An Empirical Investigation of the Italian Stock Market based on the Three Factors Model

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Abstract: In this paper we show that the Three Factors Model developed by Fama and French can be applied to a relatively small market as the Italian Stock Market. We employ a two step empirical analysis on the Italian Stock Market data from 1-jan-1980 to 1-apr-2002. We estimate the restricted model, with the pricing errors equal to zero, through the approach of Generalized Methods of Moments (GMM) that required very weak statistical assuptions. The key findings of the paper are: 1-The "size premium" for stocks shown seems to be confirmed for a domestic Italian investor, but, the "value premium" appears to be statistically weakly different from zero. 2-The pricing errors appear to be not different from zero in most of the portfolios. 3-The GMM test of the Three Factors Model appears to support the Fama and French Model applied to the Italian Stock Market.

Keywords: *Asset Pricing, GMM, Three Factor Model*

1 Introduction

In 1992 Fama and French published a paper which shows a strong evidence of explanatory power by factors, as the size and the book to market value, for the cross-sectional variation of asset returns, compared with a little or no capacity in explaining it by the beta. After this well known paper a large body of literature has proof about the evidence that beta has a little explanatory capacity for asset returns. Empirical works have mostly used US data and most of them reject beta and CAPM model (i.e. Grinold [1993], Davis [1994] and Fama and French [1993, 1995, 1996]). In an another landmark paper, Fama and French [1993] proceed to a time-series analysis finding basically the same evidence. Despite the fact that this model is a landmark in the asset pricing theory very little evidence has been published concerning other markets than the US one. The goal of this paper is to examine whether it is possible to apply the Three Factors Model to a relatively small Stock Market as the Italian Stock Market. The paper is organized as follows: in section 2 we review the main theoretical and empirical contributions identifying the factor structure of equity returns. In section 3 we present the theoretical background of the Three Factors Model and the empirical specification used to test it. In section 4, we discuss the data used for the empirical analysis and we explain the procedure adopted to costruct the portfolios and the mimicking portfolios for the explanatory factors. In the section 5 we present the results while section 6 concludes.

2 Factor Structure and equity returns

The seminal work by Fama and French (1992) (hereafter FF) tries to explain how the stock equity returns depend not only on market factor measured in the classical theory of CAPM by the β, but also on other factors. In particular, they find that the strongest consistency in explaining the average returns is represented by size and book-to-market value or indifferently the earning-price ratio, the cash-price ratio or the dividend-price ratio[1]. Adding more factors than two does not improve the

[1]According to Gordon's formula good economic proxies for the book-to-market ratio are: dividend-to-price ratio, cash-to-price ratio and earning-to-price ratio. An alternative measure of the past growth of a firm is given by growth in sales that are less volatile than either cash flow or earnings. Concerning this point see Lakonishok, Shleifer and Vishny [1994] and Fama and French [1998].

estimates obtained by the three factor models. In the next two subsections we try to identify the different factors explaining stock returns reviewing the main theoretical and empirical works on this subject. The first section considers country factors in a national asset pricing model; the last one is based on the main contributions considering the international pricing models.

2.1 Theoretical and empirical considerations

As discussed in FF (1992) some critics to the standard CAPM model emergerd just in the eighties: for example, Bhandari (1988) notes a positive relation between the firm leverage and the stock average return; Rosemberg, Reid and Lanstein (1985) find that the U.S. stock average returns are positively linked to the book-market value ratio. What FF (1992) add to the previous literature is the joint role of market β, size, earning-price ratio, leverage and book-to-market ratio with reference to NYSE, AMEX and NASDAQ stock returns. In their seminal work they show that the CAPM model does not work in the U.S. market for the all period between 1941-1990. In particular, they show the existence that the univariate relations between average return and size, leverage, E/P, and book-to-market equity are strong. The main conclusion of FF (1992) is that stock risks are multidimensional: one dimension of risk is proxied by size, the other one is proxied by the ratio of the book value of common equity to its market value. In this way FF (1992) confute the role of β in the explanation of the stock returns; in other terms if there is a role for β in average returns, it has to be found in a multi-factor model. Following this paper Fama and French (1993) developed a time-series model extended to the bond market. This extention implies the consideration of two more risk factors: one related to the maturity risk and the other one to the default risk. This further development is important because since the stock market and the bond market are not segmented the term-structure factors capture many stock return variation. In other words a market portfolio of stocks captures the common variation in stock returns associated with five factors: three stock market factors and the two term-structure factors. Even if the pioneer works by FF (FF, 1992 and FF, 1993) have given origin to a new and rich stream of the literature their results are not immune by critics. Critics (see, for example, De Bondt and Thaler [1985], Lakonishok, Shleifer and Vishny [1994], Haugen, [1995], MacKinlay [1995] and Knez and Ready [1997]) are mainly founded on the observation that the violations of the CAPM model are not simply linked to missing risk factors as in FF but to the existence of market imperfections, to the presence of irrational investors and to the inclusion of biases in the empirical methodology.

On one hand, De Bondt and Thaler [1985], Lakonishok, Shleifer and Vishny [1994] and Haugen, [1995] argue that the so called “value” strategies - small market capitalization and high book-to-market equity stocks - yield higher returns than “glamour” strategies - large market capitalization and low book-to-market equity stock - because of investor overreaction rather than compensation for risk bearing. Contrary to FF, Lakonishok, Shleifer and Vishny [1994], with reference to the US stock market (NYSE and AMEX) from April 1968 to April 1990, find little support for the view that value strategies are fundamentally riskier than glamour strategies. Other authors - see, for example, Jegadeesh and Titman [1993] and Rouwenhorst [1998] - advance critics both to FF argument and to De Bondt-Thaler, Lakonishok-Shleifer-Vishny and Haugen counterargument. They assert that the relevant period to evaluate the performance is the medium-term and not the long-term. They document that over a medium time horizon performance persists: firms with high returns over the past three months to one year continue to outperform firms with low past returns over the same period. In other terms the momentum effect holds[2]. On the other hand, MacKinlay [1995] and Knez and Ready [1997] base their arguments on the empirical methodology. In particular, MacKinlay [1995] evaluates the plausibility of multifactors models *à la* FF using *ex ante* analysis instead of *ex post* analysis. They show that, *ex ante*, CAPM deviations due to missing risk factors will be very difficult to detect empirically, whereas deviations resulting from nonrisk-based sources are easily detectable. Another empirical test of the FF multifactor model is advanced by Knez and Ready [1997]. In particular, they find that the FF “size” effect is completely driven by sample extreme observations that represent less than 1% of each month’s data. The Least Trimmed Squares (LTS) regression used instead of the OLS regression of FF implies that most small firms actually do worse than larger firms. The result obtained by Knez and Ready [1997] is particularly relevant for the Italian Stock Market formed for most by small firms. However, further empirical analysis would be useful to accept such a result as an economic regularity rather than a sampling error. Concerning this point many authors (see, for exam-

[2] In the rest of the paper we show that with reference to the Italian Stock Market there is no evidence of any momentum effect. See section 5.

ple, Ferson, Sarkissian and Simin [1999]) cautions against using empirical regularities as "explanatory risk factors". One way to test the empirical validity of FF three factors model is to use international data.

2.2 International factors

An extension of the multifactors model to an international framework is advanced by Fama and French [1998]. They argue that an international CAPM cannot explain the difference between value stock returns and glamour stock returns. After having observed that there is evidence of an existing value premium in twelve markets outside the U.S. during the 1975-1995 period, FF (1998) show that an international three-factor model that includes a risk factor for relative distress seems to capture the value premiun in the returns for major markets. This result holds also for emerging markets. However, they do not compare the world factor model to country-specific models. In the effort to understand if the explanatory power of world factors are driven by the country-specific components Griffin (2002) proceeds to this comparison. In particular, he finds that the domestic models explain more time-series variation and generally provide more accurate pricing than the world model. In summary, there are no benefits to extending the three-factor model to an international context[3].

3 THEORETICAL BACKGROUND

The aim of this section is to test the Fama and French Three Factor Model [FF, 1992 and FF, 1993] on the the Italian Stock Market. As anticipated in the previous section FF found a strong evidence of capacity in explaining cross sectional [FF, 1992] and time series [FF, 1993] asset returns by variables as the firms' size and the book-to-market ratio. The Fama and French model can be expressed as follows:

$$\begin{aligned} E(ExR_i) &= b_i E(ExRm) + \\ &\quad c_i E(SMB) + d_i E(HML); \end{aligned} \tag{1}$$

where ExR_i is the excess return on asset i, $(R_i - R_f)$ $[i = 1..N]$; $ExRm$ is the excess return on market portfolio; $(R_m - R_f)$; SMB is the return on the mimicking portfolio for the size factor; HML is the return on the mimicking portfolio for the value-growth factor; R_f is the return on a risk-free asset. To test this model it is necessary to estimate the following equation:

$$\begin{aligned} R_{it} - R_{ft} &= a_i + b_i(R_{mt} - R_{ft}) \\ &\quad + c_i SMB_t + d_i HML_t + \varepsilon_{it}. \end{aligned} \tag{2}$$

For doing it we perform a two step test. i) First we test the unrestricted model with the classical OLS method for finding the consistence of the model and to investigate if the pricing errors (alpha) are not significantly different from zero. In fact, comparing the equations [1] and [2], it appears obvious that the model has one important implication: the intercept term (alpha) in a time-series regression should be zero, that means the alpha of the model is equal to the pricing error. Given this implication we use the Black, Jensen and Scholes [1972] approach for evaluating this assumption: bassically we run a time-series regression for each asset to be tested and then we use the standard OLS t-statistics for testing if the pricing errors (alpha) are zero. ii) After this empirical analysis we use the Generalized Methods of Moments (GMM) to test the resticted (alpha=0) FF Model. The GMM framework allows us to avoid the assumption that the asset returns are normally distributed and temporarily i.i.d. The basic idea of GMM procedure is to choose the parameters to be estimated so as to match the moments of the model itself with the empirical moments of the data. The main advantage of GMM procedure is that the statistical assuptions required are very weak. The resticted model to be estimated is:

$$\begin{aligned} R_{it} - R_{ft} &= b_i(R_{mt} - R_{ft}) \\ &\quad + c_i SMB_t + d_i HML_t + \varepsilon_{it}, \end{aligned} \tag{3}$$

with 4N sample moment condition for each portfolio and 3N parameters to be estimated. We can test the N over-identifying restrictions using the GMM-statistic that is the minimized value of the objective function. We compute the GMM-statistic as:

$$GMM = m(\theta)' S^{-1} m(\theta); \tag{4}$$

where $m(\theta)$ is the empirical vector of moment conditions; S is the weighting matrix used for estimating the parameters. Under the null hypothesis that the over-identifying restrictions are satisfied, the GMM-statistic times the number of regression observations is asymptotically χ^2 with degrees of

[3] For more developments on the international multifactos models see, among others, Stulz (1995),

freedom equal to the number of over-identifying restrictions. Finally for calculating the standard errors of our estimated parametrs we use the Newey and West [1987] variance-covariance estimator.

4 DATA

The data used for testing the Three Factors Model are derived from the close price of the entire Italian Stock Market for the period between the 1-jan-1980 and 1-apr-2002. The total number of assets included is 587 and the frequency is monthly. We included 287 stock from MIBTEL Index, 45 stocks from NUMTEL Index and 255 stock from the DEAD-STOCKS Index[4] for avoiding possible survivor biases. The source is DataStream. We compute the return on a single asset as:

$$r_t = \frac{p_t - p_{t-1}}{p_{t-1}} + dy_t; \quad (5)$$

where p_t = price at time t; dy_t= estimated monthly dividend yield at time t. In order to estimate the monthly dividend yields, we spread the correspondent annual dividend yields supplied by DataStream so that, coupounding the monthly dividends gives back exactly the annual dividends. The risk-free asset used in our empirical tests is the 1-months ITL Euro-Currency.

4.1 Risk factors

In order to obtain the mimicking portfolios for the factors, we construct three groups of assets based on Size tertiles and 3 groups of assets based on the Price-Earnings ratio (P/E) tertiles. By the intersection of these groups we obtain 9 portfolios named as R1V, R2V, R3V, R1M, R2M, R3M, R1G, R2G, R3G; where for example R3G is the portfolio containing the firms with an high P/E ratio (growth firms) and a high Market Value (big firms). On those portfolios we calculate the value weighted returns. Each portfolios is rebalanced every year[5].

The next step is to costruct the risk factors:

i) Market Factor (MKT): index constructed by calculating the value weighted return of all the assets listed. The risk factor is calculated by subtracting the risk free rate[6].

[4]The list of dead stocks is provided by DataStream.

[5]Due to lack of data the first available period for constructing all the tertiles is 1-jan-1986.

[6]To confirm the correctness of our methodology we calculate the correlation between the Market Factor and the Morgan Stanley Capital International Index (MSCI ITALY). The result is more than comforting: 98% on the entire sample period.

ii) Size Factor (SMB): mimicking portfolio constructed by calculating the difference between the simple mean of the returns on the “small firms” portfolios and the return on the “big firms” portfolios:

$$SMB_t = \sum_{i=V,M,G} \frac{1}{3} R1i_t - \sum_{i=V,M,G} \frac{1}{3} R3i_t. \quad (6)$$

iii) P/E Factor (HML): mimicking portfolio constructed by calculating the difference between the simple mean of the returns on the “value firms” portfolios and the return on the “growth firms” portfolios[7]:

$$HML_t = \sum_{i=1}^{3} \frac{1}{3} RiV_t - \sum_{i=1}^{3} \frac{1}{3} RiG_t. \quad (7)$$

Last step before starting the empirical tests is to construct the portfolios of which the returns has to be explained in the Three Factors Model. To obtain the dependent variables of our time-series regression we costruct sixteen portfolios based on “value-growth” ranking and on “size” ranking of the firms.

If we identify two distinct set of assets as GV (four groups of assets based on P/E ratio quartiles) and SZ (four groups of assets based on Market Value quartiles), we can obtain, from the intersection of GV and SZ, sixteen portofolios and we can calculate the value weighted returns as the returns calculated for the mimicking portfolios (see above in this section).

4.2 Preliminary analysis

As expected, the correlations between the three factors are low and in two cases are not statistically different from zero[8]. This result is consitent with the FF model and allows us in using the three series for testing the model. Moreover, all the mimicking portfolios series show a consistent evidence of non normality in the monthly returns. This is consistent with a a well known literature (see for example Fama [1965, 1976] or Blattemberg and Gonedes [1974]). This evidence lead us to use the GMM framework for testing the restricted model as

[7]We use the Price-Earning ratio (P/E) instead of the Book-to-Market ratio used by Fama and French for two main reason. First of all our choice is due to the avaiability of the data for the Italian Market; second because the P/E ratio is well accepted in literature as proxy to identify a firm as a “value” or as a “growth” firm.

[8]A simple method to test the null hypothesis that the product moment correlation coefficient is zero can be obtained using Student’s t-test on the t statistic $T - stat = \rho\sqrt{N-2}/\sqrt{1-\rho^2}$, where N is the number of observations. Under the null hypothesis that the correlation between the two variables is not significantly different from zero, the t-statistic is distribuited as a Student’s t with $N-2$ degrees of freedom.

explained above. Generally speaking all the constructed portfolios show annualized returns statistically significant[9], and, going deeper in our analysis, is possible to investigate some characteristics of the Italian Market. The annualized return on the "size" mimicking portfolio (SMB) is about 13% with a 20% of volatility and appears to be statistically significant. This is consistent with the theory of a risk premium for the small firms. On the contrary the annualized return of the "value-growth" mimicking portfolio (HML) is about 7,5% with a volatility of 17,5% and it appears to be statistically weakly different from zero. Finally the annual excess return of the Market index (MKT) is about 11,36% with a volatility of about 25% and, hence, consistent with the assumption of risk aversion[10].

5 RESULTS

footnoteIn order to keep this version of the paper brief, we omitted all the detailed tables. All of them are available from the authors The results for the OLS analysis to test if the pricing errors (alpha) are different from zero can be summarized as follows: in fiftheen portfolios the intercept term is not statistically significant. Looking at the classical OLS statistics, we cannot reject the null hypothesis (5% confidence level) of alpha=0 only in portfolio R44. In this case the composition of the portofolio is based on only few assets for the first observations due to lack of data. This characteristic can lead the model to be rejected because, in practice, we are testing with the same regression two totally different "assets": a single stock in the beggining of the sample and a diversified portolio in the remaining period. The results for the GMM analysis to test if the Three Factors Model developed by FF can be applied to the Italian Stock Market can be summarized as follows: The results seem to support the model; we find an R^2 range between 0.39 and 0.89 and, in nine of the portfolios, the model cannot be rejected, as the p-values of the GMM statistics show, with a 5% of confidence level. We reject the null hypothesis that the overidentifying restrictions are satisfied in portfolios R12, R21, R32, R33, R41, R43 and R44. For understanding the motivation behind the rejection of the null hypothesis in those portfolios, we investigate if there are other factors that can be used in the model. In order to to that first of all we estimate the unrestricted model of equation 2 with a GMM procedure for finding if the model has some pricing errors[11]. Then we try to estimate a model with other mimicking factors. The most natural thing is to investigate if there is some momentum effect in the Italian Market as in other stock markets (see Rouwenhorst [1998]). For doing that we construct another mimicking portfolio based on the difference between the stock with the highest past year's average returns and the stock with the lowest past year's average returns. In pratice we construct three groups of assets based on Size tertiles and 3 groups of assets based on the past year's returns tertiles. By the intersection of these groups we obtain 6 portfolios named as R1W, R2W, R3W, R1WL, R2WL, R3WL, R1LS, R2LS, R3LS; where for example R3W is the portfolio containing the "winners" with a high Market Value. The factor is: W/L Factor (WML): mimicking portfolio constructed by calculating the difference between the simple mean of the returns on the "winners" portfolios and the return on the "losers" portfolios:

$$WML_t = \sum \frac{1}{3} RiW_t - \sum \frac{1}{3} RiLS_t. \quad (8)$$

The annualized return on the momentum mimicking portfolio (WML) is about -1,5% with and appears to be statistically non different from zero. This is an evidence of absence of momentum effect in the Italian Stock Market. However the correlation with the other factors (SMB HML MKT) is respectively 0.07, 0.03 and 0.09 and is never statistically significant. The new resticted model to be estimated is:

$$\begin{aligned} R_{it} - R_{ft} &= b_i(R_{mt} - R_{ft}) \\ &\quad + c_i SMB_t + d_i HML_t \\ &\quad + e_i WML_t + \varepsilon_{it} \end{aligned} \quad (9)$$

with 5N sample moment condition for each portfolio and 4N parameters to be estimated. Hence we get again N over-identifying restrictions. The results for the GMM analysis of restricted model with the momentum mimicking factor can be summarized as follows: all the seven portfolios present evidence of pricing errors, with all the constant terms significant at 5% confidence level. On the contrary we reject the null hypothesis that the overidentifying restrictions are satisfied in all the portfolios for

[9] In this case for testing the null hypothesis that the returns are significantly different from zero we use the classical t-statistic: $T - stat = \mu\sigma^{-1}N^{-1/2}$, where N is the sample period; μ is the mean return; σ is the volatility. Under the null hypothesis that the return is equal to zero the t-statistic is distribuited as a Student's t with N degrees of freedom.

[10] Considering the sample period 1-jan-1986 to 1-apr-2002, the t-stat. of the annual excess return on the market index is 1,77 and seems to be statistically weakly different from zero. But, on the other hand, if we consider the entire sample period, from 1-jan-1980 to 1-apr-2002, we find an annual excess return of 17,2% with a volatility of about 27% and a t-stat. of 2,56.

[11] In this case we use GMM procedure for estimating the unrestricted model for avoiding possible biases given by the distribution assumption.

the model with the momentum factor (see table 3). It seems possible to conclude that there is no momentum effect in the Italian Stock Market.

6 Conclusion

The key findings of our work are three: first of all, the size premium seems to be confirmed for a domestic Italian investor, on the other hand the value premium is statistically weakly different from zero for the Italian Market. Then the pricing errors appears to be not different from zero in most of the portfolios; when they are not it is probably due to the composition of the portolios that, being formed by only few assets at the beggining, may present a bigger variance of the disturbance term that can affect the model specification. Then the GMM test of the Three Factors Model appears to support the FF Model applied to the Italian Stock Market with an R^2 range between 0.34 and 0.89. In nine portofolios the GMM-statistics show a p-value that lead us to conclude that the null hypothesis that the overidentifying restrictions are satisfied, cannot be rejected. Finally we investigate if there is some evidence of momentum effect but we have found no evidence of it on the Italian Stock Market. Further research, both theoretical and empirical, could come from an extension of the model referred to the Italian Market. In particular, considering the anomaly of an high risk free rate that we can find during 80's in Italy, it seems interesting to investigate if others factors related with the yield curve can help to explain the asset returns.

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