An Empirical Investigation of the Italian Stock Market Based on the Four-Factor Pricing Model

Paola Brighi[1] and Stefano d Addona[2]

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Abstract:

Aim of this paper is to identify the pricing factor structure of Italian equity returns. The Italian Stock Market is characterized mainly by small quoted firms. Small stocks have higher beta but beta differences are not enough to explain returns differences. We investigate how these differences can be explained by other factors like size, value and momentum. A two step empirical analysis is provided where first we estimate an unrestricted three factor Model to test if there is any evidence of mispecification. Secondly, we estimate the restricted model, with pricing errors equal to zero, through the Generalized Methods of Moments (GMM). Key findings of the paper can be classified as follows:

1-The size premium for stocks shown in literature seems to be confirmed for a domestic Italian investor, on the contrary the value premium appears to be statistically weakly different from zero. Furthermore, augmenting the model with a momentum factor does not improve its performance.

2-Pricing errors appear to be not statistically different from zero in most of the analyzed portfolios, few exceptions are probably due to the small number of stocks composing them.

3-The GMM test of the Three Factors Model appears to support the Fama and French Model applied to the Italian Stock Market.

1 Introduction

In 1992 Fama and French (hereafter FF) published a landmark paper in which it is shown - with a cross-sectional analysis - strong evidence of explanatory power by size and book to market factors, compared with a little or no capacity by the beta to explain equity returns differences. After them a large body of literature come out with evidence of little explanatory power by beta for explaining asset returns. Empirical works have mostly used US data and most of them reject beta and CAPM model (see, for example, Grinold, 1993).

In another paper, Fama and French (1993) - using a time-series approach - find basically the same evidence. Despite the fact that this model is a landmark

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[1] University of Bologna - Department of Economics, Strada Maggiore 45, 40125 Bologna. e.mail: paola.brighi@unibo.it. Ph. +39 051 2092636, Fax. +39 051 2092664.

[2] University of Bologna - Department of Economics, Strada Maggiore 45, 40125 and Columbia Business School -Doctoral Program-3022 Broadway, 311 Uris Hall New York, NY 10027. Email: sd2123@columbia.edu.

in the asset pricing theory little evidence has been published concerning international markets, with some exceptions for Japan (Chan et al., 1991, Daniel et al., 2001 and Charitou and Constantinidis, 2004) and UK (Fletcher, 1997, Strong and Xu, 1997, Gregory et al., 2001, Levis and Liodakis, 2001 and Daniel et al, 2004). Regarding small markets only recently a few papers have been published[3]. Concerning the Italian Stock Market some results have been recently produced on the empirical relevance of Fama and French three factors model (Aleati, Gottardo and Murgia, 2000 and Beltratti and Di Tria, 2002), on the source of momentum and contrarian strategies (Mengoli, 2004) and on the relation between equity returns and macroeconomic forces (Panetta, 2002). Following Fama and French (1993) we investigate the factor structure of the Italian Stock Market, through a GMM test of the Fama and French model augmented by a momentum effect from 1986 to 2004. Our empirical analysis shed further light on the relevance of different factors than beta - as size, book-to-market value and momentum effect - to explain equity returns differences. 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 describe the data used for the empirical analysis and we explain the procedure adopted to construct the portfolios and the mimicking portfolios for the explanatory factors. Section 4 presents the results while section 5 concludes.

2 The theory of the factor structure determining equity returns

Even if the CAPM by Sharpe (1964), Lintner (1965) and Black (1972) (hereafter SLB) has been extensively studied and accepted, there is strong evidence in the literature rejecting its validity (see, for example, Grinold, 1993 and Fama and French, 1996b). Many attempts have been made to extend the one-factor model by SLB to multifactor models in order to explain better average returns. This approach is based on the empirical evidence that the intercept of the linear function of the CAPM is statistically different from zero: i.e. the beta does not explain alone the stock average returns.

The seminal work by Fama and French (1992) shows how the stock returns differences are better explained by other factors than the market, as instead postulated by the classical theory of SLB. In particular, they find that the strongest consistency in explaining the average stock returns is represented by size and book-to-market value or equally the earning-price ratio, the cash-price ratio or the dividend-price ratio[4]. Unlike to the past literature on the Arbitrage

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[3] See, for example, L'Her et al., 2004 for Canada; Asgharian and Hansoon, 2002 for Sweden; Di Iorio and Faff, 2000 and Faff, 2001 for Australia.

[4] As suggested by Lakonishok, Shleifer and Vishny [1994, p. 1547] B/M is not a clean variable uniquely associated with economically interpretable characteristics of the firms however they can be succesfully proxied by the market's expectations of future growth and the past growth of the firms involved. The expected growth can be proxied by various measures of profitability to price that according to Gordon's formula are: dividend-to-price ratio (D/P),

Pricing Theory[5], FF (1992) suggest that adding more factors than two does not improve the estimates obtained by their model on stock returns[6]. However, after FF some authors find evidence in favour of a third pricing factor known as the momentum factor (see, for example, Jegadeesh and Titman, 1993). Coherently with our econometric investigation in the next two subsections we review the main theoretical and empirical works on the different pricing factors as size, book-to-market value and momentum in a national asset pricing perspective.

2.1 Literature review

2.1.1 Theoretical models

The FF thesis As discussed in FF (1992) some critics to the standard SLB model emergerd just in the eighties: for example, Banz (1981) shows that the firm size improves the estimation of the stock average return; Bhandari (1988) notes a positive relation between the firm leverage and the stock average return; Stattman (1980) and Roseberg, Reid and Lanstein (1985) find that the U.S. stock average returns are positively linked to the book-market value ratio; Basu (1983) shows that the earning-price ratio improves the estimation of the U.S. stock cross-section average returns when in the statistical test it is considered the firm size and the market β at the same time.

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 SLB model does not work in the U.S. market for the all period between 1941-1990. In particular, they show that the univariate relation between average return and size, leverage, E/P, and book-to-market equity are strong. In multivariate tests, the negative relation between size and average returns is robust to the inclusion of other variables. The positive relation between book-

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cash-to-price ratio (C/P) and earning-to-price ratio (E/P). An alternative way to classify stocks is based on past growth rather than on expectations of future growth. In this case past growth is measured by growth in sales since sales is less volatile than either cash flow or earnings. The above analysis supported empirically by Lakonishok, Shleifer and Vishny [1994] and by Fama and French [1998] implies that to estimate stocks value we can choose among our regressors indifferently the ratios B/M, D/P, E/P and C/P. This is the reason why - without any loss of generality - in our following econometric analysis we use the ratio E/P instead of B/M. Another way to proxy the B/M ratio is through the Tobin's Q, which is in turn a measure of future investment opportunities. We thank an anonimous referee to have helped us to clarify this point.

[5] See Ross, 1976, Roll and Ross, 1980, Chen et al., 1986 and Asprem, 1989.

[6] In a augmented FF model augmented by macro factors - as industrial production growth, consumer prices, both expected and unexpected, risk premiums, interest term structure, the federal funds rate, housing starts, the producer index and an idiosyncratic return proxy - Merville et al. (2001) find that the most significant factors for an individual common stock can be associated to: i) the market return - beta; ii) the market capitalization - size; and iii) the investment opportunity set - value. Higher-order factors can be uniquely associated with macroeconomic variables that, however, add little explanatory power to the standard three FF model.

to-market equity and average returns also persists in competition with other variables.

Moreover, FF (1992) show that even if the size factor has attracted more attention among the researchers the book-to-market equity has a consistently stronger role in average returns.

The FF (1992) analysis finally implies that, first the SLB market ¯ is not so useful to understand the cross-section of average stock returns in U.S. and second the combination of size and book-to-market equity seems to absorb the roles of leverage and E/P in average stock returns. In other terms, 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 ¯ in the explanation of the stock returns; in other terms if there is a role for ¯ in average returns, it has to be found in a multi-factor model.

Critics to FF model 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 based on the observation that the violations of the SLB 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 the 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. They argue that investors systematically overreact to recent corporate news, unrealistically extrapolating high or low growth into the future. This, in turn, leads to underpricing of value and the overpricing of glamour stocks. The value strategies produce higher returns because these strategies exploit the suboptimal behavior of the typical investor and not because these strategies are fundamentally riskier.

Unlike 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.

So the reason of the controversy is not the fact that value strategies perform better than glamour strategies - on which there is some consensus at the least with reference to US markets[7] - but the reason of why this happens. According to Lakonishok, Shleifer and Vishny [1994] the reason has to be found in the

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[7] In fact concerning the Italian Stock Market the value premium does not hold at all for the entire period considered (January 1980-April 2002). See section 5.

irrational behavior of investors[8].

On the other hand, MacKinlay [1995] and Knez and Ready [1997] base their arguments on the empirical methodology. 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 be empirically detected, whereas deviations resulting from nonrisk-based sources are easily detectable. They finally conclude that multifactor pricing models alone do not entirely resolve CAPM deviations. The empirical test of the FF multifactor model conducted by Knez and Ready [1997] suggest that the "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. In fact, the LTS regression implies a positive relation between firm size and average return that is exactly the opposite of what FF obtained in their study. 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 example, 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.

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 à la SLB 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. Griffin (2002) compares the world factor model to country specific models and finds that the domestic models explain more time-series variation and generally provide more accurate pricing than the world model. Moreover, he does not find any benefits from the extension of the FF three factors model to a global context. Even if from a statistical point of view the world model seems more significant than a country model, from an economic point of view it implies a small increase in explanatory power. In fact, the country-specific three model has lower in-sample and out-of-sample pricing errors than models that include foreign factors. In summary, there are no benefits to extending the three-factor model to an international context[9].

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[8] For further developments on this point see, for example, Shefrin [2001].

[9] For more developments on the international multifactos models see, among others, Kora-

The momentum effect

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2.1.2 Empirical models

The cross-section approach

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The time-series approach

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3 Data and methodology

The aim of this section is to test the Fama and French Three Factor Model [FF, 1992 and FF, 1993] on 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:

$$[1] \qquad E(ExR_i) = \beta_i E(ExRm) + \gamma_i E(SMB) + d_i E(HML);$$

where:

ExR_i = excess return on asset i, $(R_i - R_f)$ where $i = 1; \ldots; N$;

$ExRm$ = excess return on market portfolio, $(R_m - R_f)$;

SMB (Small Minus Big) = the return on the mimicking portfolio for the size factor;

HML (High Minus Low) = the return on the mimicking portfolio for the book-to-market factor;

R_f = return on a risk-free asset.

To test this model it is necessary to estimate the following equation:

$$[2] \qquad R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \gamma_i (SMB_t) + \delta_i (HML_t) + \varepsilon_{it}:$$

To estimate the above equation 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 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

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jczyk and Viallet (1989), Bansal, Hsieh and Viswanathan (1993), Stulz (1995), the model is equal to the pricing error. Given this implication we use the Black, Jensen and Scholes [1972] approach for evaluating this assumption: basically 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:

$$[3] \qquad R_{it} - R_{ft} = \beta_i (R_{mt} - R_{ft}) + \gamma_i (SMB_t) + \delta_i (HML_t) + \varepsilon_{it} \qquad [i = 1 \ldots N]$$

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:

$$[4] \qquad GMM = m(\theta)' S^{-1} m(\theta)$$

where:

$m(\theta)$ = empirical vector of moment conditions;

S = weighting matrix used for estimating the parameters.

Under the null hypothesis that the overidentifying restrictions are satisfied, the GMM-statistic times the number of regression observations is asymptotically χ^2 with degrees of freedom equal to the number of overidentifying restrictions. Finally for calculating the standard errors of our estimated parametrs we use the Newey and West [1987] variance-covariance estimator.

3.1 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[10] for avoiding possible survivor biases[11]. The source is Datastream.

We compute the return on a single asset as:

$$[5] \qquad r_t = \frac{p_t - p_{t-1}}{p_{t-1}} + dy_t$$

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[10] The list of dead stocks is provided by Datastream.

[11] See Banz and Breen (1986) and Fama and French (1998).

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, compounding 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.

3.2 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[12].

The next step is to construct 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[13].

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:

$$[6] \qquad SMB_t = \sum_{i=V;M;G} \tfrac{1}{3} Ri1_t - \sum_{i=V;M;G} \tfrac{1}{3} Ri3_t:$$

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[14]:

$$[7] \qquad HML_t = \sum_{i=1}^{3} \tfrac{1}{3} RiV_t - \sum_{i=1}^{3} \tfrac{1}{3} RiG_t:$$

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

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

[13] 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.

[14] 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. See also footnote 5.

dependent variables of our time-series regression we construct 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 Results

4.1 Summary statistics

The whole sample period is January 1986-September 2004. As expected, table 1 shows that the correlations between the three factors are low and in two cases are not statistically different from zero[15]. This result is consitent with the FF model and allows us in using the three series for testing the model.

[Insert table 1]

As the table 2 shows, all the mimicking portfolios series show a consistent evidence of non normality in the monthly returns. This is consistent with a well known literature (see for example Fama [1965, 1976] or Blattemberg and Gonedes [1974]).

[Insert table 2]

This evidence suggests to use a GMM framework for testing the restricted model. Generally speaking all the constructed portfolios show annualized returns statistically significant[16], and, going deeper in our analysis, is possible to show some characteristics of the Italian Market. As shown in the table 2, 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.

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[15] 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:

$$T - stat = \frac{\rho\sqrt{N-2}}{\sqrt{1-\rho^2}};$$

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.

[16] In this case for testing the null hypothesis that the returns are significantly different from zero we use the classical t-statistic. 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.

On the contrary the annualized return of the value-growth mimicking portfolio (HML) is about 7,5% with a volatility of 18% and it appears to be statistically weakly different from zero.

Finally the annual excess return of the Market index (MKT) is about 11% with a volatility of about 26% and, hence, consistent with the assumption of risk aversion[17].

4.2 Econometric results

Table 3A and 3B report the results for the OLS analysis to test if the pricing errors (alpha) are different from zero. In fifteen 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 beginning of the sample and a diversified portfolio in the remaining period.

[Insert tables 3A & 3B].

Table 4A and 4B report the results for the GMM analysis to test the Three Factors Model developed by FF applied to the Italian Stock Market. The results seem to support the model; we find an R^2 range between 0.39 for the R14 portfolio and 0.89 for the portfolio R44 and, in nine out of 16 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 seven out of 16 portfolios: R12, R21, R32, R33, R41, R43 and R44.

[Insert tables 4A & 4B]

To understand the motivation behind the rejection of the null hypothesis in seven out of 16 portfolios, we investigate if there are other factors that can be used in the model to explain portfolio returns. In order to do that first of all we estimate the unrestricted model (see equation 2) with a GMM procedure to investigate if the model is characterized by some pricing errors[18].

[Insert Table 5]

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[17] 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% with a volatility of about 27% and a t-stat. of 2,56.

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

4.2.1 The momentum effect

Then we try to estimate a model with other mimicking factors. To investigate if there is some momentum effect in the Italian Market as in other stock markets (see Rouwenhorst [1998]) 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 practice 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 9 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 mimicking portfolio associated to the momentum factor WML (Winner Minus Loser) is constructed by calculating the difference between the simple mean of the returns on the winners portfolios and the return on the losers portfolios:

$$[8] \qquad WML_t = \sum_{i=1} \frac{1}{3} RiW_t - \sum_{i=1} \frac{1}{3} RiLS_t.$$

The annualized return on the momentum mimicking portfolio (WML) is about -1,5% 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 and MKT) is respectively 0.07, 0.03 and 0.09 and is never statistically significant.

The new restricted model to be estimated is:

$$[9] \qquad R_{it} - R_{ft} = \beta_i (R_{mt} - R_{ft}) + \gamma_i (SMB_t) + \delta_i (HML_t) + \eta_i (WML_t) + \varepsilon_{it} \qquad [i = 1 \ldots N]$$

with 5N sample moment condition for each portfolio and 4N parameters to be estimated. Hence we get again N over-identifying restrictions.

Table 6 reports the results for the GMM analysis of the restricted model with the momentum mimicking factor. The results are pretty clear: we reject the null hypothesis that the overidentifying restrictions are satisfied in all the portfolios for the model with the momentum factor. It seems possible to conclude that there is no momentum effect in the Italian Stock Market.

[Insert table 6]

5 Conclusions

The key findings of our work can be summarized as follows. The size premium is confirmed for a domestic Italian investor while 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 0.39 and 0.89. In nine out of 16 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 could come from the inclusion in the model of other explaining factors. In particular it could be interesting to investigate how the anomaly of an high risk free rate during 80 s in Italy as well as others factors related with the yield curve can explain the italian stock returns. Further developments can also derive from the inclusion in the model of the exhange-rate risk.

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Table 1: Correlation matrix

Correlation	SMB	HML	MKT
SMB	1.0000	0.3196	-0.0598
HML	0.3196	1.0000	0.0337
MKT	-0.0598	0.0337	1.0000
t-stat			
SMB-HML	4.699		
SMB-MKT	-0.835		
HML-MKT	0.469		

Monthly data 1-jan-86 to 1-apr-2002

Table 2: Basic descriptive statistics

	SMB	HML	MKTRF
Mean	0.0109	0.0060	0.0090
Median	0.0076	0.0010	-0.0039
Maximum	0.3741	0.4178	0.2747
Minimum	-0.1272	-0.2685	-0.1618
Std. Dev.	0.0577	0.0517	0.0743
Skewness	1.5781	2.0697	0.7072
Kurtosis	11.0095	26.4809	4.0580
Jarque-Bera	599.0821	4595.2510	25.3497
Probability	0.0000	0.0000	0.0000
Annualized return	0.1383	0.0740	0.1136
Annualized volatility	0.2000	0.1790	0.2575
t-stat	2.7810	1.6631	1.7733

Monthly data 1-apr-86 to 1-apr-2002

Table 3A: OLS Test of unrestricted Fama and French Model

Dependent Variable: R11					Dependent Variable: R13				
	Coefficient	Std. Error	t-Statistic	Prob.		Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.3519	0.0703	5.0000	0.0000	SMB	0.2236	0.0733	3.0500	0.0030
HML	0.2119	0.0785	2.7000	0.0080	HML	-0.1127	0.0818	-1.3800	0.1700
MKT	0.7737	0.0517	14.9700	0.0000	MKT	0.8675	0.0538	16.1100	0.0000
CONS	0.0019	0.0039	0.4800	0.6330	CONS	0.0066	0.0041	1.6200	0.1080
F(3,188)	88.3100				F(3,177)	87.7100			
Prob > F	0.0000				Prob > F	0.0000			
R-squared	0.5824				R-squared	0.5807			
Adj R-squared	0.5758				Adj R-squared	0.5741			
Dependent Variable: R12					Dependent Variable: R14				
	Coefficient	Std. Error	t-Statistic	Prob.		Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.3831	0.0701	5.4700	0.0000	SMB	0.5783	0.0941	6.1500	0.0000
HML	0.0804	0.0782	1.0300	0.3050	HML	-0.2759	0.1050	-2.6300	0.0090
MKT	0.7944	0.0515	15.4300	0.0000	MKT	0.6695	0.0691	9.6900	0.0000
CONS	-0.0026	0.0039	-0.6700	0.5050	CONS	0.0025	0.0053	0.4700	0.6380
F(3,188)	89.6200				F(3,188)	41.2000			
Prob > F	0.0000				Prob > F	0.0000			
R-squared	0.5859				R-squared	0.3941			
Adj R-squared	0.5794				Adj R-squared	0.3846			
Dependent Variable: R21					Dependent Variable: R23				
	Coefficient	Std. Error	t-Statistic	Prob.		Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.4035	0.0581	6.9400	0.0000	SMB	0.2247	0.0641	3.5000	0.0010
HML	0.3067	0.0649	4.7300	0.0000	HML	-0.0351	0.0716	-0.4900	0.6240
MKT	0.8224	0.0427	19.2500	0.0000	MKT	0.6590	0.0471	13.9900	0.0000
CONS	-0.0026	0.0032	-0.8100	0.4170	CONS	-0.0015	0.0036	-0.4100	0.6790
F(3,188)	155.0500				F(3,188)	67.6800			
Prob > F	0.0000				Prob > F	0.0000			
R-squared	0.7100				R-squared	0.5166			
Adj R-squared	0.7054				Adj R-squared	0.5089			
Dependent Variable: R22					Dependent Variable: R24				
	Coefficient	Std. Error	t-Statistic	Prob.		Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.2637	0.0685	3.8500	0.0000	SMB	0.4832	0.0593	8.1500	0.0000
HML	0.0714	0.0764	0.9300	0.3510	HML	-0.4813	0.0662	-7.2700	0.0000
MKT	0.6797	0.0503	13.5100	0.0000	MKT	0.8168	0.0436	18.7400	0.0000
CONS	-0.0008	0.0038	-0.2200	0.8300	CONS	0.0020	0.0033	0.6000	0.5490
F(3,188)	66.0600				F(3,188)	138.4800			
Prob > F	0.0000				Prob > F	0.0000			
R-squared	0.5105				R-squared	0.6862			
Adj R-squared	0.5028				Adj R-squared	0.6812			

Monthly data 1-jan-86 to 1-apr 2002

Table 3B: OLS Test of unrestricted Fama and French Model

Dependent Variable: R31

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.1502	0.0699	2.1500	0.0330
HML	0.3201	0.0780	4.1000	0.0000
MKT	0.9112	0.0514	17.7300	0.0000
CONS	0.0042	0.0039	1.0600	0.2890
F(3,188)	115.7600			
Prob > F	0.0000			
R-squared	0.6464			
Adj R-squared	0.6408			

Dependent Variable: R33

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.2364	0.0505	4.6900	0.0000
HML	0.0169	0.0563	0.3000	0.7640
MKT	0.7972	0.0371	21.5000	0.0000
CONS	-0.0005	0.0028	-0.1700	0.8610
F(3,188)	159.6300			
Prob > F	0.0000			
R-squared	0.7160			
Adj R-squared	0.7115			

Dependent Variable: R32

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.4061	0.0619	6.5600	0.0000
HML	-0.0442	0.0691	-0.6400	0.5230
MKT	0.8892	0.0455	19.5500	0.0000
CONS	-0.0021	0.0035	-0.5900	0.5540
F(3,188)	137.7700			
Prob > F	0.0000			
R-squared	0.6851			
Adj R-squared	0.6801			

Dependent Variable: R34

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.3938	0.0757	5.2000	0.0000
HML	-0.2713	0.0845	-3.2100	0.0020
MKT	1.0170	0.0556	18.2800	0.0000
CONS	-0.0020	0.0042	-0.4600	0.6430
F(3,188)	116.6300			
Prob > F	0.0000			
R-squared	0.6481			
Adj R-squared	0.6425			

Dependent Variable: R41

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	-0.2225	0.0592	-3.7600	0.0000
HML	0.4408	0.0660	6.6800	0.0000
MKT	0.9319	0.0435	21.4400	0.0000
CONS	-0.0056	0.0033	-1.7000	0.0910
F(3,188)	176.9900			
Prob > F	0.0000			
R-squared	0.7365			
Adj R-squared	0.7323			

Dependent Variable: R43

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	-0.0502	0.0472	-1.0600	0.2890
HML	0.0361	0.0527	0.6800	0.4950
MKT	0.9502	0.0347	27.3800	0.0000
CONS	-0.0023	0.0026	-0.8800	0.3790
F(3,188)	253.5900			
Prob > F	0.0000			
R-squared	0.8002			
Adj R-squared	0.7970			

Dependent Variable: R42

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	-0.2022	0.0431	-4.6900	0.0000
HML	0.2445	0.0481	5.0800	0.0000
MKT	0.8426	0.0317	26.5900	0.0000
CONS	0.0017	0.0024	0.7000	0.4830
F(3,188)	257.9800			
Prob > F	0.0000			
R-squared	0.8029			
Adj R-squared	0.7998			

Dependent Variable: R44

	Coefficient	Std. Error	t-Statistic	Prob.
SMB	0.0510	0.0323	1.5800	0.1160
HML	-0.1915	0.0361	-5.3100	0.0000
MKT	1.0784	0.0237	45.4200	0.0000
CONS	-0.0051	0.0018	-2.8400	0.0050
F(3,188)	693.0200			
Prob > F	0.0000			
R-squared	0.9163			
Adj R-squared	0.9149			

Monthly data 1-jan-86 to 1-apr 2002.

Table 4A: GMM Test of restricted Fama and French Model

Dependent Variable: R11					Dependent Variable: R13				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.1589	0.1504	1.0564	0.2921	HML	-0.0984	0.1729	-0.5693	0.5698
SMB	0.3710	0.1366	2.7166	0.0072	SMB	0.2224	0.1379	1.6129	0.1084
MKT	0.7921	0.0870	9.1061	0.0000	MKT	0.8615	0.0795	10.8332	0.0000
R-squared	0.5755				R-squared	0.5798			
Adjusted R-squared	0.5710				Adjusted R-squared	0.5754			
GMM-stat	0.9626				GMM-stat	0.0519			
p-value	0.3265				p-value	0.8197			
Dependent Variable: R12					Dependent Variable: R14				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.0816	0.1571	0.5195	0.6040	HML	-0.3257	0.2036	-1.5997	0.1113
SMB	0.3149	0.1524	2.0660	0.0402	SMB	0.6216	0.1488	4.1782	0.0000
MKT	0.7695	0.0922	8.3490	0.0000	MKT	0.6577	0.0929	7.0772	0.0000
R-squared	0.5728				R-squared	0.3875			
Adjusted R-squared	0.5683				Adjusted R-squared	0.3811			
GMM-stat	4.6707				GMM-stat	0.4379			
p-value	0.0307				p-value	0.5082			
Dependent Variable: R21					Dependent Variable: R23				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.2086	0.1121	1.8613	0.0642	HML	-0.1065	0.1735	-0.6137	0.5401
SMB	0.4052	0.0944	4.2933	0.0000	SMB	0.2065	0.1632	1.2652	0.2073
MKT	0.8339	0.0808	10.3219	0.0000	MKT	0.6767	0.1126	6.0078	0.0000
R-squared	0.6921				R-squared	0.4991			
Adjusted R-squared	0.6889				Adjusted R-squared	0.4939			
GMM-stat	5.6966				GMM-stat	3.6476			
p-value	0.0169				p-value	0.0561			
Dependent Variable: R22					Dependent Variable: R24				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.0675	0.1147	0.5887	0.5568	HML	-0.4838	0.0929	-5.2103	0.0000
SMB	0.2250	0.1064	2.1147	0.0358	SMB	0.4615	0.0684	6.7513	0.0000
MKT	0.6398	0.0851	7.5184	0.0000	MKT	0.8134	0.0638	12.7483	0.0000
R-squared	0.4997				R-squared	0.6828			
Adjusted R-squared	0.4945				Adjusted R-squared	0.6795			
GMM-stat	2.5412				GMM-stat	0.9202			
p-value	0.1109				p-value	0.3374			

Monthly data 1-jan-86 to 1-apr 2002

Table 4B: GMM Test of restricted Fama and French Model

Dependent Variable: R31					Dependent Variable: R33				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.3546	0.1922	1.8447	0.0666	HML	-0.0342	0.1279	-0.2676	0.7893
SMB	0.1180	0.1181	0.9995	0.3188	SMB	0.2098	0.1098	1.9112	0.0575
MKT	0.9078	0.0703	12.9085	0.0000	MKT	0.7817	0.0812	9.6225	0.0000
R-squared	0.6476				R-squared	0.7066			
Adjusted R-squared	0.6440				Adjusted R-squared	0.7035			
GMM-stat	0.1842				GMM-stat	4.5537			
p-value	0.6678				p-value	0.0328			
Dependent Variable: R32					Dependent Variable: R34				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	-0.1788	0.0975	-1.8345	0.0681	HML	-0.3064	0.1001	-3.0618	0.0025
SMB	0.3581	0.1144	3.1290	0.0020	SMB	0.3458	0.1630	2.1214	0.0352
MKT	0.8980	0.0907	9.9058	0.0000	MKT	1.0576	0.1128	9.3725	0.0000
R-squared	0.6661				R-squared	0.6376			
Adjusted R-squared	0.6627				Adjusted R-squared	0.6338			
GMM-stat	5.1482				GMM-stat	3.6086			
p-value	0.0233				p-value	0.0575			
Dependent Variable: R41					Dependent Variable: R43				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.4782	0.1131	4.2284	0.0000	HML	0.1300	0.1097	1.1855	0.2373
SMB	-0.3833	0.1043	-3.6759	0.0003	SMB	-0.2274	0.0910	-2.4981	0.0133
MKT	0.9634	0.0637	15.1285	0.0000	MKT	0.9455	0.0550	17.1812	0.0000
R-squared	0.7078				R-squared	0.7812			
Adjusted R-squared	0.7048				Adjusted R-squared	0.7789			
GMM-stat	8.0599				GMM-stat	7.7432			
p-value	0.0045				p-value	0.0054			
Dependent Variable: R42					Dependent Variable: R44				
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.2087	0.0802	2.6015	0.0100	HML	-0.1785	0.0577	-3.0948	0.0023
SMB	-0.2233	0.0637	-3.5041	0.0006	SMB	0.0342	0.0468	0.7322	0.4650
MKT	0.8743	0.0613	14.2658	0.0000	MKT	1.0126	0.0361	28.0421	0.0000
R-squared	0.7940				R-squared	0.8961			
Adjusted R-squared	0.7918				Adjusted R-squared	0.8950			
GMM-stat	2.1232				GMM-stat	16.3914			
p-value	0.1451				p-value	0.0001			

Monthly data 1-jan-86 to 1-apr-2002

Table 5: GMM Test of unrestricted Fama and French Model

Dependent Variable: R12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.0888	0.1626	0.5460	0.5857
SMB	0.3767	0.1556	2.4210	0.0164
MKT	0.7899	0.0905	8.7235	0.0000
C	-0.0083	0.0036	-2.3154	0.0217
R-squared	0.5833			
Adjusted R-squared	0.5767			
GMM-stat	0.0000			
p-value	1.0000			

Dependent Variable: R21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.3151	0.1046	3.0122	0.0029
SMB	0.3971	0.0927	4.2839	0.0000
MKT	0.8178	0.0750	10.9051	0.0000
C	-0.0083	0.0030	-2.7835	0.0059
R-squared	0.7062			
Adjusted R-squared	0.7016			
GMM-stat	0.0000			
p-value	1.0000			

Dependent Variable: R32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	-0.0358	0.1221	-0.2934	0.7695
SMB	0.3997	0.1357	2.9462	0.0036
MKT	0.8846	0.0948	9.3278	0.0000
C	-0.0077	0.0029	-2.6996	0.0076
R-squared	0.6830			
Adjusted R-squared	0.6780			
GMM-stat	0.0000			
p-value	1.0000			

Dependent Variable: R33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.0253	0.1232	0.2055	0.8374
SMB	0.2300	0.1057	2.1763	0.0308
MKT	0.7927	0.0780	10.1571	0.0000
C	-0.0061	0.0026	-2.3338	0.0207
R-squared	0.7154			
Adjusted R-squared	0.7109			
GMM-stat	0.0000			
p-value	1.0000			

Dependent Variable: R41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.449145	0.133313	3.3691	0.0009
SMB	-0.228868	0.122422	-1.8695	0.0631
MKT	0.927391	0.060306	15.3782	0
C	-0.011272	0.003328	-3.38686	0.0009
R-squared	0.732525			
Adjusted R-squared	0.728302			
GMM-stat	0.0000			
p-value	1.0000			

Dependent Variable: R43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.0444	0.1154	0.3853	0.7005
SMB	-0.0566	0.1073	-0.5275	0.5985
MKT	0.9456	0.0611	15.4695	0.0000
C	-0.0080	0.0025	-3.2382	0.0014
R-squared	0.8025			
Adjusted R-squared	0.7994			
GMM-stat	0.0000			
p-value	1.0000			

Dependent Variable: R44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	-0.183155	0.060546	-3.02507	0.0028
SMB	0.044599	0.046995	0.94901	0.3438
MKT	1.073835	0.036832	29.1551	0
C	-0.010777	0.001972	-5.46589	0
R-squared	0.913824			
Adjusted R-squared	0.912463			
GMM-stat	0.0000			
p-value	1.0000			

Monthly data 1-jan-86 to 1-apr 2002

Table 6: GMM Test of restricted Fama and French Model with WML Factor

Dependent Variable: R12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.0877	0.1486	0.5899	0.5560
SMB	0.3349	0.1467	2.2838	0.0235
MKT	0.7803	0.0900	8.6657	0.0000
WML	-0.0512	0.0623	-0.8227	0.4117
R-squared	0.5745			
Adjusted R-squared	0.5678			
GMM-stat	4.9340			
p-value	0.0263			

Dependent Variable: R21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.2202	0.1013	2.1733	0.0310
SMB	0.4081	0.0879	4.6425	0.0000
MKT	0.8393	0.0771	10.8926	0.0000
WML	-0.0561	0.0532	-1.0540	0.2932
R-squared	0.6970			
Adjusted R-squared	0.6922			
GMM-stat	6.1880			
p-value	0.0128			

Dependent Variable: R32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	-0.1751	0.0949	-1.8452	0.0666
SMB	0.3640	0.1141	3.1916	0.0017
MKT	0.9030	0.0900	10.0364	0.0000
WML	-0.0241	0.0419	-0.5756	0.5655
R-squared	0.6675			
Adjusted R-squared	0.6623			
GMM-stat	5.2960			
p-value	0.0213			

Dependent Variable: R33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	-0.0321	0.1242	-0.2585	0.7963
SMB	0.2163	0.1069	2.0226	0.0445
MKT	0.7855	0.0793	9.9058	0.0000
WML	-0.0226	0.0459	-0.4912	0.6239
R-squared	0.7091			
Adjusted R-squared	0.7045			
GMM-stat	4.7830			
p-value	0.0287			

Dependent Variable: R41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.4880	0.1115	4.3759	0.0000
SMB	-0.3849	0.1043	-3.6885	0.0003
MKT	0.9651	0.0633	15.2373	0.0000
WML	-0.0112	0.0290	-0.3869	0.6992
R-squared	0.7080			
Adjusted R-squared	0.7034			
GMM-stat	8.1370			
p-value	0.0043			

Dependent Variable: R43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	0.1310	0.1088	1.2036	0.2302
SMB	-0.2314	0.0896	-2.5830	0.0105
MKT	0.9494	0.0525	18.0714	0.0000
WML	-0.0238	0.0279	-0.8502	0.3963
R-squared	0.7822			
Adjusted R-squared	0.7788			
GMM-stat	7.9760			
p-value	0.0047			

Dependent Variable: R44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HML	-0.1685	0.0477	-3.5316	0.0005
SMB	0.0347	0.0417	0.8303	0.4074
MKT	1.0074	0.0359	28.0336	0.0000
WML	0.0379	0.0121	3.1318	0.0020
R-squared	0.8992			
Adjusted R-squared	0.8976			
GMM-stat	16.1320			
p-value	0.0000			

Monthly data 1-jan-86 to 1-apr-2002