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Abstract

This paper investigates the performance of size- and value-based strategies in the Italian Stock Market in the period 2000 - 2018. Previous research (Beltratti and Di Tria (2002)) argued the impossibility to define properly value sorted portfolios due to the inaccuracy of book-to-market ratios available for Italian listed stocks. The Datastream database, which was commonly used by previous authors, contains errors which may undermine the result of the analysis. Using accurate data provided by Borsa Italiana and Mediobanca, we implement portfolios sorting based on value and growth stocks, in order to asses the relevance of the value factor in the Italian Stock Market. We find that the CAPM fails to explain the cross section of returns on the different strategies while the Fama and French (1993) three-factor model provides a better fit. The results show that all three factors are significant in explaining Italian stock returns during the sample period. Unlike previous studies, which either found no value effect at all (Barontini (1997); Aleati et al., (2000)) or no clear cut results when testing the book-to-market variable (Bruni et al. (2006); Rossi (2012)), we find that the value factor is statistically significant and the associated risk premium is of a considerable size.

1 Introduction

The Capital Asset Pricing Model (CAPM) postulates a linear dependency of expected stock returns on their regression coefficient on the market factor. A number of theoretical and empirical inconsistencies of the CAPM model are known, namely the critiques by Roll (1977) and Hansen and Richard (1987) on the testability of the model, and empirical inconsistencies like the small-firm effect by Banz (1981) and the inability to explain returns of value- and growth-sorted portfolios by Fama and French (1993). Such issues have motivated extensive research into alternative models.

In response to the empirical shortcomings, Fama and French (1993) proposed a three-factor model in which additional common sources of variation in stock prices are represented by the difference in return of high book-to-market stocks and low book-to-market stocks (HML), and the difference in return of small and big stocks (SMB). The Fama French (1993) (henceforth FF) model has been very successful in explaining stock returns compared to multifactor models based on macroeconomic variables in the US. Fama and French (1998) extended their results to other major stock markets. The economic mechanism underlying the pricing impact of the additional FF factors is not however completely understood, and it is often interpreted as an example of Ross (1976) Arbitrage Pricing Theory.

While there is extensive empirical evidence of the performance of the FF model in the US and other major stock markets like the UK and Japan, few papers have investigated it on the Italian stock market. There have been contributions by Barontini (1997), Cavaliere and Costa (1999), Aleati et al. (2000), Betratti and Di Tria (2002), Alesii (2006), Brighi and D´Addona (2008), and Silvestri and Veltri (2011) who test different multifactor model specification including FF factors. Bruni et al. (2006) and Rossi (2012) stick to the FF testing framework and concentrate on SMB and HML.

In general, there was high heterogeneity across all the studies on the Italian Stock Market as far as the sample period, model and econometric method were concerned. The sample period range in these studies was very wide, from 9 years (Cavaliere and Costa (1999)) to 86 years (Alesii (2006)), which led to a different number of observations and consequently different methods of conducting the tests.

As for the FF risk factors, previous results broadly support the conclusion that beta and the size factor are needed to explain the variations in Italian stock returns, whereas the book-to-market (B/M) ratio was significant in some studies and not significant in others.

Aleati et al. (2000), who studied the sample period 1981-1993, were concerned with the explanatory power of HML and SMB for average stock returns compared to the Chen, Roll and Ross (1986) macroeconomic factors. Applying different econometric methods, they failed to detect a significant role of the HML factor on its own. They applied tests on single stock returns rather than portfolios because of the small number of stocks available. Beltratti and Di Tria (2002) considered the sample period 1990-2000 and used FF and macroeconomic factors to explain the returns of portfolios sorted by industry size and dividend yield. They claimed that the poor quality of book-to-market data for Italian stocks prevents reliable calculation of the HML factor which they substituted with dividend yield. They found opposite results for the explanatory power of the FF model in cross-sectional as opposed to time-series regressions. Bruni et al. (2006) and Rossi (2012) carried out time series tests on size and value sorted portfolios in the 1989-2004 sample period, and concluded in favor of the FF three-factor specification, including the HML value-growth factor, against the CAPM, for the explanation of the return on value- and size-based portfolios, although the significance of HML was not clear cut.

In this paper we follow the approach of Cavaliere and Costa (1999), Bruni et al. (2006) and Rossi (2012), comparing the FF model with the CAPM in the pricing of size- and value-based strategies. We extend the testing period to the most recent sample 2000-2018, which includes the financial crises of 2002, 2005 and 2007-2008, with an overall negative average stock index return of (-48%). Moreover, we address a number of shortcomings of the tests of the FF model in the Italian Stock Market used in previous studies. We show that B/M data in Datastream, the data source used in many previous studies (Beltratti and Di Tria (2002), Bruni el al. (2006) and Rossi (2012) among others) is often inaccurate. We use accurate sources for market capitalization and book-to-market data in order to correctly define the SMB and especially the HML factor. We also overcome the incompleteness of the universe of stocks used by Bruni et al. (2006) and Rossi (2012) who tested an arbitrary small sample of 109 ordinary stocks that were listed in the period 1989-2004, excluding savings and preferred stocks [1], representing only about 50 percent of the market capitalization.[2]

Our empirical contribution is to identify more accurate data sources, and show that a properly defined HML factor is a statistically significant explanatory variable for the return of value- and size-sorted portfolios of Italian stocks. Consistent with international evidence, these returns cannot be explained by the CAPM. Moreover, the risk premium on the HML factor in our sample is about 5% on a yearly basis and is statistically significant.

The plan of the paper is as follows: in Section 2 we describe the data and the problems detected with often-used B/M and market capitalization data, which we check against reliable sources. We deal with the construction of the sorted portfolios and FF factors based on our more accurate data. Section 3 contains statistics on the sorted portfolio returns. In Section 4 we apply a single factor model and the FF model to the returns of the size- and value-sorted portfolios, and show that the additional HML and SMB factors are essential explanatory variables for these strategies. In Section 5 we analyze the key components of HML factor return. Section 6 concludes.

2 Data and Research Methodology

We use all the stocks traded in the period between the end of June 2000 and the end of June 2018. Our data source is Datastream. The number of stocks in our sample is 499. This sample was obtained starting with 632 stocks in the Datastream database, listed at some time between 2000 and 2018. However in most cases the reported trading volume was zero and the time series of the corresponding price showed a constant price or the price was not available in Datastream. Hence only stock prices with a corresponding positive trading volume were used, leaving 521 stocks which had a positive volume at some time in the sample period. Of these, 22 turned out to be duplications due to the fact that after a merger, Datastream continued to store the series both names. The stocks listed continuously in the sample period number 65. The available stocks were grouped into portfolios according to size-based and value-based strategies by sorting stocks in ascending order, first according to market capitalization at the end of June each year, and then according to book to market at the end of the previous year. We considered a variable sample that takes into account new listings and delistings. In order to be included in a portfolio, a stock must be traded at the end of June and at the end of the previous year. We used adjusted month end prices to compute monthly returns for each stock over the sample period, and if a monthly return was missing the stock was excluded from the portfolio in that month. This narrows the sample. The number of stocks listed and processed in each year of our sample period is between 224 and 301. Hence we decided to follow Bruni et al. (2006) and Rossi (2012) and sorted stocks into 16 portfolios instead of 25 as in FF.

We took special care in addressing the quality of the data. As already mentioned, because of the "low quality of Italian book-to-market data", Beltratti and Di Tria (2002) gave up the HML factor obtained by sorting stocks

[1] FF (1993) noted that the assignment of book value to preferred stocks requires specific assumptions.

[2] Using the same source, we could not exactly replicate their results. It was not possible to get the exact data used by the authors due to the fact that some companies have merged with others and Datastream (and Bloomberg) merged their relative values, book-to-market and prices. Thus, the initial sample analyzed in this study comprised 108 stocks, not 109 (SMI merged with Intek Group and it was not possible to get the separate time series)

according to high and low book to market, and chose the dividend yield as a proxy. We obtained adjusted stock returns, book to market and market capitalization data from Datastream. We also obtained end-of-June market capitalization data directly from the Italian Stock Exchange (Borsa Italiana), and book-to-market data from the publication *Indici e Dati* by Mediobanca S.p.A. (Mediobanca), which contains carefully processed data and is considered an authoritative source for Italian listed-stock statistics. We also used stock price data from Bloomberg to counter check anomalous returns which we corrected in few cases. Our market excess return is computed using FTSE Mib and 3-month Euribor.

We then proceeded to compare book to market and market capitalization values from these databases.

2.1 Accuracy of Book to Market and Market Capitalization Data

We considered whether the book to market and market capitalization data available in the Datastream database can be reliably used in the sorting procedure. The B/M value is based on the book value attributed to each stock, compared to its market value. The book value is obtained from company financial statements at the end of each calendar year, i.e. 31st December, and used in the sorting at the end of June of the following year, when this information is certainly in the public domain. When a company has different categories of stocks other than common stock outstanding, the attribution of book value to the different categories depends on the seniority of stock holders in case of liquidation. We investigated the reliability of B/M ratios for individual stocks by comparing the information available from Datastream and from *Indici e Dati* by Mediobanca. We also checked whether market capitalization data available in Datastream is reliable by comparing it with data obtained directly from the stock exchange Borsa Italiana. Table 1 contains summary statistics on the discrepancies of year-end B/M values in Datastream and Mediobanca for all available stocks, as well as discrepancies between 30th June market capitalization values in Datastream and those obtained from the Italian Stock Exchange (about 5000 observations for which we have both values). While small discrepancies may be due to rounding, B/M point values in Datastream are often substantially different from those published by Mediobanca, and at times even negative, providing some support for the argument that the Italian B/M ratios available in commercial databases are not reliable and need to be carefully considered before they are used. A lesser issue was detected for market capitalization values. In the FF framework B/M and market capitalization values can be used to devise specific trading strategies through sorted portfolios, and also to derive more general factors that can explain the expected return of specific strategies, namely the HML and SMB. It is important that the quantiles into which stocks are sorted are computed according to accurate B/M and market capitalization data. Wrong values for market capitalization and book to market alter the break points for the computation of quantiles and modify the composition of sorted portfolios. A problem with the Datastream data is also the tendency to report the previous period market capitalization and B/M even after a stock is no longer listed. If not identified, this issue increases the number of stock processed every year in sorting by size and B/M, altering the definition of quantiles and the composition of value and size portfolios. As returns for stocks which are no longer listed are not available, the portfolios shrink in size when their returns are computed, and contain the wrong stocks, making it difficult to attribute returns to value and size categories.

2.2 Portfolio Sorting and Construction of HML and SMB

We sorted stocks into quartiles according to June market capitalizations from Borsa Italiana and year-end B/M from Mediobanca, which we consider to be more reliable. Table 2 describes the average of the quartiles into which stocks are binned by market capitalization and B/M value in order to simulate strategies based on value and size. High B/M indicates value stocks that the stock market undervalues with respect to their equity. The sorting procedure produces one such table defining 16 portfolios at the end of June, when portfolios are rebalanced, for every year between 2000 and 2018, and here only the average of the break points are reported. As is well known, small stocks in Italy can be really small, with market capitalizations as low as 0.3 million euro. High B/M values are, on average, more pronounced for small stocks, with top (average) B/M values of about 5, which are twice as high as B/M values found for large stocks, about 2.5. Large stocks tend to have lower B/M. Over time (not reported), B/M tends to increase in our sample for stocks of all sizes, but small stocks in recent years have sometimes reached B/M values over 9. We labeled the 16 portfolios P1 through P16, characterized by size and value according to the structure described in Table 3.

The additional FF risk factors HML and SMB result from partitioning the same stocks into six portfolios by sorting according to market capitalization into two groups, small and big, and then sorting these two groups by B/M according to percentiles corresponding to 30, 40 and 30 percent into Growth, Neutral, and Value stocks:

$$HML = \frac{(LargeValue + SmallValue) - (LargeGrowth + SmallGrowth)}{2}, \quad (1)$$

$$SMB = \frac{(SmallValue + SmallNeutral + SmallGrowth) - (LargeValue + LargeNeutral + LargeGrowth)}{3}. \quad (2)$$

3 Sorted Portfolios Returns

The monthly returns of each of the sixteen portfolios were calculated from the end of June of each year for the subsequent twelve months, starting with July. We computed equally weighted and value weighted returns. The calculation was repeated for each year to produce returns for the whole duration of the sample.

Table 4 shows descriptive statistics for the time series of equally weighted portfolio returns obtained by this procedure. With two exceptions (P5 and P6), the average return on the size-value strategies is positive. Returns on the first portfolio (P1) which contains the smallest stocks with the lowest B/M are the most erratic, as it can be seen from the wide range and descriptive statistics in Table 4. There are signs of a size effect: when the size of the companies in the portfolios increases, there is a certain tendency in portfolio returns to decrease which means that the sample shows an inverse relationship between size and stock returns. The portfolios containing the larger stocks (P13-P16) earn a return somewhat lower than those containing the smaller stocks (P1-P4). If portfolios with different B/M ratio are considered, there are also signs of a value effect: as the ratio grows, the portfolio returns tend to grow, as the high B/M portfolios P4, P8, P12 and P16 show higher returns than the corresponding low B/M portfolios of the same size, namely P1, P5, P9 and P13. When we consider value weighted returns, Table 5 shows that the outliers in the return of small size portfolios are evened out and the small/growth portfolio P1 no longer has a positive return. As the B/M ratio of the portfolio grows, once again the average return tends to grow: P4, P8, P12 show higher returns than the corresponding low B/M portfolios of the same size: P1, P5, and P9, however the big/value portfolio P16 has about the same return as the big/growth portfolio P9.

Table 6 provides a similar analysis for the equally weighted and value weighted HML and SMB factors. As shown in equations (1) and (2), these factors correspond to excess returns, and their average return represents the risk premium for a unit exposure to the factor. Differently from the the case of macroeconomic factors (Mazzariello and Roma (1999), Panetta (2002)) no further estimation is needed. From Table 6 the two risk premia for the equally weighted factors, λ_{HML} and λ_{SMB} are equal to 0.4% and 0.035%, respectively, on a monthly basis, or 4.8% and 0.42% annualized. The size of the value factor risk premium is considerable. On the other hand the average of the stock market index excess return over the risk free rate, λ_{MK}) was negative over the sample period and equal to -0.32%, or -3.8% annualized. Table 7 contains the correlation matrix of all equally weighted variables. We can see that the size factor SMB is correlated positively with the return of the smallest stocks portfolios (P1-P12), and the correlation decreases as size increases, with portfolios containing larger stocks (P13-P16) showing inverse correlations with the size factor, which is what we would intuitively expect. A pattern of correlation between the HML factor and portfolio returns is also evident, with the return of the value portfolios

P4, P8, P12, and P16 positively correlated with this factor and P1, P5, P9 and P13 negatively correlated with it. The correlation between HML and SMB is low and equal to -0.247 showing that these factors capture different aspects of the sample of stock returns. When value weighted factors are considered (Table 6), the risk premium of the size factor (SMBVW) becomes negative, and hence no size effect can be detected. On the other hand, the risk premium on the value-weighted HML factor (HMLVW) remains highly positive, and it is larger (0.0045 on a monthly basis, 5.4% annualized, more than twice its standard deviation), indicating that big stocks rather than small stocks are the source of the value premium.

4 Empirical Performance of the CAPM and FF Models

We now check whether a single factor model like the CAPM can rationalize the returns on the size- and value-based strategies represented by the 16 sorted portfolios in our sample and compare it to the FF model. We estimate the single factor model (CAPM) through the regression

$$(R^p - R^f)_t \,=\, \alpha^p + \beta^p_{MK}(R_m - R_f)_t + \varepsilon^p_t, \tag{3}$$

and a three-risk factors model (FF) through the regression

$$(R^p - R^f)_t \,=\, \alpha^p + \beta^p_{MK}(R_m - R_f)_t + \beta^p_{HML}HML_t + \beta^p_{SMB}SMB_t + \varepsilon^p_t, \tag{4}$$

where the term on the left is the excess portfolio return, the term in brackets on the right is the market risk premium, SMB and HML are the FF additional risk factors, and β_{HML} and β_{SMB} are the corresponding regression coefficients. In the regressions (3) and (4), p = 1,2,. . .,16 indicates portfolios, t = 1,2. . .,216 indicates monthly observations. Since the time series regressions are in excess return form, if the model holds the intercept α^p should be statistically indistinguishable from zero. So, we test the hypothesis H0: $\alpha^p = 0$. In Table 8 on page 17 we see the results for the one-factor model (CAPM) applied to equally weighted returns. In the different panels, estimated coefficents correspond to portfolios according to the structure described in Table 3. The market index excess return is always highly significant in explaining the size and value strategy returns, but much less so for small size portfolios P1-P4, represented in the first row of each panel of the Table. The R^2 of the regressions clearly increase with size, with the first portfolio (P1, small/growth) showing the lowest value, 0.17. The hypothesis $H0$ is seldom rejected. However, when we look at the point values of the β_{MK} coefficients and compare them with the average returns of the portfolios from Table 4, we do not see the positive linear association that the CAPM predicts, that is the CAPM is once again unable to characterize the expected return of size and value based strategies in our sample. The left scatter of Figure 1 shows a lack of any positive linear association between the average return on the equally weighted strategies and their market beta, for this sample, hence the CAPM produces inconsistent results.

In Table 9 we show the results of the FF model (4) applied to equally weighted returns. The fit of the regression is materially improved. The coefficient on the size factor SMB is significant in all cases except for two big stock portfolios (P14 and P16) in the last row of the panel, and its values tend to decrease as size increases, as expected. Coefficients on HML are more variable in significance, although they are clearly positive and significant for value portfolios (P4,P8,P12, P16) and negative for growth portfolios (P1,P5,P9,P13). When we look at the ability of the FF model to account for average return in the cross section of equally weighted portfolios, the scatter on the right of Figure 1 shows some positive linear association between average returns and the projection of the three risk factors of the FF model, which is however visibly altered by the leftmost point, which represents portfolio P1, small/growth. We note in the comment to the descriptive statistics in Section 3 that the return of this portfolio containing the smallest stocks has somewhat erratic behavior.

When we consider value weighted strategies, the results of the regressions (3) and (4) reported in Tables 10 and 11 show the different performance of the two models. The single factor model (CAPM) produces better results for small size value weighted portfolios compared to the equally weighted case, once the smallest stocks are given less weight (the R^2 on the first small/growth portfolio increases from 0.17 to 0.48), but the additional HML and SMB factors of the FF model add explanatory power for the strategies, producing a marked increase in R^2 throughout the 16 portfolios. The SMB factor is significant for all but two of the largest size portfolios, while the HML factor coefficient is positive and significant for value strategies and negative for growth strategies. Again, the single beta model does not explain the cross section of average returns on the strategies. The left scatter of Figure 2 shows a negative linear relationship between average value-weighted returns on the 16 strategies and their beta on the market, which is not compatible with the CAPM, while, in the right scatter, the prediction from the FF model provides a linear cross-sectional fit with positive slope.

5 Analysis of the HML factor

The pricing impact of the SMB factor, which characterizes a strategy of going long on small stocks and short on large stocks, is usually linked to the specific risks of these stocks, mostly their lack of liquidity and their lower resilience to downturns in the business cycle. Given the importance of small stocks in the Italian Stock Market, it is not surprising that the SMB plays an important role in explaining stock returns, as already established in the literature discussed in the Introduction. In the down market we analyzed, the risk premium for the size strategy is not unequivocally positive. On the other hand, in the 2000-2018 sample the value-based strategy produces high positive returns. The HML factor, which characterizes the strategy of going long on high B/M stocks and short on low B/M stocks, has an associated risk premium of 4.8% on a yearly basis in the 2000-2018 equally-weighted sample, and a risk premium of 5.4% on a yearly basis in the value weighted sample, more than twice its standard deviation. In what follows we try to look at the determinants of its returns by examining in more detail the statistical properties of the returns of value and growth stocks in the sample.

We took the returns of all stocks in the 30% top and bottom percentiles of the HML factor sorting and looked at their frequency distribution. The large mean return of the equally-weighted HML factor in Table 6 comes from the difference between the mean return of all value stocks and all growth stocks included in the HML factor. In turn, the mean return of value and growth stocks is the sum of returns on small and big value and growth stocks (1). The frequency distribution of these returns helps to understand the differences in average returns of value and growth strategies. In particular, from Figures 3 and 4 and from Table 12 we see that value stocks have a somewhat higher frequency of large returns between 10 and 20 percent and growth stocks have a higher frequency of both small (0 to minus 5 percent) and large negative returns. When we consider small and big stocks separately, (Figure 3) small growth stocks have a higher frequency of negative returns throughout the support, and small value stocks have more positive returns in the range 5 to 10 percent, while big value stocks have more positive returns between 10 and 20 percent. Table 13 reports average returns by year, which are generally of the same sign as the stock index return with a tendency for value stocks to do better than the market. When we looked at the high returns of value stocks from a qualitative point of view, we found many cases in which the high positive return was associated with a merger-arbitrage event (mergers, acquisitions), unexpected positive reporting by the company or company turnaround plans that occasionally produced large change in price. Such returns involve risks which are not fully described by general market risk but are not idiosyncratic either. Our conjecture is that a very high risk premium recorded for value stocks during the sample period is partly due to these events.

6 Conclusion

We investigated the risk return characteristics of size- and value-based trading strategies in the Italian stock market in the 2000-2018 sample period. We analyzed the quality of the book-to-market data and market capitalization data available in Datastream. We found that book-to-market data from this source contain inaccuracies, as hinted in previous research (Beltratti and Di Tria (2002)). We used more reliable data from Borsa Italiana and

Mediobanca in order to correctly define value- and size-based strategies and the HML factor. Unlike previous studies, our analysis is based on all available stocks, rather than partial samples.

In the sample period, the time series of the return on these strategies are poorly explained by a single factor model, and in the cross section, average returns are not positively related to market beta, contradicting the CAPM. This result is in line with previous evidence, and requires the definition of additional risk factors to rationalize the observed returns on these strategies. The HML and SMB factors proposed by Fama and French (1993) help explain the returns on value- and size-based strategies in a consistent way. The R^2 of the FF model is consistently higher than that of the CAPM for every strategy. In the FF model, the return on small stock portfolios is significantly and positively associated with SMB, and the return on value portfolios is significantly and positively associated with HML. While previous research did not confirm the pricing relevance of the HML factor, we show its significance in pricing aggregate stock returns in our sample.

In the 2000-2018 period, in which the stock market showed a negative return, the risk premium of the value-based strategy represented by HML is considerable, and about 5% annualized. By analyzing the distribution of the individual components of this return in detail, we find that it can be attributed to a higher frequency of large returns on value stocks. This pattern is compatible with the idea that value stocks are subject to turnaround, acquisitions and merger-arbitrage activities, which occasionally produce large changes in price.

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Table 1: **Frequency of large deviations between data sources**

	Book to Market Datastream vs Mediobanca		**Market Capitalization Datastream vs Borsa Italiana**	
Threshold value of deviation	No. of Deviations	Frequency	No. of Deviations	Frequency
2%	1395	27.5%	259	4.8%
5%	847	17.2%	104	1.9%
10%	535	10.8%	89	1.6%
15%	372	7.5%	78	1.4%

In Table 1 the deviations are calculated as the percentage difference of the Datastream value from the Mediobanca value for Book to Market data on 31 December and as the percentage difference of the Datastrem value from the Borsa Italiana value for the market capitalization on June 30, when both values are available. Observations that exceed the tresholds are reported.

Table 2: **Average Size and B/M Quartiles**

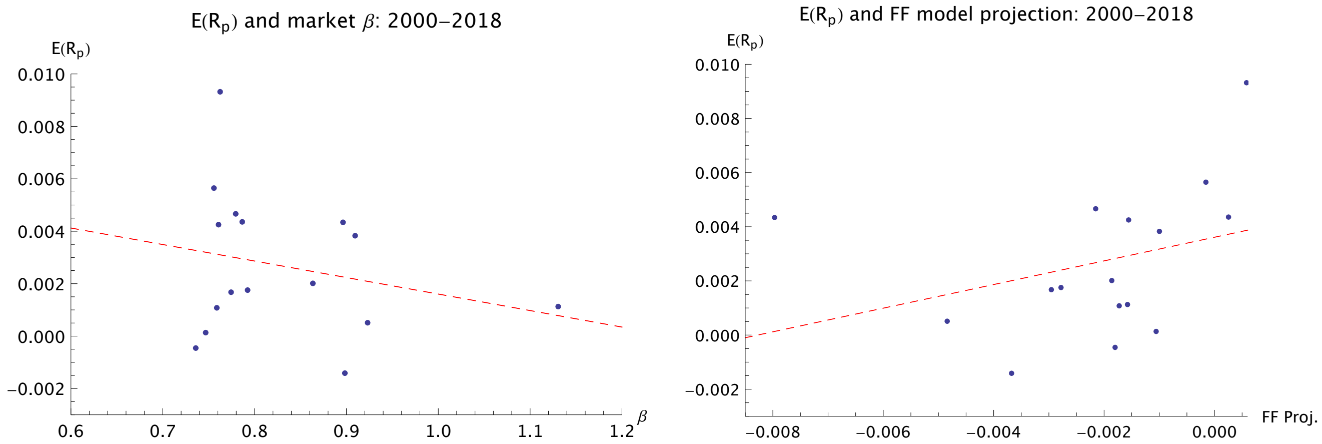
Size	**Growth** $\longrightarrow$ **Value**			
(Million Euro)	B/M			
0.3 - 57	0.10 - 0.51	0.51 - 0.91	0.91 - 1.49	1.49 - 4.99
57-198	0.12 - 0.59	0.59 - 0.91	0.91 - 1.41	1.4 - 4.07
198-946	0.12 - 0.47	0.47 - 0.8	0.8 - 1.33	1.33 - 3.65
946-6,916	0.10 - 0.36	0.36 - 0.68	0.68 -1.04	1.04 - 2.49

In Table 2 the first column describes the average size of stocks grouped into quartiles in ascending order during the sample period June 2000 - June 2018. On the same row of the size bracket are reported the average B/M values for each of the four quartiles into which a size group is subdivided.

Table 3: **Names of Size-Value sorted portfolios**

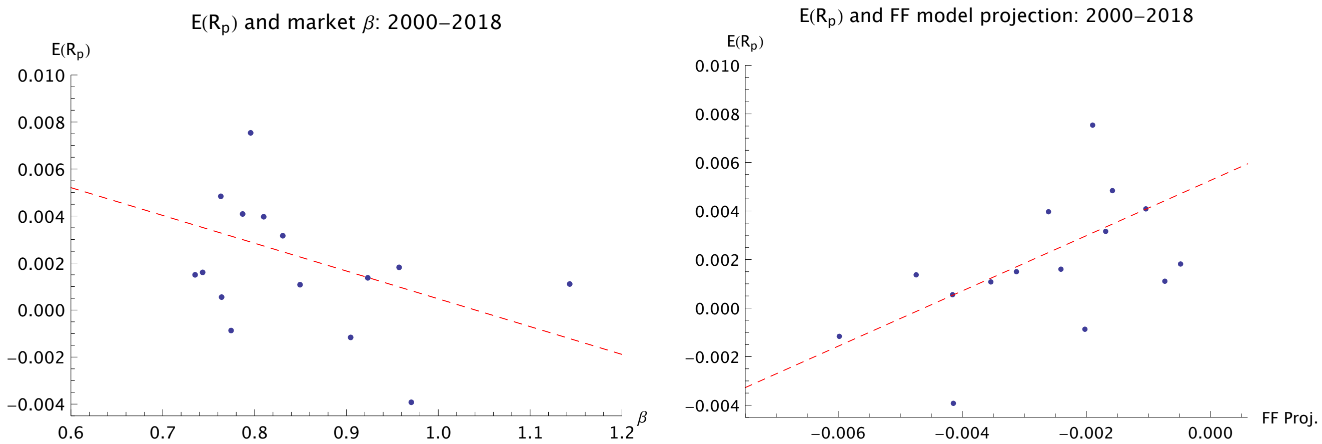
	Growth	⟶		Value
Small ↓ Big	P1	P2	P3	P4
	P5	P6	P7	P8
	P9	P10	P11	P12
	P13	P14	P15	P16

Figure 1: **CAPM and FF Model 2000-2018 - Equally Weighted**



In Figure 1 the scatter on the left depicts, on the y axis, the average return on the 16 portfolios as in Table 4 against, on the x axis, the betas from model (3). In the scatter on the right the same average returns are plotted against the projection $\beta_{MK}\lambda_{MK} + \beta_{HML}\lambda_{HML} + \beta_{SMB}\lambda_{SMB}$ from the FF model (4) on the x axis. The dashed line is the OLS fit.

Figure 2: **CAPM and FF Model 2000-2018 - Value Weighted**



In Figure 2 the scatter on the left depicts, on the y axis, the average return on the 16 portfolios as in Table 5 against, on the x axis, the betas from model (3). In the scatter on the right the same average returns are plotted against the projection $\beta_{MK}\lambda_{MK} + \beta_{HML}\lambda_{HML} + \beta_{SMB}\lambda_{SMB}$ from the FF model (4) on the x axis. The dashed line is the OLS fit.

Table 4: **Descriptive statistics of the equally weighted sorted portfolios returns**

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Mean	.00434	.00108	.00565	.00932	-.00141	-.00046	.00013	.00436	.00168	.00466	.00425	.00383	.00051	.00175	.00201	.00113
Median	-.00819	-.00064	.00433	.00690	-.00091	.00472	.00239	.00496	.00564	.00924	.00434	.01029	.00595	.00687	.00712	.00110
Std. Deviation	.13089	.06607	.06780	.07178	.06954	.05643	.05874	.06447	.05926	.05856	.05722	.06789	.06418	.05300	.05679	.07441
Variance	.01713	.00437	.00460	.00515	.00484	.00318	.00345	.00416	.00351	.00343	.00327	.00461	.00412	.00281	.00322	.00554
Kurtosis	64.048	1.287	.631	1.722	1.588	.680	.588	1.174	1.878	1.848	.814	.350	1.741	1.422	1.012	.878
Skewness	6.479	.258	-.007	.733	.078	-.352	-.243	-.004	-.065	-.015	-.095	-.266	-.463	-.292	-.187	-.303
Range	1.59659	.40694	.39741	.46094	.49781	.36099	.32463	.40754	.42281	.41972	.35870	.39934	.44501	.41553	.39634	.48782
Minimum	-.18712	-.18349	-.20682	-.18700	-.22935	-.19197	-.17840	-.19115	-.20848	-.18686	-.17983	-.18620	-.23472	-.20844	-.17919	-.24015
Maximum	1.40947	.22345	.19059	.27394	.26847	.16902	.14623	.21639	.21434	.23286	.17887	.21314	.21030	.20709	.21715	.24767

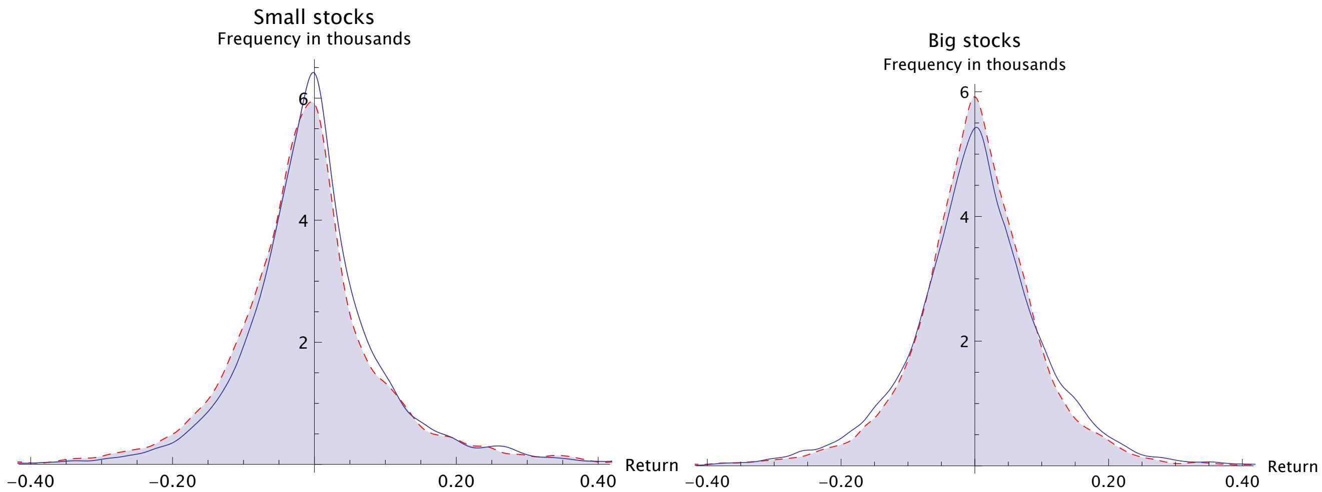
Table 5: **Descriptive statistics of the value weighted sorted portfolios returns**

	P1-VW	P2-VW	P3-VW	P4-VW	P5-VW	P6-VW	P7-VW	P8-VW	P9-VW	P-10VW	P11-VW	P12-VW	P13-VW	P14-VW	P15-VW	P16-V
Average	-.00392	.00160	.00754	.01019	-.00116	.00150	-.00087	.00409	.00055	.00397	.00484	.00182	.00137	.00108	.00316	.0011
Median	-.01110	-.00129	.00639	-.00016	-.00272	.00595	.00184	.00459	.00596	.00759	.00799	.00397	.00719	.00791	.00954	.0025
Std. Deviation	.08239	.06745	.07508	.07998	.07003	.05736	.06267	.06613	.05900	.06171	.05761	.07055	.06417	.05698	.05506	.0759
Variance	.00679	.00455	.00564	.00640	.00490	.00329	.00393	.00437	.00348	.00381	.00332	.00498	.00412	.00325	.00303	.0057
Kurtosis	4.143	4.246	.809	4.119	1.439	.924	1.342	1.455	1.375	1.587	.865	.217	2.085	4.284	.475	1.075
Skewness	1.071	.825	.061	1.320	-.052	-.299	-.070	.010	-.120	.037	-.001	-.301	-.480	.205	-.273	-.369
Minimum	-.21100	-.16657	-.22980	-.18037	-.23995	-.20307	-.19775	-.21195	-.20480	-.19842	-.16409	-.20403	-.25788	-.22386	-.16531	-.2534
Maximum	.41971	.36843	.23303	.40955	.26399	.19901	.25183	.22872	.20586	.21668	.18692	.19503	.20449	.31482	.17303	.2478

Table 6: **Descriptive statistics of the three risk factors**

	HML	SMB	HMLVW	SMBVW	Rm-Rf
Mean	0.00401	0.00035	0.00454	-0.00055	-0.00327
Median	.00456	-.00210	0.00463	-.00023	.00338
Standard Deviation	.03267	.02887	0.03093	.02419	.05962
Sample Variance	.00107	.00083	.00096	.00059	.00355
Kurtosis	24.267	14.196	.834	.982	.611
Skewness	-2.859	2.159	-.078	.268	-.247
Minimum	-.27569	-.06884	-.12638	-.06722	-.17010
Maximum	.08194	.21638	.09369	.09390	.20672
Count	216	216	216	216	216

Figure 3: **Frequency distribution of returns for Growth and Value stocks**



In Figure 3 the dashed line, along the shaded area, represents the frequency distribution of returns on Growth stocks, the solid line the frequency distribution of returns on Value stocks. Sample period 2000-2018.

Table 7: **Correlation of portfolio returns and factors**

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	HML	SMB	Rm-Rf
P1	1.00																		
P2	.611	1.00																	
P3	.485	.767	1.00																
P4	.515	.782	.734	1.00															
P5	.487	.750	.703	.685	1.00														
P6	.461	.777	.763	.740	.830	1.00													
P7	.528	.808	.770	.775	.821	.836	1.00												
P8	.488	.793	.780	.758	.776	.830	.841	1.00											
P9	.465	.782	.724	.740	.866	.857	.824	.772	1.00										
P10	.482	.766	.726	.725	.810	.843	.821	.772	.837	1.00									
P11	.491	.752	.723	.704	.825	.821	.828	.825	.816	.865	1.00								
P12	.539	.769	.736	.735	.777	.801	.826	.822	.793	.830	.859	1.00							
P13	.405	.655	.606	.549	.769	.775	.694	.650	.799	.780	.749	.721	1.00						
P14	.428	.716	.669	.657	.795	.826	.762	.714	.818	.825	.842	.810	.853	1.00					
P15	.432	.756	.725	.705	.776	.822	.794	.791	.810	.843	.828	.856	.824	.889	1.00				
P16	.445	.701	.706	.675	.743	.763	.795	.757	.757	.807	.826	.877	.766	.839	.901	1.00			
HML	-.475	-.050	.135	.184	-.158	.003	.071	.214	-.106	.012	.080	.170	-.198	-.028	.113	.206	1.00		
SMB	.604	.370	.316	.376	.160	.148	.249	.282	.065	.010	.021	.038	-.181	-.135	-.095	-.120	-.247	1.00	
Rm-Rf	.408	.685	.665	.633	.770	.778	.758	.727	.779	.794	.793	.799	.858	.891	.907	.906	.044	-.152	1.00

Table 8: **CAPM regression results - equally weighted**

α	Growth	$\longrightarrow$		Value
Small	0.00694	0.00328	0.00784	0.01153
↓	(0.86)	(0.99)	(**2.25**)	(**2.99**)
	0.00120	0.00168	0.00230	0.00664
	(0.39)	(0.69)	(0.88)	(**2.17**)
	0.00392	0.00693	0.00646	0.00647
	(1.54)	(**2.83**)	(**2.70**)	(**2.32**)
Big	0.00319	0.00406	0.00452	0.00441
	(1.43)	(**2.48**)	(**2.75**)	(**2.05**)
β_{MK}	**Growth**	$\longrightarrow$		**Value**
Small	0.89626	0.75885	0.75571	0.76246
↓	(**7.71**)	(**14.24**)	(**11.62**)	(**12.35**)
	0.89830	0.73593	0.74674	0.78654
	(**17.40**)	(**17.71**)	(**14.79**)	(**13.46**)
	0.77439	0.77945	0.76073	0.90947
	(**16.75**)	(**16.51**)	(**17.71**)	(**18.53**)
Big	0.92307	0.79239	0.86343	1.13058
	(**18.61**)	(**22.62**)	(**26.78**)	(**25.74**)
R^2	**Growth**	$\longrightarrow$		**Value**
Small	0.17	0.47	0.44	0.40
↓	0.59	0.60	0.57	0.53
	0.61	0.63	0.63	0.64
Big	0.74	0.79	0.82	0.82

Table 8 reports the result of the OLS regression of the CAPM (3) applied to equally weighted returns, with robust standart errors. In parenthesis are reported the t-statistics of the coefficents.

Table 9: **FF Model regression results - equally weighted**

α	Growth	$\longrightarrow$	Value	
Small	0.01129	0.00172	0.00472	0.00769
↓	(**1.96**)	(0.69)	(1.72)	(**2.87**)
	0.00118	0.00021	0.00007	0.00306
	(0.39)	(0.09)	(0.03)	(1.46)
	0.00349	0.00569	0.00468	0.00380
	(1.34)	(**2.41**)	(**2.04**)	(1.44)
Big	0.00423	0.00339	0.00278	0.00175
	(**2.13**)	(**2.09**)	(1.75)	(0.84)
β_{MK}	**Growth**	$\longrightarrow$	**Value**	
Small	1.14792	0.85278	0.83510	0.86002
↓	(**13.12**)	(**19.98**)	(**16.87**)	(**17.94**)
	0.95944	0.78243	0.80997	0.86167
	(**20.04**)	(**19.60**)	(**20.35**)	(**20.03**)
	0.81419	0.81061	0.79174	0.94889
	(**18.12**)	(**17.18**)	(**19.39**)	(**21.89**)
Big	0.92892	0.80352	0.87988	1.14683
	(**22.53**)	(**23.56**)	(**27.57**)	(**30.79**)
β_{HML}	**Growth**	$\longrightarrow$	**Value**	
Small	-1.42737	0.06261	0.44424	0.62214
↓	(**-2.90**)	(0.76)	(**4.69**)	(**6.03**)
	-0.29892	0.04773	0.23045	0.56714
	(-1.58)	(0.46)	(**3.56**)	(**7.79**)
	-0.20001	0.00355	0.13247	0.36674
	(-1.58)	(0.04)	(1.73)	(**2.85**)
Big	-0.53586	-0.13178	0.13838	0.39392
	(**-7.55**)	(**-2.71**)	(**3.22**)	(**3.54**)
β_{SMB}	**Growth**	$\longrightarrow$	**Value**	
Small	2.70003	1.13188	1.12669	1.37790
↓	(**5.60**)	(**9.85**)	(**9.92**)	(**12.33**)
	0.60160	0.54686	0.82516	1.05831
	(**3.55**)	(**5.01**)	(**9.96**)	(**13.30**)
	0.33053	0.27365	0.32645	0.48962
	(**2.62**)	(**3.01**)	(**3.72**)	(**3.60**)
Big	-0.26489	-0.03556	0.12665	0.16112
	(**-3.47**)	(-0.58)	(**2.23**)	(1.47)
R^2	**Growth**	$\longrightarrow$	**Value**	
Small	0.74	0.71	0.67	0.71
↓	0.69	0.68	0.73	0.77
	0.66	0.65	0.66	0.70
Big	0.81	0.81	0.83	0.86

Table 9 reports the result of the FF model OLS regression (4) applied to value equally weighted returns, with robust standart errors. In parenthesis are reported the t-statistics of the coefficents.

Table 10: **CAPM regression results - value weighted**

α	**Growth**	$\longrightarrow$	**Value**	
Small	-0.00225	0.00252	0.00863	0.01122
↓	(-0.54)	(0.71)	(**2.14**)	(**2.44**)
	0.00029	0.00239	0.00015	0.00515
	(0.09)	(0.93)	(0.05)	(1.58)
	0.00154	0.00511	0.00582	0.00344
	(0.58)	(1.89)	(**2.34**)	(1.19)
Big	0.00288	0.00235	0.00437	0.00334
	(1.24)	(1.23)	(**2.51**)	(1.41)
β_{MK}	**Growth**	$\longrightarrow$	**Value**	
Small	0.97063	0.74343	0.79570	0.77821
↓	(**10.22**)	(**12.96**)	(**10.42**)	(**10.28**)
	0.90460	0.73522	0.77441	0.78697
	(**16.55**)	(**16.15**)	(**13.67**)	(**12.65**)
	0.76409	0.80991	0.76320	0.95736
	(**16.93**)	(**15.81**)	(**17.45**)	(**18.44**)
Big	0.92325	0.84948	0.83069	1.14313
	(**17.60**)	(**15.75**)	(**23.97**)	(**22.98**)
R^2	**Growth**	$\longrightarrow$	**Value**	
Small	0.48	0.42	0.39	0.33
↓	0.58	0.57	0.53	0.49
	0.58	0.60	0.61	0.64
Big	0.72	0.77	0.79	0.79

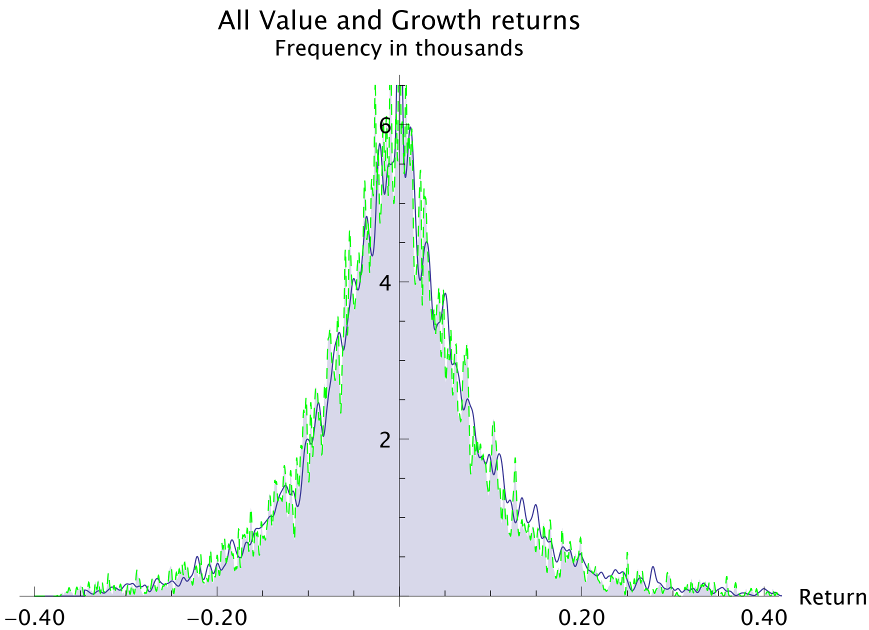
Table 10 reports the result of the OLS regression for the CAPM (3) applied to value weighted returns, with robust standart errors. In parenthesis are reported the t-statistics of the coefficents.

Table 11: **FF Model regression results - value weighted**

α	Growth	$\longrightarrow$	Value	
Small	-0.00090	0.00280	0.00825	0.01041
	(-0.24)	(0.94)	(**2.48**)	(**2.76**)
	0.00367	0.00340	-0.00005	0.00393
	(1.39)	(1.47)	(-0.02)	(1.56)
↓	0.00350	0.00537	0.00519	0.00114
	(1.44)	(**1.98**)	(**2.12**)	(0.43)
Big	0.00495	0.00343	0.00365	0.00075
	(**2.32**)	(1.79)	(**2.17**)	(0.34)
β_{MK}	**Growth**	$\longrightarrow$	**Value**	
Small	1.05144	0.81070	0.87000	0.86313
	(**11.75**)	(**14.77**)	(**14.37**)	(**13.60**)
	0.98193	0.78443	0.82230	0.83867
	(**21.38**)	(**19.27**)	(**17.92**)	(**17.46**)
↓	0.81490	0.82791	0.77141	0.95456
	(**20.11**)	(**15.91**)	(**18.59**)	(**19.98**)
Big	0.92924	0.86435	0.83135	1.12139
	(**20.03**)	(**16.67**)	(**25.11**)	(**26.15**)
β_{HML}	**Growth**	$\longrightarrow$	**Value**	
Small	-0.08522	0.12767	0.30161	0.43357
	(-0.69)	(1.30)	(**2.77**)	(**3.25**)
	-0.56801	-0.09507	0.18506	0.43312
	(**-4.96**)	(-1.35)	(**2.33**)	(**5.30**)
↓	-0.31111	-0.01046	0.17098	0.52791
	(**-4.08**)	(-0.10)	(1.84)	(**5.81**)
Big	-0.46415	-0.20901	0.17038	0.54214
	(**-6.81**)	(**-3.35**)	(**3.23**)	(**7.02**)
β_{SMB}	**Growth**	$\longrightarrow$	**Value**	
Small	1.27663	1.15219	1.34469	1.57692
	(**9.78**)	(**5.36**)	(**8.37**)	(**8.57**)
	1.00248	0.75791	0.86255	1.03630
	(**9.38**)	(**6.79**)	(**7.97**)	(**9.24**)
↓	0.68677	0.28809	0.21058	0.19218
	(**6.23**)	(**2.10**)	(1.88)	(1.89)
Big	-0.11163	0.14772	0.08759	-0.10944
	(-1.32)	(1.72)	(1.16)	(-1.41)
R^2	**Growth**	$\longrightarrow$	**Value**	
Small	0.62	0.60	0.61	0.60
	0.74	0.67	0.66	0.69
↓	0.67	0.61	0.63	0.70
Big	0.77	0.79	0.80	0.84

Table 11 reports the result of the FF model OLS regression (4) applied to value weighted returns, with robust standart errors. In parenthesis are reported the t-statistics of the coefficents.

Figure 4: **Frequency distribution of returns for Growth and Value stocks**



In Figure 4 the dashed line, along the shaded area, represents the frequency distribution of returns on Growth stocks, the solid line the frequency distribution of returns on Value stocks. Sample period 2000-2018.

Table 12: **Frequency distribution of value and growth stock returns**

	$x < -0.2$	$-0.2 < x \leq -0.1$	$-0.1 < x \leq -0.05$	$-0.05 < x \leq 0$	$0 < x \leq 0.05$	$0.05 < x \leq 0.1$	$0.1 < x \leq 0.2$	$0.2 < x$	Average x	Count
Small Growth	.039	.115	.151	.252	.203	.092	.075	.048	-.001	7629
Small Value	.026	.088	.136	.242	.207	.111	.074	.050	.006	7750
Big Growth	.027	.083	.130	.246	.246	.145	.088	.023	.001	8513
Big Value	.032	.096	.129	.220	.227	.136	.107	.031	.003	8489
All Growth	.033	.098	.140	.249	.226	.120	.082	.035	.000	16142
All Value	.029	.093	.134	.233	.219	.125	.092	.040	.004	16239

Table 13: **Mean return of value and growth components of HML by year**

Year	SG	SV	BG	BV	Rm
2000-2001	- .009	.009	- .020	.005	- .017
2001-2002	- .025	- .009	- .023	- .011	- .021
2002-2003	- .014	.000	- .009	- .008	- .007
2003-2004	.000	.011	.013	.024	.011
2004-2005	.015	.030	.013	.027	.012
2005-2006	.018	.017	.007	.016	.010
2006-2007	.018	.039	.011	.027	.012
2007-2008	- .049	- .027	- .048	- .040	- .028
2007-2008	- .013	- .019	- .011	- .026	- .031
2009-2010	- .002	- .007	.003	.004	.003
2010-2011	.006	.007	.011	- .001	.006
2011-2012	- .029	- .034	- .014	- .034	- .025
2012-2013	.016	.013	.017	.025	.007
2013-2014	.032	.059	.024	.043	.029
2014-2015	- .004	.000	.018	.008	.005
2015-2016	- .036	- .020	.000	- .021	- .025
2016-2017	.070	.028	.029	.023	.021
2017-2018	.005	.015	.009	- .005	.005

In Table 13 SG denotes the return on the small/growth component of HML, SV the return on the small/value component, BG thereturn on the big/growth component, BV the return on the big/value component, Rm is the return of the stock index.