of equity is low (4.33%). The main reason can be attributed to the low short-term performance of this sector, given its high negative sensitivity to the momentum factor (-0.57). Insurance sector is also composed by big and value stocks (in trouble), and have small negative short-term returns ($w_i = -0.03$), but, it displays the highest cost of equity (8.55). This can be explained by the high sensitivity of insurance companies to market and book-to-market risk (respectively, $b_i = 0.45$ and $h_i = 0.40$).

Finally, considering FFPM to estimate Tunisian costs of equity seems to lead to the best and least biased results, according to the AIC and SC criteria. This proves the importance of the presence of factors relative to stocks size, BE/ME equity ratio and short-term momentum in the TSE. However, Tunisian investors neglect the effect of skewness and kurtosis factors in assets pricing. In contrast to the literature, Tunisian financial market compensates big stocks instead of small stocks.

<Insert table 6 near here>

5. Conclusion

This study has compared nine different asset pricing models, used for the valuation of financial assets, in order to select the best one and use it to measure the cost of equity of the Tunisian listed companies. The selection method adopted in this paper is of interest since we substitute the popular $\overline{R}^2$ by more performing measures for comparing models such as the SC and AIC criteria.

Using information criteria, the results show that the FFPM of Carhart is the most appropriate model for estimating Tunisian listed firms cost of equity. Furthermore, Tunisian investors do not consider skewness and kurtosis as risk factors, but compensate market, size, book-to-market and momentum risks in their assets pricing. Contrary to Harvey and Siddique (2000), conditional skewness in asset pricing did not explain the puzzle of momentum anomaly. Contrary to expectation, the results indicate that big companies (mostly financial institutions) require higher returns for compensation in the Tunisian stock exchange which could be linked to the difficulties that these companies are undergoing during the last 10 years.

We next use the random coefficient model of Swamy to estimate the coefficients on the FFPM factors. This technique accounts for inter-individual heterogeneity in order to account for cross-sectional variability of the coefficients. The evidence shows that costs of equity estimated by the four-factor pricing model vary between 4.33% for the agro-alimentary sector to 8.55% for insurance companies.

Our results suggest further research is needed to estimated cost of equity with models that suppose changes in the risk parameters through time like the conditional models because CAPM do a poor job of explaining expected returns when beta is assumed to be fixed. We can then estimated rolling model (five year window of data), GARCH model (ratio of covariance to variance) and dynamic linear factor model (make assumption of how beta changes). It could be relevant to extend our work to estimate cost of equity using models devised for emerging markets (Godfrey and Espinosa (1996), Erb, Harvey and Viskanta (1996), Damodaran (1998) and Estrada (2000). Finally, as Tunisia is ending the liberalization of the capital account it will be interesting to compare models with local and global index since the TSE is becoming more and more integrated.

Appendix: List of companies by sector

Sectors	Firms	
Banking	ATB	Amen Bank
	BH	Banque de l'Habitat
	BIAT	Banque Internationale Arabe de Tunisie
	BNA	Banque Nationale Agricole
	BS	Banque du Sud
	BT	Banque de Tunisie
	BTEI	Banque de Tunisie et des Emirats d'Investissement
	STB	Société Tunisienne de Banque
	UBCI	Union Bancaire pour le Commerce et l'Industrie
	UIB	Union Internationale des banques
	AB	Amen Bank
Insurance	ASTREE	Compagnie d'Assurance et de Réassurance
	LA CARTE	Compagnie d'Assurance et de Réassurance Tuniso-Européenne
	STAR	Société Tunisienne d'Assurance et de Réassurance
Leasing	AL	Amen Lease
	ATL	Arab Tunisian Lease
	CIL	Compagnie Internationale de Leasing
	GLEASING	General Leasing
	TLEASING	Tunisie Leasing
Investment	PLACTUNISIE	Placement de Tunisie-SICAF
	SPDIT	Société de Placement et de Développement Industriel et Touristique-SICAF
	TINVEST	Société Tunisienne d'Investissement à Capital Risque
Agro-alimentary	ALMAZRAA	Al Mazraa
	SFBT	Société Frigorifique et Brasserie de Tunis
	TLAIT	Tunisie Lait
Manufacturing	ALIQUIDE	Air Liquide de Tunisie
	ALKIMIA	Société Chimique Alkimia
	ICF	Société des industries Chimiques du Fluor
	SOTUVER	Société Tunisienne de Verrerie

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Table 1
Akaike's Information Criterion and the Schwarz Criterion measures

	BVMT	Model ranking	Tunindex	Model ranking
AIC				
CAPM	-5.72303	5	-5.76351	6
SCAPM	-5.71748	7	-5.75826	8
KCAPM	-5.71225	9	-5.75384	9
TFPM	-5.72520	4	-5.76708	4
STFPM	-5.72220	6	-5.76441	5
KTFPM	-5.71722	8	-5.75896	7
FFPM	-5.77055	1	-5.80571	1
SFFPM	-5.76515	2	-5.80154	2
KFFPM	-5.75981	3	-5.79613	3
SC				
CAPM	-5.70144	2	-5.74192	2
SCAPM	-5.68509	4	-5.72587	4
KCAPM	-5.66907	8	-5.71066	7
TFPM	-5.68202	6	-5.72390	5
STFPM	-5.66823	7	-5.71044	8
KTFPM	-5.65246	9	-5.69419	9
FFPM	-5.71658	1	-5.75173	1
SFFPM	-5.70038	3	-5.73677	3
KFFPM	-5.68425	5	-5.72057	6

Table 1 reports the pricing performance of the nine asset pricing models between July 2000 and June 2005. AIC and SC are the Akaike's Information Criterion and the Schwarz Criterion measures, respectively.

Table 2
Monthly FFPM explanatory returns and monthly excess returns over the period [July 2000-June 2005]

Year	Months	$R_i - R_f$	$R_m - R_f$	SMB	HML	WML
2000-2001	July	-0.0187	0.0447	0.0575	-0.0654	-0.0878
	August	0.0492	0.0082	0.0017	0.0572	0.0497
	September	0.0169	0.0111	-0.0379	0.0073	-0.0060
	October	-0.0114	-0.0630	-0.0955	0.0163	0.0260
	November	0.0324	0.0224	-0.0287	0.0487	-0.0401
	Décember	0.0168	0.0172	0.0181	0.0187	-0.0213
	January	-0.1147	-0.0260	-0.2563	0.1580	0.2840
	February	-0.0880	-0.0651	-0.0759	-0.0037	0.0933
	March	-0.0075	-0.0024	0.0653	-0.0514	0.0001
	April	-0.0092	0.0038	-0.0406	-0.0114	0.0162
	May	0.0673	0.0275	0.0449	-0.0815	-0.1075
	June	-0.0176	-0.0575	-0.0822	-0.0046	0.0138
2001-2002	July	-0.0128	0.0053	0.0729	0.0057	-0.0345
	August	-0.0432	-0.0942	0.0075	0.0131	0.0589
	September	-0.0327	-0.0022	0.0385	0.0297	0.0344
	October	0.0399	-0.0277	-0.0117	0.0351	-0.0142
	November	-0.0205	0.0084	0.0565	0.0067	0.0010
	Décember	0.0342	0.0019	-0.0502	0.0367	-0.0729
	January	-0.0279	-0.0080	0.0015	-0.0309	-0.0434
	February	-0.0222	-0.0080	0.0586	-0.0333	0.0183
	March	-0.0543	-0.0179	0.0392	-0.0780	-0.0464
	April	-0.0193	-0.0516	-0.0506	-0.0096	0.0358
	May	0.0406	-0.0055	0.0359	0.0087	0.0415
	June	-0.0116	-0.0120	-0.0026	-0.0120	-0.0044
2002-2003	July	-0.0333	-0.0109	-0.0302	0.0374	0.0330
	August	-0.0371	-0.0395	0.0129	-0.0419	-0.0134
	September	0.0542	0.0425	-0.0601	0.0191	-0.0148
	October	-0.0413	-0.0557	0.1013	0.0114	0.0069
	November	-0.0297	-0.0153	-0.0002	-0.0034	0.0372
	Décember	0,0040	-0,0113	-0,0631	0,0122	0,0050
	January	-0.0253	-0.0647	0.0221	0.0453	-0.0404
	February	-0.0168	-0.0127	0.0204	0.0176	0.0593
	March	-0.0218	-0.0096	-0.0184	-0.0721	0.0825
	April	0.0995	0.1217	-0.0810	-0.0297	-0.0340
	May	0.0178	-0.0263	0.0485	-0.0070	0.0346
	June	0.0376	0.0044	0.0302	0.0383	-0.0210
2003-2004	July	0.0591	0.0507	0.0725	-0.0732	-0.0356
	August	-0.0198	-0.0131	0.0113	-0.0350	0.0234
	September	-0.0029	-0.0060	-0.0519	0.0059	0.0321
	October	0.0056	-0.0061	-0.0203	0.0003	-0.0130
	November	0.0484	0.0023	-0.0459	0.0655	0.0263
	Décember	0.0210	0.0170	-0.0375	-0.0109	-0.0137
	January	-0.0040	0.0025	0.0287	0.0290	0.0175
	February	-0.0070	-0.0019	-0.0085	-0.0012	0.0125
	March	0.0263	0.0279	0.0001	0.0138	0.0079
	April	0.0012	0.0095	0.0209	-0.0209	0.0017
	May	0.0162	0.0042	0.0726	-0.0106	-0.0165
	June	0.0336	-0.0093	-0.0186	0.0362	0.0274
2004-2005	July	0.0086	-0.0048	0.0119	0.0278	0.0328
	August	0.0521	-0.0045	-0.0342	0.0799	0.0596
	September	-0.0173	-0.0102	-0.0078	-0.0336	-0.0091

Table 3- *Continued*

	October	0.0150	0.0200	0.0697	-0.0023	-0.0388
	November	0.0178	-0.0180	-0.0253	0.0091	0.0259
	Décember	0.0116	-0.0022	-0.0355	-0.0006	0.0320
	January	-0.0026	-0.0021	0.0176	-0.0022	0.0100
	February	-0.0312	-0.0096	0.0161	-0.0403	-0.0123
	March	0.0169	0.0068	0.0394	0.0149	-0.0730
	April	0.0161	-0.0030	-0.0018	0.0011	0.0061
	May	0.0260	-0.0031	-0.0013	0.0009	0.0058
	June	-0.0017	-0.0028	-0.0016	0.0011	0.0062
Mean		0.0014	-0.0054	-0.0030	0.0024	0.0074
# of negative observations		31	38	30	27	24
Proportion in the sample		51.67 percent	63.33 percent	50 percent	45 percent	40 percent

R_f is the risk free asset estimated from the monthly TMM (money market rate). For the variable $R_i - R_f$, mean value over the 29 firms is considered for each month. R_m is the market return, estimated as the value-weighted return computed from the Tunindex. The explanatory market return $R_m - R_f$ is estimated by calculating the mean of the annual market excess return of each year [July$_t$-June $_{t+1}$]. The explanatory returns SMB, HML, and WML are formed from the six portfolios already defined. The number of negative observations is in fact the number of negative monthly returns. We give also the proportions of these observations in the total sample. Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at the 1%, 5% and 10% level.

Table 3
Factor risk premiums for the FFPM

	$R_m - R_f$	**SMB**	**HML**	**WML**
Annualized (12 times monthly)				
Average premium	5.89	-3.60	2.88	8.88
Standard deviation	3.17	5.54	4.01	5.31
t-value	-1.3077	-0.4184	0.4535	1.0709

The returns here and in the following tables are in percents. R_f is the risk free asset estimated from the monthly TMM (money market rate). R_m is the market return, estimated as the value-weighted return computed from the Tunindex. The explanatory market return $R_m - R_f$ is estimated by calculating the mean of the annual market excess return of each year of [July$_t$-June $_{t+1}$]. The explanatory returns SMB, HML, and WML are formed from the six portfolios already defined. Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at the 1%, 5% and 10% level.

Table 4
Annual mean premiums obtained by comparable studies (in percentage)

Study		$R_m - R_f$	SMB	HML	WML
Fama and French (1996)	Average premium	5.94*	4.92*	6.33***	-
	Standard deviation	16.33	15.44	13.11	-
	t-value	1.96	1.72	2.60	-
Liew and Vassalou (2000)	Average premium	-	4.85*	7.44***	14.50***
	Standard deviation	-	10.71	11.06	14.80
	t-value	-	2.01	2.98	4.34
Berkovitz and Qiu (2001)	Average premium	-	4.61	5.34*	5.11
	Standard deviation	-	4.45	3.48	4.00
	t-value	-	1.24	1.77	1.53
L'Her et al. (2004)	Average premium	4.52*	5.08***	5.04**	16.08***
	Standard deviation	15.23	10.97	12.72	4.45
	t-value	1.89	2.96	2.55	6.66

Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at the 1%, 5% and 10% level.

Table 5
Random coefficient estimates and predictors of FFPM

Sector	Firms	Intercept	b_i	s_i	h_i	w_i
Banks	ATB	0.0092*	0.5713***	0.1652	0.0229	-0.0637
		(1.71)	(3.40)	(1.36)	(0.14)	(-0.43)
	BH	0.0030	0.5012***	0.1084	-0.1421	-0.0406
		(0.58)	(3.08)	(0.92)	(-0.87)	(-0.29)
	BIAT	0.0124**	0.6773***	-0.0394	-0.2799*	0.0763
		(2.53)	(4.40)	(-0.36)	(-1.83)	(0.58)
	BNA	-0.0022	0.3276**	-0.1075	-0.1089	-0.0741
		(-0.51)	(2.43)	(-1.11)	(-0.83)	(-0.65)
	BS	0.0054	0.5440***	-0.1052	-0.2402	0.0743
		(0.89)	(2.90)	(-0.77)	(-1.23)	(0.44)
	BT	0.0137**	0.7114***	-0.0834	0.0845	0.1369
		(2.41)	(4.04)	(-0.66)	(0.47)	(0.88)
	BTEI	0.0189***	0.7277***	0.3404**	0.2844	0.3405**
		(3.14)	(3.94)	(2.54)	(1.49)	(2.05)
	STB	-0.0037	0.7921***	-0.0822	0.1023	-0.0037
		(-0.62)	(4.33)	(-0.62)	(0.54)	(-0.30)
	UBCI	0.0046	0.5083**	0.3208*	-0.5735**	0.0046***
		(0.61)	(2.36)	(2.00)	(-2.28)	(-4.49)
	UIB	0.0112*	0.7864***	-0.0113	-0.0773	0.0909
		(1.76)	(4.07)	(-0.08)	(-0.38)	(0.51)
	AMEN BANK	0.0059	0.3511**	0.0329	-0.0812	-0.1045
		(1.21)	(2.29)	(0.30)	(-0.53)	(-0.79)
Insurance	ASTREE	0.0101	0.5172**	-0.0551	0.5190**	0.0101
		(1.33)	(2.41)	(-0.36)	(2.11)	(-1.55)
	LA CARTE	-0.0084	0.5205**	0.1252	-0.2444	-0.1216
		(-1.12)	(2.47)	(0.75)	(-0.87)	(-0.48)
	STAR	0.0047	0.3018	-0.1621	0.9203***	0.0047
		(0.66)	(1.55)	(-1.04)	(3.51)	(-0.66)
Leasing	AMEN LEASE	-0.0076	0.3960*	-0.1284	0.5581**	-0.5330**
		(-1.04)	(1.85)	(-0.81)	(2.29)	(-2.50)
	ATL	0.0065	0.7975***	-0.0823	0.3638	-0.3366*
		(0.92)	(3.80)	(-0.53)	(1.56)	(-1.65)
	CIL	0.0034	0.4080**	0.1338	0.5483**	-0.3232
		(0.51)	(2.02)	(0.91)	(2.52)	(-1.70)
	GLEASING	-0.0076	0.4149**	-0.0868	0.4513**	-0.1929
		(-1.16)	(2.10)	(-0.60)	(2.14)	(-1.05)
	TLEASING	0.0051	0.6205***	0.4242***	0.0959	-0.3035
		(0.70)	(2.91)	(2.68)	(0.40)	(-1.43)
Investment	PLACTUNISIE	-0.0040	0.5662***	-0.0154	0.3926	-0.3129
		(-0.53)	(2.64)	(-0.10)	(1.61)	(-1.59)
	SPDIT	0.0219***	0.8737***	0.1077	0.3610	-0.2003
		(2.91)	(4.15)	(0.64)	(1.27)	(-0.78)
	TINVEST	0.0105*	0.6704***	0.2692*	0.3672	0.0922
		(1.64)	(3.32)	(1.70)	(1.53)	(0.39)

Table 6- *Continued*

Agro-alimentary	ALMAZRAA	0.0092	0.3808	-0.1263	0.6920***	-0.3582
		(1.21)	(1.76)	(-0.78)	(2.67)	(-1.57)
	SFBT	-0.0021	0.8344***	0.1366	-0.3868	-1.2829***
		(-0.28)	(3.87)	(0.85)	(-1.52)	(-5.76)
	TLAIT	0.0010	0.3981**	-0.2235	0.7713***	-0.0836
		(0.15)	(2.04)	(-1.42)	(2.76)	(-0.34)
Manufacturing	ALIQUIDE	0.0085	0.1075	0.1399	-0.6950***	-0.9653***
		(1.14)	(0.50)	(0.87)	(-2.80)	(-4.43)
	ALKIMIA	0.0134	0.5374**	0.5104***	-0.2974	-0.1777
		(1.87)	(2.54)	(3.28)	(-1.26)	(-0.86)
	SOTUVER	0.0009	0.7172***	-0.2383	0.1246	0.1959
		(0.13)	(3.40)	(-1.53)	(0.53)	(0.95)
	SPIDT	0.0106	0.9220***	-0.4290**	0.4614*	0.2633
		(1.43)	(4.29)	(-2.69)	(1.86)	(1.21)
	Mean vector	0.0053*	0.6836***	0.0289	0.1377	-0.1969*
		(1.64)	(5.90)	(0.39)	(1.14)	(-1.88)
	Statistic $\chi^2_{0,05}$			51.71		

Companies composing sectors are defined in Appendix. b_i, s_i, h_i and w_i are the specific coefficients in the regression: $R_i - R_f = \alpha_i + b_i[R_m - R_f] + s_i SMB + h_i HML + w_i WML + \varepsilon_i$, obtained by applying the random-coefficient model of Swamy (1970) already defined. Figures given in parentheses are the t-values of the specific coefficients. Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at the 1%, 5% and 10% level.

Table 6
Estimated and predicted costs of equity for the 6 sectors at 30th June 2006

Sector	b_i	s_i	h_i	w_i	Cost of equity
Banking	0.591***	0.049	-0.092	0.040	**8.40**
	(-11.50)	(0.94)	(-1.28)	(0.60)	
Insurance	0.447***	-0.031	0.398	-0.036	**8.56**
	(5.03)	(-0.30)	(0.95)	(-0.68)	
Leasing	0.527***	0.052	0.404***	-0.338***	**6.06**
	(5.95)	(0.45)	(4.26)	(-5.49)	
Investment	0.507***	0.137	0.330***	0.007	**8.52**
	(4.58)	(1.35)	(27.83)	(0.04)	
Agro-alimentary	0.538***	-0.071	0.359	-0.575	**4.33**
	(2.96)	(-0.54)	(0.78)	(-1.29)	
Manufacturing	0.571***	-0.004	-0.102	-0.171	**6.57**
	(2.85)	(-0.01)	(-0.35)	(-0.52)	

The costs of equity here are in percents. Companies composing sectors are defined in Appendix. b_i, s_i, h_i, and w_i are the specific coefficients in the regression (10), obtained by applying the random-coefficient model of Swamy (1970) already defined. The costs of equity are obtained by substituting the regression coefficients in the table and the risk premiums $R_m - R_f$, SMB, HML, and WML in table 3 into (21) and (22). Figures given in parentheses are the t-values of the coefficients. Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at the 1%, 5% and 10% level.