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Adapting and testing the Fama and French model, with some variations of company characteristics

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ABSTRACT

We examine whether the Fama and French (1992) (F&F) model can be adapted to become a more versatile and flexible tool, capable of incorporating variations of company characteristics in a more dynamic form. For this, the risk factors are reconstructed at the end of each reading of monthly data. We argue that, over time, the evaluation of a company may change as a result of variations in its market price, size or book price, and we are aware that the F&F model does not accurately reflect these dynamics. Our results show that the adapted model is able to capture the behaviour of a greater number of stocks than the original F&F model and risk factors are more significant when building them through our procedure. In addition, we carry out these adaptations during a period of instability in financial markets.

KEYWORDS

Financial models; Fama and French model; risk factors

JEL CLASSIFICATION

G11; G12

I. Introduction

In this article, we pay attention to the procedure that Fama and French (1992) (hereafter referred to as F&F) follow to build risk factors. F&F construct their risk factors from data taken annually, and the value and size of portfolios are assessed once a year, maintaining invariability during the whole period. However, it should be noted that variations can occur in the characteristics of a company during any given 12-month period, which will not be accounted for by the F&F procedure.

The F&F model has been widely used and analysed in the literature recently (Abhakorn, Smith, and Wickens 2013; Eraslan 2013; Gregory, Tharyan, and Christidis 2013; Soumaré et al. 2013; Nichol and Dowling 2014; Zhong, Limkriangkrai, and Gray 2014; and Ferruz and Badía 2015; among many others). Our main research goal is to test the capacity of the model, taking month-to-month data and rebuilding the value and size portfolios at the end of each month, with the aim of developing a more dynamic and adaptable tool.

This approach has two clear implications. First, the book-to-market (BM) ratio varies according to the characteristics of the company at any given moment. Although we can expect that the numerator or book price appears invariant for an entire period, the denominator or market price does vary and, therefore, a company may be moving between different value portfolios during the year without being captured, i.e. between low, medium and high portfolios. Second, our approach provides greater variability in the size factor, which allows us to capture variations in the capitalization of the company as a result of, among other things, price fluctuations of the stock, which can have consequences for the classification of a company (such as, big or small).

The variation that may arise in the characteristics of a company, causing it to move between different value and size portfolios, has a direct impact on the associated return of the portfolios. Thus, our approach allows us to form new portfolios every month by utilizing the true set of characteristics, and the yields reflected by these portfolios are better suited to the situation at any given moment.

To test the ability of the Adapted model, the significance of the model as a whole and the individual coefficients considered in the regression are checked.

The rest of the article is organized as follows. In Section II, we present the data and methodology, in Section III, we offer the results of the empirical analysis and in Section IV, we discuss our conclusions.

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II. Data and methodology

Our data covers the period from January 2006 to December 2010. Five-year intervals to estimate the coefficients, as argued by Brooks (2008), are often used for this purpose, and the financial crisis period is included in order to test the effectiveness of our recursive construction process of the factors, in a highly volatile environment during which stock markets suffered major shocks, as did the valuations of companies and their variables.

We sample a total of 692 nonfinancial firms trading in the UK[1] market. Company monthly prices and the rest of the necessary data are taken from the Morningstar Database. Returns are calculated as the natural logarithm of the quotient between the price at time *t* and price at *t-1*. The FTSE All Share Index is used as a proxy for the market portfolio, and the 3-month UK Treasury Bill rate is the risk-free asset.

We also use risk factors built by F&F in order to compare the results of our proposal. These data are obtained from the website of Kenneth French.

To build the adapted model, we reconstruct the risk factors at the end of each month from the monthly data. Thus, to obtain the size factor, we take the stock exchange capitalization at the end of each month, and the BM factor is calculated as the quotient between the book price and the share market price, both also taken at the end of every month.

Subsequently, we proceed to construct the SMB (small minus big) and HML (high minus low) portfolios. The procedure is the same as that followed by F&F, except that they build their portfolios annually (in June) and hold them during the entire period, whereas we conduct our procedures on a month-to-month basis.

Thus, to construct the SMB portfolio, we rank the securities by capitalization value at the end of each month and establish two groups, dividing the sample by the median. In this way, we have the large-capitalization assets on one side and the small-capitalization assets on the other.

Thereafter, every group is ranked from highest to lowest according to the BM value and divided into three subgroups, taking the same values as F&F, with the percentiles of 30% and 70%. In this way, the value portfolio (high), the neutral portfolio (medium) and the growth portfolio (low) of big and small companies are obtained.

The SMB risk factor is the average return associated with the difference between the average return portfolio of small-cap companies and the mean return portfolio of large-cap companies, whereas the HML factor risk is the average return portfolio of value assets minus the average return portfolio of growth assets.

In this way, we create six portfolios, by size and BM ratio, and reconstructed each month according to changes in the characteristics of the companies, with the target being to provide greater reaction and adaptability to the model under certain contingencies.

Once the portfolios SMB and HML are obtained for each month, regressions are run for each security in which the coefficients of the model are estimated.

$$R_i - R_f = \alpha_i + \beta_i \mathrm{RMRF} + \beta_i \mathrm{SMB} + \beta_i \mathrm{HML} + \varepsilon_i \quad (1)$$

where R_i is the performance of the securities, R_f is the return on the risk-free asset, RMRF is the market risk factor (i.e. the excess return of the benchmark on the risk-free asset), SMB is the difference between the small-cap stocks portfolio returns and the large-cap stocks portfolio returns, and HML is the difference between the high securities portfolio returns and the low securities portfolio returns; α_i is the intercept term of the regression, β_i is the slope of the model and ε_i is the disturbance term.

III. Empirical analysis

The estimation results for each model are presented in Table 1, which allows us to observe and to compare the ability of the factors, and the model as a whole, according to both approaches. For each coefficient, the number of times that it appears significant is counted, and its significance level, in each one of the 692 regressions of each model. Each percentage is calculated on the total titles. The accumulated value is the total to 10%, i.e. the sum of 1%, 5% and 10%.

[1]Financial companies are excluded, for the same reasons as Fama and French (1992).

Table 1. Significance results of the coefficients on F&F model and on adapted model.

	Significance level							
F&F model	1%	%	5%	%	10%	%	Accumulated	%
Intercept	692	*100*	0	*0.00*	0	*0.00*	692	*100*
RMRF	56	*8.09*	100	*14.45*	82	*11.85*	238	*34.39*
HML	3	*0.43*	32	*4.62*	46	*6.65*	81	*11.71*
SMB	28	*4.05*	91	*13.15*	154	*22.25*	273	*39.45*
F-statistic	111	*16.04*	162	*23.41*	94	*13.58*	367	*53.03*
	Significance level							
Adapted model	1%	%	5%	%	10%	%	Accumulated	%
Intercept	12	*1.73*	31	*4.48*	51	*7.37*	94	*14*
RMRF	471	*68.06*	20	*2.89*	27	*3.90*	518	*74.86*
HML	102	*14.74*	79	*11.42*	50	*7.23*	231	*33.38*
SMB	99	*14.31*	90	*13.01*	71	*10.26*	260	*37.57*
F-statistic	670	*96.82*	13	*1.88*	4	*0.58*	687	*99.28*

For each coefficient, the number of times that it appears significant is counted, along with its significance level, in each one of the 692 regressions with each model. Each percentage is calculated on the total titles. The accumulation is the total to 10%, i.e. the sum of 1%, 5% and 10%.

Taking the 1% significance level, it can be seen that the RMRF factor on the F&F model appears significant to 56 regressions (8.09%), while on the adapted model, it is shown to be significant to 471 regressions (68.06%). In the case of the HML factor, it appears significant to 102 regressions (14.74%) of the adapted model and only to 3 regressions (0.43%) on the F&F model. The SMB factor is shown to be significant in 99 titles (14.31%) in our adapted model, while in the F&F model, it appears in 28 titles (4.05%).

When we observe the cumulative total, i.e. increasing the significance level up to 10%, we appreciate that both RMRF and HML factors appear on more significant occasions according to the adapted model (74.86% and 33.38%, respectively) than with the F&F model (34.39% and 11.71%, respectively). For the SMB factor, this appears significant more often for the F&F model, but we note that, in most cases (22.25%), it occurs at the 10% level.

As for intercept values, the case of the F&F model appears significant at 1% for all regressions (100%), while for the adapted model, it is only in 12 regressions (1.73%). A good model specification produces intercepts that are indistinguishable from zero (Merton 1973). As F&F indicate, the intercept estimation provides a simple measure, and in turn a formal test of how the different factors capture the average performance. Therefore, these results show that most of the stock behaviour is captured by the risk factors considered in the adapted model.

The *F*-statistic values settle results. When we consider the 1% level, the F&F model fits the behaviour of 16.04% titles, while the adapted model captures 96.82%, a more than relevant amount. When we broaden the significance level and observe the accumulation, the adapted model captures almost the entire stock behaviour (99.28%), while the F&F model captures just over half (53.03%).

These results are presented as being of particular relevance to investors and management, not only because the ability of the adapted model to fit the returns of companies is better than the F&F model, but also because it is carried out during a period of high instability. Often, the effectiveness of this type of model is criticized when market conditions are in crisis and the efficient market hypothesis is compromised. Hence, the importance of our results.

IV. Conclusions

The results of our proposed adaptation of the F&F model indicate that it can be converted into a more flexible, versatile and dynamic tool, since the construction of the risk factors taking monthly data allows us to adapt them more recurrently, resulting in an improved ability to capture the variations that may arise in the characteristics of companies in the course of any given period.

It is important to stress that the intercept and *F*-statistic values show that the adapted model is able to fit the behaviour of almost all stocks, while the F&F model only does so for just over half.

Thus, in view of the results, we maintain that this procedure has important implications, as well as presenting a more efficient model than the original F&F model, with its efficiency proven when applied to a period of crisis.

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