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The Determinants of Risk Premia on the Italian Stock Market: Empirical Evidence on Common Factors in Asset Pricing Models

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We study the pricing factor structure of Italian equity returns using 25 years of data. A two-step empirical analysis is provided where first we estimate an unrestricted multifactor model to test if there is any evidence of misspecification. Then, we estimate the restricted model through the Generalized Methods of Moments. We find that the market premium and the size premium are confirmed for a domestic Italian investor. On the contrary, weak evidence is found for the value premium. Finally, we highlight, that augmenting the model with a momentum factor may at least partially improve its performance. As a robustness check we control if the above results also hold for three shorter sub-periods taking into account the macroeconomic and financial conditions that characterized the Italian economy. The results are generally confirmed in the case of the size and value factors while the momentum effect shows an irregular trend playing any role in the first sub-period but becoming more important in the subsequent two.

(*J.E.L.*: *G10; G12*).

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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, for the cross-sectional variation of asset returns, compared with a little or no capacity in explaining it by the market factor. After this seminal paper a large body of literature showed evidence of scarce or little explanatory capacity by the market beta to explain asset returns. Empirical works have mostly used US data and most of them have rejected beta and CAPM model (i.e., Grinold, 1993; Davis, 1994; Fama and French, 1993, 1995, 1996).

In an another 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 contribution in the asset pricing theory, critics to the three-factor model (Lakonishok *et al.*, 1994; Haugen, 1995), highlight the role of investor overreaction (De Bondt and Thaler, 1985) in explaining the value anomaly. Further notable evidence is the overreaction/underreaction argument to information with reference to Jegadeesh and Titman (1993) and Rouwenhorst (1998) who document the existence of a momentum anomaly: over a medium time horizon firms with high returns over the past 3 months to 1-year continue to outperform firms with low past returns over the same period.

The novelty of this paper can be related to three main findings. First, using stock market data from 1986 to 2010 we provide an up-to-date empirical analysis to shed further light on the relevance of different factors besides the market factor to explain equity returns over a long time horizon. From a methodological point of view we use a GMM test procedure. We find evidence supporting the presence of a size premium and to a lesser extent of a value premium. Second, we show that the expected returns anomalies persist over the time-horizon analyzed and are robust to a three-factor model specification. Third, we provide a robustness check to better understand if our main results hold for three short-term sub-periods taking into account the macroeconomic and financial conditions that characterized the Italian economy.

We further investigate if a four-factor structure also holds in the case of the Italian stock market. We find a weak momentum premium over the entire sample period. In summary, estimating a four-factor model using a GMM procedure on 25 years of data, we show that the size and value factors in addition to the market factor contribute to the explanation of stock returns in Italy. Our asset pricing tests support the momentum factor as an additional explanatory variable only partially.

The rest of the paper is organized as follows: in Section 2 we provide a brief review of the main related literature, while 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 both for the short and long-run version while Section 5 concludes.

2. Related Literature

In their seminal work Fama and French try to explain how the stock returns depend not only on the market factor measured in the classical theory of CAPM by the beta, but also on other factors. Mainly, they find that the strongest consistency in explaining the average returns is represented by size and book-to market value or similarly the earning-price ratio, the cash-price ratio or the dividend-price ratio.[1]

The first critics to the standard CAPM emerged in the eighties highlighting a positive relation between the firm leverage and the stock average return (Bhandari, 1988). At the same time some other authors find that the US stock average returns are positively linked to the book-to-market ratio (Rosenberg *et al*., 1985). What Fama and French (1992) add to the previous literature is the joint role of market beta, size, earning-price ratio, leverage and book-to-market ratio with reference to NYSE, AMEX, and NASDAQ stock returns. They find that the CAPM model does not hold in the US market for the period between 1941 and 1990. In addition, they show that the univariate relations between average return and size, leverage, *E*/*P*, and book-to-market value are strong. Their main conclusion is that stock risks are multidimensional: one dimension of risk is approximated by size, the other one by the ratio of the book value to its market value. In this way Fama and French (1992) confute the role of the market factor in the explanation of the stock returns; in other terms if there is a role for beta in average returns, it has to be found in a multi-factor model. Even if the Fama and French insights have given origin to a new and rich stream of the literature their results are not immune by critics that are mainly founded on the observation that the violations of the CAPM model are not simply linked to missing risk factors but to the existence of market imperfections, to the presence of irrational investors and to the inclusion of biases in the empirical methodology (see, e.g., De Bondt and Thaler, 1985; Lakonishok *et al*., 1994; Haugen, 1995; MacKinlay, 1995; Knez and Ready, 1997).

De Bondt and Thaler (1985), Lakonishok *et al*. (1994), and Haugen (1995) point out 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-

[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, among others, Lakonishok *et al*. (1994), Fama and French (1998), and Anderson and Brooks (2006).

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. The explanation for this difference has been the subject of numerous studies, using different methods of investigation, to find out whether there is a risk premium for value stocks. Some of the results are controversial.

Lakonishok *et al*. (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: they report that value betas are higher than growth betas in good times but are lower in bad times.

Petkova and Zhang (2005) and Chen *et al*. (2008) further investigate this aspect finding that value betas tend to covary positively, and growth betas tend to covary negatively with the expected market risk premium. This result holds for most sample periods and for various value and growth strategies. However, although time-varying risk goes in the right direction, the magnitude of the value premium remains positive and mostly significant after having controlled for time-varying risk. Therefore, it is necessary to consider other possible drivers of the value anomaly.

Since the relevant period to evaluate the performance is the medium-term and not the long-term as in Lakonishok *et al*. (1994) some authors – see, for example, Jegadeesh and Titman (1993) and Rouwenhorst (1998) – suggest that a momentum anomaly can exist. They document that over a medium time horizon performance persists: firms with high returns over the past 3 months to 1-year continue to outperform firms with low past returns over the same period. In other terms the momentum effect holds. The momentum anomaly takes origin from the investor capacity to extrapolate from the previous stock prices the right market value of future stock prices. With reference to the US market, Jegadeesh and Titman (1993, 2001) show that strategies that involve taking a long (short) position in well (poorly) performing stocks on the basis of past performance over the previous 3–12 months tend to produce significantly positive abnormal returns of about 1 per cent per month for the following year. These return continuation strategies – momentum return in individual stocks – should not be justified if markets were efficient. So, for these time horizons, what goes up tends to keep rising and vice versa. Two reasons can justify these results. One reason can be found in the variability of firms' fundamentals. When earnings growth exceeds expectations or consensus, forecasts of future earnings are revised upward and an 'earnings momentum' is observed (Chan *et al*., 1999). Another reason can be reconnected to the fact that strategies based on price momentum and earnings momentum may be profitable because they exploit market underreaction to different information. For instance earnings momentum strategies may exploit underreaction to information about the short-term prospects of companies that will ultimately be manifested in near-term earnings. Price momentum strategies may exploit slow reactions to a broader set of value-relevant information, including long-term information that have not been fully captured by near-term earnings forecasts or past earnings growth. If both these explanations hold, then a strategy based on past returns in combination with a strategy based on earnings momentum should lead to higher profits than either strategies individually.

The evidence is mixed. In the recent past a large and growing body of research supported the presence of a momentum anomaly also with reference to European markets (Rouwenhorst, 1998), Asian markets (Chui *et al.*, 2003), Canadian market, (L'Her *et al.*, 2004) and minor markets like Italy (Beltratti and di Tria, 2002; Mengoli, 2004).[2] Recently some authors have further investigated this aspect finding opposite results. Hwang and Rubesam (2008), for example, find that the risk-adjusted momentum premium is significantly positive only during certain periods and that is going to disappear since the late 1990s in a process which was delayed by the occurrence of the high-technology stock bubble of the 1990s.

Moreover, Bulkley and Nawosah (2009) point out a general problem in testing asset pricing models because the residual pricing errors from the model specified may erroneously be interpret as momentum. Removing the effect of unconditional expected returns from the raw returns and then testing for momentum in the resulting series over the whole sample period implies the complete disappearance of the momentum effect.

3. Data and Methodology

3.1. Data

The data used to test the multifactor models are derived from the closing price of the domestic Italian firms listed on the Milan stock exchange for the period between the January 1, 1986 and the February 1, 2010. Our dataset, based on a monthly frequency, includes survivor stocks for all the period considered and delisted stocks just for the period for which the firms are traded.[3] To be included in the sample we require that a firm has complete market and accounting/financial data for price (P), market capitalization

[2]For a novel contribution on cultural differences interaction with momentum returns in 50 countries see Chui *et al.* (2010).

[3]In this case items for delisted firms are eliminated from the delisting date to the end of our sample period. On the survivorship bias problem see, among others, Banz and Breen (1986) and Fama and French (1998).

(MV), earnings per share (EPS), dividend per share (DPS), and book value of equity (Worldscope item #03501) provided by the Thomson Reuters Datastream and Thomson Reuters Worldscope databases. Additionally a firm must have a minimum of 12 consecutive monthly returns.[4] Finally we consider firms with voting shares thus excluding limited-voting shares when a company listed both, while we include limited-voting shares if these are the unique class of securities traded for a company. The total number of stocks is 475. All data are expressed in Euros, converted from Italian Lira when a firm has been delisted prior to January 1999. The risk-free rate used in our empirical tests is the 3-month Italian Treasury bill rate, from the Bank of Italy, converted to the equivalent monthly rate.[5]

3.2. Methodology

The aim of this section is to explain the methodology adopted to test the Fama and French three-factor model (Fama and French, 1992, 1993, 1996) on the Italian stock market. The theoretical ex ante Fama and French model can be expressed as follows:

$$(1) \qquad E(R_i) - R_f = b_i[E(R_m) - R_f] + s_i E(\text{SMB}) + h_i E(\text{HML})$$

where $E(R_i) - R_f$ is the expected excess return on asset *i*, $E(R_m) - R_f$ is the expected excess return on market portfolio, $E(\text{SMB})$ is the expected return on the mimicking portfolio for the small minus big size factor, $E(\text{HML})$ is the expected return on the mimicking portfolio for the high minus low value-growth factor and R_f is the return on a risk-free asset.

If the market determines the asset *i* price at the beginning of each period according to equation (1), and given the hypothesis of rational expectations for the CAPM, the asset *i* excess return observed ex post for every period will respect the following empirical expression of the model:

$$(2) \qquad R_{it} - R_{ft} = \alpha_i + b_i(R_{mt} - R_{ft}) + s_i \text{SMB}_t + h_i \text{HML}_t + \varepsilon_{it}$$

where ε_{it} is an i.i.d. error term normally distributed with 0 mean and constant variance.

[4] Returns are computed using the Datastream total index (RI) provided for each stock and assuming that dividends are re-invested to purchase additional units of a stock at the closing price applicable on the ex-dividend payment date (PYD). Since detailed dividend payment data are available in Datastream for Italian stocks only after 1988, returns from 1986 to 1988 are calculated using the annualised dividend yield. This method adds an increment of $1/N^{\text{th}}$ part of the dividend yield (DY) to the market price each weekday. There are assumed to be $N = 261$ weekdays in a year. Market holidays are excluded.

[5] As an alternative proxy for the risk-free rate we also use the average between ask and bid rates of the Italian interbank rate listed on the London Interbank Market published by Datastream. The choice of this variable does not produce significant differences in our results for the expected *premia* and for the asset pricing tests.

If the above hypothesis holds we can use the OLS method to estimate the parameters of the model. However, if either the homoskedasticity or the normality assumption are not satisfied, we need an alternative method of estimation such as the generalized least squares (GLS) or the generalized methods of moments (GMM). The latter one requires very weak assumptions (see Hansen, 1982), leaving aside the hypothesis of normality of the error term as well as the zero correlation hypothesis between the explicative variables and the error term itself (see Ruud, 2000; Hall, 2005; Greene, 2008).

To estimate Equation (2) we perform a two-step test. As a preliminary analysis we estimate the unrestricted model with the classical OLS method to test 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. Given this implication we use the Black *et al.* (1972) approach to evaluate this assumption: basically we run a time-series regression for each portfolio of assets and then we use the standard OLS t-statistics to test if the pricing errors (alphas) are zero. We also compute the GRS-F statistic (Gibbons *et al.*, 1989) to test the hypothesis that the alphas obtained in the separated time-series regressions are jointly zero. In a multifactor asset pricing model the GRS statistic is F distributed with N and $T–N–K$ degrees of freedom, where T is the number of monthly observations, N is the number of portfolios, and K is the number of factors. A higher value of the GRS test statistic implies that the hypothesis of jointly zero alphas will be rejected. As a second more accurate analysis of the factor structure of the Italian stock market, we test the restricted Fama and French model (alphas = 0) using a GMM procedure. The basic idea of the GMM is to choose the parameters to be estimated to match the moments of the model itself with the empirical ones. The restricted model to be estimated is obtained by converting Equation (1) in the following empirical counterpart:

$$
\begin{aligned}
(3)\qquad & R_{it} - R_{ft} = b_i(R_{mt} - R_{ft}) + s_i \mathrm{SMB}_t + h_i \mathrm{HML}_t + \varepsilon_{it} \\
& \quad \text{with } i = 1, \ldots, N \text{ and } t = 1, \ldots, T
\end{aligned}
$$

where $R_{it} - R_{ft}$ is the realized excess return on asset i, $R_{mt} - R_{ft}$ is the realized excess return on market portfolio, SMB_t is the realized return on the mimicking portfolio for the Small *minus* Big size factor and HML_t is the realized return on the mimicking portfolio for the high *minus* low value-growth factor, with four sample moments for each portfolio:

$$
\left[\frac{1}{T\sum_{t=1}^{T} \varepsilon_{it}(R_{mt} - R_f)}, \frac{1}{T\sum_{t=1}^{T} \varepsilon_{it}\mathrm{SMB}_t}, \frac{1}{T\sum_{t=1}^{T} \varepsilon_{it}\mathrm{HML}_t}, \frac{1}{T\sum_{t=1}^{T} \varepsilon_{it}} \right]
$$

and three parameters ($\boldsymbol{\theta} = b_i, s_i, h_i$) to be estimated.

We can test the over-identifying restrictions using the Hansen's (1982) J statistic which is appropriate with the GMM estimator. We compute the two-step GMM estimator (see MacKinlay and Richardson, 1991; Campbell *et al.*, 1996; Cochrane, 2005) as:

$$\hat{\boldsymbol{\theta}}_1 \equiv \arg\min_{\theta} G(\boldsymbol{\theta}) \tag{4a}$$

where $G(\boldsymbol{\theta}) = g_T(\boldsymbol{\theta})'\mathbf{W}g_T(\boldsymbol{\theta})$ is the quadratic function of the moment conditions, $g_T(\boldsymbol{\theta}) = \frac{1}{T}\sum_{t=1}^{T} f_T(\boldsymbol{\theta})$ is the empirical moment conditions vector and $\boldsymbol{W}$ is the weight matrix used for estimating the parameters.[6]

To the test to be valid the weight matrix $\boldsymbol{W}$ must be optimal, in the sense that it has to be equal to the inverse of the covariance matrix of the moment condition ($\boldsymbol{S}^{-1}$).

In the first-step we thus obtain parameters based on the initial weight matrix ($\boldsymbol{W}$) according to Equation (4a), then compute a new weight matrix ($\boldsymbol{S}^{-1}$) based on those estimates, and in the second-step we re-estimate the parameters based on that weight matrix:

$$\hat{\boldsymbol{\theta}}_2 \equiv \arg\min_{\theta} G(\boldsymbol{\theta}) \tag{4b}$$

where $G(\boldsymbol{\theta}) = g_T(\boldsymbol{\theta})'\mathbf{S}^{-1}\ g_T(\boldsymbol{\theta})$.

Under the null hypothesis that the over-identifying restrictions are satisfied, the efficient GMM-estimator times the number of regression observations is asymptotically χ^2 with degrees of freedom equal to the number of over-identifying restrictions (# of moment conditions − # of parameters):

$$T \cdot J = T \cdot [arg\,\min_{\theta} g_T(\boldsymbol{\theta})'\mathbf{S}^{-1}\ g_T(\boldsymbol{\theta})]^{\sim}\ \chi^2_{[\#\ mom - \#\ par]}$$

Finally to compute the standard errors of our estimated parameters we use the Newey and West (1987) variance–covariance estimator.

3.3. Construction of the risk factors

In order to obtain the mimicking portfolios for the risk factors, we construct two groups of assets based on size and three groups of assets based on the price-earnings ratio (PE) tertiles. In this case (P) is the actual price at the end of month t (with $t = 1,2,\ldots,12$) and (E) is the fully diluted earnings

[6] In a recent contribution Jagannathan *et al.* (2010) review the main econometric procedures used in asset pricing tests.

per shares with fiscal year in year $s-1$ (with $s = 1986, 1987,\ldots,2011$). Negative trailing *P*/*E* are excluded according to the procedure reported in Worldscope. Using the original notation of Fama and French (1992, 1993) we identified the first (last) tertile of *E*/*P* (*P*/*E*) as the one containing firms with the lower (higher) scores of *E*/*P* (*P*/*E*). By the intersection of the groups of size and *E*/*P* tertiles we obtain six portfolios named as S/L, S/M, S/H, B/L, B/M, B/H, where S and B indicate, respectively small and big firms, while L, M, and H indicate, respectively firms with low (growth), medium and high (value) *E*/*P*, so that for example B/H is the portfolio containing the firms with a high market value (big firms) and a high *E*/*P* ratio (value firms). On those portfolios we calculate the value-weighted returns. Each portfolio is rebalanced yearly.

The next step is to construct the mimicking portfolios for each risk factor. The market factor (MKT) is constructed by calculating the monthly value-weighted returns of the stocks included in the sample.[7] The risk factor is calculated by subtracting the relevant monthly risk free rate. The size factor (SMB) is obtained as the average return on the three ‘small firms’ portfolios minus the average return on the three ‘big firms’ portfolios:

$$\text{SMB}_t = \sum_{i=\text{L,M,H}} \frac{1}{3} R_i S_t - \sum_{i=\text{L,M,H}} \frac{1}{3} R_i B_t \tag{5}$$

The value factor (HML) is obtained as the average return on the two ‘value firms’ portfolios minus the average return on the two ‘growth firms’ portfolios[8]:

$$\text{HML}_t = \sum_{i=\text{S,B}} \frac{1}{2} R_i H_t - \sum_{i=\text{S,B}} \frac{1}{2} R_i L_t \tag{6}$$

To obtain the momentum factor, a different sorting procedure is needed. In practice we construct the momentum factor from a three-by-three tertiles sort on size and firm’s past return, calculated according to the Carhart (1997) procedure as the compound 11-months returns lagged 1-month. By the intersection of these groups we obtain nine portfolios named as S/W, M/W, B/W, S/N, M/N, B/N, S/LS, M/LS, B/LS where, S, M, and B indicate small,

[7]To confirm the correctness of our methodology we calculate the correlation between the Market Factor and the Morgan Stanley Capital International Index (MSCI ITALY) and the Milan Stock Exchange Index (FTSE ITALY All Shares). The results are more than comforting. The correlation coefficients are 98% and 99%, respectively on the entire sample period.

[8]We use the Price–Earnings ratio (P/E) instead of the Market-to-Book ratio (M/B) used by Fama and French because the P/E ratio is well accepted in literature as proxy to identify a firm as a ‘value’ or as a ‘growth’ firm. We replicate our tests using the Market-to-Book ratio (M/B) and the main results remain unchanged. Market-to-Book ratios are obtained from Datastream (MTBV) as market capitalisation (MV) divided book value of equity (Worldscope item #03501). Results are available from the authors upon request.

medium, and big firms while W, WL, and LS indicate, respectively, 'winner', 'neutral', and 'loser' firms so that, for example, B/W is the portfolio containing the 'winners' with a high market value. The momentum factor (WML) is obtained as the average return on the three 'winner firms' portfolios minus the average return on the three 'loser firms' portfolios:

$$\text{WML}_t = \sum_{i=\text{S,M,B}} \frac{1}{3} R_i W_t - \sum_{i=\text{S,M,B}} \frac{1}{3} R_i LS_t \tag{7}$$

The new unrestricted and restricted models to be estimated are obtained by augmenting the initial three-factor model (see Eqs. 2 and 3) with the momentum factor.

$$\begin{aligned} R_{it} - R_{ft} = \alpha_i + b_i(R_{mt} - R_{ft}) + s_i\text{SMB}_t + h_i\text{HML}_t + w_i\text{WML}_t \\ + \varepsilon_{it} \end{aligned} \tag{8}$$

$$R_{it} - R_{ft} = b_i(R_{mt} - R_{ft}) + s_i\text{SMB}_t + h_i\text{HML}_t + w_i\text{WML}_t + \varepsilon_{it} \tag{9}$$

with $i = 1,\ldots, N$ and $t = 1,\ldots, T$.

Thus, we obtain five sample moments for each portfolio and an extra parameter to be estimated, that is, an over-identified system:

$$\left[\frac{1}{T\sum_{t=1}^{T}\varepsilon_{it}(R_{mt}-R_f)}, \frac{1}{T\sum_{t=1}^{T}\varepsilon_{it}\text{SMB}_t} \frac{1}{T\sum_{t=1}^{T}\varepsilon_{it}\text{HML}_t}, \frac{1}{T\sum_{t=1}^{T}\varepsilon_{it}\text{WML}_t}, \frac{1}{T\sum_{t=1}^{T}\varepsilon_{it}}\right],$$

with four parameters ($\boldsymbol{\theta} = b_i, s_i, h_i, w_i$).

To obtain the dependent variables of our time-series regression (i.e., the portfolios to be estimated with the factor models), we calculate the value-weighted returns for the 16 portfolios obtained from the four-by-four quartiles sort on market capitalization 'size' rankings and 'value-growth' rankings of the firms.

4. Results

4.1. Summary statistics and preliminary OLS results

In this subsection we report some preliminary results. Table 1 shows that the correlations between the four factors are low and only in one case (market factor and size factor) statistically different from zero. This result provides some support for using the factors as explanatory variables in our test.

Table 1: Correlations Between Fama-French-Carhart Factors

Correlation	MKT[a]	SMB[b]	HML[c]	WML[d]
MKT	1			
SMB	−0.3931	1		
HML	0.0836	−0.0533	1	
WML	−0.0517	0.0214	0.0634	1
p-value				
MKT-SMB	0.000	***		
MKT-HML	0.156			
MKT-WML	0.148			
SMB-HML	0.366			
SMB-WML	0.943			
HML-WML	0.109			

Notes: [a]MKT is the market factor = averaged value-weighted returns of all the assets included in the sample minus the risk free rate.
[b]SMB = small minus big is the return on the mimicking portfolio for the size factor.
[c]HML = high minus low is the return on the mimicking portfolio for the value-growth factor.
[d]WML = winners minus losers is the return on the mimicking portfolio for the momentum factor. Monthly data from January 1, 1986 to February 1, 2010.
***Statistically significant at a 1 per cent level.

As shown in Table 2 all the mimicking portfolios excess returns series exhibit, in line with the existing literature (see for example Fama, 1965 or Blattenberg and Gonedes, 1974) a consistent evidence of absence of normality in the monthly returns. Generally speaking the annualized return on the ‘size’ mimicking portfolio (SMB) is about 4.6 per cent, with a 19 per cent volatility. This is consistent with the theory of a risk premium for the smaller firms. On the contrary the annualized return of the ‘value-growth’ mimicking portfolio (HML) is about 0.7 per cent with a volatility of 13 per

Table 2: Basic Descriptive Statistics

	MKT[a]	SMB[b]	HML[c]	WML[d]
Mean	0.0016	0.0037	0.0006	−0.0006
Median	−0.0029	0.0042	0.0008	0.0059
Maximum	0.2728	0.1791	0.1951	0.2176
Minimum	−0.1771	−0.1621	−0.1942	−0.6792
Std. dev.	0.0646	0.0429	0.0373	0.0675
Skewness	0.5324	0.2130	0.4549	−4.2573
Kurtosis	4.7585	5.2593	11.5230	38.8088
Annualized return	0.0191	0.0458	0.0073	−0.0073
Annualized volatility	0.2239	0.1485	0.1291	0.2340

Notes: [a]MKT is the Market Factor = averaged value-weighted returns of all the assets included in the sample minus the risk free rate.
[b]SMB = Small Minus Big is the return on the mimicking portfolio for the size factor.
[c]HML = High Minus Low is the return on the mimicking portfolio for the value-growth factor.
[d]WML = Winners Minus Losers is the return on the mimicking portfolio for the momentum factor. Monthly data from January 1, 1986 to February 1, 2010.

cent. The annual excess return of the market index (MKT) is about 2 per cent with a volatility of about 22 per cent and, hence, consistent with the assumption of risk aversion. Finally, the annual excess return on the momentum mimicking portfolio (WML) is about -0.6 per cent with a volatility of about 22 per cent. This preliminary descriptive analysis seems to suggest the absence of a momentum effect in the Italian stock market.

Table 3 reports, as a preliminary analysis, the OLS results to test if the pricing errors (alpha) are different from zero. In 10 portfolios the intercept term is not statistically significant.

That is, looking at the classical OLS statistics, we can reject the null hypothesis at a 1% confidence level of alpha $= 0$, for 6 portfolios out of 16. In these six cases, because of the thinness of the market, the composition of the portfolios is based on one or very few stocks at the beginning of the sample period. This characteristic can lead to reject the null hypothesis because, in practice, we are testing with the same regression two totally different 'assets': a single stock at the beginning of the sample and a diversified portfolio in the remaining period.

As an additional test to assess the three-factor model we use the GRS F-statistic and verify if the alphas of the portfolios obtained in the separated OLS regressions are jointly equal to zero. The value of the GRS test statistic ($F = 3.03, p$-value $= 0.000$) evidences that the three-factor model performs poorly in explaining the variation of returns for the 16 portfolios in the entire sample period since we cannot reject the alternative hypotheses that the intercepts are jointly different from zero. In addition Table 3 reports the average absolute value of the intercepts (0.30 per cent per month) and the average adjusted R^2 (0.65). Considering the relatively high value of the mean intercept, the low explanatory power of the model and the GRS test, our initial OLS results suggest that the three-factor model is rejected in the 1986–2010 sample period.

4.2. GMM tests of the restricted Fama-French model

Table 4 reports the results for the GMM analysis to test the restricted three-factor model applied to the Italian stock market. The results seem to support the model in 9 out of 16 portfolios, the null hypothesis cannot be rejected, as shown by the GMM statistics, with a 1 per cent confidence level. We reject the null hypothesis that the model is correctly specified in 7 out of 16 portfolios: 1-1, 1-4, 2-1, 2-2, 3-1, 3-3, and 4-4.

To understand the motivation behind the rejection of the null hypothesis in the above mentioned seven portfolios, we investigate if there are other factors that can be used in the model to explain portfolio returns. First of all, we estimate the unrestricted model (see Eq. 2) with a GMM procedure to investigate if the model is characterized by some pricing errors. We find that in all these portfolios the constant term is significantly different from zero

Table 3: OLS Regressions of Excess Returns on Excess Market Return ($R_m - R_f$) and the mimicking returns for the size (SMB) and earnings/price (HML) factors: January 1986 to February 2010 (289 Months) $R_i - R_f = \alpha_i + b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

Size quartiles	Earnings/price (*E*/*P*) quartiles							
	Low	2	3	High	Low	2	3	High
	α				$t(\alpha)$			
Small	0.0054	−0.0005	−0.0008	0.0068	1.36	−0.17	−0.24	1.90
2	0.0054	0.0049	−0.0008	0.0016	2.72	2.44	−0.37	0.62
3	0.0084	0.0039	0.0037	0.0028	3.12	1.51	1.68	1.12
Big	0.0002	0.0026	0.0015	0.0050	0.10	1.31	1.03	2.84
	b				$t(b)$			
Small	0.7545	0.7778	0.8312	0.9513	11.61	16.50	15.67	16.32
2	1.1510	0.9165	0.8230	0.8424	35.75	28.21	22.56	19.48
3	0.9416	0.9245	0.8219	0.9947	21.59	22.10	22.99	24.24
Big	0.8537	0.8527	0.9105	1.1329	22.81	26.70	38.12	39.79
	s				$t(s)$			
Small	0.8734	0.6953	0.5736	1.0876	7.96	8.73	6.40	11.05
2	1.0579	0.5959	0.5547	0.9935	16.46	10.86	9.00	13.60
3	0.3250	0.2478	0.3331	0.3983	4.41	3.51	5.52	5.75
Big	−0.1110	−0.1178	−0.1354	−0.0612	−1.76	−3.18	−3.36	−1.27
	h				$t(h)$			
Small	−0.2352	−0.0867	0.0828	0.1703	−2.18	−1.11	0.94	1.76
2	−0.8951	−0.0538	−0.0457	0.5803	−16.72	−1.00	−0.75	8.07
3	−0.3669	−0.0036	−0.0935	0.0905	−5.06	−0.05	−1.57	1.33
Big	−0.4453	−0.3340	−0.0502	0.2737	−7.15	−6.29	−1.26	5.78
	adj R^2							
Small	0.3534	0.4958	0.4596	0.5107	GRS F-statistic		3.03	
2	0.8510	0.7344	0.6389	0.6296	p-value		0.000	
3	0.6320	0.6354	0.6490	0.6731	avg $\lvert\alpha\rvert$		0.0034	
Big	0.6944	0.7522	0.8578	0.8664	avg adj R^2		0.6521	

Notes: b_i is the Market-factor beta, s_i is the size-factor beta and h_i is the value growth-factor beta. The GRS-test statistic for the hypothesis that the intercepts in the separated time-series regressions are jointly equal to zero is distributed as a F with (N, T–N–K) degrees of freedom, where N is the number of portfolios, T is the number of monthly observations, and K is the number of factors. With 16 portfolios and 289 monthly returns, the critical values of the GRS statistic for the model are: 90 per cent: 1.50; 95 per cent: 1.68 and 99 per cent: 2.07. avg $\lvert\alpha\rvert$ is the average absolute intercept, avg adj R^2 is the average adjusted R^2.

(see Table 5). Here the estimates are similar to the ones obtained in the OLS regressions, where the model is tested assuming a number of parameters equals to the number of moment condition. However, as noted by Aretz *et al.* (2010), the GMM procedures correct standard errors for the additional

Table 4: GMM Estimations of Excess Returns on Excess Market Return ($R_m - R_f$) and the mimicking returns for the size (SMB) and earnings/price (HML) factors: January 1986 to February 2010 (289 Months) $R_i - R_f = b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

	Earnings/price (*E*/*P*) quartiles							
Size quartiles	Low	2	3	High	Low	2	3	High
	b				*z*(*b*)			
Small	0.6933	0.7824	0.8393	0.8672	8.09	10.95	8.04	9.76
2	1.1367	0.8497	0.8317	0.8281	26.76	16.06	13.94	14.05
3	0.8820	0.9105	0.7850	0.9670	16.38	11.99	14.22	13.46
Big	0.8520	0.8193	0.9062	1.1048	13.57	14.13	23.97	23.12
	s				*z*(*s*)			
Small	0.6095	0.7003	0.5793	1.0002	2.70	5.02	4.38	5.52
2	1.0275	0.5886	0.5547	0.9653	7.67	6.73	6.12	7.40
3	0.3082	0.3038	0.3638	0.3919	2.67	2.18	6.02	3.50
Big	−0.1086	−0.0951	−0.1370	−0.0251	−1.24	−1.19	−2.22	−0.28
	h				*z*(*h*)			
Small	−0.0852	−0.0845	0.0866	0.0555	−0.31	−0.59	0.70	0.31
2	−0.8046	−0.1140	−0.0371	0.5187	−4.58	−1.03	−0.34	3.32
3	−0.3652	−0.0142	−0.1150	0.0663	−3.04	−0.13	−1.60	0.66
Big	−0.4478	−0.3694	−0.0637	0.2496	−4.17	−3.58	−1.07	2.83
	χ^2				*p*-value			
Small	3.6888	0.0367	0.0679	4.5413	0.055	0.848	0.794	0.033
2	9.8170	6.6592	0.1556	0.4681	0.002	0.010	0.693	0.494
3	10.9037	2.2069	2.7665	1.4265	0.001	0.137	0.096	0.232
Big	0.0090	1.7299	1.1552	8.3561	0.923	0.188	0.283	0.004

Notes: b_i is the market-factor beta, s_i is the size-factor beta, h_i is the Value Growth-factor beta. The generalized method of moments (GMM) test statistic testing the three-factor model holds, is distributed as a chi-square with (# moment conditions − # of parameters) degrees of freedom. The associated *p*-value is indicated after the GMM statistics.

uncertainty induced through the generated regressors. Even if the descriptive analysis provided above does not support a momentum effect for the Italian market, the lack of this risk factor could represent a possible explanation of the rejection of our model in 7 out of 16 portfolios. To analyze this possibility, we run a GMM test on the restricted Fama and French model augmented by a momentum effect. As shown in Table 5, for all the seven portfolios considered, we reject the null hypothesis that the over-identifying restrictions are satisfied. This result confirms our preliminary intuition that there is a weak momentum effect in the Italian stock market in the entire

Table 5: GMM Estimations of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) Earnings/Price (HML) and Momentum (WML) Factors: January 1986 to February 2010 (289 Months)

	$R_i - R_f = \alpha_i + b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$					$R_i - R_f = b_i(R_m - R_t) + s_i\text{SMB} + h_i\text{HML} + w_i\text{WML} + \varepsilon_i$					
Size-*E*/*P*	α	b	s	h	adj R^2	b	s	h	w	χ^2	*p*-Value
1-1	0.0054 (1.93)	0.7530 (8.10)	0.8726 (3.18)	−0.2352 (−0.76)	0.3534	0.6578 (6.48)	0.7284 (2.94)	−0.1730 (−0.68)	−0.2134 (−1.00)	3.0193	0.082
1-4	0.0068 (2.15)	0.9451 (10.08)	1.0841 (6.06)	0.1703 (0.91)	0.5106	0.8666 (9.57)	0.9944 (5.58)	0.0576 (0.32)	0.0155 (0.19)	4.6077	0.032
2-1	0.0054 (3.22)	1.1505 (28.59)	1.0577 (8.51)	−0.8951 (−5.71)	0.8510	1.1620 (27.75)	1.0312 (9.61)	−0.8390 (−5.85)	0.1917 (2.24)	11.1832	0.001
2-2	0.0049 (2.60)	0.9165 (16.21)	0.5959 (6.94)	−0.0538 (−0.50)	0.7344	0.8465 (16.38)	0.6058 (8.02)	−0.0942 (−0.96)	−0.1148 (−2.44)	6.0953	0.014
3-1	0.0084 (3.36)	0.9371 (16.64)	0.3225 (2.77)	−0.3669 (−2.86)	0.6320	0.8826 (16.49)	0.3289 (2.92)	−0.3490 (−3.08)	−0.0688 (−0.96)	10.6516	0.001
3-3	0.0037 (1.67)	0.8183 (13.76)	0.3311 (5.45)	−0.0935 (−1.33)	0.6490	0.7855 (14.17)	0.3629 (5.98)	−0.1162 (−1.62)	0.0060 (0.14)	2.7928	0.095
4-4	0.0050 (2.96)	1.1336 (24.23)	−0.0608 (−0.68)	0.2737 (2.96)	0.8663	1.1164 (23.57)	−0.0336 (−0.43)	0.2400 (3.13)	0.0987 (2.03)	9.3163	0.002

Notes: The first equation refers to the unrestricted three-factor model while the second equation is the restricted four-factor model. b_i is the market-factor beta, s_i is the size-factor beta, h_i is the value/growth-factor beta, w_i is the momentum-factor beta. The associated z-statistic is contained in parentheses after the coefficient estimate. Results are reported for the portfolios for which the null hypothesis that the restricted three-factor model is correctly specified is rejected as shown in Table 4. The generalized method of moments (GMM) test statistic testing the four-factor model holds, is distributed as a chi-square with (# moment conditions − # of parameters) degrees of freedom. The associated p-value is indicated after the GMM statistics.

sample period. In fact, only portfolios 2-1, 2-2, and 4-4 show a significant coefficient at a 5 per cent level.

4.3. A robustness analysis

Given the length of the sample period, as a robustness exercise we investigate how the external macroeconomic and financial conditions[9] could have influenced the average returns of our four factors and the stability of the underlying risk-return relations. This is particularly relevant for a country like Italy historically characterized by high public debt as well as high inflation rate in the years preceding the European Monetary Union. We therefore test the existence of significant multiple a priori unknown structural changes in the returns of our factors using the modified version of the SupFL sequential testing procedure as suggested by Bai and Perron (2006).[10] The test is two-step procedure that uses in first stage the double maximum test for the null hypothesis of no structural break against an unknown break (udmax) and in the second stage the sequential testing procedure of the null hypothesis of $m = l$ breaks against the alternative of $m = l + 1$ breaks (SupFL).[11] Table 6 summarizes the main results of the tests.[12] The values of the test statistics suggest that for each factor at least one distinct break exists at a 1 per cent significance level. The break dates are October 1992, February 1999, May 2008, and September 2009 for the market, size, value-growth, and momentum factor, respectively. The break dates for the market and size factors are then selected to identify three consecutive and non-overlapping sub-periods and for testing the relative effectiveness of the three-factor model. These three periods are: (i) the eighties (1986:01-1992:10), characterized by a strong international financial market liberalization with high stock market performance across several markets, and by an unprecedented crash event on October 19, 1987 (see Shiller, 1989); (ii) the nineties (1992:11-1999:02), characterized by the European convergence process that, under the Maastricht Treaty, led to the European Monetary Union; (iii) the new millennium (1999:03-2010:02) characterized by the new economy bubble at the beginning, and by the subprime crises towards the end of the period. Our time periods partition is also justified by the temporal pattern of at least three main macroeconomic and two firm-level indicators. Among the macro indicators we consider the

[9]See for example, Aleati *et al*. (2000) and Panetta (2002) for earlier analyses of the relation between securities returns and macroeconomic factors in the Italian stock market.

[10]We thank Monika Kerekes for providing us the Stata code used to perform the modified SupFL test (udmaxL procedure). For further applications in macroeconomic time-series see Kerekes (2011).

[11]See Bai and Perron (2003).

[12]The tests specifications are: a minimum length h between the beaks of 5, a trimming parameter ε of 0.20 ($\varepsilon = h/T$), a maximum of five structural breaks and an heteroskedasticity and autocorrelation consistent covariance matrix for the errors.

Table 6: Structural Changes on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) Earnings/Price (HML) and Momentum (WML) Factors: January 1986 to February 2010 (289 Months)

	Udmax	SupFL	UdmaxL	Avg excess return (1986:01–1992:10; %)	Avg excess return (1992:11–1999:02; %)	Avg excess return (1999:03–2010:02; %)
Factors	H_0: $m = 0$ H_1: $m = 1$	H_0: $m = l$ H_1: $m = l + 1$	Break Date			
MKT	33.77 (12.02)	6.58*** (13.61)	1992:10	−0.75	1.41	0.00
SMB	30.39 (12.02)	9.88*** (13.61)	1999:02	0.60	−0.53	0.75
HML	42.56 (12.02)	2.33*** (13.61)	2008:05	0.39	−0.02	−0.09
WML	20.54 (12.02)	6.62*** (13.61)	2009:09	0.15	−1.29	0.52

Notes: udmax is the double maximum test, supFL is the sequential testing procedure, udmaxL is the two-stage sequential test that uses the udmax in the first step and the supFL in the second step. The critical values of the test statistic are in parentheses below the values of the test. (***) Statistically significant at a 1 per cent level. The last three columns show the average excess return for each factor in three consecutive sample sub-periods.

government gross debt over GDP ratio; the annual inflation average rate and the industrial production general index.[13] The firm-level indicators we use are the aggregate earnings reported by the firms included in the sample and the aggregate amount of dividends distributed to shareholders. Positive and negative earnings (accounting losses) are cumulated separately for each firm-year observations splitting the annual net income (Worldscope item # 01706) and taking into account the corresponding sign. Dividends paid to investors are cumulated using annual cash dividends amounts (Worldscope item # 04551). Data are Euro-converted and expressed in billions.

Starting from the analysis of the market excess return the macroeconomic conditions that characterized Italy along our sample period imply: (i) in the eighties a rising public debt[14] and high inflation rate with a decreasing importance of the market factor. In the first sub-sample period the mean monthly market excess return is negative (−0.75 per cent) and the 1-month Italian Treasury bill rate reached its absolute higher level of 1.39 per cent in October 1992 in the aftermath of the speculative attacks that forced Italy outside of the European Monetary System in 1992; (ii) the entry in the European Union, leading to public debt and inflation reduction policies, implies then an increased credibility and the market premium becomes positive (the mean monthly market excess return is 1.41 per cent over the period and the industrial production general index exceeds 100 by the end of 1998); (iii) finally we observe a worsening both in 2001 and 2008 in correspondence to the technological bubble in the first case and to the Lehman default in the second case. The main consequences of this last event are an increase in the public debt ratio, a strong decrease in the industrial production along with a deflation process due to the ECB injection of new liquidity and a sharp decline of earnings and dividends (in the third sub-period the mean monthly market excess return is nearly nill at −0.004 per cent; Table 6).

Turning to the OLS and GMM results of the three-factor model the market excess return is statistically different from zero in all the sub-periods considered. However as for the case of the entire sample we find that the alphas obtained from the OLS time-series regressions are statistically different from zero in 3 out of 16 cases in the eighties; in 4 out of 16 cases in the nineties and in 7 out of 16 cases in last sub-period. These results suggest that more accurate investigation is needed to assess if other factors than the market return can explain this result. Even if from a descriptive point of view the size factor seems to negatively contribute to the average Italian equity returns at least in the second sub-period (mean monthly return is

[13]We obtain historical time series for the government gross debt (as a percentage of national GDP), annual average inflation rate and the industrial production general index form the IMF (World Economic Outlook), Bank of Italy and ISTAT databases.

[14]By the end of 1992 the government gross debt over national GDP ratio exceeds 100%.

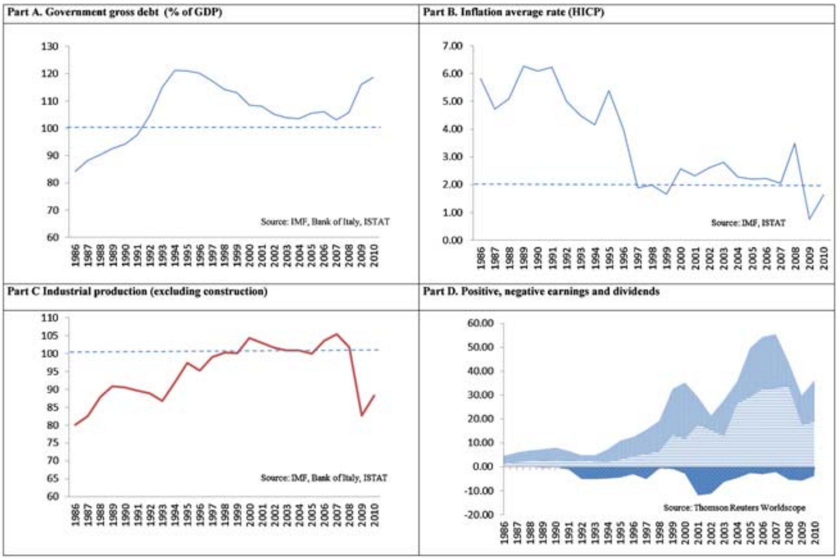

Figure 1: Macroeconomic Indicators and Aggregated Earnings

Notes: Part A Governement gross debt (per cent of GDP) defined according to the convergence criteria set out in the Maastricht Treaty. Part B Inflation annual average rate (percent change). The index is based on 2000 = 100. Definition: Harmonized index of consumer prices annual average. Part C Industrial production (general index, base date 2005 = 100), working day and seasonally adjusted. Part D Positive, negative earnings and dividends. The vertical lines area aggregates positive earnings for each firm-year observation, the horizontal lines area aggregates the total amount of cash dividends paid to shareholder and the dotted area aggregates negative earnings (accounting losses) for each firm-year observation.

−0.53 per cent), it shows a positive persistence all over the remaining periods (0.60 per cent and 0.75 per cent) that can be interpreted as a structural characteristic of the Italian market. This result is also confirmed by the econometric analysis. In all the three periods investigated the size factor is statistically different from zero for nearly all the portfolios considered both for OLS test and GMM procedure (see Tables A3.1, A3.2, A3.3, A4.1, A4.2, A4.3, and A5.1 in Appendix).

The value-growth factor has been positive in the first part of the sample (mean monthly return of 0.39 per cent), but becomes and remains substantially negative since the mid-nineties till the end of our sample period (−0.02 per cent and −0.09 per cent). The momentum effect shows an irregular trend with a negative effect overall the analyzed period, being strongly negative before the technological bubble burst (mean monthly return −1.29 per cent) but positive in the other two sub-periods (0.15 per cent and 0.52 per cent). From an econometric point of view it does not play any role in the eighties (Table A5.1) however it becomes more important in the two subsequent sub-periods. In fact it is statistically significant in two out of four portfolios in the nineties while in five out of seven portfolios in the last decade. Finally our sub-periods estimations reveal that the three-factors model performs moderately in explaining the differences in portfolios returns in the first two periods (the GRS *F*-statistics are 1.92 and 1.76 with *p* values of 0.035 and 0.062, respectively) while it is much less effective in the last period (GRS *F*-statistic 2.44, *p*-value 0.003).

5. Conclusions

This paper empirically tests a multi-factor model on the Italian stock market using 25 years of data. Our main results can be summarized as follows. Firstly, we find that the market premium and the size premium are confirmed for a domestic Italian investor. The value premium over the time horizon is modest in magnitude. The pricing errors do not appear statistically different from zero in 9 out of 16 portfolios. When they are statistically different from zero is probably due to the composition of the portfolios that, being formed by only a few assets at the beginning of the sample period, can affect the model specification. In the entire sample period the traditional Fama-French three-factor model seems however to perform poorly in explaining the differences in portfolios returns. While it can be considered as an effective asset pricing model in nearly the first half of our sample period, it is rejected in the last decade. Secondly, the GMM test of the three factors specification appears to support the initial evidence reported in OLS analysis applied to the Italian stock market. In 9 out of 16 portfolios the null hypothesis that the over-identifying restrictions are satisfied cannot be rejected. Finally, we found weak evidence of a momentum effect in the Italian stock market. The results of the analysis suggest that one potential explanation of the relative scarce performance of our multifactor asset pricing models could be related to macroeconomic conditions that influence some of the risk-based factors. Liu and Zhang (2008) document that winners and losers portfolios are strongly related to the growth rate of industrial production and that macroeconomic risks, better than investors' (ir) rationality, could explain differences in portfolios returns. Further analysis is needed to understand if the same pattern exists in the Italian stock market also for others common factors. Moreover, assuming that at least the market and size effects hold in the models specifications, a promising development of our research is to use investment-based factors[15] (Hou *et al*., 2012) in addition to market and size factors and assess the effectiveness on new classes of investment-based multifactor asset pricing models in explaining anomalies.

[15]See Lin and Zhang (2013) for a comparison between risk-based factors and investment-based factors in asset pricing models.

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Appendix

Table A3.1: OLS Regressions of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) and Earnings/Price (HML) Factors: January 1986 to October 1992 (81 Months)

$$R_i - R_f = \alpha_i + b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

Size quartiles	Earnings/price (E/P) quartiles							
	Low	2	3	High	Low	2	3	High
	α				$t(\alpha)$			
Small	0.0024	−0.0047	−0.0023	0.0011	0.75	−1.43	−0.57	0.19
2	0.0077	0.0060	−0.0042	−0.0029	3.22	1.59	−1.01	−0.68
3	0.0025	0.0019	−0.0068	0.0029	0.72	0.36	−1.52	0.73
Big	−0.0041	−0.0083	0.0025	0.0074	−0.98	−2.23	0.96	3.12
	b				$t(b)$			
Small	0.7639	0.6078	0.8701	0.6365	13.57	10.35	12.05	6.09
2	1.0811	0.9800	0.8131	0.6509	25.42	14.83	11.08	8.54
3	0.7797	0.9383	0.6736	0.8882	12.53	10.35	8.55	12.75
Big	0.7900	0.7168	1.0549	0.8942	10.60	10.93	22.97	21.17
	s				$t(s)$			
Small	0.9475	0.6190	0.7444	0.5812	7.78	4.87	4.76	2.57
2	0.7187	0.4608	0.7704	0.8962	7.81	3.22	4.85	5.43
3	0.1590	−0.2983	0.4174	0.1881	1.18	−1.52	2.45	1.25
Big	0.3602	0.3285	−0.7921	−0.6233	2.23	2.31	−0.80	−6.82
	h				$t(h)$			
Small	−0.7090	−0.5288	0.2228	−0.4085	−6.06	−4.33	1.48	−1.88
2	−0.6044	−0.2545	−0.3922	−0.3686	−6.84	−1.85	−2.57	−2.33
3	−0.6768	−0.2431	−0.6173	0.0002	−5.23	−1.29	−3.77	0.00
Big	−1.0716	−0.8709	−0.0236	0.4618	−6.92	−6.39	−0.25	5.26
	adj R^2							
Small	0.7061	0.5795	0.6685	0.3061	GRS F-statistic		1.92	
2	0.8968	0.7566	0.6031	0.4707	p-value		0.035	
3	0.7221	0.6850	0.5051	0.7215	avg $\lvert\alpha\rvert$		0.0042	
Big	0.6575	0.6604	0.9064	0.9237	avg adj R^2		0.6730	

Notes: b_i is the market-factor beta, s_i is the size-factor beta and h_i is the value growth-factor beta. The GRS-test statistic for the hypothesis that the intercepts in the separated time-series regressions are jointly equal to zero is distributed as a F with (N, T–N–K) degrees of freedom, where N is the number of portfolios, T is the number of monthly observations, and K is the number of factors. With 16 portfolios and 81 monthly returns, the critical values of the GRS statistic for the model are: 90 per cent: 1.59; 95 per cent: 2.33 and 99 per cent: 3.37. avg $\lvert\alpha\rvert$ is the average absolute intercept, avg adj R^2 is the average adjusted R^2.

Table A3.2: OLS Regressions of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) and Earnings/Price (HML) Factors: November 1992 to February 1999 (76 Months)

$$R_i - R_f = \alpha_i + b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

Size quartiles	Earnings/price (E/P) quartiles							
	Low	2	3	High	Low	2	3	High
	α				$t(\alpha)$			
Small	0.0063	0.0059	−0.0012	0.0042	1.13	0.74	−0.15	0.53
2	0.0035	0.0028	0.0021	0.0007	1.24	0.88	0.46	0.20
3	0.0113	0.0014	0.0095	0.0003	1.71	0.39	2.14	0.06
Big	−0.0041	0.0066	−0.0008	0.0053	−0.89	1.99	−0.29	1.96
	b				$t(b)$			
Small	0.6250	1.1048	0.9567	1.1217	8.02	10.57	8.76	10.40
2	1.0452	1.0049	0.8734	0.9941	27.04	23.09	13.96	20.07
3	1.0506	0.8752	0.9816	0.9140	11.49	17.05	16.05	12.76
Big	0.9876	0.9673	0.9178	1.0897	15.57	20.95	24.70	29.06
	s				$t(s)$			
Small	0.7181	1.3699	0.7687	1.4449	5.29	7.52	4.03	7.70
2	0.8553	0.9309	0.6451	0.9660	12.24	12.27	5.91	11.18
3	0.7291	0.4383	0.5001	0.4125	4.57	4.90	4.69	3.30
Big	−0.0213	−0.2121	−0.1443	−0.1464	−0.19	−2.63	−2.23	−2.24
	h				$t(h)$			
Small	−0.3290	0.0924	−0.4167	0.2624	−1.73	0.36	−1.56	1.00
2	−0.7648	−0.4119	−0.1307	0.2998	−8.11	−3.88	−0.86	2.48
3	−0.6208	−0.3096	−0.1284	−0.2316	−2.78	−2.47	−0.86	−1.32
Big	−0.7472	−0.2140	−0.2220	0.4603	−4.83	−1.90	−2.45	5.03
	adj R^2							
Small	0.4872	0.6324	0.5042	0.6325	GRS F-statistic		1.76	
2	0.9124	0.8824	0.7216	0.8544	p-value		0.062	
3	0.6403	0.7941	0.7727	0.6814	avg $\|\alpha\|$		0.0041	
Big	0.7884	0.8764	0.9057	0.9336	avg adj R^2		0.7494	

Notes: b_i is the market-factor beta, s_i is the size-factor beta and h_i is the value growth-factor beta. The GRS-test statistic for the hypothesis that the intercepts in the separated time-series regressions are jointly equal to zero is distributed as a F with (N, T–N–K) degrees of freedom, where N is the number of portfolios, T is the number of monthly observations, and K is the number of factors. With 16 portfolios and 76 monthly returns, the critical values of the GRS statistic for the model are: 90 per cent: 1.60; 95 per cent: 1.82 and 99 per cent: 2.33. avg $|\alpha|$ is the average absolute intercept, avg adj R^2 is the average adjusted R.

Table A3.3: OLS Regressions of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) and Earnings/Price (HML) Factors: March 1999 to February 2010 (132 Months)

$$R_i - R_f = \alpha_i + b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

Size quartiles	Earnings/price (*E*/*P*) quartiles							
	Low	2	3	High	Low	2	3	High
	α				$t(\alpha)$			
Small	0.0069	0.0010	0.0012	0.0128	0.86	0.28	0.24	2.51
2	0.0036	0.0080	−0.0000	0.0032	0.99	2.64	−0.01	0.78
3	0.0124	0.0090	0.0065	0.0049	3.38	2.28	2.49	1.25
Big	0.0053	0.0049	0.0027	0.0019	1.86	1.98	1.18	0.64
	b				$t(b)$			
Small	0.9192	0.6181	0.7180	1.0254	6.29	10.37	7.93	11.11
2	1.2346	0.8087	0.8370	0.9037	18.69	14.77	13.80	11.99
3	0.9945	0.9277	0.8151	1.1759	14.87	12.99	17.20	16.42
Big	0.9101	0.9166	0.7943	1.2760	17.45	20.39	19.31	23.86
	s				$t(s)$			
Small	0.9943	0.3104	0.3937	1.0102	4.78	3.66	3.05	7.69
2	1.2810	0.4452	0.4649	1.1264	13.62	5.71	5.38	10.49
3	0.1264	0.3095	0.2382	0.4494	1.33	3.04	3.53	4.40
Big	−0.2815	−0.1638	−0.1363	0.1381	−3.79	−2.52	−2.33	1.81
	h				$t(h)$			
Small	−0.0701	−0.0800	0.1330	0.3178	−0.40	−1.11	1.22	2.85
2	−0.9459	0.0580	0.0400	0.9037	−11.84	0.88	0.55	9.92
3	−0.2332	0.1649	0.0329	0.2285	−2.88	1.91	0.57	2.64
Big	−0.2531	−0.2457	−0.0314	0.2480	−4.01	−4.52	−0.63	3.84
	adj R^2							
Small	0.2721	0.4579	0.3194	0.5315	GRS *F*-statistic		2.44	
2	0.8383	0.6273	0.5956	0.6685	*p*-value		0.003	
3	0.6450	0.5595	0.6916	0.6719	avg $\lvert\alpha\rvert$		0.0053	
Big	0.7471	0.7915	0.7634	0.8161	avg adj R^2		0.6248	

Notes: b_i is the market-factor beta, s_i is the size-factor beta and h_i is the Value growth-factor beta. The GRS-test statistic for the hypothesis that the intercepts in the separated time-series regressions are jointly equal to zero is distributed as a *F* with (*N*, *T–N–K*) degrees of freedom, where *N* is the number of portfolios, *T* is the number of monthly observations, and *K* is the number of factors. With 16 portfolios and 132 monthly returns, the critical values of the GRS statistic for the model are: 90 per cent: 1.53; 95 per cent: 1.73 and 99 per cent: 2.16. avg $|\alpha|$ is the average absolute intercept, avg adj R^2 is the average adjusted R^2.

Table A4.1: GMM Estimations of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) and Earnings/Price (HML) Factors: January 1986 to October 1992 (81 Months)

$$R_i - R_f = b_i(R_m - R_f) + s_i SMB + h_i HML + \varepsilon_i$$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

Size quartiles	Earnings/price (*E/P*) quartiles							
	Low	2	3	High	Low	2	3	High
	b				$z(b)$			
Small	0.7438	0.6093	0.8807	0.6304	11.65	7.87	12.16	5.43
2	1.0762	0.8555	0.8647	0.6638	18.55	14.03	9.06	6.57
3	0.7655	0.9568	0.7425	0.8641	11.44	10.64	8.43	12.32
Big	0.8333	0.8001	1.0507	0.8312	9.53	8.68	23.87	11.02
	s				$z(s)$			
Small	0.9550	0.5134	0.7413	0.5953	5.75	4.08	4.07	1.90
2	0.8847	0.5748	0.7317	0.8536	5.28	3.62	3.70	4.30
3	0.1898	−0.1909	0.3452	0.2357	0.99	−0.55	2.47	1.77
Big	0.3171	0.2324	−0.0548	−0.4202	1.94	1.58	−0.46	−2.47
	h				$z(h)$			
Small	−0.7145	−0.5131	0.2636	−0.4268	−5.92	−4.30	0.99	−1.74
2	−0.5415	−0.4848	−0.3233	−0.3518	−4.31	−2.13	−1.74	−2.20
3	−0.6766	−0.2554	−0.6335	−0.0037	−7.34	−1.19	−2.86	−0.03
Big	−1.0036	−0.7165	−0.0532	0.2700	−4.68	−4.03	−0.42	1.86
	χ^2				p-value			
Small	0.5486	1.7698	0.3464	0.0359	0.459	0.183	0.556	0.850
2	8.0779	1.7802	0.8901	0.4189	0.005	0.182	0.346	0.518
3	0.4662	0.0977	1.8791	0.4346	0.495	0.755	0.170	0.510
Big	0.8491	4.2117	0.9195	7.0028	0.357	0.040	0.338	0.008

Notes: b_i is the Market-factor beta, s_i is the size-factor beta, h_i is the value growth-factor beta. The generalized method of moments (GMM) test statistic testing the three-factor model holds, is distributed as a chi-square with (# moment conditions − # of parameters) degrees of freedom. The associated p-value is indicated after the GMM statistics.

Table A4.2: GMM Estimations of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) and Earnings/Price (HML) Factors: November 1992 to February 1999 (76 Months)

$$R_i - R_f = b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

Size quartiles	Earnings/price (E/P) quartiles							
	Low	2	3	High	Low	2	3	High
	b				$z(b)$			
Small	0.5993	1.0892	0.9661	1.0806	8.51	11.61	4.36	9.56
2	1.0531	0.9898	0.8704	0.9944	29.69	17.97	9.78	19.59
3	0.9991	0.8787	0.9696	0.9145	11.11	12.17	15.92	11.67
Big	0.9805	0.9761	0.9148	1.0902	14.82	17.60	24.71	21.19
	s				$z(s)$			
Small	0.5817	1.2725	0.7795	1.3498	3.62	5.82	3.06	5.70
2	0.8076	0.8856	0.6347	0.9610	14.61	10.43	7.09	13.6
3	0.5369	0.4336	0.5179	0.4126	2.66	4.50	6.08	2.82
Big	−0.0534	−0.2371	−0.1512	−0.1187	−0.48	−2.74	−2.21	−1.38
	h				$z(h)$			
Small	−0.3505	0.1146	−0.4335	0.1807	−1.58	0.46	−1.67	0.58
2	−0.7179	−0.4562	−0.1330	0.2947	−6.92	−4.29	−1.03	2.85
3	−0.7372	−0.3066	−0.1919	−0.2325	−3.67	−2.81	−1.58	−1.27
Big	−0.7124	−0.2862	−0.2173	0.4093	−5.30	−2.43	−2.16	5.74
	χ^2				p-value			
Small	1.3472	0.5878	0.0312	0.3543	0.246	0.443	0.860	0.552
2	1.5688	0.9002	0.2494	0.0413	0.210	0.343	0.618	0.839
3	3.1997	0.1579	5.1118	0.0044	0.074	0.691	0.024	0.947
Big	0.9010	4.0127	0.0914	4.4909	0.343	0.045	0.762	0.034

Notes: b_i is the market-factor beta, s_i is the size-factor beta, h_i is the value growth-factor beta. The generalized method of moments (GMM) test statistic testing the three-factor model holds, is distributed as a chi-square with (# moment conditions − # of parameters) degrees of freedom. The associated p-value is indicated after the GMM statistics.

Table A4.3: GMM Estimations of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) and Earnings/Price (HML) Factors: March 1999 to February 2010 (132 Months)

$$R_i - R_f = b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$$

Dependent variable: excess returns on 16 stock portfolios formed on size and earnings/price

Size quartiles	Earnings/price (E/P) quartiles							
	Low	2	3	High	Low	2	3	High
	b				*z*(*b*)			
Small	0.8686	0.6208	0.7120	0.9926	4.10	6.70	5.40	6.00
2	1.2458	0.7748	0.8372	0.8853	16.23	12.42	8.17	12.26
3	0.9255	0.7852	0.8386	1.1316	10.78	4.25	15.77	6.92
Big	0.9321	0.9296	0.7806	1.2738	13.91	17.35	9.93	14.79
	s				*z*(*s*)			
Small	0.8461	0.3182	0.3959	0.9044	1.79	2.66	2.67	3.95
2	1.3023	0.5059	0.4648	1.0403	6.88	4.92	3.35	4.99
3	0.2131	0.2141	0.2914	0.4282	2.18	1.17	4.58	2.48
Big	−0.2562	−0.1518	−0.1469	0.1409	−2.71	−1.42	−1.65	1.24
	h				*z*(*h*)			
Small	−0.0895	−0.0852	0.1248	0.1521	−0.22	−0.72	1.02	0.79
2	−0.9404	0.0538	0.0404	0.8080	−5.41	0.60	0.32	3.85
3	−0.1861	0.0942	0.0386	0.1809	−1.75	0.57	0.71	1.27
Big	−0.2956	−0.2838	−0.0516	0.2360	−3.63	−2.62	−0.67	2.65
	χ^2				*p*-value			
Small	2.5454	0.0819	0.0616	9.0670	0.111	0.775	0.804	0.003
2	1.6957	7.0624	0.0001	1.1137	0.193	0.008	0.991	0.291
3	11.2324	7.4453	5.8576	2.0740	0.001	0.006	0.016	0.150
Big	3.5796	4.7492	1.8170	0.4955	0.059	0.029	0.178	0.482

Notes: b_i is the market-factor beta., s_i is the size-factor beta, h_i is the value growth-factor beta. The generalized method of moments (GMM) test statistic testing the three-factor model holds, is distributed as a chi-square with (# moment conditions − # of parameters) degrees of freedom. The associated p-value is indicated after the GMM statistics.

Table A5.1: GMM Estimations of Excess Returns on Excess Market Return ($R_m - R_f$) and the Mimicking Returns for the Size (SMB) Earnings/Price (HML) and Momentum (WML) Factors

	$R_i - R_f = \alpha_i + b_i(R_m - R_f) + s_i\text{SMB} + h_i\text{HML} + \varepsilon_i$					$R_i - R_f = b_i(R_m - R_t) + s_i\text{SMB} + h_i\text{HML} + w_i\text{WML} + \varepsilon_i$					
Size-*E*/*P*	α	b	s	h	adj R^2	b	s	h	w	χ^2	*p*-value
January 1986–October 1992 (81 months)											
2-1	0.0773 (3.07)	1.0811 (23.77)	0.7187 (5.55)	−0.6044 (−5.26)	0.8968	1.0762 (19.19)	0.8802 (5.29)	−0.5358 (−4.27)	−0.0199 (−0.50)	8.1420	0.004
4-2	−0.0083 (−2.14)	0.7168 (8.13)	0.3285 (2.49)	−0.8789 (−4.69)	0.6604	0.7901 (8.36)	0.2284 (1.51)	−0.6759 (−3.61)	−0.0985 (−0.87)	4.3967	0.036
4-4	0.0074 (2.84)	0.8942 (15.99)	−0.6233 (−4.17)	0.4618 (2.91)	0.9237	0.8355 (11.57)	−0.4289 (−2.50)	0.2817 (1.90)	0.0060 (0.13)	7.1766	0.007
November 1992–February 1999 (76 months)											
3-1	0.1132 (1.83)	1.0501 (11.28)	0.7291 (3.23)	−0.6208 (−2.79)	0.6403	1.0127 (11.44)	0.5407 (2.71)	−0.8075 (−3.39)	0.0977 (2.18)	3.8845	0.049
3-3	0.0095 (2.36)	0.9816 (17.82)	0.5001 (5.55)	−0.1284 (−1.02)	0.7727	0.9641 (15.64)	0.5044 (5.64)	−0.1787 (−1.40)	−0.0263 (−0.45)	4.9604	0.026
4-2	0.0066 (2.06)	0.9673 (17.59)	−0.2121 (−2.52)	−0.2140 (−1.74)	0.8764	0.9701 (17.69)	−0.2346 (−2.78)	−0.2557 (−2.10)	−0.0335 (−0.99)	3.7266	0.054
4-4	0.0053 (2.18)	1.0898 (20.79)	−0.1465 (−1.79)	0.4603 (5.87)	0.9336	1.0967 (21.68)	−0.1006 (−1.21)	0.3823 (5.54)	0.0387 (1.73)	5.4287	0.020
March 1999–February 2010 (132 months)											
1-4	0.0128 (3.13)	1.0254 (7.11)	1.0102 (4.53)	0.3178 (1.58)	0.5315	1.0091 (6.55)	0.8663 (4.20)	0.1487 (0.74)	0.1667 (1.42)	9.1218	0.003
2-2	0.0080 (2.70)	0.8087 (12.65)	0.4452 (4.13)	0.0580 (0.67)	0.6273	0.7759 (14.57)	0.5711 (6.52)	0.0609 (0.78)	−0.1524 (−2.83)	7.2954	0.007
3-1	0.0124 (3.46)	0.9945 (11.38)	0.1264 (1.15)	−0.2332 (−2.03)	0.6450	0.9462 (12.48)	0.2804 (2.86)	−0.1651 (−1.89)	−0.1608 (−1.90)	12.6579	0.000
3-2	0.0090 (2.79)	0.9277 (5.32)	0.3095 (1.79)	0.1649 (1.07)	0.5595	0.7822 (4.05)	0.2133 (1.49)	0.0998 (0.62)	0.0109 (0.08)	7.3756	0.007
3-3	0.0065 (2.46)	0.8151 (15.13)	0.2382 (3.48)	0.0329 (0.61)	0.6916	0.8412 (16.09)	0.2454 (4.17)	0.0397 (0.79)	1.0182 (3.07)	6.3934	0.012
4-1	0.0053 (1.91)	0.9101 (13.00)	−0.2815 (−3.14)	−0.2531 (−3.28)	0.7471	0.9295 (14.25)	−0.2017 (−2.54)	−0.2889 (−4.12)	−0.1196 (−2.46)	3.5496	0.060
4-2	0.0049 (2.21)	0.9166 (16.35)	−0.1638 (−1.63)	−0.2457 (−2.41)	0.7915	0.9227 (19.84)	−0.0653 (−0.76)	−0.2716 (−3.12)	−0.1873 (−4.85)	4.9927	0.026

Notes: The first equation refers to the unrestricted three-factor model while the second equation is the restricted four-factor model. b_i is the market-factor beta, s_i is the size-factor beta, h_i is the value/growth-factor beta, w_i is the Momentum-factor beta. The associated z-statistic is contained in parentheses after the coefficient estimate. Results are reported for the portfolios for which the null hypothesis that the restricted three-factor models are correctly specified are rejected as shown in Tables A4.1, A4.2, and A4.3. The generalized method of moments (GMM) test statistic testing the four-factor model holds, is distributed as a chi-square with (# moment conditions − # of parameters) degrees of freedom. The associated *p*-value is indicated after the GMM statistics.

Non-technical Summary

In this paper, we provide an empirical study of the Fama and French model augmented by the momentum factor on the Italian market. We find that over the last 25 years, the pricing factor structure of Italian equity returns has depended on the market and size factors. Other factors such as value and momentum play only a marginal role. Moreover, since the Italian economy is typically characterized by macro-regularities such as high public debt, a high inflation rate and a slow production growth rate, we check if the results hold for several sub-periods. Evidence suggests that the results are generally confirmed in the case of the size and value factors, while the momentum becomes more important only in recent years.