

The Three-Factor Model: Evidence from the Italian Stock Market

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Abstract

This paper describes the results obtained with the Fama-French model on the Italian Stock Exchange. The three-factor model was estimated on a sample of common stock during the period 1989-2004. The results found show that size has explanation power on the excess returns. In this paper, a comparison was made between one-factor model (CAPM) and the three-factor model. The size and beta show better explanation power if considered together. The results are similar to those of Fama and French (1998), and Cavaliere and Costa (1999). Unlike Cavaliere and Costa (1999), this work examines both variables size and book-to-market value. The results confirm a size effect.

Keywords: Three-Factor Model; Capital Asset Pricing Model; Italian Stock Market; Investment Decisions; Asset Pricing; Size Effect; Book-to-market.

1. Introduction

There are not many studies on the asset-pricing model in the Italian Stock Market. The asset-pricing model in general, and CAPM in particular, are employed for both stock pricing and DCF. Their applicability is fundamental because the major analysts use this procedure for their analysis on the stocks. The analyst's recommendations are based on the risk-return relationship; they sell these recommendations to investors. In the Discounted Cash Flow Analysis, in public and private investment, the "cost of capital" is calculated beginning from the CAPM.

Both DCF and CAPM procedures are currently employed also in Italy, and beta is the most widespread coefficient between the financial analysts. For this reason, the Italian Stock Market is mature to investigate the asset-pricing model.

The Capital Asset Pricing Model, as formulated by Sharpe (1964), Lintner (1965a), and Mossin (1966), shows the linear risk-return relationship. All variations in stock returns depend only on beta. Most empirical evidence documents that the beta and return relationship is weak (e.g. Lintner, 1965b).

The first tests were carried out to verify the CAPM on open mutual funds were carried out by Sharpe (1966) and Jensen (1967).

Sharpe (1966) examined the risk-return relationship of 34 mutual funds using the standard deviation as a measure of risk, and the results obtained appeared almost in line with the assumptions of the CAPM. He noted that the riskier funds recorded a higher performance than less risky funds and that the correlation between the average return and the standard deviation was statistically significant.

A second empirical study was carried out by Jensen (1967) on a sample of mutual funds in the period 1945-1964. However, this study differs from that of Sharpe for two reasons: the first is related to using the beta instead of the standard deviation, the second concerns the aims of the research. Jensen, in fact, studied the ability of fund managers to achieve returns higher than the level of risk. In other words, by examining the excess returns he indirectly verified the relationship inherent in the Capital Asset Pricing Model. The author examined during the reporting period 115 mutual funds confirming, on the one hand, the risk – return ratio, and, second, the validity of beta as the appropriate measure of risk.

Sharpe and Cooper (1972) investigate all shares listed on the U.S. stock market in the period 1931-1967 and find that there is a linear relationship between risk and return. Dividing the sample into 10 portfolios based on risk class, measured by beta, they conclude that portfolios with lowest betas are lower returns and vice versa for higher risk portfolios.

Black, Jensen and Scholes (1972) constructed a series of portfolios with different beta to test and find that the empirical results, while not reflecting expectations of the classic version of the CAPM, are in line with the zero betas CAPM.

Fama and MacBeth (1973), and Black (1993) document evidence supporting the CAPM "zero beta model". Ross (1976) and Roll (1977) criticize the CAPM and they suggest a multifactor approach called Arbitrage Pricing Model.

Basu (1977), for example, found a relationship between price/earning and return examining 1,400 companies listed on the NYSE in the period from 1957 to 1971. Basu shows that stocks with a low value of the price / earnings ratio recorded higher returns than those with high P/E, and to an extreme even compared to their level of systematic risk.

Banz (1981), for example, was the first to point out that the variable size is better able to interpret the layout of the CAPM theory; he detects the presence of a negative relationship between size and performance.

Rosenberg, Reid, and Lanstein (1985) find that average returns on U.S stocks are positively related to the ratio of a firm's book value of common equity, BE/ME. Chan, Hamao and Lakonishok (1991) find that book to market equity, BE/ME, also has a strong role in explaining the cross section of average returns on Japanese stocks.

Fama and French (1992) show that the beta as an explanatory variable of the risk – return relationship does not fully capture all of the risk factors. The two authors develop the three-factor model through which they show that the risk premium depends on the factor market, as stated by the CAPM, and on two other factors: the size of the company and the relationship between book value and market value. According to the authors, the empirical evidence shows that the three-factor model is able to explain the returns of equities.

Capaul, Rowley, and Sharpe (1993) observe a similar BE/ME effect in four European stock markets and in Japan.

Fama and French (1993) suggested the three-factor model that considers beta, size and book-to-market.

Further research by Fama and French (1995) found that a company with low profit had high book-to-market value (BE/ME), a strong company had high profit and low BE/ME.

For many years both academics and professionals have debated about the applicability of the CAPM in the "real world". Only such a robust theory, as CAPM, can resist numerous empirical attacks. However, the debate on the CAPM is not closed and in Italy it has just started. Our stock market is particular if we consider the number of companies listed and the ownership nature. The family company is the most widespread model of ownership structure, and the public company is desired. Some big state-owned companies have been listed after the privatization of certain economic sectors (e.g. Enel, Eni, BNL, etc.). The banks play a fundamental role in the Italian economic system and there are few institutional investors.

One of the main studies in Italy was carried out by Caprio (1989) which analyzes the CAPM considering a time horizon of about forty years. The author examines a sample of approximately 100 securities during the period December 1949 - December 1988 using as a proxy of the market portfolio both the "Il Sole 24 ore" index and the COMIT index. In particular, he divides this horizon in 7 five-year sub-periods and in one four-year sub-period and carries out both the time-series analyses and the cross section. The author's objective is twofold: on the one hand, to check the linearity between risk and return, and, whether the risk premium is positive. In general, the results achieved by Caprio seem to support the hypothesis of the Capital Asset Pricing Model. Specifically, "the systematic risk of equity investment is paid" and "residual risk is not rewarded." With regard to the second test, the risk premium, the data is not encouraging as the "premium time" is not statistically different from zero. However, the results seem to support the thesis of the model.

The current size of the Italian stock market in terms of value and number of listed companies can better test the asset pricing models than in the past. In this period there is an increase in the informational efficiency in our market. Some empirical evidence demonstrates that our market is weakly efficient. For example, Siciliano (1999) examined both the MIB and MIB30 and found that our markets were efficient. Like Siciliano (1999), Rossi (2005) also examined the weakly efficient market hypothesis. In particular, he investigated 50 stocks in the period 1998-2003 and found that the Italian Stock Market was more efficient than past years. Rossi (2005) didn't find a correlation between the performance in different periods and analyzing the dates daily, weekly and monthly showed that returns in our market don't have an overall correlation in the STAR market. Rossi (2005) also investigated the MIB30 and MIBTEL and

found similar results to Siciliano (1999). Our market is "mature" to be investigated in terms of risk-return relationship.

Fama and French (1998) confirmed their results on numerous stock markets and also in Italy. Fama and French (1998) find that the price ratios that produce problems for the CAPM in U.S. data show up in the same way in the stock returns of twelve non-U.S. major markets, and they are present in emerging market returns. This evidence suggests that the contradictions of the CAPM associated with price ratios are not sample specific. Davis (1994) confirmed the book-to-market effect in the US market.

The empirical evidence on the Three-Factor model (Fama and French, 1993), in Italy, is documented by Fama and French (1998), Cavaliere and Costa (1999), Aleati, Gottardo and Murgia (2000).

Cavaliere and Costa (1999), for example, investigated all Italian listed companies during the period 1986-1995 and found a relationship between beta and size. They also note the beta's tendency to increase with the size of the company.

Aleati, Gottardo and Murgia (2000) investigated the Italian stock market during the period 1981-1993 through the modified Three Factor Model to include other macroeconomic variables such as the change in interest rates and the default premium, and found that the relationship between beta and stock return is robust. The relationship between size and stock return depends instead on the estimation methodology.

Bruni, Campisi and Rossi (2006) found that the CAPM does not have a strong explanatory power and requires additional factors beyond the beta to better explain the risk-return relationship.

This paper examines the three-factor model on the Italian Stock Market during the period 1989-2004 through the time-series analysis. and also compares the explanatory power of one-factor CAPM with the three-factor model. Unlike Cavaliere and Costa (1999), this work examines both size and book-to-market.

2. Methodology

A sample of 109 common stocks listed on the Italian Stock Market was studied. The time series of prices for stock and COMIT Global Stock Price Index, a value-weighted index as proxy, comes from "Datastream". Every year sixteen portfolios from intersection between market value and BE/ME were sorted. The Book Equity represents the book value at the end of the company's fiscal year. The Market Equity is the market value of the company at the end of the fiscal year (December 31).

In June of year *t*, the monthly average returns of the portfolios were calculated for the next twelve months starting from July to June of the year *t*+1. After calculating the returns of the portfolios throughout the range investigated (fifteen years), we regressed the returns of each portfolio relative to the market resulting in the post-ranking beta.

Beta, size and BE/ME coefficients were estimated and the portfolios excess returns were calculated as a difference between the monthly average returns of the portfolios and the risk-free rate. The Market Risk Premium was calculated as the difference between monthly average returns of the "market portfolio" and the risk-free rate, and the portfolios were sorted starting from small (low) portfolios to big (high) portfolios.

The variables were estimated with the following equation:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p \left[R_{mt} - R_{ft}\right] + \lambda_p \left[SMB_t\right] + \mu_p \left[HML_t\right] + e_t \quad (1)$$

where:

$R_{pt} - R_{ft}$ is the portfolio excess return at time *t*; α_p, "alpha", it is the intercept; *p* is the number of portfolios (where p = 1,2,…16), *t* is the monthly observation (where t = 1, 2,….180). $[R_{mt} - R_{ft}]$ is the monthly difference between the return on the value-weighted "market portfolio" and the return on the risk-free rate (three-month treasury bill, so-called BOT or "Buoni Ordinari del Tesoro"). The variable SMB_t is the difference between small minus big portfolios returns. The variable HML_t is the difference between high minus low portfolios returns; β_p, γ_p, and μ_p are coefficients.

In addition two regressions were also estimated:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p (R_{mt} - R_{ft}) + e_t \quad (2)$$

and

$$R_{pt} - R_{ft} = \alpha_p + \lambda_p (SMB_t) + \mu_p (HML_t) + e_t \quad (3)$$

The (2) is the classic formula of the single-factor CAPM, and (3) is the two-factor model that considers size and BE/ME. Unlike the study by Fama and French (1992) using 25 portfolios, in this work 16 portfolios were constructed to address the lack of data making it a more reliable analysis.

3. Results

The returns of small portfolios are higher than big portfolios. The premium is bigger for small portfolios confirming the size and returns relationship (Table 1).

Table 1. The Average risk premium of the portfolios Size-BE/ME (1989-2004. The portfolios were formed starting from small (low) for large portfolios (high) portfolios. $R_{pt} - R_{ft}$ is the portfolio excess return at time *t*. It is the difference between monthly average returns of the portfolios and the risk-free rate (three-month treasury bill, the so-called BOT or "Buoni Ordinari del Tesoro"). * denotes the values' statistical significance at 5% level and better.

		Book-to-market value					
Size			1 (L)	2	3	4 (H)	
	R_p - R_f	Average	1.12%	0.20%	-0.27%	-0.70%	H - L
	1 (S)	0.41%	1.71%	0.36%	0.11%	-0.54%	-2.3%*
	2	-0.06%	0.89%	0.08%	-0.30%	-0.91%	-1.8%*
	3	0.10%	1.20%	0.22%	-0.28%	-0.73%	-1.9%*
	4 (B)	-0.10%	0.67%	0.15%	-0.60%	-0.62%	-1.3%
	S - B		1.04%	0.22%	0.71%	0.08%	

Table 2 shows the results from the one-factor model. In particular, the intercepts are often significantly different from zero, and beta's coefficients are always significantly different from zero. The R-squared are insignificant for smaller portfolios, while they are higher for bigger portfolios.

Also, the bigger portfolios for size are riskier than smaller portfolios.

Table 2. The results of the regression analysis from the one-factor model $R_{pt} - R_{ft} = \alpha_p + \beta_p (R_{mt} - R_{ft}) + e_t$. In June of year t, the monthly average returns of the portfolios were calculated for the next twelve months starting from July to June of the year t+1. The beta, size and BE/ME coefficients were estimated. $R_{pt} - R_{ft}$ is the portfolio excess return at time *t*. It is the difference between the monthly average returns of the portfolios and the risk-free rate (three-month treasury bill, the so-called BOT or "Buoni Ordinari del Tesoro"). $[R_{mt} - R_{ft}]$ is the monthly difference between the return on the value-weighted "market portfolio" and the return on the risk-free rate (BOT). The portfolios were formed starting from small (low) for large portfolios (high) portfolios. * denotes the values' statistical significance at 5% level and better.

α		Book-to-market			
		1	2	3	4
Size	1	1.70%*	0.35%	0.10%	-0.55%
	2	0.88%	0.07%	-0.31%	-0.92%*
	3	1.19%*	0.20%	-0.30%	-0.74%*
	4	0.66%*	0.13%	-0.61%*	-0.64%*
β		Book-to-market			
		1	2	3	4
Size	1	0.63*	0.79*	0.88*	0.80*
	2	0.83*	0.81*	0.86*	0.82*
	3	0.87*	0.80*	0.89*	1.12*
	4	1.11*	1.01*	1.02*	1.12*
R^2		Book-to-market			
		1	2	3	4
Size	1	15%	49%	48%	34%
	2	42%	58%	58%	58%
	3	54%	65%	62%	72%
	4	76%	77%	78%	82%

The results showed that R-squared for size and BE/ME, estimated with the two-factor model, are insignificant (Table 3). This demonstrates that size and book-to-market value without beta don't explain the excess returns. In addition, this work highlights that the coefficient size is almost statistically significant. The coefficient seems to suggest a positive, or negative, correction at the portfolios returns.

Table 3. The results of the regression analysis from the two-factor model $R_{pt} - R_{ft} = \alpha_p + \lambda_p (SMB_t) + \mu_p (HML_t) + e_t$. In June of year t, the monthly average returns of the portfolios were calculated for the next twelve months starting from July to June of the year t+1. The beta, size and BE/ME coefficients were estimated. The portfolios were formed starting from small (low) for large portfolios (high) portfolios. The variable SMB_t is the difference between small minus big portfolios returns. The variable HML_t is the difference between high minus low portfolios returns. $R_{pt} - R_{ft}$ is the portfolio excess return at time *t*. It is the difference between monthly average returns of the portfolios and the risk-free rate (three-month Treasury bill, the so-called BOT or "Buoni Ordinari del Tesoro"). * denotes the values' statistical significance at 5% level and better.

α		Book-to-market			
		1	2	3	4
Size	1	1.15%	0.68%	0.02%	0.07%
	2	0.84%	0.34%	0.17%	-0.71%
	3	1.15%	0.19%	-0.09%	-0.15%
	4	0.72%	0.18%	-0.39%	-0.45%
λ		Book-to-market			
		1	2	3	4
Size	1	1.17*	0.57*	0.68*	0.91*
	2	0.58*	0.42*	0.35*	0.35*
	3	0.02	-0.04	-0.15	-0.03
	4	-0.42*	-0.24	-0.40*	-0.35*
μ		Book-to-market			
		1	2	3	4
Size	1	-0.25	0.30*	0.03	0.56*
	2	0.04	0.24	0.38*	0.19
	3	-0.03	-0.02	0.12	0.41*
	4	-0.02	-0.01	0.09	0.07
R^2		Book-to-market			
		1	2	3	4
Size	1	23.0%	9.2%	10.3%	16.1%

	2	7.2%	5.8%	5.3%	3.8%
	3	0.0%	0.1%	1.3%	3.4%
	4	3.9%	1.6%	5.2%	3.4%

In this work was used the three-factor model and was found that intercepts are almost not significantly different from zero (Table 4). Further, were found that beta coefficients are always significantly different from zero and increase with the size-factor. The bigger portfolios are more risky than the smaller ones; the coefficients are almost statistically significant and decrease when the size increases.

Table 4. The results of the regression analysis from the Fama-French or three-factor model $R_{pt} - R_{ft} = \alpha_p + \beta_p (R_{mt} - R_{ft}) + \lambda_p (SMB_t) + \mu_p (HML_t) + e_t$. In June of year t, the monthly average returns of the portfolios for the next twelve months starting from July to June of the year t+1 were calculated. The beta, size and BE/ME coefficients were estimated. The excess returns were calculated as a difference between monthly average returns of the "market portfolio" and the risk-free rate. The portfolios were formed starting from small (low) for large portfolios (high) portfolios. The variable SMB_t is the difference between small minus big portfolios returns. The variable HML_t is the difference between high minus low portfolios returns.$[R_{mt} - R_{ft}]$ is the monthly difference between the return on the value-weighted "market portfolio" and the return on the risk-free rate (three-month Treasury bill, the so-called BOT or "Buoni Ordinari del Tesoro"). * denotes the values' statistical significance at 5% level and better

α		Book-to-market			
		1	2	3	4
Size	1	1.08%	0.61%	-0.06%	0.00%
	2	0.76%	0.27%	0.10%	-0.78%*
	3	1.08%*	0.12%	-0.16%	-0.24%
	4	0.63%	0.10%	-0.47%	-0.54%
β		Book-to-market			
		1	2	3	4
Size	1	0.80*	0.88*	1.00*	0.93*
	2	0.93*	0.89*	0.92*	0.89*
	3	0.91*	0.82*	0.90*	1.15*
	4	1.10*	1.02*	1.01*	1.12*
λ		Book-to-market			
		1	2	3	4
Size	1	1.43*	0.85*	0.99*	1.20*
	2	0.87*	0.70*	0.64*	0.63*
	3	0.30*	0.22*	0.14	0.33*
	4	-0.07	0.08	-0.08	0.00
μ		Book-to-market			
		1	2	3	4
Size	1	-0.25	0.30*	0.02	0.56*

	2	0.03	0.24*	0.38*	0.19*
	3	-0.04	-0.03	0.12	0.41*
	4	-0.03	-0.01	0.09	0.07
R^2		Book-to-market			
		1	2	3	4
Size	1	47%	68%	70%	59%
	2	58%	73%	69%	69%
	3	56%	66%	63%	76%
	4	76%	78%	79%	82%

The analysis also documents significant value, above all, for portfolios with higher BE/ME. The R-squared values of small size portfolios are higher if compared with small portfolios of the one-factor model. They range from 47% to 82%.

4. Conclusions

The results achieved with the three-factor model show that the beta alone cannot explain the risk-returns relationship. The results found are similar to those of Fama and French (1998), and Cavaliere and Costa (1999).

In this paper the inverse relationship between beta and size is confirmed. The values of "lambda" coefficients are almost statistically different from zero and it decreases when the size increases: the results exhibit a size-effect. The results of this study emphasize that the variable size accompanied by the beta seems to have a greater explanatory power. The beta, all statistically significant, does not decrease with increasing size, but on the contrary increases, and does not seem to follow particular patterns to increase the book-to-market value. The values of the "lambda" coefficient are almost always statistically significant, and decrease with increasing size, indicating a higher risk premium for riskier assets as predicted by the CAPM. In such circumstances, even the portfolio returns, with some exceptions, decrease, and this does not allow to reject the hypothesis of a relationship between performance and size. As for the relationship between yield and BE/ME there are no linear trends as in the work of Fama and French (1992).

Like in Cavaliere and Costa (1999) this work also confirms the trend in our beta to grow with the size measured by market capitalization, it also confirms the importance of the size factor in explaining stock returns. The results obtained with the three-factor model, then, seem to confirm the existence of additional factors that can explain better returns. This is not the only work in which doubts are expressed about the empirical validity of the CAPM, the results produced by the international literature are quite evident despite numerous efforts by supporters to defend the model.

Finally, they appear to suggest the presence of other factors beyond beta-coefficients. However, these results cannot be considered definitive because of the small number of observations examined. Additional investigations are necessary to confirm that beta-factor is not the only variable that is able to explain the excess returns.

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Notes

Note 1. The MIBTEL, MIB30, and MIB, are Italian "value-weighted" Stock Indices. The MIBTEL is a general index that includes all listed companies. Currently it is no longer active as it has been replaced by the FTSE Italy All-Share.

Note 2. The COMIT Global Stock Price Index is a general index that includes all Italian Stocks and the time-series is available from 1973. Unlike the MIBTEL the time-series is available from 1994.

Note 3. The dates come from Datastream.

Note 4. The data on the risk-free rate comes from "Indici e dati relativi ad investimenti in titoli quotati", Mediobanca, various years.

Note 5. The t-test values are available from the author.